Arduino-Uno based Controlled Water Sprinkler Robot

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Abstract— In this day and age innovation has created in each area including the horticulture area. In nations like Israel, USA (United States of America), China and a lot more nations are involving trend setting innovation for horticulture reaping and yield over years. Field upkeep is a monotonous assignment that requires watering, cutting and preparing to be completed at standard spans to keep a sound field. Huge wastage and contamination happen because of inappropriate field support rehearses. With numerous monotonous and routine assignments being supplanted by mechanical frameworks, field upkeep could likewise be accomplished utilizing an automated framework that would restrict wastage and contamination, guarantee a solid field and decrease the work content of the proprietor. This automated framework created to soak a field proficiently by estimating loam dampness levels. The framework includes a fastened versatile stage and a watering framework.

***Index Terms*— Arduino-uno, water sprinkler, Soil moisture, Temperature, Humidity**

I. INTRODUCTION

Human life standard has changed a ton during the previous hundred years, because of the creation of PCs and the advancement in innovation, which prompted the utilization of mechanical technology, working on the personal satisfaction of people. Throughout the long term, robots have supplanted human work in monotonous businesses. Furthermore, the utilization of independent robots to deal with family errands is a creating pattern, which should be visible in the previous ten years. While considering family errands, grass support can be thought of as one of the more dreary assignments requiring a ton of consideration and work. Despite the fact that cutting, watering and treating are the general undertakings which should be completed; time expected to deal with these tasks and the difficult work required, impedes the yard proprietor's everyday daily schedule. Likewise, inappropriate practices have prompted a ton of wastage and contamination. While considering grass support watering is the region wherein a ton of wastage is occurring and is likewise the errand which must be done most frequently. To work on the functional proficiency of grass watering, a watering framework prepared to do ideally covering the entire yard with least water wastage is required. Expectedly, static sprinkler framework is utilized with loam dampness level detecting capacity, however it expands the underlying expense of the framework. Conveying a water holder and topping off when it is appropriated, will require various returns for topping off, and expanding the compartment size will bring about having pointlessly enormous frameworks. In this manner, there is a prerequisite of a more improved arrangement[1,2,3].

This controlled automated framework to water a field productively by estimating soil dampness levels and we control robot movements by using application which is connected to HC-05 blueetooth module[4,5]. The permanent installation of sprinkler and piping for irrigating fields is too costly and it will result in few lakh rupees. The permanent sprinkler system needs lot of primary investments there is a need of practical solution in between the higher cost and conservation of the water. Field support is a drawn-out task that requires appropriate watering to be done at normal stretches to keep a solid field. Huge wastage of water and contamination happens because of inappropriate field upkeep rehearses. With numerous redundant and routine assignments being supplanted by automated frameworks, field support could likewise be accomplished utilizing a mechanical framework that guarantees a solid land and diminish the work content of the field proprietor[6,7].

II. METHODOLOGY

Device is developed in such a way that it starts water the plants by soil moisture which gets detected by using the soil moisture sensor module which is connected to the Arduino uno. We have developed a mobile application to control the robot to move

forward, backward, right direction, left direction and a stop button to operate the sprinkler robot. This mobile application stage which could cover the whole yard region and water the grass at the necessary level by identifying soil dampness content for every district of the grass can be viewed as an answer for the issue. This mobile application is connected through Bluetooth module which is connected to a robot that helps to control the robot movements in lawn [8,9].

In robot we have connected a 65mm size wheels in 4 sides which are connected to a stepper motor of 3v. We have connected the battery of three cells. Each cell consists of 3.8 v and which is total of almost 12 v battery. We have used driver circuit to control the stepper motors which are connected to wheels[10].

We used a DHT 11 sensor to detect the “Temperature” and “Humidity” around us. This helps to understand and gives more information around us for better yield. To operate the water sprinkler we are using relay module. This relay module acts as a switch between Arduino uno and Motor used for water sprinkling. To block diagram of proposed system is shown Fig.1. The components used in proposed system and their workings are:

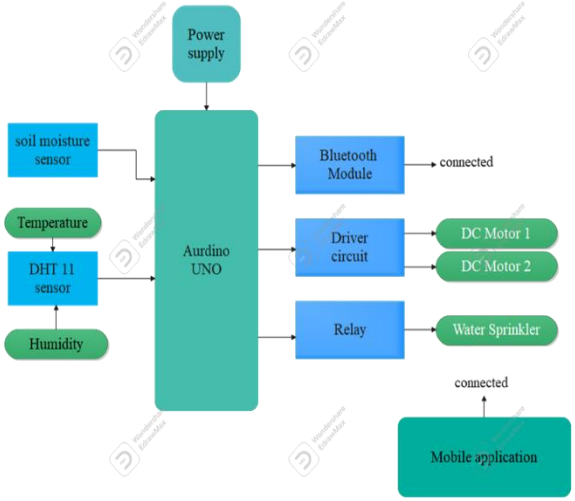

Fig 1. Block diagram of water Sprinkler Robot

a) Arduino Uno: Arduino Uno is an open-source model which is reliant to utilize various gadgets and programming together. We have some control over the board by sending a bunch of directions to the microcontroller on the board[11].

