SENSOR FOR MONITORING SOIL MOISTURE

A COMMUNITY SERVICE PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Agricultural technology has seen an increasing demand for soil monitoring systems that utilize Machine Learning (ML) and Internet of Things (IoT) to provide accurate data extraction and analysis. Soil moisture is a critical parameter in agriculture, environmental science, and water resource management. Accurate and timely measurement of soil moisture content is essential for optimizing irrigation, crop yield, and overall land use efficiency. There is a need for providing an in-depth review of sensor-based soil moisture monitoring, focusing on various sensor types, working principles, applications, advantages, and challenges associated with this technology. Each type is explored in detail, explaining its mechanisms for measuring soil moisture and the advantages and limitations of their use. The selection of most suitable sensor type based on specific applications and environmental conditions are analysed and are explained clearly to the farmers about its usage. The farmers can get a clear idea about the usage of sensors for soil monitoring and can get all the information about the soil moisture content in their mobile phone. This will help them to analyse and do the appropriate plantation according to the moisture content and will lead to high yield.

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CHAPTER 1

INTRODUCTION

Farming is one of the odd professions where computer technology is not frequently used. The main reason for this is that most ranchers in India and other developing nations are facing financial difficulties. The reason why agricultural products are becoming steadily more scarce is due to urbanisation and population growth. In essence, the rural region is shrinking and there is less farmland available, which could lead to a decrease in agricultural output. Increasing crop productivity while making judicious resource usage is currently required to resolve this issue. For such challenges to be overcome, farming must be done carefully. In this case, efforts are taken to cut down on resource waste.Precision agriculture refers to a method in which the harvest growing process is carried out with the perfect amount of resources needed by the yield for a certain time period. For instance, in the conventional irrigation system, the irrigation process is carried out based on the farmer's knowledge and without taking into account the actual requirements of the crop. As a result, there's a chance that water will be lost, which might have an effect on how much crop production. Conversely, when crops required water, their current productivity was significantly damaged. Therefore, by adopting precision agricultural techniques, the problem of over- and under-irrigation can be easily remedied.

Internet of Things (IoT) has been used in a range of sectors, including banking, education, home appliances, healthcare, and agriculture to carry out activities precisely and accurately, even though there are several technologies available to automate any type of labour. Food is a fundamental need for both people and animals, and as a result, the agricultural sector is expanding. Different methods and tactics are employed to increase crop yield at various stages of the farming process. The irrigation process is a crucial aspect of agriculture. The adoption of IoT devices can improve farming's precision and effectiveness. Precision agriculture is the practise of continuously monitoring an agricultural field utilising cutting-edge technologies.

1.1 SOIL MOISTURE CONTENT

In agriculture, soil moisture content plays a pivotal role in determining the success of crop cultivation. The amount of water present in the soil directly impacts plant growth and overall crop yield. Farmers and agronomists closely monitor soil moisture levels to ensure that they provide the right amount of irrigation to their crops. An optimal soil moisture content ensures that plants receive adequate water for their growth and development. However, both excessive moisture and drought conditions can have detrimental effects on crops. Proper management of soil moisture is essential to maximize agricultural productivity, conserve water resources, and minimize the risk of crop stress and yield loss. Farmers use various tools and techniques, including soil moisture sensors and irrigation systems, to maintain the ideal moisture balance in their fields, ultimately contributing to the sustainability and success of agricultural practices.

1.2 SOIL TYPES

Soil is a natural resource that can be categorised into different soil types, each with distinct characteristics that provide growing benefits and limitations. Identifying the type of soil you require for a project is paramount to support the healthy growth of plant life.Soil can be categorised into sand, clay, silt, peat, chalk and loam types of soil based on the dominating size of the particles within a soil.In agriculture, there are several types of soils that are important for crop production. These soil types can be categorized based on their properties and suitability for farming

1.2.1 Clay Soil

Clay Soil is a heavy soil type that benefits from high nutrients. Clay soils remain wet and cold in winter and dry out in summer.These soils are made of over 25 percent clay, and because of the spaces found between clay particles, clay soils hold a high amount of water.Because these soils drain slowly and take longer to warm up in summer, combined with drying out and cracking in summer, they can often test gardeners.

1.2.2 Sandy Soil

Sandy Soil is light, warm, dry and tends to be acidic and low in nutrients. Sandy soils are often known as light soils due to their high proportion of sand and little clay (clay weighs more than sand).These soils have quick water drainage and are easy to work with. They are quicker to warm up in spring than clay soils but tend to dry out in summer and suffer from low nutrients that are washed away by rain.The addition of organic matter can help give plants an additional boost of nutrients by improving the nutrient and water holding capacity of the soil.

1.2.3 Loam Soil

Loam soil is a mixture of sand, silt and clay that are combined to avoid the negative effects of each type.These soils are fertile, easy to work with and provide good drainage. Depending on their predominant composition they can be either sandy or clay loam.As the soils are a perfect balance of soil particles, they are considered to be a gardeners best friend, but still benefit from topping up with additional organic matter.

1.2.4 Silt Soil

Silt Soil is a light and moisture retentive soil type with a high fertility rating. As silt soils compromise of medium sized particles they are well drained and hold moisture well.As the particles are fine, they can be easily compacted and are prone to washing away with rain.By adding organic matter, the silt particles can be bound into more stable clumps.

1.3 INTERNET OF THINGS (IoT) IN AGRICULTURE

The Internet of Things (IoT) is a reducing technology that is now used practically everywhere. Many application fields need remote management or control of an item or entity. IoT is the term used to describe a group of physical objects or things that are connected online. All of these things are individually recognisable by the user, who can operate them from a distance. IoT is a more contemporary field that combines many types of hardware and software. It consists of computer programmes such essential connectivity tools, smartphone applications, or Windows programmes. Numerous hardware elements are also supplied, including wireless connectors, electrical sensors, RFID tags for identification, and many more. A novel area of agriculture called ”precision agriculture” prioritises crop quality while seeking to boost agricultural yield. Most agricultural research today is concentrated on precision farming. Precision agriculture especially makes use of a range of information technology concepts to achieve the goals. Sensor networks with various instruments, such as those for temperature, humidity, wetness, and soil pH, are the main component of IoT in the agricultural industry. Modern technologies like WiFi, Bluetooth, and AI are used by IoT networks. Because of its streamlined hardware, which includes inexpensive microcontrollers, low-cost computing units, and wireless sensors, the demand for IoT is increasing every day. Another important consideration is the choice of IoT cloud platform for the system's development. The agriculture domain's several application areas are depicted in Figure 1.1. It can be broadly divided into four major groups. The main concern of environment sensing and control applications is how to detect environmental variables like temperature, air moisture, soil moisture, wind speed, etc. Applications for irrigation mostly deal with difficulties pertaining to crop irrigation, including timing and frequency depending on information gathered from the soil and water level. Security and safety issues deal with protecting a farm in dangerous weather conditions, such as shielding crops from flooding and severe winds, as well as offering protection from other animals. Agricultural quality criteria like optimal growth, productivity, and pest management are dealt with in ecological applications.

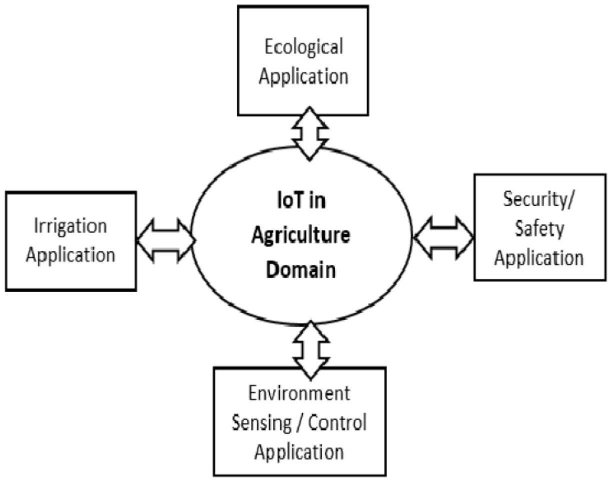


Figure 1.1: **IoT in agriculture domain**

1.4 IMPORTANCE OF IoT IN AGRICULTURE

The use of IoT in agriculture differs in various aspects around the world. The reason for this difference lies in the acceptance of technological developments in different parts of the world. Using IoT solutions in agriculture can drive exponential growth and improve operations. You can achieve great benefits by integrating advanced technologies such as 5G, cloud computing with IoT solutions and improving agricultural services. The main idea behind bringing IoT to the farming sector is to introduce automation and add better ways to increase productivity.In terms of revenue growth, North America appears to be a major contributor to the increase in digitalization, technology awareness and IoT adoption among farmers. The use of IoT technology can prove beneficial in all aspects of improving agricultural strategies and increasing income. It works with sensors and gateways for efficient data acquisition and process communication. It is a system consisting of advanced sensors/devices connected via a cloud platform to process data into meaningful information. It also stores data for convenient access in the future via connected gadgets and internet devices. The use of IoT technology in agriculture to mitigate challenges such as weather issues, farm management, pesticide requirements, crop quality, etc. In this way, it is a step forward in the development of production in terms of the highest quality and income.

