IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 5, June 2023

A Research Paper on Smart Farming using IoT

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Abstract: *The Internet of Things (IoT) is revolutionizing various industries and impacting people's lives by introducing intelligent capabilities. It encompasses a network of interconnected devices that form a self-configuring system. One of the areas experiencing significant advancements through IoT is smart farming, which is reshaping traditional agricultural practices by optimizing operations and reducing costs for farmers while minimizing crop wastage. In this context, I propose a technology that can generate notifications for farmers through various platforms. This product aims to assist farmers by providing real-time data on crucial parameters such as temperature, humidity, soil moisture, UV index, and infrared radiation from their farmland. Armed with this information, farmers can make informed decisions and implement smart farming techniques to increase crop yields and conserve valuable resources such as water and fertilizers. By leveraging IoT, farmers gain access to a wealth of data from sensors strategically placed throughout their fields. These sensors continuously monitor environmental conditions, transmitting the collected information to a central hub or cloud platform. The data is then processed and analyzed, allowing farmers to receive actionable insights and alerts through different messaging platforms. For instance, the system can send instant notifications to farmers' smartphones or tablets, providing them with updates on the current status of their crops and environmental conditions. They can receive warnings if the temperature exceeds a certain threshold or if soil moisture levels indicate the need for irrigation. These messages can be sent via SMS, mobile applications, or even through voice-enabled assistants to ensure farmers stay informed at all times. With this technology, farmers can take necessary measures promptly, such as adjusting irrigation schedules based on real-time soil moisture levels or deploying protective measures when extreme weather conditions are detected. By optimizing resource allocation and implementing precision farming techniques, farmers can significantly reduce wastage and improve overall productivity. Furthermore, the availability of historical data and analytics allows farmers to gain insights into long-term trends and patterns. They can identify correlations between specific environmental conditions and crop performance, facilitating better decision-making and planning for future seasons. In summary, the integration of IoT technology into smart farming practices enables farmers to make data-driven decisions and optimize their agricultural operations. By receiving live data on temperature, humidity, soil moisture, UV index, and infrared radiation, farmers can increase crop yields while conserving resources. This technology's messaging capabilities ensure farmers are promptly notified of critical information, empowering them to adopt sustainable and efficient farming practices.*

Keywords: Internet of Things (IOT), Smart farming using IOT, Soil Moisture Sensor, Water level Sensor, crop management.

I. INTRODUCTION

Smart agriculture is an emerging concept that leverages IoT sensors to gather information about agricultural fields and take action based on user input. This project aims to harness evolving technology to identify smart farming techniques that can rejuvenate the traditional agricultural sector.One of the key techniques in smart farming is precision agriculture, which optimizes resource usage and reduces the improper or excessive application of pesticides and fertilizers. By utilizing IoT sensors, farmers can gather real-time data on factors like soil moisture, humidity, and nutrient levels. This data enables them to make informed decisions about irrigation, fertilization, and crop protection, leading to increased yield per acre of land.Efficient water management is another crucial aspect of smart agriculture. With water tables diminishing rapidly, especially in countries like India facing high demand from agriculture and industry, smart techniques help in conserving water resources. IoT sensors provide accurate information about soil moisture levels, allowing farmers to implement precise irrigation strategies and avoid water wastage. The adoption of smart farming practices also addresses the challenges faced by the agricultural sector during the COVID-19 pandemic. Many skilled migrants who returned to their native villages have chosen farming as their profession and are reluctant to go back to cities. These individuals can readily embrace smart agriculture systems, as they require less time and effort compared to traditional farming methods. By implementing IoT-based solutions, these farmers can efficiently manage their crops, monitor environmental conditions, and make data-driven decisions to maximize productivity. It is crucial to overcome the resistance to change among farmers who still adhere to traditional practices. Timely implementation of smart agriculture systems is essential to prevent further decline in the agricultural sector, which plays a significant role in India's GDP. Education and awareness programs can help farmers understand the benefits of adopting smart techniques, such as increased efficiency, reduced costs, and improved sustainability.

In conclusion, smart agriculture, driven by IoT sensors and advanced technologies, holds immense potential to transform the traditional agricultural sector. By embracing precision farming, efficient water management, and other smart techniques, farmers can increase crop yields, conserve resources, and adapt to changing circumstances.

Encouraging the adoption of smart agriculture among skilled migrants and addressing the resistance to change will contribute to the sector's growth and overall economic development.

II. EXISTING AGRICULTURAL PRACTICES

In many rural areas, agriculture remains a primary livelihood strategy for the majority of people. Traditional farming methods are followed, often relying on indigenous agricultural knowledge passed down through generations based on experience and careful observations. Resource-poor farmers adapt their farming practices to suit their specific environments. Typically, household members are the primary source of farm labor, with men primarily involved in plowing activities, while women handle planting, weeding, and harvesting tasks. Crop protection against pests is managed using traditional methods, where farmers create mixtures of locally available resources for pest control to minimize losses. However, traditional farming practices lack essential elements such as weather monitoring, moisture dampness analysis, and water management. Farmers often rely solely on rainfall and the natural flow of water from upstream to downstream, along with a basic canal watering system. As agriculture has become more labor-intensive and skilled individuals have migrated to urban areas for livelihood opportunities and improved living conditions, traditional farmers face increased expenses and risks. Instances of low crop yields leading to farmer suicides have been reported.

