Hindawi
Journal of Food Quality
Volume 2023, Article ID 9781316, 1 page
https://doi.org/10.1155/2023/9781316

Retraction

Retracted: Smart Farming System Based on Intelligent Internet of Things and Predictive Analytics

Journal of Food Quality

Received 22 August 2023; Accepted 22 August 2023; Published 23 August 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] N. Ferehan, A. Haqiq, and M. W. Ahmad, "Smart Farming System Based on Intelligent Internet of Things and Predictive Analytics," *Journal of Food Quality*, vol. 2022, Article ID 7484088, 8 pages, 2022.

Hindawi
Journal of Food Quality
Volume 2022, Article ID 7484088, 8 pages
https://doi.org/10.1155/2022/7484088

Research Article

Smart Farming System Based on Intelligent Internet of Things and Predictive Analytics

Nourelhouda Ferehan,[1] **Abdelkrim Haqiq**,[1] **and Mohd Wazih Ahmad**[2]

[1]*Hassan First University, Faculty of Sciences and Techniques, Computer, Networks, Mobility and Modeling Laboratory: IR2M, Settat, Morocco*
[2]*Adama Science and Technology University, Adama, Ethiopia*

Correspondence should be addressed to Nourelhouda Ferehan; n.ferehan@uhp.ac.ma and Mohd Wazih Ahmad; wazih.ahmad@astu.edu.et

Received 24 March 2022; Accepted 15 April 2022; Published 20 May 2022

Academic Editor: Rijwan Khan

The Internet of Things (IoT) makes it conceivable to communicate among distinctive things. The use of IoT in the farming industry is critical for increasing utility. Smart agricultural practices may boost crop yield while also creating more output with the same amount of input. The majority of farmers, however, are still unaware of the most recent technologies and procedures. In this study, a revolutionary wireless mobile robot based on the Internet of Things (IoT) is created and installed to perform a variety of outdoor tasks. The benefits of this work include more accurate and efficient data, as well as a reduction in manpower. This research has applications in agriculture, arrival, and water division. Keen agrarian frameworks have been built up in different parts of the world utilising the Internet of Things (IoT) and remote sensor systems. One of the branches that springs to intellect in this respect is exactness cultivating. Numerous analysts have made checking and robotization frameworks for different cultivating capacities. Information collection and transmission between IoT gadgets set in ranches will be basic utilising WSN. The Kalman Filter (KF) is used with expectation investigation within the proposed method to get high-quality information free of commotion and exchange it with cluster-based WSNs. The quality of information utilised for examination is progressed as a result of this strategy, and information transport overhead within the wireless sensor network application is decreased. A decision tree is used for forecast analytics decision making for trim surrender expectation, trim classification, soil classification, climate expectation, and trim malady expectation. IoT components integrated with IoT cloud are coordinates in proposed framework to supply keen arrangement for edit development observing to clients.

1. Introduction

The most popular word Internet of Things (IoT) is basically a combination of two scientific terms Internet and Things. The concept of things in IoT insinuates to diverse IoT contraptions having one-of-a-kind identities and abilities to execute more distant recognizing, activation, and online observation of a certain type of data. IoT contraptions besides allow for direct data interchange with other related contraptions and application either particularly or in an indirect way, or collect data from other contraptions and process the information and send it to various servers [1]. The Internet of Things (IoT) is a combination of global data and web-connected items which will play an important role in the future Internet. The Internet of Things focuses on process optimization by eliminating the engagement of human. In the automation process, IoT collects data with sensors, processes the data with controllers, and completes the automation processes with actuators [2, 3]. The Internet of Things (IoT) distinguishes itself as a class of existing interconnections that connect billions of computers throughout the world and allow for information exchange. Consequently, the IoT can be characterized as follows: A self-configuring global organize system performs based on standard and connect operable communication. The true value of Internet of Things comes from the nexus of data

collection and utilisation. All of the data collected by all of the sensors in the world is useless unless there is a system in place to evaluate it in real time [4, 5]. IoT in agriculture and allied focus is automating all elements of farming and farming methods to make the process much more efficient. Traditional conservation farming systems (such as cattle identification) are not entirely automated and have several disadvantages such as increased human involvement, labour costs, electricity usage, and so on [6, 7].

