Tec Empresarial
P-ISSN: 1659-2395; E-ISSN: 1659-3359

INTELLIGENT AGRICULTURE –BASED CROP SELECTION ANALYSIS USING BIG DATA

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ABSTRACT
The demand for agricultural products is always increasing along with the growth of the human population. However, as the environment throughout the world changes, many crops frequently suffer weather-related harm.This project makes use of IoT technology for Intelligent Agriculture to keep track of environmental variables on a farm. To analyse the environmental parameters affecting that farm, 3D cluster analysis was applied to the data that had been obtained. The suggested plan has the following characteristics: The system determines whether a selected crop has been placed in the appropriate cluster by combining moving average and average variance; (2) we used 3D cluster analysis to analyse the relationship between environmental factors; (3) we then looked at the farmers' rules of thumb; (4) The system determines if a crop is appropriate for the farm by setting a critical value in the cluster based on potential environmental conditions. We installed IoT equipment for Intelligent Agriculture on the farm for monitoring purposes, and we used the algorithm from our study to do an actual-scenario analysis. The findings show that our suggested plan is definitely workable.

KEYWORDS: Big Data, Intelligent Agriculture, Internet of Things, Agricultural engineering, Data mining.

INTRODUCTION

The demand for agricultural products is always expanding along with the growth of the human population.Study [1] indicates that the world population is anticipated to increase, causing a sharp increase in demand for dairy products, from 1.8 billion in 2009 to 4.9 billion in 2030. According to study [2], human population growth would cause a rise in the demand for agricultural products, necessitating the development of farmland and an increase in crop output. Meanwhile, crops are frequently harmed by extreme weather as a result of global warming. In response to the global

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food problem, countries all over the world are investing in the creation of intelligent agriculture, according to study [3]. In order to lower cultivation costs, particularly in water resources, many farms, as noted in study [4], have started to rely more heavily on natural resources, such as using hydropower, geothermal energy, or solar electricity. According to study [5], a labour shortage will become a significant problem over the coming few decades. At this time, the agricultural The labour force is primarily made up of elderly individuals who operate on instinct and generalisations; in addition, they lack the necessary tools to monitor environmental elements on their farms. In light of the fact that many crops are now considered to be inappropriate for long-term cultivation due to global climate change, farmers are therefore unable to determine which crops can thrive on their soil. In light of the aforementioned, we must make use of the Internet of Things and big data to analyse farm soil and environment in order to give farmers with acceptable crop selections and monitor their cultivation methods as well as environmental conditions at their farms. According to study [6], establishing an agricultural ecosystem is necessary if we want to address the global food issue. Monitoring farm data that can be used to resolve production difficulties should be done using the system. However, according to study [7], 2 more billion people would live on the planet in the future, making residential areas smaller and preventing the expansion of agricultural land.

We must therefore rely on Intelligent Agriculture to advance Farmers typically rely on generalisations when it comes to cultivation methods, but as climate change occurs, crops that grew well in the past may not be able to adapt tothe efficiency of farms. A farm's environmental parameters must be monitored, but Intelligent Agriculture also has to exa mine how weather affects the farm's environment and how longterm crop production affects soil erosion or changes in the soil's structure.Crop productivity issues can be avoided by monitoring a farm with big data ,IoT. When it comes to cultivation methods, farmers sometimes rely on generalisations; yet, as climate change occurs, crops that grew well in the past may not be able to adapt to current farm conditions.Farmers typically rely on generalisations when it comes to cultivation methods, but as climate change occurs, crops that grew well in the past may not be able to adapt tothe efficiency of farms. A farm's environmental parameters must be monitored, but Intelligent Agriculture also has to exa mine how weather affects the farm's environment and how longterm crop production affects soil erosion or changes in the soil's structure.

Crop productivity issues can be avoided by monitoring a farm with big data and IoT.Farmers should use Intelligent Agriculture technologies to monitor their farm environment because they currently have no way of knowing the state of their farm soil. The Intelligent Agriculture system must be financially accessible and have a green power storage function because many farms are small, outside farms. The Intelligent Agriculture system's monitoring of farm data makes big data analysis possible and aids in our understanding of a farm's environmental elements and soil composition.

