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Agrobot

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ABSTRACT:

Agriculture is our wisest pursuit because it will in the end contribute most to real wealth, good morals, and happiness. Agriculture needs a lot of manpower and hard work, so this Agrobot is invented to ease the processes of farming. In the imminent generations, the Internet of Things will have a vital role 'Networking' and this Agrobot is incorporated with lots of sensors for monitoring the soil and the crop, so the "Internet of things" is majorly used in this project. In the traditional farming method, there are totally 6 processes, those are plowing, sowing, land leveling, irrigating, fertilizing, and harvesting. Usually, farmers use huge machinery for doing these processes. They use each machine for each machinery is so costly, it requires a lot of human intervention and it takes so much time. To overcome these obstacles there is a single solution "Agrobot". Agrobot is an agricultural robot that does multiple processes in farming. Agrobot is an agricultural robot that does multiple processes in farm This robot can do work as a total of seven processes, those are plowing, sowing, land leveling, irrigating, soil monitoring, crop monitoring, and fertilizing. This project is incorporated many like Bluetooth module, sensors, and actuators used in IoT. So, this Agrobot reduces the human intervention, reduces wastage of time and it is also cost-efficient.

Keywords: Robotics, Agriculture, Arduino UNO, Sensors & Actuators.

Introduction:

Food is the basic need of human life and without agriculture, it was never been possible to have a delicious meal. Farming needs a lot of manpower and hard work. Rather than man power it also needs huge machinery for each process and these machinery costs so much . Now a days farmers are struggling so much to do agriculture and also to afford for the machinery.

So, to ease farming we have invented a robot that can be operated remotely and it can do every process in farming except harvesting because mostly harvesting process differs according to the crops. This multipurpose agricultural robot is build using Arduino UNO microcontroller. To sense the parameters of the soil sensors are used in this project and as actuators servo motors and DC motors are incorporated.

After the incorporation of these sensors and actuators , the Arduino coding is uploaded to the Arduino UNO usingArduino IDE software. This Agrobot can be controlled by a mobile application. This mobile application is developed using MIT app inventor. This can be so easy like a kid playing a remote controlled car.The processes included in this robot are Ploughing, Sowing and leveling Fertilizing, Irrigation, Soil monitoring.

2. LITERATURE SURVEY

The objective of this paper is to design, development and the fabrication of the Agribot[1] which is a multipurpose bot can perform all the farming operations including ploughing the soil of the field, sowing seeds in the ploughing area, making the field in plain by using leveler, watering the crops, fertilizing them and monitor the agribot by using camera. The traditional farming methods consume a lot of manual labour. Some of the operations are manual, while others are operated using manually operated machines. Therefore, there are no such robots, which can perform all theseoperations autonomously. In addition with this when the major fieldwork is done, the farmer has to keep a check on the field for various reasons. This is achieved by the monitoring system. Various parameters such as drip irrigation, fertilizing, maintaining temperature (for green house farming), removal of extra water (during floods) and keeping track ofcrop growth by camera will be taken care by using monitoring system.

The Discovery of Agriculture [2] is the first big step towards civilized life, advancement of agricultural tools is the basic trend of agricultural improvement. Now the qualitative approach of this project is to develop a system which minimizes the working cost and also reduces the time for digging operation and seed sowing operation by utilizing solar energy to run the agribot. In this machine, solar panel is used to capture solar energy and then it is converted into electrical energy which is used to charge battery, which then gives the necessary power to a shunt wound DC motor. Ultrasonic Sensor and Digital Compass Sensor are used with the help of Wi-Fi interface operated on Android Application to manoeuvre robot in the field. This brings down labour dependency. Seed sowing and digging robot will move on various ground contours and performs digging, sowing the seed and covers the ground by closing it. The paper spells out the complete installation of the agribot including hardware and software facet.

Agriculture contributes [3] to a major portion of India's GDP. Two major issues in modern agriculture are water scarcity and high labor costs. These issues can be resolved using agriculture task automation, which encourages precision agriculture.Considering abundance of sunlight in India, this paper discusses the design and development of an IoT based solar powered Agribot that automates irrigation task and enables remote farm monitoring. The Agribotis developed using an Arduino microcontroller. It harvests solar power when not performing irrigation. While executing the task of irrigation, it moves along a pre-determined path of a given farm, and senses soil moisture content and temperature at regular points. At each sensing point, data acquired from multiple sensors is processed locally to decide the necessity of irrigation and accordingly farm is watered. Further, Agribot acts as an IoT device and transmits the data collected from multiple sensors to a remote server using Wi-Fi link. At the remote server, raw data is processed using signal processing operations such asfiltering, compression and prediction. Accordingly, the analyzed data statistics are displayed using an interactive interface, as per user request.

