COMPREHENSIVE APPLICATIONS OF COMPUTER SCIENCE

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CHAPTER 1

LOCALLY GROWN FOOD MENU ITEMS AND CONSUMER CHOICE AT HYPER-LOCAL RESTAURANTS: INTRINSIC AND EXTRINSIC CUE WORDS

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ABSTRACT:
This study used eye-tracking methods and an online survey to investigate whether the intrinsic fresh and extrinsic local cue words of locally produced food menu items were related to consumers' visual attention i.e., fixation count and total fixation length and menu choice. A hyper-local restaurant menu with four items was given to fifty customers at random to peruse while their eyes were being monitored with or without intrinsic or extrinsic cue words. Although their actions were not inconsistent with their opinions, the participants in this research had a relatively positive attitude towards food that was farmed nearby. The findings revealed a connection between fixation counts and the extrinsic cue word "local" for subsequent menu selections, with individuals who picked the item with the term "local" seeming to have looked at it more often before making their final menu decision. The study's participants also noted that elements including appealing menu descriptions, individual choice, and healthfulness were significant while choosing a menu. The results of this research revealed that restaurant owners may utilize carefully prepared menu descriptions that included the term local since this strategy could affect customers' menu choices.

KEYWORDS:

Healthfulness, Intrinsic, Fixation, Locavore.

INTRODUCTION

As the locavore movement in the US has persisted, consumer interest in food produced locally has expanded significantly in recent years. A person who makes an effort to eat food that is grown, raised, or produced locally, usually within 100 miles of home" is the definition of the term locavore. According to study results, more than 20% of customers said they ate locally farmed food twice a week. Furthermore, a prominent trend since 2012 has been hyper-local food sourcing, which refers to restaurants growing the food in their own gardens or manufacturing their own goods. To capitalize on this trend, several restaurants have begun including local cuisine on their menus. The triple bottom line, a company structure that encourages environmental, economic, and social responsibility, is something that consumers identify with sustainable consumption, which means that their food consumption habits are in accordance with this philosophy. Consumers, for instance, think that locally produced goods are more energy-efficient and can cut down on greenhouse gas emissions and carbon footprints. Additionally, they wish to improve their purchasing habits and make purchases that will benefit the neighborhood economy. Additionally, the entrepreneurial activities linked to the rise in demand for and consumption of locally grown food can attract more investment, boost local employment opportunities, cut down on food imports, and strengthen local food systems, all of which can contribute to the community's sustainable growth [1], [2]. The belief that these components are seen as being fresher, resulting in better-tasting, higher-quality meals, also influences the consumer's desire in buying locally farmed food. More specifically, both intrinsic and extrinsic signals have an impact on customers' positive evaluations of and purchase intentions for locally farmed foods. Extrinsic cues are objects that in some way

connect to the product but aren't really a part of it. Branding, product labelling, information provided at the point of sale, product information, packaging, location of origin, and pricing are a few examples of extrinsic cues. Additionally, consumers have come to understand and cherish the locality and place of origin of food. A product's inherent qualities, such as its freshness, appearance, color, odor, taste, and texture, are referred to as intrinsic cues. Freshness was identified as one of these qualities that customers often recognize when it comes to local cuisine. Hyper-local restaurants may be able to deliberately promote meals using locally sourced goods by utilizing these external and internal signals in their menus. For instance, prior research has shown that restaurants may employ carbon labelling, a kind of extrinsic signal, to persuade customers to choose more ecologically friendly meal selections. Since words may affect customers' knowledge and impressions, it may also be possible for restaurants to utilize certain cue words to successfully promote a locally produced menu item. The list of cue words for food produced locally, however, is extensive. Based on a review of the literature, this research used the words local and fresh to represent extrinsic and intrinsic cues, respectively, since they are commonly reported characteristics of locally cultivated food. Therefore, there are still two unanswered questions: How well do these intrinsic and extrinsic cue words convey information about locally grown menus? Do these intrinsic and extrinsic cue words affect following menu choices, and if so, how? Only if consumers pay attention can they be identified as effective cue words. The majority of earlier research on locally produced goods relied on surveys or observations to look at customer preferences, attitudes, and purchase intentions, which are subject to self-reporting biases. Therefore, Wedel and Pieters emphasized the significance of capturing customers' visual attention by employing a method like eye-tracking to ascertain the focus of consumers' visual attention throughout their decision-making process. The benefits of utilizing an eye tracker in research include its capacity to give impartial and unbiased data and its capacity to identify the precise locations and durations of viewers' searches and foci. Eye-tracking has been used in food and sustainability studies to measure consumers' visual attention to goods and services, but its use in relation to locally produced food has been rather sparse. Therefore, by integrating eye-tracking and survey methodologies to examine menu selections made by customers in response to intrinsic and extrinsic cue words on a hyper-local restaurant's menu, this study closes the aforementioned research gaps. The specific goals of this study were to: describe participants' purchasing patterns and attitudes towards locally grown food; investigate words associated with locally grown food and hyper-local; and investigate the relationship between the Intrinsic and Extrinsic Cue Words of Locally Grown Food Menu items and consumers' visual attention, total fixation durations, number of fixations, and subsequent menu selections from hyper-local restaurant menus. This research adds to the body of knowledge on locally sourced and sustainable food by demonstrating how the use of extrinsic and intrinsic cue words in menu descriptions affects restaurant patrons' menu selections. Locally farmed food and sustainable consumption provide a number of advantages. The National Park Service estimates that each year, over 250,000 tons of greenhouse gases are released into the environment as a result of the transportation of food by trucks, ships, and aero planes [3], [4]. Retailers may lessen their carbon impact by using locally farmed food and vegetables in their stores. According to the U.S. Department of Energy, food in the country travels 1500–2500 miles on average from farm to table. Additionally, the U.S. Department of Energy said that customers may minimize carbon emissions brought on by food shipping by shopping locally. Consumers' capacity to link sustainability to locally produced food was also covered in earlier research in the literature. One of the sociocultural drivers of local food consumption, according to Miros and Lawson, is the perception of environmental sustainability. Similar study was conducted by Yue and Tong on the influence of several attributes on customers' choices to purchase fresh, locally farmed food. Being ecologically friendly was significant to 61% of participants in their choice to purchase fresh, locally farmed food for a variety of reasons. The relevance of food qualities and motivators for young local food consumers in Hungary was also explored by Kovacs et al. Environmental friendliness was

noted by consumers in their survey as another quality of locally produced goods. More recently, Nakajima studied Singapore's appetite for regional foods in the perspective of sustainable food consumption. According to Nakajima, there is still a lack of demand for locally produced produce despite the fact that the vast majority of Singaporeans support the environment and believe that buying food that was grown nearby is more ecologically benign. Based on her study, Nakajima hypothesized that raising public awareness of local produce's sustainability might increase consumers' willingness to pay for it .To better comprehend the context of this study, definitions of local food are necessary; yet, there is no globally or legally accepted definition of local food .For instance, Aprile et al.'s research on consumer attitudes and preferences towards local food discovered that respondents in Naples, Italy, did not have a single, agreed-upon definition of what constitutes local cuisine. Food products that travel 400 miles or fewer from their originating location or the state in which they are produced are generally considered to be local. Local food is defined as "food produced in the province or territory in which it is sold, or food sold across provincial borders within 50 km of the originating province or territory" by the Canadian Food Inspection Agency. Similar to this, Canadian university students used phrases like "100 km" and "province-wide" to define locally cultivated food. In conclusion, even if the journey lengths differ, the two definitions are based on the same concept [5], [6].

DISCUSSION

To clarify their link with locally produced food, the words intrinsic and extrinsic cues were developed and defined. Food produced locally is purchased by consumers for a variety of reasons. Consumers employ a number of internal and extrinsic signals to assess the quality of food items. Intrinsic cues are determined by a product's inherently present characteristics, such as its external look, color, odors, taste, and texture. Before and after sampling food goods, consumers may evaluate these intrinsic qualities objectively. Lower-level signals, sometimes referred to as extrinsic cues, include branding, information offered at the point of sale, information on the packaging, and pricing. These extrinsic signals have an impact on and reinforce consumer product choices. Previous studies on locally produced food discovered that extrinsic and intrinsic factors, including freshness, health benefits, and location of origin, foster favorable impressions and have an impact on customers' purchase intentions. Consumers have been demonstrated in earlier studies to recognize the freshness of locally grown food as an intrinsic cue. In one of their early research, Bruhn et al. looked at customers' opinions of locally produced food in two villages in California's central valley. According to Bruhn et al.'s research, customers mostly choose locally produced food because they want to support local agriculture and because fresher fruit is sold in stores. Similar research was conducted by Feagan et al. on the reasons why people patronize farmers' markets in the Niagara area of Ontario, Canada. According to Feagan et al., the availability of fresh food was the main incentive for customers to visit these markets. The significance of freshness was also brought to light in a research by Yue and Tong on the significance of numerous factors in customers' choices to purchase fresh, locally farmed food. 83 percent of the participants in their survey deemed freshness to be very important for locally produced, fresh food. Chambers et al. employed a qualitative approach to examine consumer attitudes and actions towards local, national, and imported foods in the UK. They discovered that since local food travelled a shorter distance, customers believed it to be fresher than imported food. According to a Singaporean study, Nakajima found that product-specific factors, as well as ease of identification at the store, were positively related to purchases of locally grown food. These factors also appeared to have a positive impact on consumer demand for local produce among consumers who have positive perceptions of sustainability. Based on the findings of these earlier research, customers value local food's freshness in general. As a result, this study looked at how consumers responded visually to the implicit cue term fresh. Extrinsic Cue of Locally Grown Food Researchers often examine product brand names and country of origin data because they are significant extrinsic

signals. For instance, Lawley et al. investigated the function and connection of intrinsic and extrinsic signals, as well as their relative importance and consequences on Australian consumers' intake of fish products. According to Lawley al.'s research, respondents often employed the extrinsic signal of nation of origin for example, Australian-grown as a replacement indication when evaluating the quality of fish. In the present study, the area of origin has taken the place of the country of origin or brand names since earlier research has shown that consumers prefer region of origin . For instance, a prior study by Eastwood et al. revealed that in Knox County, Tennessee, the United States, tomatoes were the most frequently purchased produce, and the region of origin was the biggest concern for consumers. Research by Gallons et al. on consumers' characteristics at direct markets, such as the roadside stand, farmers market, tailgate market, and pick-your-own farm in Delaware, United States, revealed that 92.9% of respondents would rather pay more for In a study by Patterson et al., 74.4% of respondents preferred produce from Arizona, United States, over produce from other regions. In a study by Vieregge et al., which looked at consumer perceptions of the use of locally grown foods in the standard menu items at McDonald's in Switzerland, they discovered that 67.4% of respondents generally preferred the use of local produce. In a Naples, Italy-based survey, Aprile et al. reported that 95% of respondents tried to find and buy local food. In conclusion, these findings can support the notion that local food origins are essential to consumers. A description of the rules governing country of origin labelling is required to demonstrate that the extrinsic cue, area of origin, is reliable enough to be evaluated in this study. Based on an examination of menu labelling laws, it was previously stated in the introduction that restaurants are not required to provide such information. As a result, the area of origin is a construct that may pass scrutiny. Overall, this study looked at how consumers responded visually to the extrinsic signal local. Theoretical Framework Two situations are used to illustrate the theory of attention in visual marketing: the determination of attention to visual marketing stimuli reflected in consumers' eye movements and the influence of attention on the communication effects of direct marketing interest. Goal-directed attention and stimulus-driven attention are the two categories of attention, according to investigations in the prior literature. Top-down influences affect goal-directed attention, while bottom-up factors affect stimulus-driven attention. Consumers' antecedent circumstances and traits, such as expectations, prior knowledge, aspirations, and emotions, are the source of top-down variables. Bottom-up influences are brought about by the traits or sensory components of the stimuli that consumers are exposed to. The theory of attention in visual marketing makes a distinction between the salience of stimuli originating from stimulus-driven attention and the informativeness of stimuli originating from goal-directed attention in order to determine the covert patterns of attention in overt eye movements. According to the hypothesis, the informativeness and salience of items work together to influence attention and other processes. The attention of consumers will still be drawn to highly visible stimuli even if they are not receptive to them. On the other hand, consumers' attention to stimuli will vary based on their expectations and aspirations, and they will learn information in various ways. Because each customer has unique expectations and aspirations, their attention is independent of the configurations of certain stimuli. The theory of attention in visual marketing systematically harmonizes the various views of attention determinants on informativeness and salience. However, the most attention is paid when the salient stimuli are informative, and the least amount is paid when the stimuli are not informative. Additionally, the theory links these viewpoints to the proper visual marketing impacts. In marketing research, eye-tracking research expanded quickly due to the fact that visual attention offers a crucial pathway for assessing customers' responses to visual stimuli, such as product labelling. Eye-tracking methods thus shown good promise for accurately assessing how consumers perceive food product labels and other visual stimuli .2.4. Visual Attention: Top-Down Effect [7], [8]. The most thoroughly studied top-down influence on visual attention is familiarity, since psychological studies have shown that familiar items tend to catch people's attention more readily. According to prior study, familiarity has varying

effects on attention to ad items and has been proven to affect how much attention is given to an advertisement. Wedel and Pieters claim that since recognised commercials are simpler to understand than unexpected ones, they demand less attention. For instance, Pieterset al. used the eye-tracking approach to analyse how consumers responded to three exposures to print advertisements. According to Pieters et al., customers' overall attention levels decreased by more than 50%. The quantity of attention given to a brand dropped with familiarity, whereas attention given to the photos did not change, and attention given to the text grew. When Clementet al. looked at how the design elements of jam packets affected visual attention, they discovered no connection between customers' visual search habits and their knowledge with the category of jam items or a particular brand of jam. On the other hand, Fenko et al. studied the effect of familiarity on visual attention by using a health label placed on yoghurt products. They did, however, find decreases in gazing time in initial visual attention and in further attention times when consumers had prior experience at the grocery store. The researchers discovered that more health label knowledge did not translate into greater levels of visual attention being directed to the label. According to Janiszewski and Warlop, associative memory has a general role in the effects of familiarity on attention. Brand familiarity is a significant influential visual component when examining locally developed 2.4.2. In other words, brand conditioning generates the learning environment that makes semantic information accessible from memory while also boosting attention to a brand. Influence of Visual Attention on Product Choice Several gazing factors have been linked to decision-making across a range of activities. Previous eye-tracking study shown that individuals were more likely to choose an object if they fixated on it for a longer period of time. Pieters and Wallop and colleagues studied the connection between consumer attentiveness and brand preference. They found that customers are more likely to choose the brands they focused on for a longer period of time than other brands. Similarly, Burscheid and Danner investigated the connection between respondents' eye-gazing behaviour and their meal preferences. From four possibilities shown as photographs, respondents were asked to choose the one that appealed to them the most. According to Duerrschmid and Danner, there is a significant association between the respondents' likelihood of choosing and their visual attention. When a product received greater visual attention, its chances of being chosen increased considerably. Van Loo et al. reported on the significance of sustainability attributes on coffee product labels and their impact on visual attention and the willingness-to-pay of consumers in the United States in the context of sustainability label research. According to Van Loo et al., the respondents who valued sustainability labels more gave these sustainability-attribute labels greater visual focus. Additionally, respondents' increased visual attention to sustainability labels resulted in a higher willingness to pay for products with these labels. The following hypotheses were put forth because the prior research was restricted to observing consumers' visual attention and product labels: H3: Visual attention to the intrinsic cue word fresh is associated with the choice of a menu; H4: Visual attention to the extrinsic cue word local is associated with the choice of a menu. Materials and Procedures 3. Participants. The University Research Ethics Board examined and approved the research protocol prior to the study. The general public, including teachers, staff, and graduate and undergraduate students from a university in the Southeast of the United States, made up the study's participants. A minimum sample size of 39 individuals was advised by Pernice and Nielsen for the study of eye-tracking gaze point data. 50 volunteers were therefore sought after for this study's investigation. Flyers put on noticeboards throughout the university campus and electronic invites sent via the college were only two of the methods used to find the attendees. After completing the research, participants were requested to notify their friends and/or family members about it. The identical material detailing the goal of the research, eligibility requirements, and study expectations was included in both the flyer and the internet invitation. The main recruitment criteria consisted of participants' general interest in foods, and one menu item had one extrinsic cue word. An intrinsic cue word was chosen as consumers were shown to acknowledge the freshness of local food in previous research . Four

different restaurant menus were created by placing the four menu items in various orders based on the Latin square design. An extrinsic cue word was chosen because prior research has shown that consumers recognise the value of region of origin. A lattice square design is made up of many treatments that are arranged in such a manner that each treatment only appears once in each row and column. By using this technique of design, systemic mistakes brought on by rows and columns are reduced. A Latin square design was used in a number of eye-tracking tests carried out in a related setting. Additionally, this approach was used to validate certain phrases rather than particular places. For instance, if the intrinsic cue word usually appeared in the first row at the top and attracted a lot of fixations, the position of the cue may have contributed to the high fixation rate. Through the use of alternative designs, the Latin square approach adjusted for other factors that may have had an impact on this research. The style, font, size, colour, and general structure of all the menus were the same, with the exception of the sequence of the menu items. Prior to performing the study, the menu items and design were checked by two outside researchers who are experts in both hospitality research and eye-tracking techniques.3.2.2. Tobii X2-60 Eye Tracker To capture the participants' eye movements, a Tobii X2-60 Eye Tracker with 12801024 pixels was mounted at the bottom of a 17" computer display. An eye tracker with a length of 184 mm is called the Tobii X2-60. It is a covert eye tracker that may be used to provide thorough research of ordinary visual behaviour. Additionally, the subject may walk about while still maintaining accuracy and precision while recording because to its broad range of head motions. Eye trackers may be used in studies and portable eye-tracking laboratories to monitor even huge objects up to a 36-gaze angle away. The Tobii X2 Eye Tracker was selected for use in this investigation because it offers complete flexibility and a number of software and stimulus setting options.3.3. Measures3.3.1. Eye-TrackingIn general, eye-tracking data consists of the quantity and length of fixes on the Areas of Interest. Using the Tobii X2-60 Eye Tracker, this study assessed participants' FC and TFD on the AOI. The number of fixations counts the total number of times participants have focused on an AOI, while the number of fixation durations counts the entire amount of time participants have focused on an AOI. The ‘minimum fixation time' parameter is set to the default value to enable for this research's concentrate on assessing consumers' visual attention when reading menu items [9], [10].

CONCLUSION

His research contains a number of drawbacks. First, the Southeast of the United States was used to collect the samples for the present study. It's possible that samples from various geographical areas may see the tested cue words differently. The results may not apply to other regions outside of this one. Second, this study looked at how consumers responded visually to the terms fresh local, and hyper-local. Although consumers identified the terms fresh and local as crucial components, other terms suggested by participants, such as healthy, "organic," and price," may also catch customers' attention. Future research should thus broaden the scope of this study by assessing the TFDs and FCs of terms that consumers are more acquainted with. The intrinsic and extrinsic cue words were not tested in a pilot study, but rather, they were selected based on research from earlier works. Pilot research may have been used to determine if the participants found those cue phrases to be attention-grabbing. The term "hyper-local" also seemed to be unfamiliar to the participants.

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CHAPTER 2

AUTOMATIC TEST PAPER COMPOSITION ALGORITHM FUSION WITH HYBRID FUZZY CLUSTERING ALGORITHM

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ABSTRACT:
This work uses the hybrid fuzzy clustering method to examine the computer-automated test paper composition algorithm in an effort to enhance the impact of intelligent automatic test paper creation. This study builds a hybrid fuzzy clustering algorithm-based system for automatically creating test papers on computers. In addition, the hybrid fuzzy clustering algorithm employed in this work serves as the system's fundamental algorithm, and it is enhanced in accordance with the demands of intelligent document writing. The required constraint parameters are also entered using an intelligent algorithm in this article, which combines the original parameters to choose the best test questions from the database and combine them into test papers. Finally, this study builds the system structure based on the specifications for the creation of intelligent test papers. The experimental research demonstrates that the hybrid fuzzy clustering algorithm-based computer automatic test paper composition system that is presented in this paper has a good test paper composition function and can effectively advance the intelligent examination mode in colleges and universities.

KEYWORDS:

Algorithm, Granular Synthesis, Hybrid Fuzzy, Priority.

INTRODUCTION

Every year, several exams are held in the context of the school's teaching activities in order to quickly assess students' learning environments and the impact of instructors' instruction. This is a crucial step in the educational process that may assist instructors in developing their instructional strategies and elevating the quality of their instruction. The most challenging issue for instructors is often creating a test paper with thorough knowledge points and a reasonable level of difficulty. Higher standards for online tests in the future are inevitable given the growth of online education. Therefore, the requirement for an effective and clever test paper composition system is important. Granular synthesis technique, priority algorithm, backtracking heuristic method, error compensation algorithm, random extraction algorithm, and genetic algorithm are often the methods used to tackle the challenge of creating intelligent test papers. The first several algorithms take a long time and have a poor test paper composition success rate, and it is challenging to find a better solution. Although the genetic algorithm is a global search algorithm and has some effect on increasing the success rate of test paper composition, its test paper composition efficiency and effect still need to be improved. It is easy to fall into the trap of a local optimum, leading to premature phenomena [1], [2].

The network teaching management system's primary purpose is to allow students to study and train online, and to allow instructors to assess students by choosing test questions from the test question library. The implementation of online testing involves selecting test questions from a vast test bank that adhere to various instructional test standards. It is important to consider if test results accurately represent both the students' and instructors' degree of teaching proficiency and the students' actual learning environment. Currently, backtracking heuristic algorithms, evolutionary algorithms, and other intelligent test papers are used as part of the

procedure of extracting test questions and test papers from the question bank. Only when the quantity of test questions is manageable and the circumstances are appropriate can the technique of random selection of test questions be configured to meet the needs of the user. It is difficult to create a test paper that satisfies the user's needs since it will fall into the nonideal question region and repeat the selection of questions. The method for the retrospective test paper group demands several retrospective test operations in the test selection, which is no longer able to handle the test question bank's often modified questions. The network test set system's test set criteria. The genetic algorithm is capable of adaptive global optimization, intelligent search, and excellent convergence, but it is prone to issues like early maturity and local optimum solutions. In this study, the computer automatic test paper composition algorithm is examined using the hybrid fuzzy clustering algorithm. A computer automatic test paper composition system based on the hybrid fuzzy clustering algorithm is then built, helping to increase the effectiveness of intelligent test paper composition [3].

The intelligent test-setting system can easily achieve semi-automation of the exam, which not only helps instructors create test questions automatically but also best satisfies the various test needs of various teachers. The moderate difficulty and more appropriate distribution of test questions offered by the genetic algorithm-based intelligent test-setting system may guarantee the fairness and rigor of the exam. Teachers, students, and administrators are the minimum number of user categories for the intelligent group volume system. Administrators can manage user information and basic data management of test questions. Teachers can view all of the students in their class, manage all test questions under their own subjects, add test paper requirements, create test papers for the subjects they teach, publish tests, mark subjective questions, view score analysis, etc. Basic data management of test questions comprises question kinds, questions, answers, difficulty, score, and knowledge points. User management includes user name, account number, password, e-mail, class, and topics. Typically, the intelligent group volume system performs the following tasks: User management: Login; administrators add, remove, and modify user information as well as the rights they provide to users. Subject management: The administrator oversees each subject's subjects, including the management of the subjects' fundamental facts and the knowledge-based information they include. Test question management: control the test questions for every topic, including their insertion, modification, deletion, and export. The only test questions that a teacher may run are those for the topics for which he is responsible. The administrator can operate all test questions. Management of test papers: Each subject's instructors' needs are taken into account while creating test papers. Online test: Give pupils online quizzes on various topics and display their results. Score analysis: automatically evaluate objective questions, provide students a personal analysis of incorrect questions, and inform instructors of each student's and each class's general status. Intelligent test preparation is essentially a multi-constrained, objective optimization issue. According to the test conditions established by the test instructor, the computer system automatically provides the best answer for n-question combinations that adhere to these restrictions [3], [4]. Generally speaking, a test paper has restrictions like the overall score, test duration, test paper complexity, test question type, number of questions for each question type, and distribution of knowledge points. These restrictions on the exam paper are often determined by the kind, score, level of difficulty, knowledge points, and other results. The genetic algorithm, as its name indicates, mimics Darwin's theory of evolution by starting with a random population and constantly combining individuals to produce the next generation. Additionally, there will be variance throughout this time. Finally, the survival of the fittest down concept ensures that the best one or more people are kept. Applying it to the intelligent volume system is more appropriate. According to the test paper difficulty, test paper structure, knowledge point distribution, and other test paper group factors requested by the instructor, it may intelligently construct a set of test papers that satisfy the requirements. The database and test question data table are first designed after the purpose of the intelligent test has been

examined, typically in accordance with the types of test questions that will be asked. A data table is associated with each inquiry type. When the function of an intelligent test paper is realized by coding, the test questions are first chosen from the database to create the test paper, and then the test paper is evaluated to see whether it is the best test paper. In further detail, you may first locate every test question associated with the chosen knowledge point by using that knowledge point, and then randomly combine these test questions into several test papers. Until the fitness reaches greater than 0.98 or the number of cycles approaches 10,000, the test paper with the greatest fitness in each set of test papers is chosen as the male parent and the other test papers are randomly picked as the female parent to produce the next generation.

