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A Novel Rel-DASA Model for Reliable Data Analysis in IoT Based Smart Agriculture

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Abstract: Agriculture today depends largely on these technologies to supply food for human consumption because to their widespread usage. The Internet of Things bridges the gap by providing farmers with critical tools to predict crop growth, availability of moisture in the soil, soil status, and so on. We describe a comprehensive agricultural monitoring system for accurate crop growth management. This proposed research investigates how supplying farmers with real-time data such as weather forecasts through sensor integration might enhance decision-making. Internet of Things, Agricultural Sensors, Wi-Fi Module, Android App, and Raspberry Pi are all integrated.

1. Introduction

It is clear from that the Internet of Things is a game-changing paradigm for permissive communication technologies that may facilitate intercommunication through Wireless Sensor Network (WSN) and Machine to Machine (M2M). Internet of Things is an acronym for "Internet of Thingses." The phrases are "Internet" and "Things," where "Things" refers to any physical thing that may establish an online connection. Kevin Ashton, an expert in consumer sensors, coined the term on January 20, 1999. Typical actions of an IoTdevice.

a. **Sensor:** Sensors that pick up data useful to the task. It's possible that these sensors will either be built into the device or attached to it in some way.
b. **Actuator:** Several different kinds of actuators allow for action to be taken on physical objects or devices.
c. **Communicate:** These modules are responsible for sending the collected data to other devices or a cloud server, such as an Amazon server, IBM server, Google server, ThingSpeak, ThingsWorx, a Things Board, Xively, or another.
d. **Take Action:** These parts are in charge of acting on the information gathered.

Motivation

It is crucial that resource utilization be optimized to the fullest extent possible to reduce wasting in light of global warming and the massive growth in population. IoT and machine learning are relied on heavily by Smart Monitors to automatically sense the surrounding conditions and analyse the vast volumes of data produced. In the same way that our understanding of sensors has advanced, new types of sensors, such as environmental sensors and gas sensors, have been invented and put to use in a variety of contexts. Both cloud computing and the mobile computing interface are well-established technologies with numerous examples of their application across a wide range of fields. Using the aforementioned agricultural technology and the corresponding improvement tools and technologies.

2. Literature Review

The agricultural sector is the backbone of the Indian economy, providing both staple food items and the raw resources that other industries rely on. The Internet of Things is crucial in many areas of agriculture, including Smart Irrigation, Greenhouse management, and many more. Farmers in developed nations, like India, are now facing a critical difficulty with Smart irrigation.

Improve operational efficiency, sustainability, and cost-effectiveness in agricultural production with the aid of cutting-edge Internet of Things technologies, and you'll have made significant progress towards solving some of agriculture's most pressing problems. Internet of Things sensors are giving farmers information on things like crop yields, insect management, and rainfall in the field. IoT presents a promising avenue for farmers to track improvements in productivity, crop yields, soil and crop health, and storage conditions. Internet of Things (IoT) sensors monitor soil quality, including soil health, crop health, and so on] continuously.With an automated system and applied numerous system designs for Smart agriculture, Precision farming, and Smart irrigation, massive technologies now play an important part in the Agricultural sector. Large-scale efforts are being made to advance agricultural knowledge. As an example of the current works, consider the following.

Karunakanth et al. [3] presented an Internet of Things–based smart irrigation system for indoor organic gardening.The author built a system for a home organic garden utilisingIoT technology and a variety of sensors (including thermometers, humidity monitors, ultrasonic moisture detectors, and soil moisture monitors). The exorbitant price tag is due in part to the four sensors included in the architecture's design. Vanaja et al. presented an architecture for an Internet of Things (IoT)-based agricultural system built on Node MCUs. The system's primary objective is to provide efficient, cost-effective, and low-cost irrigation by reducing water waste.

The architecture is made up of several field regions, a DHT11 sensor with Arduino Uno and Node MCU linked to the IoT cloud, and a mobile app such as Blynk for controlling everything. By keeping an eye on the readings from a bunch of sensors, we were able to confirm that the system works in practise.