b) HC-05: HC-05 is a Bluetooth module which can communicate in two ways Which means, It is full-duplex. We can use it with most micro controllers. Because it operates Serial Port Protocol (SSP). The module communicates with the help of USART at the baud rate of 9600. Thus, we can communicate this module with any microcontroller which upholds USART. The HC-05 can work in two modes. One is Data mode and other is AT order mode. Whenever the empower pin is "LOW" the HC-05 is in Data Mode. Assuming that pin set as "HIGH" the module is in AT order mode[12].

c) Relay module: The relay module uses an electric current to open or close the contacts of a switch. A 5v hand-off is a programmed switch that is ordinarily utilized in a programmed control circuit and to control a high-current utilizing a low-current sign. The info voltage of the hand-off signal reaches from 0 to 5V[13].

d) Motor driver IC: motor driver IC is an incorporated circuit chip which is normally used to control engines in robots. Engine driver IC’s go about as a point of interaction between chip in robots and the engines in the robot[14].

e) DHT11 sensor: The DHT11 sensor is a fundamental, super minimal expense computerized temperature and stickiness sensor. The main genuine disadvantage of this sensor is you can get new information from it once like clockwork, the sensor readings can be as long as 2 seconds old. The DHT11 estimates relative dampness. The general moistness is how much water fume in air versus the immersion point of water fume in the air [15].

f) Soil Moisture Sensor: The Soil Moisture Sensor (Fig 1.8) is utilized to gauge the volumetric water content of soil. This makes it ideal for performing tests in courses like soil science, farming science, ecological science, cultivation, herbal science, and science. In this we have the test and module. The sensor contains a fork-molded test with two uncovered guides that goes into the dirt or elsewhere where the water content is to be estimated. The module delivers a result voltage as per the opposition of the test and is made accessible at an Analog Output (AO) pin. A similar sign is taken care of to a LM393 High Precision Comparator to digitize it and is made accessible at a Digital Output (DO) pin.

III. WORKING

This gadget depends on water content present in the cultivating soil. In this device we have divided the whole system into two parts.

i. Watering plants
ii. Controlling robot

The first part in this robotic system is watering plants. In this we are using Soil moisture sensor, DHT 11 sensor, Arduino Uno, water pumping motor, and bucket to hold water. At the point when soil dampness sensor kept on the dirt it distinguishes the dirt dampness level and feed it to the information pin of sensor. The other two pins with the exception of information pin associated with 5v and GND of Arduino Uno. The information pin in sensor holds the information and send it to Arduino for registering the cycle. In the wake of getting the information from dampness sensor it process it according to the code which was at that point unloaded into the Arduino. To understand the further steps much better take a look at the flowchart given in Fig.2.

After processing the code we have different conditions to water the farm. First the code check the soil condition that is "If soil is dry" the Arduino gives command in the form of 5v to the relay module. So, relay module consider it has condition satisfied and turns on the external power supply which is attached to relay module. Now the power supply passes through the relay module and turns on the motor which is submerged in water tank attached in our robot.

The second condition is when "Soil is Wet". In the condition information pin of DHT11 is associated with Arduino UNO's pin 2. Arduino is modified to convey a beginning message to the DHT11 sensor, and afterward to peruse the reaction heartbeat and sequential information from the sensor. After receiving the data from DHT 11 sensor about humidity and temperature. Now Arduino checks the conditions in the code. If the humidity and temperature are exact or more than the given value Arduino gives feed to motor (which we explained in above paragraph) to turn on pump the water in to farm field. If the humidity and temperature are less than the given value Arduino doesn't give any feed to relay module to turn ON. So, due to this relay module is turned off which leads to no power supply to the motor.

