Advancements in the Field of Agriculture using IoT based Integrated System

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Abstract : In today's busy world, people run out of time and technology is empowering them in all sectors. Basically the Indian economy probably depends on the agricultural sector, to cultivate yield or productivity is most essential in today's environment. Traditional farming having various ambiguities to identify some chemical properties of soil impacts the productivity of plants directly. Another impactful parameter is on-time water distribution two plants should be the effect on plant productivity. In this research, he proposed soil fertility parameter identification with Smart water management and plant prediction using IoT and machine learning environment. This research also carried out to detect the soil parameter in a real-time environment and identify where are chemical properties like PH values, humidity, temperature, soil moisture, etc. The systematic implementation will introduced semi-supervised learning implementation using Q-learning algorithm. In the experiment analysis, we tasted various numbers of samples and shows the effectiveness of proposed implementation.

Keywords : IoT, soil fertility, PH values, microcontroller, Semi-supervised learning, plant prediction, smart water management.

Introduction

The Indian economy's most important sector is agriculture. India's agriculture contributes 18 percent to the country's GDP and employs half of the country's workforce. In this new era, farmers will be able to use technology to monitor the complexities of crop management and water usage. Farmers have earned new technology and tools to optimise their income thanks to the introduction of SaaS and cloud computing, which has resulted in a rise in the number of discerning customers and unrivalled temperature values in recent humans. Many studies suggest using devices that collect data from a variety of sources and then send it to cloud servers via WiFi. The information gathered offers useful insight into complex environmental conditions, which necessitates system regulation. For growing agricultural production, environmental management requirements are inadequate and systematic. There are many other variables that have a major effect on performance. Attacks on insects and rodents, for example, can be tracked by splattering the field with the appropriate insecticides and pesticides. To assess how much additional nutrient material needs to be added to soil to increase crop fertility, soil content N (nitrogen), P (phosphorus), and K (potassium) must be determined. NPK levels are tracked using soil fertility sensors. Soil fertiliser contains large quantities of nitrogen, phosphorus, and potassium. Understanding their soil's concentration can lead to nutritional deficiency or an excess of soil used to sustain plant growth. Moisture sensors are essential tools for monitoring moisture levels in a given region. Technically, the system is used to determine the amount of humidity in the air. A hygrometer is a device that measures humidity and temperature in the area. Relative humidity is the ratio of humidity in the air at a given temperature to the lowest humidity level. When it comes to finding protection, relative humidity plays a major role.

Irrigation is the method of watering plants in controlled quantities at regular intervals. It aids in the cultivation of field crops, the protection of habitats, and the re-vegetation of depleted soils in desert regions, even when rainfall cycles are less than average. Other agricultural growth requirements include avoiding soil acquisition, preventing the freeze, and growing weeds in grain fields. The effect of temperature on agricultural growth is important. It has a major impact on crop growth, production, and yields, as well as the incidence of pests and diseases, as well as water and fertiliser requirements.

Environmental factors affect crop quality, production, and yield. In all of science, we want to achieve the following.

- Data generation with IoT module for current soil parameters.
- Cloud storage to track application run-time.
- Sense land productivity
- Planting prediction as per present scenario.

Literature Review

Since cloud-based IoT services are becoming more prevalent, Agraj Aher [1] is attempting to digitalize the agricultural field using a mobile application. The main role is to collect data from different locations on a farm. Farmers will have access to this information through a cloud service. A smartphone application can be used to access the information. Not only can the data be displayed graphically, but the smartphone device can also provide farmers with other valuable tools. This is a remote control system for the agriculture industry, when combined with other farmer-friendly applications. The main objective is to collect data from multiple nodes and enable farmers to manage various activities wirelessly, resulting in a digital agricultural sector for smart farmers.

According to Ojas Savale [2, the Internet of Things, the idea of linking real-world objects with one another will radically change the way users organise, gather, and consume information. In the Digital Agriculture world, IoT allows for a range of applications, such as crop growth monitoring and selection, irrigation decision support, and so on. The Wireless Sensors Network (WSN) is a popular option for developing decision-making networks. These applications conquer a variety of real-world obstacles. Precision agriculture (PA) is one of the most important fields where decision-support systems are becoming more and more relevant. Agriculture can be connected to IoT through sensor networks, enabling agronomists, farmers, and grains to establish connections despite their geographical separation. This approach will provide farmers with real-time land and crop information to assist them in making the best decisions possible. The main advantage of using WSN in Precision Agriculture (PA) is that it will optimise the use of water fertilisers, thus increasing crop yields, and it will also help in the study of field weather conditions.