Agribot is a robot [4] deployed for agricultural purposes. This is a robot that performs the farming techniques. It is an autonomous prototype robot that will help farmers in the farmland. This is an arduino controlled robot that will be able to plough, sow and water the farmland. It can replace traditional farming machinery in third world country. It can perform all the functions of farming with the click of a switch. The robot will perform farming using the analogy of ultrasonic detection in order to change its position from one farming strip to another within 1s + - 0.05s. At present specifications the robot can perform on 0.25 acre farm land. There is scope of upgrading the specs to perform in large scale farmland. The robot Thus, will contribute greatly in developing the farming strategies and reduce farmers cost of cultivation and will also increase their profit margins.

Robotics in agriculture [5] is not a new concept; in controlled environments (green houses), it has a history of over 20 years. Research has been performed to develop harvesters for cherry tomatoes, cucumbers, mushrooms, and other fruits. In horticulture, robots have been introduced to harvest citrus and apples. In this paper autonomous robot for agriculture (AgriBot) is a prototype and implemented for performing various agricultural activities like seeding, weeding, spraying of fertilizers, insecticides. AgriBot is controlled with a Arduino Mega board having At mega 2560 microcontroller. The powerful Raspberry Pi a mini computer is used to control and monitor the working of the robot. The Arduino Mega is mounted on a robot allowing for access to all of the pins for rapid prototyping. Its hexapod body can autonomously walk in any direction, avoiding objects with its ultrasonic proximity sensor. Its walking algorithms allow it to instantly change direction and walk in any new direction without turning its body. An underbody sensory array allows the robot to know if a seed has been planted in the area at the optimal spacing and depth. AgriBot can then dig a hole, plant a seed in the hole, cover the seed with soil, and apply any pre-emergence fertilizers and/or herbicides along with the marking agent. AgriBot can then signal to other robots in the immediate proximity that it needs help planting in that area or that this area has been planted and to move on by communicating through Wi-Fi.

3. EXISTING SYSTEM

The existing system of agrobot contains only two or three process of farming like plowing and sowing. There is an automatic irrigation system and remote based irrigation control system. There is an drone fertilizer sprayer system and a separate machine just for spraying fertilizer in a large farm at once. There is a system for monitoring the PH of soil, temperature, humidity and moisture level. In these systems on thing is common, that is there are only two or three process done by the single robot.

In some system they have tried to conserve energy in the system. They have used solar panel for the conservation of energy. Solar panel is attached on the top of the robot and a battery is fixed, that can store and convert the energy. Even this system is only focused on plowing and sowing only. So, as per the system analysis of the existing system, there are systems that has only one to three processes incorporated in a single machinery up to now.

4.PROPOSED SYSTEM

In the traditional farming method, there are totally 6 processes, those are plowing, sowing, land leveling, irrigating, fertilizing, and harvesting. Usually, farmers use huge machinery for doing these processes.They use each machine for each process, this machinery is so costly, it requires a lot of human intervention and it takes so much time. To overcome these obstacles there is a single solution “Agrobot”. Agrobot is an agricultural robot that does multiple processes in farming.

This multipurpose agricultural robot is build using Arduino UNO microcontroller. To sense the parameters of the soil sensors are used in this project and as actuators servo motors and DC motors are incorporated.

After the incorporation of these sensors and actuators , the Arduino coding is uploaded to the Arduino UNO using Arduino IDE software. This Agrobot can be controlled by a mobile application. This mobile application is developed using MIT app inventor. This can be so easy like a kid playing a remote controlled car.