DISCUSSION

The main purpose of the smart component system is to evaluate student learning results. Students often use exams as part of the educational process to gauge their progress, and in order for these exams to be successful, high-quality test questions are frequently required. The design of the exam papers often calls for a high level of assessment and professional standards from the instructors. However, a lot of professors are often solely in charge of the teaching component. The exam papers include little research and often leave out important information. If you do not understand the test papers' major topics, you will not do well on the test. The scientific and intelligent character of the test question bank allows us to deal with the questions on the exam paper in accordance with the syllabus and carry out the construction of the intelligent test question bank. The created test papers must be separated into various degrees of difficulty and delivered in phases after utilising the intelligent group test question bank method in order to divide the test results precisely. The level of examination by the students will be impacted by the exam papers' difficulty or simplicity, even if there is no difference in the test results. Exam papers that are overly challenging and out of the scope of the students' knowledge will not be able to accurately reflect the students' level of learning. In extreme cases, students will lose faith in their ability to learn; if exam questions are too easy, all candidates can quickly correctly answer them, giving all students the same grades in a large area; it is also impossible to determine each student's individual level of learning; and this formalised exam will also negatively impact students' enthusiasm, making it difficult for them to focus and devote themselves to learning. To summarise, the ability level of the majority of middle-level students must be considered in the test question bank's design in order for most students to accept the difficulty and allow for a stepwise distribution of marks. Exams may have a certain guiding function in students' learning since, in the present educational environment, students often place a high value on more formal exams. Therefore, the exam questions shouldn't be memory-based since this would cause students to think rigidly and force them to study just for test results, which is counterproductive to achieving educational goals [5], [6]. The questions in the question bank have the proper symbols and wording. Exams are serious and sombre. Exam problems will help students laugh and make tests seem less serious. In order to make the test's goal and character clear, as well as to account for the syllabus' criteria, the test's content must be properly planned. The instructor must rigorously evaluate and calculate the test paper before it is used in class, identify any hidden faults in the test questions, and quickly correct them. Having a thorough grasp of the style, level of difficulty, and scope of each exam question is also essential in order to provide students who made errors after the test specific coaching and instruction. accelerate the production of test materials. The combination of cellular automata and genetic algorithm is used for intelligent test composition, and the test question query two-dimensional space uses a spatial topological structure, which better guarantees the diversity of test questions and provides conducive conditions to find the best combination of test questions. This approach addresses the drawbacks of traditional genetic algorithms, such as precociousness and slow optimization speed. The artificial fish swarm algorithm's foraging, tail-chasing, and other behaviours were enhanced in literature and used to group rolls, which produced positive results and increased the speed and quality of the rolls.

The fuzzy similarity connection matrix is first established as part of the matrix analysis based on the fuzzy equivalency relationship, and it is then transformed using the square approach, which involves a significant amount of labour. As a result, researchers are looking at the nets approach of direct clustering that starts with the fuzzy similarity matrix. The easy and logical matrix self-multiplication operation is not used in this technique. In the so-called "netting method the element symbol is filled in on the diagonal of a set level cut matrix. Replace 1 with, with a space, and "call the node of the position" in the bottom left corner of the diagonal. The next step is netting, which involves drawing the warp and weft lines diagonally from the nodes. In other words, the warp and weft lines are utilized to link the nodes, and they may be thought of as being bundled together when they pass through the same node. Thus, it is tangled. To achieve categorization, the points that may be related to one another by "knotting" fall under the same heading. The maximum tree approach may be utilised for direct classification for matrices that only include reflexive and symmetric fuzzy similarity connections. The maximum tree approach involves creating a particular network for clustering that adheres to the graph theory idea of "tree" and has n vertices and n 1 linked edges but no loops.

The mathematical model of test paper composition, test paper composition target constraints, test paper composition algorithm, test paper evaluation indicators, test question structure, algorithm coding method, etc. are the main theoretical foundations of the intelligent test paper composition system [7], [8]. The exam paper composition system's intelligence algorithm, which is also the subject of this essay, is what makes it challenging and important. The essential constraint parameters are first entered into the intelligent test paper composition module's execution process, after which the original parameters are combined to choose the most appropriate test questions from the database and combine them into test papers. Figure 1 depicts the precise stages. This study utilizes business activity diagrams to illustrate the work and behavior of instructors' test paper preparation and students' online test execution, combining users' needs for an intelligent test paper composition system. The business activity flowchart for the test paper composition by the instructor. We can observe how the instructor composes the exam paper by looking at the activity diagram. The system examines the test paper composition conditions to assess if the test questions comply with the test paper composition requirements when the instructor enters the test paper composition system and sets the test paper restrictions in accordance with the prompts. The exam questions will be chosen and the test paper will be prepared if the requirements are satisfied. If it doesn't, the procedure is over and the test paper composition is deemed unsuccessful. It is the flow chart for the creation of an intelligent test paper. The test paper settings are initially read by the system in order to determine the number of test questions of each distinct kind, as shown in the flow chart for the test paper creation. The system also conducts random initialization selection while initializing the selection state of each test question and setting the test question's unselected state to 0. The system then determines whether the test paper is suitable for purpose after computing its fitness in this condition. If the conditions are not satisfied, the animal engages in tail-chasing, flocking, or foraging behaviors, and the fitness may only be recalculated if the criterion is reached. The exam paper will be released if the fitness level is attained. In the event that the instructor is happy, the test paper composition procedure is finished; otherwise, it is repeated [9], [10].

CONCLUSION

An essential component of achieving a scientific and effective management of educational administration is the study of intelligent test paper composition systems, which is a significant area of study for computer test paper composition. In order to create a test paper that satisfies the criteria, computer test paper composition involves resolving multiobjective constraints for the quality indicators that impact the test paper, such as difficulty, content, time, score, and instructional needs. Additionally, the intelligent test paper creation system serves as the foundation for other testing innovations such as online testing, standardization and

customization of exams, and paperless testing. The intelligent test paper composition system also combines artificial intelligence technology with the expertise of human education experts in test paper composition, completes the design of the test paper content through the computer, and ensures that the test paper generated by the computer meets the expert-level standard. In this study, the hybrid fuzzy clustering algorithm is combined to explore the computer-automated test paper composition method, and a hybrid fuzzy clustering algorithm-based computer-automated test paper composition system is developed. The experimental research demonstrates that the hybrid fuzzy clustering algorithm-based computer automatic test paper composition system that is presented in this paper has a good test paper composition function and can effectively advance the intelligent examination mode in colleges and universities.

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CHAPTER 3

STATISTICS MINING AND CLOUD-BASED ACCOUNTING INFORMATIZATION

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ABSTRACT:
The number of all types of data information is growing quickly along with the quick growth of information technology. Big data technology offers management decision makers a thorough strategic foundation that the conventional processing mode cannot match. It is a significant tool for gathering, storing, and managing massive amounts of data, as well as for analyzing and predicting the habits and characteristics of specific groups of people and even the development trend of an industry. Modern management accounting produces a wide range of different data since it supports the whole business internal control process. More and more people are starting to study data mining as a result of the rapid expansion of network data and the size of databases, and the classification algorithm the primary technology used in data mining has drawn a lot of attention as well. Many businesses started paying more attention to data mining in order to advance the information technology level of enterprise management accounting and deepen information application, and deep data mining improved the scope and depth of enterprise data analysis. Data mining technology makes up approximately 50% of the informatization in the study on data and accounting informatization, which is the direction for future growth. The dependency of businesses on information technology in the process of accounting management has increased with the advent of the information age. Businesses need to focus more on management accounting information technology and enhance their staff members' information application skills if they wish to prosper in the information era.

KEYWORDS:

Algorithm, Bayesian, Information Technology, Informatization.

INTRODUCTION

Numerous classify algorithms exist. The decision tree, Bayesian, genetic, artificial neural network, and classification algorithms based on association rules will be the main topics of this research. We must first establish the adaptability of statistics mining to management accounting and the essential relationship between statistics mining techniques and management accounting concepts in order to build a functioning method system for management accounting based on statistics mining. An in-depth examination of the relationships between statistics, the discovery of these relationships, analysis of the business circumstances of enterprises, the identification of operational issues, and promotion of an improvement in the level of financial analysis and decision-making of enterprises are all parts of statistics mining. The statistics classification algorithm has grown in importance in statistical analysis technologies. More and more statistics categories algorithms have been suggested as statistical analysis study has progressed. Building a statistics classifier, which is used to precisely identify certain unknown kinds of statistics, is an essential stage in the statistics classification process [1], [2]. A considerable number of hardware and software items had to be purchased in the past in order to build an accounting information system, and ongoing maintenance and updating were also quite expensive. Numerous factors demanded a lot of labor and material resources, which raised operational expenses for businesses. The fundamental component of massive statistics mining is the statistics classification algorithm. Its primary purpose is to extract important information and message from massively disordered statistics using a variety of procedures, analyses the

characteristics of all types of messages, and give statistical support for researchers to further anticipate a certain trend. The quantity of statistics that businesses must account for is growing along with the big data age, which practically increases the workload and difficulties of accountants. Cloud computing has enough network storage space since it is an outcome of the Internet's advanced growth. A new computer paradigm based on shared resources, cloud computing has grown significantly in recent years. Technology for cloud storage is the main component of this. A mass storage device is brought together by app software to operate together through RAC, networking, or multitiered file storage system, offering practical and affordable mass storage services. The number of statistics used in accounting work is growing, and the difficulty of statistics calculation and analysis is getting higher and higher in the age of big statistics, which inevitably has a significant impact on the accounting work of businesses. The natural result of the growth of statistics base technology is statistics mining, which is the process of extracting valuable information and value from a vast number of statistics. Numerous industries, including retail, banking, insurance, health care, and communication, have made extensive use of statistics mining. One of the most crucial technologies in statistics mining is classify, and several algorithms have so far been suggested. In order to categories samples of unclassified categories, the technology Classify builds a classifier based on the properties of statistical sets [3], [4].

Accounting's objective is to offer communication support for an organization's internal management and control. The management accounting team's primary objective in gathering and compiling all messages is to analyses the firm's future production and operation condition based on historical production and operation outcomes, in order to support the strategic decision of the enterprise. The management accounting message technology is a requirement for the statistics mining app. Through the use of messaging technology, statistics' breadth and depth, business organizations' capacity for financial analysis, and their degree of financial management may all be enhanced. The early investment in hardware and software has been dramatically reduced since the statistical period and the development of cloud service technology, and just a few computers are often required, which significantly reduces the cost of organizations. Statistics classify algorithms are continuously developing and being gradually optimised as a result of the widespread use of statistics mining technology, among which the traditional classify algorithms are decision tree classify algorithm, naive Bayes algorithm, support vector machine classify algorithm, artificial neural network classify algorithm, etc. . Additionally, this study employs a range of research techniques. The principal model diagram and algorithm formula are created in the statistics mining research to investigate and analyse it. The associated statistics graph is produced in the study on accounting informatization cloud statistics in order to analyse and explain it.

An algorithm formula is constructed in this study to describe the research, which is one of the study's primary contributions. A model diagram is constructed for analysis in this study's statistics mining investigation. According to the report, accounting information technology is expected to advance steadily on the basis of statistics mining. The remainder of this study is structured as follows: The second portion presents the relevant work and provides a succinct critique of its research. The third section describes and analyses statistics mining. The fourth section introduces and analyses accounting information technology. The whole text is compiled in the fifth section. People are becoming more concerned about security and privacy problems as popular technologies like cloud computing and storage have significantly fulfilled the rising need for storage space. Due to improper management, insufficient security, bit rot, disc controller error, and tape failure, as well as the fact that cloud storage service providers are not entirely reliable, it is possible for the integrity of user statistics to be lost. rapid and efficient scaling. When used in corporate internal accounting tasks, it may increase accounting efficiency. It is necessary to use statistics mining technology to conduct statistics analysis during the enterprise management accounting message processing process in order to provide

reliable statistics support for management accounting and provide reliable assurance for the development of enterprises and the improvement of message processing capability. Accounting is a kind of accounting job that focuses mostly on the internal administration and control of businesses. The message that management accounting pays attention to and collects is frequently not only limited to the single financial message, but also the reflected content is not only the post-reaction and supervision of the enterprise's operating results. This is because there is a fundamental difference between financial accounting and financial accounting in the service object. A computer technology called statistics base-based knowledge discovery has been put out with the quick advancement of artificial intelligence and statistics base. Many fields, including machine learning, pattern recognition, statistics, knowledge acquisition, intelligent statistics base, expert systems, and high-performance computing are closely related to this technology because it searches the hidden useful message from a large number of statistics using some algorithm.

In order to significantly lower the cost of calculating hashes for large-scale statistical structures, Chen proposed the idea of the Merkle Hash Tree. The BLS signature has less signatures than the RSA and DSA signature schemes under the same security conditions and a modulus of 1024 bits, according to a short message signature system presented by Hu, Chen, and Ling. The Zheng approach fills the gap left by the lack of sample data that the Bayesian classify method requires. Shi et al. proposed a number of enhanced Bayesian classification algorithms, including the semi-naive Bayesian algorithm, candidate compressed Bayesian network building algorithm, TAN algorithm, and other efficient techniques that may decrease autonomy. A CBA classification technique was presented by Yun yang et al. Two processes make up the majority of the CBA algorithm. Yang suggested a sentinel-based statistics recoverability proof technique that, if the statistics are destroyed, may partially restore the original statistics in addition to verifying the integrity of the statistics on the distant node [5], [6].

DISCUSSION

Finding relevant bits of statistical messages and interpreting them in light of their development trend and composition style are the main goals of statistics mining. The knowledge learning stage is often referred to as statistics mining. Statistics mining is an important phase in knowledge discovery based on statistics base. Sorting the training set based on the attribute value is time-consuming when dealing with continuous attributes since each internal node must find its own appropriate splitting criteria. An inductive learning technique called decision tree categorise predicts a collection of random and disorganized sample data in the form of a tree structure. The decision tree classification algorithm, which is made up of root nodes, internal nodes, leaf nodes, and directed edge nodes, may naturally depict the issues and major issues faced by decision-making classes in each decision-making stage. Currently, the traditional classifiers used in big data analysis and statistics mining mostly consist of decision trees, naive Bayes, support vector machines, neural network classifiers, and others. The non-C4.5 approach is prevalent among decision tree classifiers, however as computer and messaging technology has advanced, the 4C5 technique is no longer able to keep up with the complexity of statistical classifiers. various categorise techniques thus have their own features and various challenges that need to be solved in order to fit to the processing of large-scale statistical collections. Pre-sorting technology is used by the SL IQ algorithm to do away with the requirement to sort statistics sets at each node of the decision tree. One of the inductive learning algorithms is the decision tree classify algorithm, which primarily refers to the classification rules that infer "tree" structure from a collection of irregular and unordered sample statistical messages. Decision tree classify algorithms have numerous clear benefits over more conventional statistics classify algorithms like statistical techniques and neural network methods. For instance, the decision tree classifies algorithm's statistical classification principles are

straightforward, simple to comprehend, and tough to erroneously use in practise. The decision tree can learn several concepts by analyzing and summarizing case sets. It is simple to use and has many different applications. When categorizing large-scale case data represented by unstructured attribute-value pairs, the decision tree technique is a superior option. The most popular decision tree learning algorithms at the moment are. illustrate how the research's associated model diagrams are set up to analyses and explain them.

The data mining principle model diagram in Figure 1 further exemplifies the data mining application principle and directs the development of the data mining algorithm. Big statistics mining technology primarily involves the process of gathering and segmenting statistics messages from enormous message statistics in accordance with a certain characteristic, and then acquiring and amassing some useful messages over time. In the age of large statistics, network message technology has evolved into statistics mining technology, which primarily uses artificial intelligence, statistics base, statistics, and other techniques. Depending on whether fault-tolerant preprocessing is used on the statistics, the methods for ensuring statistical integrity in cloud storage may be separated into two categories: statistics holding proof mechanisms and statistics recoverability proof mechanisms. According to specialised study on the classification algorithm, there is a high association between the algorithm's efficacy and the traits of statistics, which include vacancy value, loud noise, and dispersion. Some data are dispersed and jumbled, whereas others have continuous attribute features. The creation of a classifier typically involves two steps: training and testing. An accurate description or model of the related statistics set is created for each category once the properties of the training statistics set are examined. During the testing step, the test is categorized using the category's description or model, and the classification's accuracy is evaluated. In general, the testing phase costs substantially less than the training phase does. Big statistics is only the mining and integration of big statistics message as an abstract term. These data kinds are varied, there is a large volume of statistics, a low value density, and a rapid growth rate. The app value hidden beneath them can only be found via suitable statistics mining and statistical analysis. Numerous sectors are developing their output, which means that daily statistics production will increase. This message has a subtle impact on people's daily lives and even the growth of a certain business thanks to big data technologies [7], [8].

The decision tree categories algorithm may visually display the issues and crucial elements of various decision-making classes at various stages of the whole decision-making process. Root nodes, internal nodes, leaf nodes, and directed edges linking nodes make up the decision tree. The root node is distinct; it represents a collection of samples that have been categorized, while the internal group represents an attribute of the item and the terminal node the classification's outcome. The process continues this process until the last node and category of the route are put in the leaf node, starting with the root node and selecting the relevant attribute value from top to bottom. The decision tree classify algorithm may now provide a collection of rules that are simple to comprehend since each branch of the decision tree corresponds to a classify rule. The decision tree statistics classification technique offers a lot of benefits, but it also has a lot of drawbacks. Because the decision tree determines the statistics analysis process, it is inevitable that the statistics will be scanned and sorted several times in succession during the statistics classification process, particularly during the tree construction process. This will inevitably cause the entire statistics analysis process to become slow. The Bayes classify algorithm, which is based on the Bayes formula, is a classification method that makes use of probability statistical information. The classify method uses the Bayes theorem to compute the likelihood that a given sample belonging to an unknown class belongs to each class when the prior probability and class conditional probability are known. It then chooses the class with the greatest probability as the determined class of the sample. SLIQ algorithm technology has high scalability for expanding the number of records and characteristics to some level because Li algorithm is upgraded in many ways based on 4C5 algorithm technology and also incorporates

sorting and breadth-first strategy technologies. To analyses them, relevant calculation formulae, such as formulas –, are constructed in the research algorithm.

since of the C45 algorithm's features, the decision tree's construction is finished using the depth-first approach, which has an incredibly poor efficiency since each important node must be examined throughout the statistics' classification and analysis. However, once the breadth-first strategy technology is used, it is possible to get the best splitting criterion for each leaf node in the present decision tree by simply scanning each attribute list once for each layer. Because of the many properties of the statistics themselves, the naive Bayesian method is rather stable and won't significantly affect the outcomes of the classification. The accuracy of the classification findings increases with the strength of the independence between the naive Bayesian statistics. But it's important to keep in mind that the conditional independence hypothesis, which is the ideal situation, must serve as the foundation for the classification algorithm. The accuracy of the classification will be decreased by linkages between statistical characteristics in a real programme, making it challenging to achieve the theoretical maximum impact of this strategy. It aims to boost the value of statistics and the processing capacity of statistics. From a technological perspective, big statistics and cloud computing are similar to the front and back of a coin in their interdependence. Massive statistics may be mined in a multitiered manner because enormous statistics cannot be handled by a single computer and must be implemented in a multitiered architecture. It must, however, depend on the multitiered processor and cloud storage virtualization technologies of cloud computing. Big statistics has increasingly become more popular as the cloud age has progressed. The decision tree algorithm's statistics analysis structure has undergone corresponding changes thanks to the SPRIN algorithm. In particular, the list of statistics categories that the SLI Q algorithm needed to store in memory has been deleted, and its place has been taken by a list of attributes for each statistics number. The benefit of this technique is that it may avoid repeating statistics analysis when it traverses each attribute list to determine the best splitting standard for the current node while analysing a large number of statistics. The statistical computation of the category distribution message of the statistics set corresponding to each non-terminal node and the splitting of the statistics set using splitting criteria are the two procedures that take the longest to complete while creating a decision tree. The genetic algorithm is an effective search and random optimisation method that developed from the principle of biological evolution. Both operations are realized. It represents a significant advancement in the use of computer algorithms to natural science. The method converts problem-solving into the process of identifying chromosomes with high fitness in accordance with the genes on chromosomes by using the concept of natural evolution. This algorithm overcomes the drawback that most optimization techniques are simple to fall into local optimum because it combines the benefits of directional search and random search, giving it high global search ability. The method solves the flaw that the conventional optimum solution is difficult to accomplish local optimization by combining random search with directed search, improving its global optimization performance. Genetic algorithms may fix issues without being aware of them, much like nature. Its primary responsibility is to assess each chromosome produced by the algorithm and choose the appropriate chromosomes based on fitness, making the chromosomes simpler to replicate. Although researchers in the subject of statistics base have contributed to the growth of statistics mining research, most of the algorithms put out to far have not used the technology associated with statistics base, and it is challenging for statistics mining applications to interact with statistics base platforms. One of the most important problems in this area is now this one. In our investigation of its algorithms, we again generated formulae for each algorithm to analyses and explain it, including formulas through.

MIND builds the classifier using the standard decision tree building technique. The precise procedures resemble SLIQ. The UDF technique and SQL statement offered by statistics base are used to generate the tree, which is the primary difference. Simply stated, a dimension table

is created for each attribute at each level of the tree, and the number of each attribute value belonging to each category and the node number to which it belongs are kept in it. The fundamental way the CBA algorithm builds classifiers is by locating association rules in training sets. In order to find association rules, the traditional method Apriori is utilized, which is efficient for finding association rules buried in a huge number of transaction data. The sorts of statistics that may be analyzed are not, however, intentionally limited or excluded by statistics mining. Statistics mining does not exclude it, whether it be financial statistics, non-financial data that accounting disciplines may analyse, or even non-statistics message. As a result, statistics mining may be effectively adapted to management accounting in terms of both aim and goal. Through the parameter estimation outcomes of regression analysis, multi-factor variance analysis, and other methods, the method of statistics mining can find correlations between all different types of messages, making it possible to pinpoint the factors that influence the message that managers are concerned about. When addressing an issue, a genetic algorithm doesn't need to be aware of it. Its only responsibility is to assess every chromosome created by the algorithm, sort them based on fitness value, and then choose those that have the best probability of reproducing in the future generation. Financial sharing has favorable technological circumstances thanks to the advancement of communication technology. The growth of the Internet makes it possible to share business financial data, which benefits the timely delivery of financial information in corporate accounting messaging systems. Multitiered computing includes cloud computing as a key component. In particular, it breaks down enormous statistics processing and computer programmed into innumerable smaller ones, processes and analyses them via a system made up of several servers, and then relays the findings to consumers. Early cloud computing likewise used a straightforward multitiered work allocation and integrated computing outcomes. Advanced software and hardware facilities cannot be isolated from message management. To make existing library resources into digital message content that can be easily searched for and downloaded on the platform, we should first strengthen the construction and improvement of basic management facilities. Next, we should upload the converted library resources to the designated library resources platform. A key factor in enhancing the timeliness of the financial statistics message in the enterprise accounting message system is the message platform's comprehensive management of the financial statistics of each region of the enterprise. As a result, the financial statistics can appear on the financial sharing platform in due time after they occur, allowing the financial staff to handle the accounts in due time after obtaining the pertinent statistics. In order to implement the management accounting message system and realize the overall meccanization of enterprises, we should further broaden the scope of message processing, assist businesses in doing so, and incorporate the operation statistics of other departments into the accounting message system. This will enable us to manage and supervise the entire enterprise and will enhance the management impact of the accounting message system.