In their article, "Smart Agricultural Model by Integrating IoT, Mobile, and Cloud-based Big Data Analytics," Rajeswari et al [5]. By using new technologies including the Internet of Things (IoT), the World Wide Web (WWW), cloud computing (cloud), big data (big data), mobile (mobile), and data mining, the author hopes to increase agricultural yield output. No actual hardware solution was shown in this article. Ashwini et al. [1] reported a study on smart irrigation system using IoT for crop-field monitoring. The author detailed the IoT-based system architecture for smart irrigation. A variety of sensors, including those for measuring soil moisture, temperature, and humidity, are linked to this system. These sensors will communicate with an Arduino board via a Z igbee module, and then the collected data will be used to inform a decision-making mobile app for farmers and end users. The system uses just three sensors and may be implemented at a modest cost. Using the Internet of Things, Srishti et al. [6] offered an evaluation of the smart irrigation system. Both hardware and software make up this system. When it comes to agriculture-related data, the sensing unit displays the results on the web, while the hardware block is composed of embedded devices. In this way, the farmer may keep tabs on the farm's irrigation system from anywhere he or she may be. A single, inexpensive sensor, such a moisture probe in the soil, interfaced with an Arduino board. the soil moisture found in the moisture sensors section

IOT Based Smart Agriculture

The information that can be extracted from objects and sent via the internet is the backbone of the IoT. Installed Internet of Things (IoT) devices on a farm should collect and process data in a repeated loop that allows farmers to respond swiftly to new problems and shifting environmental conditions. Methods comparable to this cycle can be found in "smart farming."

1. Looking about. Plants, animals, soil, and air can all be monitored with the help of sensors.
2. The second is the process of diagnosis. The data from the sensors is sent to an Internet-of-Things (IoT) platform in the cloud where it is processed by a set of predetermined decision rules and models (also known as "business logic") to determine the state of the item under scrutiny and pinpoint any problems or needs.

3. Determination #3. Whether or whether a location-specific treatment is required, and if so, which, is determined when problems are exposed by the user and/or machine learning-driven components of the IoT platform.
4. The Fourth: Do Something! Following feedback and response from the final consumer, the process starts all over again.

Role of Data Analytics in Smart Agriculture

All along the agricultural value chain, analytics has a wide variety of potential uses. To keep things straightforward, though, we'll focus just on crop production and agricultural financing and insurance. In order to generate useful data for analysis, analytics solutions make use of Big data, Internet of Things (IoT), Cloud Computing, and Global Positioning System (GPS) technologies. Beneficial for both farmers and banks, this facilitates data-driven decision making.

The potential of analytics can only be realised if fundamental data from Management Information Systems has been requested. Because of this, precision agriculture will be propelled forward, and better decisions will be made. The advantages of analytics-enabled smart farming are laid forth in a framework in Figure 5.

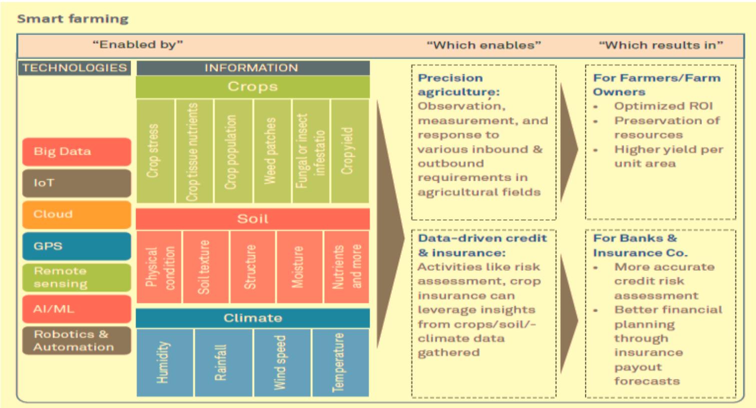

Figure 1. Role of Data Analytics in Smart Agriculture

Source (https://www.wipro.com/analytics/smart-farming-powered-by-analytics)

