Hand Gesture Controlled Seed Dispensing and Irrigation Agro-Bot

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***Abstract*— India is a nation where most of its population earns their daily livelihood from agricultural activities. Agriculture is one of the most practiced primary activities in the country. The agricultural sector is already on the verge of automation. Various technological inventions and innovations have started entering the field. The purpose of introducing novelty technological features in agriculture is to increase the farmer's yield in a minimum amount of time span. To utilize all the available resources intelligently and optimize the Farmer-Resource relationship. Providing the finest facilities to the crofters in modern-day India is one of the primary objectives of this project. The improvement in innovations in the primary sector will not only take the country one step closer to becoming self-reliant but also attract foreign investments in the sector. The aim of this paper is to present a model of an agricultural robot that will be useful for sowing seeds and irrigation purposes. Furthermore, the robot will be hand gesture-controlled using radio signals.**

Keywords*— *Agro-bot, Irrigation, Seed-sowing, automation, agriculture

I. INTRODUCTION

Currently, the agriculture industry in India mostly relies on manual labour. Whether watering the crops, sowing the seeds, fertilizing the field, cutting the weed, etc. irrigation tasks are becoming extremely hectic for the farmers to keep up with the field. Automation assists the field worker in saving their time and increasing the task's efficiency. The agro-bot designed as a part of this project is aimed at the same principles. Seed sowing and irrigation are the main aspects of it, it provides aid to the farmer in reducing the time on the field.

The semi-automation in this project has been achieved by making the bot gesture controlled. Radio Frequency technology has been used to control the bot using a gyro sensor. For the seed-sowing mechanism, a servo motor has been used to dispense the seeds at the command of the farmer. A motor pump has been used for irrigation purposes. To reduce the burden on the farmer and his family. The agro-bot will be a multipurpose tool for farmers to optimize agriculture. The agricultural sector will be experiencing a boom in the coming years due to technological advancements.

Arduino UNO R3 microcontroller has been used for the programming of the robot. The major portion of the programming includes controlling the robot using hand gestures with the help of a Gyro Sensor. The intention is to make the robot wireless so that space and physical relief features of land do not pose a constraint to the farmer. By improving upon the current gyro sensors, and RF Transmitters and Receivers, the working range of the robot can further be increased and made more accurate as well as precise.

II. LITERATURE SURVEY

The study of Redmond Ramin Shamshir et al. [1] reviews advancements in autonomous weed control, field scouting, and harvesting. An approach to utilize an army of agro-bots and agro-drones was presented. However, entirely automated digital farming does not provide good value as compared to hybrid farming. Some of the issues that he recognized with digital farming are object identification, task planning algorithms, digitization, and sensor optimization. In their study, Halil Durmuş et al. [2] discuss a mobile autonomous robot with the ability to process and oversee field activities such as fertilization, disease diagnosis, yield analysis, soil analysis, and other agricultural tasks such as spraying remedies for precision farming. Cloud services from the Environmental Agriculture Informatics Applied Research Centre (TARBIL) allow all devices on the network to connect, and application software will be able to transport data to farmers' mobile devices, tractors, and farming vehicles. K Durga Sowjanya et al. [3] have developed a Bluetooth-controlled robot for plowing, seeding, and irrigation which is aimed at reducing human intervention, proper irrigation, and proper utilization of resources. The objectives of the suggested system are to turn the top layer of soil down, shut the seeds and mechanically level the ground, provide irrigation by sprinkling water with a pump in the field, and plow the seeds with a structure resembling a tooth at the end. In his development, F Buemi et al. [4] discuss a robot that is used for the production cycle of tomato plants in a greenhouse environment. The main components include – a head with a picking arm and two micro cameras and a VME rack for complete control. The robot will have the ability to move between plant rows. To harvest ripe tomatoes and spray anticryptogamin solutions on flowers, stop near each plant and identify the pertinent things (fruits or flowers). In their study, Yael Edan et al. [5] analyze the agricultural robot's performance using a system engineering method that simulates and contrasts various robot types, arm counts, multiple arm configurations, workspace layouts, and dynamic properties. For the task of harvesting melons, the Cartesian robot outperformed the Cylindrical robot in speed. The fastest arrangement tested was two arms being activated simultaneously. Before building a prototype, simulation served as a useful tool for assessing a variety of design and crop characteristics and quickly comparing potential solutions.

