

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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### A Mini Project Report

**On**

***“Agricultural Area Sensors”***

*Submitted in partial fulfillment of the requirements for the I semester Assignment of the Course innovation and Design Thinking of* ***Bachelor of Engineering in Computer Science and Engineering (Data Science)*** *of Visvesvaraya Technological University, Belagavi*

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**2022-2023**



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**CERTIFICATE**

Certified that the Mini Project Work entitled **“Agricultural Area Sensors”** has been successfully carried out by **R Khushwith Kumar (1RN22CD069),Sunil Raju (1RN22CD104),** bonafide students of **RNS Institute of Technology, Bengaluru** in partial fulfillment of the requirements of **Bachelor of Engineering in Computer Science and Engineering** of **Visvesvaraya Technological University, Belgaum** during academic year **2022-2023**. The Mini project report has been approved as it satisfies the academic requirements in respect of project work for the said degree.

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# ABSTRACT

The use of agricultural area monitors in contemporary farming methods is growing in popularity. Temperature, humidity, soil moisture, nutrient levels, and other environmental and crop-related parameters are among the parameters that these sensors are intended to track in agricultural areas. These sensors' data can offer useful insights into the crop growth and development and aid farms in managing irrigation and fertilizer more effectively.

The capacity of agricultural area sensors to provide real-time data is one of their main advantages. As a result, farmers can rapidly detect and address potential problems like outbreaks of pests and diseases or changes in the weather. Farmers can improve crop yields, cut down on resource waste, and eventually increase profitability by using this data to inform their choices.

Additionally, as agricultural area sensors become more interconnected, farmers will be able to access data online using smartphones or other devices. This connectivity also makes it possible to use sophisticated analytics and machine learning algorithms, which can offer even more insightful analysis and suggestions to improve farming practices.

Overall, agricultural area sensors have the power to completely change the way farmers handle their resources and crops. These sensors can support farmers in making data-driven decisions to boost efficiency and output while reducing waste and environmental impact by providing real-time data and insights.

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**CHAPTER 1**

# INTRODUCTION

The need to produce more food is driving up pressure on farms to increase crop yields as the world's population continues to rise. The use of sensors in agriculture is one method farmers are able to meet this demand. Real-time monitoring of a variety of environmental and crop-related parameters by sensors enables farmers to optimize their agricultural techniques and boost yields.

Agriculture has always placed a significant emphasis on environmental variables like temperature and soil quality. But thanks to the development of new technologies like sensors, producers can now practice more preventative farming. Sensors can keep an eye on environmental factors like temperature, humidity, and soil wetness, giving farmers useful information they can use to improve their fertilization and irrigation methods as well as spot pest and disease outbreaks before they become serious issues.

The use of sensors in agriculture has the ability to completely change the sector and make it more efficient and sustainable. By promoting precision farming techniques, farmers can lessen their effect on the environment with the aid of sensors. Farmers can minimize waste and raise agricultural productivity by making the best use of resources like water and fertilizer.

In addition to assisting farmers in streamlining their farming techniques, sensors offer customers more transparency and traceability in the food supply chain. Sensors enable farmers to gather data on every stage of crop development and production, giving customers important details about the source and quality of their food. As more ethical and sustainable farming methods are demanded by consumers, this degree of transparency is becoming more and more crucial.

In the upcoming years, it is anticipated that the use of sensors in agriculture will continue to expand. In order to help farmers meet the rising demand for food production while reducing their environmental impact, sensors will become more and more important as they become more sophisticated and cheap.

**CHAPTER 2**

# LITERATURE SURVEY

J. Maja and P. V. M. Rao's "The Role of Sensors in Precision Agriculture" was published in 2017. The various sensor kinds used in precision agriculture, their applications, and effects on crop yields and resource efficiency are all thoroughly covered in this review paper. The authors discuss the difficulties that need to be overcome for widespread adoption while highlighting the possible advantages of sensor-based technologies for sustainable agriculture.

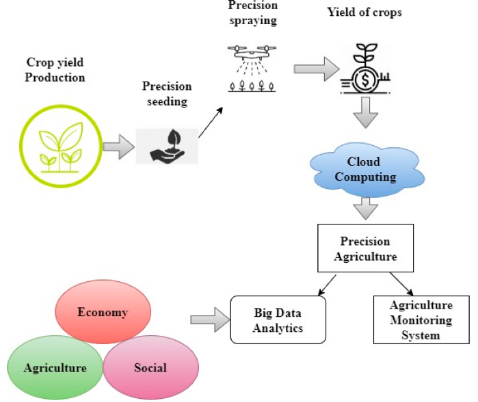


Fig 2.1.1

A. Lloret and colleagues published "Wireless Sensor Networks for Agriculture: The State-of-the-Art in Practice and Future Challenges" in 2017. The most recent advancements in wireless sensor networks for agriculture, including uses in precision farming, animal monitoring, and environmental monitoring, are summarized in this paper. The authors emphasis the potential for further study in this area and talk about the difficulties in integrating sensor networks with current farming practices.