Precision agriculture (PA) could be a concept used for the same reason in cultivating, where field crops require pesticides, manures, and water system for way better development. Data such as temperature, stickiness, manure, and soil dampness can be bolstered into a decision bolster framework by PA in order to expand trim development while making the finest utilisation of accessible assets and limiting natural effects [8]. Precision agriculture (PA) is the study of using high-tech sensors or analysis tools to increase agricultural production and help strategic decisions. PA is a revolutionary idea and has been used everywhere to increase output, save labour time, and ensure appropriate fertiliser and irrigation administration [9, 10]. In arrangement to satisfy this work, the sensor hubs dispersed all through cultivation that ought to continuously consider vitality utilisation. Because crops change in time and space, PA necessitates perceptions in both spatial and temporal measurements. Sensor data is routed to a centralised substance for study and improvement. The outcomes of the examination are handed over to cultivation specialists [11]. They make considerable use of records/knowledge to improve production resource consumption, yields, and crop productivity. PA is a trimming agricultural invention and field-level way of managing that aims to increase agricultural resource production. As a consequence, PA is a highly innovations technique in which farmers regulate inputs such as water and fertiliser in order to enhance efficiency, quality, and yield [12, 13]. Application energy is the most important performance component in any wireless sensor network (WSN). According to prior research, the majority of sensor node resources are used in the communication process [14].

The primary findings of this study include the ability to predict agricultural requirements using earlier data sets and to increase farmer production utilising an IoT platform. Using this technology, farmers will be able to connect a variety of devices to the Internet, resulting in increased agricultural yield, reduced waste, greater pest control, and easier animal care. Precision farming employs data from a number of sources to increase agriculture production while lowering the cost of farm management practices such as fertiliser inputs, irrigation, and pesticide application. Precision agriculture refers to technologies and procedures that are applicable domestically at subfield sizes. Though definitions differ, the word is most usually used to tools and approaches that are useful locally at subfield sizes [15, 16]. The Internet of Things infrastructure is used to develop a new type of automated agriculture in the connected farm. The three fundamental components of the associated cultivation framework are associated IoT gadgets, such as observing sensors and controllers, IoT door (called and 3D shape), and IoT benefit stage (called Mobius). Physical sensors (such as temperature, mugginess, CO_2, and lighting) and controllers (such as sprinklers, driven lights, discussed conditioners, and radiators) are utilised to screen and control the farm's natural conditions in connected ranches [17–19]. All sensors and controllers are connected to IoT doors, which are at that point connected to the IoT benefit stage. Conclusion clients (ranchers) can communicate with the associated cultivation framework to screen natural conditions or enact cultivating utilities.

Drones, Global Positioning Systems (GPS), and irrigation technologies are all instances of precision agriculture. Precision agriculture's purpose is to discover new management strategies that will boost the profitability of agricultural production. "At the heart of my study is assisting farmers in maximising their profits." Despite its rarity, precision agriculture is one of the most essential IoT applications. These new technology advancements to improve harvests could save lives as our globe approaches a food catastrophe. Natural conditions must be predicted and responded to as quickly as possible in order for farming to be efficient and profitable. Due to the availability of real-time data, such estimates were less precise in the past than they are now. So, this research paper is organized as follows: Section 2 deals with literature review, Section 3 discusses methodology, and at last Sections 4 and 5 include simulation result and conclusion.

2. Literature Reviews

Forecast combined with the Precision Kalman Filter (PKF) may be a cost-effective communication method in WSNs. Rather than the match of KF required for execution in sensor hubs in conveyed KF [20], PKF employs a combination of KF-based predicators to diminish computation overhead [21]. Little bundle sizes are utilised in numerous works to attain more noteworthy compression; in any case in PKF, bundle sent per second is kept to uncovered least, diminishing the sum of vitality required for each exchange. Rather than utilising time-based models for expectation, the KF-based strategy utilises an entire demonstration for expectation, with a few states obscure, coming about in a more exact forecast investigation [22]. The quality of information decreases as the pace of transmission decreases. Making strides for cultivation efficiency is basic for boosting cultivation generation and joining developing request for food-fed nourishment as the world's populace develops quickly. Understanding and anticipating trim execution in an assortment of natural circumstances can make assistance ranchers boost their yield. Existing Internet of Things (IoT) gadgets, such as remote arrange sensors, network-connected climate channels, cameras, and savvy phones, can be utilised to communicate enormous sums of organic information based on worldly information. Sensor information, camera area information, and visual clues are obtained and recorded by means of the versatile phone app [23–25].

The Smart Farm Net was presented in [26], a stage that collects natural information, soil, fertiliser, and water system data; then inputs such information and filters out invalid

information from plant execution tests and provides edit details and suggestions for any produce. It is conceivable to associate nearly any IoT gadget, counting commercial sensors, cameras, weather stations, and more and store information within the cloud for examination and suggestions. The report concludes with a stage test of the Smart Farm Net application. The world's biggest investigation and suggestion program (based on the number of sensors joined, crops tried, and clients backed) is Smart Farm Net.