The processes included in this robot are:

1. 1.Ploughing
2. 2.Sowing
3. 3.Land leveling
4. 4.Fertilizing
5. 5.Irrigation
6. 6.Soil monitoring

5.MODULE DESCRIPTION

5.1 Design of the navigation system

First of all the navigation system should be set for the movement of the agricultural robot. It is a like a remote control car that is going to be operated using the mobile application. So, this system is build using Arduino UNO, motor driver shield, Bluetooth module, ultrasonic sensor, DC motors, wheels and the battery.Arduino Uno- Arduino is a microcontroller-based opensource electronic prototyping board which can be programmed with an easy-to-use Arduino IDE. Arduino consists of both a physical programmable circuit board and a piece of software as shown in the Figure.5.1. The major components of the Arduino UNO are the following USB connector, Power port, Microcontroller, Analog inputs pin, Digital pins, Reset switch Crystal Oscillator, USB interface chip and TX RX LEDs.

Figure 5.1.Arduino UNO.

HC-05 Bluetooth Module- HC-05 is a Bluetooth module which can communicate in two ways. We can use it with most micro controllers as it operates Serial Port Protocol (SSP). It is designed for clear wireless serial association.

Motor Driver- This L298N Based Motor Driver Module is a powerful engine driver ideal for driving DC motors and stepper motors as shown. We need motor driver shield because the microcontroller which we connect to different actuator.

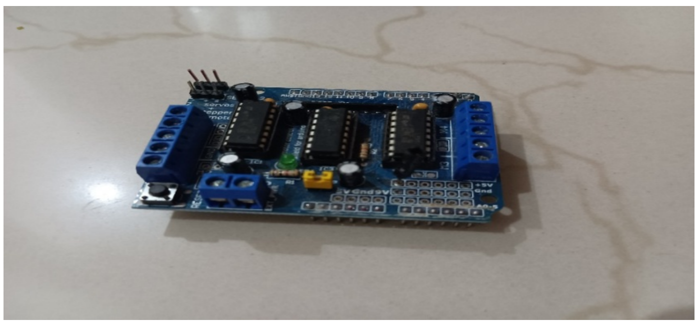


Figure 5.2.Motor driver shield.

Servo Motor- A servomotor is a rotating actuator or straight actuator that takes into account exact control of angular or linear position, speed and acceleration.A servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller.

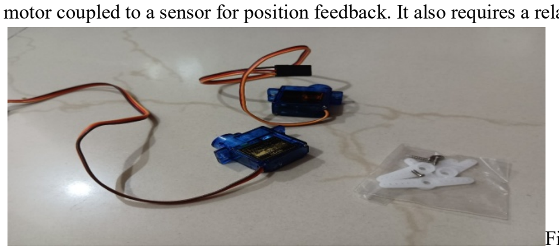


Figure 5.3.Servo motor

Ultrasonic Senor- An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves as shown in the Figure.5.4. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

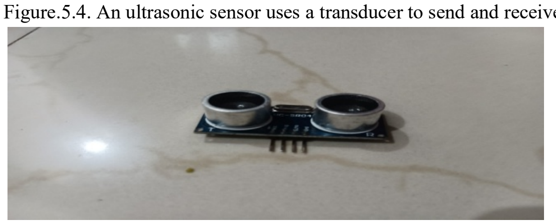


Figure 5.4.Ultrasonic sensor.

DC Motor- A DC motor or Direct Current Motor converts electrical energy into mechanical energy as shown in the Figure.5.5. A direct current (DC) motor is a fairly simple electric motor that uses electricity and a magnetic field to produce torque, which turns the rotor and hence give mechanical work.

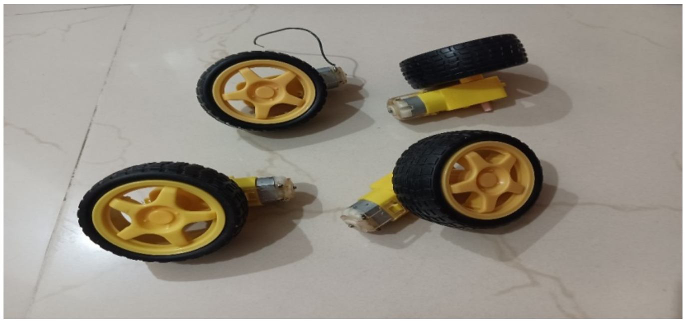


Figure 5.5.DC motor with wheels.

