MINI PROJECT REPORT

ON

# Eco Sense: Smart Arduino-Based Plant Health Monitoring System


Submitted by

GOTTAM VENKATA ABHINAV

NC.SC.U4CSE24250


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Dr. P. SIVA RAJA

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# 1. Abstract:

A new and developing field called "smart gardening" blends horticulture and technology to enable intelligent and e ective management of small farms and indoor gardens. In order to automate the monitoring of vital growth parameters such as soil humidity, ambient temperature, and light levels, this work presents a Smart Plant Monitoring System built on the Arduino platform. By o ering proactive notifications and real-time feedback, the system maximizes plant health and reduces the possibility of human error in manual monitoring.

The project is a realistic illustration of embedded system design using easily accessible hardware components and the Tinkercad simulation tool. The system is simple to use but incredibly e ective because to the usage of sensors, a buzzer for notifications, and the Serial Monitor for insightful data visualization. In addition to simplifying plant maintenance, the solution serves as a springboard for increasingly intricate smart agricultural applications, encouraging innovation and sustainability in daily life.

# 2. Introduction:

Plants are invaluable to life on Earth, providing food, oxygen, and beauty. Intelligent technologies that maximize plant development and eliminate the need for routine care have gained popularity in recent years. Common gardening practices, though effective, tend to be a matter of constant observation, which is not always possible for all people because of time limits or a lack of skills. This void has opened the door for smart systems that automate plant care and enhance results.

The Smart Plant Monitoring System uses Arduino microcontrollers' versatility to continuously monitor critical environmental parameters. The system gives precise information about the surroundings of the plant by integrating sensors for light, temperature, and soil moisture. The provision of real-time alerting through a buzzer guarantees consumers are kept immediately aware of undesirable situations to permit swift corrective efforts. This project exhibits integration between technology and nature, and the sophisticated plant care is now made available to enthusiasts, students, and professionals.

## 3. Literature Review / Background Study:

Agriculture has been significantly impacted by technological advancements, with sensor-based technologies revolutionizing traditional practices. Research has demonstrated the importance of soil moisture in irrigation processes, where precise monitoring can lead to significant water savings and more nutritious crops. Controlling the temperature is also essential because large fluctuations can stunt growth or cause stress responses in plants. Plant growth and yield are directly impacted by light intensity, which is essential to photosynthesis.

Because Arduino-based solutions are flexible and inexpensive, many projects have tried using them for environmental monitoring. However, the majority of existing systems are parameter-centric and isolated, lacking integrated solutions that take into account several factors in real-time. Hardware prototyping has become even more accessible thanks to simulation programs like Tinkercad, which o er virtual labs for learning and testing. The proposed study fills a major gap in the smart gardening systems that are currently accessible by integrating multi-sensor fusion, a real-time alerting mechanism, and simulation possibilities.

## 4. Problem Statement:

Close control of environmental factors is necessary for optimal plant health, but doing it by hand can be an enormous undertaking. In addition to being labor-intensive, manual monitoring is also prone to mistakes, especially when caring for several plants or complex surroundings. Inadequate light, temperature stress, or under- or overwatering are frequently overlooked until it is too late to save the plant or encourage healthy growth.

Both novice and seasoned gardeners have a challenging challenge in the absence of a comprehensive, self-governing monitoring system. A solution that can help users maintain ideal circumstances, send out regular reminders, and track important growth factors in realtime is desperately needed. In order to enable more intelligent, sustainable plant care, the solution should be inexpensive, easy to use, and adaptable enough to fit a variety of species and settings.

## 5. System Requirements:

The Smart Plant Monitoring System is made accessible and scalable, using components that are commercially available and simple to construct. The major hardware needs are an Arduino Uno microcontroller, an analog water level detection sensor for soil moisture, a TMP36 ambient temperature sensor, and a photoresistor (LDR) for light intensity. A piezo buzzer is added to provide audible signals whenever the system recognizes undesirable conditions.

In addition to the hardware, the project makes use of Tinkercad Circuits or the Arduino IDE for programming and simulation. The Serial Monitor makes data visualization simple and enables users to read sensor values and take appropriate action. Future enhancements, such as adding more sensors, integrating wireless communication, or automating irrigation, are made simpler by the system's modular design, which makes it suitable for both real-world and instructional applications.