Analysts show a single arrangement for programmed water system of trim plants (tomatoes, but the arrangement moreover applies to the planting of all other crops, grass arrangement, natural product water system, and so on) in their investigation [27]. Temperature and stickiness sensors DHT22, DS18b20 temperature sensor, ground dampness sensor, and 8 exchange board are all open on the Raspberry Pi 3 Rev B connected stage. The administration of water system is supported. Concurring to a table arranged for each day of plant development in decently damp soil, there are specialized prerequisites for the era of the fitting sum of water for tomatoes. All information is put away in a MySQL database for examination and for permitting water system pointers to be considered. Concurring to the discoveries of competing trials, the outside appearance, quality, and generation of tomatoes are all great as long as the plants have bounty of soil dampness [28]. Moreover, this is often a low-cost arrangement for a totally self-contained framework. The framework can be overseen over the web (SSH) within the same way that the current circumstance can be controlled over the web (WWW). The prerequisites are that the Apache server is preinstalled where the Raspberry is associated to the web through a remote association.

Anticipating agrarian yields plays a critical part in rural generation. It is up to the rancher to choose the crop's future generation, capacity, promoting strategies, and hazard administration [18]. Strategies are used to assess generation plans for a particular sort of trim in progress. The primary could be a factual strategy like autoregressive integrated moving normal (ARIMA) or Holt-Winter [29], whereas the moment could be a machine learning strategy like back vector machine or manufactured neural arrange. The back vector machine and the ARIMA are utilised to test these techniques on two information sets.

Artificial neural systems are utilised to select the edit and expect the crop's generation rate utilising information obtained by cultivating sensors. Parameters such as soil, temperature, weight, precipitation, and mugginess are included in this information. In paper [30], the effect of these characteristics on trim development is depicted, and the discoveries are dissected. It has been found that air parameters, soil sort, and soil composition have an effect on edit generation rates. In expansion, the method depicted in this inquiry is about predictions and fitting trim generation rate in development. Fake neural systems are a valuable apparatus for demonstrating and anticipating agrarian generation rates, and they make strides trim expectation exactness.

Precision agriculture (PA), along with other important approaches, is a critical farm management system that enables farmers to reduce the application of critical elements such as water and/or fertilizers by combining the use of robotics and sensors, drones, advanced GPS and GNSS (Global Navigation Satellite Systems), the Internet of Things (IoT), weather modelling, and customised input application. Furthermore, PA entails the application of techniques and technologies that emphasise the significance of implementing specific ecological principles and biodiversity management procedures into agroscape management while optimising inputs for maximum yields. Nonetheless, few studies have looked into the practicality of these technologies for small firms, taking not just their cost into account, but also the knowledge required to access, treat, and interpret the data gathered through their use.

To meet this challenge, a large number of agricultural specialists and farmers will be needed to analyse the economic and environmental consequences of these new technologies. Furthermore, greater research investment will be required to improve the execution of these techniques in all aspects of a culture's output while limiting agricultural system degradation.

The main outcome of this research is stated in twofold:

(1) Predicting the farm requirement from the historical previous data sets

(2) Enhancing the farmer productivity using IoT platform

3. Computational and Experimental Methodology

The proposed investigation focuses on the arrangement of successful IOT gadgets and productive calculations for information refinement and expectation utilising decision learning. We considered the stream of communication between diverse framework components, as well as input and yield for the different modules within the framework plan [31]. Figure 1 delineates the framework engineering. The system's primary components incorporate IoT sensors, calculation for data refinement, and counterfeit insights calculation for expectation.

IoT frameworks advance the execution of gadgets used in writing-related keen developing frameworks. Modern IoT devices are being successfully integrated onto ranches, adding to the utility of farming [32].

Horizontal smart farm cultivation frameworks are moreover being received as a result of the sending of IoT gadgets, permitting all ranches to be associated and share cultivating information from experienced clients. The IoT-enabled savvy cultivation may bolster a wide extent of gadgets from an assortment of rural gadget merchants. Besides, organized ranches may be able to supply more astute rural administrations based on pooled master information. Individuals with small involvement in cultivating might use this data to choose crops that will surrender a great benefit. It may be simpler to distinguish illness on crops or viral spread over ranches utilising forecast methods

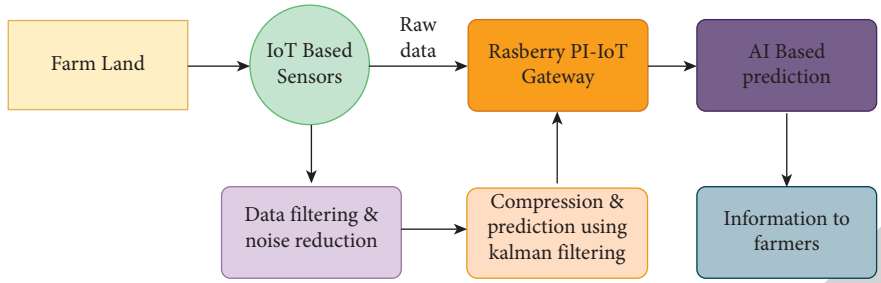

Figure 1: IoT-based system architecture.

as a result of the sending of associated ranches, and ranchers may be able to recognize such ranches from others.

