A Smart Agriculture Robot for Sowing Seeds

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Abstract - The conventional method of seed sowing commonly employed in agriculture demands additional time and manual labor. The seed feed rate is higher, but the overall operation takes longer and requires more manpower, increasing the overall cost. The traditional seed-sowing equipment takes longer and is less effective. Agriculture and other industries are expected to grow quickly in the current age. Farmers must adopt innovative practices that will boost crop productivity while not affecting soil texture to fulfill future food demand. The seeding process is the primary requirement for a crop to yield well. In this project, a Robotic vehicle is designed for Seeding on the farm using an Arduino Mega which is controlled by the Bluetooth module. Certain types of sensors are also used. This Robot is unique in its kind in prototype design. This approach can also be implemented across various levels of agricultural practices and other design aspects to enhance time management, labor efficiency, and overall output, resulting in increased crop productivity

***Key Words*:** Smart Agriculture, Arduino Mega, Agribot, Robotics.

1. INTRODUCTION

For a very long time, agriculture has been and will continue to be the foundation of the Indian economy. The environmental impact of agricultural production is a major topic of discussion nowadays, and industry expectations are rising. The majority of Indian cities currently lack adequate qualified labor in the agricultural sector, which has an impact on the development of developing nations. As a result, farmers must engage in agricultural activities using modern technologies. The manual method entails manually dispersing the seeds and water. So, to solve these issues, the industry needs to be automated.

The project's innovative concept involves automating tasks like checking whether the soil is suitable for cultivation, planting seeds, and spraying water to minimize the need for human labor.

A robot used for agriculture is referred to as an agricultural robot. The main goals are to determine whether the soil is suitable for cultivation, plant the seeds in rows at the appropriate depth and distance, and provide the proper compaction to the soil over the seeds.

The robot uses an android application to control water spraying, seed sowing, and soil suitability testing. This project's novel concept involves a robot that not only does numerous farming tasks but also keeps track of all activities linked to robot mobility, such as battery power and obstacle recognition. The suggested system falls under the agricultural category.

The system will be used for communication, control, monitoring, and sensing functions. To measure variables like soil moisture and obstacle detection, various sensors are employed. The microcontroller will perform the required operations by the sensor's output. If the soil is suitable for cultivation, it will be possible to tell from the moisture sensor output. The practice of sowing seeds can begin once the soil is suitable. Additionally, water spraying operations can be carried out whenever the moisture in the soil is not detected. An Android application can be used to control the robot's actions.

2. LITERATURE REVIEW

The primary objective of an automated water irrigation system is to optimize water usage by incorporating advanced sensors such as water level sensors and moisture sensors in the fields. These sensors enable the system to continuously monitor the water level and soil moisture content. Whenever the water level falls below a pre-established threshold and the soil moisture indicates a need for irrigation, the system automatically activates irrigation by opening the entrance valve. Once the water level reaches the desired threshold, the entrance valve closes, and a SMS notification is sent to the farmer, informing them of the duration it took to adequately water the field. In

contrast to traditional systems where farmers manually manage water flow, constantly monitor water levels, and physically redirect water to specific fields, the proposed automated system ensures efficient water utilization and mitigates crop damage caused by water overflow. [1].

Agriculture holds a crucial position in the economy, serving as its backbone. This project aims to address the challenges related to seed-sowing processes. The seeds-sowing machine system incorporates battery-powered wheels and a built-in DC motor within these wheels. It is equipped with a seed storage level detector that raises an alarm when the seed level is depleted. Additionally, the machine effectively detects obstacles or deviations in its path, ensuring seamless operation. With each rotation of the rotating wheel, seeds are dispensed from the seeds drum, facilitating a smooth and efficient seed plantation process while minimizing seed wastage. The system concludes its operation with an alarm, providing comprehensive and efficient functionalities [2].

The research paper introduces an automatic irrigation system utilizing the Arduino microcontroller, grove moisture sensor, and water flow sensor. Communication between the components is established through the Zigbee protocol, allowing the Arduino microcontroller to control the system based on the soil moisture levels. Within the network, two Xbee radios are configured as master and slave, working in conjunction with the Arduino microcontroller. When a specific moisture threshold is reached, the system enables water flow in the pipe, and relevant data such as flow range, water pressure, and time are recorded in a database and displayed on a web portal. The agricultural field owner has the convenience to monitor moisture levels and motor status at any time. Furthermore, the motor's operational status is transmitted to the farmer's mobile phone using GSM technology [3].