## 6. System Design:

The Arduino Uno is a key component of the system, coordinating the collection and processing of sensor data. The location of the soil moisture sensor allows it to accurately monitor the soil's humidity content, providing crucial data on how hydrated the plant is. To make sure the plant is not exposed to harmful extremes, the TMP36 temperature sensor captures the surrounding air temperature. Together with a 10kΩ resistor, the LDR measures light intensity and o ers helpful information about how much light the plant receives from artificial or solar sources.

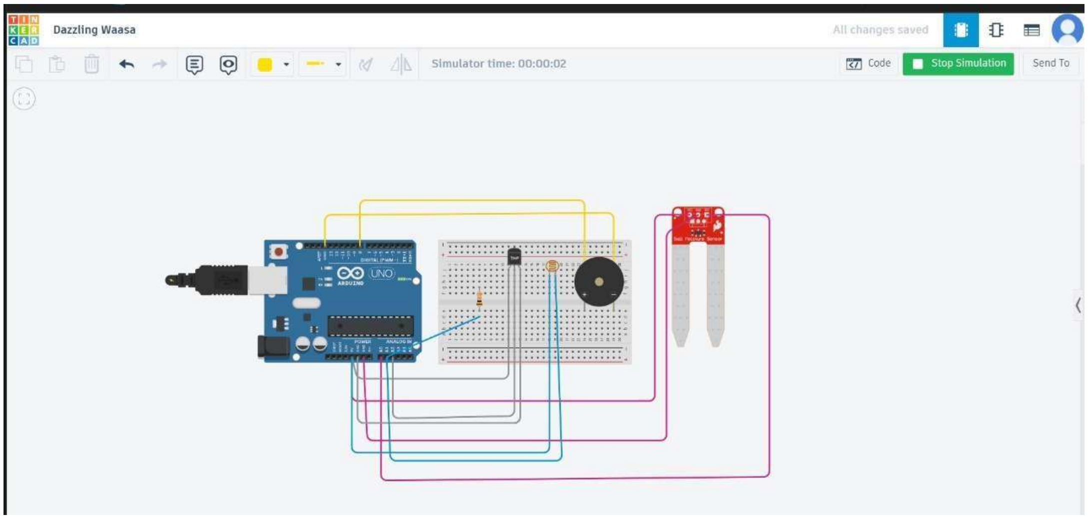
The system's design places a strong emphasis on usability and modularity. A breadboard is used to connect the sensors to the Arduino for easy setup and upkeep. Both the piezo buzzer and the analog inputs are e ective signaling devices and o er sensitive environmental state measurement. Users may make informed decisions about plant maintenance thanks to the Serial Monitor's regular refreshes of the data collected by the sensors. Users may virtually pilot and optimize the system before it is really deployed thanks to the model's compatibility with Tinkercad simulation.

## 7. Implementation:

The first step in the implementation process is to ensure that the hardware components are securely linked to the Arduino Uno by properly connecting them on a breadboard. A voltage divider circuit is used to connect the LDR setup to A1, the TMP36 temperature sensor to A2, and the SIG of the soil moisture sensor to analog input A0. All sensors are driven by the Arduino's regulated 5V and GND outputs, and the piezo buzzer is linked to digital pin 8.

Coding is needed to read sensor data, interpret it, and output it to the serial monitor when programming an Arduino in the C programming language. Every parameter has a threshold established by the rules, which cause the buzzer to sound anytime values deviate from the optimal range. Tinkercad simulation creates a safe and flexible environment for experimentation by allowing users to alter sensor inputs and observe system responses in real time. The project's execution emphasizes how important it is to integrate hardware correctly and have dependable software in order to ensure timely and trustworthy plant monitoring.