A cube, a device software platform, is employed in this suggested system, in which a gateway is implemented. This gateway connects all sensors and actuators that are used to monitor and cultivate crops. An IoT service server then communicates with the gateway. The technique's reason is to not screen different cultivating parameters, but moreover to communicate with the farm's portal. To create the farm fit for developing crops, it will interface with a master cultivating information framework and control actuators.

The following is the total data collection procedure. To begin, each equipment in the farm (sensors and controllers) must be registered in the system and cube. When a device is registered, the system creates a virtual representation of it based on the resource type. As shown in Figure 2, sensors for observing the cultivating exchange collected natural information from checked districts to the and 3D shape, which hence transmits the information to the IoT framework. At long last, conclusion clients can use IoT applications on their smartphones or tablets to screen and control their connected cultivation by getting to a virtual delineation of the system's gadgets.

The IoT will interact with each and every phase of the system, which will help to predict the exact requirements at every stage. This will help the farmers to achieve the minimum wastage of any materials. IoT provides an interactive platform between farmers and the market, making it easy to understand the requirements when needed. Overall, the time period from farm to market is reduced, which means the availability of farm products is fresh and has good quality [33].

3.1. Predictive Kalman Filter. For estimate utilising KF, sensor centres need to be shape cluster set for further process. The cluster head will catch information in visible form of almost different parameters of the surroundings from leaf centre, the one proved to be good or workable to gather or amass something and communicate it to head [34]. In PKF, it is well acknowledged that the cluster head may predict current information in visible form supplied by the leaf centre alongside palatable blunder making use of information in visible form caught by the leaf hub ahead of time. The PKF disguises talk between a leaf centre and allure cluster head concerning occasion. To minimise the importance of concept exercise, cluster head settles a problem of Kalman perfect values for leaf centre making use of basic predicator PKF. The leaf centre executes the predictor at regular intervals by recognising the cluster head captured and comparing the data with perfect respect to ensure precise prediction assessment. In the event that the wish botch is more important than a likely limit, the current of no real worth consideration passes to the head of each cluster. PKF employs a well-considered combination of pre-indicators. It should be noted that this indication is proportional to the k-step of the Kalman filter. Figure 3 depicts the Kalman Filter used in the procedure. The framework foresees at that point overhaul and this handle is nonstop until the blunder in client interface is less than 2%.

Qualitative forecasting approaches must be employed if there are no data available or if the data provided are not relevant to the forecasts. There are well-developed organised procedures for obtaining effective forecasts without using historical data, so these methods are not just guessing [35, 36].

When two conditions are met, quantitative forecasting can be used:

(1) Historical data is available in numerical form

(2) It is realistic to expect some features of historical patterns to persist in the future

Quantitative forecasting approaches come in a variety of shapes and sizes and are frequently developed within certain fields for specific objectives. Each technique has its own set of features, accuracies, and costs that must be taken into account while selecting a method.

3.2. Using Decision Trees as AI-Based Prediction. The Decision Tree algorithm is a member of the family of supervised learning algorithms. Unlike other supervised learning algorithms, the clustering algorithm technique may also be used to address regression and classification tasks.

The goal of using a Choice Tree is to construct a testbed that can be used to forecast the class or value of the target variable by learning fundamental decision rules learned from prior data (training data). A classifier, also known as a decision tree, is used to allocate a time interval event space iteratively. The Decision Tree is a simplified tree with a single essential root core and no creeping closer borders. Every other centre point has one drawing closer edge. A single discrete task with the data input of a quality regard is utilised to form the Decision Tree, where event scope exists separated into two or more substitute-room by the ingoing

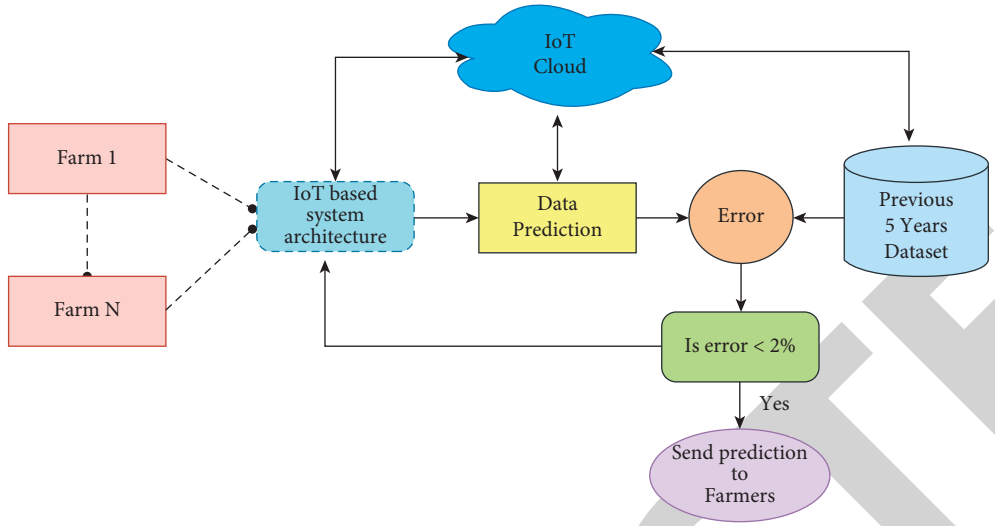

Figure 2: User interface network using IoT.