The main advantages of using IoT to improve agriculture are as follows:

- Water management can be effectively implemented using IoT without wasting water in the sensors used.
- IoT helps you constantly monitor the area so you can take early precautions.
- Increase productivity, reduce manual labor, reduce time and make farming more efficient.
- Plant Monitoring can be easily performed to observe plant growth.

• Soil management such as pH, moisture level, etc. easy to identify, allowing the farmer to sow seeds according to soil conditions.

• RFID sensors and chips help detect plant and crop diseases. RFID tags send EPC (information) to the reader and are made available on the internet. A farmer or scientist can remotely access this information and take action. Plants can be automatically protected against future diseases.

• Sales of agricultural products on the world market will increase. The farmer can easily connect to the global market without being tied to a geographic area.

Technologies and the IoT have the potential to transform agriculture in many ways. That said, there are 6 ways IoT can improve farming Figure 1.2 shows the benefits of IoT in Agriculture:

1.Data, tons of data collected by smart farming sensors, including weather conditions, soil quality, vegetation progress or animal health. This data can be used to monitor the overall health of your business, as well as the performance of employees, devices, and more.

2.Better control of internal processes and thus lower production risk: The ability to predict production volume allows you to plan for better product distribution. When you know exactly how many crops you're going to harvest, you can be sure your product won't go unsold.

3.Manage costs and reduce waste with better production control: By detecting anomalies in crop growth or animal health, the risk of crop losses can be reduced.

4.Increased business efficiency through process automation: With smart devices, you can automate many processes throughout the production cycle, such as: B. Irrigation, fertilization and pest control.

5.Improving the quality and quantity of products: Gain better control over your production process and maintain higher standards of harvest quality and viability through automation.

6.Reduced environmental impact: Automation also has ecological advantages. Smart farming technologies can reduce the use of pesticides and fertilizers, enabling more accurate coverage, thereby reducing greenhouse gas emissions.

1.5 MACHINE LEARNING APPLICATIONS IN PRECISION AGRICULTURE

Farmers often stick to conventional farming practices as they trust the tried-and-tested techniques that have been passed down through generations across various countries. However, the effects of global warming have resulted in unpredictable weather patterns and erratic rainfall, leaving crops vulnerable to unpredictable weather conditions. Traditional methods of manually applying pesticides are also harmful to the environment and can deplete valuable resources.

Fortunately, with the help of AI and IoT technology, precision agriculture has eliminated the element of chance and allows modern farmers to optimize every aspect of the farming process. Figure 1.3 and Figure 1.4 visually depict the difference between traditional agriculture and a field management strategy. The different ways machine learning techniques have been used in agriculture are listed in this section. These techniques will result in greater field yield while demanding less labour

Figure 1.2: **The advantages of implementing the Internet of Things (IoT) technology in the field of agriculture**

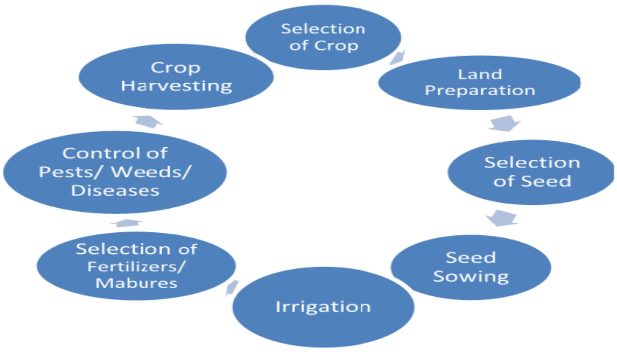


Figure 1.3: **Traditional agriculture cycle**

from farmers. A few examples include managing field conditions and livestock, choosing crops and forecasting crop yield, weather forecasting, intelligent irrigation systems, crop diseases, forecasts used to determine the minimum support price, species recognition, and species breeding. Machine learning (ML) has numerous applications in precision agriculture, which involves using technology to optimize agricultural processes and maximize crop yields.

Here are some examples of ML applications in precision agriculture:

1. **Crop yield prediction:** ML algorithms can analyze data from multiple sources, such as weather data, soil moisture data, and historical crop yield data, to predict crop yields with high accuracy. This can help farmers make informed decisions about planting and harvesting times, as well as fertilizer and pesticide application.

2. **Disease detection:** ML algorithms can analyze images of crops to detect signs of diseases or pests. This can help farmers identify problems early and take targeted actions to mitigate the damage.

3. **Irrigation management:** ML algorithms can analyze soil moisture data to determine the optimal

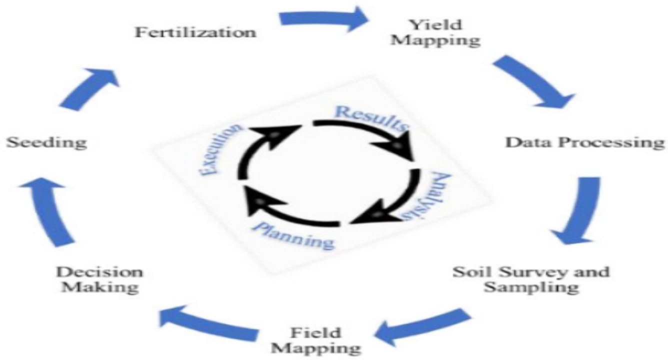


Figure 1.4: **Precision agriculture cycle**

amount of water to apply to crops. This can help farmers save water and reduce costs, while ensuring that crops receive the right amount of moisture for optimal growth.

4. **Precision fertilizer application:** ML algorithms can analyze soil nutrient data to determine the optimal amount and type of fertilizer to apply to crops. This can help farmers reduce fertilizer use and costs, while maximizing crop yields and minimizing environmental impact.

5. **Weed detection and management:** ML algorithms can analyze images of crops to detect weeds and identify the most effective ways to manage them, such as targeted herbicide application or mechanical removal.

CHAPTER 2

LITERATURE SURVEY

Habib et al (2022) stated the use of Wi-Fi and an IoT server, the suggested irrigation system that will be able to monitor the soil's moisture, temperature, and air temperature as well as relay the information to the user in real-time. Compared to other previously proposed and produced irrigation systems, the IoT-based irrigation system is superior. This is due to the old, expensive, and inefficient way in which autonomous irrigation was previously implemented. As a result, there was a low profit margin and production issues. This study promotes the creation of an automated irrigation system for agricultural monitoring through IoT connection. The implementation model has the potential to be more efficient, accurate, and responsive in a relatively short amount of time, the authors have been able to confirm thanks to this investigation. The proposed model is superior to existing Internet of Things models because of the benefits it provides over those models. For example, by developing a dashboard based on the HTTP protocol, users will be able to change parameters like moisture and water flow rates through IoT devices and turn on and off water pumps.In the future, it may be possible to integrate sensor grids to determine critical factors like pH, CEC, SAR, organic soil components, and other characteristics. The paper is created using an algorithm to support the title and a critical analysis of recent literature. It contributes to the body of technical knowledge by using basic electronics and straightforward programme code to create applications.