According to the survey, despite the fact that some libraries have established intelligent message management platforms and introduced advanced library message management equipment at this time, there is a problem that the message management reform is not yet complete, and the majority of the books and materials in their collections are still not entered into the message management platform, but kept in traditional paper formats. The evolution of human civilization has now reached a stage of complete Informa ionization, and batch message processing, quick message transmission, and message sharing have emerged as the defining characteristics of the modern era. It heralds the dawn of the big statistics age. A certain level of capital expenditure is also required for the installation, testing, and operation of accounting message software, which will put the financial staff's expertise to the test. To ensure the efficient functioning of accounting message creation, it is still essential to modify the equipment maintenance software at a later stage. As a result, the strain on businesses will increase due to ongoing cost consumption, even if the standard accounting message business

procedure is still rather complex. Statistics serves as the theoretical foundation and source of the concepts that underpin the message selection and trend analysis processes used in statistics mining. One of the fundamental principles of statistics mining is the selection of samples in order to infer the features of the population and to determine if the observed samples fall into the same category as the known population. To fully understand the statistics message, it is essential to guarantee the validity and timeliness of the original statistics throughout the implementation of corporate management accounting Informa ionization. The degree of work and consumers of financial reports are significantly impacted by how quickly financial work is completed, and the slow transmission of original data has grown to be a significant factor that influences how well-informed corporate management accounting is. illustrate how the research's associated statistics graphs are set up for analysis and interpretation [9], [10].

CONCLUSION

The development of cloud computing technology in the age of big statistics has increased the opportunities for business accounting informatization, but there are also still a number of concerns. In the age of big numbers, how to take advantage of the chance to deal with risks and problems is still a significant issue that every organization is facing. By methodically examining the classify algorithm used in statistics mining, we can learn about the benefits and drawbacks of the decision tree classify algorithm, naive Bayes classify algorithm, support vector machine classify algorithm, and neural network classify algorithm as well as the scenarios in which they are useful. We can then make targeted improvements and optimizations to address their drawbacks. Big data and cloud computing technologies make it much easier to construct accounting information technology, which not only lowers costs and increases efficiency but also realizes resource sharing and has excellent growth potential. The significance of the statistics category's algorithm will become clearer with the emergence of the age of large data, and the statistical analysis trend will shift towards the features of algorithms like execution speed, scalability, and understandability of output findings. Enterprises need to pay more attention to the level of financial personnel, increase the level of financial informatization, and provide a human resource foundation for better development of financial informatization when applying statistics mining to management accounting message processing.

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CHAPTER 4

QUANTITATIVE EVALUATION OF RURAL SOIL NUTRIENT VARIABILITY THROUGH WIRELESS REMOTE SENSORS

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ABSTRACT:
A new kind of communication network may be created by combining radio technology with wireless sensor networks. Although conventional wireless sensor networks and radio technology networks cannot be directly used to wireless sensors, the development of wireless sensor networks has successfully overcome the issues that existed in radio technology. Based on this, this research investigates the use of wireless sensors for remote detecting soil nutrient variability in agricultural land. Farmland soil nutrient variability has resulted in polarization as a result of conventional farmland management and agricultural systems: rich soil contains extra nutrients, which lowers the usage rate of chemical fertilizers and pollutes high-quality farmland. To fully comprehend the spatiotemporal variability of soil nutrients during plant development, current technologies must be applied since traditional agricultural techniques are no longer able to match the demands. The benefits of remote sensing technology include precision, speed, economy, and ongoing monitoring. It offers fresh perspectives and technological assurances for assessing soil quality in land consolidation and development projects. The application of statistical quantitative assessment technology for multidimensional statistical quantification of soil protection function evaluation at a specific place is also studied in this study. The link between various natural elements and quantitative evaluation of soil protection is finally examined using wireless sensor networks. This research examines the variability of agricultural soil nutrients and statistical quantitative assessment using wireless sensor technologies in an effort to provide the groundwork for the future growth of agriculture and statistics.

KEYWORDS:

Fertility, Investigates, Nutrient, Variability.

INTRODUCTION

Wireless sensor networks have drawn a lot of interest from both academia and business over the last several decades. Through a wireless network, sensor nodes may connect with one other and execute tasks while communicating over small distances. Hundreds or even thousands of sensor nodes may be employed to gather data for soil detection. The development of routing protocols appropriate for soil detection, extending the life of the network, and increasing utilization rate are of great significance to the promotion of agricultural development due to the low cost of sensor nodes, constant changes in availability, and limited sensor energy. In light of this, this article examines the variation in soil nutrients seen in agricultural areas. As opposed to taking into account the geographical distribution of agricultural soil nutrient variability, which affects fertility, China still mostly uses conventional farmland management practices [1], [2]. The excess of nutrients in the plots led to wasteful production, decreased fertilizer usage, and extensive agricultural nonpoint source pollution. Nutrient availability was limited on the arid area and could not support agricultural growth. The criteria can no longer be addressed by conventional agriculture management techniques due to the diverse soil types and vast soil information. It is vital to apply contemporary science and technology to comprehend the varying properties of agricultural nutrients in order to accomplish successful fertilization and production management. New concepts and technological assurances for soil

assessment have been brought about by the effective use of remote sensing technology in elements such as soil organic matter monitoring, soil moisture monitoring, vegetation index, and others. based on remote sensing, land consolidation, and development quality In this work, research on statistical quantitative assessment is also conducted based on the heterogeneity of soil nutrients in agricultural land. China is still carrying out real estate development and consolidation projects, as well as land development and consolidation initiatives. Following completion, quantitative evaluation of soil quality becomes more crucial. Strengthening research on evaluating soil quality following land consolidation is now required. On the one hand, assessing soil quality requires significant human, material, and financial resources. On the other hand, since there are no set criteria for evaluating soil quality, this job is seldom done. The majority of statistical quantitative assessment approaches and artificial field analysis are being used in the evaluation of development and land consolidation. This kind of assessment approach lacks objective comparison, the macroscopic character of evaluation, and it is expensive, time-consuming, and labor-intensive. The aforementioned study may help advance further in-depth investigations into quantitative science and remote sensing technologies. Additionally, it may advance the acceptance and assessment of consolidation, advance the advancement of land development theoretical systems, and support the growth of precision agriculture and digital agriculture in China [3], [4]. According to the literature, a wireless sensor network that overcomes the drawbacks of conventional wireless sensor networks is produced when remote sensing technology is used to wireless sensors. The sensor node analyses the circumstances on its own or in collaboration with other nodes, then utilises the permitted channel to send the data. The remote sensing system quickly exits the current channel if it detects nutrient activity in the soil of the primary user. According to the literature, agricultural land is a scarce natural resource with an uneven geographic distribution, a lengthy origin time, and a limited quantity. From a natural perspective, the five components of parent material biology, climate, geography, and time affect its genesis. Although each of these five components has unique traits and qualities, taken together, they have a strong influence on how soil develops and takes on features. The literature discusses a plan to use remote sensing and wireless sensor networks to monitor the environmental geology of mining areas, and in light of the challenges this plan faces, it suggests combining these two technologies to create a dynamic model of vegetation net initial value productivity in the mining area.

According to the literature, the remote sensing technology model's soil protection module conducts quantitative research on soil protection in a specific area so that its spatial attributes can be seen in three dimensions and uses soil-based detectors to reveal the connection between soil protection and various natural functions. Agronomy, forestry, horticulture, ecology, and other fields must quickly find a solution to the issue of the temporal and geographical variability of nutrients in soil. Quantitative research has evolved from qualitative research, and quantitative approaches have replaced the original classical statistical techniques in research. In contrast to traditional statistical study, variables should be completely random, and regional variables should be used. According to the literature, there is a large-scale impact of the geographical variability of soil nutrients, and soil sampling at various scales indicates the matching spatial structural features and changing laws. At various scales, the spatial variability of the same attribute varies significantly, and large-scale research will look at the structural traits of small-scale soils. Soil scientists increasingly attempt to analyses the variability of soil nutrients from various angles in order to precisely and systematically record soil variability. Independent sensor nodes connect with other nodes using wireless technology in wireless sensor networks to send information to the proper locations. The sensor node analyses the data internally before sending the combined data to the subsequent hop node. Since they were first developed more than 30 years ago, wireless sensor network research has been advancing quickly to satisfy the demands of military applications. The fundamental tenet of a WSN is that

although each sensor node's capacity is constrained, the network as a whole has enough performance to carry out the necessary tasks. depicts the conventional WSN network structure.

The following are some characteristics of wireless sensor networks: First, sensor networks utilize randomly chosen nodes as opposed to certain deterministic networks. Second, as wireless sensor networks are created for certain circumstances, the kinds and quantities of sensors deployed in various scenarios vary as well. One use is the monitoring of buildings, which only needs a few discrete sensors. Image registration, or geometric rectification, offers two types of point selection technology: and. The first two techniques of choosing points are illustrated in this experiment, and the ground control point coordinates are measured on the spot [5], [6].

DISCUSSION

A paradigm for assessing ecosystem service operations is the model. It has various submodules of terrestrial, freshwater, and marine ecosystems in addition to three core modules. The work's findings are graphically shown in the form of a map, which aids in understanding the characteristics of ecosystem services. Actual erosion is less than prospective erosion, which is shown in the difference between the two. This latter statement signifies that the grid block's capacity to intercept the sediment or other sediments on the slope is determined by the product of the quantity of sand and the degree of sediment retention. In order to determine the yearly value of precipitation erosivity and the value of the annual average rainfall erosivity factor, this study analyses the monthly precipitation data of a specific area and 6 counties and cities collected over 35 years, from 1986 to 2020. Thus, a R layer based on the six counties from 1986 to 2020 was created using the Kriging interpolation technique on the GIS platform. The mask was then removed to produce the geographical distribution of the R factor of the A district and countie. The R value steadily drops from south to north, as seen in Figure 2. High-value and high-precipitation regions D and E are close by area A's southwest and southeast, whereas a low-value area may be found in the dry, hot area to the northwest of the valley.

The difficulty of separating and moving soil with various particle sizes is reflected in the soil erodibility K factor, and the variation in the K factor represents the susceptibility of various kinds of soil to erosion. Data may be retrieved, measurements taken, and calculations made to determine the K value. The Vischmeier nomogram is the most often used technique for data sleuthing. More information on soil structure coefficients and permeability levels are needed for this strategy. China now relies heavily on the findings of the national soil census for its soil data, which falls well short of the standards. Using this approach directly is not viable since reclamation and ploughing will both alter the character of the soil. The real measurement comprises the most accurate assessment of physical and chemical attributes in addition to the standard battery testing technique, but there are downsides, including time consumption, difficult processes, equipment limits, inclement weather, and other unforeseeable circumstances.

Zone A has an average soil erosion factor of with a range of. The soil erosion coefficient K in a particular area is with an average value of according to the macro distribution of the soil erosion K value in China's water erosion area; in contrast to this value, the calculation result for the soil erosion rate coefficient K in circle A is marginally higher than the provincial average. The Yuanjiang River borders the north and northeast, where there is a lot of dry heat evaporation but little precipitation. Because of the imperfect erosional conditions, K is tiny and uniform. Reducing slope, altering the subsoil, and constructing ponds and dams are common methods of protecting soil and water. These actions primarily alter flow and speed to reduce soil erosion. Among these, lowering the slope and building ponds and dams both have the

ability to modify and lower the flow. These actions are successful in preventing soil erosion and minimizing soil erosion. The majority of the current research on value is based on various land use types; however, owing to the varied real circumstances in the study location, the value of the same land use type varies in different places. The P factor must be determined by combining real research after making thorough reference to comparable disciplines or similar study areas. It is thought that the P component in the Invest model is the most challenging to estimate because of its particularity, which allows for a high degree of subjectivity in value determination. Southwest China's Area A is a hilly region with many steep, deep slopes, a lot of rain, and a lot of soil erosion. Local communities undertake soil preservation practices include afforestation, building terraces, contour farming, and enhancing irrigation and drainage systems. Statistics on the nutrients that are present in the soil at various sample sizes. As shown in Table 3, AP has the highest change intensity on the sampling scale, followed by AK and AN, and AN has the lowest change intensity. On the field scale, AP exhibits the largest change intensity, followed by AN and AK, and on the plot scale, AN exhibit the largest change intensity, followed by AP and AK. The AN, AP, and AK regions are the largest at the county level; at the field scale, the range is reduced by 118.31 m, 55.41 m, and 112.21 m, respectively; at the block scale, the range further decreases to 18.61 m, 43.31 m, and 27.61 m; this results in dramatic changes in small-scale soils AN, AP, and AK and significantly reduces their scope [7], [8].

Scale Effect of Soil Nutrient Spatial Variability At various sample sizes, the soil's accessible nutrient map is fragmented to varying degrees. The distribution is well dispersed, and the greatest effective phosphorus PD value is. The fundamental explanation is that AP distributions are discontinuous and have clear local features because AP is more vulnerable to random causes. the geographic distribution of nutrients that are accessible at various sample sizes. Using the AN sampling range of 0-180. On the 0–120 AP sampling scale. On the 0-600 AK sampling scale. The alkali hydrolyzed nitrogen is continually distributed in the soil at the county level, with the exception of a tiny area that is in a barren condition, and the majority of the other nutrients are at an average level, as can be seen from the spatial distribution of nutrients. displays the equivalent curve diagram for the soil organic matter content recorded at the sampling location on November. On November 2, 2020, a curve was fitted using the observed sample point reflectivity and the soil organic matter content. $y = 0.0019x + 0.2098 + 0.0002x2$. The data collected show that the research approach used in this study is polynomial modelling mixed with comparison experiments. One of the sample points from the polynomial fitting is chosen, and it is used as the control point in the research. depicts the correction curve for the reflectance and soil organic matter content at the image sample point on November 2, 2020.

Fitting curve for image sample point reflectivity and soil organic matter concentration on November. The accuracy is identical when we compare the sampling points to one of the sample points for polynomial fitting, demonstrating the model's high degree of accuracy and its ability to invert the soil organic matter over the whole region. Table 6 provides a statistical comparison of the proportion of organic matter in a specific region during the three time periods. Table comparing the proportion of organic matter present in a given region throughout three time periods. shows the distribution of the organic matter content during the three time periods in the test region. The findings indicate that the results of the inversion of organic matter by remote sensing and the content of organic matter as determined by field sampling are both compatible. Following land consolidation, the experimental area's organic matter content is mostly dispersed on the plains and above. Table comparing the proportion of organic matter present in a given region throughout three time periods. The distribution of organic matter during the three time periods in the study region is represented statistically, and the findings of the remote sensing inversion of organic matter in the designated test area are compatible with the information on organic matter gleaned via field sampling. Table 7

demonstrates that following land development and consolidation in a particular experimental location, soil fertility, soil quality, and the impact of land development and consolidation have all dramatically improved. A prediction set and a verification set are created from the 26 samples in a particular experimental region. Nine sets of verifications and fifteen sets of predictions are included. The whole spectrum is used to compute the sample's spectral band, which is a laborious computation that has nothing to do with the sample's makeup. The principal component analysis approach is capable of performing principal component analysis on both the prediction sample and the verification set while accurately reflecting the data from the original multiwavelength variables.

a statistical comparison chart showing the amount of organic matter in a given region during two time periods. The inversion outcomes from Table 9 are roughly equivalent to those from the polynomial inversion model. The findings demonstrated that following land consolidation, the amount of soil organic matter in this region greatly increased, improving the fertility and quality of the soil. Recent studies have indicated that the development trend for measuring soil organic matter is the way of integrating multisource satellite pictures and multitemporal images with laboratory spectral analysis and ground-based in situ research. Since satellite data can be used to compute the surface temperature and is a primary element of remote sensing technology, it is evident that this approach is the best one for determining the surface temperature. The idea and technique for recognizing satellite hot air duct data is called sensor technology. Currently, infrared satellite sensor systems using single and multiple channels, infrared thermometers to detect surface temperature, and microwave remote sensing are the major surface temperature remote sensing algorithms. The use of infrared thermal data to track surface temperature is now much more advanced. Both surface heat balance and ecosystem water balance depend heavily on soil surface evapotranspiration. The thermal balance between water and soil is quite big, and it impacts the amount and geographical distribution of water resources. It controls the weather and the change in the climate, which in turn controls the quality of the soil and the emergence and growth of ecosystems. Surface evapotranspiration is presently being tracked using remote sensing equipment. The majority of models are single-layer and double-layer, particularly the SEBAL model, which is based on the idea of an energy balance equation. Its major benefit is that it is appropriate for all climates and has a solid physical base. The vegetation index is a quick and accurate way to gauge how much vegetation is there and how well plants are growing. The usage of remote sensing technologies to derive the vegetation index has grown somewhat in recent years due to the fast growth of this field of science. The vegetation index in ecology investigates ecosystems on a global scale and extrapolates findings from patch-level ecosystem study to the whole planet [9], [10].

CONCLUSION

In the age of the Internet of Things, a wireless sensor network which comprises of sensor nodes with radio capabilities is a highly promising approach. Although adopting remote sensing technology minimizes its disadvantages, there are still issues with energy and equipment. Therefore, new approaches to the issues with energy and remote sensing technologies are required. This research primarily addresses the issues of power consumption, interference, interclassed communication, and channel stability in wireless sensor networks by developing relevant algorithms. The soil conservation module determines the geographical distribution of soil environmental resistance, calculates and analyses the functional strength of soil protection in a given region in 2020, and compares the findings with the coefficient of determination to assess the correctness of the study. In terms of quantitative statistics, this article examines certain regions using a mix of egotistic, classical statistics, and a geostatistical analysis model using remote sensing technologies. It is obvious that following land consolidation, the soil fertility in the corrected area has grown, the amount of linked organic matter has also greatly increased, and the fertility and quality of the soil have both improved.

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CHAPTER 5

STRATEGY FOR REDUCING POLLUTANT EMISSIONS AND SIMULATION OF PAPER-MAKING BUSINESSES USING THE REWARD AND PUNISHMENT MECHANISM

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ABSTRACT:
Controlling environmental pollution is urgently needed since it has grown to be a significant barrier to the development of an ecological civilization. This thesis focuses on analyzing how paper-making firms pick their own emission reduction methods under the reward and punishment mechanism by setting up an evolutionary game model. Finally, via simulation research, this thesis analyses the evolutionary routes of pollutant emission techniques used by paper-making firms under the reward and punishment mechanism. It also examines how societal welfare evolves under the reward and punishment mechanism. As a consequence of the reward and punishment system, the gaming system will constantly fluctuate around a point while it remains static. Right now, there isn't a stable equilibrium position. A stable equilibrium point will eventually be reached by the game system under the dynamic reward and punishment mechanism. According to the findings of social welfare analysis, high-intensity incentives will increase social welfare by lowering the quantity of pollution that paper-making businesses emit. On the other hand, paper-making businesses will face harsh fines if they release a significant quantity of pollutants.

KEYWORDS:

Civilization, Ecological, Punishment, Social Welfare.

INTRODUCTION

Due to their volatility and difficulty in eliminating them, pollutant emissions from paper-making businesses have traditionally been a significant source of environmental pollution. Pollutant emissions from paper-making industries continue to play a significant role in the ecological environmental pollution. However, our nation has never given up trying to improve the government system. According to the China Paper Yearbook, the wastewater discharge from paper-making businesses has decreased from 2011 to 2015. From 5.8% in 2011 to 3.22% in 2015 a reduction of 2.58 percentage points the share of wastewater discharged by the paper industry in the nation's overall wastewater discharge. Additionally, during the previous five years, the wastewater discharged by paper-making businesses has grown by -11.29% yearly. On the one hand, the decrease in pollution emissions demonstrates that China has successfully eliminated its antiquated manufacturing capacity. Only businesses with strong growth foundations and development potential may survive. On the other side, we can also observe how committed and persistent the Chinese government is in reducing environmental pollution. By raising benefits or punishments for them, it controls or limits polluting industries [1], [2]. The internal logic and process of the paper-making firms still need to be investigated when they decide on their own pollution emission methods under the government's incentive and punishment system, despite the fact that these measures have produced some outcomes. Studying the government's reward and punishment system and the paper-making industry's decisions regarding pollution emission strategies calls for careful consideration of the government's reward and punishment system and the strength of its implementation in light of the conflicting interests of the two parties in the game. To completely grasp human

collaboration, there are still many obstacles to overcome. According to the data above, China's pollution has been effectively managed as a result of increasing efforts in pollution control. However, further research is still required to determine how the incentive and punishment system would affect the pollution emission tactics of the polluting firms. Although some academics have examined the measures used by businesses to reduce their pollution, they have disregarded the changes in societal welfare under the incentive and punishment mechanism. In general, incentives and penalties may have varied effects on polluting businesses, but their main goal is always to increase societal welfare. This thesis examines how paper-making businesses decide on their own emission reduction tactics in the absence of a reward and punishment system by setting up an evolutionary game model. It also examines ways to maximize social welfare while using the penal system. The government may use the analysis of the pollutant discharge strategy of paper-making firms under the incentive and punishment mechanism as a guide for developing effective environmental governance measures. The following is the breakdown of this article. The literature on business pollution reduction is reviewed in Section 2. It does a mechanistic study of how various incentive and punishment systems impact the techniques used by businesses that manufacture paper to reduce pollution. The selection of tactics by the government and paper-making businesses under the static reward and punishment system is the subject of Section 3's analysis. The strategic decisions made by the two parties in the dynamic reward and punishment system are examined in Section 4. In Section 5, it is examined how the incentive and punishment system affects societal wellbeing. The growth of the government and paper-making businesses under various types of reward and punishment mechanisms is analyzed using MATLAB. The study results and suggestions are presented in Section, along with a further discussion of the findings [3], [4].

The sources of the firms' pollution emissions are intricate, and they also produce rather wide pollutant swaths. Most academics have conducted extensive study to lessen the damage brought on by businesses' pollution emission. Researchers' studies on governance and pollution reduction may be loosely categorized into the following groups after an assessment of the available literature. One is that a lot of writers looked at environmental rules from the standpoint of how to control and reduce pollution from businesses. The majority of academics thought that environmental rules might successfully lower environmental pollution. According to some academics, environmental restrictions have varying effects on businesses with various degrees of pollution; the effects on businesses with high pollution levels were much bigger than those on businesses with low pollution levels. Environmental rules not only decreased the export revenues of businesses that produce a lot of pollution, but also limited their export periods. Additionally, the impact of various environmental restrictions on the environmental pollution by businesses varied. Environmental pollution and charge-based environmental laws exhibited an inverse U-shaped association. Environmental pollution and investment-based environmental laws have a U-shaped connection. Environmental laws also weren't always effective. The partiality of local governments would undermine the functions of environmental rules in regions with a large number of polluting businesses, which would increase pollution. Some academics thought that enacting obligatory environmental laws and raising environmental tax rates may be effective ways to improve the efficacy of environmental regulations.

The second is that several scholars have focused on cooperative regional governance when studying the cross-regional pollution of businesses. It was difficult to properly coordinate the two administrations to address a problem while they were members of separate political coalitions . The formulation of public policies that coordinate relationships between governments at all levels, as well as inter- and cross-level departmental communication and cooperation, was a crucial step for many governments. There was still a peer spillover effect across governments from a horizontal viewpoint. A firm was more likely to be impacted by its peers when choosing emission reduction techniques if it had frequent interactions with nearby

businesses. This peer spillover effect would unquestionably significantly aid in the management of environmental pollution in China. In order to create a stable and coordinated governance model among diverse local governments, higher-level governments have to be monitored and penalized from a vertical viewpoint. However, if local governments had to deal with ever-tougher political responsibilities, they wouldn't be able to function well enough to decide on the best course of action for themselves. Although the underlying logic of many organizational forms varied, from the standpoint of organizational form, both the logic of authority and the logic of meaning often supported various organizational arrangements. If there were no restrictions, the Interreg ions tended to go untreated in the cross-regional treatments of the air pollution. On the other hand, people inclined to collaborate in governance when there were restrictions [5], [6]. The third is that some writers employed reward and punishment mechanisms to explore the multiagent governance of the pollution caused by the firms, specifically the effects of punishment on the two parties' ability to cooperate and regulate pollution in the game. Government subsidies and harsher punishments may encourage the game's development to a stable state. The tactics between the government and the businesses, as well as the course of each party's progress, were unpredictable under the static punishment system. However, the development routes between the government and the company tended to converge to a stable value under the dynamic punishment mechanism. It would be difficult for both parties to work voluntarily to achieve ecological compensation without the strict oversight provided by the higher-level government. The game would reach equilibrium if the penalty for uncooperative participants were increased.