In the four DC motors, wires are connected to the positive and the ground pins and then attached to the four sides of the cardboard. Then four wheels are attached to the four DC motors. At the next step Arduino UNOis attached to the cardboard, then at the top of the Arduino UNO, motor driver shield is fixed. In the motor driver shield the four wires of four DC motors are connected. Next the servo motor is fixed to the cardboard facing front of the navigation system, then the wire of the servo motor is connected to the motor driver shield port servo 1.The battery holder is fixed to the cardboard and the positive and ground wire of the batteryholder isattachedto the motor driver shield. Then the Bluetooth module is connected to the motor driver shield. At last the ultrasonic sensor is attached to the servo motor and the coding is uploaded to the Arduino UNO.

5.2 Design of the plowing system

A plough or plow is a farm tool for loosening or turning the soil before sowing seed or planting. Ploughs were traditionally drawn by oxen and horses, but in modern farms are drawn by tractors. A plough may have a wooden, iron or steel frame, with a blade attached to cut and loosen the soil.

The traditional method for ploughing involves strenuous labour wherein the farmer along with animals or tractor (machine) ploughs the entire field manually. In this project a plowing equipment is attached to the servo motor. Then the servo motor is connected to the servo_2 connection in the Arduino UNO as shown in the Figure.5.6. This is operated using the mobile application developed by the MIT app inventor, a slider is attached in the MIT app inventor to control the servo motor. It sends a command to the microcontroller through the Bluetooth module

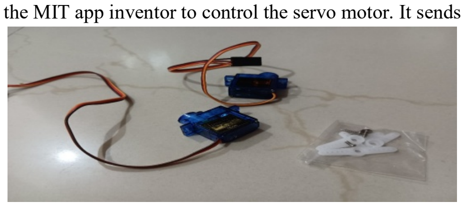


Figure 5.6.Servo motor

5.3 Design of the soil monitoring system

Soil Monitoring with IoT uses technology to empower farmers and producers to maximize yield, reduce disease and optimize resources. To monitor the parameters of soil 5 in 1 sensor is used . This sensor is connected to a servo motor that can be inserted in the soil while we want to monitor the soil. This 5 in 1 sensor monitors humidity, PH level, moisture, temperature and the sunlight level. This sensor takes care of the soil and environment parameters. The soil monitoring sensor is attached to a servo motor, the servo motor is attached to the servo_1 pin of Arduino UNO. This is operated using the mobile application developed by the MIT app inventor, a slider is attached in the MIT app inventor to control the servo motor. It sends a command to the microcontroller through the Bluetooth module. Then the servo motor activates the inserts the sensor in the field to monitor the parameters of soil .

The sensor has three pins, those are GND, VCC and AO. GND pin of the soil sensor is connected to the GND pin of Arduino UNO, then the VCC pin of the sensor is connected to the 5V pin of the Arduino UNO and the AO pin of the sensor is connected to the A2 of the Arduino UNO. This system is operated using the mobile application. It will get the value from the sensor of the moisture level. Then the value will be displayed on the mobile application.

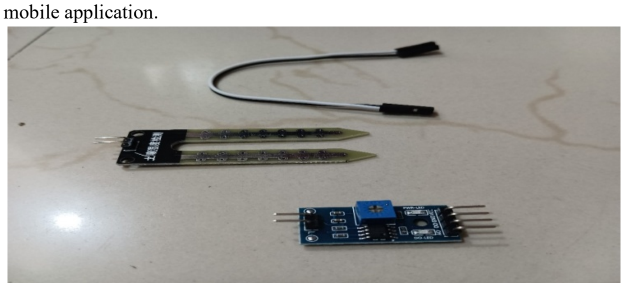


Figure 5.7. 5 in 1 soil sensor.

5.4 Design of the irrigation system

Irrigation is the agricultural process of applying controlled amounts of water to land to assist in the production of crops, as well as to grow landscape plants and lawns, where it may be known as watering. Watering the field is done using drip irrigation. Drip irrigation uses the pipelines (with appropriate openings) which are spread across the field and water is fed to the crops according to the requirement. The water is fed in the pipelines by a water pump inside the water tank, which is present on the agrobot. In manual mode, the freedom to control this operation separately.

The water is stored in the water tank, a water pump is dipped inside the water tank and the water pump is connected to the pipe which is left below the system to flow the water as shown A wire is attached in the water pump that has two terminals, and that is connected to the 4-channel relay module. A 4-channel relay module is connected to the motor Arduino UNO as . There are four input pins, one GND pin and one VCC pin. 4 input pins of 4-channel relay module is connected to 2,3,4, and 5 digital pins of Arduino UNO. The GND pin of 4-channe relay module is connected to the GND pin of Arduino UNO. This system is controlled using a mobile application.

