Monitoring of Agricultural Activities in a Digital Environment

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Abstract: ***Digital era is playing a very important role in each and every field. Agriculture plays a very important role in increasing the economy of any country. Monitoring the agricultural yield is a big challenge now a day because of varying in climate conditions monitoring the various parameter such as soil content, moisture level, and pesticides for varieties of crops is a big challenge. Sure the digital era can help in the monitoring of all these parameters by using sensors and also by using the related data information to predict the best yield of any crops. One strategy for improving productivity and income in agriculture around the world is digital agriculture. In the paper, different techniques to monitor agricultural activities in a digital environment are explored to increase the productivity of the growth of the cultivated field. The success of digital agriculture depends on decreased technological costs, user-friendly portable gear, pay-per-use rental arrangements, legislative assistance, and leveraging the strength of farmer collectives. The IoT with machine learning, big data storage, and analysis of the data-taking relevant technologies are discussed in the article. IoT with machine learning techniques and applications for smart agriculture is trending in favourable directions, and they also present opportunities and problems.***

Keywords: Smart farming, IoT, Big Data, Machine Learning

1. Introduction

In the digital era, information and communiqué technologies (ICTs), such as computing machines and smart phones, have extremely reformed how public access acquaintance and information, deportment professional, and custom facilities [1]. Digital technology access can present important advantages for rural small-scale farmers promoting your company by offering information and access to suppliers allowing consumers to access labour talent, construct accessing a strategic alliance and assistance services such services like training, money, and law, but most importantly, reach both consumers and markets. The paradigm for agriculture is shifting, and data collecting and decision-making are becoming increasingly crucial. One strategy for achieving growth in economics and levitation safety in developing nations has been the deliberate application of information and communication technology (ICT) [2] to enhance information sharing. Many national and international programmes have pushed smart farming [3] using ICT components for inclusion in development activities. Digital capabilities, such as data gathering methods, analytical approaches, and communication tools, provide opportunity for scientists and agricultural practitioners to comprehend complex farming ecosystems and address agricultural difficulties [4]. ICTs can give farmers better access to information and increase their capacity to share that knowledge with others and among themselves.

Internet of Things (IoT):
The Internet of Things (IoT) is the most effective and crucial methodology for creating answers to issues. Sensors, apps, network components, and other electronic devices serve as the foundation for the Internet of Things (IoT). It enhances knowledge's efficacy in addition. Without the assistance of a human, data may exchange over a network thanks to IoT. In the farming industry, innovative thinking and Internet of Things tactics were required to boost productivity and eliminate boundaries. Farmers may now overcome the enormous barriers they confront thanks to the Internet of Things (IoT), [5] which is now turning its attention to the agricultural industry. Farmers may have access to a variety of information about upcoming trends and innovations thanks to the Internet of Things (IoT).

A wide term used to describe farming and food production methods that use Machine to Machine communication using the internet (IoT) using the huge data set available, and sophisticated analytics is "smart agriculture. " The integration of analytics, automation, and sensing technology into current agricultural processes is referred to as the "Internet of Things. "With a wide variety of sensors being utilised for diverse smart agricultural goals, the IoT has also recently made a major influence on the agriculture sector. IoT applications are growing dramatically each year.

The following are the IoT applications in smart agriculture that are most popular:

- Sensor-based systems for keeping an eye on crops, fields, livestock, barns, and pretty much anything else that affects productivity.
- Drones, self-driving robots, and actuators are examples of smart agricultural vehicles.
- Smart greenhouses and hydroponics are two examples of connected agricultural settings.
- Data analytics, management systems, and visualisation.

Machine Learning with IoT in Agricultural monitoring:
IoT with Machine Learning techniques can be applied for agriculture monitoring, to predict the parameters required to improve the efficiency of the crop production yield, to monitor the environmental parameters such as temperature, compression allegation, area moistness, sunny condition,

and rain prediction values, also to monitor and predict the plants' diseases and take the immediate action to avoid the spoil of the crop growth. A data mining system [6]compiles data from several climatic stations and estimates the moisture of the soil using real-time data. Different machine learning techniques such as Random Forest and Artificial Neural Networks (ANN)., to extract soil parameters using an adjustable network grounded fuzzy inference (ANFIS) system can be applied.