centre. Decision Tree [28, 29] may well be broadly utilised for both backslide [31] and classification [32]. Computation 3 is an example of a Decision Tree calculation. A recursive call within the calculation adds hubs to the tree until the end condition is reached. As a result, two capabilities are utilised in calculations: first locate the best part returning the driving part point property, and constraint of a centre; second piece parts the planning data that agrees on the best part point. To start with, histograms of the qualities are created (for effortlessness altering over numerical values of nonstop characteristics to restricted canisters) by analysing all planning data on the current centre; at that point, all portion focuses are traded from cleared out to right, and cleared out aggregate and right entirety are utilised to obtain aggregate of cleared out and right parts of the portion point, exclusively [37, 38]. When selecting the driving portion point, an instruction degree is embraced. The most commonly used educator measures are information pick up and change pick up for classification and backslide, respectively. Algorithms 1 and 2 show the AI based Decision Tree building and algorithm to flow split operation, respectively.

4. Simulation Results

The IoT based sensor comprises different sensors used to record the data regarding soil nature and moisture content. There are differing sorts of soil sensor progresses and estimation strategies that have been made for the estimation of soil moistness substance. The most common type of soil sensors used is based on repeat space reflectometry (FDR), which livelihoods capacitance tests to degree proportional to soil dielectric permittivity. The temperature sensor utilised within the extent is LM35 which is essentially an IC. It has three terminals and required a maximum of 5.5 V supply. This sort of sensor comprises a fabric that performs the operation concurring to temperature to differ the resistance. This altering of resistance is detected by circuit and it calculates temperature. When the voltage increases at that point, the temperature moreover rises.

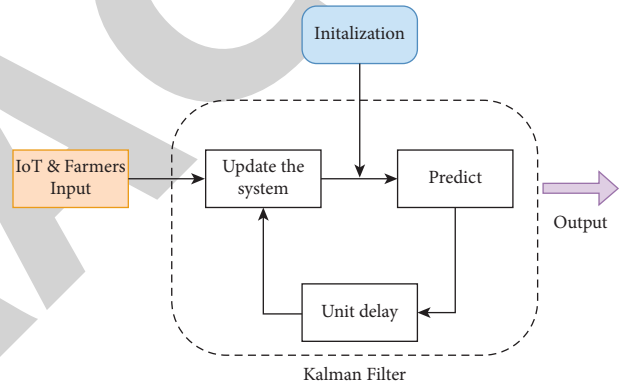

Figure 3: Kalman filter for the IoT based prediction system.

This empowers the user/farmer to have total mindfulness approximately the field and development. This effort is primarily beneficial to agriculturists who rely on labour to build the produce. They do not need to visit their arrival frequently. They can employ this focused venture to obtain valuable recommendations and notices in the field. GSM communication is utilised for sending the content message to the farmer's portable phone. GSM SIM900 module is utilised in this venture for acknowledging the client. Any GSM module sort can be utilised based on our prerequisites. It employs AT commands for sending the message. It moreover empowers two-way communication where the client can answer to the framework. When there is low dampness and tall temperature, the GSM sends a message to the client with approximately the condition and demands for irrigating the plant. When the EC esteem goes past the extent, the fertilisers for moving forward the soil supplement are also suggested within the content message.

The prediction done throughout the year is shown in Figure 4. It is clear from the graph that almost 90% of prediction was correct regarding the crop selection. Figure 5 shows the % of moisture maintains capability using IoT based system for water requirement.

Decision Tree Building
(i) Stage 1: Donate input as set of hubs and information set
(ii) Stage 2: In case hub comes to halting criteria of information set at that point, hub is added
(iii) Stage 3: Else return and move to best part point again
(iv) Stage 4: Part preparation data is set in accordance with the best part point discovered in step 3
(v) Stage 5: Include cleared out child
(vi) Step 6: Include right child.

Algorithm 1: AI based Decision Tree building.

Split algorithm
(i) Stage 1: Donate preparing information set as input
(ii) Stage 2: Develop the histogram of attributes
(iii) Stage 3: Navigate all part focuses
(iv) Stage 4: Discover best split
(v) Stage 5: Create a histogram for the split point's cleared out totality and right entirety.
(vii) Stage 6: Calculate for fear that entirety and right sum for all parts concentrated in histogram
(viii) Stage 7: Calculate the part pick-up for the cleared out totality and the correct sum
(ix) Stage 8: Choose the optimal part point based on the part pick-up estimated in step 7.