The research paper introduces an innovative experimental setup known as "Android-based speed control of DC motor." This setup allows users to control the system using a smartphone connected via Bluetooth. The setup comprises two primary components: the smartphone's Bluetooth, which is connected to the Arduino Uno ATmega328P-Pu microcontroller IC and an L293D motor driver IC interfaced with a DC motor; and a Bluetooth module HC-05 for establishing wireless communication between the smartphone and the microcontroller through Bluetooth technology. To enhance user experience, an Android application is developed and installed on the smartphone, serving as a user interface for sending, receiving, and viewing input and output data of the DC motor. The application provides a convenient display panel that showcases commands and corresponding responses. Overall, this research proposes a methodology that allows users to control the speed of a DC motor using an Android-based smartphone, offering a practical and easily implemented remote-control solution utilizing microcontroller technology. [4].

3. METHODOLOGY

The newly developed technique introduces a robotic vehicle featuring four wheels as its primary means of mobility. The system incorporates two sensors to measure soil temperature, moisturization, and humidity in the field. Two types of motors are utilized in this system: DC motors and Servo motors. DC motors are responsible for propelling the wheels of the robotic vehicle, enabling its movement. On the other hand, Servo motors are employed for the rotational function of the seeds funnel on the robot, allowing precise seed dispersion.

A. BLOCK DIAGRAM AND DESCRIPTION OF ROBOT

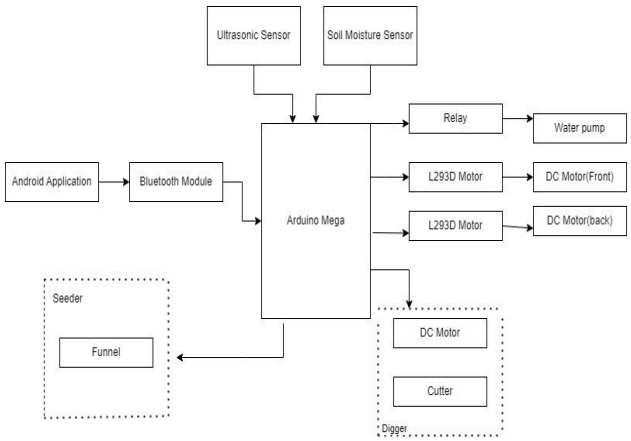

Figure.1. Block Diagram for A smart agriculture robot for seed sowing

The proposed project incorporates an Ultrasonic sensor and a soil moisture sensor, along with a microcontroller at its core. Power is provided by a laptop, while three DC motors enable the robot's movement. The robot is equipped with a cutter for digging, a sprinkler for water spraying, and a Bluetooth module for sensor communication, all interfaced with the microcontroller. Motor control is achieved through the use of a motor driver L293D. This integrated system allows the robot to sense its environment using the sensors, navigate using the DC motors, and perform specific actions using the attached tools.

B. WORKING

The ultrasonic sensor is equipped with four pins: Vcc, trigger, echo, and ground. In our setup, the trigger pin is connected to pin number 7 of the Arduino board, while the echo pin is connected to pin number 8. When triggered, the sensor emits pulses through the trigger pin and receives them through the echo pin. If these pulses encounter an obstacle in their path, they bounce back and are detected by the sensor. This allows us to detect the presence of any obstacles in the robot's path.

The soil moisture sensor comprises two conducting probes. By measuring the change in resistance between these probes, it can determine the moisture content in the soil. When the soil is wet, it exhibits lower resistance, while dry soil results in higher resistance. This enables us to monitor and analyse the moisture levels in the soil.

To interface between the microcontroller and the motor, we utilize the L293D motor driver IC in our circuit. This IC has 16 pins and can simultaneously control two DC motors in any desired direction. While the DC motor operates at 12V, the microcontroller produces an output voltage of 5V. Therefore, we require a motor driver that can provide the necessary 12V input to the DC motor. In our setup, pins 3 and 6 of the L293D IC are connected to the DC motor to facilitate motor control.

C. ANDROID APPLICATION

To establish control over the system using mobile phones, Bluetooth connectivity is employed. Initially, the functions of the system are connected to the mobile phone through a relay, acting as an electromagnetic switch. Subsequently, an Arduino is utilized to program the data as per the specific requirements. Power transmission to the rear wheel is accomplished through gears, allowing for control via an Android application that adapts to the necessary conditions.

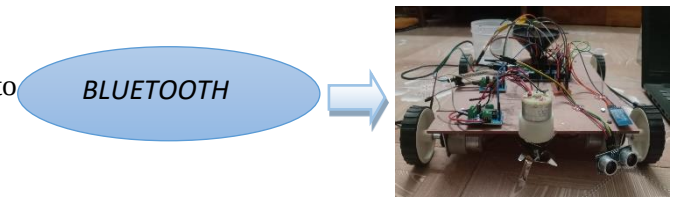

Figure.2. Android App Connecting to Robot.