The following strategies could help the evolutionary game reach its ideal state: increasing oversight while lowering the cost of higher-level government oversight, stiffening fines for local businesses and governments that fail to cooperate and violate pollution discharge regulations, and enhancing incentive systems. Regarding the influence of prizes on the two parties' collaboration and game-related efforts to manage pollution, they have an identical impact to punishment. By suitably enhancing the enterprise's multiplication factors, that is, boosting the advantages of environmental improvement after pollution control, the businesses' excitement for collaborating in the pollution control would be encouraged. Additionally, raising the company's expectations for the advantages of taking part in pollution management may also have a similar effect. The degree of the incentive, however, relied on how well the groups worked together. The two have a good association with one another. It may be possible to incentivize businesses to cut down on pollution emissions by increasing investment in special transfer payments for environmental protection. However, just stiffening the penalty for municipal governments that disobey their obligations won't make them comply. Additionally, the two parties' feelings had a more immediate influence on their ability to work together and limit pollution. Pessimistic emotions would cause disputes to break out between the border walls, while optimistic emotions would drive the collaboration between the two sides to a steady position. Government oversight and citizen involvement were beneficial to environmental governance. Businesses' pollution control practises may be successfully improved by reducing the harm to the public's perception of the government and by fostering more public engagement. Because a company's efficiency was negatively correlated with its investment in innovation, polluting firms with higher efficiency may produce more pollutants. The literature cited above has undoubtedly contributed significantly to the study of the emission reduction tactics used by polluting industries. It also provided a strong theoretical framework on which to write my thesis. There are still certain restrictions, however. One is that the government's system of rewards and penalties is not completely taken into account. The other is that the incentive and punishment system seldom affects social welfare improvements. This thesis proposes an evolutionary game model with no reward punishment mechanism as well as one with a reward and punishment mechanism based on the discussion above and building on the research experience of the predecessors. It also analyses how the use of punishment affects

societal wellbeing. Finally, it employs simulation studies to examine how paper-making businesses reduce emissions under an incentive and punishment system.

DISCUSSION

This study examines the impact of the government's static reward and punishment system on the decisions made by paper-making businesses regarding their pollution emission strategies. It also examines the impact of the government's dynamic reward and punishment system on these decisions. Based on this, it also examines how the incentive and punishment system has affected societal wellbeing. The development route of the government's reward and punishment system as well as the decision of the paper-making companies' pollution emission techniques are both numerically simulated in this research using MATLAB. It also examines how the various levels of incentive and punishment mechanisms affect the tactics used by the paper-making industry to reduce pollution. The main variables influencing the player's choice of strategy are identified via evolutionary game and numerical simulation analysis. The dynamic reward and punishment system is superior to the static one in terms of effectiveness. Increased benefits and penalties will encourage paper-making businesses to use no discharge practices. It won't always be beneficial to increase the incentives for avoiding releasing toxins into the environment. The government's incentives and penalties will have an impact on the emission reduction strategies of paper-making businesses in addition to their own costs and benefits. The government's incentives and sanctions for paper-making businesses, however, will ultimately convert into costs and advantages for the businesses. It is important to understand how the government's incentives and sanctions for paper-making businesses impact the measures they choose to use to reduce emissions. The particular material is shown in Figure 1. The investigation of the mechanisms used by businesses producing paper to reduce emissions under the incentive and punishment system.

illustrates that the starting point and goal of the two sides' chosen tactics in the game between the government's environmental supervision agency and the paper-making businesses is always that their own interests outweigh their own expenses. Even if the incentives and penalties under the static reward and punishment system are now of the greatest caliber, they are unable to make a significant influence on the paper-making businesses. The paper-making businesses are thus more likely to choose pollutant discharge options. According to the dynamic reward and punishment system, the government's environmental supervision department will implement incentives and penalties in direct proportion to the likelihood that the paper-making firm will decide to release pollutants. In other words, the severity of the penalty will increase with the likelihood that the paper-making firm releases pollution. The likelihood that the paper-making businesses won't release pollutants increases the benefits that they will get. Additionally, as there is no maximum limit for these benefits and penalties, paper-making businesses will be forced to employ no discharge practices. The true goal is not to reward complying parties and punish noncompliant parties. The ultimate objective is to reduce environmental pollution via incentives and sanctions. shows that the dynamic reward and punishment system is more stable than the static reward and punishment mechanism under the identical circumstances. According to the research above, there is currently no balancing point and the evolutionary game system will bounce about the center point under the static reward and punishment mechanism. These are some of the potential causes. One is that the government's environmental monitoring department's incentives and sanctions currently do not exist at a level that can effectively stop the paper-making businesses from discharging. Second, there is now no discernible difference between the advantages and costs of no discharge in terms of the paper-making industries. Therefore, it will have a very low likelihood of selecting a non-discharge method. Third, the incentives and penalties that paper-making businesses get under the static reward and punishment system are already of the greatest caliber. Paper-making businesses won't face additional incentives or penalties even if they decide not to release pollutants or

release more of them. However, the government's environmental oversight agency and paper-making businesses will trend to a stable position in the game under the dynamic reward and punishment process. Because the benefits and penalties that the paper-making businesses now get are inversely correlated with the likelihood that they will choose to release pollution. In other words, there is currently no upper limit on the incentives and penalties. When paper-making businesses are subject to severe fines for pollution discharge, their motive to do so will be greatly diminished. displays the game phase diagram at this moment. Table 9 shows that paper-making businesses are more likely to employ no discharge techniques when their illicit revenue is smaller than the incentive or penalty they would get. Because the advantages it receives are now less than the cost of supervision, the government's environmental supervision department is more likely to opt for a no supervision policy. In other words, the two sides of the game are not autonomous with regard to the market and interests since both sides of the game have constrained rationality. Therefore, depending on the scale of their expenses and benefits, both the government's environmental monitoring agency and paper-making businesses make strategic decisions [7], [8].

Based on the research above, this thesis makes the assumption that there are two means—reward and punishment in the game process of reducing environmental pollution. Following the use of these two strategies, social welfare may experience similar or diametrically opposed changes. The major focus of this section is an analysis of how these two reward and punishment systems would affect societal wellbeing. The details of the analysis are as follows: First Premise: During the Game, Different discharge states will be present in paper-making businesses. It may be separated into big discharge and tiny discharge based on the quantity of discharge. The discharge may be categorized as compliance discharge and noncompliance discharge depending on whether it is compliant or not. It may be split into two categories: sewage and no sewage, depending on whether it releases pollutants. The sewage may be categorized into four categories: sewage that has already been released, sewage that has not yet been discharged, and sewage that is now being discharged. During the game, paper-making businesses may choose one of the pollutant discharge states. However, the status of the paper-making businesses is uncertain when the findings are not visible. To demonstrate the condition of discharge of the paper-making firm, the author therefore presents the disorganized set A. The disorganized set A may be stated as, which represents the condition of operation of the paper-making businesses, or as. It is required to provide each state of pollutant emission by a paper-making firm a specific probability since the state is unpredictable. In other words, the likelihood of a paper-making business releasing pollutants is. It is still unclear if it will release pollutants. The risk that a paper-making firm will release pollution in any pollution discharge condition is what the author assigns a specific probability to. The kind and level of supervision used by the government's environmental supervision agency will influence the likelihood of pollutant discharge. The discharge of paper-making businesses is a continuous random variable, according to the author. The loss probability density function, which is used to calculate the social welfare losses brought on by the emission of paper-making firms, is used to calculate the loss to society and ecosystem caused by the discharge of pollutants in any state. The social welfare loss function is defined as under assumption number two. is used to show that the paper-making businesses have received the prize for not carrying out emission discharge under any state. is used to identify the uncontaminated zones. shows the region's overall income and level of wellbeing. Although awards won't stop businesses from emitting pollutants, they may lower pollution levels. Whatever the decrease is, let it be. The pollution function of the paper-making industries is used to quantify the level of pollution. The aforementioned assumption states that the pollution caused by paper-making firms is a function of regional total income, pollutant emissions, and incentives. The penalty meted out to the paper-making firm for pollution discharge in any state is represented by the formula as. Likewise, denotes the polluted region. Thus, the harm caused to societal welfare by the

pollution of paper-making businesses. Although the penalty won't entirely stop the paper-making businesses from releasing pollution [9], [10].

CONCLUSION

The research above shows that the dynamic reward and punishment system is superior than the static one in terms of effectiveness. The development paths of the government's environmental supervision agency and the paper-making businesses will progressively converge at a point under the dynamic reward and punishment system. While the game system's development route between the two sides under the fixed reward and punishment system exhibits wavy shocks. Even while the likelihood of pollutant emission from paper-making firms would fluctuate under the static reward and punishment system, it is still generally inclined to do so. The dynamic reward and punishment system tends to provide paper-making businesses a better incentive not to release pollutants. Because once contaminants are released, companies might be subject to severe penalties for pollution. It can be demonstrated from the study of social welfare maximization that the benefits received by paper-making firms are negatively correlated with the quantity of pollution they emit. More specifically, the benefits increase when pollution emissions from paper-making businesses decrease. The incentives decrease as emissions increase.

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CHAPTER 6

DESIGNING PAPER CUTTING PATTERNS USING IMAGE RESTORATION TECHNOLOGY

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ABSTRACT:
Paper-cutting, a popular folk craft that has characteristics such as "round as the autumn moon, sharp as the wheat mane, square as the green brick, missing as the serrated teeth, and thread as the beard," is one of the priceless intangible cultural heritages of China. The craft of paper cutting provides fresh ideas for building design, and by altering the topology of the raw material, a material or structure may experience major changes in its physical characteristics, including those relating to its optical, thermal, acoustic, and mechanical aspects. It is a process of cultural self-awareness, contemplation, and enlightenment to safeguard intangible cultural property. The preservation of paper-cutting as an example of "intangible heritage" has unquestionably been very important in the history of fostering socialist cultural growth. In order to fill in the designated area of the digital image with information, a natural transition between the filled area and the original area of the image is required, and artificial traces are minimized to make the image appear as though it has never been damaged. The goal of digital image repair is to restore the integrity of the broken image.

KEYWORDS:

Fostering, Heritages, Intangible, Paper-Cutting.

INTRODUCTION

Due to the many social divisions of labor throughout China's lengthy history, common workers eventually developed the technique of paper-cutting with scissors in their hands. The patterns cut out with carving knives or scissors may provide the appearance of translucency, which is aesthetically appealing. Paper-cutting art, which has several degrees of roles and manifestations, has cultural worth, aesthetic value, economic value, and scientific and educational value as a kind of intangible cultural legacy that accurately reflects the history of regional culture and customary changes. International design, on the other hand, exerts psychological pressure in the form of tedium, apathy, and a lack of human emotion. Visual art design has changed from being an elite modernist culture to a pluralistic development with the people as the major emphasis as a result of the growth of China's economy and the maturing domestic visual art design awareness. However, the conventional approach to creating different styles of paper-cutting patterns calls for first analyzing the traits of the patterns and then developing unique algorithms for each pattern; this method not only entails a significant amount of work but also necessitates the operator to possess a certain level of artistic creation. It has significance for the computer modelling of paper-cutting art that several nonrealistic drawing approaches to replicate traditional art mediums, such as watercolors and pencil drawings, have shown successful outcomes in recent years [1], [2]. The structure's total stiffness is decreased as a result of the cutout, improving its flexibility and malleability. The two forms of partial differential equation-based restoration models and texture synthesis-based restoration models are now the most prevalent picture restoration approaches both domestically and internationally. According to a specific method, the region to be restored is progressively filled to accomplish restoration in the human eye effect based on the correlation of known pixels surrounding the area to be restored. Exaggerating the physical items in reality and reflecting their intriguing features, paper-cutting creates an exaggerated, transparent, and

abstract visual experience that is derived from life yet is higher than life and provides people with the delight of art. Traditional Chinese paper-cutting, one of the most recognizable folk arts, has evolved into a kind of "imaginative" cultural emblem with its own distinct creative and aesthetic notions and modelling techniques via history and interpretation. The world is introduced to paper-cutting as a visual representation of traditional Chinese art, culture, and spirit. The template-based method produces better results but requires a large library of paper-cut templates, making it computationally intensive and challenging to maintain the object features in the original image. The thresholding method is sensitive to algorithm parameters and easily loses details in the image. Therefore, utilizing image restoration methods to create paper-cut patterns is surely another approach to communicate traditional folk culture. The blend of contemporary and traditional may maintain the design current and help more people understand the art of paper-cutting and the growth of the local economy [3], [4].

The following are this paper's novel points:

The human eye can still detect a break at the restored edge that is not sufficiently smooth, hence a broken edge reconstruction approach is used in this research to repair fractured pictures with missing key components. The priority of border pixel points is continually updated in this study to accomplish pixel point restoration in accordance with anisotropic repair order. The article takes the design, recognition, and matching of paper-cutting images as the research object, which is a relatively novel viewpoint. It does this by using image restoration technology to examine the relationship between hand-made paper-cutting works and pattern design. Chinese folk art of paper cutting has a long history of employing everyday instruments, straightforward manufacturing, and a broad range of materials and styles. For dynamic performance, there are static window accents and realism shadows that may be manually adjusted. The "imagery" expression of the paper-cutting patterns, a traditional Chinese cultural resource, corresponds with the uses of graphics in graphic design. According to Shi et al.'s research, basic compositional patterns of pictures based on paper-cut patterns were broken down into independent and conforming patterns, and new patterns were created by applying simple logical operations to these fundamental images, among other things. In the Journal of Computer Engineering, Liang offered a concept for a computerized paper-cutting system based on a pattern library that includes designs with a variety of distinct features and can be modified to meet various needs via parameter modification. Duan and Wang categorized paper-cut patterns, examined the fundamental traits and structure of paper-cut patterns, and investigated the techniques for pattern development using hand-cut paper as the test subject. In-depth research on decorative patterns was done by Xu et al., who also suggested various techniques for creating composite patterns, such gradient path decorating and enlarged symmetrical pattern design. Sayed et al. investigated and analyzed paper-cutting modelling, separated paper-cutting images from the necessary basic patterns, applied genetic algorithms to pattern generation, and allowed the computer to automatically generate patterns so that the resulting patterns are more colorful. On this foundation, they also added the measures of curve uniformity and smoothness to optimize the quality of paper-cutting pattern generation. Working people design traditional Chinese folk paper-cutting designs to satisfy their own spiritual needs, conveying the strong and straightforward feelings of common people. In keeping with the graphic's visual message, the pattern for the text is often chosen based on the aesthetic ideal of praying for a better life and the pursuit of beauty. After tens of thousands of years of inheritance and growth, it has been incorporated and absorbed by many facets of civilization. It has evolved into a key source of information for the study of history and culture since it includes information on the Chinese economy, politics, culture, way of life, folklore, spirituality, and religious beliefs, in addition to being a kind of hand-cut paper art [5], [6].

DISCUSSION

Different works of the same kind of pattern are distinguished from one another by the use of extreme distortion in their patterns, and the qualities of various patterns cannot be adequately described by a single distinguishing parameter. Paper-cutting artworks are now saved in digital form thanks to the development of computers, digital cameras, scanners, and other tools, and the craft has expanded into new areas. Yamanaka and Miyashita manually disassembled paper-cutting patterns, generated a library of patterns, and then chose patterns to insert in certain locations inside the paper-cutting contours. The structural information, which outlines the fundamental elements of the picture and may be seen as a description on a broader scale, explicitly relates to the overall change of the image. In all of Yang's suggested techniques, the picture was first divided into different parts using color or structural cues, and the segments were then patched together. In line with this, texture information depicts local information features, which are often represented as recurrent particular patterns, such as patterns. Iyer has sped up the creation of digital methods for the age-old craft of paper cutting by compiling a database of fundamental symbols and examining a huge number of paper-cutting patterns. Higashi and Kanai proposed an adaptive restoration algorithm based on CDD to address the issues of significant time overhead and parameter instability in the CDD model, which model dynamically and freely restores the image based on the local feature information of the missing boundary part of the image. Chu et al. proposed an image restoration method that can repair images with overlapping structural textures and other textures. Based on the local feature information of the missing border portion of the picture, the algorithm model dynamically and arbitrarily chooses the diffusion restoration.

The demand for photos in practical applications, whether it be everyday life or the application of high-tech situations, is to give effective information, thus we need to repair the photographs by adding any missing information. The essay analyses the features of handmade paper-cutting art in-depth using the findings of previous research and suggests a paper-cutting pattern creation approach that incorporates image restoration technology to enhance the aforementioned method. The method by which patterns are generated stems from the direct creative goal of the designer, and many of them are really the visualized result of images. Patterns are employed as ornamentation. Such a community of experts in art restoration has arisen in order to protect the integrity of faulty cultural artefacts. It is important to capture and save the graphic picture on the computer for a realistic hand-cut artwork to become a digital image that can be stored, recognized, and processed by a computer. Data acquisition is the act of converting physical things in space into digital signals that, with the aid of certain sensors, can be stored and processed by a computer. The preprocessing, edge, and key point submodules make up the paper-cut picture pattern extraction module. To begin with, the paper-cut picture's major components are the image region and backdrop area. Some bright areas and dark spots will exhibit noise interference, which may be eliminated using a simple mean filtering technique without affecting the image's binarization effect. The foreground is crudely extracted from the input picture using segmentation, and the high-frequency portion of the foreground is then faded away. The image capture card transfers the noise-free picture to the computer, where it is subjected to preprocessing, character segmentation, character training, and character recognition operations to provide the segmentation result. The flat point relates to low-frequency information, the noise to high-frequency information, and the edge to high-frequency information in general. The secret to maintaining the edge information and eliminating the noise is understanding how to differentiate the noise information in the high-frequency band. The paper-cutting pictures were created by combining the patterns to create the paper-cutting patterns with ethnic style. The paper-cutting patterns were created utilizing the spline curve. illustrates the three components of the paper-cutting design module: drawing parameter setup, common graphics drawing, and pattern drawing [7], [8].

In order to set up for more precise edge extraction, the grayscale picture is split into two parts, one of which is set to 0 and the other to. The paper-cut pattern, as seen from the perspective of contemporary visual communication design, arranges the natural items found in various locations and times in accordance with a defined design objective and reduces the three-dimensional world to a two-dimensional paper surface. To improve tracking accuracy and speed, the center-of-mass positions of each color grouping are calculated. This method incorporates pixel location data. The frame picture, the pixel location in the target area, the histogram color value, and the color value of the pixel are used to compute the centre of mass of each color unit. The gradients corresponding to their grey functions are greater at the edges of the pictures and smaller at the nonedged of the images, where the grey scale does not vary greatly, in order to represent edge information. After determining an appropriate threshold to binarize the whole picture, a technique for connecting disconnected parts is applied. Edge detection, however, might result in a broad or broken edge someplace if noise and picture blurring are present. In order to determine the image border, the picture is thus damaged using this structural element and the corrupted result is then subtracted from the original image.

After the picture has been filtered, a threshold is established before binarization, which is then utilised to separate the object region from the background area. For the purpose of determining the threshold, pixels are either turned to white or black depending on their brightness value. The organization of dots, lines, and surfaces, the contrast of black and white in yin and yang engraving, and the lack of light-and-shadow effects in paper-cut patterns, however, do not diminish the richness of the hierarchy and sense of rhythm. This unique medium and expression of paper-cut patterns determines its flat two-dimensional modelling characteristics. A digital picture often holds a multitude of data. Edge information and non-edge information, which both comprise noise locations in the picture itself, may be divided into two categories based on the properties of the image edges. The non edge information changes more smoothly. The binary image's target pixel may be regarded as not being a boundary pixel if, after it is removed, its ten neighbours can still form a closed boundary line without the boundary line's position or shape being altered. If different sorts of patterns are to be made, the conventional approach demands a lot of labour and calls for the operator to have a particular level of creative invention. A paper-cut pattern design based on image restoration technology transforms the three-dimensional world into a two-dimensional paper surface and organises natural objects that are purposefully situated in a different time and place in accordance with a clear design intention, forming a way of thinking and observation that is compatible with plastic arts. Both picture restoration algorithms and restoration models have received a lot of attention. There are now two primary typical picture restoration algorithms, and Figure 3 depicts the image restoration technology method. The first step is to extract the fundamental feature symbols from the preexisting paper-cutting patterns. Following this, the edges of the paper-cut pattern area are cropped in either a clockwise or anticlockwise orientation. While cropping in a clockwise way will remove the region within the edge, anticlockwise cropping will leave the picture portion inside the edge intact. To make the repair process more dependable, it is often advised to repair blocks with high confidence values first. The confidence level is defined as follows: is the confidence level and is the area of. However, the design of paper cutouts requires careful consideration of many different elements, including the brightness and blackness of pixels, the tensile strength of edges, the connectedness in general, etc. It is clear that the threshold-based method, which bases its determination of each pixel's skeletonization feature only on its brightness or darkness, is incompatible with the aesthetic qualities of paper cutouts. Therefore, it is a crucial step in the extraction of images. The gradient magnitude of all known points in the block to be repaired may, to some extent, provide the structural information of this area since it indicates the degree of the colour change of pixel dots. Because of this, when patching, it is only necessary to apply the patching in the direction of the iso-illumination line; the patching effect is unaffected by the gradient rotation direction and only requires that the

direction of change of the minimum grey value be observed. The spatial Gaussian kernel and the luminance Gaussian kernel, which represent the spatial information weight function and the grey similarity weight function, respectively, and the original image, output image, and luminance Gaussian kernel, respectively, are multiplied to create the bilateral filtering kernel. when a result, when the distribution of the initial samples changes, the location of the neighborhood's centre shifts continually until the iterative process is complete and the center's position hardly changes at all is the location of the new block's centre that needs repair. In order to organise the closed curves of individual edges in one direction either anticlockwise or clockwise—pixel by pixel, image edge tracking uses edge connectivity. This method stores the positions of individual pixels, or the horizontal and vertical coordinate values for each pixel. In order to maximise the difference in grey value between the two parts, the grey number of the image is divided into two parts by the grey level, and the best threshold is determined by calculating the maximum value of variance between classes: is the total number of image pixels, is the number of pixels with grey level, and is the probability of grey level in image.

Nonlinear diffusion is used in the following restoration procedure to make the colours that were randomly filled in the damaged region stand out against the surrounding area. The gradient is parallel to the direction of the image's highest grey change, whereas the gradient is perpendicular to the direction of the least grey change. The improved priority calculation method may be obtained by simply changing the operators of and to summing and adding weights for weighting, respectively: the data item. The fundamental graphic components are then separated from the paper-cut pattern, and based on these graphic elements, the other graphic elements that are missing from the original pattern are created. In order to realise the traversal and judgement of this pixel value, it adds the coordinate value of the centre pixel to the offset corresponding to that direction to produce the coordinate value of a pixel in that direction. In other words, iterations take place at the waiting repair area's edge pixels, and with each iteration, the actual update area moves one pixel forward in the waiting repair area. The signal is referred to as sparse if there are significantly more nonzero elements than zero elements. Natural signals are not typically scarce in reality. To obtain an approximation of sparsity, we can perform a sparse representation of the signal in the overcomplete dictionary. In order to maintain accurate information transfer at the boundary of the damaged region and achieve smooth image edges, we must run anisotropic diffusion several more times after each image restoration. The Criminisi algorithm is the first to introduce the idea of repair priority and uses the image's structural information as a guide for the image repair order, making the algorithm's repair order more logical. A large number of paper-cut patterns in various shapes can be produced if the graphic elements are changed or curve fitting is used. The benefit of curve fitting is that by providing enough control points, more complex curves can be produced. The peak signal-to-noise ratio, is the ratio of the signal's maximum possible power to the destructive noise power that affects the signal's ability to be accurately represented. Since the change of image gradient reflects the change of image spatial frequency, i.e., it can reflect the local characteristics of the image, the sample block size is determined adaptively according to the gradient value size. However, since the selection is based on the sum of the smallest equal illumination lines, if the defective area contains relatively thin lines, it is likely to be truncated during the restoration process, thus destroying the visual connectivity principle. So the atoms found by traversing the dictionary in each iteration with the highest similarity to the signal are orthogonalized, and such an operation avoids repeated selection of atoms in the image and improves the accuracy of the priority solution. Finally, a global search is used to find a matching block within the known region that is most similar to the texture information of the block to be repaired using the SSD matching criterion, and then the corresponding pixel information in that block is copied and filled into the block to be repaired. The pure white initialization prompts the individual points within the rest to have all 0 propagation, and it is only the points waiting for the edge locations of the repaired region that can rely on the residual

information to get the propagation and further update the values. The digital image restoration process is mainly to keep the edge information as much as possible while restoring the image, try to keep the rate of change of the image edge in the gradient direction during the image smoothing process, and try to make a large smoothness in all directions at the nonedge points so that a good repair of the broken image can be achieved. Analysis of Image Damaged Edge Reconstruction to obtain good image restoration results, it is necessary to first constrain the restoration of image structure information, i.e., to connect and continue the image edge information accurately and effectively and to ensure that the part to be restored with significant structural features can be restored first. First, as an important basis for fracture point matching, the color feature mainly describes the color composition of the neighborhood of the defective region, while the curvature information describes the extension direction of the defective structure of the image. Priority is given to repairing structural information and information in the vicinity of structural regions. Before repairing a broken image, an anisotropic smooth diffusion of that image is performed in advance, with the purpose of eliminating the effect of noise on the whole repair process, after which the alternating cycle of repair and diffusion is entered. The texture of the image, especially the texture to be filled in the area to be repaired, is a very irregular texture, which is relatively messy. Therefore, we want to add the amount of information in the area to be repaired and give the initial values to the internal points, thus increasing the iteration speed with a large number of points getting the conductivity and expecting to improve the repair effect. Instead of deciding pixel by pixel whether to skeletonize or preserve, the paper-cut pattern generation task calculates the skeletonization properties of each segmented region, i.e., whether to skeletonize the whole. A comparison of the feasibility of the algorithms in this paper is also performed using 20 sets of images from the OTB-2020 dataset, where the comparison algorithm is CSK. Finally, the tracking accuracy graph shown in Figure 6 and the tracking success rate graph shown in are obtained [9], [10].