Verdouw, C.N. [3] The Internet of Things (IoT) research in agriculture and health presented a review of existing structures, emerging technologies, and significant roadblocks ahead. His research reveals that Asian scientists, especially from China, have a strong grip on IoT in agriculture and food. Until recently, non-agricultural scientists on other continents were the main supporters of the Internet of Things. Food supply chains are frequently discussed in the implementation sector, along with arable farming. The reviewed literature focuses on monitoring and sensing, whereas remote control and actuation attract much less attention. According to the study, IoT in the livestock and food industries is still in its infancy. Frameworks are still fractured, lacking in smooth functionality, and more complex methods, in particular, are still in their infancy. To address this situation, major challenges include I integrating current IoT solutions through open IoT systems, interfaces, and standards, (ii) extending the usage of interoperable IoT technologies beyond early adopters, in particular by simplifying existing solutions and making them more feasible for end users, and (iii) further enhancing IoT technologies to ensure a long-term future, and (iv) further enhancing IoT technologies to ensure a long-term future.

Agriculture accounts for one-third of India's gross domestic product. Agriculture-related issues have often hindered the country's growth. By modernising current traditional agricultural methods, smart agriculture is the only solution to this issue. Nikesh Gondchawar and Dr. R. S. Kawitkar[4] aim to make agriculture intelligent through the use of automation and IoT technologies as part of their mission. Smart GPS-based remote controlled robot for tasks such as weeding, irrigation, sensing rain, scaring birds and wildlife, and keeping an eye on items. The second and most critical component of intelligent warehouse management is predictive analysis and strategic decision-making based on accurate real-time field data. This includes warehouse temperature conservation, humidity conservation, and theft detection. Those operations can be carried out by any Internet-connected smart computer or system, using interfacing sensors, Wi-Fi or ZigBee systems, microcontroller and camera actuators, and the Raspberry Pi. The introduction of these initiatives would definitely be helpful in this area.

[5] Xiaohui Wang Introduces related Internet of Things technologies with the aim of creating an Agricultural Means of Production Supply Chain concept based on them. This paper explores the function and usefulness of the internet of things that relate to the agricultural supply chain's means of production. The creation and opportunities of Internet of Things technologies in the Food Supply Chain for Agricultural Purposes are discussed in this article. How to increase the efficiency and profitability of agricultural supply chain operation is the key to problem solving. The use of IoT in the agricultural supply chain aids in increasing the degree of information technology in the agricultural supply chain, as well as enhancing the supply chain's operational efficiency for agricultural products by improving the supply chain's overall convergence. In the face of intense global competition, our country's agriculture exemplifies a low level of industrialization, a low-value chain point, a low level of management, and a low level of expertise. To answer the above question, applying new technology, such as the Internet of Things Technologies to the agricultural supply chain, is a viable approach for growing the operational efficiency of the agricultural supply chain and encouraging the growth of agriculture in our country.

Zhao Liqiang [6], Zhao Liqiang [7], Zhao Liqiang [8 The main activity in the proposed agricultural use of wireless sensor networks is the installation of two types of nodes and the development of a sensor network. Application process unit, radio module, sensor control matrix, data storage light, power supply set, analogue interfaces, and extended wireless interfaces make up the hardware architecture. TinyOS is a computer system that includes a system kernel, computer drivers, and applications. The energy-saving algorithm is used in the automated framework. To network, the control network uses two protocols. The Collection Tree Protocol is a tree-based collection protocol that collects network data in a base station. The distribution process runs simultaneously with the compilation. The propagation mechanism sends a piece of control and synchronisation guidance to any node in the network in a consistent manner. Finally, the results of the experiments indicate that the tracking system could be used in precision agriculture.