4. SOFTWARE DESIGN

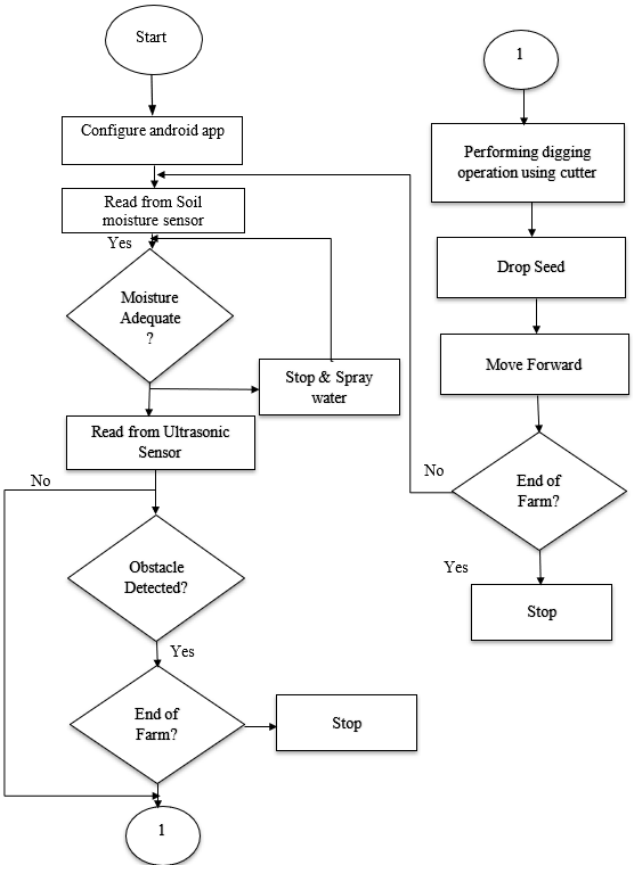

Figure.3. Flowchart

Algorithm of Seed Sowing operation:

1. Start the robot by powering it up. Here, the power is provided by the System.
2. Configure the Android application on the smartphone by giving input for the seeds-sowing

operation. Then this command will be sent to the robot.

3. Now first read the output of the soil moisture sensor. Verify if the soil is suitable for the cultivation of the required crop. If the soil is not suitable then stop and Spray Water, and if the soil is suitable then continue with the further operation. When the sensor is inserted into the soil, the resistance will decrease and get better conductivity between plates. The sensor is used to verify if the soil contains appropriate moisture content for growing crops for example (wheat, jowar, and sunflower).
4. Once the soil suitability is verified, check the ultrasonic sensor's output. The sensor is used to detect if any obstacle is present in the path of the robot. If any obstacle is encountered then the robot will stop its operation otherwise it will continue its operation.
5. Now, perform the digging operation using Cutter, After the digging is done, drop the seeds of the crop in the dug holes. After dropping is done move forward. The directions of the robot are controlled using the Android Application.

A. Result

The project entails the construction of a four-wheel robot utilizing Arduino, sensors, motor drivers, and Bluetooth. This system is designed to be cost-effective, efficient, and consume low power. The effectiveness of seed placement relies on the characteristics of the terrain, which is monitored using sensors, thereby providing accurate results.

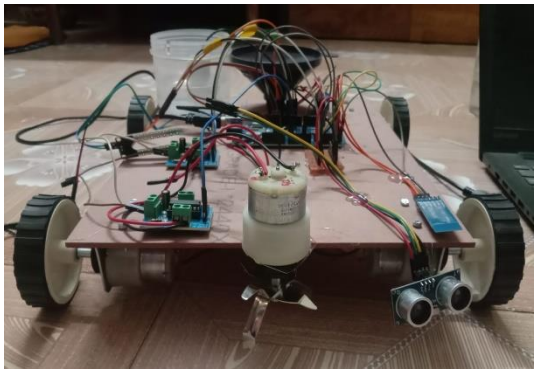

Figure.4. Implemented Result

5. CONCLUSIONS

This project is designed fully functional automated product. In this work, seeds sowing and water spraying robots with wireless control are successfully developed and implemented in a real-time environment. This system is developed at low power and low cost with an efficient output. This robot with wireless control system gives an alternative way of broadcasting seeds and water by hand. This robot will perform the seed sowing and water spraying operations and hence will save labor requirements such as cost, time, and a lot of energy.

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