CIRCUIT CONNECTION:

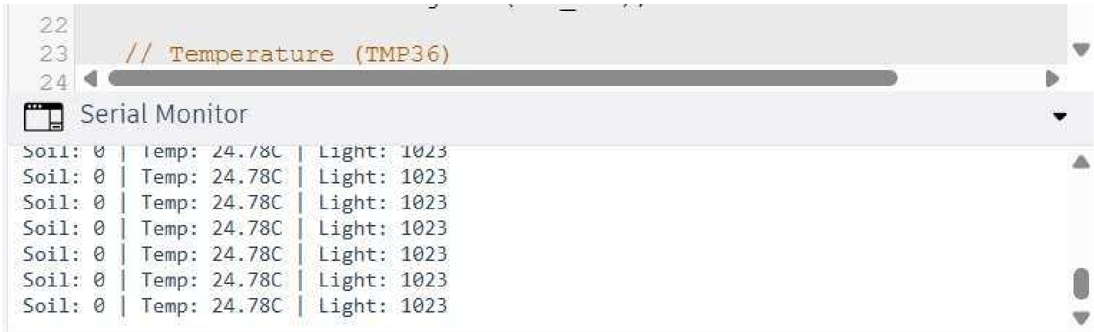



8. Results and Output:

The e ectiveness of the Smart Plant Monitoring System in tracking and preserving plant health is demonstrated by experiments and simulations conducted in Tinkercad. The device accurately tracks temperature, light intensity, and soil moisture, displaying data in real time on the Serial Monitor. The buzzer is activated instantly to alert the user when the temperature rises above safe limits or the soil moisture level drops below the predetermined threshold.

The research provides a reliable and automated method of plant care while demonstrating a significant reduction in human labor and error. The alert tool gives users early notice of significant changes, and the data visualization feature enables users to monitor trends and make informed adjustments. These results demonstrate the system's potential as a valuable resource for small-scale farmers, students, and hobbyists looking to use technology to enhance plant care.

OUTPUT:




## 9. Discussion and Analysis:

The Smart Plant Monitoring System is unique because it uses a comprehensive approach to environmental monitoring, integrating several sensors and real-time alerts into a user-friendly package. Because of its module-based architecture, it is simple to expand and customize, making it suitable for a variety of plant species and development conditions. A broad range of users, from inexperienced to expert users, may a ord it thanks to the utilization of easily accessible components and simulation platforms.

Despite its e ectiveness in closed systems, the method has several limits that must be acknowledged. Accurate readings require sensor calibration, and factors such as soil, ambient electrical noise, and sensor position might a ect performance. Although the current design relies on human action and local notification, future iterations might incorporate cloud-based analytics, automated irrigation, or wireless communication. All things considered, the initiative o ers a solid foundation for upcoming advancements in environmental monitoring and smart farming.

## 10. Applications and Future Scope:

There are several applications for this project in small-scale farming, research, schools, and personal gardening. Its modularity allows for further experimentation and learning, and its cost and ease of use make it desirable to those who wish to automate plant care. The system can be used by educational institutions to teach students programming, electronics, and sustainable agriculture while promoting inquiry and hands-on learning.

Looking ahead, the Internet of Things (IoT) may be used to power the Smart Plant Monitoring System, enabling remote control and monitoring via cloud platforms or smartphones. Potential avenues for development include the utilization of solar electricity, automated irrigation, and weather forecast integration services. This technology might be improved over time to become a comprehensive smart agricultural solution that promotes resource e iciency and environmental sustainability more broadly.

## 11. Conclusion:

The Smart Plant Monitoring System, which is built on Tinkercad and Arduino, is a prime example of how technology is revolutionizing everyday life. The technology enables users to easily have flourishing plants with little e ort by automating the control of important plant growth markers. It bridges the gap between automated technology and traditional gardening by combining sensors, real-time messages, and visual data representations into a handy and instructive platform.

All things considered, this project encourages sustainable practices and technology education while meeting important needs in plant care. Its adaptability and scalability ensure that it may be used in a variety of settings, including school labs and home gardens. As a basis for future innovation, the Smart Plant Monitoring System underscores the long-term importance of embedded systems as a means of improving the quality of life and encouraging environmental protection.

## 12. References: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3. TMP36 Temperature Sensor Datasheet,
[https://www.analog.com/media/en/technical-documentation/datasheets/TMP35_36_37.pdf](https://www.analog.com/media/en/technicaldocumentation/data-sheets/TMP35_36_37.pdf)

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## 13. GitHub link of the project:

https://github.com/VenkatAbhinav17/Eco-Sense-Smart-Arduino-Based-Plant-Health-Monitoring-System-