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Smart Farming Using IoT

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Abstract

In advancement with the rapid emergence of IoT-based technologies Smart farming industry created revolutionary changes with existing farming methods. However, the quality of farming methods and framing products were decreased. So our "Smart farming using IoT" system hardware integrated with a software application that provides suggestions to farmers when the hardware system analyses the soil. After analyzing the characteristics and quality of the soil with the hardware system consisting of various sensors like DHT11 sensor and Soil moisture sensor, it provides the analyzed data to the application via the Internet. Then this application compares the data in the database and provides user suggestions and also remotely monitor and control equipment like drip irrigation system and electric fencing, etc. The database system analyses the data provided by the hardware as input and gives the user suggestions like, which crop is best suited for this soil, its organic farming methods and irrigation methods, etc. After that, it can also predict any animal intrusion by using a PIR sensor. This application mainly uses data analytics and database management techniques to derive suitable crops and their cultivation methods from the data sets that were collected from the research centers and organic farmers. And also helps to monitor and control farmland using IoT.

Keywords: Internet of Things (IoT), Hardware integrated with Software, Smart Farming, and Data Analytics.

1. Introduction

Food is the essential thing for every living being to survive and Agriculture is the only way to produce food. As we all know agriculture is the backbone for a healthy and significant food supply. A healthy and good quality crop can be produced only by organic farming using the traditional way of agriculture. But nowadays, the traditional method seems impossible due to a rise in temperature and varying climatic conditions. As a result, the practice of agriculture has been diminished, which results in the usage of chemicals and genetically modified crops. This results in the production of poor quality and unhealthy crops. [1] With the advancement of new technologies nowadayssensor systems have become more intelligent and compact in size as compared to other traditional sensor systems. In thisresearch work, an IoT (Internet of Things) based low-cost and power-efficient hardware system integrated with IoT and mobile application is presented to solve the issue in performing organic agriculture. There are so many inventions in the field of agriculture but these technologies fail to provide a traditional way to do agriculture.

[2] Central Intelligent Agency (CIA) factbook ranked India a number 2 out of 238 countries. India takes of 17% of the world's population, but with 4% of freshwaterresources. Out of which 80% of water is used for agriculture. A country like India has very good natural resources, but not used in a congruous way. In most of the agricultural lands, the crops are over watered without checking the soil moisture. This leads to the waste of water resources which can be utilized in some other areas where there is in need of water. [5] So by using Soil Moisture Sensor and DHT11 Sensor we measure soil moisture, humidity, and temperature of the soil and suggest water the crops at right time and for a specific duration. This helps us from damaging the crops by improper irrigation. This also increases the quality of the crop and its growing time. [3-5] and also a method has been advanced to protect the field from fire accidents and animal and bird intrusions by using PIR Sensor. The merging of solutions of all the above-mentioned points at issue can give rise to a smart agricultural system reducing human labor. This system can be connected to the internet which provides the means for the farmers to control their crops from far-off places. We mainly aim at bringing traditional agriculture back through smart farming using IoT. In this paper, we provide the best farming by proposing a system that collects the data by using a clustering algorithm to control agriculture using IoT. [6-9]This system is a combination of various technologies using sensors, IoT, and data analytics to gather data and process the data to give suggestions regarding which is the suitable crop for the soil and its irrigation method by Information and Communication Technologies to provides simple and cost-effective techniques for farmers to enable precision agriculture also guide new farmers and remotely monitoring their field, harvest crops, and control farming equipment with the help of the smart farming application. The information such as temperature, humidity, soil moisture level, the water level of the farmlandis intimated to the farmers by the smart farming application and instructs the farmers to follow traditional agriculture to improve the yield, quality of crops, and also the overall production rate.[10-11]

2. Problem Identification:

2.1. Aim of the Paper:

The aim of the paper is to provide a solution to farmers by finding the issues like an animal intrusion, improper irrigation, and improper seasonal crop cycle in the agriculture field. So we have proposed an IoT-based farmland monitoring and control system which consists of sensors and an android app with cloud technology. We developed a smart farming application that focuses to solve the issues and suggests the farmers about the traditional organic farming methods, crop cycle pattern, irrigation based on soil moisture, and control agricultural tools. This helps us reduce workload and manpower.

