International Journal of Research Publication and Reviews, Vol 6, Issue 4, pp 1357-1360 April 2025

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Review: Automated Seeding and Irrigation Using Arduino

Ajith K [a], Krishnajith U [b], Rahul R [c], Lt. Sanoj T [d]

Department of Mecchanical Engineering, Nehru College of Engineering and Researh Centre, Pampady, Thrissur

A B S T R A C T

Automation in agriculture is critical for enhancing performance and resource control. Often, labor-in depth methods and too high water use observe conventional seeding and irrigation practices. This paper looks at an Arduino-based automatic seeding and irrigation system designed to boom agricultural accuracy. The gadget employs motorised seed dispensers, automatic irrigation systems, and soil moisture sensors to maximise water use and ensure right seed placement. The paper discusses how such automation influences lowering manual effort, improving crop yield, and managing implementation challenges. The take a look at also considers smart farming and IoT-primarily based agricultural answers future developments. The device increases crop output and reduces waste by means of ensuring best water use and particular seed placement. Using actual-time monitoring and manage, farmers can gain greater efficiency with least human involvement. The paper looks at future possibilities in integrating IoT and synthetic intelligence-primarily based technology for smarter farming solutions, viable implementation troubles, and exclusive tendencies in precision agriculture.

Keywords: Automated Irrigation, Precision Farming, Smart Agriculture, Soil Moisture Sensor, Seeding Mechanism , IoT in Agriculture, Agricultural Automation, Sustainable Farming.

1. Introduction

Automation in agriculture is critical for enhancing performance and resource control. Often, labor-in depth methods and too high water use observe conventional seeding and irrigation practices. This paper looks at an Arduino-based automatic seeding and irrigation system designed to boom agricultural accuracy. The gadget employs motorised seed dispensers, automatic irrigation systems, and soil moisture sensors to maximise water use and ensure right seed placement. The paper discusses how such automation influences lowering manual effort, improving crop yield, and managing implementation challenges. The take a look at also considers smart farming and IoT-primarily based agricultural answers future developments. The device increases crop output and reduces waste by means of ensuring best water use and particular seed placement. Using actual-time monitoring and manage, farmers can gain greater efficiency with least human involvement. The paper looks at future possibilities in integrating IoT and synthetic intelligence-primarily based technology for smarter farming solutions, viable implementation troubles, and exclusive tendencies in precision agriculture.

2. Prior Work

M. Aravind Kumar et al. (2018) developed a seeding and irrigation machine aimed at minimizing operational costs and reducing planting time. The system is powered by solar energy and incorporates a sharp iron tool at the front to dig the soil for seed placement. A rear-mounted mechanism then covers the seed with soil after planting. Additionally, an automated irrigation system was integrated to ensure adequate watering. However, the study does not incorporate immediate irrigation following seed placement.

Md. Didarul Islam Sujon et al. (2018) designed an autonomous agricultural robot to assist farmers in essential farming tasks. This Arduino-based system performs plowing, sowing, and watering, with ultrasonic sensors guiding its movement between farming strips. The robot significantly improves farming efficiency and reduces labor costs. However, its functionality is restricted to small-scale land areas, limiting its suitability for extensive farming.

K. A. Sunitha et al. (2017) introduced a robotic system capable of autonomous navigation without human assistance. It features tentacle-like saw blades for plowing, while its movement is facilitated by wheels enclosed within conveyor belts. A gear-based seed dispensing mechanism ensures uniform seed placement. Additionally, a front-mounted camera tracks a predefined path at regular intervals. Despite these advantages, the reliance on image processing for object detection increases system complexity. Furthermore, motion blur due to camera movement or lens contamination can cause detection inaccuracies.

S. Thawali et al. (2017) proposed a robotic system designed for automated plowing, seed dispensing, and pesticide spraying. The robot operates autonomously in the field but can also be manually controlled via a remote for navigation. While it efficiently performs seeding and spraying, the absence of an obstacle detection system poses a risk of damaging planted crops if human supervision is not provided.

