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Design and Implementation of an IoT Based Smart Garden Automation and Monitoring System

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Abstract: *Due to time constraints and irregular plant requirements monitoring, maintaining a garden has become increasingly difficult in today's fast-paced world. For optimum growth, plants require enough water, sunlight, and the right temperature; the surrounding environment must also be kept hygienic and clean. In order to address these problems, this project presents a Smart Garden and Monitoring System, a sensor- driven, automated solution that automates gardening tasks and incorporates a waste management function. By using an autonomous water pump connected to a soil moisture sensor, the system ensures that plants are watered whenever the soil dries out. By preventing both overwatering and underwatering, this feature saves water and guarantees that the soil is suited for plant vitality. Since sunlight is essential for photosynthesis and general plant growth, an LDR (Light Dependent Resistor) sensor is included to measure the amount of light that the plants get. A temperature sensor helps determine whether the ambient temperature is suitable for plant growth by continuously monitoring the local climate. In addition to plant monitoring, the project has an intelligent trash can featuring a detecting mechanism that indicates if the bin is full or empty. This promotes hygiene in the garden area by improving cleanliness and reducing the problem of waste overflow.*

Keywords: *autonomous water pump*

I. INTRODUCTION

In recent years, people's time for gardening and efficient waste management has decreased due to the rapid growth of urbanization and busy lifestyles. Intelligent technologies are being integrated into daily life to create automated, efficient, and sustainable systems in order to address these problems. The Smart Garden and Monitoring System is one such innovative approach that combines the ideas of automation and the Internet of Things (IoT) to promote plant growth, monitor environmental conditions, and ensure cleanliness through an intelligent waste management system. This project's primary goal is to reduce human work while automating garden maintenance. A soil moisture sensor built within the device continuously measures the soil's moisture content. When the soil dries out, the technology uses real-time data to automatically control a water pump to irrigate the plants. This promotes water conservation by ensuring that plants get the right amount of water without wasting any.

This information helps track how much natural light the plants receive, which is essential for photosynthesis and general growth. Similar to this, a temperature sensor is used to measure the ambient temperature, enabling users to ascertain whether the temperature is suitable for the growth of healthy plants. The system includes a smart dustbin to address trash management in addition to garden monitoring. The dustbin's ultrasonic sensor allows it to detect when it is full or empty. This feature encourages appropriate trash disposal in the garden area by preserving hygiene and reducing the possibility of overflow.

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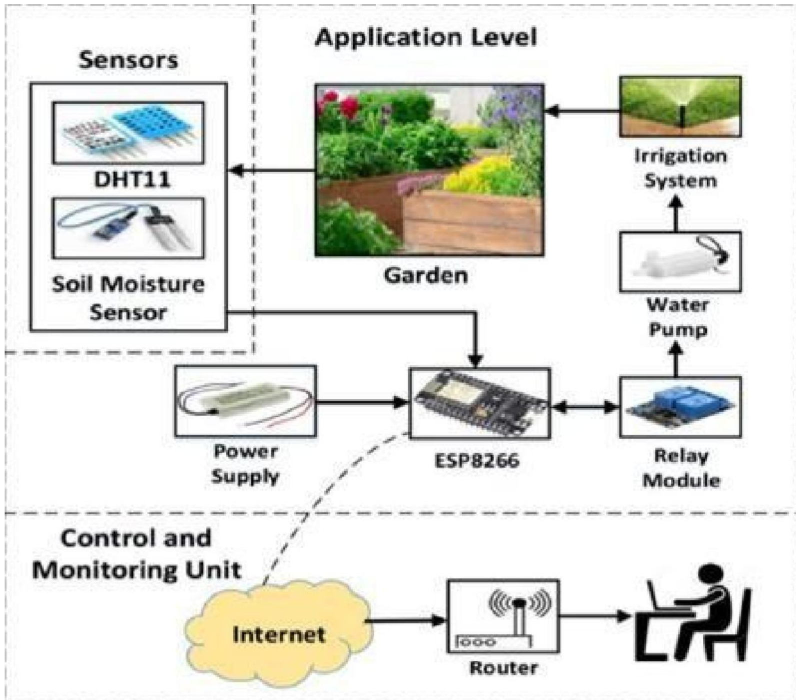

Fig1. System Architecture of IoT-based Smart Garden Irrigation and Monitoring System