2.2. Issues:

Practicing organic agriculture seems impossible due to the changes in climatic conditions and natural disasters like global warming, flood, and heavy rain. The field of agriculture is facing so many crises in producing more quality crops with fewer resources, without affecting the quality of crops and the environment. Data Analytics and cloud technology are the solutions to solve this issue. No proper guidance and maintenance of the cultivated crops is a major disadvantage in an agricultural field. We introduce Smart Farming to overcome these drawbacks.

3. Proposed System:

We have proposed a hardware system integrated with software that consists of the sensors and cloud technology working together along with an android application based on IoT. The working of our proposed system is interfaced with IoT and mobile applications as shown in Figure 1. The proposed system is classified into three divisions, such as System sensors, Data collection and analysis, and Android application which works together to solve the issues in the agriculture field through smart farming.

3.1. System Sensors:

System sensors are used to detect the characteristics of the soil. The soil moisture, temperature, humidity, water level, and animal intrusion are monitored using various sensors in the farmland. As a result, the humidity of the land or the level of moisture content in soil or animal intrusion is detected using DHT11, Soil moisture, and PIR sensors. This system consists of the major part of this Smart farming System.

3.2. Data collection and Analysis:

The Collected data from the System Sensors must be analyzed and used for providing smarter solutions during real-time traditional organic farming. The prediction is made using the data on soil humidity, temperature, moisture and analyzing it with the data gathered from agricultural research institutes and provides suitable seasonal crop cycle pattern and its maturity time. Data Analytics plays a vital role in providing precision agriculture which helps to manage the farming land. The Wi-Fi module (ESP2866) with embedded sensors provides the raw data from the farmland and then cloud technology is used for gathering the information and sends these data to compare it with the database. In this process, the enormous set of data is collected from the farmland and transferred to the application has been analyzed and all possible results will be displayed.

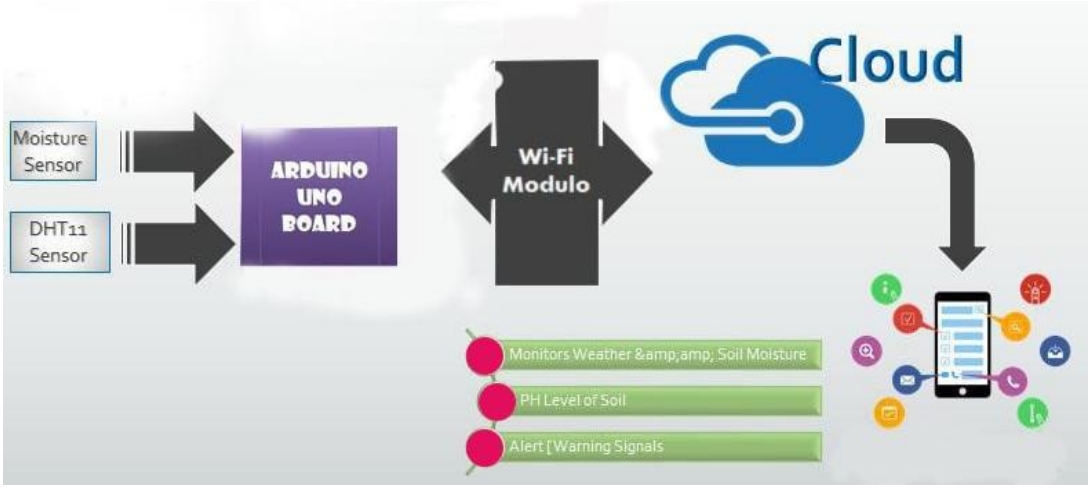

Fig.1: System Design

3.3. Android application:

This is the last and primary sector of the Smart farming application. It is used to show instructions to the farmer, about how to perform the correct method of seasonal crop cycle for organic farming by displaying the suggestion in the app. This also aims at remotely monitor and control the farming tools and control irrigation system as farmer needs.

4. Methodology:

The sensor monitoring system, Big Data Analytics, Android monitoring, and control system are the main methodologies used in the proposed Smart farming system. The theoretical study of each methodology has been clearly mentioned below,

4.1. Sensor Monitoring System:

This System consists of DHT11 Sensor, Soil Moisture Sensor, and PIR Sensor which is used to monitor the entire field. Figure 2 shows the idea of fixing sensors around the environment.

4.1.1. DHT11 Sensor:

The main purpose of the Digital Humidity and Temperature (DHT11) sensor is to measure the temperature and humidity of the surrounding air. In this system, this sensor uses a capacitive humidity sensor and thermistor to measure the temperature and humidity by measuring the relative electrical resistance of the surrounding air in cultivation land. This data is used to predict which crop to be cultivated in farmland for this season. This sensor gives the accurate climatic change to do agriculture with perfection. It uses the android application to alert the farmers by predicting the changes in climatic conditions and suggests a seasonal crop cycle method.