Contreras et al (2022) stated assessed SAgric-IoT, an IoT platform, comprising its embedded system, the communication protocol, and its algorithms, in terms of packet delivery ratio and energy consumption in a small-scale network under controlled conditions (laboratory) and test bed conditions in the field. Current agricultural information gathering systems require extensive human engagement, but SAgric-IoT minimises this requirement and delivers information more quickly. Results showed that SAgric-IoT is superior in terms of energy savings and transmission reliability. The CNN model, on the other hand, offers a high degree of accuracy for detecting diseases in the crop, with average values better than 95level for recognising early disease issues influencing the production. Because SAgric-IoT is a wireless platform that employs low-power algorithms for data collection, we come to the conclusion that it is a workable approach to enhance precision agriculture.

T. Blesslin Sheeba et al (2022) stated wrong crop management and soil management practises are the main causes of the decline in soil quality. The ELM algorithm is used to determine the soil's level of fertility. Using IoT in farming, this technology can be used to build a neural network that predicts soil fertility based on the characteristics of soil samples. The Tamil Nadu government would find this methodology helpful in managing the soil and addressing the problems with nutrient deficiencies. This methodology will also be helpful for mapping the fertility of the soil and determining the fertility indices of other nutrients that are similar. To diagnose the soil properties, it can also be applied in agroecological regions. So, a thorough investigation of the soils in four Tamil Nadu districts is carried out. The outcomes are then documented for future reference and appropriate action. Overall, the soil is found to be rich in potassium (35 percent of samples), nitrogen (80 percent of tests), and sulphur (75 percent of samples), while magnesium, boron, zinc, and copper are either sufficient or lacking.

Sharma et al (2021) stated precision agriculture utilizes advanced technology to assist farmers in obtaining optimal results with minimal input. This technology includes smart sensors, actuators, satellite imagery, robotics, and drones equipped with Internet of Things (IoT) capabilities. By collecting real-time data, these tools enable farmers to make informed decisions without the need for human intervention. Artificial intelligence (AI) plays a vital role in precision agriculture, helping to automate intelligent behavior and benefitting numerous aspects of daily life. In recent research, authors have explored the applications of machine learning (ML) in precision agriculture. Regression algorithms serve as the foundation for predicting soil characteristics, weather patterns, and crop yields. Deep learning (DL) algorithms such as Convolutional Neural Networks (CNN) and ML classification techniques such as Support Vector Machines (SVM), Decision Trees, and Random Forests are utilized to identify plant diseases and weeds. Effective irrigation systems and harvesting methods are essential for precision agriculture and can be achieved through the use of robots and drones equipped with cameras. Livestock management is also a concern for farmers worldwide, and intelligent IoT and AI tools can effectively manage cattle through knowledge-based agriculture systems.

C K.Gomathy et al (2021) focused on estimating rainfall, it is believed that SVR is a useful and flexible method that may assist the client manage challenges related to the distributional characteristics of essential components, the geometry of the data, and the common problem of model overfitting. For SVR showing, the hit capacity decision is fundamental. For each direct and nondirect relationship, we advise tenderfoots to use the straight and RBF component. As an expectation approach, SVR is superior to MIR, as we can see. When MLR is unable to detect the non-linearity in a data set, SVR proves to be beneficial. We also carry out processing. Mean Absolute Error (MAE) is used to evaluate the performance of the MLR and SVR models. Finally, we examine the SLR presentation. Tuned SVR model and SVR. accurate for Finally, we examine the SLR, SVR, and tweaked SVR models' presentations. The best expectation is provided by the tuned SVR model, as expected. The best expectation comes from the tuned SVR model.

Jain et al(2021) designed monitoring the three characteristics in particular. The system is flawless and transmits data between the server and mobile app quickly and effectively. However, a number of widely available sensors can also be used to monitor and analyse other characteristics, such as the level of CO2 in the air, the PH of the soil, etc. An artificial intelligence-based application algorithm for a new application module will be built in the upcoming work.

Hetal Patela et al (2021) found out that the use of IoT, precision agriculture is advancing agriculture to boost crop productivity and maximise resources. The farmer has also made preparations to utilise these resources. With the development of IoT, the goal of smart agriculture is to incorporate the most recent technology in farming and agriculture for increased crop production by assembling the current real-time crop status and educating farmers on agricultural innovation, with a variety of new features and functionality to improve agricultural practises.

Rajinder kumar et al (2020) created a wireless sensor network with peer-to-peer communication between a router XBee and a coordinator XBee using this suggested framework and the prototype. Additionally, a star network or a mesh network can be constructed on a bigger scale for use in the real world. We were successful in demonstrating how ZigBee technology's key benefits, such as low data rate, low power consumption, and wider area coverage, can be used to develop a practical, affordable solution for precision agriculture. In comparison to other sensors in the same class that were available, the chosen sensors were not only affordable but also had a high level of accuracy. The prototype was able to automate irrigation while utilising less labour and resources (especially water). Through these findings, it can be seen that the use of wireless sensors in conjunction with wireless technology like ZigBee will enable farmers to reduce the cost of resources, particularly the scarce resource of water, as well as the labour required, and to gain benefits in the form of increased production quality and quantity. In order to further our work, we would like to add a few more sensors to get data on the soil and field plants. We also want to test our framework in the field by building a mesh network, which would be more dependable and cover a greater area.

Achilles D. Boursianis et al (2020) proposed a AREThOU5A platform, an IoT platform created to implement intelligent irrigation practises and policies in the water irrigation management of a perennial olive crop, has been presented and examined. The layered architecture stack that has been implemented as well as the subsystems of the AREThOU5A IoT platform are presented and discussed. An novel method for providing electricity to the platform's IoT nodes has been used in the context of the AREThOU5A IoT platform. In order to achieve this, a rectenna module for the measurement subsystem of the AREThOU5A IoT platform has been created. The manufactured retractable antenna has been experimentally validated, and the results show that the antenna and

RF-to-DC converter function satisfactorily outside. The antenna's reflection coefficient is measured to be excellent at -31.18 dB at 870 MHz and -27.84 dB at 937.5 MHz, and the rectifier's efficiency is measured to be satisfactory at 68% for Pin = 0 dBm. The installation of the rectenna module in various IoT nodes inside a cultivation field is part of future work that will be done to evaluate its performance.

S. Puengsungwan et al (2020) introduced the use of Internet of Things (IoT) technology in the field of smart farming. The IoT ecosystem for smart farming includes four main components: connected devices, a cloud platform, a user interface, and data analytics. Figure 11 illustrates that real-time moisture data can be analyzed, and an online-MATLAB platform can be utilized to obtain online analyzed data. Future work will involve the use of IoT-based controllers to implement data analytics. The proposed concept involves the connected device activating the controller, which then connects to the cloud to retrieve available data for analysis and hardware control. To fully harness the potential of IoT in agriculture, it is crucial to understand that this technology involves advanced systems and processes for real-time data analysis.

CHAPTER 3

SUGGESTED METHOD

Precision agriculture aims to optimize crop yield and quality while minimizing waste and reducing the environmental impact of farming practices. Soil monitoring is a critical component of precision agriculture because soil conditions can have a significant impact on crop growth and productivity. An IoT-based soil monitoring system can provide farmers with real-time data on soil moisture levels, temperature, and nutrient content, allowing them to make informed decisions about when and how much to irrigate, fertilize, and manage their crops. This can help farmers optimize resource usage, reduce water waste, and increase crop yields and quality. By monitoring soil conditions continuously, farmers can also detect changes in soil quality and address issues before they negatively impact crop growth. This can help reduce crop losses and increase the sustainability of farming practices.

3.1 OBJECTIVES

- To increase the yield of the crop by using IoT technology.

- The agricultural environment is monitored for various factors, including soil moisture, temperature, humidity, pH level, and light intensity.

- The optimum crop for the soil can be chosen using real-time data collected from the soil, and machine learning algorithms can estimate the likelihood of rain by using temperature and humidity measurements.

3.2 BLOCK DIAGRAM OF SUGGESTED SYSTEM

The system's goal is to assist farmers in making wise decisions while forecasting the crops. The concept suggests employing sensor networks to monitor several soil properties and displaying the information on an Android app. Temperature, humidity, wetness, and pH of the soil are all measured using different types of soil sensors. The technology will create an integrated circuit that will automatically measure the soil's pH, temperature, and moisture content. The Node MCU ESP32 serves as the microcontroller for the suggested system. To collect various metrics from the farm, DHT11 (Digital humidity and temperature) sensors, soil moisture sensors, and soil pH sensors are used.