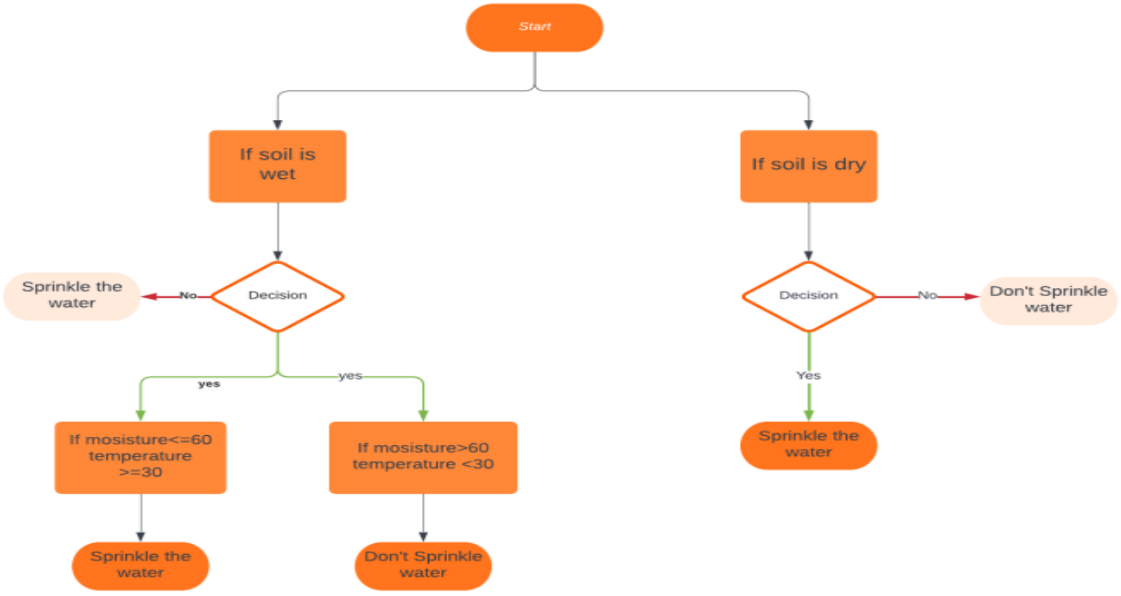

Fig 2. Working flow chart of water Sprinkler Robot

The second part in this robotic system is controlling robot. In this we are using 12 v battery, driver circuit, wheels, card board, nails, Bluetooth module and a mobile application.

An Android application acts as a remote to control device for movements. Bluetooth module acts as interface between mobile and Arduino UNO. Here Bluetooth module HC-05 gives commands given by the application developed to control robot. Arduino will be like a brain of the robot. The mobile application is connected to HC-05 module with Bluetooth in mobile by entering a security password.

After connecting mobile and Bluetooth module together commands are sent to Bluetooth module and it further moves to Arduino Uno. Now the Arduino gives feed to motor circuit to react and start the motors connected to wheels. The robot moves in the direction we have given command in our application. The circuit diagram of proposed system is shown in Fig.3. The mobile application is designed to control the operation of the designed water Sprinkler Robot In mobile application we added the following commands to control the sprinkler robot:

i. Front
ii. Right
iii. Left
iv. Back

The Fig.4 shows the screen of developed mobile application to control the operation of the designed Sprinkler Robot.

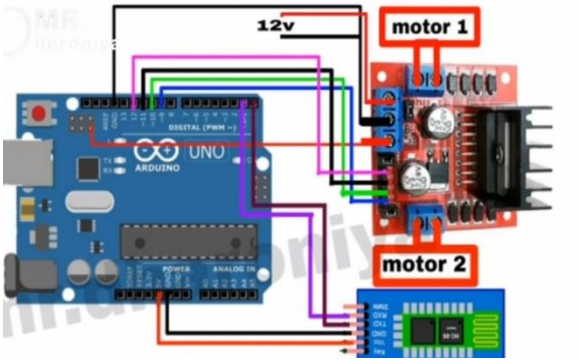

Fig .3 Circuit diagram of water Sprinkler Robot.

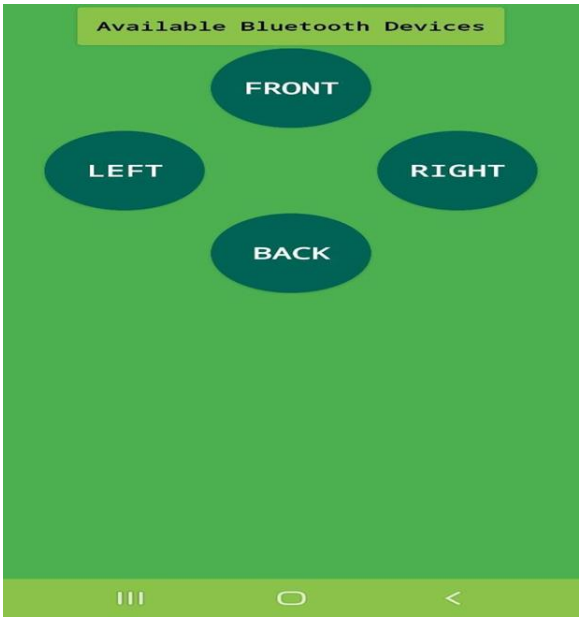

Fig .4. Mobile Application

IV.RESULT AND DISCUSSION

The Arduino Uno-based Controlled Water Sprinkler Robot successfully demonstrated effective control over watering operations in various environments. The project aimed to provide an automated solution for efficient watering of plants or lawns, enhancing convenience and optimizing water usage. The Fig.5 shows the working model of designed Water Sprinkler Robot. This section discusses the results obtained and explores potential implications and improvements.

