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Internet of Things (IoT) based Smart Agriculture in India

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ABSTRACT

The increasing global population demands improved production to provide food in all sectors, especially in agriculture. Still, at certain periods, demand and supply will not match. Managing and sustaining capital and manpower is still a demanding challenge for improving agricultural production. Smart agriculture is a better option for growing food production, resource management, and labor. This research provides an overview of predictive analysis, Internet of Things (IoT) devices with cloud management, security units for multi-culture in the agriculture sector with considering farmer's prior experiences. And also highlights the challenges and complications expected while integrating modern technology in the traditional farming practice experience. Based on the statistical and quantitative approaches gives better revolutionary changes in the current agriculture system. Besides, drone activation from IoT encounters crop status and stages, irrigation, plant leaves diseases in the green field. The sensors are activated for various purposes in IoT are discussed. Modern agriculture with state -of-the-art IoT devices and concepts is the main objective of this research. The systematic evaluation provides current and future trends in the agriculture sector.
Keywords: *IoT, Smart agriculture, Agriculture robots*

1. INTRODUCTION

The fast-growing world population can be expected around 10 billion in the year 2060 as per the survey [1]. However, the demand for food grain increases abruptly these years due to population. Unfortunately, the food grain is indirectly proportional to growth in population. Food production should be improved for this reason in coming years globally [2]. Figure 1 shows the overview of IoT-based smart agriculture factors.

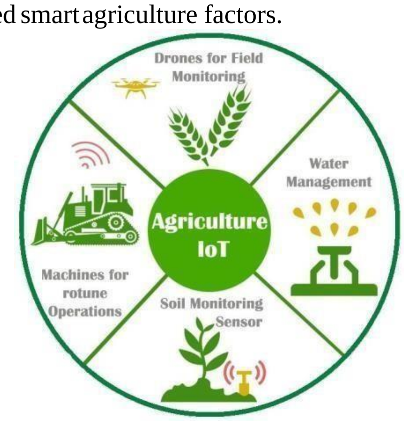

Figure 1 Overview of an agriculture IoT

The IoT has also recently given a strong impression of the agriculture sector with a wide range of sensors used for various smart agriculture targets. The IoT applications are increased exceedingly year by year. Figure 2 show monitoring control of IoT devices for smart agriculture. Different sensors in the agriculture sector play a significant role in IoT technologies [3].

Figure 2 Smart agriculture with IoT Monitor

Connecting multiple interconnected devices, such as several sensors, drivers and smart objects, to mobile devices through the use of the Internet[4]. The sharing of information with intelligent control and decision-making services consists of IoT services due to the many cloud- based remote data acquisition. Such capabilities can provide efficient production to the smart agriculture industry. The conventional approach of agriculture is to enhance modernized cultivation with the exploration of the IoT region of interest in the agricultural field [5]. IoT development has given heaps of advantages in all sectors over the last decade.

The IoT is a key element for the integration of scalable software, hardware, cost-effective process, self-sustainable, and smart decision for smart farming. Figure 3 indicates different measuring components for smart architecture. Scheduling including all activities such as irrigation, plant growth, identification of disease by its leaf, and production management in the smart agriculture sector [7].

Figure 3 Various measurement of smart architecture

In the overall situation, the cost is very reasonable for all farming solutions with IoT- based smart agriculture. Researchers introduced several integrated advanced technologies to increase productivity in the agricultural sector [8]. Therefore, in order to achieve the target progressively, many new innovations can be combined with traditional farming. With multiple sensors and described in green nature, the IoTcan smartly build agriculture[9].

2. ORGANIZATION OF THE RESEARCH

The structure of the research article is organized as follows; Section 3 provides existing research articles on IoT-based smart agriculture. Section 4 discusses the complication for the implementation of modernizing agriculture and a solution is suggested for future trends processing. Section 5 presents a description of various tests in real-time agriculture. Section 6 concludes the research workalongwith the futurescope.

3 MAJOR APPLICATIONS

By implementing the latest sensing and IoT technologies in agriculture practices, every aspect of traditional farming methods can be fundamentally changed. Currently, seamless integration of wireless sensors and the IoT in smart agricul- ture can raise agriculture to levels which were previously unimaginable. By following the practices of smart agricul- ture, IoT can help to improve the solutions of many traditional farming issues, like drought response, yield optimization, land suitability, irrigation, and pest control. Figure 3 lists a hierarchy of major applications, services and wireless sensors being used for smart agriculture applications. While, major instances in which the advanced technologies are helping at various stages to enhance overall efficiencyare discussed below.

