Design and Development of Plant Watering Robot Using Arduino Microcontroller

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Abstract- With the growing demand for efficient and sustainable agricultural practices, there is an increasing need for innovative solutions to automate plant care processes. This project presents the design and development of a Plant Watering Robot utilizing Arduino microcontroller.

The aim of this project is to create an intelligent and autonomous system capable of providing precise and timely watering to plants and also like a obstacle avoidance robot while it is spraying water & ensuring their optimal growth while minimizing water usage.

An Arduino microcontroller serves as the brain of the system, enabling the integration of various sensors to collect environmental data, The combination of obstacle avoidance sensors ensures safe and efficient movement, preventing collisions with obstacles and potential damage to the robot or plants. The heart of the system lies in the intelligent decision-making algorithm implemented on the Arduino microcontroller.

Keywords—IR sensors, L298N Controller driver, HC05 Bluetooth module, Arduino microcontroller, motors.

I. INTRODUCTION

Robotics is part of Todays communication. In today's world ROBOTICS is fast growing and interesting field. It is simplest way for latest technology modification. So I decided to work on ROBOTICS field, and design something which will make human life simpler in today aspect.

In recent years, there has been a growing interest in leveraging technology to address agricultural challenges and promote sustainable practices. One such innovative solution is the design and development of a Plant Watering Robot using Arduino microcontroller technology. This project aims to automate the process of watering plants, providing an efficient and reliable solution for plant care.

This Project includes many components like IR sensors, Bluetooth modules, L298N drivers & 2 motors for action, it's just intro when we go deeper, we can know what the miracle included in it and how wonderfully does this robot works.

This works as a three in one body why because it works like a obstacle avoidance robot while it is spraying water, it can communicate with any other device my injecting simple Bluetooth module and sensor & can operate through a remote or app, finally the main theme is to water plants efficiently through button control or remote control.

II. PROBLEM STATEMENT

Design and develop a plant watering robot utilizing Arduino microcontroller technology to autonomously water indoor plants. The robot should be capable of accurately detecting soil moisture levels and dispensing appropriate amounts of water accordingly. Additionally, it should incorporate features such as adjustable watering schedules, obstacle avoidance, and remote monitoring/control via a smartphone application. The aim is to create an efficient and user-friendly solution that promotes plant health and reduces the manual effort required for plant care. the robot should be energy-efficient, utilizing power-saving techniques to prolong battery life or integrate a sustainable power source such as solar energy. The design should prioritize compactness and aesthetic appeal to seamlessly integrate into indoor environments. Additionally, the system should include fail-safe mechanisms to prevent over-watering or system malfunctions, ensuring the safety and well-being of the plants.

III – METHODOLOGY

Based on our problem statement, we have created a prototype to implement a automatic plant watering system considering all aspects of assembling the hardware components, including IR sensors for soil moisture detection, an L298N controller driver for motor control, an HC05 Bluetooth module for remote monitoring, an Arduino microcontroller for central processing, DC motors for movement, a sprinkler for watering, a relay for switching, batteries for power, switches for control, and a water pump for dispensing. Subsequently, software development involves coding algorithms for sensor data interpretation, motor control logic, and Bluetooth communication protocols. Extensive testing and calibration procedures are conducted to ensure precise functionality and reliability, followed by rigorous field testing in indoor environments to validate real-world

performance. Thorough documentation is maintained throughout the development process, detailing component specifications, wiring diagrams, code snippets, test results, and iterative refinements, ensuring project repeatability and scalability for future enhancements or similar projects.

IV. COMPONENTS USED

A. ARDUINO UNO

Arduino UNO R3 serves as the brain of the Bluetooth-controlled plant watering robot, providing the necessary computational power and control logic for the entire system. As a microcontroller board, the Arduino UNO R3 acts as the central processing unit that coordinates the various components of the robot, including the HC-05 Bluetooth module, L298N Motor Driver, and motors. One of the primary functions of the Arduino UNO R3 in this project is to interface with the HC-05 Bluetooth module, establishing a communication link between the robot and the user's mobile device. The microcontroller processes the commands received via Bluetooth, translating them into actionable instructions for the other components. This allows users to remotely control the robot and manage the plant watering process through a dedicated mobile application.

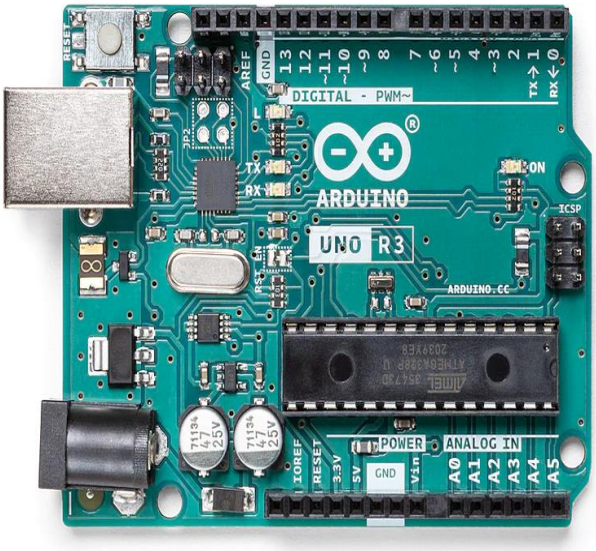

Figure 1: ARDUINO UNO

B. IR SENSOR

The IR sensors significantly contribute to the autonomy of the plant watering robot, enabling it to operate in diverse environments with varying layouts. As the robot moves, the IR sensors continuously scan the surroundings, providing real-time feedback to the control system. This dynamic feedback loop allows the robot to adapt its path and avoid obstacles, ensuring a seamless and efficient plant watering process. The integration of IR sensors aligns with the broader goal of creating a smart and responsive robot capable of autonomously performing its designated tasks in a user-friendly manner.