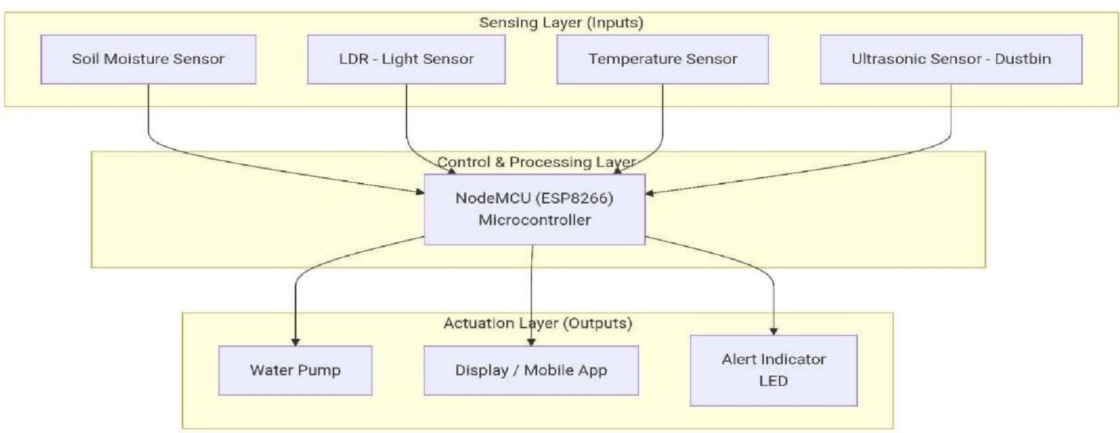

Fig2. Working Flow

Three main levels make up the suggested system: the actuation layer, the control and processing layer, and the sensing layer. The sensing layer uses a range of sensors to collect environmental data in real time. In order to ensure that plants receive the water they require while conserving resources, a soil moisture sensor detects the soil's moisture content and initiates irrigation when the levels fall below a predetermined threshold. While the temperature sensor evaluates environmental circumstances to make sure plants flourish in the right climate, the LDR sensor measures the amount of ambient light, which is crucial for photosynthesis. In order to preserve cleanliness and hygiene, the trashcan also has an ultrasonic sensor built into it that monitors its capacity and sends out alarms when it fills up.

The system's central microprocessor, the NodeMCU (ESP8266), handles the data gathered by the sensors. For real-time monitoring, it can be linked to IoT systems or mobile apps via its Wi-Fi. It controls the warning LED, activates the water pump automatically, and refreshes the screen or mobile app.based on sensor inputs. For example, the water pump is triggered when the soil moisture content is low, and the alert LED turns on when the trashcan is full or the environment is odd. This integration ensures both local decision-making and remote access, allowing users to monitor and control the system in real-time.

II. LITERATURE SURVEY

[1]. P.S. Prakash et al. It provides a system for monitoring plant health in sustainable agriculture that combines AI and IoT technology. The system was designed to monitor key parameters like light intensity, pH, humidity, and fertilizer levels in a hydroponic system, which grows plants without soil. The major objective was to provide a controlled environment for plant growth while reducing the waste of water and fertilizer. By supplying nutrients only when required, this ingenious idea further enhanced efficiency, as hydroponics today uses 70–80% less water than conventional cultivation. In order to minimize unnecessary power usage and guarantee optimal growth circumstances, energy-efficient lighting was incorporated.

The technology stack included cloud-integrated microcontrollers, AI-based decision-making algorithms, and Internet of Things sensors for real-time automation and monitoring. The goal of this strategy was to construct a scalable and intelligent hydroponic system that ensures sustained plant growth while reducing dependency on natural resources. The findings demonstrated improved water use, lower fertilizer waste, and higher crop yields as compared to conventional methods. Additionally, automated monitoring reduced the amount of manual effort, making the system more reliable for urban and indoor farming. Overall, the study found that IoT and AI might significantly increase the sustainability and productivity of intelligent hydroponic gardening systems.

[2] A. Morchid et al. It was created for a smart irrigation system that uses real-time integrated technology in sustainable agriculture. The model was developed to monitor soil moisture and environmental conditions to ensure that irrigation is only activated when plants require it. The main objective was to reduce water waste while maintaining crop health. They achieved water savings of more than 35–40% when comparing their approach to conventional irrigation techniques. IoT sensors, embedded controllers, and automated watering systems are some of the technologies utilized to make decisions in real time. This strategy sought to link sustainability with smart farming by minimizing human intervention and conserving resources. The results demonstrated improved soil moisture management, healthier plant growth, and increased water efficiency. Although light saving was not particularly included in the study, it was shown that embedded technologies can have a significant impact on eco-friendly smart gardening.

[3]. K. Thongkhao et al. In order to monitor soil conditions in a Thai pomelo garden, an Internet of Things- based smart watering system has been suggested. The technology was designed to automatically increase soil moisture levels when they dropped below a preset threshold, ensuring optimal growth for fruit crops. Its main objective was to conserve water by using it only when required and to maintain healthy soil conditions. The model's usage of smart irrigation saved between 30 and 40 percent of the water used in traditional farming methods. Among the technologies used were wireless connection, a microprocessor, and Internet of Things sensors for real-time monitoring and control. This technique aimed to reduce human labor and create a sustainable watering system for large-scale fruit plantations.The results showed improved soil moisture balance, healthier plant development, and less water waste. Even though the primary objective was not light conservation, the concept proved highly effective in promoting resource- efficient smart gardening.

[4]. Mubashir Ali et al. By continuously monitoring soil moisture, temperature, and humidity levels, it has created an Internet of Things-based smart garden and monitoring system that aims to reduce the challenges related to manual gardening. The main objective was to improve plant health and minimize water waste by only delivering water when necessary. The device may save 30 to 35% of water when compared to traditional watering methods, according to the data. Even though light saving was not a top priority, the model ensured efficient energy usage by automating irrigation based on current conditions.