Farmers use an unnecessary decision-support system to optimise water use. Indeed, real-time study of microclimatic factors is the only way to learn a culture's water requirements in this context. Wireless sensor networks have played a significant role in the farmers community since the advent of the Internet of Things and the generalisation of cloud use. It would be wise to have monitoring available via web resources. The IoT cloud is a set of frameworks that make it possible to create Web services for Internet-connected objects.

Ali Karim Fough [7] Using IOT technologies, a warning system for plant water stress management is presented. The steps of development identified the decision support system intended for an agricultural society to be able to decide the amount of water needed in the first part of the project; for irrigation management, the farmer can benefit from a dashboard programme in the form of a graph to monitor changes in soil conditions in real time and, on the other hand, an SMS alert mechanism that the frame created. This technology can be improved by making it more advanced. For example, we might integrate the evapotranspiration method of calculating a plant's daily water demand into our decision-making programme.

Agriculture is evolving as a result of the adoption of digital and communication technologies. Efforts are being made to boost performance and reduce rising losses using cutting-edge technologies and facilities. Since most farmers are unaware of new technology and techniques, the international community has established a range of expert programmes to assist farmers. These advanced programmes rely on a knowledge base that already exists.

[8] Raheela Shahzadi Propose an expert system based on the Internet of Things (IoT) that can use real-time feedback data. This aids in taking preventive and preventative measures to minimise disease and insect/pest losses.

There is a major change from advanced mechatronic systems to Cyber-Physical Systems, according to Ciprian-Radu RAD [9]. (CPS). CPS has a major role in precision agriculture, and it is expected to increase demand in order to feed the world and prevent hunger. It is crucial to develop techniques, facilities, hardware, and software components based on a transdisciplinary approach, as well as prototypes and test beds, in order to accelerate and facilitate the realisation of CPS in the field of precision agriculture. Ciprian-Radu RAD proposed an integrated network architecture for agricultural precision control, based on CPS software and design technologies, to monitor the plant status of potato crops. This software assists farmers in tracking the evolution of certain criteria of interest and making the best decisions possible in order to increase agricultural production.

According to Fan TongKe[10], IoT is inextricably connected to cloud computing in the sense that cloud computing provides IoT with powerful computational tools, and cloud computing is the best IoT-based medium of practise. Cloud computing is used to power agricultural information systems, and intelligent agriculture is developed using a combination of IoT and RFID. By leveraging vitalization technologies, hardware resources are integrated into the resource pool in the agricultural information network, achieving complex resource allocation and load balancing, and significantly increasing resource consumption efficiency. Using radio frequency identification, wireless communication, automated tracking, and IoT information sensing techniques, a vast amount of data is obtained, and smart agriculture is truly realised.