Thorat Swapnil V et al. (2017) introduced a robotic sowing machine capable of planting various seed types with adjustable spacing. The seed storage tank is positioned near the rear wheels, and a front-mounted sensor detects obstacles, enabling the robot to adjust its path accordingly. However, the system lacks features for soil or plant condition monitoring, requiring farmers to use additional monitoring tools for effective crop management.

3. Arduino DC Motor Control

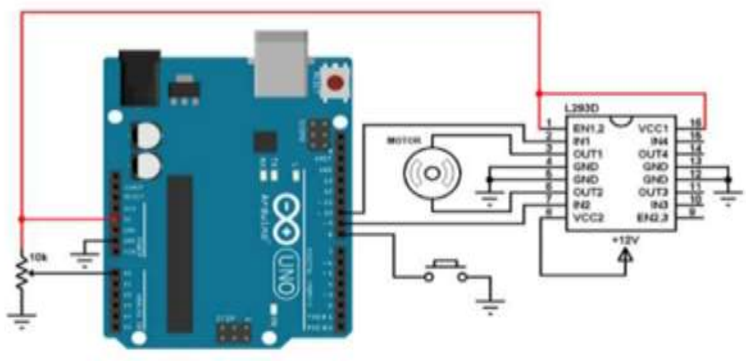

Fig 1 Arduino Dc motor control

The figure illustrates the circuit diagram for controlling a DC motor using an Arduino. The system operates with just three Arduino pins: pin 8 is linked to a push button responsible for changing the motor's rotation direction. Pins 9 and 10 function as PWM (Pulse Width Modulation) signal outputs, with only one of them active at a time. This setup allows for precise control of both direction and speed by modifying the PWM signal's duty cycle. The active PWM pin determines the motor's rotational direction, while the inactive pin remains at a logic low state.

A 10kΩ potentiometer, connected to analog pin A0, is used to regulate the motor's speed in both directions. The L293D motor driver includes two VCC pins: VCC1 (+5V) powers the logic circuit, whereas VCC2 (+12V) supplies power to the motor. The driver's control pins (IN1 and IN2) govern motor operation, with their corresponding functions detailed in Table 1.

IN1	IN2	Function
L	H	Direction 1
H	L	Direction 2
L	L	Fast motor stop
H	H	Fast motor stop

Table 1: IN1 and IN2 function

4. Monitoring System

This section details a temperature and soil moisture monitoring system integrated with an Android application to enhance user accessibility. Developed using MIT App Inventor, the system continuously tracks soil moisture, humidity, and temperature levels. The application displays real-time data for each land segment, allowing farmers to monitor environmental conditions and enable on-demand irrigation. Additionally, it provides a data storage feature that helps predict future weather patterns and supports informed decision-making for land management.

To ensure smooth navigation, an ultrasonic sensor detects obstacles, allowing the system to avoid them and effectively reach taller plants for irrigation. Soil moisture and DHT22 sensors are embedded in the soil to measure moisture content, humidity, and temperature. The system transmits these readings to the user via SMS every minute while also making the data accessible through an Android application.The robot follows a programmed path, moving forward to dispense seeds at predetermined intervals of 7 cm. Once seeding is completed at a point, the robot waters the seed and then advances to the next location to repeat the process. This automation significantly reduces manual labor and enhances efficiency in farming operations.Potential future improvements include incorporating image processing technology for more precise weed and obstacle detection. Additionally, a robotic arm could be integrated for automatic weed removal, further reducing human intervention and improving overall field maintenance.

5. Seeding and irrigation Mechanism

The essential goal of this system is to build an self reliant robotic capable of appearing irrigation and seeding tasks. Upon activation, the robot undergoes ten seconds of initialisation. It then runs at 2 hundred rpm for 2 seconds before preventing to perform the seeding and irrigation responsibilities. Once these obligations are complete, the robot advances for every other seconds after which adjustments to the subsequent row. The gadget dispenses a seed every six seconds at a distance of seven cm. Figure 6 depicts the seeding technique of mung dal.