[5]. K.S. Kunal et al. Using the NodeMCU microcontroller, an Internet of Things-based smart plant monitoring system was created that ensures optimal growing conditions and automates plant care. The technology monitors temperature, humidity, and soil moisture in real time, enabling autonomous irrigation only when required. Reducing water waste and human labour in plant maintenance were the main objectives. Through better environmental management, lighting energy savings were indirectly doubled, and the system reported water reductions of over 30%. This technique ensures healthier

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plant growth through efficient monitoring and timely irrigation. Among the technologies utilized for user convenience were NodeMCU, cloud-based data storage, IoT-enabled sensors, and remote monitoring interfaces. This concept was created to provide an intelligent, automated solution for sustainable gardening for both indoor and outdoor plants.

It was developed automated plant care and guarantee ideal growing circumstances for IoT-based smart plant monitoring system utilizing the NodeMCU microcontroller. Real-time soil moisture, temperature, and humidity monitoring by the system allows for automatic irrigation only when necessary. The primary goal was to decrease human labor in plant maintenance and reduce water waste. Nearly 30% water reductions were reported by the system, and improved environmental management indirectly increased lighting energy savings. This method uses timely irrigation and effective monitoring to guarantee healthier plant growth.NodeMCU, IoT-enabled sensors, cloud-based data storage, and remote monitoring interfaces were among the technologies used for user convenience. This model was designed to give both indoor and outdoor plants intelligent, automated solution for sustainable gardening. The results demonstrated improved plant health, consistent soil moisture levels, and effective resource management. Overall, the study demonstrated how integrating IoT into gardening might increase sustainability, reduce resource consumption, and simplify plant maintenance.

[6]. D. S. et al. They have proposed an enhanced hydroponic plant monitoring system that uses Internet of Things technology to automate fertilizer and environmental management. The introduction stressed the importance of precision management in hydroponic farming to optimize plant growth and resource use. The main objective was to keep an eye on environmental factors, water quality, and nutritional levels to ensure healthy plant growth. The system's automation of nitrogen supply and watering resulted in water savings of about 40%. By using energy-efficient lights, the ideal conditions for hydroponic plants were preserved while electricity consumption was reduced. The technology stack included cloud-based monitoring platforms, microcontrollers, Internet of Things sensors, and automated actuators for precise control. The goal of this strategy was to create an intelligent hydroponic environment that ensures resource-efficient plant growth while reducing manual labor. The results demonstrated improved fertilizer management, stronger plants, and significant water savings. Overall, the study demonstrated that IoT- based hydroponics can increase crop yields, enhance sustainability, and provide an automated solution for modern smart gardening systems.

[7]. L. Renkuan et al. It has created an intelligent irrigation system for greenhouse environments. The introduction emphasized the challenges of manual irrigation and the need for precise management to encourage plant growth while conserving water. By installing an automatic system that only irrigates when soil moisture drops below a predetermined threshold, the aim was to reduce water waste. Through improved environmental control, the system not only achieved up to 35% water savings but also indirectly boosted lighting energy savings. This approach ensured more efficient use of resources and healthier plants in greenhouse farming. Soil moisture sensors, microcontrollers, automated valves, and Internet of Things-enabled monitoring were among the technologies utilized for real-time control and data logging.

The objective of this model was to create a smart irrigation proof-of-concept that could boost crop yields while conserving water. The results demonstrated reduced resource waste, improved plant development, and constant soil moisture regulation. Overall, the study showed how IoT and automated watering may significantly increase greenhouse and smart gardening systems' sustainability.

[8]. S.S. Varun et al. An Internet of Things (IoT)-based smart garden monitoring and control system was suggested with the intention of automating irrigation and environmental management. In order to save human work and save resources, the introduction stressed the importance of using real-time soil moisture, temperature, and humidity monitoring. The main objective was to maximize water use and improve plant health through automated irrigation. The system showed water savings of about 30 to 35%, and lighting energy reductions were indirectly aided by regulated environmental management. By using this technique, waste was reduced and consistent growing conditions for plants were created. IoT sensors, cloud platforms, NodeMCU microcontrollers, and automated control systems were some of the technologies used for real-time garden management. The results showed improved soil moisture management, healthier plants, and more efficient usage of water. Overall, the study found that IoT integration in garden systems provides reliable plant care solutions, reduces human labor, and enhances sustainability.

[9]. M. Anwar et al. The introduction emphasized the need for automated systems to optimize the distribution of light, water, and nutrients, as well as the challenges associated with maintaining indoor plants. The main objective was to

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enhance plant growth while conserving water and electricity and providing clients with simple remote control. The solution produced water savings of about 30 to 40 percent and reduced unnecessary artificial lighting through automated management based on plant demands. The technology stack included mobile app integration, automated actuators, microcontrollers, and Internet of Things sensors for remote operation and data visualization. The objective of this idea was to offer urban residents an easy-to-use, resource-efficient indoor gardening alternative. Reduced physical labor, improved plant health, and resource efficiency were the results. Overall, Garduino demonstrated how Internet of Things and mobile technology can transform indoor gardening into a regulated, sustainable, and intelligent ecosystem.