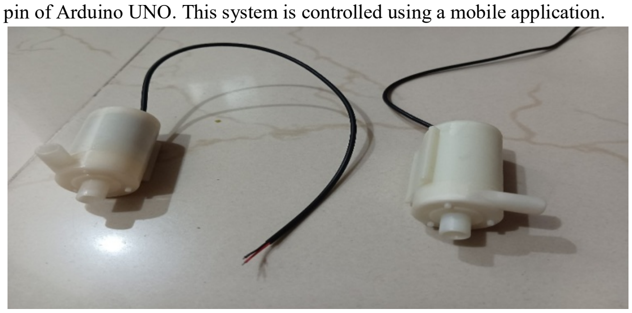


Figure 5.8.Water pump.

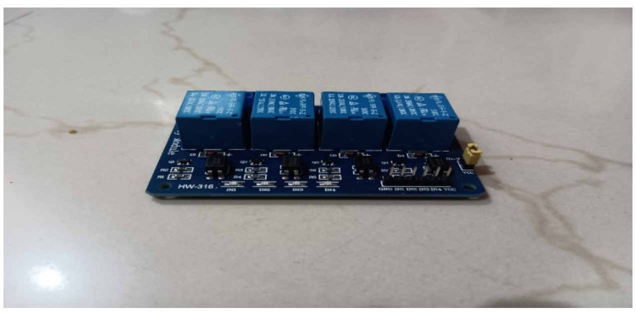


Figure 5.9. 4-channel relay module.

5.5 Design of the sowing system

Sowing is the process of planting seeds. An area or object that has seeds planted in it will be described as a sowed area. Traditionally, sowing is done manually that is the farmer or his workers sow seeds by scattering them on the soil. In this project, a servomotor along with a tank containing seeds is placed on the agrobot with appropriate openings. For sowing, the shaft is rotated up to a desired angle and as the robot moves, the seed falls down in the soil from the openings present on robot. In the manual mode, the frequency of the seeds falling on the ground can be controlled by rotating the shaft of the motor accordingly.

A funnel is connected to a DC motor as shown in the Figure The funnel helps to drop the seeds in an aligned manner as shown The DC motor is used to rotate the funnel. The DC motor has two terminals, these two terminals are connected to the 4-channel relay module and the 4-channel relay module is already connected to the Arduino UNO. This system is controlled by an android application.

Figure 5.11.DC motor.

5.6 Design of the land leveling system

Levelling the field is the basis of the third object. When the seed is sowing manually, it is inserted into the soil. This operation consumes manual labour and time. While sowing the field, the seeds were not dug into the soil. Therefore, this operation named levelling, which levels the land and the seeds are sown properly.

A roller is attached to the backside of the agricultural robot when the robot is finished with plowing and sowing the seed, it moves forward and the land is levelled when the roller rolls.

Figure 5.12.Roller.

5.7 Design of the fertilization system

In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Fertilizing the field is the next operation in the line, which is necessary to ensure proper growth of the crops. According to the traditional farming methods, manual labour is used to fertilize the field. This process again, consumes time and energy of the farmer. A tank (with appropriate openings) filled up with fertilizers along with the pump on the agrobot.In this process as like the irrigation system, a tank full of fertilizer is filled and attached on top of the agrobot, a water pump is immersed in the water tank as shown in the Figure.5.13, the pump is connected to a pipe which is use to flow or spray the fertilizer through a sprayer. Again this process is controlled using the android application.

Figure 5.13.Water pump.

5.8 Mobile application development in MIT app inventor

MIT app inventor is a mobile app development platform, it is so user friendly and that is designed in the manner of drag and drop system as shown in the Figure.5.15. A project named “Agro” is created, then there are two platforms there to work on, one is designer, that is to design the front end of the mobile application that is given in the figure and the other one is blocks, that is to design the back end or the coding area, however there is no need to type a code for this, there are inbuilt codes in the blocks.

