

Soil Fertility Detection and Plant Prediction using IoT and Machine Learning Approach

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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.

I.INTRODUCTION

Agriculture is the largest important field of the Indian Economy. Indian farming accounts for 18% of India's GDP and generates jobs for 50% of the country's labor force. In this new period, the farmer may use technologies to exert influence over the complexities of adjusting crop management and water usage. With both the advent of SaaS and cloud computing, farmers have received modern technology and resources to maximize their income, growing the amount of discerning customers and unparalleled temperature values over the last few years. Sadly, many farmers still use traditional farming methods which lead to low yields of crops and fruits. Yet everywhere there was technology and the mechanical equipment was substituted by humans. Many papers recommend utilizing devices that gather data from various forms of devices and then using a Wifi to transfer it to servers in the cloud. The gathered data provide valuable knowledge on particular environmental factors, which requires control of the device in effect. Environmental management standards are not sufficient and systematic for increasing agricultural production. There are several other factors that affect the efficiency significantly. Such factors include attacks on insects and rodents that can be tracked by splattering the field with the insecticides and pesticides required. Measurement of soil content N (nitrogen), P (phosphorus), and K (potassium) is needed to decide how much additional nutrient material needs to be applied to soil to improve crop fertility. Soil fertility sensors are used to monitor NPK.

Nitrogen, phosphorus, and potassium are a significant component of soil fertilizer. Understanding the concentration of their soil will give rise to nutritional deficiency or excess of soil used to support plant growth. Moisture sensors are very important instruments for monitoring moisture in the area. Technically, the device used to measure humidity in the atmosphere. A hygrometer measures measurements, measuring humidity and ambient temperatures. The ratio of humidity in the air at a specified air temperature to the lowest humidity level is called relative humidity. The relative humidity becomes an important factor when seeking safety. Irrigation is the operation of regulated amounts of watering plants at the appropriate intervals. It helps cultivate field crops, preserve ecosystems, and vegetate deranged soils in desert regions even in less than normal cycles of rainfall. It has other agricultural development requirements, including preventing the freeze, rising weeds in grain fields and avoiding soil acquisition. Temperature plays a significant part in agricultural growth. It has profound effects on crop growth, development and yields, the occurrence of pests and diseases, water needs and fertilizer needs. Factors of environment lead to maximum crop production, production, and yield. We're seeking to do the following in the whole of science.

- 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.

II.LITERATURE REVIEW

AgrajAher [1] is trying to digitalize the agricultural field using the mobile application because Cloud-based IoT services are getting popular. The key job is to collect data at a farm from various places. Such data would be made accessible through the cloud service to the farmers. You may access the data through a smartphone application. Not only can the data be given graphically, but the smartphone device can also include other useful resources for the farmers. Combined with other farmer friendly software, this is a remote control device for the agriculture industry. The key aim is to capture readings from several nodes and enable farmers handle various activities wirelessly, providing smart farmers with a digital agricultural sector.

OjasSavale [2] says IoT, The concept of linking real-world artifacts with one another would fundamentally transform the way users organise, collect and ingest content. IoT allows for numerous applications in the Digital Agriculture environment, such as crop growth tracking and selection, irrigation decision support, etc. The Wireless Sensors Network (WSN) is commonly used to develop networks that enable decision taking. Such applications surmount several real-world challenges. Precision Agriculture (PA) is one of the most important fields in which decision-support systems are progressively required. Agriculture can be linked to IoT via sensor networks, which enables the formation of ties between agronomists, Farmers and grains, despite their spatial distinctions. With this method, which will offer real-time land and crop details to help farmers make the right choices. The key benefit is that the application of WSN in Precision Agriculture (PA) would maximize the usage of water fertilizers thus optimizing crop yields and will also aid in the study of field weather conditions.

C.N. Verdouw [3] In agriculture and health, the Internet of Things (IoT) analysis offered an summary of current systems, emerging innovations and big obstacles ahead. His study reveals that IoT is very much controlled by Asian scientists in agriculture and food, especially from China. Until recently, the idea of IoT was primarily embraced in other continents by non-agricultural scientists. In the implementation field the food supply chains are discussed most often, accompanied by arable farming. The literature reviewed focuses on tracking and sensing, whereas remote control and actuation are considerably less focused. The reports suggest that IoT in the livestock and food fields is already in its infancy. Frameworks are still fragmentary, lack smooth functionality, and more complex approaches in particular remain in an embryonic development period. In order to address this circumstance, major challenges involve I incorporating current IoT solutions across accessible IoT frameworks, interfaces and standards, (ii) enhancing the use of interoperable IoT technologies beyond early adopters, in particular through simplifying established solutions and rendering them more viable for end users, and (iii) further enhancing IoT technologies to ensure a wide use.