[10]. S.T. Fauziah et al. It has created a smart garden system prototype that enables long-range, low-power communication with LoRa technology. At the outset, emphasis was placed on the need to efficiently monitor large garden areas while avoiding excessive energy use. The main objective was to automate environmental monitoring and watering in order to improve plant health and conserve water. Through better environmental control, the system not only achieved about 30% water savings but also indirectly enhanced lighting energy savings. Among the technologies employed were automated irrigation systems, cloud-based monitoring platforms, microcontrollers, and LoRa sensors. The goal of this strategy was to provide a scalable and energy-efficient smart garden solution that can be remotely monitored over long distances. The results demonstrated improved soil moisture management, healthier plant growth, and less manual intervention. Overall, the study showed that IoT systems based on LoRa may effectively increase automation and sustainability in smart gardening applications.

[11]. I.N. Azhar et al. It has suggested a greenhouse monitoring system that tracks room temperature and environmental factors across long distances with minimal energy use. The introduction stressed the importance of maintaining the optimal temperature for plant health and reducing the amount of human monitoring required in greenhouse settings. The main objectives were to improve the efficiency of plant growth and guarantee ideal climatic management. Although temperature management was the primary focus of the study, automated monitoring also indirectly contributed to improved energy use for lighting and cooling systems and water savings of roughly 20% to 30%. Among the technologies used were remote monitoring interfaces, cloud-based data platforms, microcontrollers, and LoRaWAN sensors. The creation of a scalable, low-power smart greenhouse system for autonomous environmental management was the aim of this concept. The results demonstrated more effective temperature management, fewer human participation, and healthier plant development. Overall, the study demonstrated that LoRaWAN-based IoT solutions offer effective, long-range automation and monitoring for greenhouse and sustainable smart gardening applications.

[12]. G. Choudhari et al. It developed an IoT-based smart garden and monitoring system with the goal of automating watering and environmental monitoring to guarantee ideal plant growth. The difficulties of maintaining a garden by hand were highlighted in the introduction, as was the necessity of intelligent systems to effectively regulate light, soil, and water. The primary goal was to automatically regulate irrigation based on real-time sensor data in order to reduce water usage and sustain healthier plants. Water reductions of around 30 to 35% were attained by the system, while lighting energy savings were indirectly enhanced by improving environmental conditions. For remote and real-time garden management, IoT sensors, microcontrollers, automated valves, and cloud-based monitoring platforms were among the technologies used. Developing a sustainable, user-friendly smart gardening solution that minimizes manual intervention and resource waste was the aim of this concept. The outcomes showed better soil moisture management, more robust plant development, and effective water use.

Author(s)	Year	Technology Used	Sensors/Methods	Accuracy / Performance	Notable Feature
A. Kumar et al.	2023	Machine Learning (ML) with IoT	Soil moisture, temperatu re, humidity	Regression & classification models for accurate prediction	Closed-loop ML- driven system giving optimized actuator commands
D. Patel et al.	2022	Cloud Computing (AWS IoT Core, Kinesis)	Layered architecture (Sensor → Gateway	Real-time stream processing for immediate alerts	Scalable, multi- tenant cloud IoT with “Things-as-a- Service”

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			→ Cloud → User)		
R. Fernandez et al.	2022	ESP32 + Blynk IoT Platform	Wi- Fi/BLE, drag-and- drop app	Low-cost with acceptable accuracy	Democratization of IoT via frugal, replicable, and student-friendly design
P. Mishra et al.	2020	IoT + Feedback Control Theory	Soil moisture sensor, temperatu re sensor	Efficient water use vs timed irrigation	Proof-of-concept of automated irrigation via feedback loop
J. Anderson et al.	2020	IoT with Context-Aware Irrigation	Soil moisture, canopy temperatu re, weather API	Reduced water consumption compared to manual methods	Combines hydration monitoring with stress indicators (thermal sensing)
C. Rodriguez et al.	2021	IoT + Weather API	Soil moisture, canopy temperatu re sensors	High efficiency in saving water	Context-aware irrigation with rainfall prediction
Y. Kim et al.	2020	AI + Computer Vision	Cameras, CV disease/pe st models	Accurate plant disease & pest detection	Maximizing yield in space-limited vertical farms
N. Ahmed et al.	2021	Mobile-first IoT App	Mobile app, notificatio ns, manual override	Reliable and user-friendly	Focus on transparency, usability, and trust in automation
K. Johnson et al.	2021	LoRaWAN + MQTT Protocols	Soil moisture, temp., humidity, light	Low power, long range, dependable data transfer	LoRaWAN ensures long-range low-power communication for large farms