Algorithm 2: Algorithm to flow split operation.

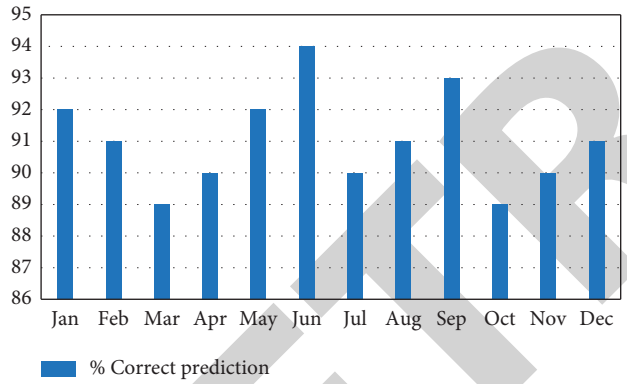

Figure 4: Crop prediction.

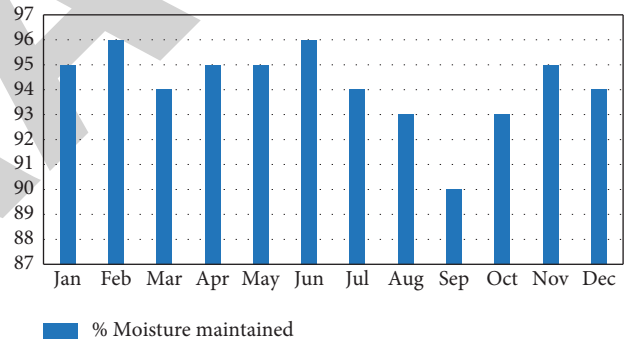

Figure 5: % of moisture maintained.

Finally, Figure 6 shows the % of electricity saved due to use of IoT based smart farming as electricity usage plays a big role in deciding the profit of the farmer.

5. Discussion

Agreeing to an arrangement declared in 2015 beneath "The 2030 Plan for Feasible Improvement," the UN and universal research agency set a target to conclusion starvation by 2030. In any case, later figures discharged by WHO (World Health Organization) do not see empowering sufficient to back the plan, as more than 800 million individuals around the world are confronting the nourishment shortage—one out of each nine individuals. In spite of the fact that these figures are very disturbing on their possession, what is more stunning is the quality of nourishment. Other than accessibility, the quality of nourishment is getting to be another genuine issue and indeed more basic. Here, we have examined advanced elements that can be put into the advancement of programmed farming. Such a framework is utilised to control intemperate and unnecessary use of fertilisers and to thwart the perilous impact on crops as well as on the human body. It can moreover offer assistance to control the richness of the soil. In this framework, less fertilisers are utilised which tend to play down the supplement misfortunes. By the use of different sensors, we screen the soil dampness and environmental temperature and humidity. These analysed values are used to urge proficiency within the horticulture field. This project can experience advanced inquiry to progress the functionality of the gadget and its application ranges and attach more sensors. The benefits of this work are more efficient and precise data is brought, reducing manpower. The applications of this work are in farming fields and water division.

The IoT gadget is considered to be the most driver of change within the agrarian segment for a long time to come. IoT gadgets empower cultivating directors to track crops in real-time, with exact planting, livestock administration, and savvy nursery administration, etc. Unfortunately, there is as

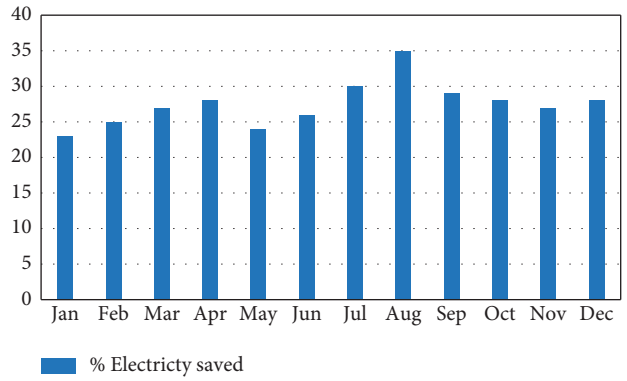

Figure 6: % of electricity saved throughout the year.

well a rate of laborer turnover from the rural division to other businesses. Not at all like other businesses, IoT framework gadgets establishments and upkeep are a small troublesome and require parcels of venture.