4.1.2. Soil Moisture Sensor:

Soil Moisture Sensor helps to measure the moisture content of the soil. It gives the data about the water content and moisture level of the soil by measuring the volumetric water content in which the crops are cultivated. This water content is analyzed by measuring dielectric permittivity using capacitance and creating voltage proportional to the permittivity. From the predicted moisture content it suggests a suitable crop be cultivated and provide irrigation. These sensors monitor assssnd alert the farmer when the water content of the soil increased or decreased.

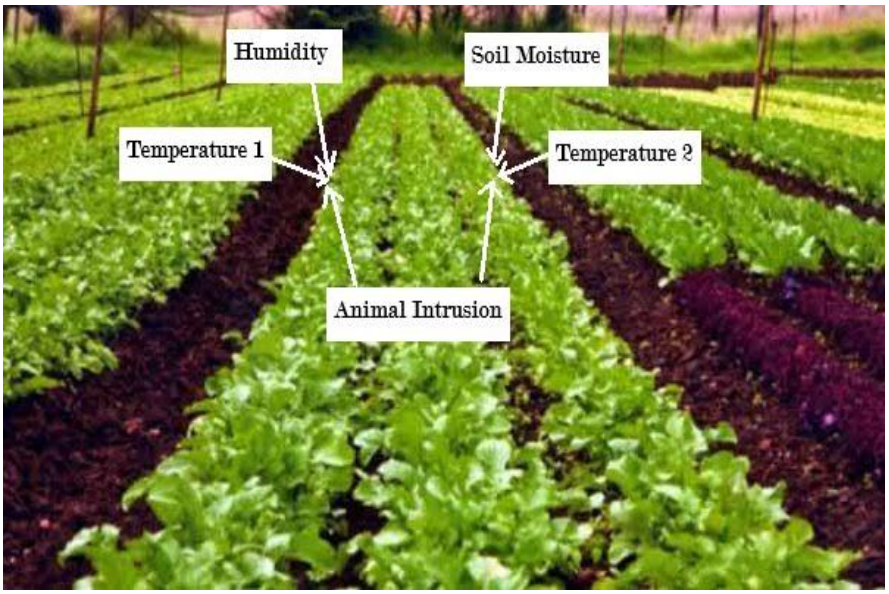

Fig.2: Sensor Processing

4.1.3. PIR Sensor:

A Passive Infrared (PIR) Sensor is a motion detector sensor used to detect the movement of animals, birds, insects, and other objects by measuring the infrared light or radiant heat emitted from the object by converting the wavelength into output voltage and trigger the alarm. It can be used to protect the farm land from birds, animals, and insects. When the crops are affected by a large number of insects, it gives an alert to the farmers.

4.2. Big data Analytics:

Big data Analytics is used to filter the required information from the collection of an enormous set of data, by data processing. Big data is diverse and has complex architecture and techniques. This is used to collect the enormous set of data from sensors via Wi-Fi modulo and process the data by using dynamic clustering and provides the required information to the application used and alert the farmer. This plays an important role in delivering information about the farm land to android applications.

4.3. Android monitoring and control system:

Android is an open-source operating system based on the Linux kernel which is used by smartphones and tablets. The Android operating system (OS) is specially developed for creating a mobile application. An application called Smart farming is an IoT-based farmland monitoring and control system. The application performs the monitoring and controlling process of the farm land and displays the results of sensor predictions in the mobile for proper organic and traditional cultivations. This application also shows suggestions like which crop is more suitable for the soil and alerts about the water content problems and changes in soil humidity and temperature. It provides the instructions for maintaining and cultivating the crops and controls the farming equipment in the agricultural field by the traditional and organic agricultural methods.

Conclusion:

To improve the yield of efficient and good quality crops, monitoring the farmland plays a major role. Smart farming application is designed with the help of IoT, cloud technology, big data analysis, and an android application system to improve the efficiency of agriculture.A large-scale agricultural system requires a lot of maintenance, knowledge, and supervision. In the above-mentioned project, we have automated the Maintenance, Crop cycle, Water Management, and Crop Monitoring, by using the data collected from sensors that are embedded in the farm. Thereby reducing the need for maintenance, knowledge, and supervision.

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