Throughout India one-third of the country's revenue falls from agriculture. Problems related to agriculture have always been hindering in the country's growth. Smart agriculture is the only solution to this issue by modernizing current conventional methods of agriculture. In their mission, NikeshGondchawar and Dr R. S. Kawitkar[4] plan to render agriculture intelligent through the usage of automation and IoT technologies. Smart GPS-based remote operated robot to conduct activities such as weeding, watering, detecting rain, scaring birds and wildlife, watchfulness etc. Intelligent irrigation with predictive monitoring and strategic decision-making focused on reliable real-time field data is the second and essentially intelligent warehouse management that involves warehouse temperature conservation, humidity conservation, and theft detection. Those operations will be operated by any remote smart device or machine linked to the Internet and the operations will be done through interfacing sensors, Wi-Fi or ZigBee devices, microcontroller and camera actuators, raspberry pi. The deployment of these programs would certainly benefit in this field.

Xiaohui Wang [5] Introduces similar Internet of Things innovations and aims to construct upon them a concept of the Agricultural Means of Production Supply Chain. That analyzes the role and utility of the internet of items that contribute to the supply chain's agricultural means of production. This article discusses the developments and opportunities of Internet of Things technologies in the Food Supply Chain for Agricultural Purposes. The secret to problem solving is how to boost quality and profitability of the activity of the agricultural supply chain. Use of IoT in the agricultural supply chain helps increase the degree of information technology in the agricultural supply chain, To boost the organizational performance of the supply chain for agricultural goods by improving the convergence of the whole supply chain. Our country agriculture highlights low level of industrialization, low-value chain stage, low level of management, low level of knowledge, in the intense global competition climate. To address the above question, the introduction of modern technologies is a feasible approach, the introduction of the Internet of Things Technologies to

the supply chain of agricultural products, to increase the operational efficiency of the supply chain of agricultural products, and to encourage the growth of agriculture in our country.

Zhao Liqiang [6], Proposed agricultural usage of wireless sensor network, the key activity is the installation of two forms of nodes and the creation of a sensor network. The hardware architecture is composed of application process unit, radio module, sensor control matrix, data storage light, power supply package, analog interfaces, and expanded wireless interfaces. Computer system is TinyOS which consists of system kernel, computer drivers, and applications. Throughout automated framework the energy-saving algorithm is applied. The management network adopts two protocols to network. Collection Tree Protocol is a tree-based collection protocol that collects in a base station the data produced in the network. The distribution is parallel to the compilation process. The propagation mechanism is to send any node in the network a piece of control and synchronization guidance consistently. Eventually, the experimental findings suggest that the tracking device is feasible for precision agriculture applications.

To maximize water use, farmers use an unnecessary decision-support device. Indeed, in this sense real-time analysis of microclimatic factors is the only way to learn a culture's water needs. Since the emergence of the Internet of Things and the generalization of the usage of the cloud in the farmers culture, wireless sensor networks play an significant role. Having monitoring available through web resources would be judicious. The IoT cloud represents frameworks that enable the development of Web services suitable for Internet-integrated artifacts.

Fough Ali Karim [7] Presentation of an warning device for water stress management of plants utilizing IOT technologies. In the first part of the project, the steps of development defined the decision support mechanism intended for an agricultural society to be able to determine the amount of water needed. For irrigation management, the farmer can profit from a dashboard program in the form of a graph to track the changes in soil conditions in real time and, on the other hand, an SMS warning mechanism that the framework transmits when a essential amount is reached to prevent water stress. This technology can be enhanced by rendering it very advanced one envisages incorporating the evapotranspiration approach to measure a plant's water demand per day into our decision support program.

With the introduction of digital and communication technologies the agriculture industry is changing. Employing state-of-the-art technology and facilities, attempts are being made to improve efficiency and rising damages. Most farmers are ignorant of the technologies and the new techniques, the world has developed a number of expert programs to encourage the farmers. Such specialized programs depend on the existing knowledge base.

RaheelaShahzadi [8] Propose an Internet of Things (IoT) dependent expert framework that can utilize feedback data gathered in real time. That help to take constructive and protective steps to reduce disease and insect / pest losses.