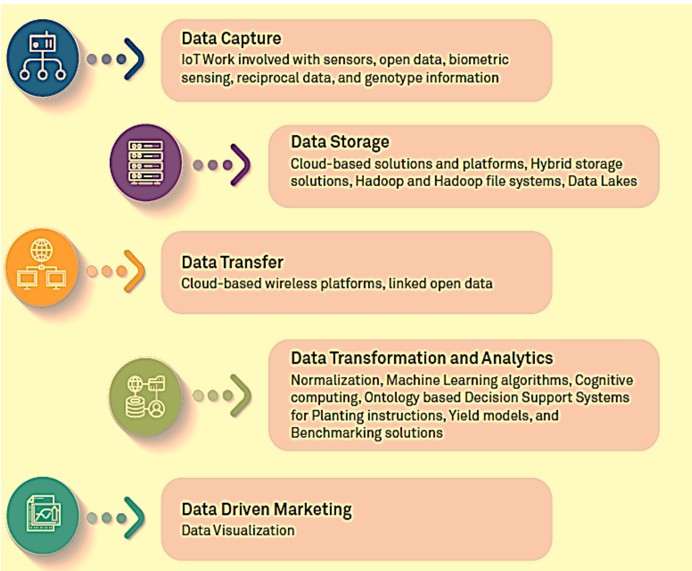

Figure 2 . Data Analytics source

(https://www.wipro.com/analytics/smart-farming-powered-by-analytics)

Data Analytics Usage

The Internet of Things (IoT) and analytics have many applications in smart farming.

1. Track the operation of farm machinery from afar.
2. Monitoring and optimising farm operations with analytics
3. Analytics for foreseeing the weather's course
4. Analytics for forecasting harvest yields
5. Predicting crop yields analytically can help determine a farmer's creditworthiness or the amount of a crop insurance payout.

Smart Agriculture

1. Crop selection: in-field sensors can report precise details on weather and soil conditions, water levels, fertilizer/manure needs, and pest populations. With this information, farmers may choose crops wisely.
2. GPS-enabled tractors and trucks facilitate land preparation via tractors and ploughing equipment. This will aid in getting the most out of the time when heavy machinery is in use.
3. Better seed selection is possible with the help of sensor data on soil health, weather, water content, pest data, and fertilizer/manure needs. The ideal seeds for the climate and budget can be chosen with the use of predictive analytics.
4. Sowing seeds: The timing and method of sowing seeds depends on factors such as the type of seed, the climate, and the soil's and water supply. Sensor and smart device data on the aforementioned aspects can aid with more efficient and cost-effective seed sowing.
5. When it comes to irrigation, the type of crop, the type of soil, the water content of the soil, and the weather of the past, present, and future all play a role. Such information is useful for fine-tuning watering schedules.
6. Analytic tools can aid in diagnostic monitoring of crop growth at any time. If the analysis reveals discrepancies, adjustments can be made.
7. Fertilization/Manuring: Knowing the soil's nutrient level and its needs is essential for effective fertilization/manuring. As a result of data analytics, farmers now have more information at their disposal to use when deciding which and how often to apply fertilisers and manure.
8. Harvesting is a mechanical and labor-intensive procedure. Data analytics can be used to improve the efficiency of these equipment.

Proposed Model for Smart Agriculture

The smart agricultural system proposed here includes several pieces of hardware, including a moisture sensor, a temperature and humidity sensor (DHT11), a raspberry pi with a Wi-Fi module, an android mobile, and the thingSpeak cloud. Using an analog-to-digital converter (MCP3008), these Internet of Things sensors communicate with a Raspberry Pi to send data to a remote server. Data is collected, analysed, and then sent to the consumer or farmer. By developing an Android app using MIT's App Inventor, users may have access to information stored in the cloud or a database like thingSpeak. Until then, farmers have no way of knowing whether or not their efforts to improve things like crop yields, productivity, and water management are really paying off. Figure 5 is a process diagram for the smart agricultural monitoring system, and Figure 4 shows the general structure of the Smart agricultural system.