A. SOIL SAMPLING AND MAPPING

Soil is the ''stomach'' of plants, and its sampling is the first step of examination to obtain field-specific information, which is then further used to make various critical decisions at different stages. The main objective of soil analysis is to determine the nutrient status of a fieldso that measures can be taken accordingly when nutrient deficiencies are found. Comprehensive soil tests are recommended on an annual basis, ideally in Spring; however, based on soil conditions and weather consents, it may be done in in Fall or Winter [23]. The factors that are critical to analyze the soil nutrient lev-els include soil type, cropping history, fertilizer application, irrigation level, topography, etc. These factors give insight regarding the chemical, physical, and biological statuses of a soil to identify the limiting factors such that the crops can be dealt accordingly. Soil mapping opens the door to sowing different crop varieties in a specific field to better match soil properties accordingly, like seed suitability, time to sow, and even the planting depth, as some are deep-rooted and others less.

4 METHODOLOGIES

Figure 4 shows a block diagram of proposed concepts. This functional block diagram is consisting the units of culture analysis, predictive analysis, IoT clouds, IoT devices and sensor module, Agri robot, and security management for all integrating devices [18]. The IoT system collects and processes the data from the different sensor outputs with centralized processing servers and provides input to green fieldwork devices in real-time. Thus IoT devices are integrating all other sensor infrastructure. The audio and video interfaces for display output of the system [19]. The sensor data created from raw data from soil or any appropriate places and is processed by IoTcentral processingunit with optimum scheduled time.

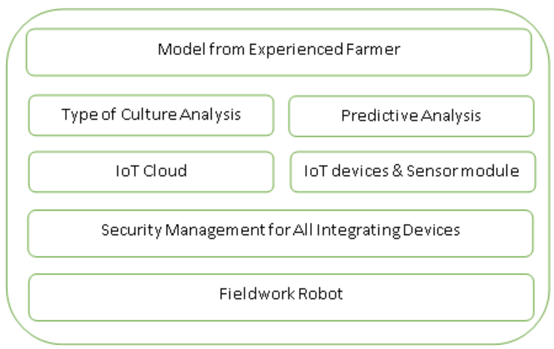

Figure 4 Block diagram of overall Proposing Concepts

4.1 Multi culture framework

Figure 5 shows a block diagram of multi-culture. Generally, there are many culture classifications and the proposed model shows the block diagram of multi-culture types in figure

For horticulture, floriculture, and citriculture[20], crop status and pest control can be activated. The profit margin can be estimated for the number of fruits and flowers that can be separately listed from citrus fruits. The organic fertilizer is created by cultivating earthworms named vermiculture. Silviculture is used to establish the control of the composition and quality of land to be evaluated for various growths [21].

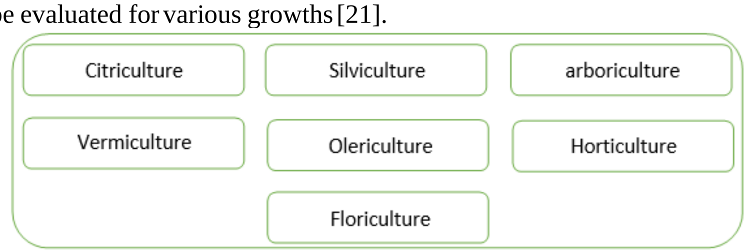

Figure 5 Block diagram of classification of Multi-culture

Cloud computing enhances forest cultivation by environmental analysis. Arboriculture is related to bushes and woody plants which are used to standardize the soil nutrients [22]. Olericulture is predictingthe vegetation status from consumption of the human community.

4.2 Predictive analysis framework

The cloud computing process performs to demand predictive analysis with big data processing from IoT for multi-culture analysis. The probabilistic measures provide increased production in the next monsoon named predictive analysis [23]. The block diagram of predictive analysis for the proposed system is shown in figure 6. Traditional agriculture can have ideas about field areas including soil nutrients, temperature, rainfall details, and future climatic conditions with a very experienced farmers' community [24]. Here the predictive analysis framework is performed with many sector data analyzes based on the detection capability for predicting the probable situation that occurred. In conventional agriculture, the pest and attack solution trends in the field are based on past data [25]. An optimized prediction method is used to predict the scenario before big data analysis. This structure analysis can also predict the use of the vehicle for carrying all plugged goods from the plant product. This structure can have a good profit margin and a positive impact on the sale of goods on the market. This forecast will explain the role of profit or loss that has occurred at present and also in the future. With the support of this predictive system, the farmer will mitigate many risk factors. For the successful functioning of the new age of framing, this system formulates and processes.