According to Ciprian-Radu RAD [9], there is an intense shift from advanced mechatronic systems to Cyber-Physical Systems (CPS). CPS plays an significant position in the area of precision agriculture, and it is projected to increase production to feed the planet and avoid hunger. In order to speed up and promote the realization of CPS in the field of precision agriculture, it is important to build approaches, equipment, hardware and software components focused on Transdisciplinary approach, along with testing of the concepts by means of prototypes and test beds. Ciprian-Radu RAD proposed integrated network architecture for agricultural precision control to track the plant status of potato crops focused on CPS software and design technologies. This program helps farmers to track the development of such criteria of interest and take correct decisions to maximize agricultural production.

Fan TongKe[10] says IoT is directly related to cloud computing in such a way that IoT obtains powerful computational resources via cloud computing, and cloud computing considers the best IoT-based medium of practice. Agricultural knowledge system is based on cloud computing, and intelligent agriculture is developed with a combination of IoT and RFID. Hardware services are incorporated into the resource pool in the agricultural knowledge network by leveraging vitalization technologies, achieving complex resource allocation and load balancing, dramatically increasing resource consumption performance. A huge amount of data is collected using radio frequency recognition, wireless communication, automated monitoring, IoT knowledge sensing techniques are treated with agricultural knowledge cloud, and smart agriculture is truly achieved.

III. PROPOSED SYSTEM DESIGN

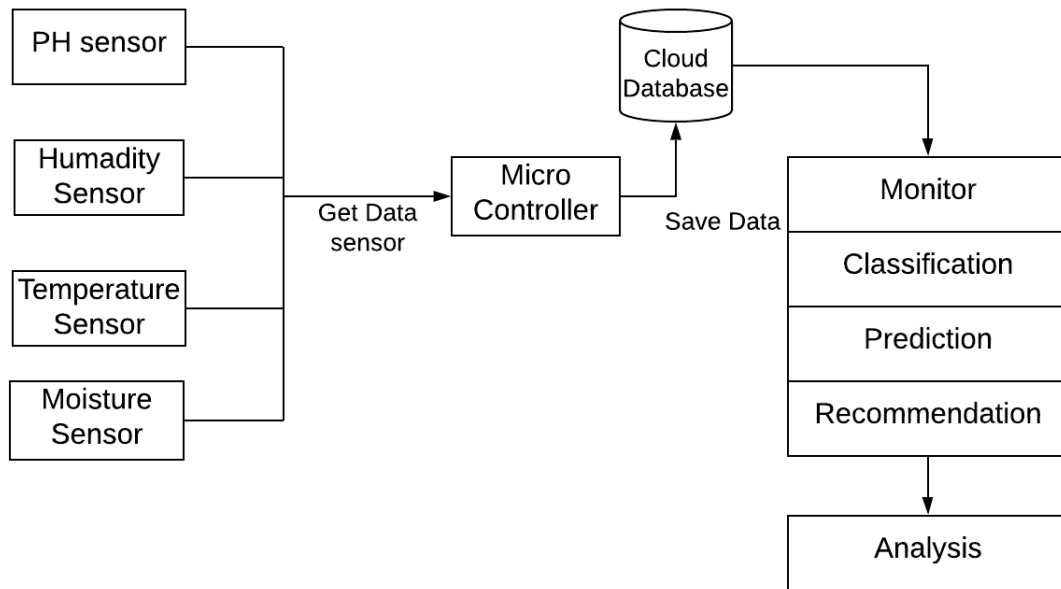


Figure 1 : Proposed system architecture

- 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)



$$CVal = \sum_{k=0}^n Parts[k]$$

Step 3:

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

IV.RESULTS AND DISCUSSIONS

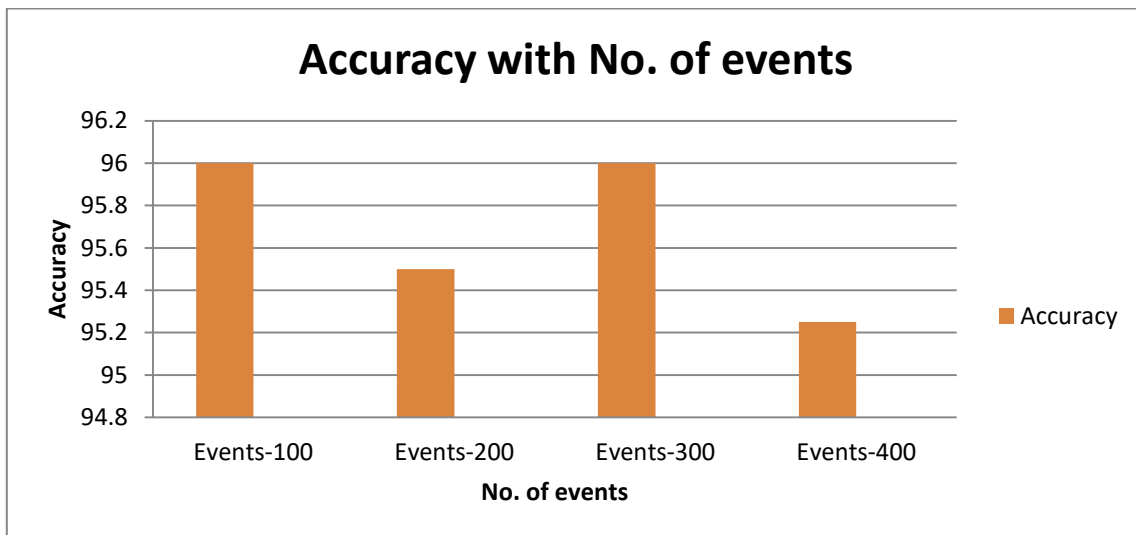


Figure 2: Classification accuracy on number of events using Q-Learning algorithm

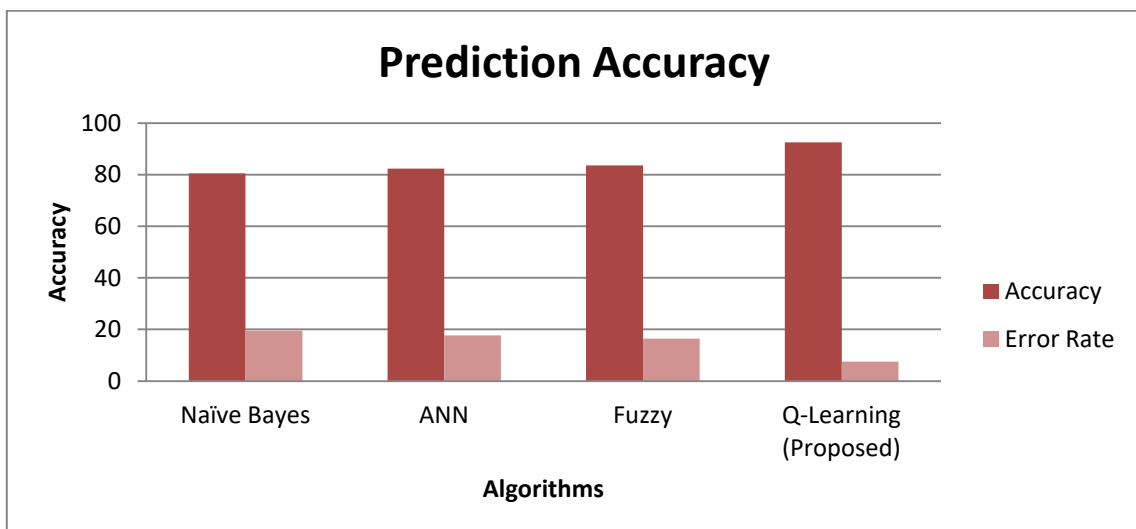


Figure 3: Classification accuracy with various machine learning algorithm

V.CONCLUSION

In this Research We demonstrate soil fertility control and smart plant forecasting utilizing IOT technologies and machine learning. The module has high efficiency and accuracy in obtaining live temperature, Ph sensor, and soil humidity data. This module will help farmers increase farm yields and take care of food production efficiently, as the module will always help farmers get accurate live feed from environmental temperature and soil moisture, as well as certain chemical properties available in soil with more than the most accurate results. The key benefit of this method, which is relevant to soil productivity everywhere, as well as achieving successful plant prediction according to the current scenario. The proposed Q-Learning module has an average accuracy of over 95 percent in different soil samples, which is more powerful than other supervised learning algorithms. We have done this research with minimal soil sample data due to certain hardware dependence, utilizing several hardware tools and obtaining full soil properties to estimate the deep classification would be the important work for the future. This work also can be extended by adding advanced engineering technologies provided new approaches for soil testing with cost effective manner.

Future work increasing the sensors on this stick will concentrate more on collecting more data, especially with regard to Pest Control, and also incorporating the GPS module into this IoT Stick to improve this IoT Agriculture Technology to the Maximum Product Precision Agriculture.

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