Various machine learning (ML) algorithms are utilized to conduct further analysis on the extracted parameters. The outcome of this project is monitoring soil and crop recommendation based on the processing of different parameters of soil and result is display on android app. This project replaces the primitive method of soil testing and so, the farmers get to know about their soil quickly. The result provides by this project helps the farmers to take up the decision. Figure 3.1 shows the Block Diagram of suggested System.

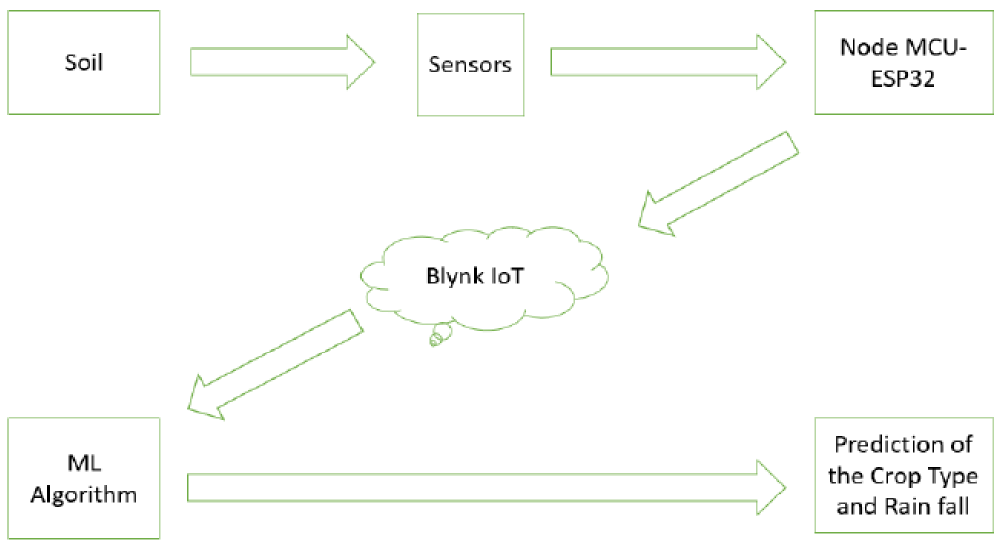


Figure 3.1: **Traditional agriculture cycle**

All the sensors DHT11 (Digital Humidity and Temperature) sensor, Soil moisture sensor, Soil pH sensor are connected to the Node MCU ESP32 which acts as microcontroller. Live data is collected from the farm like temperature, humidity, moisture, soil pH and the live data is uploaded to the Blynk IoT. Data regarding temperature, humidity, soil moisture, soil pH, and historical rainfall are gathered and stored from government websites and/or the Google Weather API. Furthermore, the type of soil utilized by the farmer is documented. This historical data is crucial for monitoring and analyzing the agricultural environment, allowing farmers to optimize growing conditions for their crops. Various Machine Learning (ML) algorithms are utilized for further analysis of the extracted parameters. These algorithms are applied to both live and historical data to determine the most appropriate crop to be cultivated. The predictions made by these algorithms help in identifying the optimal crop for planting.

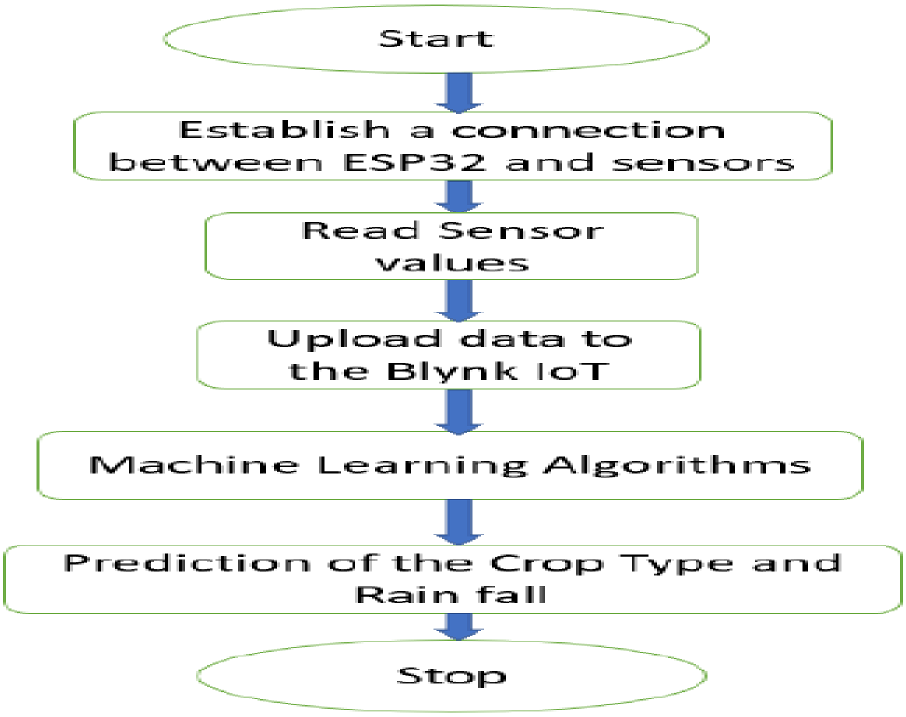


Figure 3.2: **Flow Diagram for the Suggested System**

Figure 3.2 shows the step by step process of how the suggested model works and how the data is collected and recorded, i.e is from data collection to final output of the model.

CHAPTER 4

SURVEY DETAILS

4.1 INTRODUCTION ABOUT VILLAGE

Bhimadole is a village located in Eluru district of Andhra Pradesh, India, Which is popularly known as West Godavari. Our village is a quintessential example of the close relation ship between humans and the land. With a rich heritage that spans generations, farming is not just a wat of life here;it's the soul of community. The village has population of about 60,000 people. Villages play a crucial role in the agriculture sector, serving as the backbone of agricultural production in many regions. These rural communities are often characterized by a strong agrarian economy and are essential for the cultivation of crops and the raising of livestock. Villagers engage in various agricultural activities, including crop cultivation, animal husbandry, and agro-processing. The satellite view of the village is shown in Figure 4.1.

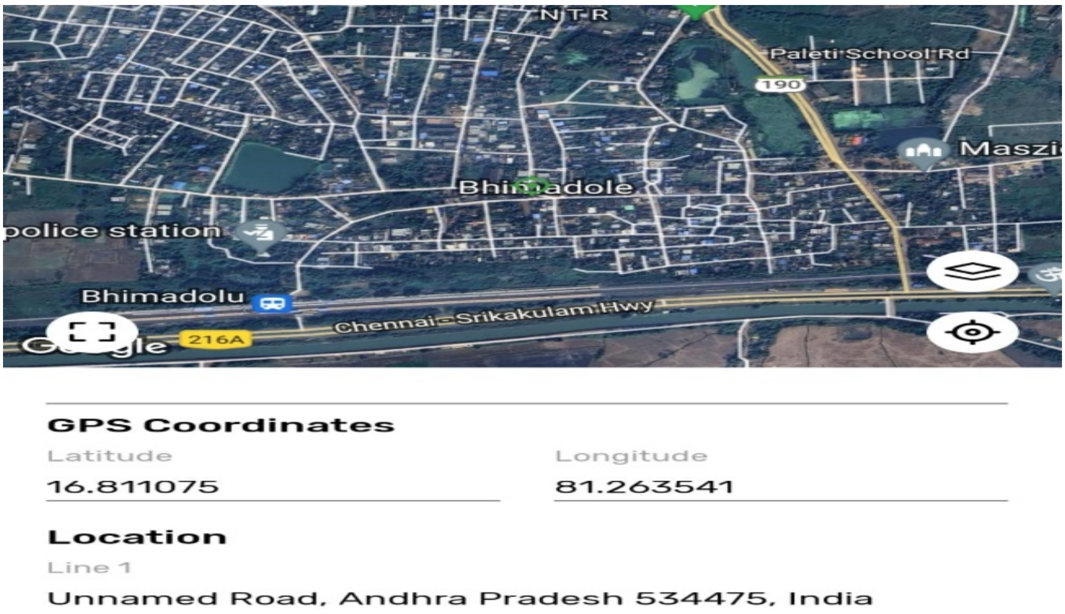


Figure 4.1: **Bhimadole Village**

4.2 PROJECT ACTIVITY LOG

WEEK	BRIEF DESCRIPTION OF THE DAILY ACTIVITY	LEARNING OUTCOME
Day 1	Survey planning and preparation	Well-structured survey instruments ready for data collection.
Day 2	Pre-survey communication	Increased awareness about the upcoming survey and its significance.
Day 3	Data collection	Gathered valuable insights into the soil moisture knowledge and practices.
Day 4	Survey with community	Gathered information about soil moisture in our community.
Day 5	Community feedback	Enhanced community engagement and inclusion in soil testing.