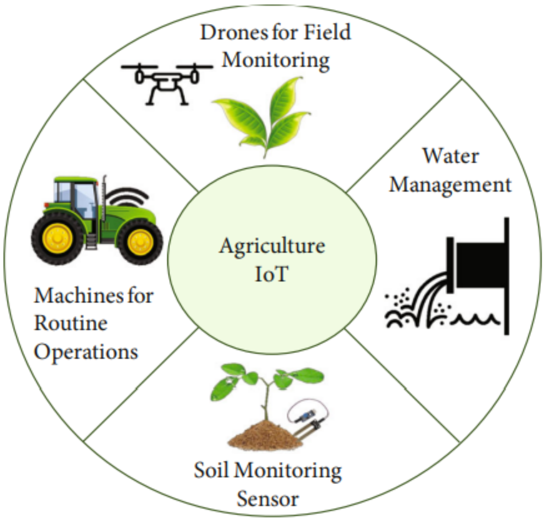

Figure 1.1: Overview of Agriculture monitoring

Remote growers can identify plant illnesses and pests with the help of IoT and machine learning equipment. Farmers may immediately change environmental conditions by snapping a picture of the plant and using the device to run machine learning models.

2. Literature Review

In this proposed theory, [7] farmers who can express their thoughts and feelings good and bad—with one other and with specialists are better equipped to control their fields and their crops. ICT-based virtual farming may make it easier for farmers to communicate with professionals, other agricultural enthusiasts, and other growers about their experiences. Numerous national and international initiatives have encouraged the use of ICT components in smart farming (Griffith et al.,) for inclusion in development programmes. Digital capabilities, including data gathering methods, analytical approaches, and communication tools, provide opportunity for researchers and agricultural practitioners to comprehend complex farming ecosystems and address agricultural difficulties (Kamilaris et al.,). ICTs can improve farmers' access to information and their capacity to communicate that information with others as well as among themselves.

In order to illustrate the already attained findings [8], the ongoing studies, and the remaining obstacles, technical as well as non-technical, the author presents an overview of the newest research efforts in this subject, both in the form of research and scientific areas. The author largely concentrates on the area of the EU, highlighting dangers and challenges, and then examining at current and prospective results to overwhelmed the obstacles. The use of ICT in farming is called as smartness farming (SF). The purpose of creating and promoting the use of novel technologies to assist farmers on the ground is motivated by the data generated and analysed using ICT techniques.

Sarkar et al., [9] have proposed that IoT, which connects everything used in daily life to the internet and allows for remote monitoring and control, is consistently one of the most popular topics that is developing at a breakneck pace. IoT has numerous uses in a variety of industries, with farmland being one of its fantastic fields. For maximising the output, controlling environmental factors is crucial. Specifically, keeping an eye on numerous farming factors that influence the vegetation, such as temperature, moisture, humidity, soli pH value, and others. With the aid of a microprocessor and Bluetooth technology, Yue Shaobo et al., created a smart weather station that can monitor agricultural parameters such as temperature. A reduced cellular approach is offered by the technology. M. Haefkeet al., created a ZigBee-based sensing and actuation platform that functions as an intelligent meteorological stations to assess environmental parameters such as temperature, relative humidity, pressures, and sunshine.

In this theory, [10] the semi-arid region, where issues with water scarcity are escalating, water management is more crucial for sustainable farming. In order to accurately irrigate crops using remote sensing technology, more precise water status recovery in crops is needed. Although they enable the collecting of environmental information in real-time, these technologies have a lot of potential for clever irrigation. The effectiveness of UAVs in water stress calculations depends on UAV features such versatility in flight planning, affordability, dependability, autonomous, and the capacity to deliver elevated information on time. Utilizing particular parameters, UAV equipped with a thermal sensor is said to be the most efficient method for identifying water crisis. Thermal imaging can spot changes in water status and crop water stress index (CWSI).