The robot waters the sown seeds following the seeding method. Knowing the ideal water necessities of the plants beneath cultivation helps to promote effective water distribution. Crops like mung dal and peas, for instance, require an preliminary water supply of 20ml to 25ml consistent with seed to permit right irrigation. This guarantees enough moisture for early development and germination.Designed to maximize water use, the robotic's irrigation device guarantees even subject distribution. Table 2 gives thorough irrigation information for the robot prototype together with water amounts in step with seed, irrigation periods, and system overall performance underneath diverse subject conditions.

Table 2: Irrigation Detail

Irrigation Tank Capacity: 500ml
Irrigation Pump Flow Rate: 1.2-1.6 L/min
Irrigation per seed: 20ml - 30ml
Irrigation type: Drip irrigation

6. Relay Control for Irrigation

Relay control in irrigation structures is a modern method that automates the water distribution system, consequently increasing performance and reducing water waste by using automation. This system uses relays, electrically controlled switches, running high-strength devices like water pumps relying on sensor-detected situations. Relay control in irrigation ensures particular watering, minimises human involvement, and guarantees that vegetation get the greatest amount of water.Data accrued from soil moisture sensors in a relay-managed irrigation machine is processed by a microcontroller consisting of an Arduino or Raspberry Pi. These sensors monitor the soil moisture level and ship this records to the microcontroller. Should the soil be dry, the microcontroller activates the relay, which then operates the water pump. Once the soil reaches the preferred moisture degree, the relay shuts off the pump, consequently finishing the irrigation operation. This ensures that crops acquire precisely the proper amount of water and facilitates to prevent over-watering, which can sell water waste and terrible plant fitness.

Relay manipulate irrigation gives numerous advantages. First and most important, it helps store water via ensuring irrigation most effective occurs while the soil moisture level is missing. This not most effective prevents over-watering however also reduces the want for frequent guide tracking. Automation of the machine reduces labour fees and permits farmers awareness on other crucial duties. Furthermore, by means of this system, water use is optimised so that vegetation are watered on the right time and inside the proper amount, so fostering better flora and greater output.Relay-managed irrigation systems can be modified for diverse farm sizes as well as scalable. Whether they're small gardens or large agricultural land, the system can be modified to match the needs of different farming setups.Looking in advance, greater advancements in relay-managed irrigation systems could consist of the integration of gadget gaining knowledge of to more precisely predict water wishes, wi-fi verbal exchange, and weather forecasting information. Solar-powered irrigation structures could also beautify sustainability through reducing power use.In the give up, relay manage for irrigation is a quick, reasonably-priced answer for contemporary agriculture that enables to store water, lessen labour charges, and growth crop manufacturing. Sustainable agriculture will rely upon relay-controlled irrigation structures as era develops, therefore ensuring that farming is each efficient and environmentally useful.

7.Conclusion

The proposed technique is meant to do an irrigation method after first seeding. The robot has eight wheels to ensure clean motion throughout the field. Two ultrasonic sensors at the the front and base of the robot permit it discover boundaries each in the front of and below it. By raising itself to clean the barrier and decreasing backtrack as soon as it has handed the obstacle, the robotic guarantees constant operation. This feature also allows the robot to water tall vegetation.Field placement of soil moisture, temperature, and humidity level monitoring DHT22 sensors and soil moisture we could An Android app additionally gives the consumer get admission to to the facts; SMS sends those readings to the user every minute. After irrigating the planted seed, executing seeding at a designated factor, and shifting ahead, the robot actions to the following factor to repeat the system. The robotic robotically distributes seeds at a hard and fast distance of seven cm.Adding a robotic arm for weed removal and including photograph processing for extra specific navigation would assist the gadget to be better seeing that it would then be extra powerful.

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