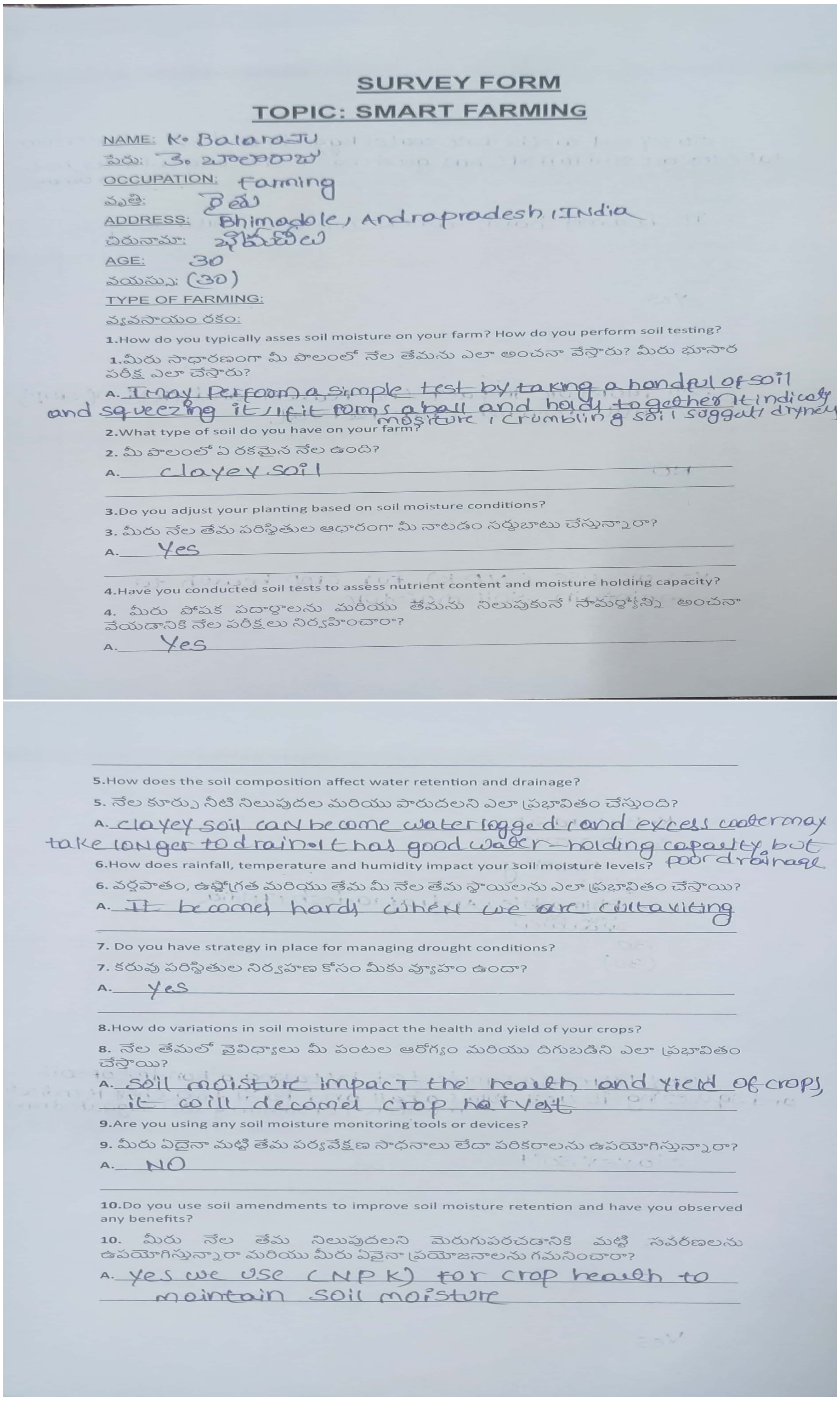
Table 4.1: **Activity Log**

4.3 SURVEY ANALYSIS

Google Link: https://forms.gle/fnkFTfSwEPXP1VJMA
Video Link: https://screenpal.com/watch/c0XjiOVGX3r

4.4 SUMMARY

Conducted a survey about how to identify the soil moisture content in soil. Mainly conducted a survey in four types of soils like silt,sandy,clay,loam soils. In all these soils observed that clay soil has high moisture content. The survey around 10 farmers about how they check the soil moisture content and what are the tools they are using for testing moisture content. A survey analysis on agriculture can provide valuable insights into the challenges, opportunities, and trends within this vital sector. The survey delved into various aspects of agriculture, from farming practices to the impact of technology. One notable finding was the growing concern for sustainable farming methods. Respondents highlighted the need to reduce the environmental footprint of agriculture, emphasizing practices that promote soil health, water conservation, and reduced chemical use. The survey also shed light on the role of technology in modern agriculture. Farmers expressed their growing reliance on precision agriculture techniques, such as GPS-guided tractors and drones for monitoring crops. Furthermore, the analysis indicated that the agricultural community is facing challenges related to climate change. Erratic weather patterns and extreme conditions are causing disruptions in crop cycles and livestock management. The survey analysis underscores the significance of agriculture in the modern world and the need for sustainable and technology-driven solutions to address the challenges that farmers face. It highlights the importance of policy decisions and collective efforts to ensure the long-term



SURVEY FORM

TOPIC: SMART FARMING

NAME: K• Balaraju
పేరు: కె. బాలరాజు
OCCUPATION: Farming
వృత్తి: రైతు
ADDRESS: Bhimadole, Andrapradesh, INdia
చిరునామా: భీమడోలు
AGE: 30
వయస్సు: (30)
TYPE OF FARMING:
వ్యవసాయం రకం:

1.How do you typically asses soil moisture on your farm? How do you perform soil testing?
1.మీరు సాధారణంగా మీ పొలంలో నేల తేమను ఎలా అంచనా వేస్తారు? మీరు భూసార పరీక్ష ఎలా చేస్తారు?
A. I may perform a simple test by taking a handful of soil and squeezing it, if it forms a ball and holds together it indicates mositure, crumbling soil suggests dryness

2.What type of soil do you have on your farm?
2. మీ పొలంలో ఏ రకమైన నేల ఉంది?
A. clayey.soil

3.Do you adjust your planting based on soil moisture conditions?
3. మీరు నేల తేమ పరిస్థితుల ఆధారంగా మీ నాటడం సర్దుబాటు చేస్తున్నారా?
A. Yes

4.Have you conducted soil tests to assess nutrient content and moisture holding capacity?
4. మీరు పోషక పదార్థాలను మరియు తేమను నిలుపుకునే సామర్థ్యాన్ని అంచనా వేయడానికి నేల పరీక్షలు నిర్వహించారా?
A. Yes

5.How does the soil composition affect water retention and drainage?
5. నేల కూర్పు నీటి నిలుపుదల మరియు పారుదలని ఎలా ప్రభావితం చేస్తుంది?
A. clayey soil can become waterlogged, and excess water may take longer to drain. It has good water-holding capacity, but poor drainage

6.How does rainfall, temperature and humidity impact your soil moisture levels?
6. వర్షపాతం, ఉష్ణోగ్రత మరియు తేమ మీ నేల తేమ స్థాయిలను ఎలా ప్రభావితం చేస్తాయి?
A. It becomes hard when we are cultivating