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A farm's environmental parameters must be monitored, but Intelligent Agriculture also has to exa mine how weather affects the farm's environment and how longterm crop production affects soil erosion or changes in the soil's structure.Crop productivity issues can be avoided by monitoring a farm with big data , IoT.This study suggests using intelligent agriculture to analyse large amounts of farm data. The following functionalities are offered by our platform for intelligent agriculture: (1) IoT sensors for temperature, humidity, atmospheric pressure, lighting, electrical conductivity of soil, and irrigation; (2) a solar power storage system that helps cut electricity costs; and (3) an XMPP web platform that aids in gathering data from the IoT sensors. The system will send the data back to the platform on a regular basis every 10 minutes. The suggested Intelligent Agriculture system uses reasonably priced sensors, which aids in the widespread adoption of Intelligent Agriculture systems. In addition, the system is mobile thanks to the solar power storage system, making it appropriate for outdoor farms. Big data analysis is used in this study to examine the data gathered by the Intelligent Agriculture system. Farmers typically rely on generalisations when it comes to cultivation methods, but as climate change occurs, crops that grew well in the past may not be able to adapt to the efficiency of farms.
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(1) Examining the methods of horticulture used by
(2) Analysing a farm's environmental elements and selecting appropriate crops for it;
(3) communicating with farmers, comprehending how the crops are growing, and examining environmental changes; and cultivation. Through behaviour analysis, this study explores the experiences of farmers and their farming practises to look at data such irrigation patterns and how much water the soil need. To better understand how weather conditions cause environmental changes, the study also examines the farm's environmental elements. It then prioritises which crops are best for the farm depending on timing. The following ideas are included in our suggested big data analysis methodology:
(1) using moving average and average variance to normalise the data;
(2) using 3D cluster analysis to examine the relationship between various environmental
(3) determining whether a chosen crop has been placed in the appropriate cluster;
(4) setting a critical value in the cluster based on future environments and offering advice on whether a crop is suitable for the farm. These steps take into account various factors and then look at the farmers' common sense. If the locally grown crop is a good choice, our suggested big data analysis method has been put through simulation.

RELATED WORKS

A system framework that combines big data and intelligent agriculture is suggested in Study [8]. The data from IoT sensors is stored using cloud technology and used for big data analysis for farm management. The farm may use big data analysis to forecast crop growth and environmental changes, and it may even give the information to food processing companies for authentication or

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product traceability. Big data analysis requires data normalisation, which can be accomplished through processes like data cleaning and normalisation. A review of the literature in study [6] shows how previous partnerships between big data and IoT networks have had a significant influence on agriculture and farming. Many of the studies listed in the study focused on the analysis of farm water resources and helped to cut costs. The mismanagement of water supplies. Drones are employed to collect sensor data because it is demonstrated in study [9] that large-scale farms lack suitable power equipment, making network transmission of sensors a major problem. Data collecting in the air, however, encounters signal interference issues that call for multi-level data cleaning procedures before obtaining thorough sensor data. Study [10] takes a new tack and analyses irrigation locations in agricultural practises using big data. The study suggests an agent-based strategy for locating a cropland's ideal irrigation site.

The paper suggests an agent mechanism that enables communication between IoT networks for monitoring irrigation conditions because many IoT networks must transmit data back to a remote server, but the remote server might not be able to respond instantly owing to network issues.

The data of a specified area are evaluated using Kalman filtering in research [11], which also provides a further estimate of future data. The research employs fuzzy neural networks to increase forecast accuracy and convergence rate. The ability to forecast future environmental changes on the farm and enable temperature control for indoor farms depends on the environmental factor data that has been gathered. By examining mean values and similarities in the context of seasonal fluctuations, study [12] explores pig illnesses in the livestock business. To provide light on patterns and illness prevention, the study uses big data analysis to look at the health of pigs on 44 different farms. On a side note, study [9] recommends installing tiny weather stations on the farm in addition to IoT technology to monitor local weather and atmospheric changes. The transmission of large amounts of image data frequently results in packet loss because farm areas frequently have poor wireless network connections; as a result, the study uses a variety of image compression techniques in their analysis to effectively increase data compression volume and reduce image distortion. In relation to data preservation, study [13] believes According to study [14], integrating cloud technologies into IoT data storage can significantly improve data security and integrity. The intelligent healthcare system indicated in study [15] uses big data to analyse pertinent data for the avoidance of specific diseases that, in turn, minimise medical burden in addition to monitoring a patient's physical status and operating other associated applications. Big data is used in study [16] to optimise power distribution in Volt-VAR Control (VVC) procedures used in the production of wind energy.

The study focuses on how to best combine the primary power source with wind power generation, and the VVC centres can be either centralised, dispersed, or hierarchical. A transmission structure incorporating IoT and big data is recommended by study [17]. The monitoring platform requires rapid warnings when each mechanical platform reads data, executes operations, and does big data analysis, for example. An IoT network shares its data across numerous systems.In the meantime, study [18] suggests computing group decision-making issues using a hybrid weighted geometric averaging operator. In the field of decisionmaking research, multiple group decision-making issues

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have received particular attention; cluster processes are also frequently employed in a variety of fields. Adopting the suggested strategy in research [18] can help with the clusters' concerns with rapid convergence and critical value. A clustering decision-making system with a feedback mechanism is provided by study [19]. The study uses the feedback mechanism and threshold to rank, by order, A transmission structure incorporating IoT and big data is recommended by study [17]. The monitoring platform requires rapid warnings when each mechanical platform reads data, executes operations, and does big data analysis, for example. An IoT network shares its data across numerous systems.