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III. PROPOSED MODELLING

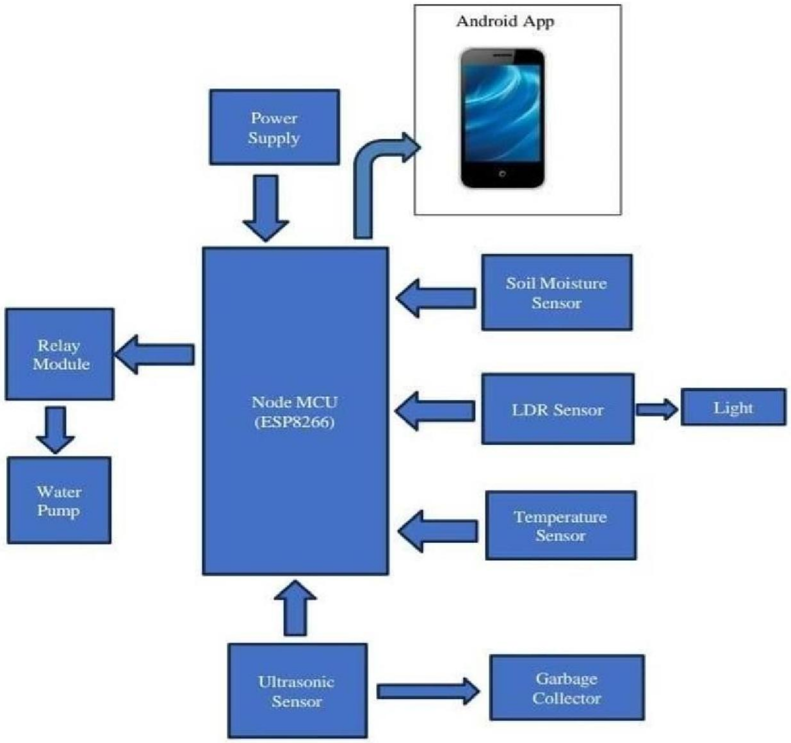

Fig 3. Block diagram of IoT Based Smart Garden and Monitoring System

Node MCU (ESP8266):- Digital I/O: The GPIO pins, which are identified by the numbers D0 through D8 and so on, can be set to operate as inputs or outputs.

Fig. Node MCU

Serial Communication: The device has two inputs: RX, which stands for receive, and TX, which stands for transmit.Every pin has a voltage level of precisely 3.3V.

Specifications: - The Tensilica CPU used by this device is 32-bit. The specified operating voltage is 3.3V. It is compatible with 802.11 b/g/n Wi-Fi standards. The frequency at which it operates is 2.4GHz. The range of the clock speed is 80 to 160 MHz

Wi-Fi Range: Its range is roughly 30 to 50 meters in typical interior situations. In perfect, unhindered conditions, its range extends to a maximum of several hundred meters.

Storage: Usually, 4 MB of flash memory is included. Approximately 80 kB of RAM is available to users.

Temperature Sensor:

GND: Ground. Between Vcc and Data, a pull-up resistor (4.7kΩ to 10kΩ) is necessary. N/C: Not Connected.

Temperature: The resistance of a Negative Temperature Coefficient (NTC) thermistor increases with temperature. The sensor's tiny 8-bit CPU reads these values and sends a 40-bit data packet containing temperature, humidity, and a checksum across the single data pin. A substrate that holds moisture between two electrodes is used to detect humidity; the electrical resistance of this substrate changes in response to humidity. A negative temperature coefficient

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(NTC) for temperature A thermistor is employed; its resistance increases with temperature. The sensor's tiny 8-bit CPU reads these values and sends a 40-bit data packet containing temperature, humidity, and a checksum across the single data pin.

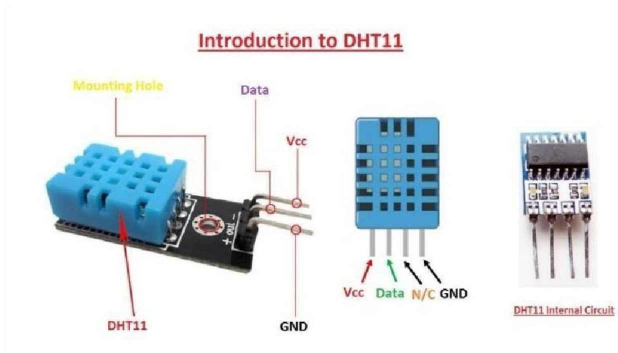

Fig. Temperature Sensor

Soil Moisture Sensor
To determine the soil's volumetric water content. utilized in systems that water plants automatically.

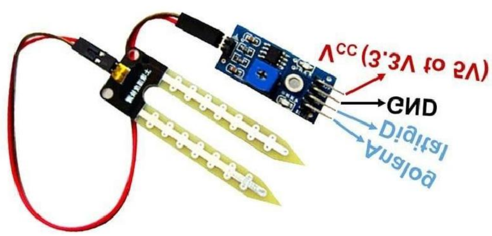

Fig. Soil Moisture Sensor

Specifics: Operating Voltage Range: 3.3V to 5V DC Results Signal Types: Analog and Digital Vcc: +5V Power; Data & Pinout: GND: The planet Earth. The A0 (Analog Output) outputs variable voltage. In dry soil, the output voltage is higher. In wet soil, it is lower. D0 (Digital Output): This produces a HIGH or LOW signal depending on a moisture threshold set by the built-in potentiometer. Range and Detection: The electrical conductivity, or resistivity, between the sensor's two exposed probes is measured. Higher resistance leads to decreased resistance. How it Identifies: In the detection procedure, the two probes serve as a variable resistor.