III. PROPOSED SYSTEMS

As traditional farming practices continue to be labor-intensive and risky, often resulting in low yields or losses due to unpredictable events, there is a growing disparity between small farmers who are unaware of smart agriculture technologies and larger corporations that are benefiting from these advancements. However, the COVID-19 pandemic has led to the return of migrants to their villages, many of whom are now embracing agriculture as their primary occupation due to the lack of other income sources. During this time, small players in farming can take advantage of IoT-based devices such as Smart Irrigation Systems. These systems automate the irrigation process by analyzing soil moisture levels and climate conditions, including rainfall. By incorporating these technologies, small farmers can improve their crop yield and increase their profitability. The advancement of IoT in agriculture provides valuable information on atmospheric conditions, temperature, soil productivity, weed infestation, water levels, pest detection, animal interference, crop development, and cultivation. Farmers can now access details about their farm conditions remotely through sensor frameworks and Wireless Sensor Networking (WSN) systems, allowing them to monitor and manage their farms from the comfort of their homes or any other location. Moreover, the integration of IoT technologies in agriculture has the potential to address challenges faced by small farmers, such as lack of access to resources, limited knowledge of modern farming techniques, and market constraints. IoT-based solutions provide real-time data and insights, enabling small farmers to make informed decisions about irrigation, pest control, and resource management, ultimately improving their chances of success and profitability. Additionally, it is important to consider the role of government support and initiatives in promoting the adoption of smart agriculture among small farmers.

Providing training programs, financial assistance, and access to IoT technologies can empower small farmers and bridge the gap between large and small-scale agricultural operations. By leveraging the benefits of IoT and smart

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agriculture, small farmers can enhance their farming practices, increase their yields, reduce risks, and ultimately improve their livelihoods. It is crucial to raise awareness and provide support for the adoption of these technologies among small-scale farmers to ensure a more inclusive and sustainable agricultural sector.

IV. METHODOLOGY

Smart agriculture systems integrate modern technologies, such as the Internet of Things (IoT), to optimize agricultural practices. These systems provide real-time monitoring and control of various parameters crucial for crop growth, enabling farmers to make data-driven decisions. Some of the key components of smart agriculture include:

- Weather Monitoring: IoT-based weather stations can collect and analyze data on temperature, humidity, rainfall, wind speed, and solar radiation.
- Soil Moisture Management: IoT sensors installed in the fields can monitor soil moisture levels, allowing farmers to optimize irrigation practices. This helps prevent over-watering or under-watering, ensuring efficient water usage and avoiding crop damage.
- Precision Irrigation: IoT-enabled irrigation systems can deliver water precisely to specific areas of the field based on soil moisture levels and crop water requirements. This ensures that crops receive the appropriate amount of water, reducing water wastage and increasing water-use efficiency.
- Pest and Disease Monitoring: IoT devices, such as smart traps and sensors, can detect pests and
- diseases in real-time. Early detection enables timely intervention, minimizing crop losses and reducing the need for excessive pesticide use.
- Data Analytics and Decision Support: Collected data from IoT devices can be processed and analyzed using advanced algorithms and machine learning techniques. This provides valuable insights and
- predictions, enabling farmers to optimize their farming practices, make informed decisions, and improve overall crop yield.
- Market Linkages and Traceability: IoT-based systems can facilitate the integration of farmers into broader supply chains, enabling real-time monitoring of produce from farm to market. This enhances transparency, traceability, and market access for farmers.

By adopting smart agriculture systems, traditional farmers can benefit from improved resource management, increased productivity, reduced risks, and higher profitability. However, the successful implementation of such systems requires overcoming challenges related to cost, technological accessibility, and capacity building

V. LITERATURE SURVEY

The Internet of Things (IoT) has greatly transformed the agricultural industry by introducing various techniques such as precision farming and resource conservation. However, there have been challenges and limitations associated with implementing these technologies. One of the proposed modalities for the agriculture sector is an irrigation system based on soil water measurement, which determines the precise amount of water required for irrigation. However, this system relies on Bluetooth communication, which has limitations such as a limited range and device compatibility. In 2016, an author suggested scheduling power supply to sensors to improve energy efficiency. The use of IoT in agriculture has been mentioned in a paper, but it highlights the lack of interoperability, which is crucial for large agricultural fields where different devices need to communicate seamlessly.