CHAPTER 2 LITERATURE SURVEY

"Sensor-Based Monitoring of Crop Water Stress in Corn and Soybean" (2016) by M. A. Youssef et al. This research article explores the use of sensors for monitoring crop water stress in corn and soybean plants. The authors present a methodology for using sensors to monitor plant water status and demonstrate how this information can be used to optimize irrigation scheduling and improve crop yields.

H. Zheng and J. Zhao's "Smart Agriculture: An Application of IoT Technology in Agriculture" was published in 2019. The most recent advancements in IoT technology for agriculture, such as sensor-based monitoring and control systems, are summarized in this article. The authors talk about the possible advantages of IoT technology for environmentally friendly farming and highlight the difficulties that still need to be overcome before it can be widely adopted.

M. F. A. M. Rashid and colleagues published "Sensors for Agricultural Monitoring: Recent Advances and Future Directions" in 2019. An overview of the most recent sensor advancements for agricultural monitoring, including applications for precision farming, livestock management, and environmental monitoring, is provided in this review paper. The authors discuss the difficulties that need to be overcome for widespread adoption while highlighting the possible advantages of sensor-based technologies for sustainable agriculture.

In general, the literature on sensors in agriculture emphasizes the potential advantages of these technologies for resource-efficient farming practices, including better crop yields, decreased environmental impact, and increased resource efficiency. The high cost of some sensor technologies, the requirement for data management and analysis tools, and the need for additional study to improve sensor-based farming techniques are all issues that must be addressed.

**CHAPTER 3**

# TYPES OF SENSORS USED IN AGRICULTURE

Sensors used in agricultural areas are used to gather information on a range of environmental, crop, and soil factors. They have developed into a crucial instrument for precision agriculture, assisting farmers in making knowledgeable choices, optimizing crop yields, and reducing their negative environmental effects.

Various agricultural area sensor types exist, each of which is intended to monitor a particular parameter. Crop sensors are used to track crop growth and health, while environmental sensors are used to measure weather and soil conditions. The use of pest and disease sensors allows farmers to act quickly to avoid harm by identifying the presence of pests and diseases in their crops.

These sensors usually wirelessly transmit the data they gather to a central data management system, where it can be analyzed and used as a decision-making tool. As a result, waste is decreased and total efficiency is increased by allowing farmers to make more targeted and exact interventions in their fields.

Generally speaking, as farmers look to optimize their operations and produce food more sustainably, the use of agricultural area sensors is quickly growing. In the upcoming years, it is possible that the use of sensors in agriculture will increase even further as technology develops and becomes more accessible.

## SOIL MOISTURE SENSORS

* + - Measure moisture content of soil to optimize irrigation and fertilization practices.
    - Tensiometers, gypsum blocks, capacitance sensors, and time domain reflectometry sensors.
    - Measure tension or suction force of soil.
    - Measure resistance of soil to electrical current.
    - Time domain reflectometry sensors: Measure time it takes for electrical pulse to travel through soil.

**CHAPTER 3 TYPES OF AGRICULTURAL SENSORS**

## WEATHER SENSORS

* + - Measure weather conditions in agricultural fields to inform decision-making.
    - Temperature sensors, humidity sensors, wind sensors, rainfall sensors, and light sensors.
    - Measure temperature of the air and soil.
    - Measure the amount of moisture in the air.
    - Measure wind speed and direction.
    - Typically wirelessly transmitted to central data management system for analysis and decision-making.
  1. **NUTRIENT SENSOR**
* Measure nutrient levels in soil to inform fertilization practices and improve crop yields.
* Ion-selective electrodes, optical sensors, and electrochemical sensors.
* Measure the concentration of specific ions in the soil, such as nitrate, ammonium, and potassium ions.
* Use light to measure the amount of chlorophyll in plants, which is an indicator of their nutrient status.
* Typically wirelessly transmitted to central data management system for analysis and decision-making.
  1. **IMAGING SENSOR**
* Capture images of crops and fields to detect and monitor crop health and growth.
* Multispectral sensors, hyperspectral sensors, and thermal sensors.
* Capture images in specific wavelengths of light to analyze plant health and identify stress factors.
* Capture images in many narrow wavelengths to provide detailed information on plant health, chemical composition, and water content.
* Capture images of the temperature of plants and fields to monitor growth and detect stress factors.
* Images are collected by drones or ground-based cameras, and typically processed using specialized software for analysis and decision-making.