Proposed System Design

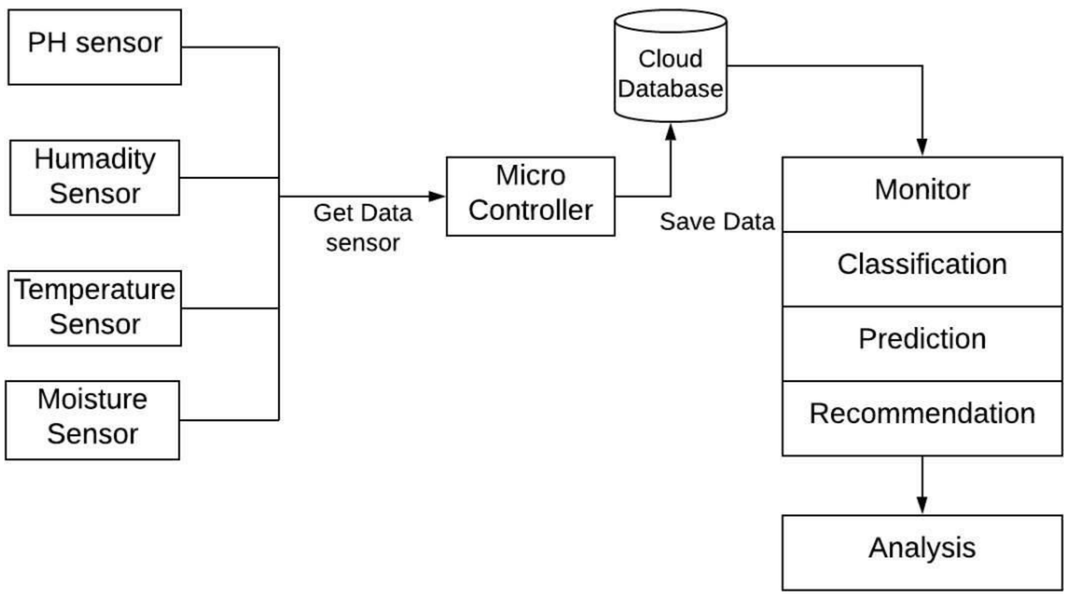

Figure 1 : Proposed system architecture

- To identify the problem of crop yield due to more or less water consumption in large agricultural environments.
- To identify the drawbacks of traditional system and define the overcome with the help of proposed system.
- First overall system categorized into three phase, IoT platform, Cloud Database and User Interface (UI) etc.

- All modules is dependent on each other, to achieve the acceptable accuracy for system we have skip local database dependencies and deploy data environment on cloud which can eliminate data inconsistency.
- To Successfully embed the IoT kit with arduino UNO as microcontroller, DHT 11 sensor, Ph and moisture sensor, water motor etc. need successfully deploy and connect with database cloud.
- The cloud has used for proposed prediction according to there values and must validate the Q-Learning linear regression algorithm.
- Finally predict the water required possibility according to achieved algorithmic outcome.
- To implement a proposed system using IoT platform to gain the various values from different sensors.
- Using cloud database services store all runtime data in cloud database server.
- Extract the data from server and apply the machine learning base classification algorithm and evaluate the accuracy of system.
- To identify system errors as well as software hardware failure etc.

Algorithm Design

Q- Learning Algorithm

Input: inp[1…..n] all input parameters which is generated by sensors, Threshold group TMin[1…n] and TMax[1…n] for all sensor, Desired Threshold Th.

Output: Trigger executed for output device as lable.

Step 1 : Read all records from database (R into DB)

Step 2: Parts [] ← Split(R)

Step 3: $$\text{CVal} = \sum_{k=0}^{n} \mathbf{Parts[k]}$$

Step 4: check (Cval with Respective threshold of TMin[1…n] and TMax[1…n])

Step 5: T← get current state with timestamp

Step 6: if(T.time > Defined Time)

Read all measure of for penalty TP and reward FN

Else continue. Tot++

Step 7: calculate penalty score = (TP *100 / Tot)

Step 8: if (score >= Th)

Generate event

end for

Results and Discussions

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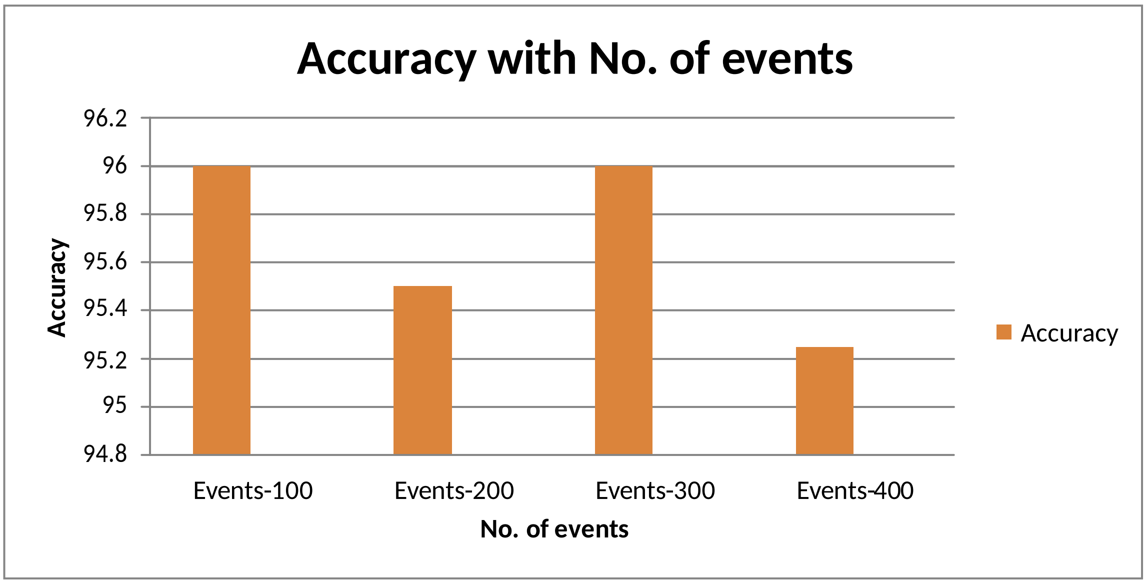