CONCLUSION

Chinese traditional folk paper-cut patterns are created by working people to meet the needs of their own spiritual life and express the passionate and simple feelings of ordinary people. It is not only a kind of manual paper-cut art but also contains China’s economy, politics, culture, life, folk customs, spirit, religious beliefs, and other intangible civilizations. It has become an important reference for the study of history and culture. Based on the existing research results, this paper deeply analyzes the characteristics of manual paper-cut art and puts forward a paper-cut pattern design method that uses image restoration technology to improve the above methods. Image restoration is actually a process of filling the damaged part with the known information in the image and obtaining the results that conform to the human visual characteristics through certain methods. This paper presents a paper-cut pattern design method based on image restoration technology and analyzes the reconstruction of image broken edges by the classical Criminisi algorithm based on texture synthesis. The algorithm not only makes the information near the area to be repaired diffuse inward according to the isoilluminance line so as to repair the image but also effectively balances the noise while ensuring the image edge. Edge reconstruction considers the continuity of the edge structure information of the damaged area in the image and preserves the texture information when repairing the damaged area, which ensures the natural texture and structure consistency of the damaged area after image repair.

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CHAPTER 7

A CRYPTOSYSTEM IDENTIFICATION SCHEME USING STATISTICS FROM ASCII CODE

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ABSTRACT:
Block cypher is often employed in the area of information security to safeguard communications, and its security naturally draws attention. The foundation of encrypted data analysis is the identification of the cryptosystem. It falls within the attack analysis subcategory of cryptanalysis and has both significant theoretical implications and practical utility. The extraction of ciphertext characteristics and the creation of classifiers for cryptosystem identification are the main topics of this study. The following are the major ideas and original contributions of this study. First, we suggest a feature extraction technique based on ciphertext ASCII statistics, which reduces the amount of data preprocessing and is inspired by language processing. On the basis of earlier research, we also expand the number of block cypher types to eight, encrypt plaintext with sizes equal to those of the experimental items, and identify the cryptosystem. Thirdly, we conduct classification tests using Random Forest and SVM, two machine learning classifiers. The results of the experiments demonstrate that, by drastically reducing the size of the feature vector, our method may not only increase the identification accuracy of eight common block cypher methods but also decrease the length of the experiment and lessen the computational burden. And as compared to previously published material, the numerous evaluation indicators produced by the technique have been substantially enhanced.

KEYWORDS:

Block Cypher, Cryptosystem, Demonstrate, Random Forest.

INTRODUCTION

Information security progressively integrates into society as the information sector develops. Cryptologists create a variety of encryption algorithms, such as DES, AES, and IDEA, depending on the requirements under various difficult settings. various cryptosystems use various mathematical theories. Therefore, there is no universally effective cryptanalysis strategy to resolve all cryptanalysis-related issues. The majority of useful cryptanalysis methods are created for certain cryptosystems with a particular structure. As a result, before analyzing particular cryptosystems, the identification of the cryptosystem becomes a fundamental job of cryptanalysis. At the same time, the capacity to evade identification by the cryptosystem may be used as a gauge for its level of security, serving as a useful guide for the design of the cryptosystem. The algorithms with good security are considered to be the cryptosystems that can withstand a distinguishing attack [1], [2]. The advancement of cryptography and the use of cryptanalysis have both benefited from the study on the identification of the cryptosystem. With the aid of text categorization and counting, Dileep and Sekhar introduced a block cypher identification system based on support vector machine in 2006. The author employed a multicryptosystem with fixed-length document vector and variable-length document vector and compared the recognition performance of SVM and K-means approach. Nagireddy identified five cryptosystems in 2008 and saw it as a kind of cryptosystem assault. Block cyphers in ECB mode were discovered to be simpler to decode. Support vector machine -based categorization technique that may be recognized and categorized as two working modes of block cyphers was suggested by Chou et al. in 2012 . The experiment uses 1000 samples and three encryption techniques to accomplish one-to-one

classification distinguishing progress. The experiment's findings demonstrate the effectiveness of SVM's cryptographic distinguishing attack. A differentiating attack based on Fisher's discriminant analysis theory was developed by Hu and Zhao in 2018 . In this study, the authors extract nine different types of statistical data as ciphertext features that are utilised in a one-to-one identification experiment to discriminate between four stream cyphers and seven block cyphers. The experiment's findings indicate that 80% of encrypted files can be identified correctly while operating in ECB mode. In CBC mode, stream cyphers SMS4 can distinguish block cyphers with an accuracy of 60%. A two-stage cryptosystem recognition approach based on random forest was suggested by Huang et al. in 2018. The cryptosystem identification issue is divided into two sequential processes in this study by Huang et al., called "cluster recognition" and "single recognition." The technique initially recognizes the group of cryptosystems, and the classifier then determines the kind of cryptosystem. Regarding recognition accuracy in the three situations under consideration, the two-stage scheme performs better than the conventional single-stage scheme in 19.55%, 21.40%, and 22.99%, respectively. The primary contribution of our study is arranged in this paper in the following manner. The fundamental notion of cryptosystem identification and a system description of the cryptosystem identification method are provided in Section 2. We provide a cryptosystem identification strategy in Section 4 that is based on the statistical properties of the ASCII code. We discussed the impact of our feature extraction technique on the experimental findings in Section 5 while using various block cypher working modes. AES-128, AES-256, Blowfish-64, Camellia-128, DES, 3DES, IDEA-64, and SMS4-128 are the additional eight cryptosystems that we add. We compare the assessment of trials using several experimental indicators, such as precision, recall, and F1-score, in order to demonstrate the impact of various machine learning classifiers [3], [4].

Block cyphers are often used by individuals to ensure the security of communication and document transfer. Applying block cyphers to provide privacy has become industry standard since they prevent anybody other than the communicator from obtaining the information being sent. The quick explanation of block cypher that is required to comprehend our work is provided below. Block cypher is a fundamental component of a cryptosystem that is often employed to safeguard the confidentiality of data. Block cypher is used as the fundamental function, together with the hash function, random number generator, and digital signature, for encrypting documents. The plaintext of the communication is separated into blocks of a defined length, which are used to encrypt its information. Block cypher separates the message into groups of a set length prior to encryption. The encryption method produces ciphertexts in groups, where are the message and key. The conversion of a block cypher to any plaintext block would be the same assuming that the key is the same. As a result, all that must be studied in the block cypher research is the transformation law of any group. The user may choose from a variety of block cypher operating modes to suit their particular needs. The electronic codebook mode and the cypher block chaining mode are the major topics of this study. A succinct encryption technique called ECB mode encrypts each block of plaintext independently. The encryption procedure may be carried out in parallel computing by applying the same technique to all blocks, provided that the plaintext bit length is an integral multiple of the block.

The CBC mode, an enhancement of the ECB mode on encryption indeterminacy, was created and suggested by IBM in 1976. The CBC mode adds a random IV to the plaintext before encryption and sets the previous cypher block as the next IV, as opposed to immediately encrypting each block.

DISCUSSION

The majority of machine learning classifier-based tasks for identifying cryptosystems use supervised learning. The plan may be broken down into four simple phases. Choose the categorization and identification item first. Next, take the experimental object's feature vectors. Third, choose the right machine learning classifier and train it. Complete the cryptosystem identification last. It is hard to perform in-depth research on the particularity of cryptosystem identification since it makes it difficult to make a significant advancement on a technical level. Instead, this explanation only categorizes the cryptosystem identification issue as a pattern identification problem. For the aforementioned reasons, we define cryptosystem identification and cryptosystem identification method in this section. The scheme's outcomes are assessed using the accuracy, recall rate, and F1-score assessment criteria of machine learning identification classification. Consider a cryptosystem set, where n is the total number of cryptosystems, and where is the ciphertexts produced by each cryptosystem inside the set. When a cryptosystem is unknown, if there is an identification scheme, it may be identified using a specific assessment indication. Identification of a cryptosystem is the method in question. The term "experimental evaluation indicator A" in the formulation above often refers to the precision, recall rate, F1-score, and accuracy of machine learning classification evaluation indicators, which vary somewhat from identification accuracy under pattern identification. Definition 2: The cryptosystem identification process. is the classifier used, the feature from the ciphertexts is retrieved, and the triple is marked as the cryptosystem identification scheme We demonstrate Algorithm 1's approach for identifying cryptosystems. Cryptosystems Set CR, Training Set C2, and Testing Set C1 as input Cryptosystems Extract the feature from the ciphertext Train the classification algorithm S using the training set Put in the feature of testing set of the cryptosystems. To create a random forest, the bootstrap resampling approach is used to build a new training sample set and randomly select samples from the first training sample set. These samples are then used to create classification trees based on the self-service sample set. The score generated by the classification tree voting determines how the new data is classified. The distribution of each tree in the forest is the same, and the classification error relies on the accuracy of each tree's categorization and the correlation between them. Using a random approach to divide each node, feature selection examines the mistakes produced in various scenarios and establishes the number of features using correlation analysis, classification ability, and error estimation [5], [6].

Support Vector Machine:

In order to maximize the distance between the two kinds of samples on the two sides of the plane that are closest to the plane, the fundamental goal of the support vector machine is to create an optimum decision hyperplane. The SVM model travels constantly to classify the samples for a multidimensional sample set until sample points from the training sample that correspond to various categories are spread out on both sides of the hyperplane. There may be a variety of hyperplanes that may accurately split the dataset for the same classification issue. As a result, the SVM learning model has high generalization capabilities for the classification issue [7], [8]. The SVM finds a hyperplane that maximizes the white space on both sides of the hyperplane while guaranteeing classification accuracy in order to get the best classification of linearly separable data. After base64 encryption, the picture is converted into an array and stored in the database as part of the encryption process for image data. However, there are a lot of pixels in the picture that are the same color, and the distribution of those pixels varies across photographs, which might cause variations in the ASCII code distribution of the encrypted image data. As a result, the definition of the previous cryptosystem identification scheme is merged with the difference in the statistical value distribution of the ASCII code in ciphertexts to create the next cryptosystem identification scheme. The programmed is divided into two phases: the testing phase and the training phase [9], [10].

CONCLUSION

An essential component of cryptanalysis is the identification of the cryptosystem. The proposed approach has an average accuracy of 84.5% and is based on the statistical value of ASCII code extracted from ciphertexts. From patterns discovered on a collection of ciphertexts, the classifier identified the following block cyphers: 3DES, AES-128, AES-256, Blowfish, Camellia-128, DES, IDEA, and SMS4. The classification's outcome demonstrates how the intrinsic mathematical properties of the encryptions yield recognizable characteristics in ciphertexts that identify one encryption from another. The experiment demonstrates that, in this instance, a suitable feature extraction approach may greatly increase the accuracy of cryptosystem identification. Additionally, because the identification was successful, we may infer that some information about encryption is reflected in the statistical value of the ASCII code from ciphertexts. The cryptographic principle that an adversary cannot decipher any information from ciphertexts presents a hurdle. We came to the conclusion that, assuming the attacker already possesses some document labelled as the training set, a series of encrypted images in ECB mode might be detected by extracting the statistical value of ASCII code. To more accurately categories the ciphertexts, further study may need to enhance feature extraction.

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CHAPTER 8

INTRODUCTION TO INTEGRATED AEROSPACE VEHICLE NAVIGATION BASED ON RANK STATISTICS

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ABSTRACT:
The navigation system of an aerospace vehicle will experience unpredictable conditions due to its large dynamic and high-speed flight, which will cause its random noise probability distribution to no longer meet the prerequisites of a Gaussian distribution set by the current filter algorithm and reduce the navigation system's accuracy. Therefore, it is crucial to provide a workable solution to the navigation system's filter issue in non-Gaussian distribution in order to increase the navigation system's precision. As a result, this work proposes an integrated navigation technique for aeronautical vehicles based on rank statistics. In order to increase the quality of system modelling, an accurate gravity calculation model has first been constructed based on the flight characteristics of aerospace vehicles. The integrated navigation system's state equation and measurement equation have since been developed. To obtain an accurate estimate of the predicted values of the state quantities, measurement quantities, and covariance matrix, sampling points are calculated and nonlinearly propagated through the transition matrix in conjunction with the rank filter algorithm and the chosen weights.

KEYWORDS:

Aerospace, Aeronautical, Navigation, Unpredictable.

INTRODUCTION

The United States class of aerospace vehicles has been the subject of continued study in recent years. Aerospace integration has been the subject of strategic study in several nations. Aerospace vehicles a new class of aircraft with the dual capabilities of an aircraft and a spacecraft, are progressively taking up a significant strategic position in the upcoming battlefield due to their abilities to operate across airspace, perform multiple missions, operate in multiple working modes, and perform massive high-speed man oeuvres. Reusable aerospace vehicles like the etc. have gained more and more attention recently, fostering the growth of low-cost space technology and serving as a hub for research. However, there are still a lot of significant issues in the realm of aeronautical vehicles that need to be resolved. One of them is how to guarantee the safe operation of aeronautical vehicles under challenging flying conditions. The control system of an aircraft vehicle must be flawlessly designed in order to increase flight dependability. The navigation system is a crucial component of the control system; its precision and dependability have a big influence on the following guiding and control components. Designing a navigation system with high dependability, high accuracy, and great resilience has thus become one of the fundamental issues to be tackled, depending on high-precision navigation sensors [1], [2]. The dominant option for big aircraft navigation systems nowadays is the multisource fusion navigation system, which uses an inertial navigation system as its core. The benefits of inertial navigation systems include total autonomy and output of comprehensive navigation parameters, which may provide ongoing navigational data to aeronautical vehicles. However, high-precision external measurement data is required to address the issue of its own inaccuracy drifting over time. Global satellite navigation system and celestial navigation system are examples of mature applications. The integrated GPS/INS system, which has been employed increasingly often as an aircraft's primary navigational aid, has been used to verify the efficacy of the multisource fusion

navigation system built by a variety of navigation sensors on a variety of aircraft kinds and models. Additionally, Margee and Johnson and Ventrella et al. noted that the employment of integrated navigation may achieve complimentary benefits across navigation systems and increase the accuracy and reliability of the navigation system output. In this area, research has produced significant findings. However, we discovered that the majority of the current navigation system solutions are suitable to close-to-the-ground aircraft via our study on the integrated navigation filter algorithms that are now in use. The earth gravity model is often simplified when the geographic coordinate system is employed as the reference coordinate system for the computation of the navigation system since the flying altitude of this kind of aircraft is typically low. Additionally, in the aforementioned procedure, the conversion matrix from the inertial coordinate system to the earth fixed coordinate system is often calculated by multiplying the earth rotation angle rate by the earth rotation time owing to the simpler modelling of the earth motion. However, as is common knowledge, the earth's ellipsoid shape makes its poles flatter. There are three basic issues with the navigation system models for aeronautical vehicles: Aerospace vehicles often have very dynamic flying characteristics; therefore the first issue is gravity. Therefore, it is evident that the accuracy requirements of an aerospace vehicle navigation system cannot be met by employing a single gravity number to depict the gravity shift over the whole procedure. The earth's radius of curvature is the second. Aerospace vehicle high-speed flight causes a quick shift in longitude and latitude. In order to increase the precision of the navigation system, modelling must take this ellipsoid surface's curvature radius into account in all directions. The third is that owing to highly dynamic flight, the navigation system model of an aeronautical vehicle is incompatible with the filter model, which lowers the accuracy of filter estimate. Through their studies of the adaptive filter and IMM filter algorithm , researchers have recently found a solution to the issue that arises when the accuracy of an integrated navigation system declines owing to an erroneous error model. The accuracy of navigation parameter estimate may be increased by using high-precision state quantity and measurement quantity, which are provided by the precise modelling of the aerospace vehicle navigation system, for the following filtering procedure [3], [4].

Due to its complicated flying characteristics, an aircraft vehicle's navigation system is a typical nonlinear system. A crucial issue now is how to appropriately predict the system's parameters. The most popular filter at the moment is the Kalman filter, however its usage is constrained by the fact that the system must be linear and the noise must follow a Gaussian distribution. As a result, it is challenging to guarantee the precision of the aerospace vehicle navigation system's parameter estimate. Many scholars have suggested filter algorithms in recent years, including EKF and UKF. Among these, the nonlinear function of the EKF is converted into a linear function for the Kalman filter by expanding the nonlinear function with Taylor odd numbers, keeping its linear component, and disregarding the high-order term. EKF, however, continues to employ the conventional Kalman filter technique for linear systems, making it only marginally suitable to nonlinear objects. Nonlinear functions, which estimate the parameters by approximating the probability distribution, are also suited for UKF. It calculates the filter gain using the estimated state quantity and the measured quantity's covariance matrix, as opposed to the Kalman filter, which calculates the filter gain using the measured quantity's prior data and the prediction mean square error matrix. Numerous filter techniques have been presented recently to address the estimation of nonlinear systems, all of which are based on the traditional Kalman filter methodology. The process equation, which was originally described as a set of stochastic ordinary differential equations, was converted into a set of stochastic difference equations by Arasaratnam et al. using the Ito-Taylor expansion of order 1.5 . The Bayesian filter's solution may be reduced to the issue of computing Gaussian-weighted integrals by building on this transformation and assuming that all conditional densities are Gaussian-distributed. When dealing with the model's nonlinear issue, Chuang et al. adopted the central difference Kalman filter transform rather than trying to solve the tricky Jacobian

matrix. The aforementioned techniques, however, are still created on the assumption that the system noise in the Kalman filter follows a Gaussian distribution. It may be challenging to adequately simulate all measurement methods and derive the statistical properties of noise due to the complicated flying environment of aeronautical vehicles. As a result, it will be challenging to adapt the conventional Kalman filter based on Gaussian distribution to this circumstance. In recent years, filter techniques for non-Gaussian distributions have also been researched. The particle filter and the filter algorithm based on the maximum correlation entropy criteria are examples of representative algorithms. Particle filter has progressively shifted into the center of several fusion approaches because to its special theoretical benefits in nonlinear non-Gaussian systems [5], [6]. The implementation of particle filters in complicated engineering is nonetheless constrained by particle degradation and sample depletion. In contrast to the traditional least mean square error criterion, which only uses the second-order moment information of the measured quantity, the filter algorithm based on the maximum correlation entropy criterion can fully utilize the higher order information of the measured quantity. Therefore, stochastic systems that are tainted by non-Gaussian noise may benefit from the correlation entropy theory. A cubature Kalman filter based on the maximal chronotropy criteria has been suggested by Zhang et al. . The maximum chronotropy criteria, which takes into account the high-order moments of estimate errors, was chosen by MCCKF as the optimization criterion. The calculated state was then repeatedly updated using fixed-point iteration methods, and a Gaussian-weighted integral was approximated using the cubature quadrature rule. In order to enhance the filter quality and resilience of kernel least mean square in non-Gaussian noises, Zhang et al. devised the minimal kernel risk-sensitive loss method . We can see from the study above that the classic filter approach based on Gaussian distribution cannot be approximated successfully in the presence of complicated non-Gaussian systems like an aircraft vehicle navigation system. Therefore, non-Gaussian noise filter algorithms have been the subject of much study. The aforementioned algorithm still has issues with complicated calculations and poor efficiency, making it challenging to suit the needs of an aeronautical vehicle navigation system. An effective strategy for simulating the probability distribution of system states has recently been developed. A rank filter mechanism has been suggested in light of this. It may be used to solve nonlinear filtering issues if the noise has a Gaussian or non-Gaussian distribution. Additionally, this approach has the benefits of easy computation and less calculation compared to UKF, PF, and other algorithms, making it handy for engineering applications.

DISCUSSION

In order to fulfil the requirements of its full navigation parameter measurement, the aerospace vehicle might use a multisource navigation system. To increase the accuracy of the navigation system, different supplementary navigation sensors might be chosen on the basis of changes in the real flying environment. Various navigation sensors may be added simultaneously based on the demands of real-world applications. This study conducts algorithm research on the integrated navigation system of aeronautical vehicles based on the aforementioned navigation configuration. The following two aspects make up the main innovations: first, an accurate model is established to increase the accuracy of navigation calculation. This is done in accordance with the characteristics of aerospace vehicles flying in large dynamics, long distances, and far from the earth's surface. The transformation matrix from the earth-centered inertial coordinate system to the earth fixed coordinate system is established at the same time in conjunction with the earth motion parameters such as pole shift, vernal equinox time angle, nutation, and precession of the equinoxes to improve the accuracy of the model in order to conform to the actual flight environment of aerospace vehicles. Accordingly, the real distribution has been simulated using the rank filter algorithm and combined with the principle of rank statistics, and the rank Kalman filter is used to realize the precise estimation of navigation parameters. This is due to the multisource navigation sensor configuration of

aerospace vehicles, as well as the issue that the system noise no longer obeys the Gaussian distribution during large-dynamic flight. The suggested method can successfully complete a large-scale, highly maneuverable flight while meeting the accuracy and reliability demands of the navigation system for aeronautical vehicles [7], [8].

Programming Design:

ASV has a wide range of flight envelopes, and the whole flight cycle may be broken down into launch, on-orbit, reentry, and landing phases. Aerospace vehicles often travel in low-Earth orbit, roughly 300 km from the earth, because to the differences in their flight characteristics from unmanned aerial vehicles, aero planes, and other near-ground vehicles. Currently, the near-ground vehicle algorithms often neglect the influence of the earth's flawed elliptical shape on the navigation results when employing the geographic coordinate system as the reference coordinate system for navigation computation. The near-ground vehicle's navigation calculation accuracy won't be significantly impacted by this processing technique. However, since the aerospace vehicle is flying far from the planet's surface, factors associated to the earth have a significant influence on how the navigation computation of the aerospace vehicle is done. On the other side, a more accurate navigation system is needed. As a result, the reference coordinate system for this procedure is chosen to be the launch inertial coordinate system. The rank sampling method is then used to more effectively simulate the real system distribution and increase the output accuracy of the filter because the noise distribution of the system state quantity and measurement quantity is no longer consistent with the conventional Gaussian distribution due to many uncertain factors in the actual flight process of the aerospace vehicle. Figure 1 depicts the algorithm's general layout.

An algorithm scheme diagram. the algorithm is split into three sections. Inertial navigation system modelling is shown in the blue portion. First, the gyroscope is used to determine the aerospace vehicle's angular rate, and the quaternion technique is used to determine its attitude. The accelerometer measures the particular force, and position and speed are computed. In order to calculate the acceleration in the upward direction, the specific force of the body coordinate system in relation to the inertial coordinate system is projected in the geographic coordinate system, and the gravity potential function is calculated using the spherical harmonic function. These calculations serve as the foundation for the modelling of the subsequent filtering equation. Filter modelling is represented by the green portion. First, the sensors are used to measure the navigation parameters, and then an indirect technique is used to create the Kalman filter model. The system noise does not follow a Gaussian distribution, for this reason. For rank statistics analysis, the orange portion is utilized. To construct the variance matrix of a one-step prediction error, rank sampling points are first produced. The navigation parameter error is then fixed after obtaining the revised filter gain matrix via the state matrix transition and measurement matrix transition. the effect of earth's gravity Aerospace vehicles, unlike aviation planes, travel at great altitudes, therefore the simplified earth model used by conventional inertial navigation algorithms in the geographic coordinate system is no longer appropriate for ASV navigation systems. Converting from the WGS84 coordinate system to the J2000 coordinate system is a crucial conversion matrix for converting aerospace vehicle coordinates. The pole shift, vernal equinox time angle, nutation, and precession of the equinoxes are the main factors that contribute to the difference between the WGS84 coordinate system and the J2000 coordinate system since the global satellite navigation receiver typically receives rectangular coordinates under the WGS84 coordinate system. Figure 2 depicts the procedures involved in changing the WGS84 coordinate system to the J2000 coordinate system. As shown in Figure 2, it is vital to completely take into account the relevant earth motion characteristics when calculating the transformation matrix from the J2000 coordinate system to the WGS84 coordinate system. The nutation effect must be taken into account in the transformation from the instantaneous horizontal celestial coordinate system to the instantaneous true celestial

coordinate system, while the influence of precession is first taken into account when calculating the coordinate transformation matrix from the J2000 coordinate system to the instantaneous horizontal celestial coordinate system. Then, while switching from the instantaneous true horizontal celestial coordinate system to the instantaneous ground fixed coordinate system, the effect of the vernal equinox time angle must be taken into account. The instantaneous ground fixed coordinate system is then changed to the WGS84 coordinate system in accordance with the pole's coordinates.