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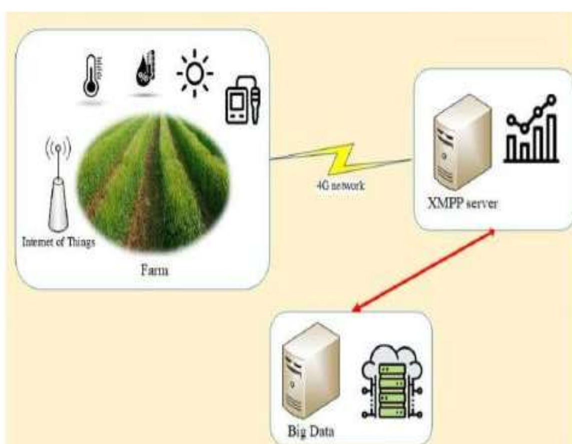
PROPOSED SCHEME

The system model is illustrated in Section 3.1 of this work. Data cleaning and normalisation are covered in Section 3.2. A 3D cluster correlation analysis is covered in Section 3.3.explains crop selection analysis and decision-making in more detail.

SYSTEM MODEL

Our suggested plan necessitates the creation of the Intelligent Agriculture platform depicted in Figure 1. We installed Internet of Things (IoT) sensors in farms to keep an eye on the surrounding environment. These sensors may assist measure temperature, humidity, illumination, air pressure, electrical conductivity (EC), moisture content, and salinity of the soil. Through the EC, we can learn about the soil fertility conditions, and we can use the sensors to decide how much and when to irrigate the soil. Our solution requires IoT sensors that are economically feasible, which should promote IoT adoption. Our technology uses solar power storage for IoT power consumption, which not only relieves the system of the requirement for external power assistance but also grants it physical mobility. In order to achieve information integration across many platforms and formats, the data from our IoT sensors is delivered to the server through 4G networks in XML format. To help with data display from each sensor, we have also added charts and graphs in our XMPP platform. Among other features, the charts and graphs may be exported into reports. To do big data analysis, data from all sensors can be exported from the database. Our big data analysis has the following objectives: (1) Examining the farmers' cultivation methods, comprehending how the crops grow, and watching environmental changes; and (2) Examining the farm's environmental elements and choosing appropriate crops. The 5V aspects are described by big data as (1) volume, (2) velocity, (3) variety, (4) veracity, and (5) value [22]. The big data strategy we've suggested adheres to the 5V definitions. The information used in our investigation is derived from farm-based IoT sensor data. Every 10 minutes, according to our plan, the IoT sensors gather data and send it back to the platform. Through the use of pertinent data gathered from weather stations, our study provides a variety of facts. Our system performs data cleaning and normalisation prior to any data analysis to ensure that both the analysed data and the analysis result of targets set in advance are precise. Our suggested strategy and objectives can boost crop output while assisting in the analysis of farmers' farming practises.



DATA CLEANING AND NORMALIZATION

Cleaning and normalising data is the first stage in big data research. Although our system uses 4G networks to transmit IoT data, which guarantees constant network quality, it may still have problems like packet loss or low signal. Data cleaning is done on the huge data initially, which seldom varies much because farm environments often fluctuate in a linear increase or decline pattern. Once obtaining the moving average, the system proceeds to compute the half-hard threshold. We use the variance to compute the upper/lower limit of the moving average.When the system has identified the moving average and variance of each sensor, any data that falls outside the upper/lower limit indicates variation that is too drastic and is thus removed as an anomaly; any data that falls within the upper/lower limit is preserved and undergoes the following computation: The data subsequently goes through normalisation when the data cleaning process is finished. For instance, given a temperature of 33.6 degrees, the system unconditionally rounds off the decimal point to the integer place because the outcomes of big data analysis are unaffected by the decimal points in a temperature measurement. Additionally, our system uses the equation: to do normalisation computations based on the accuracy of each sensor.D i, J = Norm D 0 i, J.