To compare energy consumption between two appliances, Jinsoohan proposed an approach in a paper published in 2017. N.K. Suryadevara and S.C. Mukhopadhyay used concepts like pervasive computing and data aggregation with Zigbee technology to monitor environmental factors in their paper. However, deploying more nodes for automation in agriculture might lead to increased power consumption. A standalone system that provides real-time information to farmers about their land and crops is described in a paper. Although this system offers necessary information, it operates independently without integration into a larger network or system. In a 2015 paper, the concepts of IoT, cloud computing, and mobile computing were applied in smart agriculture. Authors Prem Prakash Jayaraman, Doug Palmer, and Arkady Zaslavsky introduced the concept of Phononet, which is a network of smart wireless sensor nodes that share information with each other as well as a central system.Overall, while various researchers and authors have explored different aspects of IoT in agriculture, there are still challenges to address, such as interoperability, energy efficiency, and integration into comprehensive systems. These considerations are crucial for the successful implementation of smart agriculture technologies.

VI. BLOCK DIAGRAM

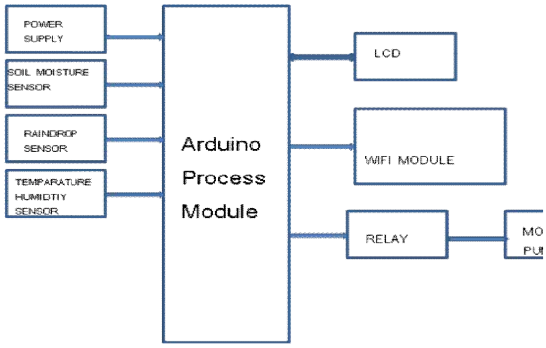
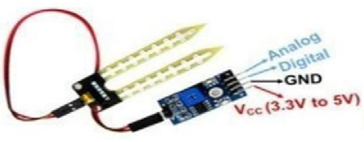


Figure-1



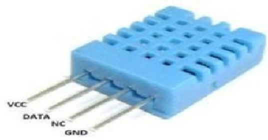


Figure-2 Soil Moisture sensor Figure – 3 Raindrop sensor Figure-4 Temperature & Humidity sensor
Smart agriculture system

6.1 Soil Moisture Sensor

The sensor averages the water content over the entire length of the soil environment wet or dry and the propelled yield.The sensors can measure temperature from 0°C to 50°C.

6.2 Rain Drop Sensor

The rain sensors detect the rain, the basic principle of working is checking resistance of sensor, and the sensor comprises two different conduction printed leads on whole surface.

6.3 Temperature & Humidity Sensor

The DHT11 humidity sensing device operates using a moisture-holding substrate with electrodes positioned on its surface. The alteration in resistance between these electrodes corresponds to the relative humidity. Humidity sensors function by detecting variations that impact electrical currents or temperature within the surrounding air.

6.4 Arduino Uno Board

Arduino platform mainly contains a Hardware Board called Arduino Board & software Arduino IDE to program it. Other external hardware as Sensor Modules, Motors, Arduino UNO and Arduino Software (IDE)- 1.0. The Uno is a microcontroller board based on the ATmega328P.power jack, an ICSP header and a reset button. Compatible to support the microcontroller; Its as simple as plug and play concept just connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can fiddle with your UNO without worrying too much about doing something wrong, worst case scenario it can be easily replaced at every minimal cost. It is used to write and load programs on the Arduino board

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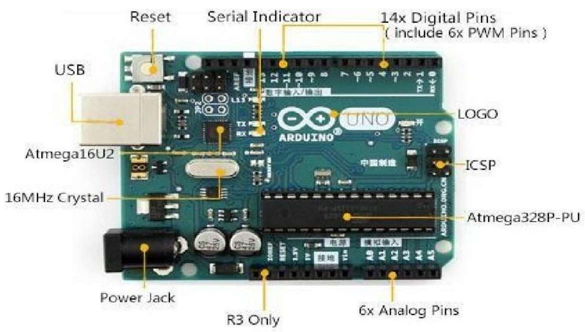

Figure -5 Arduino UNO board

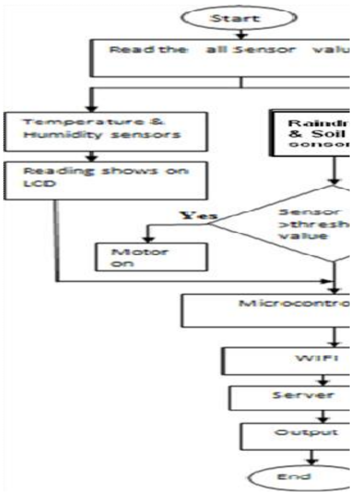

Figure -6 Flow Chart

Figure- 7 LCD data

VII. CONCLUSION

With the incorporation of the WSN&IOT, we can upgrade the agriculture farm. These systems enable to check the quality of the soil and the growth of the crop in soil and with these system farmers are able to solve irrigation problems, temperature problems, humidity problems, etc. The availability of sensors for the agricultural parameters and microcontrollers can be easily interfaced with each other and with the help of Internet of Things, wireless sensor networks communication can be achieved between various nodes. These systems offer a high application area to the users to improve their skill and output of the crops in better way. Use these systems help to increase the Rice, wheat and maize and other agricultural production in India in the near future. IOT capable to control the condition of the yield and growth, it can also able to check soil, temperature, humidity, etc. with help of IoT

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