III. ELECTRONICS

A. *Arduino UNO*

A microcontroller board called Arduino Uno is based on the ATmega328P. (datasheet). It has a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 6 analog inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; to get started, just plug in a USB cable, an AC-to-DC adapter, or a battery.

Fig. 1 – Arduino UNO R3

B. *DC Motor*

Any of a group of rotating electric motors that use direct current (DC) electricity to create mechanical energy is referred to as a DC motor. The most prevalent kinds depend on the forces created by induced magnetic fields brought on by current flowing through the coil. For a portion of the motor's current to occasionally shift direction, almost all types of DC motors contain an internal mechanism that is either electromechanical or electronic.

Fig. 2 – DC Motor

C. *Relay*

Relay is an electromagnetic switch that is used to turn on and off relatively much greater currents. It is controlled by a little current. This implies that we can turn on the relay by applying a small current, allowing a much bigger current to flow. A nice illustration of how to operate AC (alternate current) devices with a considerably smaller DC current is a relay.

Fig. 3 – Relay Module

D. *Gyro Sensor*

A gyroscope sensor is a tool that can measure and keep track of an object's orientation and angular velocity. Compared to accelerometers, these are more modern. While accelerometers can only monitor linear motion, they can measure the tilt and lateral orientation of the item.

The terms "angular rate sensor" and "angular velocity sensor" are also used to refer to gyroscope sensors. These sensors are installed in applications where it is challenging for humans to discern an object's orientation.

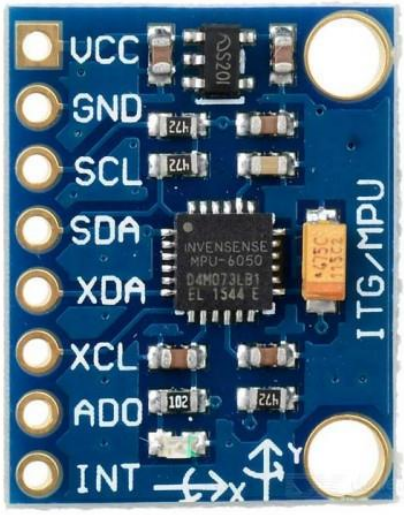

Fig. 4 – Gyro Sensor

E. RF Transmitter Reciever

In general, there are two major requirements for wireless system designers: the system must be able to operate over a specific range and transfer a specific amount of data at a particular data rate. The RF modules are extremely compact and operate across a wide voltage range, from 3V to 12V.

The RF modules are essentially RF transmitter and receiver modules operating at 433 MHz. When sending logic zero while completely suppressing the carrier frequency, the transmitter draws no power and uses a very small amount of power during battery operation. Carrier is completely on to roughly 4.5mA with a 3 volt power source when logic one is communicated. Data is transmitted serially from the transmitter to the tuned receiver. Two microcontrollers are properly interfaced to the transmitter and the receiver for data transfer.

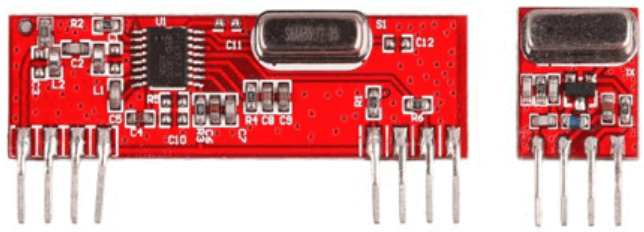

Fig. 5 – RF Transmitter and Receiver

F. Voltage Regulator Module

Since all the electronic devices used operate on different voltages, the voltage regulator is one of the most essential components to monitor and control voltages in the circuits. Arduino voltage regulator is used to regulate voltage given to devices using Arduino.

Fig. 6 – Arduino Voltage Regulator

G. Motor Driver L298N

The high power motor driver in this L298N-based motor driver module is ideal for driving DC motors and stepper motors. It makes use of the well-known L298 motor driver IC and includes an internal 5V regulator that it can utilise to power an external circuit. It has the ability to direct and speed-control up to 4 DC motors or 2 DC motors.