Relay Module

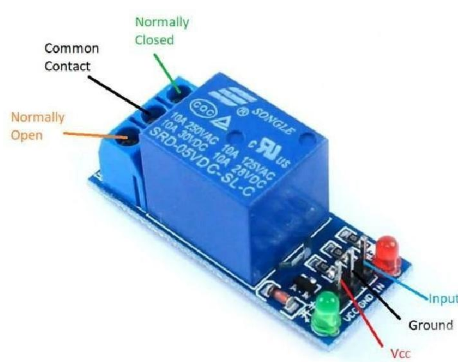

Fig. Relay Module

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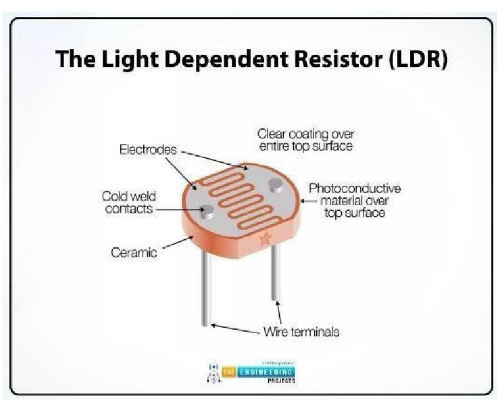
A digitally controlled switch that uses a low-voltag signal from a microcontroller to manage high- voltage/high-current devices (such as motors, pumps, and AC mains lights). It offers essential electrical separation.
Specifics: The operating voltage for the relay coil is 5V DC. Trigger Level: LOW (0V) or HIGH (3.3V/5V), depending on the module. The output side of your device: The primary point of contact is called Common (COM).
Normally Closed (NC): The relay is linked to COM when it is not in use. Normally Open (NO): The relay is linked to COM when it is turned on. Range and Detection: According to its specs, a relay's "range" is the maximum voltage and current it may switch without risk because it operates as a switch and cannot "measure."

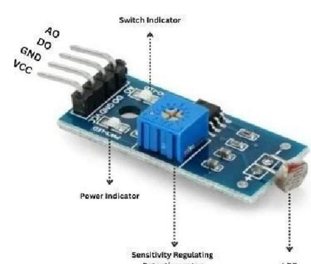
Pump Motar

This actuator is responsible for the movement of water. It is commonly used in automatic irrigation systems, fountains, aquariums, and cooling systems. Operating Voltage: 5V DC, often obtained via a USB source or a 5V regulator. Current Draw: Usually between 220mA and 500mA, depending on the model and load.

Since a microcontroller pin can typically only provide 20–40 mA, a relay or motor driver must be employed to manage this excessive current.
Retailer: Outside Diameter 7.5mm, Aperture 4.5mm ,5 mm Aperture for Water Intake For a small 5V pump, the flow rate could be anything between 80 and 120 liters per hour (L/H), depending on the manufacturer. How it's Handled: You do not provide data to the pump. You have control over its power. When 5V is supplied across the two wires, it starts up. When the electricity is turned off, it stops. This on/off control is expertly handled by a relay module.

LDR (Light Dependent Resistor)





To as certain the presence or intensity of ambient light. used in automatic street lights, security lights, and night lights.
Operating Voltage Range: 3.3V to 5V DC Both analog (variable voltage) and digital (HIGH/LOW) output signals are available. gives a variable voltage (e.g., 0-5V) that is directly proportional to the light's intensity. When there is more light, a lower LDR resistance results in a larger voltage.

Detection and Range: The LDR's resistance ranges widely, from approximately 100 Ω in strong light to more than 1 MΩ (megaohm) in dark conditions. Measurement Range: The resistance of the LDR fluctuates over a sizable range, ranging from over 1 MΩ (megaohm) in darkness to about 100 Ω in high light.

Ultrasonic Sensor

Detection and Range: The resistance of the LDR varies greatly, ranging from around 100 Ω in bright light to over 1 MΩ (megaohm) in low light. Measurement Range: The LDR's resistance varies over a wide range, from more than 1 MΩ (megaohm) in complete darkness to roughly 100 Ω in bright light.

Echo (Output Pin): This pin stays HIGH for as long as it takes for the sound wave to reach and return to the object. Trig (Input Pin): Your microcontroller should deliver a short 10µs HIGH pulse to this pin to begin a measurement.
GND: GroundThe usual measurement range is 2 cm to 400 cm (4 meters). For things that are very close (less than 2 cm), it performs poorly.

1. The Trig pin receives a 10µs pulse from the microcontroller.
2. At 40 kHz, the HC-SR04 bursts forth eight ultrasonic pulses.
3. It uses the receiver to listen for an echo.
4. (Echo Pulse Time (µs) / 2) / 29.1 = Distance (cm) (sound travels at around 343 m/s, or about 29.1 µs per cm).

Blynk IoT platform:

Monitoring Soil Moisture: By showing users the current soil moisture levels, the app assists users in determining when to water their plants and preventing overwatering.
Temperature tracking: The temperature of the surrounding air is continuously recorded.
Garbage Collection Monitoring: To promote sustainability and cleanliness, integrated rubbish detection sensors inform the app about the condition of the garden's trash cans.
User-Friendly Interface: All parameters can be easily monitored at a glance thanks to the Blynk app's dynamic dashboard, which includes gauges, graphs, and notifications.