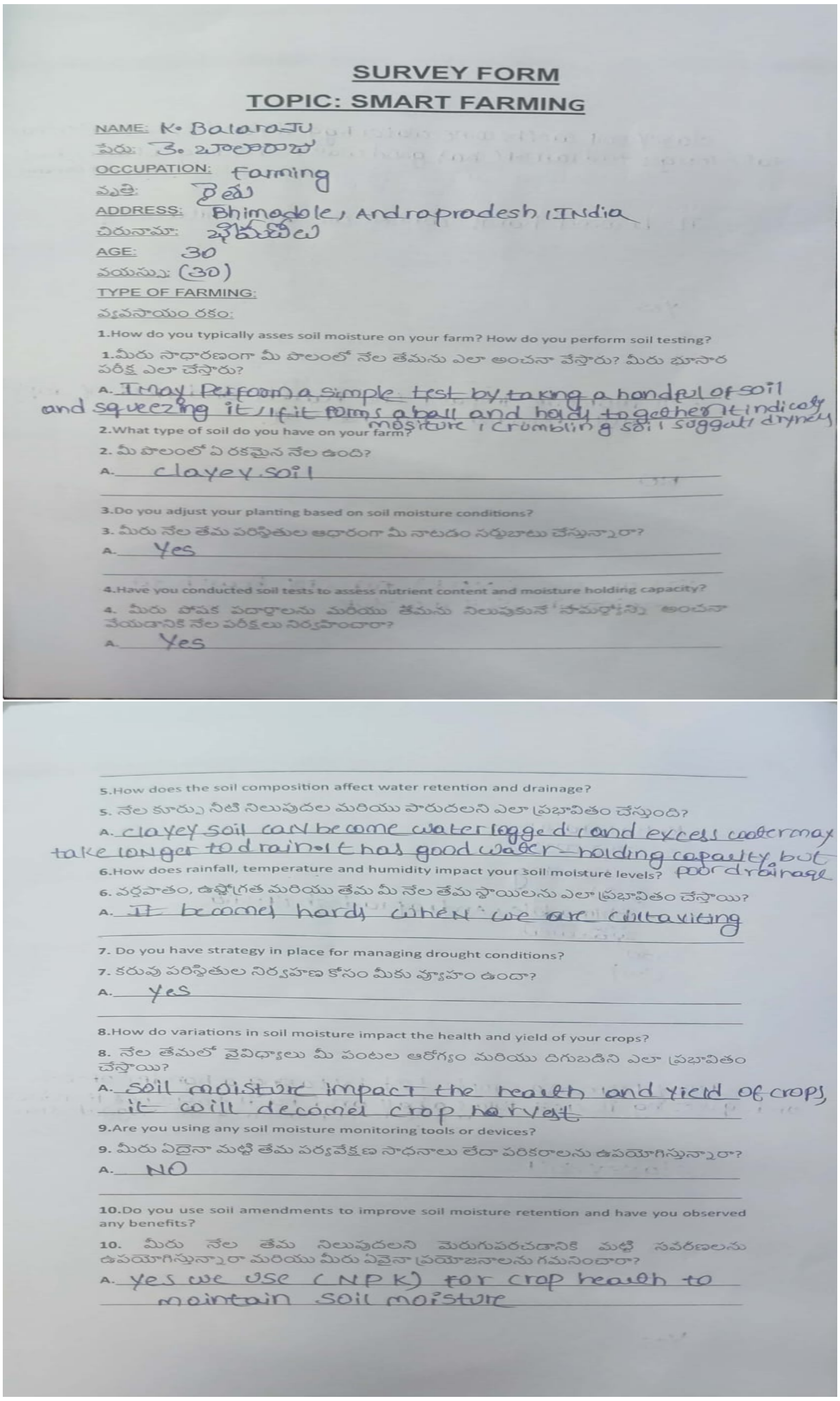
7. Do you have strategy in place for managing drought conditions?
7. కరువు పరిస్థితుల నిర్వహణ కోసం మీకు వ్యూహం ఉందా?
A. yes

8.How do variations in soil moisture impact the health and yield of your crops?
8. నేల తేమలో వైవిధ్యాలు మీ పంటల ఆరోగ్యం మరియు దిగుబడిని ఎలా ప్రభావితం చేస్తాయి?
A. soil moisture impact the health and yield of crops, it will decomes crop harvest

9.Are you using any soil moisture monitoring tools or devices?
9. మీరు ఏదైనా మట్టి తేమ పర్యవేక్షణ సాధనాలు లేదా పరికరాలను ఉపయోగిస్తున్నారా?
A. NO

10.Do you use soil amendments to improve soil moisture retention and have you observed any benefits?
10. మీరు నేల తేమ నిలుపుదలని మెరుగుపరచడానికి మట్టి సవరణలను ఉపయోగిస్తున్నారా మరియు మీరు ఏవైనా ప్రయోజనాలను గమనించారా?
A. yes we use (NPK) for crop health to maintain soil moisture

Figure 4.2: **Snapshot of survey form (Sample 1)**



SURVEY FORM

TOPIC: SMART FARMING

NAME: K. Balaraju
పేరు: కె. బాలారాజు
OCCUPATION: Farming
వృత్తి: రైతు
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AGE: 30
వయస్సు: (30)
TYPE OF FARMING:
వ్యవసాయం రకం:

1.How do you typically asses soil moisture on your farm? How do you perform soil testing?
1.మీరు సాధారణంగా మీ పొలంలో నేల తేమను ఎలా అంచనా వేస్తారు? మీరు భూసార పరీక్ష ఎలా చేస్తారు?
A. I may perform a simple test by taking a handful of soil and squeezing it, if it forms a ball and holds together it indicates moisture, crumbling soil suggests dryness

2.What type of soil do you have on your farm?
2. మీ పొలంలో ఏ రకమైన నేల ఉంది?
A. clayey soil

3.Do you adjust your planting based on soil moisture conditions?
3. మీరు నేల తేమ పరిస్థితుల ఆధారంగా మీ నాటడం సర్దుబాటు చేస్తున్నారా?
A. Yes

4.Have you conducted soil tests to assess nutrient content and moisture holding capacity?
4. మీరు పోషక పదార్థాలను మరియు తేమను నిలుపుకునే సామర్థ్యాన్ని అంచనా వేయడానికి నేల పరీక్షలు నిర్వహించారా?
A. Yes

5.How does the soil composition affect water retention and drainage?
5. నేల కూర్పు నీటి నిలుపుదల మరియు పారుదలని ఎలా ప్రభావితం చేస్తుంది?
A. clayey soil can become waterlogged and excess water may take longer to drain. It has good water-holding capacity, but poor drainage

6.How does rainfall, temperature and humidity impact your soil moisture levels?
6. వర్షపాతం, ఉష్ణోగ్రత మరియు తేమ మీ నేల తేమ స్థాయిలను ఎలా ప్రభావితం చేస్తాయి?
A. It becomes hard when we are cultivating

7. Do you have strategy in place for managing drought conditions?
7. కరువు పరిస్థితుల నిర్వహణ కోసం మీకు వ్యూహం ఉందా?
A. yes

8.How do variations in soil moisture impact the health and yield of your crops?
8. నేల తేమలో వైవిధ్యాలు మీ పంటల ఆరోగ్యం మరియు దిగుబడిని ఎలా ప్రభావితం చేస్తాయి?
A. soil moisture impact the health and yield of crops, it will decrease crop harvest

9.Are you using any soil moisture monitoring tools or devices?
9. మీరు ఏదైనా మట్టి తేమ పర్యవేక్షణ సాధనాలు లేదా పరికరాలను ఉపయోగిస్తున్నారా?
A. NO

10.Do you use soil amendments to improve soil moisture retention and have you observed any benefits?
10. మీరు నేల తేమ నిలుపుదలని మెరుగుపరచడానికి మట్టి సవరణలను ఉపయోగిస్తున్నారా మరియు మీరు ఏవైనా ప్రయోజనాలను గమనించారా?
A. yes we use (NPK) for crop health to maintain soil moisture