For robotics and mechatronics projects, this motor driver is ideal for controlling motors with microcontrollers, switches, relays, etc. Ideal for powering DC and Stepper motors for robot arms, line-following mice, and other devices.

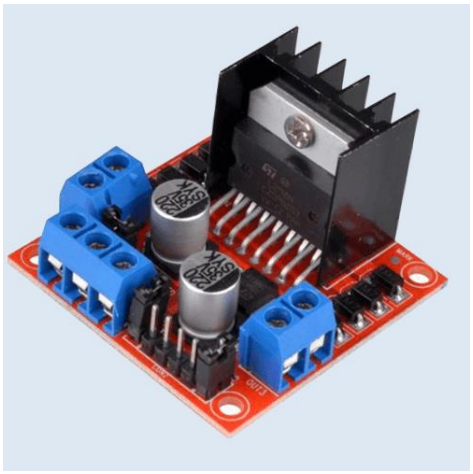

Fig. 7 – Motor Driver Circuit

H. Water Pump Motor

By analysing the information obtained from the ultrasonic distance sensor, the Arduino controls the water pump's ON/OFF status. The Arduino turns on the water pump if the data is closer to the sensor than a certain distance (in code, measured in inches). After turning it ON, it first determines whether the data is higher than a predetermined distance (in inches in code) from the sensor before turning the water pump OFF.

Fig. 8 – Water Pump Motor for Irrigation

I. Servo Motor

The rotary actuator or linear actuator known as a servomotor (or servo motor) enables precise control of angular or linear position, velocity, and acceleration. It consists of an appropriate motor connected to a position feedback sensor. It also needs a rather sophisticated controller, frequently a special module created just for use with servo motors. Although the word "servomotor" is frequently used to describe a motor appropriate for use in a closed-loop control system, servomotors are not a particular sort of motor. Applications for servomotors include robotics, CNC equipment, and automated manufacturing.

Fig. 9 – Servo Motor used for Seed Dispensing

IV. METHODOLOGY

A gyro sensor has been attached to detect the change in angle, to move the robot in either a forward or backward direction, or to turn it. The detected change in angle by the gyro sensor is sent to an Arduino microcontroller which encodes the data in a random character to further transmit the change to the motor through a radio frequency transmitter and receiver. Once the data is sent over to the robot through radio frequencies, the character is decoded, and hence as per the tilt of the gyro sensor, the motor driver circuit ensures the rotation of necessary motors of the wheels in the required direction.

A mechanism based on servo motor has been used for seed dispensing. Whenever the seeds need to be sown, with the help of servo motor, the flap opens, letting the seeds to drop on the field. A water pump motor is used to pump water from a locally mounted water tank to irrigate the field. Flowcharts shown in Fig 10 and Fig 11 have a detailed description of the working of the internal circuit of the agrobot.