Khan et al. [11] have researched that even though they are familiar with agricultural procedures, the agriculture industry is getting increasingly data-centric and demands precise, more cutting-edge information and tools than previously. Different information and cutting-edge are advancing the farming industry (IoT). The quick development of these advanced technologies has transformed virtually every other business, including modern agro, which has gone from a statistics to a quantitative methodology. The most recent potential in a succession of difficulties have been caused by this radical upheaval, which has rocked traditional farming methods. This comprehensive overview article discusses the potential of the IoT to advance agriculture as well as the challenges associated with combining these cutting-edge systems with conventional agricultural ones. These contemporary farming operations have sensor-based technological devices, according to a rapid evaluation.

In this Klerkx et al. [12], have stated that despite the fact that there is a plethora of research on various aspects of digital revolution in crop production from an organic or technological science research perspective. Social scientists have only recently begun looking into these topics in connection to plantation production technologies. An ever-present trend is digitisation, the social and technical practice of incorporating online technologies. The term "digitalization" refers to a broad category of manifestations and techniques

Shamshiri et al. [13]., have proposed that by using cutting-edge innovations like sensors, robotics, and market research, digitally agricultural replaces laborious tasks with ongoing automation. The assessment of recent developments in robotics technology in this article is focused and applied in the area of sovereignun wanted plant controllers, arena exploration, and garnering. For automated harvesting framework with abundant unpretentious manipulators may be quicker and more effective than the expensive, professionally tailored opportunists now in use. In the context of digital agriculture, issues with object identification, task planning algorithms, digitization, and sensors efficiency are emphasized. One of the entry sites for digitised agriculture was found to be the production of virtual farms employing the principles of multi-robots, human-robot collaboration, and environment reconstruction using aerial pictures and surface instrumentation.

According to research paper [14], the environmental consequences of fish cage aquaculture, which come from the deposition of organic-rich particulate matter to the sea floor, depend on the regional environmental factors and managerial practices. Four monitoring techniques that are frequently used in Norway but have varying costs and skill requirements were compared in order to see how sensitive they are to order to detect planktonic ecological effects. However, the broad variation in agricultural monitoring used and (2) the lack of data comparability brought on by the absence of uniform regular monitoring strategies have hampered the verification of these hypotheses. These techniques are visual scuba diving surveys, flora and fauna analyzation, soil molecular biology, and Sediment Profile Imagery (SPI). Results show that all approaches worked well in the "impact zone, " which is the area directly beneath and close to the cages. The responsiveness of each methodology to pick up on more minute changes at further away locations varied, though.

In this review Neethirajan et al. [15], they not only illustrates possible uses, but also offers in-depth deeper insight the characterisation and prospective deployment of digital twins in contemporary animal production. One definition of a digital model is a digital copy of a physical object. Based on the input information, it replicates the individual's activity and physiological body in the actual world, as well as its significant biological state. It supports strategic planning by optimising, forecasting, and improving it. The manufacturing, the building and healthcare industries, intelligent buildings, and the power sector have all seen radical.

In this analysis, Misra et al. [16] give a general review of big data, artificial intelligence (AI), and the internet of things (IoT) and how they are likely to affect the future of the agri-food system. Following a brief introduction to IoT, big data, and AI, we discuss how to use IoT and big data analysis to modernise supply chains, how to use social media for innovation processes and sentiment classification in the food industry, and how to assess the quality of food using spectral methodologies and sensing technologies. The Internet of Things (IoT) produces massive amounts of streaming data, also referred to as "big data, " which creates new opportunities for monitoring the food and agriculture industries. Big data from social media and sensors are both becoming more important in the food industry. Green-house tracking, intelligent agricultural tools, and drone-based agricultural picture processing are some of the agriculture applications discussed.