Fig .5. Working model of Water Sprinkler Robot

1. Performance Evaluation: The performance evaluation of the Controlled Water Sprinkler Robot revealed several key findings:

- Precision and Accuracy: The Arduino Uno microcontroller facilitated precise control over the movement of the robot and the activation of the water sprinkler. The programmed logic ensured accurate positioning and targeted watering, minimizing water wastage.
- Reliability: Throughout testing, the robot consistently responded to commands and executed watering tasks reliably. The mechanical components, including motors and water delivery systems, operated smoothly without significant failures or malfunctions.
- Coverage and Efficiency: The robot's movement algorithm enabled efficient coverage of designated areas for watering. By adjusting parameters such as speed and trajectory, optimal coverage was achieved, promoting efficient water distribution and plant nourishment.

2. Environmental Adaptability: The Controlled Water Sprinkler Robot demonstrated adaptability to various environmental conditions, including different terrains and plant layouts. It effectively navigated obstacles and adjusted watering

patterns to accommodate diverse landscapes, showcasing versatility in application.

3. User Interface and Control: The user interface, designed to enable remote control and programming via Arduino IDE, offered ease of operation and customization. Users could adjust watering schedules, movement patterns, and other parameters to suit specific requirements, enhancing flexibility and usability.
4. Water Conservation: One of the primary objectives of the project was to promote water conservation through efficient watering practices. The Controlled Water Sprinkler Robot succeeded in optimizing water usage by delivering targeted irrigation, minimizing runoff and evaporation compared to conventional sprinkler systems.
5. Future Enhancements:

While the Arduino Uno-based Controlled Water Sprinkler Robot achieved its primary objectives, several areas for improvement and future enhancements were identified:

- Sensor Integration: Incorporating environmental sensors such as moisture sensors or weather forecasts could enhance the robot's adaptive capabilities and optimize watering schedules based on real-time conditions.
- Power Management: Implementing energy-efficient components and power-saving modes could prolong battery life and operational autonomy, especially for outdoor applications where power sources may be limited.
- Smart Connectivity: Integrating wireless communication modules (e.g., Wi-Fi, Bluetooth) would enable remote monitoring and control via smartphones or other smart devices, enhancing accessibility and convenience for users.
- Data Logging and Analysis: Collecting data on watering patterns, environmental conditions, and plant growth could facilitate data-driven optimization and decision-making for enhanced efficiency and plant health management

V. CONCLUSION

The Arduino Uno-based Controlled Water Sprinkler Robot represents a significant advancement in automated watering systems, offering precise control, reliability, and adaptability to various environmental conditions. Through extensive testing and performance evaluation, the project has demonstrated the effectiveness of the robot in optimizing water usage, promoting efficient plant nourishment, and enhancing user convenience. The successful implementation of the robot underscores its potential to revolutionize traditional sprinkler systems by integrating smart technologies and sustainable practices.

VI.FUTURE WORK

While the current iteration of the Arduino Uno-based Controlled Water Sprinkler Robot has achieved its primary objectives, there are several avenues for future work and enhancements:

1. Sensor Integration: Incorporating additional sensors such as moisture sensors, temperature sensors, and soil pH sensors would enable real-time monitoring of environmental conditions and plant health, facilitating adaptive watering strategies and optimal plant growth.
2. Smart Connectivity: Integration of wireless communication modules (e.g., Wi-Fi, Bluetooth) would enable remote control and monitoring of the robot via smartphones or other smart devices, enhancing accessibility and user convenience.
3. Advanced Control Algorithms: Implementing advanced control algorithms, such as machine learning-based algorithms, could further optimize watering patterns and enhance the robot's adaptive capabilities based on historical data and environmental feedback.
4. Energy Efficiency: Enhancing power management systems and integrating energy-efficient components would prolong battery life and operational autonomy, especially for outdoor applications where power sources may be limited.
5. Data Logging and Analysis: Developing robust data logging capabilities to collect and analyze data on watering patterns, environmental conditions, and plant growth would enable data-driven decision-making and continuous optimization of the watering system.
6. User Interface Improvements: Enhancing the user interface with intuitive controls, scheduling options, and data visualization tools would improve user experience and facilitate customization of watering schedules based on specific preferences and requirements.
7. Scalability and Deployment: Exploring methods to scale up the system for larger areas and

commercial applications while ensuring cost-effectiveness and ease of deployment would expand the potential impact of the Controlled Water Sprinkler Robot.

By addressing these areas for future work and incorporating advanced features and technologies, the Arduino Uno-based Controlled Water Sprinkler Robot can further evolve as a sustainable and efficient solution for automated watering in agricultural and residential settings, contributing to water conservation efforts and promoting healthier plant growth.

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