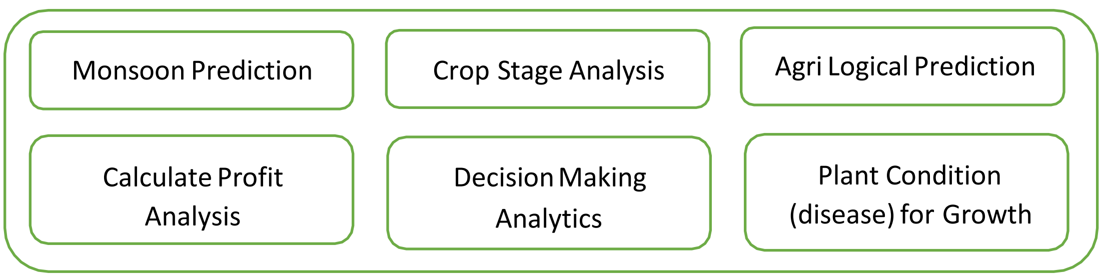

Figure 6 Block diagram of Prediction analysis for proposing system

4.3 IoT cloud for proposedmethod

This IoT-cloud plays a vital role in providing the data and transferring the data between the devices. For each analysis, the storage is maintained separately like sensor output, object identification, plant diseases, and predictive big data analysis [26]. Besides, the farmer can have the details about smart agriculture or future prediction information through internet services from agro experts. The experts can provide the idea about field crop plantation, pesticide control, and management in cultivation of the agricultural land [27]. Based on these services, the traditional farmer can equip in the field of agriculture. It would be very user-friendly and the main server is powered by IoTdevices [28].

4.4 IoT device and sensors

This section consists of many different types of sensors, cameras, display units, microcontrollers, network components such as a router, switches, etc. The parameters obtained from sensors are conditioning with actuators according to the predictive tasks performed [29]. The major focus of the central processing unit used to transfer information between components
[30] that can be used to process IoT devices.

4.5 Security Management

Security management is protecting ground cable or wireless data. The preventive measure took place under the network layer protocol infrastructure with authorized access. The malfunction, fabrication, destruction, improper handling of the IoT devices can be secured by this security management. Here the appropriate security management with the assistance of Wi- Fi, GSM, CDMA techniques for communication medium [31]. The Zigbee unit plays a vital role in communicating data between components. Also the GSM, CDMA, LTE services can avail for the communicating process. The internet facility has been used for authentication or access processes with the cooperation of user layer protocol such as HTTP, WWW, SMTP protocols [32][33][34].

4.6 Agri Robot

The proposed model consists of an Agri robot for fruit picking, driverless vehicle, and water spraying for smart agriculture. Identification of matured size, color of the fruit o r flower will be picked by the Agri robot after it received the signal from the IoT. The incorporation of the robot for agriculture farm work will be used in many applications that are above mentioned. As shown in figure 7, the fruit will be chosen by Agrirobots [34].

Figure 7 Fruit pickingagri robot

The programming can be modified for many applications such as apple, strawberry, guava fruit picking process. This harvesting time is very small compared to the traditional handpicking process [35].

5. RESULTS DISCUSSION

Figure 8 shows obtained results from fields 1-3. The irrigation data for different sensors like moisture, temperature, humidity. Once it reaches the threshold level, the device provides appropriate action to the fieldwork robot. Figure 8 shows the irrigation of raw data details with moisture, temperature, humidity sensor output. This continuous graph shows well-performed device activities during feedback processing time.

Figure 9 shows the overall performance response of the smart agriculture system. In the sensor fieldwork, the robot responds to the real-time scenario. The experimental setup of our IoT- based smart agriculture monitoring system consisting of many sensors with CPU. The microcontroller unit is connected with mobile for live stream data fetching from the raw field [36]. The raw data of temperature sensor details shows in figure 9. Based on this data, the IoT will provide proposed feedback with help of the fieldwork robots in the smart agriculture domain.
The WiFi module is used to fetch the information processes. Here, sufficient action is taken by the moisture level of the soil down IoT. Based on sensor inputs to the IoT system, so many switchingunits are "ON" & "OFF" for fieldwork output.