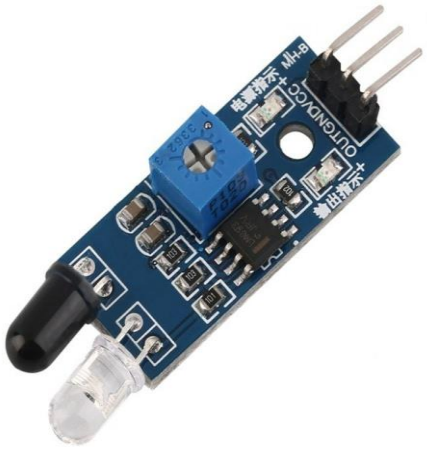

Fig 2: IR Sensor

C. HC – 05 BLUETOOTH MODULE

The HC-05 Bluetooth module plays a pivotal role in the functionality of the Bluetooth controlled plant watering robot. Serving as the wireless communication link between the robot and a mobile application, the HC-05 module enables users to remotely control the irrigation system with ease. Its integration with the Arduino UNO R3 microcontroller forms the backbone of the communication infrastructure. The Bluetooth module facilitates seamless data exchange between the robot and the user's smartphone or tablet, allowing for on-demand control of the watering process

Figure 3: HC-05 Bluetooth Module

D. L298N Motor Driver:

The L298N Motor Driver assumes a critical role in the Bluetooth-controlled plant watering robot, acting as the intermediary between the Arduino UNO R3 microcontroller and the DC motors responsible for the robot's movement. This motor driver provides a robust and efficient solution for controlling the left and right DC motors that drive the wheels of the robot. Its inclusion allows for precise control over the

speed and direction of the motors, enabling the robot to navigate through the plant environment effectively.

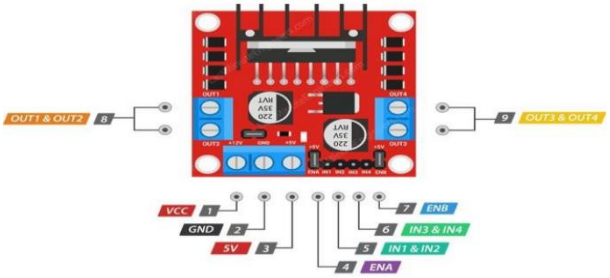

Figure 4 : L298N Driver

E. Left DC Motor and Right DC Motor

The motor shield (in Figure 6) allows us to direct the motor rotation direction and speed using Arduino board and also allows an added motor with an external power supply up to 12V.

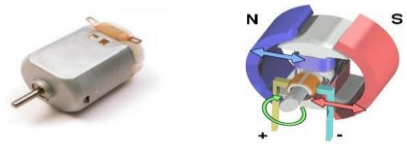

Figure 5: Left DC Motor and Right DC Motor

F. SPRINKLER

Sprinkler is a crucial component responsible for dispensing water to the targeted plants. The sprinkler serves as the mechanism through which the robot delivers water in a controlled and systematic manner, ensuring that the plants receive an adequate amount for optimal growth.

Figure 6: Sprinkler

G. Relay

relay is a critical component that plays a specific role in controlling high-power devices, such as the water pump. A relay acts as an electrically operated switch that is controlled by a low-power signal, typically from the Arduino microcontroller.

Figure 7: Relay

H. BATTERIES, SWITCHES, WATER PUMP

Power Supply for Robust Operation, User-Initiated Control with Switch.

By incorporating a water pump, the plant watering robot gains precise control over the irrigation process.

This water pump enables the robot to deliver water accurately to specific areas, minimizing water wastage.

Figure 8: BATTERIES, SWITCHES, WATER PUMP

V. Block Diagram

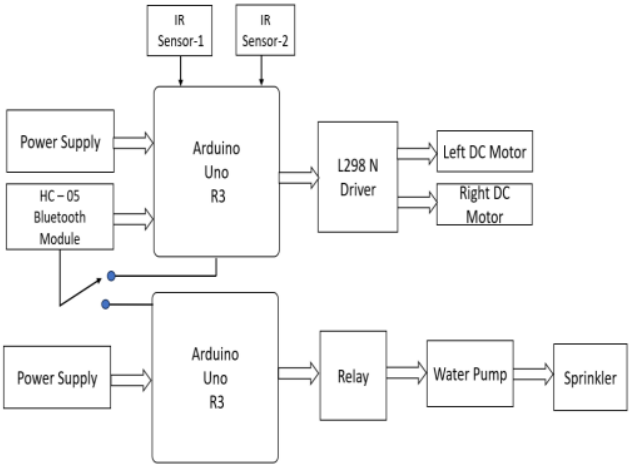

Figure 9: Block Diagram

VI. ACKNOWLEDGMENT

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CONCLUSION

This is a low budget projectIn concluding this presentation, we embark on a transformative journey from the limitations of a Bluetooth-controlled plant watering robot to the promising realm of our innovative solution - the "Design & Development of Plant Watering Robot Using Arduino Microcontroller." Our vision extends beyond mere automation; we aim to revolutionize plant care with precision, intelligence, and sustainability. By leveraging the power of Arduino microcontrollers, our proposed method not only addresses the shortcomings of existing solutions but sets a new standard for efficiency, adaptability.

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