This study's [17] objective is to find comprehensive solutions in a methodical manner, using water, electricity, and food supply, agricultural revolution with digital technology that will support sustainable development. Therefore, for a long term sustainable, technological advancements that boost agricultural production and seed production, conserve the environment, facilitate effective commodity use, and lower input prices can help us overcome many of the economic, social, and environmental challenges that are currently faced in food production. Precision agriculture and Agriculture 4.0 refer to computerized agricultural that is addressed using categories that include monitoring, control, prediction, and logistics. Road maps showing the agricultural and industrial revolutions at four stages along a chronology illustrate the shift from the prehistoric to the digital.

In this theory Zia et al. [18], Economic concerns, inadequate water administration, agricultural methods, and urban development are the principal causes of poor groundwater resources. In relation to the contributions of contaminants and nutrients, this research examines the considerable involvement of non-point sources, in particular obsolete agriculture methods. Nowadays, a variety of data collecting techniques, including as opportunity sampling and space based sensing of watercourses, are used to carry out water quality monitoring (WQM)

3. Methodology

The proposed methodology consists of four phases as shown in Figure 1.2. The raw datasets are collected from the smart farming IoT sensors. Different environmental characteristics are collected and monitored by IoT sensors and actuators. Various types of sensors are installed across the farming field to sense or collect the parameters. The dataset that was gathered from the IoT system in any smart farming application needs to be assembled. It may contain missing data values or noisy data. These missing readings could be the result of malfunctioning sensors or a breakdown in communication between system components. The system's performance is impacted by these missing values, which necessitates appropriate action. In this proposal model, the linear regression method is used to replace missing variables with their suitable values.

The analysis of environmental indicators, which chooses the most useful indicators for the farming system, is done using the Filter and Wrapper feature selection approach. The most advanced filter techniques provide each feature a score before choosing the features with the highest scores.

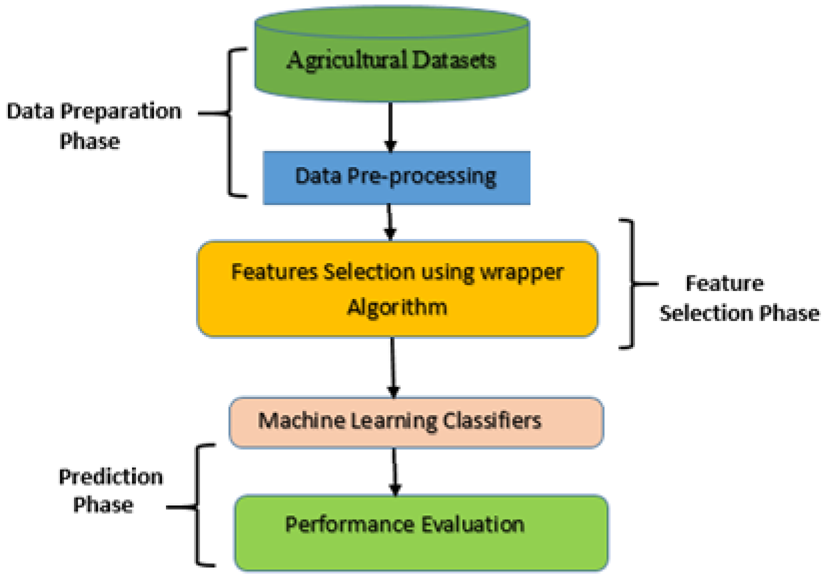

Figure 1.2: Proposed Model Architecture

In this study, wrapper selection is used to choose the most useful environmental indicators, as it is more effective than filter selection strategies when there are few dataset attributes and high levels of attribute similarity. Various machine learning techniques, including SVM, Random Forest, and Decision Tree, and PART classifiers can be used for productive prediction. The performance of the model can be measured using evaluation metrics such as precision, accuracy, F1 score, sensitivity, and specificity.

4. Conclusion

This study introduces IoT with ML based is introduced, which is an effective prediction method that may be used in the decision-making process in a smart agricultural setting that depends on IoT-based systems. The suggested approach made advantage of both Wrapper feature selections. The outcomes demonstrate that the suggested approach is successful in enhancing intelligent farming systems with decision assistance by predicting crop productivity and drought. The proposed method also showed the greatest accuracy in generating predictions and agricultural productivity based on the trial findings.

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