As a result, this paper further deduces the universal gravitation model, which affects the accuracy of the aerospace vehicle navigation system, and then improves the original model, based on previous research on the strapdown inertial navigation system model in the launch inertial coordinate system. The difference between the absolute acceleration and the gravitational acceleration of the aerospace vehicle relative to the inertial space is used to determine the specific force recorded by the accelerometer. The following is how the particular force equation is created when combined with Newton's second law: By comparing Equations and , we can see that, because Equation is generally applicable to the navigation solution of near-ground aircraft, the gravity model calculation equation in Equation only has a mathematical relationship with the aircraft's flying height and does not take the effect of the earth's ellipticity on the gravity field into account. This equation may compute an approximate estimate of the aircraft's gravity when its altitude is much lower than the earth's radius. However, it is commonly known that the spacecraft is in orbit for a considerable amount of time and that its flying altitude is around 300 kilometers. Therefore, it is impossible to disregard how the earth's ellipticity affects its gravitational field. Equation, which calculates the gravitational field of the aerospace vehicle while it is in flight, may be derived from Equation . This model enhances the precision of the navigation system model of the aerospace vehicle by completely accounting for the impact of the earth's ellipticity on the gravity field.

Integrated Navigation System Modelling:

The strapdown inertial navigation model is further developed after a precise gravity model has been constructed. The strapdown inertial navigation model may be separated into an attitude calculation module and a velocity/position calculation module in accordance with the design plan illustrated in Figure 1. When combined with gyroscope outputs, the launch inertial coordinate system, which differs from the geocentric inertial coordinate system solely in the coordinate origin, may be stated as: The projection of the angular rate of the body coordinate system with respect to the inertial coordinate system is shown in Equation. The quaternion approach is used in this research to determine the direction cosine matrix between the launch inertial coordinate system and the geographic coordinate system as well as the attitude of the aerospace vehicle in the launch inertial coordinate system. This approach may significantly minimise the amount of computation when compared to the conventional Euler angle technique. The filter algorithm of the integrated navigation system has to be further researched once the models of the strapdown inertial navigation system and integrated navigation system have been constructed. Due to the cross-airspace, high dynamic, and wide range tasks that aerospace vehicles must perform, the filter model and the actual navigation system model are inconsistent because the noise statistical characteristics of their navigation system no longer follow the Gaussian distribution. The performance of the current filter methods based on the assumption of Gaussian distribution will start to deteriorate at this point. The rank sampling algorithm is used in accordance with the rank Kalman filter's underlying principles, and it collects sampling points in accordance with the correlation principle of rank statistics before effectively simulating the probability distribution of the system state to address the issues of system model error and noise uncertainty in the actual system. This study uses the Monte Carlo simulation approach to validate the algorithm's performance. Two simulation situations are set up at the same time. First, when the system's random noise distribution deviates from a

Gaussian distribution, the algorithm's effectiveness is confirmed. Then, by modelling the discrepancy between the system model and the filter model, the system noise error is further raised on the grounds that the random noise distribution does not satisfy the Gaussian distribution. Finally, the algorithm's effectiveness is confirmed. In this study, UKF is used as the comparison method.

Aerospace vehicle launch parameters are beginning longitude, latitude, and altitude, initial yaw angle, initial azimuth angle, launch time of 0 h 0 min 0 s on November 15, 2020, flight length of 300 s, and filter period of 1 s. The driving white noise parameters of the accelerometer are different from the equivalent parameters in the filter, and the real system model random walk parameters in Table 1 are inconsistent with the filter random walk parameters in Equation . As a result, it is possible to see the simulation circumstances as a contradiction between the filtering model and the real system model. The simulation results of the gyroscope and accelerometer's random error distribution are shown in Figures 4 and 5. The red portion of the graphic is the noise used in the simulation experiment in this study, while the black line in the figure is the Gaussian distribution curve. The random error noise distribution of the accelerometer and gyroscope has been adjusted, and it is clear that it no longer follows the Gaussian distribution. Additionally, Table 2's results show that the gyroscope and accelerometer set's noise exhibit non-Gaussian noise characteristics in terms of mean and variance. This particular type of noise is utilized to test the efficacy of the technique presented in this study in further simulation trials. that the errors of the UKF and LRF algorithms change as a result of the presence of non-Gaussian noise. In the attitude error comparison curve, the heading angle error estimated by the UKF algorithm is significantly greater than that estimated by the LRF algorithm at about 100 seconds, and the roll angle error and pitch angle error estimated by the UKF algorithm are greater than those estimated by the LRF algorithm. The UKF algorithm error is much larger than the LRF algorithm error in the position error comparison curve, which exhibits the same performance as the attitude error comparison curve. As an aerospace vehicle's location is used in this research to compute its velocity, the fluctuation trend of velocity error is comparable with that of position error. The LRF technique developed in this study is more suited for the real-world engineering usage of aerospace vehicles because it can more accurately replicate the non-Gaussian distribution of system random noise. When the navigation system noise does not follow a Gaussian distribution, the statistical results of the root mean square of navigation parameter estimation error in Table 3 show that the LRF algorithm's root mean square of navigation parameter estimation error is significantly smaller than that of the UKF algorithm, indicating that the LRF algorithm has a smaller estimation error, higher accuracy, and more stability when the navigation system noise does not follow a Gaussian distribution The simulation analysis, shown in Figures 15–23, was done under the assumption that the navigation system noise follows a non-Gaussian distribution and in conjunction with the actual flight environment of aerospace vehicles, which is likely to cause inconsistency between the filter model and the navigation system model. First off, the UKF method estimates a higher navigation parameter error than the LRF algorithm because the system noise still follows the non-Gaussian distribution. The magnitude of the system noise will also fluctuate as a consequence of the discrepancy between the system model and the filter model, which will lower the algorithm's estimate accuracy. According to the estimate error curve, the LRF algorithm's estimation accuracy is noticeably higher than the UKF algorithms. It has a steadier error curve and a reduced filtering error. The statistical findings of the calculated mean square error in Table 4 further support this. Comparing the data in Tables 3 and 4, it can be observed that the data in Table 4 are greater than those in Table 3, suggesting that the system is more unstable. This is because the disagreement between the navigation system model and the filter model is increasing. The LRF algorithm proposed in this paper, however, has a smaller root mean square of navigation parameter estimation error and higher estimation accuracy when the system noise does not meet the Gaussian distribution

and the inconsistency between the navigation system model and the filter model, and it can adapt to more complex flight environments and has better robustness as can be seen from the root mean square of navigation parameter estimation error [9], [10].

CONCLUSION

Aerospace vehicles are a new kind of aircraft that have gained popularity in research due of features including reproducible takeoff and landing and long-distance travel. Researching the appropriate navigation algorithms based on the high dynamic and high-speed flight characteristics of aerospace vehicles is important to satisfy the high-precision and dependable flying requirements of these vehicles. The aerospace vehicle can fly at both the aviation level and space level, in contrast to the near-ground vehicle. Because of this, it is challenging for the conventional geographic coordinate-based navigation algorithm for close-range vehicles to match the accuracy standards of the aerospace vehicle navigation system. This study examines the impact of an accurate gravity model on the precision of an aeronautical vehicle navigation system. In addition, it improves the accuracy of system modelling and provides a high-precision system model and error model for subsequent filtering algorithms while analyzing the key variables that influence the accuracy of modelling when changing from an inertial coordinate system to an earth fixed coordinate system.

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CHAPTER 9

DIGITAL GAMES USING ARTIFICIAL INTELLIGENCE AND MATHEMATICAL STATISTICS

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ABSTRACT:
Digital games are a broad category of games created and produced using digital technologies and played on digital hardware. Related technologies like real-time graphics rendering, realistic interactivity, and artificial intelligence in games are all continually evolving along with the active growth of the current gaming business. The growth of theoretical artificial intelligence and the processing speed of real-time systems are two of them, and the artificial intelligence technology of games is constrained by these factors and lags behind visuals and interactive technology. This research suggests using artificial intelligence in digital games based on mathematical statistics approaches in order to analyses and raise the degree of intelligence in these games in order to address these issues. The approach used in this research is to examine the mathematical statistics technique and the fundamentals of the Sarsa learning algorithm before proposing the use of artificial intelligence in video games.

KEYWORDS:

Artificial Intelligence, Invention, Pertinent Indicators, Realistic.

INTRODUCTION

Since the very first computer games, which date back to the Pong and Pac-Man era, artificial intelligence has been a fundamental component of gaming. The use of mathematical statistics for categorization and correlation analysis is examined in this essay. In addition to customer stratification service requirements and occupancy rates based on this model, it also examines the concepts of group customer valuation, the design of pertinent indicators, indicator screening techniques, and weights. The computational speed of computer hardware has greatly increased over the last ten years, which has sparked the development of associated computing technologies and accelerated the growth of the video game industry. Since many businesses have invested in the gaming sector and some high-profile games have development costs in the hundreds of millions of dollars, game sales will continue to rise over time. The study of artificial intelligence in video games has significantly grown in recent years. While the majority of research on artificial intelligence in video games focuses on game engine development and technical elements, the quest of "real" visual effects also has an impact on visual effects. Artificial intelligence can adapt to technology, progress sophisticated technology, and infuse technological research with fresh ideas and creativity [1], [2]. These subject mixes technology with the arts and examines artificial intelligence technologies used in video games from a variety of angles, as well as how it affects game intelligence on numerous levels. This paper's invention is the proposal of a technology based on the Sarsa algorithm for behavior tree optimization of digital games, which enhances the process of building artificial intelligence behavior trees in such games and offers a workflow for behavior trees that may make use of the algorithm. This study illustrates the technical viability of artificial intelligence technology's participation in the development of digital games by summarizing the respective characteristics of artificial intelligence technology and digital games according to their respective stages of development. This article examines the change of digital game development concepts and the in-depth examination of certain creative ideas in which artificial intelligence technology participates in order to establish a creative route for digital games to fulfil human requirements.

It covers the evolution of artificial intelligence technology that is involved in the production of digital games and introduces the idea of interactive artificial intelligence based on artificial intelligence games. With every day that goes by, digital game production changes and study into them grows. One of the hottest study topics in academia is how to improve the use of artificial intelligence in video games. Zhao presented the formula for calculating the definite values of the RM and DFM test results. By defining pertinent parameters, such as the corresponding torque limit value, the ratio of the measured value to the true value, and the confidence coefficient related to the confidence degree and confidence probability, he developed a mathematical statistical method of residual static torque control that improved residual torque control. The objective of MBBCh was to create a statistical model based on patient characteristics to forecast how long a patient would remain in the intensive care unit after heart surgery. The measurements and key findings of the trial demonstrated that Euro SCORE could be used to distinguish and predict patients for different surgical procedures in the ICU. The model was used to categories patients into short-term or long-term hospitalizations. Alekseev examined the level of interdependencies between wavelet transform coefficients derived from network packet characteristics, computed standard deviations on this basis, and grouped the resulting coefficients to pinpoint abnormalities in the network under investigation. He suggested obtaining clusters of coefficients to identify features in the main network data using the wavelet transform mathematical technique. According to Hassabis et al., a deeper comprehension of biological brains might be essential for creating intelligent robots. They look at how artificial intelligence and neurology have historically interacted, and they emphasis recent developments in AI that may be important for improving future study in both domains . Markakis examines the potential of AI applications in healthcare and evaluates their existing condition. He thoroughly investigated how artificial intelligence may be used to treat stroke illness, focusing in particular on the three key areas of patient early identification and diagnosis, therapy, and outcome prediction and prognosis assessment. A thorough analysis of artificial intelligence systems for rotating machinery problem diagnostics from both a theoretical and practical perspective was made by Liu et al [2], [3]. Sam refers to the pattern of clever strategy responses from donors and receivers as a "numbers game." She performed in-depth interviews and detailed observations of council members' everyday activities in a city, and using data that was already available, she researched the dominant role of outcome-based assistance in the video game.

Statistical Mathematical Techniques:

Stochastic simulation, parameter estimation, hypothesis testing, and statistical decision theory are some of the fundamental techniques in mathematical statistics. The following categories may often be used to categories mathematical statistics: Sampling surveys and experimental design fall under the first group. Observational and experimental data gathering, statistical inference, and related theoretical and methodological challenges are the main topics of discussion. The major purpose of the second kind of work is to describe the fundamental ideas and procedures of statistical reasoning. The third group consists of dependability statistics, statistical quality control, and product sample inspection. The three categories of mathematical statistics—the thinking technique, the descriptive method, and the statistical inference method—according to the application of mathematical statistics method categorization are often used. Below is a description of the stochastic differential equations, sometimes known as the chemical Langevin equations. The fundamental ideas of Poisson random variables and Poisson processes are first presented in this essay. Poisson random variable: has a parameter, is represented by to, and follows a distribution.

DISCUSSION

There has never been a definition for fuzzy statistical decision theory like this, and this is a brand-new definition name. We went into great length on the characteristics of this project in the last part, so we won't go into it again. According to the aforementioned traits, there isn't a current approach that can totally address the aforementioned issues. In order to address the issue of risk assessment for such projects, a new complete integrated technique is provided here in the hopes of achieving the best assessment results ever. The task of this chapter is to examine the project's strategy for assessing risk factors, which primarily relies on the combination of fuzzy hierarchical structure and the AHP method. It provides a four-dimensional comprehensive assessment system while building on the foundation of the two-dimensional comprehensive evaluation approach used by the earlier researchers.

Games are a particular aspect of human existence, but they are also essential to the process of human material creation. There have always been games where human civilization has flourished, maybe even before. Popular sports like throwing pots and rolling balls were played often in ancient China. In addition, humans have games for all ages, including board games for adults, sports games, and more. These games range from building blocks to kid-friendly jigsaw puzzles. In actuality, the game has several features that make it more than simply for entertainment. Games may not only make people happy but can also educate and amuse them, which is crucial for the blending of many cultures. Digital games are evolving quickly and gaining popularity on a global scale. Digital games have higher growth possibilities than other cultural and creative sectors since they are a more recent creation. The sales of digital gaming gear, software, and the actual game are all now expanding quickly. Microsoft, Sony, Nintendon, and other game firms are continually releasing new products and having tremendous success. In general, decision-making and behavior are the two levels that make up game AI. One way to think about the behavior layer in the game is as middleware. The decision logic is at the top layer, while the animation resources are in the bottom layer. The objective of the study is to translate AI requests into requests for animation playback. The following behaviors that a puppy may exhibit include walking, running, sleeping, eating, and drinking. These might be seen as a succession of its acts or logical steps [4], [5]. A behavior pool is a collection of these behaviors. The most effective approach to arrange these behaviors is in a behaviour tree. Behavior tree, sometimes known as BT for short, is a tree structure with hierarchical nodes used to regulate the decision-making of AI. The behavior tree does a depth-first search after each update until the underlying leaf node reports success or the state switches to running. The AI must priorities the behavior tree in accordance with this traversal technique, and this behavior may need to be added to the left branch of the behavior tree at the time of design. Here, we'll demonstrate the structure of the behavior tree using the actions of a soldier in the game as an example. The behavior tree of a video game character. We will search the tree from the top down using certain criteria to discover the leaf nodes that need to be done and then carry them out in order to decide what sort of behaviour the current soldier will exhibit. A behaviour tree is used as the algorithm's input, and the tree is first examined to identify the deepest sequence nodes, which serve as reinforcement learning actions to determine the values that match to the value table. It is simple to divide the produced value table into sub tables, with the value sub table of actions matching to behaviours in the behaviour tree. The parameter selection corresponds to the state with the largest percentage value according to the sub table values, which are ordered from high to low. This procedure is shown in Figure 3, where the main table is separated into smaller tables by actions that are put in conditional nodes rather than conditional nodes. Based on the parameters, further algorithms filter the related states, keeping just a portion of the highest values. To support popular game kinds and popular game AI core technologies on the market, we will build and install a well-known AI engine based on Unity3D in this chapter. The main layout and overall architecture of the engine will be presented in this article. The engine is split into three sections: message mechanism, intelligent

agent architecture, and fundamental foundation class. The design and execution of these three aspects are then thoroughly examined in this study. The design and execution of decision-making systems, perceptual systems, and behavioural systems are the core fundamental elements underpinning the engine. This article provides a thorough introduction to the intelligent agent before describing the primary function of the messaging mechanism and the message kinds utilized in the engine. This chapter's implementation of a generic AI engine satisfies the performance requirements for generality, efficiency, flexibility, extension, customization, and platform expansion. It may speed up the development of the artificial intelligence needed for the game, add lifelikeness to the characters and monsters, and provide players a more "immersive" gaming experience.

The two tables that the Sarsa algorithm uses are:

The first is the state-action reward table, in which each row corresponds to a state. A reward for doing that action in that condition is represented by the table value for each column, which is an action. It is possible to define a reward for the activity in each stage by specifying the table value. The rewards for various activities in various stages will have an impact on the weights of the associated actions in each state as the algorithm continues to advance. In general, the weight of the action corresponding to the final corresponding state is positively connected with the value of a row and a column on the table. The first is a state-action table, sometimes known as a table. Each table has the same number of rows and columns as the corresponding table. The weight of the corresponding action in the corresponding state is represented by the table value of the table, and the artificial intelligence uses the weight to make decisions. In general, the algorithm will choose the action with the greater weight after assessing the state . The table value changes with each iteration in accordance with the update equation since it is not constant. The numbers in the table often stabilize after a large number of rounds . The shortest route in a static road network may be found using algorithm, which is also a useful technique for many other search issues. The final search speed increases in direct proportion to how well the distance calculated value in the algorithm matches the real value. The technique estimates the remaining distance between the current node and the terminus using a heuristic estimation function. The ordered queue often contains nodes sorted according to small to big when is used to depict the route cost from the beginning point to the destination via node [6], [7].

The algorithm's equation for calculation is as follows:

is the estimated distance from the present position to the end point, and is the route cost from the beginning point to the node in the equation. Traditional shortest route algorithms that can solve the issue in a static setting include Dijkstra's algorithm and the A algorithm. The typical shortest route algorithm cannot redirect cars in a dynamic environment where the weights on each road segment vary in real-time, which would cause an excessive concentration of vehicles and a transfer of congestion. It was discovered that the study on digital games is quite extensive and that practically all areas of digital games have been engaged after doing keyword searches on the Internet and examining existing relevant literature. Figure 4 depicts the recent trend in the volume of research on video games. The following are the key causes for the extensive study on digital games: Digital game creation is an extremely difficult and extensive endeavor that crosses several academic subjects and disciplines, including cultural studies, ethics, design studies, computer science, psychology, and communication studies. Digital games' economic usefulness has provided a significant drive for associated theoretical study. The study data of the survey company on the size of the digital gaming market in China from 2014 to 2020.

It is clear that there is a sizable development area for the mobile gaming industry. Digital games have evolved into a mature business with high technology, fast development pace, and high profit after more than fifty years of development. Domestic digital games began rather late

when compared to those in other nations. Mobile games have evolved quickly with the benefits of device popularity, portability, immediacy, and interaction in the domestic market setting, where the mobile network is established and there are many users, and their number is steadily growing. The survey results on the size of the online games market in China are shown in. Industry experts have noted that while China is still developing its digital gaming market, the problem of game uniformity and piracy is a big one. Numerous games are of poor quality, and there is little user stickiness. There is still much to learn about the design of digital games. The findings of a study on the frequency and length of digital play by kids using digital devices are shown in Figure 7. The majority of youngsters play on a daily basis, with more than 90% doing so on a weekly basis. Within one hour, 85.7% of kids play games using numbers.

This work utilizes a simulation experiment to confirm the algorithm's accuracy and concludes the simulation experiment with a sample application case. The Gladiator agent is the only agent present in the experimental scenario. The definition of the associated behaviour is as follows: resisting a particular level of harm is defence. In response, bring back a certain quantity of life. Damage is dealt in a normal attack dependent on attack power. Charged attack: It amplifies damage over subsequent hits. Finishing attack: inflict extra damage while also taking some harm. Escape by leaving the location. It is vital to create precise settings for the interaction between the agents after creating the behavior tree because the many impacts induced by the gladiators' activities need an exact measuring standard. The training results are saved in four files, as can be seen. Among these, model is the data for the model, and vector is the matching vector data. NY is the data in the form of the numpy scientific operation library, on which genism relies. 2.43 GB is the final single vector file size, which is within expectations. The system use many techniques, including packaging, network calling, and others, to achieve cross-language calling. The performance penalty caused by the local network call itself is almost nonexistent in this paper's measurement of latency and comparison to the no-network test version data. One of them, the model loading, takes a lengthy time, but only the first time the text service is launched; it has no impact on the system's normal operation. In general, the system is capable of providing real-time performance. Additionally, the behaviour tree module uses a reasonably fair amount of resources, and the complete system functions reliably. In this study, a prototype of a 3V3 basketball game is designed and implemented to test the efficacy of game artificial intelligence. This research uses the approach of automated sample capture to record 2675 real-time game data of 25 games in a 3V3 basketball game in order to analyse and evaluate the training process of the BP neural network discussed above [8], [9]. There are 15 rounds in each game, and each round may last up to 20 seconds. Real-time data is produced in the TXT format with elements being separated by spaces, and it is captured once per second. The sample is split into two pieces, and the experimental platform is MATLAB. The minimal error value is 0.02, there are 860 training samples, 1658 test samples, and there are 2000 training samples. When creating a neural network, consider a variety of training strategies and check the error curve and memory use after training. displays the error decrease graphs for several training techniques.

The training impact of the whole dataset is not optimal, according to the test findings. The first five feature data's difference degrees were 0.51, 0.83, 0.58, 0.49, and 0.78, respectively, showing that there is a significant discrepancy between the original data and the data after cluster analysis, leading to inconsistency between the training results and the original data. The scoring rate of players that were taught with the whole data set considerably declines when compared to the sixth feature data scoring rate, which is a benchmark that measures player intelligence. The sample contains contradicting data with various tactical orientations, which causes a poor training impact. On the other hand, when compared to the whole dataset, the game decision-making system trained using the sample sets from clusters 1 to N1 essentially preserves the properties of the samples. According to the running data's first five feature values are almost identical to the sample feature values, and the difference is under 20%. Due to the

neural network's intelligence not being able to completely achieve human height, the score rate decreased marginally but within acceptable bounds. According to the experimental findings, the decision-making system can identify player data based on tactical tendency after secondary clustering, and after learning, it can realize a diversification of decision-making tendency. The time complexity spectrum sensing based on mathematical statistics examined in this study primarily begins with a decrease in time complexity and is intended for a single user of the sensing, without taking into account the way of multiuser collaboration. The logic of the agent and the typical operation of the overall system are essentially realized via the processes of input acquisition and processing, word segmentation and semantic recognition, and behavior tree decision-making, together with the unique scenes and functions defined. Some challenges and issues arose throughout the design and execution phase. Although the majority of these challenges and issues have been overcome, several remain need attention or improvement. Due to the complexity of the current communication environment, it is essential to adopt a multiuser collaboration strategy for spectrum identification, while also taking the possibility of malevolent users into account. As a result, further study is required in this area of multiuser cooperation. Although the process of generating ideas has many applications in mathematical statistics, it is difficult to express. As a result, this page includes a small number of common cases in mathematical statistics that need to be further summarized [10], [11].

CONCLUSION

The core of studying mathematics is mathematical thinking, which also serves as a fundamental guiding principle for solving mathematical issues. In the experiments presented in this work, a perception system that offers input to intelligent models and a digital game-sharing artificial intelligence system that increases perception reliability are implemented using physics engine triggers. In order to optimize the structure of the action tree and increase its intelligence, this study suggests an action tree building technique based on the Sarsa algorithm. Additionally, in order to confirm its efficacy, this research performs a similar simulation experiment. The sorts of information are discussed, and the structure and processing flow are described. Among these, voice recognition's implementation theory and practice are carefully examined. A cross-language call is made possible by packaging at the same time as the voice recognition SDK is added to the completed engineering project, and ultimately, the speech input function is supported.