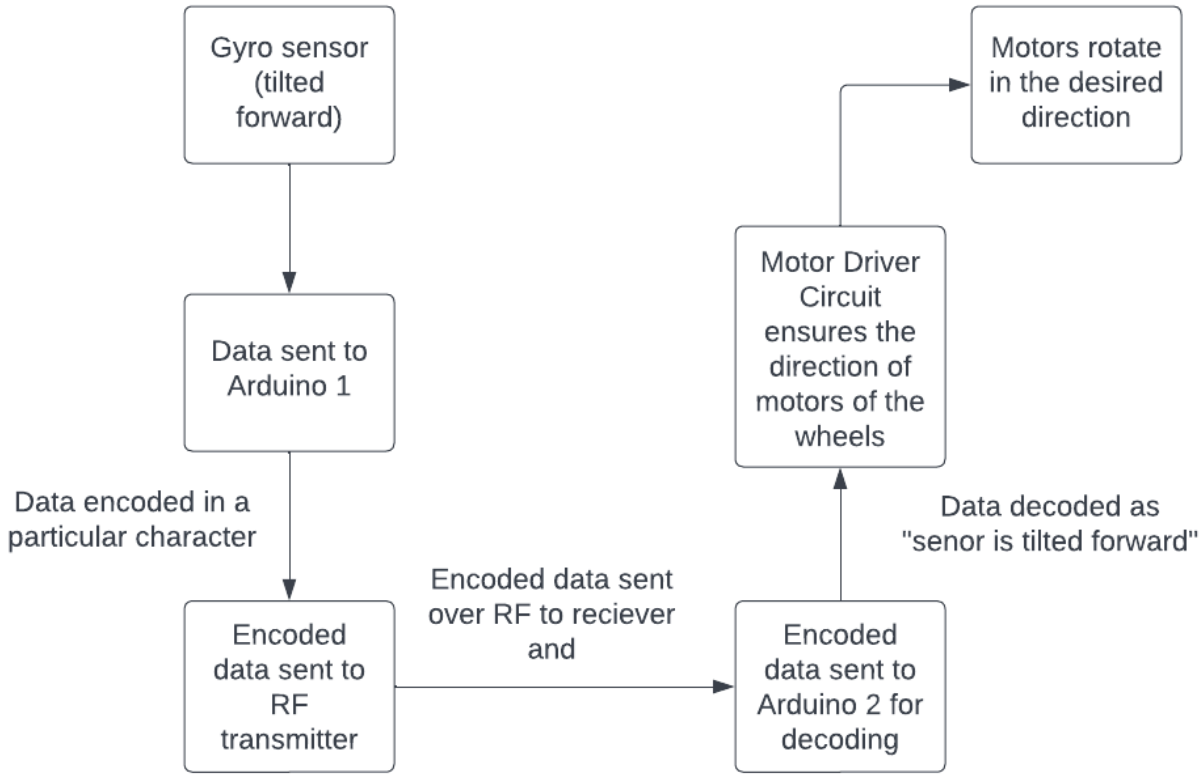

Fig. 10 - Internal Circuit of Robot for Operation

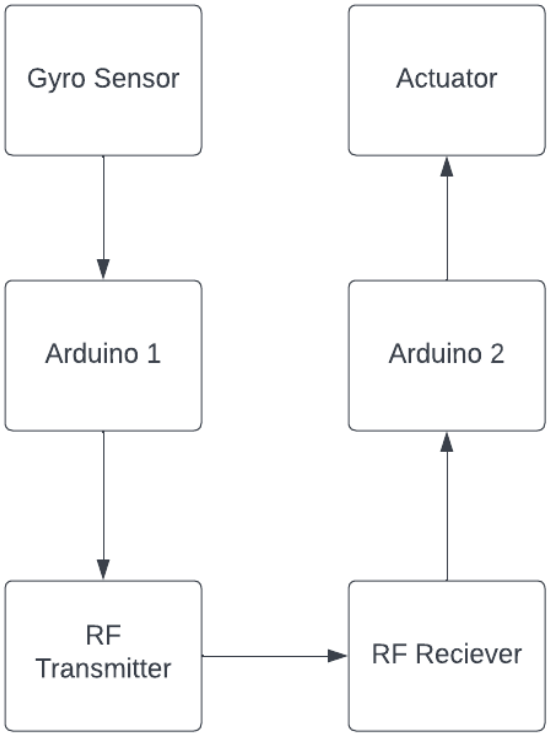

Fig. 11 – Flowchart of basic working principle of robot

V. RESULTS

The agricultural robot developed, is successful in performing two of its main tasks – Water Irrigation and Seed Dispensing and Sowing. A 9V voltage battery is used to power the Arduino. A 12V battery is used to power the entire circuit as well as to establish motion. The motor driver circuit and the relay module play important role in the motion of the wheels. The motor driver circuit is used to drive the DC motors used for the wheels. The function of the relay module is to act as a switch and control the current passing to required pair of DC motors as per the signals of remote control. Two Arduino boards were used in entire wired and wireless circuit. One of the Arduinos is used for the hand gesture controlled remote. It served purposes of detecting tilt angle of the remote and transmitting this data to the second Arduino which decodes the data and controls the direction of the robot using the motor driver circuit and relay module.