Flow Chart:

A NodeMCU serves as the central controller for the proposed system, which is an Internet of Things (IoT)-enabled smart garden and monitoring application that incorporates temperature, dustbin level, and soil moisture sensors.
Through Wi-Fi, the system connects to the internet and communicates with the real-time Blynk IoT application.
The process involves connecting to the Blynk server and the Wi-Fi network after initializing the NodeMCU and other system components. Once the connection is successful, the NodeMCU reads the data from each sensor every two seconds.
Monitoring of Soil Moisture: When the soil moisture falls, the water pump is activated to irrigate the plants.
below a preset threshold. The machine monitors the moisture level again after a few seconds. If the soil is found to be adequately moist, the pump will automatically turn off, preventing water waste.

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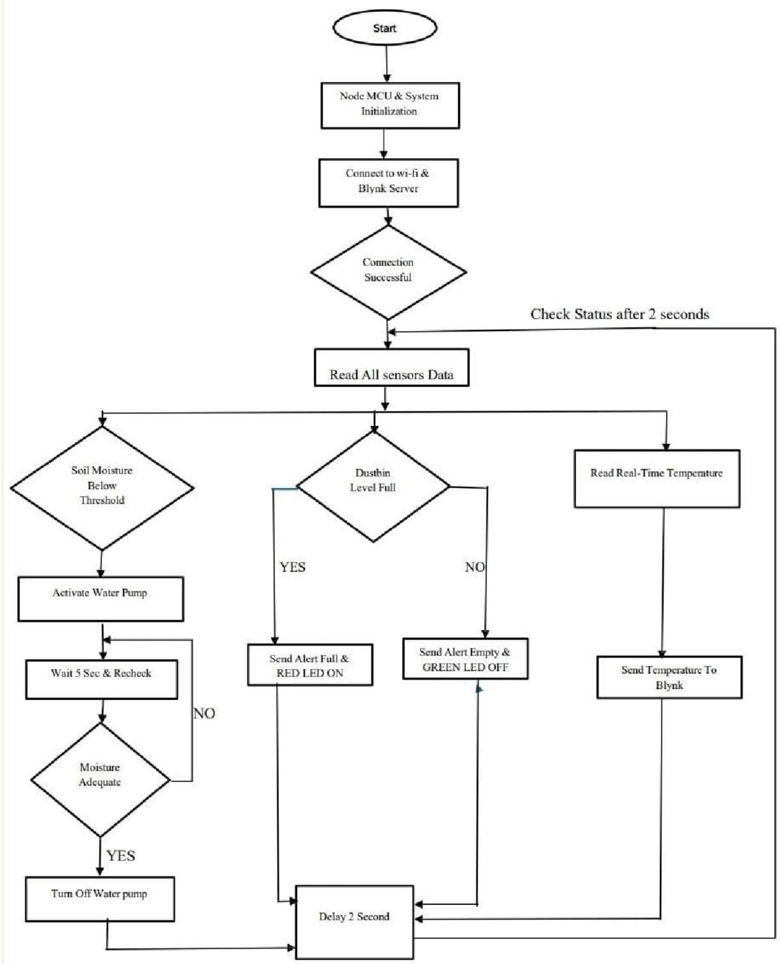

Dustbin Level Monitoring: The dustbin is monitored by an ultrasonic sensor. If the dustbin is full, a red LED indicator illuminates and a notification is sent to the Blynk app. By turning off the green LED to indicate when the trashcan is empty, the device maintains the yard area tidy.

Temperature Monitoring: The Blynk server receives continuous data from a temperature sensor that measures the current ambient temperature. This allows users to monitor the temperature of the garden. The system continuously cycles over all of the sensor data every two seconds. With Blynk's help, users can receive notifications, alerts, and real-time information on their cell phones. Better environmental monitoring, sensible trash management, and astute water resource management are all ensured by this.