Figure 2: Classification accuracy on number of events using Q-Learning algorithm

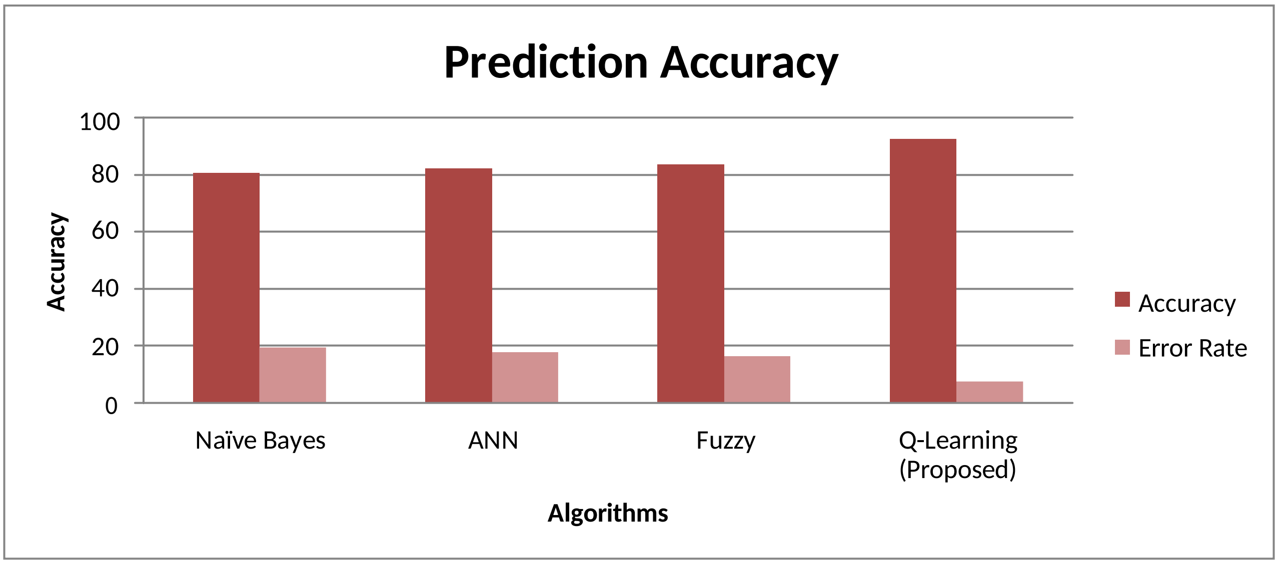

Figure 3: Classification accuracy with various machine learning algorithm

Conclusion

We use IoT and machine learning to demonstrate soil fertility control and smart plant forecasting in this report. The module obtains live temperature, pH sensor, and soil humidity data with high efficiency and accuracy. This module will assist farmers in increasing farm yields and efficiently controlling food production, as it will always assist farmers in obtaining accurate live feed from environmental temperature and soil moisture, as well as certain chemical properties present in soil, with more than the most accurate results. The main advantage of this approach is that it is applicable to soil productivity in any area, as well as achieving good plant prediction in the current scenario. In different soil samples, the proposed Q-Learning module has an average accuracy of over 95%, making it more efficient than other supervised learning algorithms. Due to a hardware dependency, we performed this research with limited soil sample data. Using multiple hardware tools and obtaining complete soil properties to estimate the deep classification will be valuable future work. This work can be improved by integrating advanced engineering technology that include new cost-effective approaches to soil testing. Future work on increasing the number of sensors on this stick will focus on collecting more data, particularly in the area of pest control, as well as integrating the GPS module into this IoT system. Continue to develop this IoT Agriculture Technology to achieve the highest degree of product precision. Agriculture is one of the most important sectors in.

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