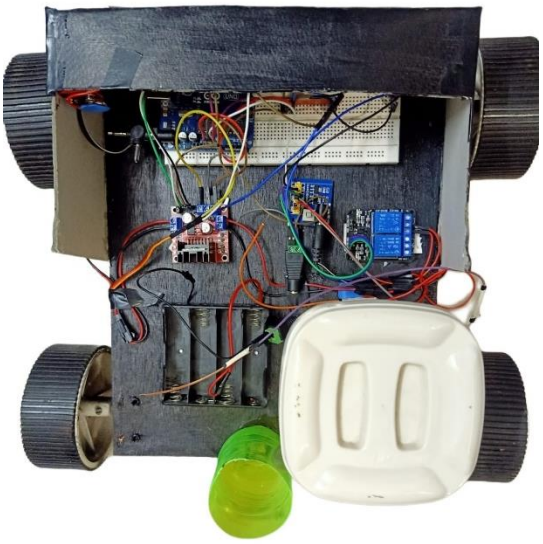

Fig. 12 – Top view of the robot

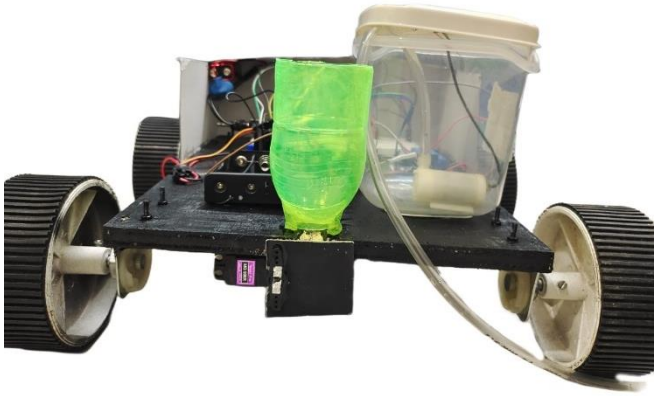

Fig. 13 – Lateral view of the robot

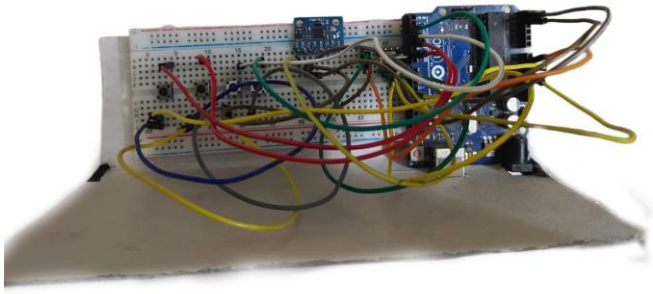

Fig. 14 – Gesture Controlled Remote

VI. FUTURE SCOPE

After the testing of the robot, and upon brainstorming the needs of the agriculture industry, a certain feature will make the robot even stronger in the aspects of generating value for the field workers. Technologies like Computer Vision can be extensively used in this machine to detect weed and filter it to get rid of it. Harvester, sprinkler, cutter are few more additions that can be done to the agro-bot.

VII. CONCLUSION

Hand gesture control for seed dispensing in agriculture bots offers numerous benefits for farmers, including improved precision and reduced physical strain. The technology allows farmers to control the dispensing of seeds with simple hand gestures, making the process more efficient and accurate. The use of hand gestures also eliminates the need for physical contact with the bot, which can prevent damage to crops and reduce the spread of disease.

The main aim of this bot is to sow seeds and do irrigation, and the seeds are dispensed by a mechanism made by a servo for irrigation 12v water pump was used and this was controlled using the wireless controller which uses RF Transmitter(433MHz). To control its motion in four directions MPU6050(Gyro Sensor) was used with Arduino and RF Receiver(433MHz). For controlling Servo and water pump push buttons were used which wirelessly sends signals to the servo and the water pump to turn on and off. The main function of the bot was focused on seed sowing and irrigating using hand gestures, which was done perfectly.

Overall, hand gesture control is a promising technology for improving agricultural practices, and its implementation in seed dispensing bots has the potential to revolutionize the industry. As technology continues to advance, we can expect to see more innovative applications in agriculture and other fields.

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