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CHAPTER 10

WHATMAN PAPER SAMPLES' STRUCTURE AND PROPERTIES AFFECTED BY VARIOUS ARTIFICIAL AGING'S

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ABSTRACT:
The natural ageing of Whatman paper samples was artificially accelerated in a climate chamber, thermal oxidation in air at constant temperature, photo-oxidation under a Xenon arc lamp, and chemical oxidation with sodium metaperiodate with the goal of controlling cellulose degradation phenomena. In addition to thermogravimetric mechanical, and optical examinations, the degradation of cellulose was investigated using viscos metric, FTIR, wide angle X-ray scattering and viscos metric methods. All of the applied treatments were found to considerably alter the structure and characteristics of the paper, with the degree of deteriorating effects varying depending on the kind of ageing. Nevertheless, direct relationships were examined between the degree of cellulose molecular breakdown, the generation of carboxyl and/or carbonyl groups, and the break strength of the paper.

KEYWORDS:

Degradation, Nevertheless, Oxidation, Thermogravimetric.

INTRODUCTION

One of the earliest and most popular man-made materials is paper. With a minor quantity of organic, inorganic, and maybe color additives, it is mostly constituted of cellulose and water. While only cellulose fibers are found in today's high-quality machine-made sheets and previous hand-made papers, low-quality paper has cellulose embedded in a matrix of hemicellulose and lignin. These four processes photodegradation, acid hydrolysis, oxidation, and biodegradation cause the most significant changes in cellulose-based materials. A complete investigation of the substance cellulose is fairly complicated since these phenomena are all interconnected. Numerous oxidizing chemicals have the potential to cause cellulose to oxidize. Cellulose may be oxidized by molecular oxygen, and alkaline conditions and high temperatures considerably speed up the attack rate. All types of oxidative damage cause the cellulose structure to change, the cellulose chain to shorten, and the cellulose fibers to deteriorate. It is widely known that extended exposure to light may harm cellulosic materials. The observable effects include some discoloration and an overall decline in strength [1], [2]. There are two different processes to take into account: in the first, light energy is the main cause of cellulose degradation, while in the second, the kind of impurities, as well as the presence of moisture and oxygen, all contribute to the assault. The chemical linkages in the cellulose chain break as a result of exposure to high-energy UV light. Last but not least, photosensitization is another deteriorating phenomenon linked to exposure to light. The study of cellulose degradation mechanisms is currently of great scientific interest in order to gain a deeper understanding of its degradation phenomena with the ultimate aim of improving the current methods of conservation and restoration of cultural heritage made up of cellulose-based materials.

Starting with this necessity, accelerated ageing cycles were set up to replicate the various deterioration processes that ancient paper objects went through, with the express goal of providing paper samples with regulated degradation levels, appropriate for use as model samples. In specifically, Whatman paper samples were aged artificially in this study using thermal oxidation, photo-oxidation under a Xenon arc lamp, accelerated ageing in a climate

chamber, and chemical oxidation. By measuring the cellulose intrinsic viscosity, the degree of crystallinity of the cellulose by wide angle X-ray scattering, the mechanical properties, the activation energy for degradation by thermogravimetric analysis, and the optical properties of the Whatman paper samples before and after each ageing procedure, the degradation level of cellulose for each ageing procedure was assessed. Whatman paper, which has a weight per square metre of 75 gr/m2, was used for the study. Four separate accelerated ageing cycles were set up in order to simulate the various degradation processes that naturally take place in cellulosic materials and provide model samples with regulated deterioration levels. Thermal oxidation was performed on Whatman sample pieces for 500 hours at 100°C in an oven without light. It is well knowledge that heat oxidation causes cellulose to shed its chemical bonds and produce carbonyl, carboxyl, and hydroperoxide groups. Whatman samples were stored in a Climatic Chamber Angel Antoni Challenge 250E under UV illumination for 500 hours at a temperature of 60°C and a relative humidity of 70% to accelerate ageing. Free radicals are produced when cellulose is exposed to UV light, which also starts a number of chemical processes such depolymerization, dehydrogenation, dihydroxylation, and DE hydromethylation that result in the creation of hydrogen, carbon monoxide, and carbon dioxide [3], [4].

Chemical oxidation: samples from the Whatman method were exposed for two hours to a sodium metaperiodate 0.1 M solution. A very precise process known as metaperiodate oxidation transforms two 2,3-dihydroxyl groups into two aldehyde groups without causing any noticeable adverse effects. Whatman samples were subjected for 500 hours to a Xenon light source in an Angel Antoni SB3000E solar box for photo-oxidation. The radiation was maintained at a temperature of 65°C and a constant power of 1000 W/m2. Increased carboxyl, hydroperoxide, and carbonyl content are the results of photo-oxidative processes. The degree of molecular breakdown of the cellulose that makes up Whatman paper was assessed using a viscos metric approach that was more advanced than the UNI 8282 standard. In actuality, the flow durations for cellulose solutions in CED at various dilutions were measured, yielding DPv values for the cellulose that were more precise than those obtained by strictly following the UNI 8282. Before and after the various ageing methods, the DPv values for cellulose isolated from paper samples were examined. Total reflection with attenuation On both young and old Whatman samples, Fourier transform infrared spectroscopy was carried out. The spectra were obtained utilising a single-reflection micro-ATR accessory and diamond ATR element with a Jasco FT/IR 6300 spectrometer. 4 cm1 of spectral resolution. In order to remove any remaining dampness, the paper samples were first dried in a desiccator under vacuum for 24 hours at room temperature.

On unaged and aged Whatman samples, WAXS analysis was performed using a Cuk-Ni-filtered radiation Pert PRO Paralytical diffractometer in reflection mode. Using a high voltage of 40 kV and a tube current of 40 mA, intensity profiles were taken in the 2 range of 5-40°. For the purpose of calculating the instrumental broadening, a standard sample was used. Paper samples were subjected to uniaxial tensile tests using an Instron 5564 tensile testing machine running at a cross-head speed of 10 mm/min at a temperature of 25°C and 50% relative humidity. The samples underwent a 24-hour conditioning period at 25°C in a vacuum before testing. Ten test pieces were used for each sample, both aged and unaged, and the results were averaged. Using a Perkin Elmer diamond thermogravimetric/differential thermal analyzer thermogravimetric analysis was used to evaluate the degradation of the paper samples. In order to determine the thermal stability of the cellulosic materials in relation to the various ageing processes, measurements were made on 10 mg paper samples in an aluminum holder at different heating rates from 30°C to 650°C in a nitrogen atmosphere [5], [6].

DISCUSSION

It should be mentioned that the kind of anti-aging therapy used significantly affects how much of a drop is really detected. The least amount of molecular breakdown is seen in thermally oxidized samples, which also have a Dev. value that is quite close to that of freshly printed paper. On the other hand, the photo-oxidized samples show the lowest DPv value, which is almost six times lower than that of the unaged sample. Additionally, compared to climatic chamber ageing, chemical oxidation produces consequences that are more severe. These findings point to a classification of the treatment's ability to degrade materials: starting with samples that were aged thermally, moving on to samples that were aged in climate chambers, then to samples that were aged chemically, and finally ending with samples that had been photo-oxidized, which had the shortest cellulose chains. It confirms that the photo-oxidation is the most potent and, hence, harmful method for causing cellulose depolymerization among the ageing treatments put up. Figure 1 contrasts the ATR-FTIR spectra of Whatman paper that has not yet aged with those of Whatman papers that have undergone various weathering processes, including thermal degradation, accelerated ageing in a climate chamber, chemical degradation, and photo-oxidation.

The strong affinity of paper for water makes FTIR analysis of paper samples challenging in general. The band of the absorbed and bound water is really in the carbonyl group area , and sometimes it may be quite wide and obscure the bands of the carbonyl groups. Despite this, it is easy to see how various ageing techniques may cause distinct oxidation processes on paper products from the range 1500-1800 cm1 shown in Figure 2. For the aged samples, it is really conceivable to see an appearance of a shoulder with a center point of roughly 1730 cm1 in this range because of the carboxyl and/or carbonyl groups. It is interesting to note that the intensity of this shoulder varies depending on the type of weathering treatment: it becomes a distinct band as the degree of cellulose depolymerization increases, or as the Dev. value reported in Table 2 decreases, as in the case of the photo-oxidized Whatman. In addition to the dissolution of chemical bonds between monomeric glucose units, cellulose thermal degradation is predicted to result in a reduction in the degree of polymerization and the generation of free radicals, carbonyl, carboxyl, and hydroperoxide groups. However, despite the fact that the thermal ageing procedure results in a certain degree of molecular degradation of the samples, as seen when comparing the DPv values, the FTIR measurement results, reveal that the spectrum of Whatman paper samples that have undergone thermal ageing did not differ noticeably from that of unaged paper samples. Free radicals are created as a consequence of cellulose photo-aging, and chemical processes including depolymerization, dehydrogenation, dihydroxylation, and DE hydromethylation are also started. Hydrogen, carbon monoxide, and dioxide are also produced. According to the carboxyl and/or carbonyl groups, the FTIR spectra of Whatman paper samples aged in a climate chamber) and photo-oxidized exhibit, respectively, a shoulder and a distinct band centered at around 1730 cm1. With its lowest Dev [7], [8]. value determined through viscos metric analysis and a noticeable increase in the absorption band's intensities around 1730 cm1, the photo oxidized Whatman sample's FTIR spectrum suggests that chain scission is the primary mechanism responsible for the photodegradation processes that occur on paper samples exposed to Xenon light. It has been documented in the literature that when cellulose is chemically oxidized with a solution of sodium metaperiodate, a particular oxidizing agent, the C2-C3 bond is broken and a 2,3-dialdehyde is produced using the Milligrade reaction's mechanism without causing any significant side effects. Furthermore, periodate oxycellulose is widely recognized to have two distinctive FTIR bands at around 1740 and 880 cm1. While the band at approximately 880 cm1 is often attributed to the creation of hemiacetal bonds between the aldehyde groups and neighboring hydroxyl groups, the absorbance at about 1740 cm1 is typical of carbonyl groups. According to information in the literature, aldehydes in non-hydrated form are present because the ATR-FTIR spectra of periodate-oxidized Whatman paper and show a shoulder centred at

about 1730 cm1 that can be attributed to the carbonyl group's C=O stretching. Figure 3 displays the WAXS intensity profiles of Whatman paper samples before and after the artificial ageing processes. As can be seen, all analysed samples display the cellulose I or "Native" spectrum along with its distinctive reflections, . These findings show that no matter how much ageing is done, the cellulose's crystalline structure remains unchanged, and all of the aged samples still contain partially crystalline microfibrils that are metastable.

values are affected by the kind of aging treatments. It is interesting to observe that the thermally oxidized and photo-oxidized samples exhibit the same crystallinity index value close to that shown by the unaged paper, whereas Whatman samples aged in climatic chamber and chemically oxidized show a value respectively higher and lower than that exhibited by the unaged samples. Such findings indicate that there is no direct correlation between chain length and crystallinity and super molecular organization contribute to determine the change in modulus as a function of crystallinity. Hence, for aged paper samples investigated, the following is to be emphasized: an increased crystallinity induces modulus improvement by a decrease of tie molecules density and vice versa. For thermally and photo-oxidised samples, it is to be also taken into account a cellulose dehydration process occurring at 100°C and at 65°C, respectively, and as consequence an increase of the sample stiffness. Note, moreover, that the strain at maximum load value, corresponding to strain at break, decreases for all aged paper sample with respect to the unaged sample, thus indicating that all the aging processes greatly influence the stiffness of the Whatman paper as show in Table 3, and the strain values tend to decrease with increasing the level of molecular degradation, that is, with decreasing DPv values and with enhancing the presence of carboxyl and/or carbonyl groups as shown by FTIR analysis. Thermogravimetric analysis was performed in order to measure the activation energy for the degradation processes that take part through one-step analysis. Tests were carried out at different heating rates, from 30°C to 650°C, in nitrogen atmosphere and the kinetic parameter activation energy was calculated for all the cellulosic materials before and after the different weathering processes.

Typical degradation curves measured for unaged Whatman sample through TGA at different heating rates are reported in in the range 200°C–450°C; it is evident that the degradation process can be approximated as a single step of weight loss. The first derivative of the curves was calculated for all the samples. values vs the age endured are presented for the analysed samples. As shown in Figure 6, the Whatman paper experiences an extreme chromatic modification when exposed to aging in climatic chamber and to photo-oxidation, thus demonstrating that the exposure to Xenon arc lamp and to UV radiation in presence of moisture stimulates the synthesis of chromophores. Moreover, the obtained findings show that the chromatic modification generated by chemical oxidation is significantly less strong than that induced by thermal aging. Considering the FTIR results previously discussed, it can be hypothesised that the extend of chromatic alteration increase with increasing the formation of carboxyl and/or carbonyl compounds as revealed by the appearance of a new shoulder in the FTIR spectra with a relative maximum at 1730 cm−1. The finding that paper samples aged in climatic chamber shows chromatic alteration comparatively higher than that exhibited by the photo-oxidized samples notwithstanding a lower presence of carbonyl/carboxyl compounds could be ascribed to the presence of moisture also contributing to the formation of chromophores containing degradation products [9], [10].

CONCLUSION

The cellulose degradation was examined using viscos metric, techniques, as well as mechanical and colorimetric analyses, with the goal of determining the physicochemical, mechanical, and aesthetical alterations caused by four different artificial ageing treatments applied to Whatman paper samples. It was discovered that every accelerated ageing procedure set up considerably

alters the Whatman paper's structure and characteristics, with the severity of the deteriorating effects varying depending on the kind of treatment used. Therefore, the following must be considered in order to avoid paper from being exposed to various environmental conditions. Despite thermally aged samples showing a modest amount of molecular depolymerization and carbonyl/carboxyl production, cellulose dehydration simply caused by temperature results in a reduction in strain at break and subsequently paper stiffness. The simultaneous impacts of temperature and light result in significant molecular degradation and a rise in the presence of carboxyl and/or carbonyl groups. Similar results were obtained using samples of Whatman paper that had been chemically aged with sodium metaperiodate. It should be noted that when the cellulose Dev. value decreases, a new absorption band caused by the carboxyl and/or carbonyl groups arises in the FTIR spectra, suggesting a clear association between chain length and the presence of carboxyl and/or carbonyl groups. Additionally, it was discovered that the chain length and the cellulose strain at break were connected, with the strain at break values falling as the Dev. values rose. The sole ageing process that causes a decrease in cellulose crystallinity is the selective oxidation of by periodic acid, which cleaves the C2-C3 link in the glycosidic ring and transforms the 2,3-dihydroxyl groups into two aldehyde groups. The cellulose dehydration for thermally aged and photo-oxidized paper and the crystallinity for paper aged in climatic chambers and chemically treated material were revealed to be the major causes of the various Young's modulus performances shown by the aged paper. Furthermore, a combination of temperature, light, and moisture production results in remarkable yellowing occurrences on paper surfaces.

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CHAPTER 11

DEGREE EVALUATION METHOD OF NONSTATIONARY SIGNAL USING MOVING STATISTICS THEORY

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ABSTRACT:
Nonstationary signals are those whose statistics fluctuate over time, and determining their degree of no stationarity may help determine the signal source's operational status. This study analyzed the applicability of various evaluation methods and offered a range of typical signal global and local nonstationary degree assessment techniques. Based on the theory of moving statistics, this paper proposed the concepts and calculation methods of the moving mean, moving standard deviation, moving variation coefficient, and moving Hurst exponent in light of the limitations of the existing evaluation methods in the range of application and taking the influence of adjacent signal points into consideration. Three distinct fields of signals sinusoidal signal, mechanical defect signal, and ECG signal are analyzed using various nonstationary degree assessment techniques. The findings demonstrate that the signal nonstationary degree evaluation method put forth in this paper has distinct advantages over other nonstationary signal processing techniques by being able to reveal the time-varying details of nonstationary signals with high precision and strong stability.

KEYWORDS:

Applicability, Nonstationary, Stationarity, Strong Stability.

INTRODUCTION

Numerous measurements and associated research demonstrate that the signals derived from natural phenomena and technical applications are often stochastic or random because of their unique properties and noise effects. The statistical approach must be used to study the random signal since it cannot be correctly recreated nor can it be characterized by a deterministic time function. Researchers in many branches of science and engineering must acquire physical characteristics or statistics that, depending on their specific requirements, may represent time-varying random signals in order to perform signal identification or diagnosis. Therefore, it is important to identify statistical features that can accurately capture the random properties of the signal. The typical statistics for random signals include the mean value, variance and correlation function, and higher-order statistics like third-order and fourth-order or higher-order moments, higher-order cumulants, and higher-order spectrum. The signal is referred to be a stationary signal if the statistic's change is time independent. The signal is referred to be a nonstationary signal if the statistic varies over time. In engineering, random signals are often nonstationary signals. When a stationary signal and nonstationary noise are combined, the nonstationary component may be eliminated using filtering or smoothing technologies, leaving just the signal's true information [1], [2]. It is necessary to conduct extensive research on the time-frequency variation characteristics and extract significant information to provide technical support for feature recognition and spectrum analysis when the nonstationary degree of the signal can represent the physical or essential characteristics of the signal source . The time-varying properties of the signal, a local distortion degree, trend term, and envelope characteristics must all be taken into consideration when the nonstationary of the signal might indicate the short- or long-term fluctuation of the signal. These characteristics may serve as a foundation for defect identification and signal categorization. Therefore, it is crucial to research the level of signal nonstationary. Many assumptions made about stationary signals in

engineering applications are no longer true as nonstationary signals are more understood. Modern signal processing has been increasingly concerned with the analysis and handling of nonstationary signals. Nonparametric technique and parametric method are the two broad categories that nonstationary signal analysis falls under, depending on the many technological approaches used. The aforementioned two categories are further classified into time-domain techniques, frequency domain methods, and time-frequency-domain methods, respectively, based on the various analytic domains of each approach. The nonparametric approach immediately transforms the signal before processing it. Total energy, cumulative energy, Teager energy operator, temporal moment of energy, power, signal envelope, and average time are the primary time-domain nonparametric approaches. The Fourier spectrum, the traditional spectral estimate technique of the power spectrum, high-order spectral analysis, average frequency, spectral moment, and other spectral parameters are the major frequency domain approaches in the nonparametric method. The wavelet decomposition, Wigner-Ville distribution decomposition, and Hilbert-Huang transform approach are the basic time-frequency-domain nonparametric methods . The time-frequency analysis approach may be used to get domain decomposition signals, but its rigour, accuracy, and adaptability need to be further enhanced owing to frequency band aliasing or cross term interference [3], [4].

Model-based technique is another name for the parametric approach. The signal is first used to construct a parametric model, which is subsequently used to analyses and process the signal in accordance with the model's parameters. The time-domain method is primarily based on the time-varying ARMA model and the time-varying basis function ARMA model of instantaneous spectrum estimation method, while the frequency domain method is primarily based on the signal power spectrum parametric modelling method and the time-frequency-domain method is primarily based on the ARMA model and the AR model of modern spectrum estimation method. It should be noted that the approaches above often employ statistics, transformation, decomposition, and other signal processing. To extract the signal's time-frequency-domain features and information is the goal. However, the quantification of nonstationary signals, or nonstationary degree assessment, can extract the features of the signal from its core and pinpoint its intrinsic quality, which is also required for many technical applications. Although the concepts of signal stationarity and nonstationary are rather straightforward, the actual procedure of determining the degree of signal nonstationary is somewhat difficult, and there isn't a universally useful quantitative index. Numerous nonstationary signal processing techniques are very simple or have other drawbacks as a result of theoretical development limits; both qualitative and quantitative analysis are not thorough and systematic, necessitating extensive study. In light of this, this research offered several approaches for evaluating the degree of signal nonstationary and contrasted their applicability and limits. Numerous signal nonstationary degree assessment approaches, such as moving variation coefficient, are presented based on moving statistical features and take into account the time-varying properties of nonstationary signals. The examination of various signal types demonstrates the effectiveness of the approaches suggested in this work and demonstrates their capacity to precisely characterize the nonstationary degree of nonstationary signals. Figure 1 displays the research flow diagram for this essay.2. Method for Nonstationary Degree Evaluation There is an urgent need for discussion in several academic domains about the assessment and analysis of nonstationary signals. To determine if a particular signal exhibits nonstationary or not and to assess the degree of nonstationary, or nonstationary degree, there are several approaches in diverse domains. For instance, average entropy theory and the unit root test technique are often employed in econometrics. Nonlinear system analysis often uses recurrence plots . Stock analysis employs the Hurst exponent. Seismic signal analysis employs the crossing-zero rate and nonlinear cross prediction technique. The aforementioned approaches each have their own benefits and drawbacks, thus the best approach should be chosen based on the technical specifications and features for actual use. The global assessment

technique and the local evaluation method may be used to categories the aforementioned methodologies. The former employs just one value for assessment and concentrates on the signal's whole nonstationary degree. The latter, whose value is a collection of vectors, may effectively indicate the local or signal's degree of nonstationary. This paper presents, examines, and talks about the application scope and features of common algorithms in order to choose an appropriate nonstationary degree assessment technique according to the signal characteristic requirements [5], [6].

DISCUSSION

Using relevant indicators, the nonstationary degree of a signal is assessed using the global nonstationary degree assessment technique. The approach for determining how nonstationary a signal is globally is straightforward to use and may qualitatively and immediately describe how nonstationary a signal is at the global level. The autocorrelation function technique, unit root test, information entropy method, and recurrence plot method are the basic approaches for evaluating signal global nonstationary degree. The autocorrelation function may indicate the degree of correlation at various points within the same process and can be used to characterize the correlation between neighboring variables in time series. A random time series signal may be regarded as stationary if the autocorrelation function quickly approaches zero as the delay increases. A sequence is deemed nonstationary if the autocorrelation function does not quickly fall to zero as the delay increases. Although the autocorrelation function approach is straightforward and easy to understand, the amount of data that can be used in the computation will decrease as delay increases since the real signal has a limited duration and is bounded. At this point, it has been challenging for the autocorrelation function to completely and precisely assess the signal's degree of stability across time.

The unit root test refers to establishing the sequence's nonstationary degree by determining if the sequence has a unit root. The signal is unstable if the sequence has a unit root. Unit root testing may be done using a variety of techniques, such as the ADF, PP, and NP tests. The unit root test can only judge whether the signal is stable or nonstationary according to weather is equal to 1, so it cannot be used to quantitatively evaluate the nonstationary degree of various signals. This is because the unit root test is a type of qualitative judgement for the evaluation of signal nonstationary, but not a quantitative analysis. By removing the upper limit of the information entropy from the original signal's stable information structure, the nonstationary degree based on information entropy measures the signal's nonstationary . Although the difference between stationary and nonstationary is not sufficiently obvious, the signal is thought to be nonstationary when the value approaches 0, and stationary when the value approaches. Additionally, the upper limit of information entropy varies slightly for different signal types, making it hard to assess the nonstationary degree of various signals using information entropy. This results in the application and expansion of information entropy being constrained. Recurrence plot analysis is a signal processing technique that illustrates the system's recursive properties using the idea of phase space reconstruction. Through the periodic trajectory of phase space visualization, it primarily assesses the nonstationary level of time series. The change in system trajectory over time in the state space is particularly sensitive to the recurrence plot. With this technique, the trajectory in a high-dimensional space may be immediately analysed. The picture representation is not entirely suitable in certain domains, and the method's capacity to evaluate some long-term signals with high nonstationary is still constrained. The global nonstationary degree assessment approach may qualitatively assess the signal's nonstationary, but it is unable to expose the signal's time-varying properties and cannot satisfy the accuracy criteria. Some random signals exhibit nonstationary and mutation in the local segment but are stationary overall. It is required to concurrently monitor the whole signal fluctuation and the local signal mutation in order to assess the stationary change of the signal completely and thoroughly. The statistic change may be quantitatively calculated using the

local nonstationary degree assessment technique. The nonlinear cross prediction method, the stationary degree method based on the Hilbert-Huang Transform , the crossing-zero rate method, and the Hurst graph approach are the most used techniques for assessing local nonstationary degree of signals [7], [8].