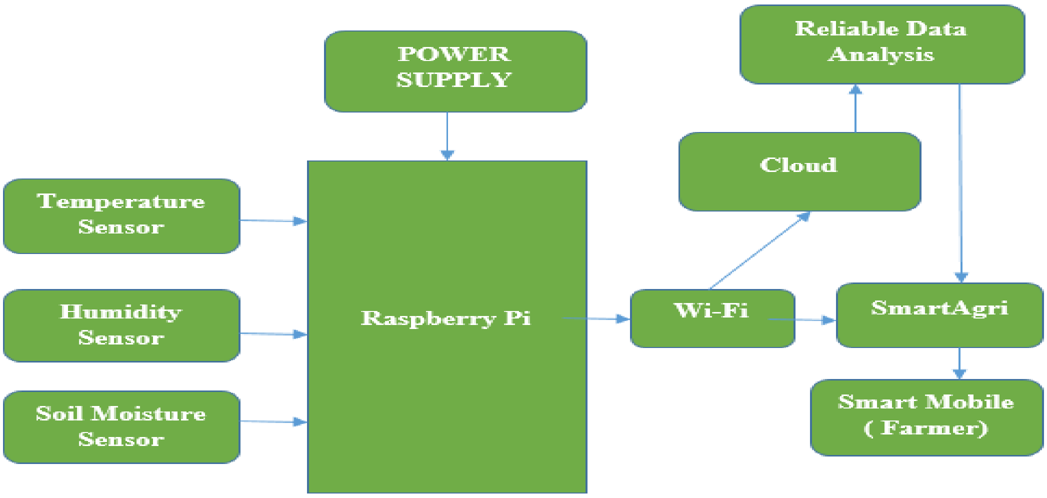

Figure 3. Proposed Model for Smart Agriculture

The physical components of the proposed smart agriculture system include a temperature and humidity sensor (DHT11), a moisture sensor, a raspberry pi with a Wi-Fi module, an android smartphone, and the thingSpeak cloud. In order to transmit data to the cloud, these IoT sensors can be hooked up to a Raspberry Pi with the help of an MCP3008 (analogue to digital converter). After data collection and analysis, it's all sent on to the farmer or user. Data from services like thingSpeak or the cloud can be accessed by using Android MIT App Inventor. Only then would farmers have a reliable way to assess the efficiency of their farms in terms of both water consumption and crop production.

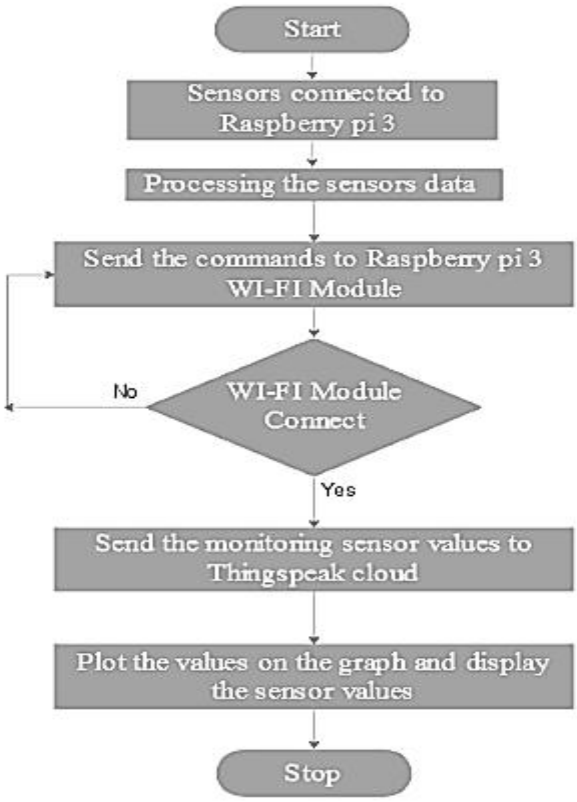

Figure 4 . Proposed Methodology

Implemntation

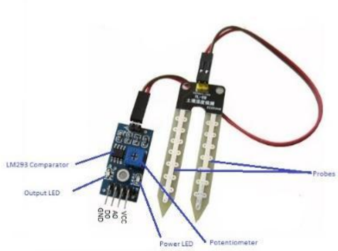

Fig. 5.1. Light SensorFig. 5.2 Soil Moisture SensorFig. 5.3 Temperature & Humidity Sensor