6. Conclusion

The study proposes an I-T-based canny farming arrangement that employs data standardisation through filtering and compression techniques, as well as decision learning computations. The framework will provide a computerised course of action for data security from remote sensors sent in development due to the incorporation of IoT gadgets. Filtering and compressing data will provide precision while also allowing for a low-cost communication method. Finally, a computation for decision-making capable system is to inform farmers about the status of their development so that they may make informed decisions about water framework, fertiliser and pesticide levels, and future contaminations. The utilisation of PKF's logical testing capability for imperativeness use and data amusement quality is investigated. Obtaining the underlying plan of estimate-based compression techniques is fulfilling. We will transfer the and 3D shape, a standardised (i.e., adhering to one M2M subtle parts) gadget computer programme organisation for IoT contraptions, to supply Web organisation for the sensors and controllers of the related develop. Aside from that, we will employ IoT, which provides APIs with the capacity to gather data from various locations and recover it, as well as a control command that can be transmitted for proper operation (e.g., examine conditioner). The flowchart of specific machine learning calculations will aid in determining the best probable course of action for decision making based on the desire for trim advancement.

Data Availability

The data used to support the findings of this study are available in the article itself.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

References

[1] R. Kumar, M. P. Singh, P. Kumar, and J. P. Singh, "Crop selection method to maximize crop yield rate using machine learning technique," in *Proceedings of the 2015 International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials*, pp. 138–145, Chennai, Tamil Nadu, India, May 2015.

[2] R. Khan, N. Tyagi, and N. Chauhan, "Safety of food and food warehouse using VIBHISHAN," *Journal of Food Quality*, vol. 2021, Article ID 1328332, 12 pages, 2021.

[3] G. S. Sriram, "Resolving security and data concerns in cloud computing by utilizing a decentralized cloud computing option," *International Research Journal of Modernization in Engineering Technology and Science*, vol. 4, no. 1, pp. 1269–1273, 2022.

[4] T. Sujjaviriyasup and K. Pitiruek, "Agricultural product forecasting using machine learning approach," *International Journal of Mathematical Analysis*, vol. 7, no. 38, pp. 1869–1875, 2013.

[5] K. Krishna Kumar, K. Rupa Kumar, R. G. Ashrit, N. R. Deshpande, and J. W. Hansen, "Climate impacts on Indian agriculture," *International Journal of Climatology*, vol. 24, no. 11, pp. 1375–1393, 2004.

[6] U. Iqbal and A. H. Mir, "Secure and scalable access control protocol for IoT environment," *Internet of Things*, vol. 12, no. 100291, Article ID 100291, 2020.

[7] V. Sahni, S. Srivastava, and R. Khan, "Modelling techniques to improve the quality of food using artificial intelligence," *Journal of Food Quality*, vol. 2021, Article ID 2140010, 10 pages, 2021.

[8] L. Wang, P. Kumar, M. E. Makhatha, and V. Jagota, "Numerical simulation of air distribution for monitoring the central air conditioning in large atrium," *International Journal of System Assurance Engineering and Management*, vol. 13, 2021.

[9] M. N. Kumar, V. Jagota, and M. Shabaz, "Retrospection of the optimization model for designing the power train of a formula student race car," *Scientific Programming*, vol. 2021, Article ID 9465702, 9 pages, 2021.

[10] J. Bhola, M. Shabaz, G. Dhiman, S. Vimal, P. Subbulakshmi, and S. K. Soni, "Performance evaluation of multilayer clustering network using distributed energy efficient clustering with enhanced threshold protocol," *Wireless Personal Communications*, 2021.

[11] X. Zhang and E. A. Davidson, *Improving Nitrogen and Water Management in Crop Production on a National Scale*, American Geophysical Union, Washington, DC, USA, 2018.

[12] Z. Yan, Y. Yu, and M. Shabaz, "Optimization research on deep learning and temporal segmentation algorithm of video shot in basketball games," *Computational Intelligence and Neuroscience*, vol. 2021, Article ID 4674140, 10 pages, 2021.

[13] J. Bhola and S. Soni, "Information theory-based defense mechanism against DDOS attacks for WSAN," in *Advances in VLSI, Communication, and Signal Processing Lecture Notes in Electrical Engineering*, D. Harvey, H. Kar, S. Verma, and V. Bhadauria, Eds., vol. 683, Singapore, Springer, 2021.

[14] J. Bhola and S. Soni, "A study on research issues and challenges in WSAN," in *Proceedings of the 2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)*, pp. 1667–1671, Chennai, India, March 2016.

[15] C. Sharma, B. Amandeep, R. Sobti, T. K. Lohani, and M. Shabaz, "A secured frame selection based video

watermarking technique to address quality loss of data: combining graph based transform, singular valued decomposition, and hyperchaotic encryption," in *Security and Communication Networks Security and Communication Networks*, M. Kaur, Ed., vol. 2021pp. 1–19, 2021.

[16] S. Saralch, V. Jagota, D. Pathak, and V. Singh, "Response surface methodology-based analysis of the impact of nanoclay addition on the wear resistance of polypropylene," *The European Physical Journal-Applied Physics*, vol. 86, pp. 1–13, Article ID 10401, 2019.

[17] D. Abhishek, R. Mishra, K. K. Maurya, R. B. Singh, and D. W. Wilson, "Estimates for World population and global food availability for global health," *The Role of Functional Food Security in Global Health*, pp. 3–24, 2019.