**CHAPTER 4**

CHAPTER 4 REQUIREMENT ANALYSIS

# APPLICATIONS OF SENSORS IN AGRICULTURE

## IRRIGATION MANAGEMENT

* + - The Flow sensors measure the volume of water that is being delivered to the field, allowing farmers to monitor water use and detect leaks or other issues.
    - Evapotranspiration sensors measure the amount of water that is lost from the soil and plants due to evaporation and transpiration. This data can be used to adjust irrigation schedules and optimize water use.

## FERTILIZATION MANAGEMENT

* + - A Nutrient sensors measure the nutrient levels in the soil, allowing farmers to adjust fertilizer applications and reduce nutrient waste.
    - pH sensors measure the acidity or alkalinity of the soil, which can impact nutrient availability. This data can be used to adjust fertilizer applications and improve nutrient uptake.
    - Imaging sensors can be used to detect nutrient deficiencies or excesses in crops, allowing farmers to adjust fertilizer applications and optimize nutrient uptake.
    - Turn off the Buzzer when required.

**4.3 CROP MANEGEMENT**

* Imaging sensors can be used to detect plant stress, diseases, or nutrient deficiencies. This data can be used to adjust fertilizer applications, irrigation schedules, and other management practices to optimize crop growth.
* Light sensors can be used to monitor the amount and intensity of light that crops receive. This data can be used to adjust lighting or shading to optimize crop growth and yield.
* Temperature sensors can be used to monitor soil and air temperatures, which can impact crop growth and development. This data can be used to adjust management practices to optimize crop growth.

**CHAPTER 4 APPLICATIONS OF SENSORS IN AGRICULTURE**

## PEST MANAGEMENT

* Monitoring pest populations using pheromone traps to capture male insects and estimate population size.
* Tracking environmental conditions such as temperature and humidity to predict pest emergence.
* Detecting early signs of pest infestations such as changes in plant health or the presence of eggs or larvae.
* Using sensors to enable precision application of pesticides, reducing waste and minimizing environmental impact.
* Using remote sensing techniques such as drones or satellites to monitor crops for signs of stress or damage caused by pests.
* Implementing automated systems that use sensors to monitor and manage pest populations, reducing the need for manual labor and enabling real-time decision-making.



Fig 4.1.1

## ENVIRONMENT BENEFITS OF USING SENSORS IN AGRICULTURE

* 1. **REDUCED WATER AND FERTILIZER USAGE**
* Sensors can be used to monitor soil moisture levels in real-time, allowing growers to irrigate crops only when and where it is needed. This can help to reduce water waste and improve the efficiency of irrigation systems.
* Sensors can also be used to monitor soil nutrient levels and apply fertilizers only where they are needed. This can help to reduce the amount of fertilizer used, while still ensuring that crops have the nutrients they need to grow.
* By using sensors to monitor plant health, growers can detect early signs of stress or disease and take action to address the problem before it becomes severe. This can help to improve crop health and reduce the need for excessive watering or fertilization.

## REDUCED USE OF PESTICIDES AND HERBICIDES

* Sensors can be used to monitor pest populations and detect early signs of infestations. This allows growers to apply pesticides only when and where they are needed, reducing the overall amount of pesticides used.
* By using sensors to monitor environmental conditions, growers can implement integrated pest management strategies that rely on non-chemical methods of pest control, such as crop rotation, biological control, or habitat management. This can help to reduce the reliance on pesticides and herbicides.
* Sensors can also be used to improve the efficiency of pesticide and herbicide application. For example, by using precision sprayers that apply pesticides only where they are needed, growers can reduce the amount of chemicals used and minimize off-target drift.

**CHAPTER 6**

# CONCLUSION AND FUTURE WORK

## CONCLUSION

In conclusion, the use of sensors in agriculture can have a positive impact on the ecosystem by reducing the need for pesticides, fertilizers, and water. Growers can improve their production techniques, cut waste, and lessen the environmental effect of agriculture by continuously tracking crop health, soil moisture, and environmental conditions.

## FUTURE WORK

There is still much work to be done to maximize their use and increase their efficacy in the rapidly evolving area of sensor use in agriculture. Future projects could consist of:

* The creation of more sophisticated sensor technologies that can take more accurate measurements and monitor a broader variety of environmental factors.
* Integration of sensor data with artificial intelligence and machine learning algorithms to enable real-time decision-making and more effective management practices.
* Testing and validation of sensor-based management strategies in different crop types and growing environments to determine their effectiveness and potential limitations.
* Growers, researchers, and business partners are working together to create and implement sensor-based technologies at scale, while also making sure that all farmers can access and afford them.

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