Figure 4.3: **Snapshot of survey form (Sample 2)**

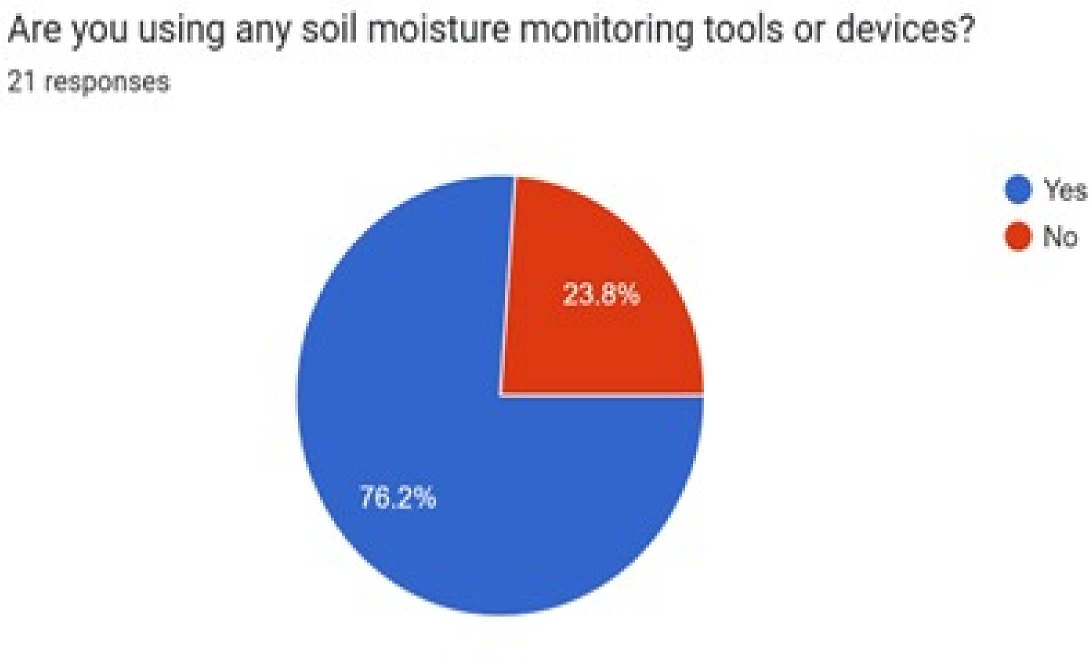


Figure 4.4: **Analysis of survey form**

health and productivity of this crucial sector, which sustains our communities and provides for our food security.

Sensors will collect the data from the soil and send to the node MCU port. From the node MCU it will send the collected data to the cloud platform. Cloud platform will either store the data or it will send data to the user.The user get the messages to their respective mobile phones. Mobile phones will get the information about the moisture content in the soil. So that the farmers know that which crop is suitable for their soil and also depending upon the climatic changes. The farmers get more crop yield by using this soil moisture sensor.

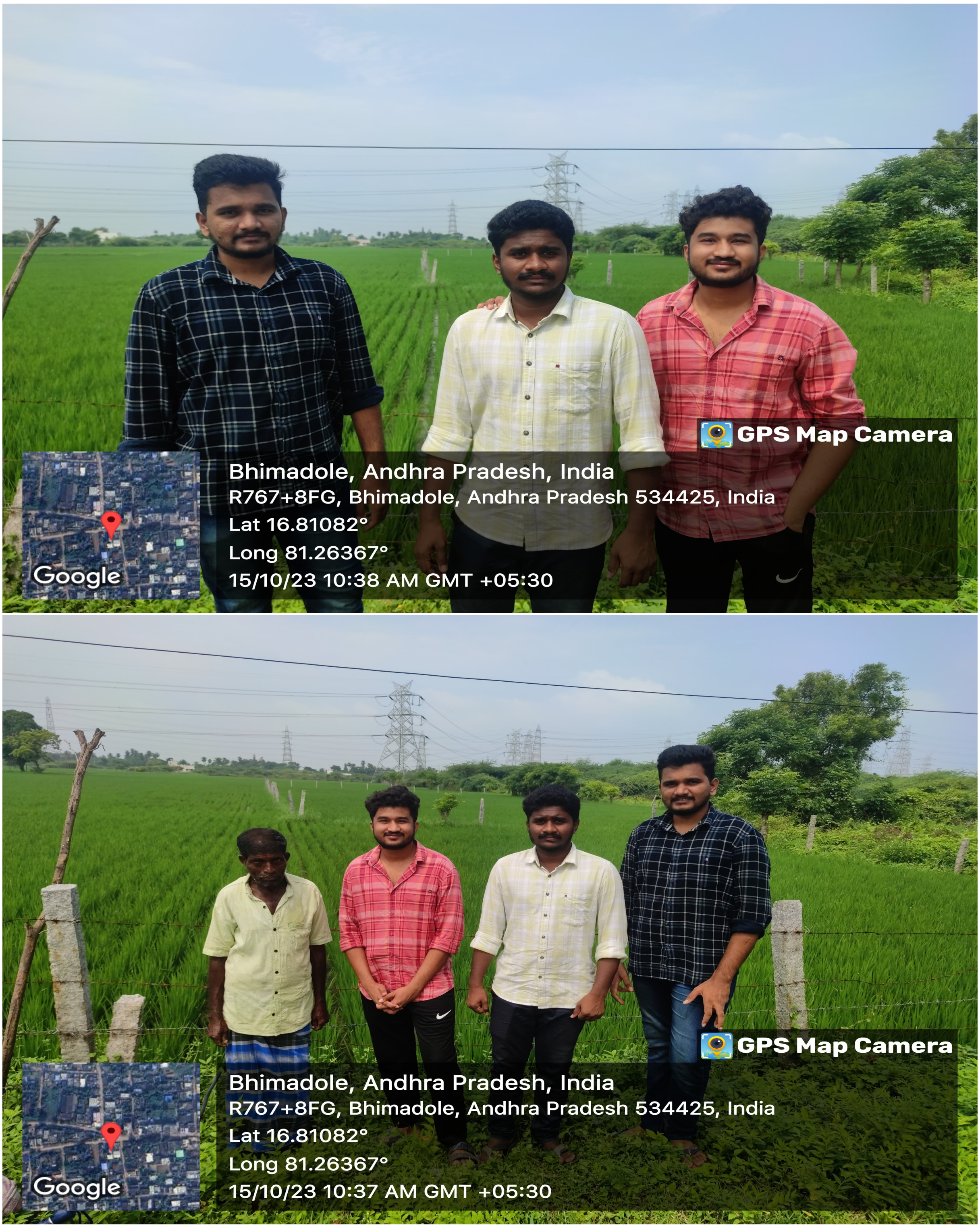
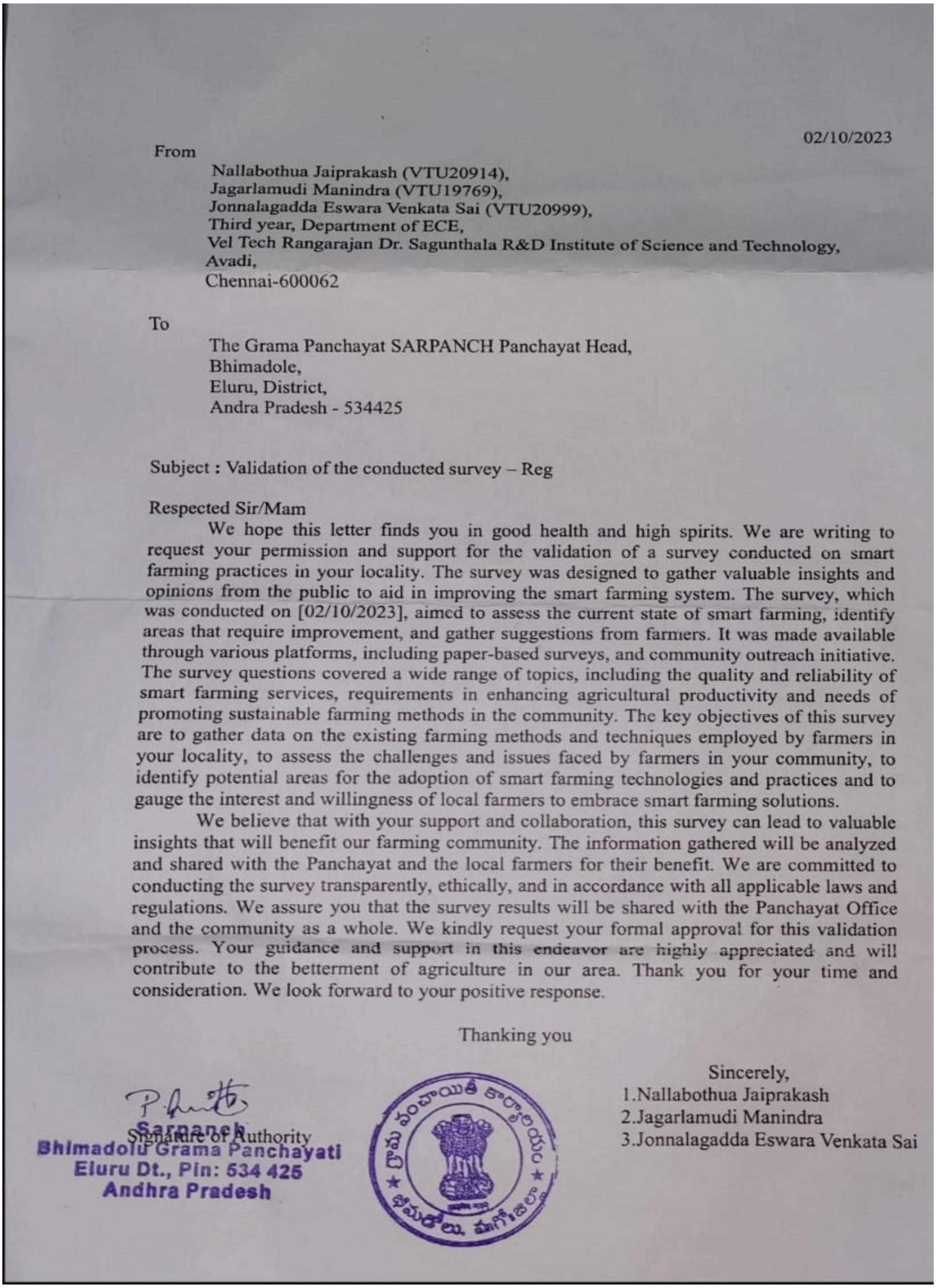