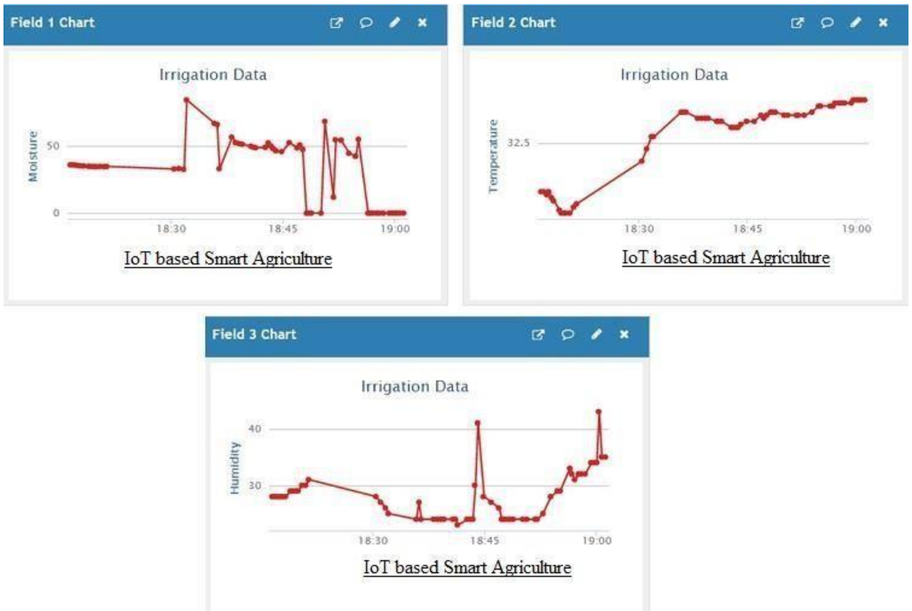

Figure 8 Obtained result from sensor data

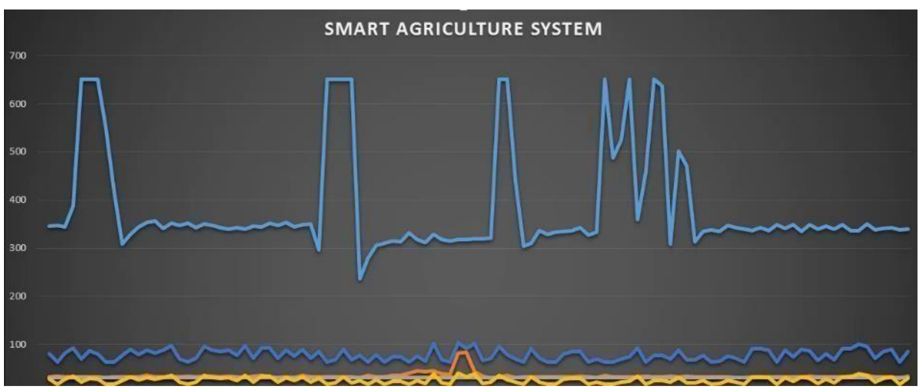

Figure 9 Overall performance response of smart agriculturesystem

6. CONCLUSION

This research describes the proposed model which consists of many analysis sections for an overall framework. Thus our integrated units having many advantages as discussed earlier in smart agriculture units with IoT modules. Few limitations are also incorporated in this constrained model for platforms and security. The number of challenges and limitations considers the most IoT-based devices for smart agriculture. The main focus is cost-effectiveness in the IoT devices in the reduction of hardware and software cost with compromising precision system output. The imported devices ignores the compromise with the component's expenses gets minimized. The standardization of the data format for the process will also provide improved device consistency and execution time. The initial process barrier providers for active farmers are regulated when improving the system's goods or services. Also, the proposed integrated system will provide complexity due to many devices interlinked through a web server. The heterogeneity property is a very complicated processin the IoT sector which provides better accuracy and excellent overall performance of the system. Finally, the deep learning analysis with a huge amount of features or data can increase the production from smart agriculture by IoT.

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