[18] S. Ghosh and S. Koley, "Machine learning for soil fertility and plant nutrient management using back propagation neural networks," *International Journal on Recent and Innovation Trends in Computing and Communication*, vol. 2, no. 2, pp. 292–297, 2014.

[19] A. Nithya and V. Sundaram, "Classification rules for Indian rice diseases," *International Journal of Computer Science*, vol. 8, no. 1, pp. 444–448, 2011.

[20] "World agriculture: towards 2015/2030 by FAO," 2019, http://www.fao.org/3/a-y4252e.pdf.

[21] L. Zhang, I. K. Dabipi, and W. L. Brown, "Internet of things applications for agriculture," in *Internet of Things A to Z: Technologies and Applications*, Q. Hassan, Ed., Wiley, New Jersey, USA, 2018.

[22] Q. F. Hassan, *Internet of Things A to Z: Technologies and Applications*, Wiley-IEEE Press, Hoboken, NJ, USA.

[23] S. Navulur, A. S. C. S. Sastry, and M. N. Giri Prasad, "Agricultural management through wireless sensors and internet of things," *International Journal of Electrical and Computer Engineering*, vol. 7, no. 6, pp. 3492–3499, 2017.

[24] E. Sisinni, A. Saifullah, S. Han, U. Jennehag, and M. Gidlund, "Industrial internet of things: challenges, opportunities, and directions," *IEEE Transactions on Industrial Informatics*, vol. 14, no. 11, pp. 4724–4734, 2018.

[25] E. Boonchieng, O. Chieochan, and A. Saokaew, "Smart farm: applying the use of Node MCU, IOT, NETPIE and LINE API for a Lingzhi mushroom farm in Thailand," *IEICE-Transactions on Communications*, vol. E101.B, no. 1, pp. 16–23, 2018.

[26] J. Lin, W. Yu, N. Zhang, X. Yang, H. Zhang, and W. Zhao, "A survey on internet of things: architecture, enabling technologies, security and privacy, and applications," *IEEE Internet of Things Journal*, vol. 4, no. 5, pp. 1125–1142, 2017.

[27] L. Rokach and O. Maimon, *Decision Trees. Data Mining and Knowledge Discovery Handbook*, pp. 165–192, Springer, New York, Dordrecht, Heidelberg, London, 2005.

[28] J. R. Quinlan, "Induction of decision trees," in *Machine Learning*, vol. 1, pp. 81–106, , no. 1, Springer, Berlin, 1986.

[29] S. R. Safavian and D. Landgrebe, "A survey of decision tree classifier methodology," *IEEE Transactions on Systems, Man, and Cybernetics*, vol. 21, no. 3, pp. 660–674, 1991.

[30] Q. Chen, L. Li, C. Chong, and X. Wang, "AI-enhanced soil management and smart farming," *Soil Use & Management*, vol. 38, 2021.

[31] N. G. Rezk, E. D. Hemdan, A. F. Attia, A. E. Sayed, and M. A. El-Rashidy, "An efficient IOT based smart farming system using machine learning algorithms," *Multimedia Tools and Applications*, vol. 80, no. 1, pp. 773–797, 2021.

[32] Z. Ünal, "Smart farming becomes even smarter with deep learning—a bibliographical analysis," *IEEE Access*, vol. 8, pp. 105587–105609, 2020.

[33] R. Saadane, A. Chehri, and S. Jeon, "AI-based modeling and data-driven evaluation for smart farming-oriented big data architecture using IoT with energy harvesting capabilities," *Sustainable Energy Technologies and Assessments*, vol. 52, Article ID 102093, 2022.

[34] P. V. Cenas, "Forecast of agricultural crop price using time series and Kalman filter method," *The Asia Pacific Journal of Multidisciplinary Research*, vol. 5, pp. 15–21, 2017.

[35] E. Jerhamre, C. J. Casten Carlberg, and V. Van Zoest, "Exploring the susceptibility of smart farming: identified opportunities and challenges," *Smart Agricultural Technology*, vol. 2, Article ID 100026, 2022.

[36] N. Lemphane, N. Junia, B. Kotze, and R. Baby Kuriakose, "A review on current IoT-based pasture management systems and applications of digital twins in farming," in *Proceedings of the Third International Conference on Sustainable Computing*, 2022.

[37] T. K. Lohani, M. T. Ayana, A. K. Mohammed, M. Shabaz, G. Dhiman, and V. Jagota, "A comprehensive approach of hydrological issues related to ground water using GIS in the Hindu holy city of Gaya, India," *World Journal of Engineering*, 6 pages, 2021.

[38] K. S. P Reddy, Y. M. Roopa, and N. S. Nandan, "IoT based smart agriculture using machine learning," in *Proceedings of the 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA)*, IEEE, Coimbatore, India, July 2020.