Figure 4.5: **Survey photos**



02/10/2023

From

Nallabothua Jaiprakash (VTU20914),
Jagarlamudi Manindra (VTU19769),
Jonnalagadda Eswara Venkata Sai (VTU20999),
Third year, Department of ECE,
Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology,
Avadi,
Chennai-600062

To

The Grama Panchayat SARPANCH Panchayat Head,
Bhimadole,
Eluru, District,
Andra Pradesh - 534425

Subject : Validation of the conducted survey – Reg

Respected Sir/Mam

We hope this letter finds you in good health and high spirits. We are writing to request your permission and support for the validation of a survey conducted on smart farming practices in your locality. The survey was designed to gather valuable insights and opinions from the public to aid in improving the smart farming system. The survey, which was conducted on [02/10/2023], aimed to assess the current state of smart farming, identify areas that require improvement, and gather suggestions from farmers. It was made available through various platforms, including paper-based surveys, and community outreach initiative. The survey questions covered a wide range of topics, including the quality and reliability of smart farming services, requirements in enhancing agricultural productivity and needs of promoting sustainable farming methods in the community. The key objectives of this survey are to gather data on the existing farming methods and techniques employed by farmers in your locality, to assess the challenges and issues faced by farmers in your community, to identify potential areas for the adoption of smart farming technologies and practices and to gauge the interest and willingness of local farmers to embrace smart farming solutions.

We believe that with your support and collaboration, this survey can lead to valuable insights that will benefit our farming community. The information gathered will be analyzed and shared with the Panchayat and the local farmers for their benefit. We are committed to conducting the survey transparently, ethically, and in accordance with all applicable laws and regulations. We assure you that the survey results will be shared with the Panchayat Office and the community as a whole. We kindly request your formal approval for this validation process. Your guidance and support in this endeavor are highly appreciated and will contribute to the betterment of agriculture in our area. Thank you for your time and consideration. We look forward to your positive response.

Thanking you

Sincerely,
1.Nallabothua Jaiprakash
2.Jagarlamudi Manindra
3.Jonnalagadda Eswara Venkata Sai

Signature of Authority

Sarpanch
Bhimadolu Grama Panchayati
Eluru Dt., Pin: 534 425
Andhra Pradesh

Figure 4.6: **Certificate from authorised head**

CHAPTER 5

CONCLUSION

This project conveys the usage of new and innovative approach to the farmers on keeping track of soil and environmental conditions in real-time. The system involves monitoring various parameters such as temperature, humidity, moisture content, and pH level, and storing the sensor readings on the Blynk IoT cloud. Users can conveniently access the data using the Blynk IoT Android application.Data analysis is performed using a hybrid algorithm that employs machine learning techniques. By gathering information on the aforementioned parameters, the proposed model enables farmers and agriculturists to make informed decisions regarding crop and rain predictions. Overall, this project presents a valuable contribution to the field of agriculture and environmental monitoring.

Looking ahead to the future, it is anticipated that this soil monitoring system will be capable of monitoring an expanded range of parameters. Moreover, to further augment the system's capabilities, additional functionalities can be incorporated that furnish users with both visual and auditory notifications, particularly in cases where unfavorable conditions are detected. Such features will provide users with an added layer of protection, enabling them to respond swiftly and effectively to any emerging issues, and ultimately safeguarding their agricultural investments.

REFERENCES

[1] Habib, S.; Alyahya, S.; Islam, M.; Alnajim, A.M.; Alabdulatif, A.; Alabdulatif, A. Design and Implementation: An IoT-Framework-Based Automated Wastewater Irrigation System. Electronics 2022, 12, 28. https://doi.org/10.3390/electronics12010028.

[2] Contreras-Castillo, J.; Guerrero-Iba˜nez, J.A.; Santana-Mancilla, P.C.; Anido-Rif´on, L. SAgric-IoT: An IoT-Based Platform and Deep Learning for Greenhouse Monitoring. Appl. Sci. 2022, 13, 1961. https://doi.org/10.3390/app13031961 .

[3] Blesslin Sheeba, T.; Anand, L. D. Vijay; Manohar, Gunaselvi; Selvan, Saravana; Wilfred, C. Bazil; Mu. 2022 Machine Learning Algorithm for Soil Analysis and Classification of Micronutrients in IoT-Enabled Automated Farms,accessed (March 04 2022)

[4] Sharma, Abhinav et al. “Machine Learning Applications for Precision Agriculture: A Comprehensive Review.” IEEE Access 9 (2021): 4843-4873.

[5] Dr. C K.Gomathy , Anna Pareddy Bala Narasimha Reddy ,”Rainfall prediction: Accuracy enhancement using machine learning and forecasting techniques.” In 2018 Fifth International Conference on Parallel, Distributed and Grid Computing (PDGC), pp. 776-782. IEEE, 2021.

[6] Jain, Neha, Yogesh Awasthi, and R. K. Jain. ”Ubiquitous Sensor based Intelligent System for Net Houses.” 2021 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS). IEEE, 2021.

[7] Hetal Pa-tel, Shailesh Khant, Atul Patel, Turkish Journal of Computer and Mathematics Education (TURCOMAT), ISSN: 1309-4653,Artificial Intelligence and IoT based Smart Irrigation system for Precision Farming.(2021)

[8] Rajinder Kumar,M.Math, and Nagaraj V. Dharwadkar. ”A wireless sensor network based low cost and energy efficient frame work for precision agriculture.” 2020 International Conference on Nascent Technologies in Engineering (ICNTE). IEEE, 2020.

[9] Achilles D.,Boursianis, Maria S. Papadopoulou, Antonis G. Gotsis, Shaouha Wan, Panagiotis G. Sarigiannidis, Spyridon Nikolaidis and Sotirios K. Goudos. “Smart Irrigation System for Precision Agriculture—The AREThOU5A IoT Platform.” IEEE Sensors Journal 21 (2020): 17539-17547.

[10] S. Puengsungwan, ”IoT based Soil Moisture Sensor for Smart Farming,” 2020 International Conference on Power, Energy and Innovations (ICPEI), Chiangmai, Thailand, 2020, pp. 221-224, doi: 10.1109/ICPEI49860.2020.9431455.