Fig. 5.4. Raspberry PiFig. 5.5. GSM ModuleFig. 5.6. Cloud

Fig. 5.7Machine LearningFig. 5.8Android Application

3. Results And Discussion

Fig 6 .Thing speak Cloud

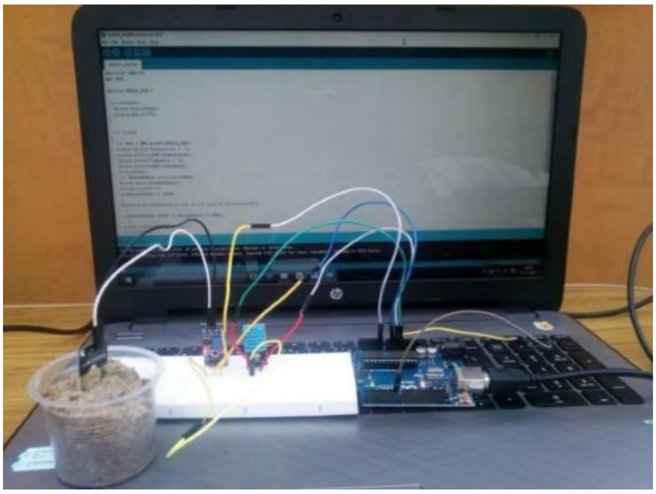

Fig 7. Deployment

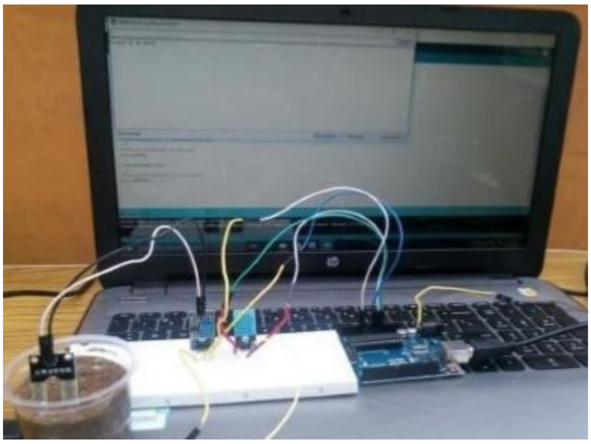

Fig 8. Output of Soil Moisture Sensor for Wet Soil

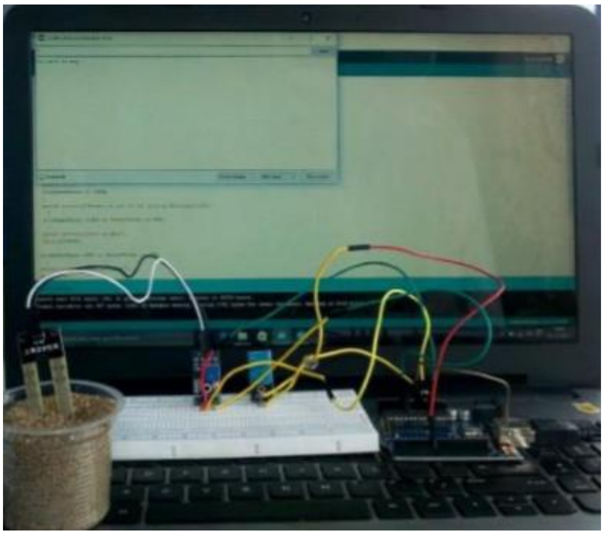

Fig 9. Output of Soil Moisture Sensor for Dry Soil

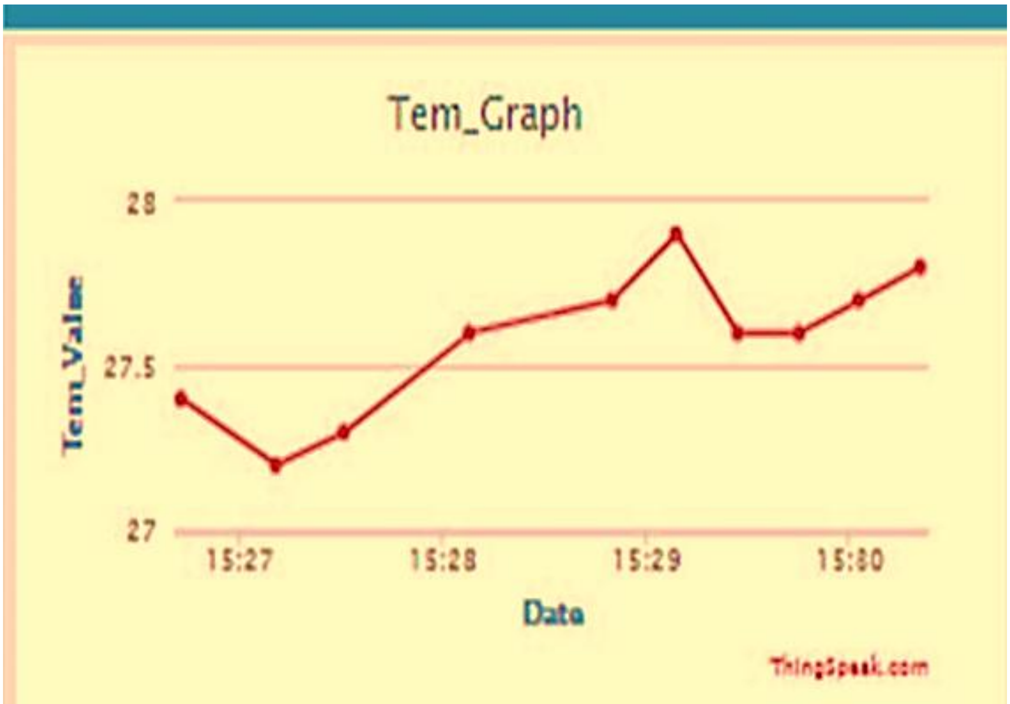

Fig 10. Graphical Output of Temperature Sensor in Thingspeak

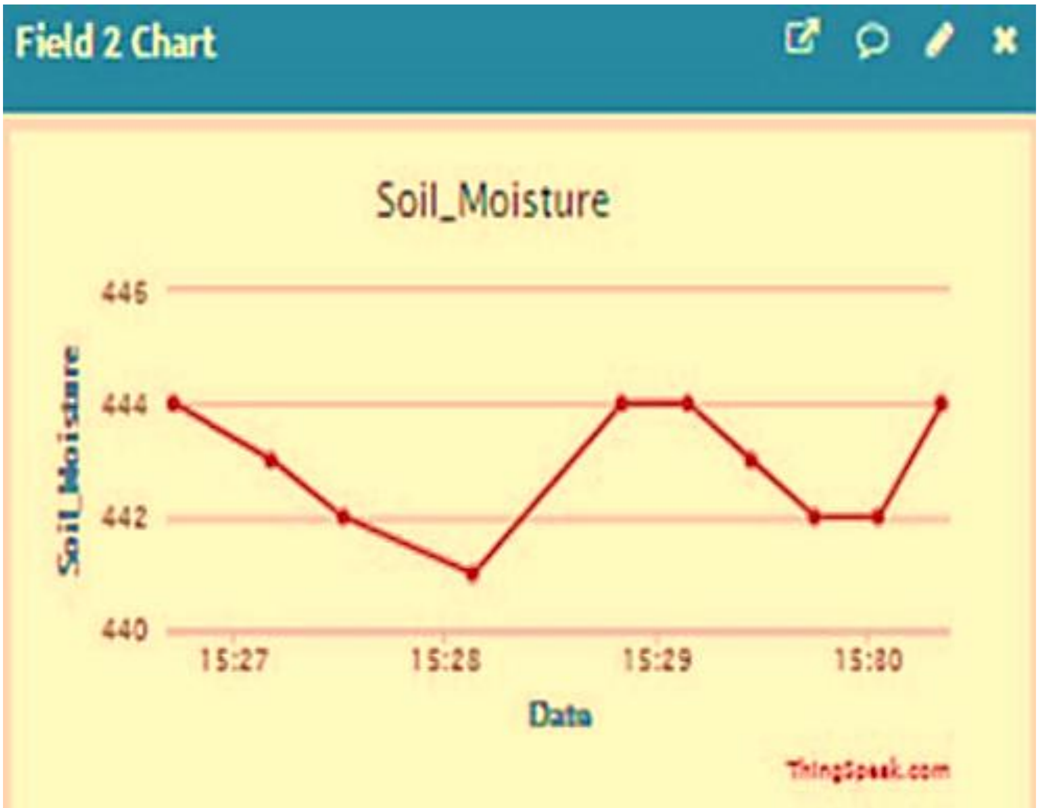

Fig 11. Graphical Output of Soil Moisture Sensor in Thingspeak

4. Conclusion

This article shows that it is crucial to adopt an IoT-based agricultural field monitoring system by describing how its ideal introduction of tools and measures taken for greatly enhanced crop yield and the deployment of simple user interfaces. This website may be changed in the future to make advantage of newly accessible technology, such as an MIT app that relays field data to farmers and enables them to adjust machines appropriately. This article discusses hardware like the raspberry pi and the connecting of several sensors to allow for flexibility in any agricultural scenario. It's a very clear display of data that can be cast and followed even in harsh environments. This novel technological approach to the farmers' problems may be quite helpful.

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