3D CLUSTER CORRELATION ANALYSIS

The system we've suggested uses 3D correlation analysis to look at how farmers cultivate their land. In order to determine the periodicity, we first use autocorrelation to determine the farmers' irrigation cycle.In which dk stands for the autocorrelation results of each day or each week. Following that, the system identifies the maximum value dk and uses it as the cycle value Where CYi denotes the highest value deemed to represent the cycle for each day or week. The system then determines whether the farmer irrigates every day or once a week. The first step in our technique is to determine the daily soil moisture content for each day. In order to determine whether the periodicity is unstable, it checks to see if the variance of CYi is more than the threshold value. If it is, the system performs the computation on a weekly basis. Equation 4 illustrates the computation for the variance of CYi, while Equation 5 is used to determine a cycle's periodicity.When RE is flase, the system returns to Equation 1 and the data range is readjusted to a weekly basis. When RE is true, the system calculates the average cycle time Dˆ i,l,t, in which t stands for the cycle time while Dˆ i,j stands for the average soil moisture content. Our suggested approach locates the soil's largest ascending curve and maps the result onto the measurement of soil moisture content to determine whether it is the maximum cycle value; if not, it means that the farmer has applied fertiliser or pesticide.To determine how the electrical conductivity (EC) of the soil is increasing, we first use the slope. When the resulting RSL is true, it shows that the soil EC has greatly increased. The system then determines if the results map onto the highest moisture sensor value; if they do, it means irrigation increased the soil's electrical conductivity value. If not, irrigation did not occur.

CROP SELECTION ANALYSIS AND DECISION-MAKING

The seven sensor data clusters identified in this study—temperature, air humidity, atmospheric pressure, soil moisture content, soil electrical conductivity, lighting, and soil salinity—were determined by the numerical size of the sensor data clusters. G0 i, j represents the sensor clustering data. The clustering is shown in Figure 4, where the x axis represents a distant to close order in time and the y axis represents a small to large numerical order in the values.The system then arranges the other conditions and necessary conditions in order to choose feasible acceptable crops.Temperature, electrical conductivity of the soil, and salinity are required parameters. Other factors can include atmospheric pressure, moisture content of the soil, air humidity, and illumination. For instance, the ability to improve air humidity and soil moisture content , lighting and air humidity. For instance, an irrigation system can increase soil moisture content and air humidity, and lighting equipment can increase illumination. The system assesses whether a crop is acceptable for the farm after completing all of the aforementioned steps.

PERFORMANCE

This chapter elaborates on our Intelligent Agriculture experiment results (Section 4.1) and big data experiment results.

INTELLIGENT AGRICULTURE EXPERIMENT RESULTS

Displays the experimental farm and tools we have available. The farm has a total area of 0.19835 hectares, and the IoT equipment can measure the air temperature, humidity, atmospheric pressure, soil moisture content, electrical conductivity of the soil, lighting, and soil salinity. Figure 7 displays data collected by IoT sensors; according to our suggested plan, the IoT gathers farm environment data every 10 minutes. Our suggested method, however, is powered by solar energy storage, allowing the machinery to be relocated to any location on the farm at any time. The XMPP platform accepts IoT data and then displays it using graphs and charts. The IoT equipment uses 4G networks for packet delivery**.**

BIG DATA EXPERIMENT RESULTS

We analysed enormous data for our investigation. Information is stored in 100,000 units each sensor, for a total of 700,000 units across all sensors. We selected celery, water spinach, green beans, and daikon for our study's crop analysis. Our method first checked to see if the crop's environmental parameters matched those of the farm; if they did, it next used normal distribution to assess risk. As seen in Figure 8, the celery has a difficult time adjusting to the farm environment due to temperature problems; normal distribution analysis also reveals potential dangers in the soil moisture content. Additionally, it is challenging to regulate temperature in an outdoor setting, so the celery does not adhere to the farm's requirements.Temperatures cause the water to congeal. Although spinach is a beneficial crop for the farm, there are concerns, according to the normal distribution study.In both air humidity and soil moisture content. However, the irrigation system can be used to address difficulties with soil moisture content and air humidity. Green beans appear to be an excellent growing match for the farm in terms of environmental characteristics like temperature and soil moisture content, as shown in Figure 10. However, further normal distribution analysis reveals the potential hazards in temperature, soil moisture content, and air humidity. Figure 11 study demonstrates that daikon are a viable crop for the farm. Big data analysis can be used by our suggested system to assist a farm in choosing a suitable crop.

CONCLUSION

Considering the drastic climatic changes and rising global We must emphasise that the public must handle food issues, especially those related to agriculture and crops. Our research suggests using an Intelligent Agriculture platform to keep track of environmental parameters on a farm and use that information to analyse the farming practises that farmers use. In order to remove data with more pronounced variation, our proposed approach uses moving average and variance. In our work, periodicity is computed using autocorrelation, and the behaviour of farmers applying fertiliser or pesticides is analysed using 3D cluster correlation. Our research examines environmental aspects to determine whether a crop is appropriate for farming; also takes into account global warming. The eExperiment results exhibit our research of four crops using our suggested methodology; the findings show that farmers can better understand whether a crop is fit for their farm by taking into account characteristics like soil moisture content and temperature. Farmers can learn which crops they can grow using the environmental factor analysis suggested in our study, and the system monitors and analyses crop cultivation behaviour in the background. Future versions of our suggested system could include artificial intelligence and make use of the findings of the investigation to assist farmers with automatic cultivation and environmental control.

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