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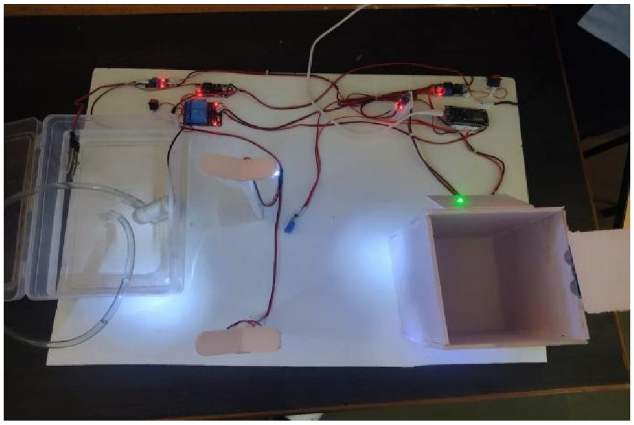
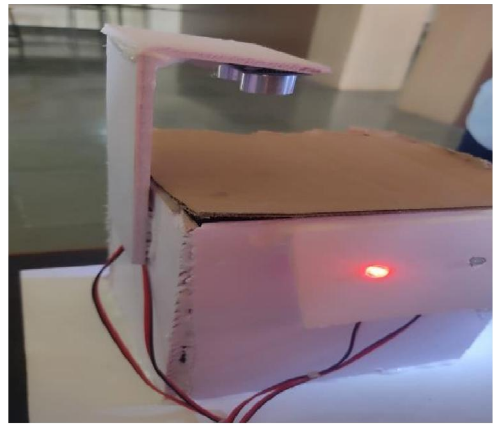
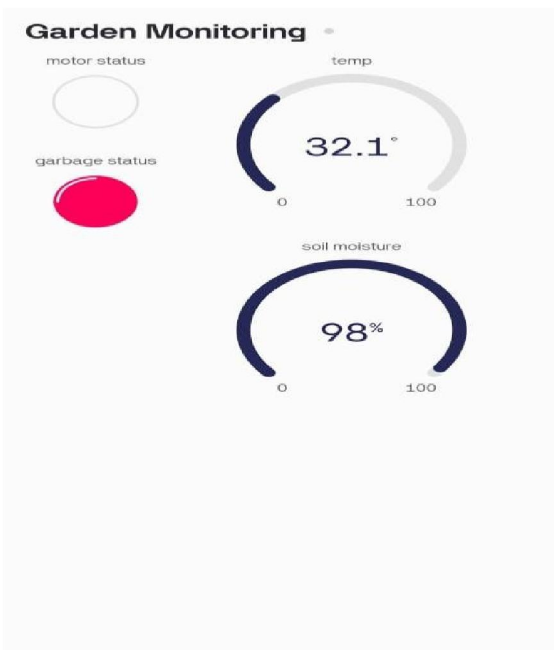
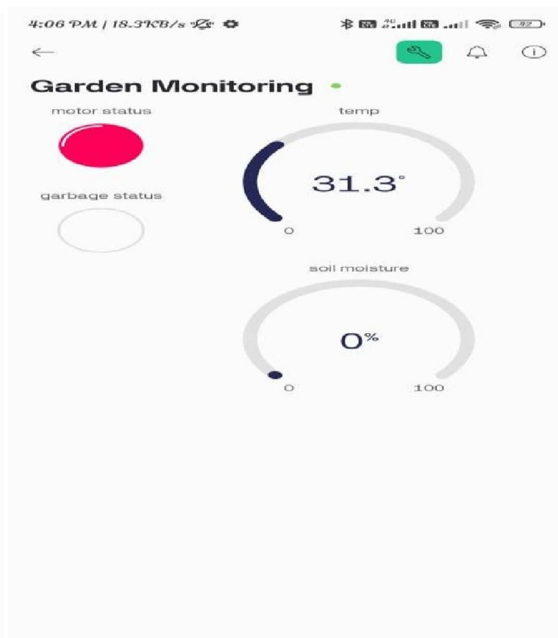
IV. RESULTS AND DISCUSSIONS









With every sensor linked to the Blynk app, the system operated flawlessly.

- The garbage level was detected by an ultrasonic sensor; a red light indicated full and a green light indicated empty. Status displayed in the Blynk app.
- Temperature Sensor: Shown Blynk's current temperature. The measurements were true to room temperature.
- Soil Moisture Sensor: Blynk displayed soil moisture. The engine automatically switched on when the moisture content fell below 30% and shut off when the soil became wet.
- Day and night detection using the LDR sensor caused the lights to automatically switch on at night.
- With a steady connection, the Blynk app showed all data in real time, including temperature, moisture, waste status, and motor state.

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V. DISCUSSIONS

For automation and monitoring, the Internet of Things-based smart garden system performed admirably. Temperature, light intensity, soil moisture, and rubbish level were all precisely monitored by the sensors. Less physical labor was required because the motor and lights responded automatically based on sensor data. The Blynk app's real-time data makes it simple to remotely monitor and control the system, increasing garden productivity and water management.

VI. CONCLUSION

To demonstrate how simple automation and sensor-based technologies may greatly improve the procedures involved in garden maintenance and environmental monitoring, the Smart Garden and Monitoring System was designed and implemented. This project demonstrates how duties like watering plants, monitoring light levels, monitoring temperature, and maintaining cleanliness can be completed consistently and methodically without requiring constant human interaction by using sensors and automatic control units. The most important part of this system is the soil moisture sensor, which is connected with the water pump. This sensor continuously checks the soil's moisture content, and if it detects dryness above a predetermined level, the water pump is immediately turned on to irrigate the plants.

This ensures that the plants get the right amount of water when they need it. The pump will automatically cut off when the soil moisture content reaches a reasonable level again. As a result, the system efficiently avoids both overwatering and underwatering, while also conserving water and encouraging the growth of healthy plants. The LDR sensor is essential for documenting how much sunlight or brightness the plants can receive. The availability of sufficient sunshine directly affects the growth and development of plants since light is one of the essential conditions for photosynthesis.

Determining if the garden is getting enough natural light can be made easier with the sensor's continual monitoring of light intensity data. The plants' ambient temperature is continuously measured by the temperature sensor. The entire growth cycle of plants is directly impacted by temperature, and some species are sensitive to changes in temperature. by monitoring this parameter.

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