The signal is separated into a number of adjacent segments based on the nonlinear cross prediction technique, and the cross prediction errors between segments are utilised to describe the degree of variation and stability of the time series of each segment. The benefit of this technique is that it is simple to produce more reliable calculation results since the nonstationary degree calculation takes into consideration both periodic fluctuations and the time series trend changes over time. However, due to its amplitude sensitivity and unclear judgement threshold, this approach can only be utilised as an auxiliary method. The number of times a signal crosses across zero points in a unit of time is known as the crossing-zero rate. It may be used to demonstrate how a signal's properties, such as its frequency or period, change with time. As a result, it can quickly display a frequency that is nonstationary to some extent. However, the crossing-zero rate, which is susceptible to high-frequency omission, makes it difficult to distinguish whether the high-frequency portion of the signal is prominent and does not entirely intersect with the zero line. As a result, the zero-crossing rate cannot accurately capture the degree of nonstationary in the signal. Typically, it has to be used in conjunction with other techniques to provide a thorough review.

Each point in the signal is connected to the neighboring points even if the real signals in many engineering domains exhibit stochastic features owing to the effect of the generating process and noise characteristics. The signal close by typically has a bigger effect on the signal point itself, whereas the signal far away often has a smaller effect on the centre point. By taking into account the link between various signal locations and their capacity for interaction, the nonstationary degree of random signals may be assessed more thoroughly. The weighted moving statistics approach may often be used to compute each point in the signal and highlight the aforementioned qualities. In order to acquire more effective signal features, data smoothing may be accomplished by giving weights to the signal points in the given range and replacing the points with statistics in the appropriate range. When signals are processed using weighted moving statistics, it is the same as low-pass filtering because the corresponding filters have a smooth transition from passband to stopband. As a result, it can reduce the impact of random fluctuations on signal trends, reflect local variation characteristics, and emphasize the general change rule. In this paper, a technique for determining the degree of signal nonstationary is provided. It is based on the weighted moving statistics approach. The method appropriately chooses and adjusts the weight value and weight range in accordance with the various precision requirements of signal analysis, and the moving statistics are parameters like mean value, variance and standard deviation, coefficient of variation, crossing-zero rate, and Hurst exponent. The fluctuation and mutation of signals may be determined by the examination and comparison of the aforementioned statistics, and the original signals can be quantitatively and clearly described. To assess the local and global nonstationary degree of signals, it is possible to define in fully the occurrence time, sequence, severity, and development process of signal characteristic changes. The approach has high application, sensitivity, and antinoise and is easy to use. The simplest statistic to illustrate the principle of signal movement change is the weighted moving mean value. Internal correlation and complicated external influences affect the signal itself. The purpose of exponential weighting is to give closer data more weight while giving faraway data less weight. It successfully reveals the overall change features and local mutation size of the signal while preserving the validity of the original signal. The standard deviation to average value ratio, or coefficient of variation, is the same as standardization when compared to the average value. Similar to standard deviation, it may represent the degree of signal dispersion. The moving standard deviation cannot accurately represent the degree of dispersion or nonstationary of different signals when the units of measurement or the amplitude

of the signals vary, whereas the moving coefficient of variation can be used for a more precise and unbiased comparison. The idea of moving coefficient of variation is put out and is based on moving mean value and moving standard deviation. It is used to describe changes in local discrete features and local stationary degrees of signals, as well as to examine trends in signal change and establish the nonstationary degrees of signals. Additionally, two alternative types of enhanced movement variation coefficients are suggested in this work in accordance with various technical criteria.

The ratio of the moving standard deviation to the moving mean value is known as the "moving variation coefficient": where the moving standard deviation at point i is and the moving mean value at point i is. Because it is possible for the moving coefficient of variation calculation results to diverge during the actual calculation process when the moving average looks to be zero or a very tiny value, it cannot be directly utilised to assess the change law of the random process. In order to convey the fluctuation and mutation of a stochastic process, the moving coefficient of variation formula is correctly altered, and two better moving coefficients of variation are suggested. Mechanical fault signals, heart disease signals, and various groups of sinusoidal signals mixed with white noise are chosen, and the aforementioned methods are each applied in turn to determine the characteristics and applicability of various nonstationary degree evaluation methods. This is done in order to compare the effectiveness of traditional methods and the moving statistical calculation method. The simplest of the three signals is the sinusoidal signal. Any complex signal may be thought of as the superposition of several sinusoidal signals of various amplitudes and frequency. The other two signals are typical complex signals seen in the mechanical and biological fields, respectively. The applicability of the suggested methodologies for simple signals and complicated signals, as well as their broad application in many domains, may be checked to some degree by using these three signals as examples for verification analysis. Additionally, the nonstationary degree analysis may be performed after removing the mean value for signals whose mean value is not zero and the nonstationary is not strong. The accuracy of the calculating results is not significantly impacted by this procedure. The difficulty of nonstationary degree analysis is lower than that of the signal whose mean value is zero for the signal whose overall mean value is not zero and the nonstationary is very strong because the signal itself has a very obvious trend term. Therefore, in this paper, the signal whose nonstationary evaluation is more difficult to analyse is not chosen. It is important to note that is considered as 0.1 in this research, and the number m of points on the two sides of the data point participating in the weighting computation is equal to 5. According to professional requirements and signal sampling rate, the values of and m must be speculatively established for other various signals. In general, the value ranges of and m should be between 0 and 0.2 and 1/100 and 1/10 of the signal sampling rate, respectively. To examine the antinomies' ability of different evaluation techniques and the capacity to characterize the periodic change of signals, nonstationary analysis of sinusoidal signals mixed with white noise is first performed. The chosen sinusoidal overlaid white noise signal has a signal-to-noise ratio of 30.24. The signal's unit root value. and the test statistic's value was found to be greater than the relevant threshold value of the Durbin-Watson statistic, indicating that it was accepted. This proves that the signal has a unit root, which is a nonstationary stochastic process. show the findings from an analysis of the sinusoidal overlaid white noise signal's degree of nonstationary. The autocorrelation function's value attenuation in Figure 2 shows that the signal is steady and periodic since it changes slowly and consistently. Although the signal has periodicity, the features of high-frequency noise change are not conveyed, as can be observed from the changing crossing-zero rate. The signal is stationary as seen by the stationary variations of the moving Hurst exponent and the HHT stationarity. The moving mean in Figure 3 shows the signal's periodic volatility. The signal may be deemed steady since the moving standard deviation's variance is minimal. It is clear from the moving coefficient of variation that the signal has periodicity since it experiences significant fluctuations whenever

the original signal hits its troughs. The place where the moving coefficient of variation abruptly changes is the same as the position where the original sinusoidal signal oscillates at its fastest rate. The degree of the mutation is not the same owing to white noise's unpredictability, however, and the shifting coefficient of variation emphasises how sensitive humans are to noise. Therefore, the moving coefficient of variation has the capacity to precisely and forcefully reflect periodic changes and mutations.

Mechanics fault signal analysis:

Mechanical equipment's vibration signal contains a wide range of frequency components, is often nonstationary and nonlinear, and exhibits coupling, interference, and transient response among distinct excitations. Traditional techniques often miss the proper location of problems. Analysing the characteristics of equipment vibration signals is required to quickly and reliably detect different abnormal or fault states of mechanical equipment and to avoid or eradicate them. The usual bearing fault detection test data signals are examined and published on the website of Western Reserve University's bearing data centre. Three distinct types of mechanical fault damage signals, each with a length of 1000 data points, make up the vibration signals. The unit root test of a few mechanical failure signals reveals that the three fault signals' individual unit root values are 12.3 and 14.1, respectively. The initial hypothesis is rejected by each of them at a 1% significance l level. In other words, the four sets of signals, which represent a stationary random process, do not have a unit root. On the surface, these signals do not seem to be stationary. It is clear that the unit root test method must be supplemented with other techniques to analyse local stationary degree signals since it is prone to errors. The signal's nonstationary degree is analyzed using additional conventional nonstationary degree techniques. display the findings from the study. Several common methods may be used to differentiate between different mechanical defect types. Different sorts of signal characteristics may be distinguished clearly using HHT stationarity, and the shifting Hurst exponent also has a positive impact. The moving variation coefficient is more effective at describing the local nonstationary degree of the signal than the moving average or moving standard deviation, which both emphasise the nonstationary variation features of the original signal. One of the most significant conditions that endanger human health is heart disease. Electrocardiogram recording data serve as the foundation for most of its diagnostic analysis. Heart rate variability, also known as HRV, is the interval between the main and secondary heartbeats that may be used to forecast sudden cardiac death, assess the health of the cardiac autonomic nervous system, and identify pathological conditions that may be associated with it. In this investigation, three ECG signals with a total of 2048 data points each are selected from the MIT-BIH arrhythmia database for patients with various cardiac conditions. The overall signal from the three separate lesions is not visibly different, as can be seen from the graph, and it is difficult to notice the heart rate variability and illness outcomes with the naked eye. The root values of the three fault signals and their combinations are and 16.0, respectively, according to the ADF test of the chosen ECG signals. The original theory is disproved at a 1% significance level. Even if it is assumed that the four sets of signals are stable random processes without unit roots, errors in judgement nevertheless happen. Using a variety of signal nonstationary degree assessment techniques, the nonstationary degree of combined ECG signals was analysed in order to properly detect the period of cardiac fluctuation and discriminate between distinct symptoms in the real analysis process [9], [10].

CONCLUSION

An efficient method for diagnosing nonstationary signals is the signal nonstationary degree assessment. This paper considers the time-varying characteristics of nonstationary signals and proposes the concepts and calculation methods of moving coefficient of variation and moving Hurst exponent based on the idea of moving statistical analysis, which can reflect the time-varying details of the signal in order to provide effective support for the evaluation of signal no stationarity. By examining the three distinct signals the sinusoidal signal, the mechanical fault signal, and the ECG signal it is possible to conclude that the moving variation coefficient, one of the nonstationary degree evaluation methods proposed in this paper, can be more accurate and reliable than the typical nonstationary degree evaluation methods currently in use. It more precisely displays the signal's fluctuation and variation, has the capacity to detect tiny changes in the local characteristics of the signal, and is better able to determine the degree to which the signal is nonstationary. The approach of signal nonstationary degree assessment based on moving statistical features put out in this study has significant technical value and application in a wide range of domains, including fault diagnostics.

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CHAPTER 12

IMPACT OF LANGUAGE DEVELOPMENT ON CHILDREN'S PSYCHOLOGICAL HEALTH: A COMPUTER-BASED DIGITAL STATISTICS ANALYSIS

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ABSTRACT:
There are significant distinctions between the psychological language development of children and adults learning a second language, which makes it impossible to compare the two. The capacity for language learning in children is innate. Through the use of their sensory organs, they may learn language characteristics and acquire linguistic information. Studying the impact of children's psychological language development may thus assist to address the issue of language acquisition and provide a solid scientific foundation for language instruction. Behavioral experiments are a key psycholinguistics research tool that can provide extensive and accurate study materials and data on children's language acquisition processes, but they are unable to capture children's psychological processes. In order to mimic the psychological mechanism of children's language acquisition process, the dual network model of language is integrated with the computer digital statistical technology model in this paper's study on the influence of children's psychological language development. The model's simulation findings demonstrate that a child's language development is significantly influenced by the learning of phoneme category. The clustering and compactness of the language's consonant and vowel phoneme range are enhanced after children finish learning compared to before, which encourages the acquisition of language elements.

KEYWORDS:

Acquisition Processes, Distinctions, Linguistic, Psychological.

INTRODUCTION

Between learning a child's first language and learning a second language, there are significant changes. Children are born with the capacity to take in linguistic information from their surroundings, process it, and learn it in the early stages of language acquisition. They are able to learn language qualities such as word significance, semantic intonation, etc. via brain processing thanks to this capacity, which allows them to acquire language information through a variety of sensory organs without corresponding linguistic expertise. Long-term study on children's language development demonstrates that some degree of randomness exists in the learning process. Although it is challenging to describe the intricate process of language information processing, this hasn't stopped researchers from studying the mechanism of language development. Many issues with language development, according to experts and academics, may be resolved by knowing how children learn languages and how they absorb linguistic information. Children's psycholinguistics is the area of study that has to be combined with other fields of study and theories to fully understand the process of language learning [1], [2]. The study on the effects of children's language development should be focused on psychological development, according to some academics, who noted that there is a substantial association between children's psychological activities and behavior. In the past, behavior experiments an important research tool in psychology were often used to study the effect of children's psychological language development. Behaviour experiments can accurately and thoroughly capture subjects' responses to language stimulation as well as their language output

and acquisition processes, and they can also provide first-hand research data for the study of children's psychological language development, which also yields many beneficial findings . The internal psychological activities and linguistic information processing strategies and processes of children cannot be accurately captured by this approach, which has limitations. The simulation study of children's psychological language development is given a fresh research concept by the use of computer digital statistics technology. In order to simulate the mechanism of children's language development and analyses the findings of a comparative experiment on children's language acquisition, this paper combines the language model duality network model and introduces the self-organizing neural network model in the research on the impact of children's psychological language development. Based on Vygotsky's study findings, psycholinguistics progressively gained acceptance and use among psychologists during the next decades. Theoretically, psycholinguistics provides a framework for investigating the enigma of language acquisition and the evolution of human language. It focuses on how children with communication disorders acquire their language skills. As a result, it is often used in the area of teaching languages to students [3], [4]. According to western psychology, the learning environment of children has little effect on how they acquire their language skills and social behaviour . According to the opposing theory advanced by some academics, acquired learning and contextual factors have a bigger impact on language acquisition than intrinsic language learning capacity in children. The acquisition of knowledge during children's early learning stages is completed through their own sensory consciousness, and the brain reorganizes and outputs the environmental difference information it senses , according to some scholars who have studied children's psychological language in depth. Many academics have acknowledged this point of view. According to some academics, the process of absorption and equilibrium brought on by contextual circumstances influencing learners' psychology or behaviour is the core of learning. Learners are at the centre of the transformation process in this process . Additionally, several academics argued that although contextual factors and acquired learning are crucial, we cannot overlook people's own subjectivity, or the effect of psychological growth.

Some researchers have proposed that children's language learning is the exchange of language information and their language acquisition process is the processing of language information. These processes are both controllable and can be studied through children learning a second language. Although some researchers contend that children's language perception and learning abilities are superior to adults' cognitive abilities, they still believe that children's language learning will continue to be stimulated by language in order to help them learn the differences between various sounds. According to some academics, children would be impacted by the mother tongue speech distribution pattern, creating a magnet perception effect and classifying mother tongue speech learning. Some academics have hypothesized that youngsters learn language pronunciation in an unconscious stage and do not reach the stage of language imitation until their corresponding organs are fully developed and steadily enhance their perception. The precision of language speech may then be increased by ongoing self-control capacity enhancement. Expressing thoughts is one of the key driving factors that support language acquisition and production in children's psychological language development. Children may also begin to think independently and partially articulate their needs during this time. Their linguistic development now heavily depends on interactive communication. Some researchers have noted that, in accordance with the language features and development law, children's psychological language would be significantly influenced by language tone and phoneme in the imitation stage, which is a crucial phase of their language acquisition . Children can perceive the tones used to indicate different languages, and because tones themselves include independent information about how languages are represented, this is another way that language is expanded. The study of tones by children will aid in the study of language phonemes. At the same time, there are less tonal faults as youngsters become older. In order to

study the relationship between children's psychological development and language development from a more scientific, systematic, and all-encompassing perspective, many scholars have recently introduced the application of high and new technology to the field. This does not imply that behavioral and psychological tests have been superseded, however. They enhance one another. They may help explain and investigate the process of children's language acquisition and development by combining it with behavioral phenomena and psychological changes in order to provide trustworthy supporting data and analytical findings for future research [5], [6].

DISCUSSION

Children and teens acquire their first languages in quite different ways while learning their second language. Many academics think that children learn languages naturally and uniquely. It uses the words of the language as the lowest unit of learning and differs from the way second languages are learned. According to pertinent psycholinguistics research, children who have spent a significant amount of time in an environment where their mother tongue is transmitted naturally can analyses and learn about the input language they have learned through their perceptual abilities, gradually comprehend the language's content, and express it. The phoneme system and the interaction between language and the phonetic system that is part of perceptual learning may help the brain better understand linguistic thesaurus information. In turn, a child's mastery and use of the phonetic system may be enhanced by linguistic vocabulary knowledge. Figure 1 is a schematic representation of how language is learned and acquired as it is used to communicate between kids and parents or instructors. According to psycholinguistic theory, children's inherent capacity to perceive sounds allows them to acquire and absorb language information, and they are more sensitive than adults to how different language phonemes contrast with one another. They may be differentiated without having the necessary expertise. The uninformed relevant language knowledge and the ambiguous language environment serve as the foundation for the study of language information in children's brains. In order to comprehend the shape and organization of the phonetic distribution, the phoneme scale and phonetic properties in linguistic information are thus elucidated in a comparable statistical manner. The child's brain will break down the pertinent phrases and words in the language information during this process, predict the syllable structure and vocabulary range, and then output the information through the effector organ, imitating language pronunciation and realising phoneme correction. Diagrammatic representation of the method through which children and instructors or parents communicate and acquire linguistic knowledge.

Understanding a child's language acquisition mechanism requires an understanding of how the brain processes and retains linguistic information. The comprehension of this process, according to relevant study findings, may increase people's proficiency in language learning and teaching and improve the controllability of instruction. When combined with psycholinguistics and information theory, the way that children's brains process language information is comparable to how computers process information technology; specifically, language information is encoded and transformed in accordance with predetermined rules, which has come to represent or represent the psychological acceptance and recognition of children. While maintaining the correctness and efficiency of language transmission information content, the coding process is not random. According to psycholinguistic theory, this has to do with how well children's brains filter and interpret different kinds of information. The status of a child's language acquisition is always changing. According to research on psycholinguistic behaviour, children between the ages of 14 and 20 months can distinguish between words with different phonetics and familiar words, but they are unable to distinguish between words with similar phonetics. Children who are older than 20 months can correctly identify words with similar pronunciation. Therefore, word segmentation and vocabulary acquisition are the main areas of emphasis throughout the early stages of children's mental

language development. those that sound differently from one another may be identified with ease, whereas those that sound similarly are more likely to be mistaken. Children at this age are not as sensitive to subtle phonetic differences. The creation of a database for children's phonetic and semantic connection information would strengthen their capacity for phonetic similarity and discrimination, as well as the processing and perception of language phonemes. It is clear that phoneme acquisition is crucial for children's language development psychologically [6], [7].

A self-organizing neural network model and a language pattern duality network model are established in section 3.2. In the past, behavioural experiments were the principal research methodology used to study children's psychological language development. However, it is challenging to demonstrate children's thought processes, perceptual processes, memory processes, and language information extraction mechanisms. The experimental findings, on the other hand, illustrate the authenticity and intuition of language phenomena in the course of children's language acquisition. Through computer digital statistical technology, it is possible to simulate children's psychological language development and address the limitations of behavioural experimentation with great efficiency and robust controllability. It demonstrates a significant theoretical and practical impact. This research builds a quantitative neural model based on the traits of children's psychological language, self-organizing neural network model, and language pattern duality network. The self-organizing neural network possesses connection scalability, which means that after model training, it can grow freely from the starting node network state to the edge node. This stage is the very beginning of a child's linguistic development. The brain network must be activated by language and external environmental elements, which is a prerequisite for children's language acquisition and perception. The neural network will now navigate all of the training data in order to prevent repeating coverage and training. The adaptive stage of integration will also direct the neural network to modify the initial node feature vector in accordance with the data details and the best matching point. The best matching position's detecting principle is shown in

The node sorting sequence based on the distance of the eigenvector is represented in the formula by, the best matching node is represented by, and all the blank places immediately next to it are represented by, respectively. Children have reached the stage of fuzzy simulation of language at this point, and language is continually stimulating and affecting their brain nerves in the context of natural language input, progressively altering their perceptual system. Children's Psycholinguistic Development Model Based on Computer Digital Statistical Technology: Experimental Results The established computer digital statistical technology model is used in this study to perform a comparison experiment on the impact of children's language development on their psychological well-being. According to psycholinguistic theory, children between the ages of 12 and 36 months are a crucial and pivotal time in their language development. The frequency distribution properties of the effect vector on children's language development during the preceding 60 days may be determined using formula , and their similarity can be examined: According to Figure 2, which compares vowels and tones in language acquisition, there are several turning moments in children's language development between the ages of 12 and 36 months, which mostly happen between 18 and 21 months. In the first 60 days prior to the defect, vowels and tones have a little resemblance. The resemblance rises every 60 days after the fault and ultimately becomes steady. A combination of experimental findings on children's psychological language development behavior and the development of children's language learning ability to the correspondence between sound and semantics during this period suggests that they are about to enter the emerging stage of language vocabulary, and their vocabulary has sharply increased. The language system has essentially been created, and as children's contact with the outside world has increased, the language system has been reinforced and adjusted. At the same time, children have finished this stage's perceptual renewal. depicts the statistical findings of the frequency of consonants

and vowels in words before and after the language development problem in children. Consonants are most often heard both before and after the error. When compared to before the fault, the frequency of is much lower after the fault, while is the opposite. Before and after the fault, voiced consonants are present, but the number of frequencies is relatively low. Vowel frequency considerably rose after the fault, whereas total frequency before and after was modest. In the experiment, there are often a lot of elements that interfere with how the children and the outside world communicate. Additionally, there are certain distinctions between instructors' and parents' intonation and pronunciation that cannot be used as a benchmark. As a result, this article contrasts the resonance data of standard English with the voice data of professionals, which it has chosen as the benchmark. The comparison between the standard voices of Chinese and English in the same acoustic environment is shown in the image.

Their pronunciation is quite similar to the standard data, and the distinctive features of their language are clearly audible, demonstrating that the voice data presented above satisfies the standards for both the data and the subsequent studies. The relearning phase and the learning phase are both included in the comparison experiment, which mimics and examines how children's consonants and vowels evolve over the course of the two periods. The representation outcomes of preschool children's consonant and vowel phoneme features in a computer digital statistical model are shown in respectively. The findings of the consonant representation are accurate. Aspirated and no aspirated bursts may be distinguished from one another with ease. There is some overlap between the areas of each consonant in the range of aspirated bursts, but overall, they each have their own stable representation range. The consonants are mostly distinct and stable among the no aspirated plosives. Overall, the model can discriminate between voiced and unvoiced tones in unvoiced plosives and between voiced and unvoiced plosives, demonstrating that it has developed the capacity to perceive common Chinese and English consonant phonemes [8], [9]. The vowel distribution conforms to the acoustic spatial distribution relationship in the vowel network results, indicating that the model's training results on the acoustic characteristics of vowels have met the requirements. The model can clearly distinguish all of the opposite phonemes of standard English vowels, clearly perceive Chinese vowel phonemes, and have the ability of vowel pe. After the model simulated children's learning, the representation outcomes of language consonant network features. Children's language development is continuously stimulated by the environment they live in, which also increases the clustering and compactness of each consonant representation range and improves the stability of the consonant phoneme representation as a whole. The frequency and quantity of consonant after errors in youngsters are decreased in the data above. In comparison to the pre-learning condition, the stability of its performance range after learning is much enhanced, and the only difference between tiny range and is confusion. On the right side of the network, there are also a few mixed phenomena between and in the representation range. It is challenging to describe only in terms of consonant phonetic properties. When just two consonants are present in the vocabulary that is significant, the children's brains interpret the high-level limitations in the language, and the low-level constraints divide them into the same range. This may be explained by the function of comparable semantic information. The current phoneme system will be affected in a certain way by the formation of semantic knowledge in children's language development. Figure 8 displays the phonemic representation outcomes of the vowel network after children's learning. The representation's general stability has improved. The vowel representation range's clustering and compactness have improved, but the representation is now split into two halves and surrounded by vowels, which may be the result of the model's local range reorganization. Additionally, there is small-scale vowel phoneme mixing, which is comparable to consonant phoneme mixing [10], [11].

CONCLUSION

The dual theory of language model and self-organizing neural network model are used in this paper to simulate and analyses children's psychological language development. This paper also introduces the computer digital statistical technology model into the research experiment of the impact on children's psychological language development. The experimental findings demonstrate that with training, the model is able to recognize the phoneme area of linguistic data. The simulation findings of children's relearning stage demonstrate that under the stimulation of ambient language, children's brain has developed the fundamental perception of language consonants and vowels and has essentially built the appropriate phoneme range. Children's language development has an incorrect turning point between the ages of 12 and 36 months, or roughly between 18 and 21 months. Children's vocabulary grew significantly at this time, and their capacity to learn languages improved to the correspondence between pronunciation and meaning. At this point, children have finished renewing their perceptions, and the language system is essentially in place.

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