Here, on the left hand side, the user interfaces, front end tools like buttons, switches, sliders, etc… are available, on the right hand side a specific object can be customized and in the middle the front end development of our mobile application is displayed in a mobile screen format.First a screen is dragged and dropped, then a checklist is dropped in the platform and that is named as “show devices”. At next a 3x3 table is created, then five buttons are dropped inside the table and those five buttons are “forward, backward, left, right, and stop”. These are the buttons used for robot navigation. Three sliders are dropped, those three are for controlling the servo motors and a DC motor speed. One is for the control of sensor insertion in the field, the other one is for the control of plower insertion in the field and the third one for the control of the speed of the sowing system or the sowing funnel.

A button is separately dropped to control the water pump for irrigation and fertilization process. An Arduino moisture sensor is dropped from the extensions to the platform to access the readings of the soil monitoring sensor. At last a Bluetooth client isdropped in the platform to access the Agrobot using the Bluetooth connectivity from the mobile.

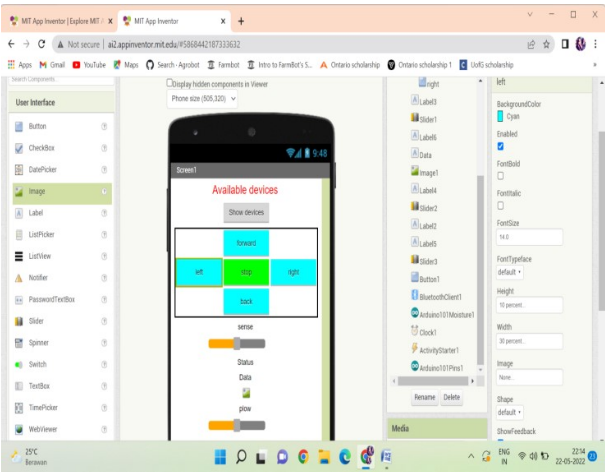


Figure 5.14.MIT app inventor front end development.

The backend that is named as blocks platform, where each and every functionality is initialized and perform operations Here, first of all a Bluetooth connectivity should be enabled, so here it is designed as when the screen is open, Bluetooth connectivity should be activated. Then four buttons should be given the functions. It is designed here as whenever the forward button is clicked, it should send a text to the Arduino as forward and through the given code in Arduino, it moves forward. Then it is designed here as whenever the back button is clicked, it should send a text to the Arduino as back and through the given code in Arduino, it moves backward.Then it is designed here as whenever the right button is clicked, it should send a text to the Arduino as right and through the given code in Arduino, it turns rightside. Then it is designed here as whenever the left button is clicked, it should send a text to the Arduino as left and through the given code in Arduino, it turns leftside. Atlast it is designed here as whenever the stop button is clicked, it should send a text to the Arduino as stop and through the given code in Arduino, it stops.

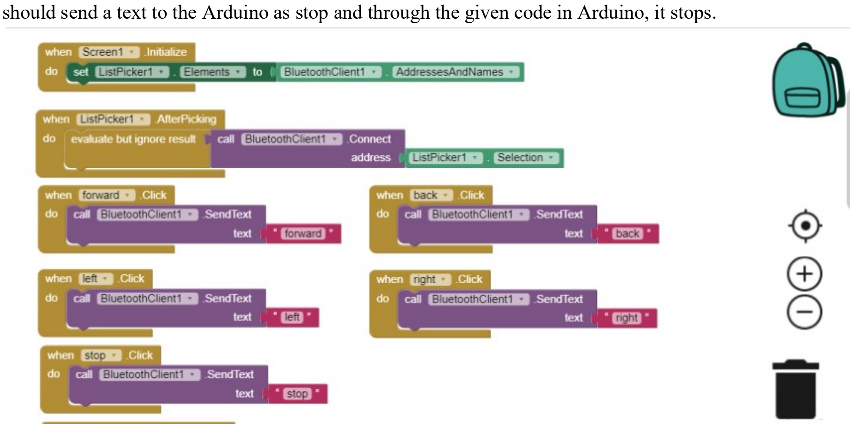


Figure 5.15.Back end development of the buttons.

The functions of three sliders are programmed here. Here two servo motors and a DC motor is controlled. It is set a thumb position for the slider as 1000 and which can also calculate the angle of rotation of the servo motor. Then for the next slider it is set to a thumb position as 2000 and it can either calculate the angle of rotation of the servo motor on the mobile screen. In the third slider the thumb position is not fixed but given some range for the angle of rotation.

Figure 5.16.Back end development of the sliders.

At last, after setting up all the components in the front end and the back end of the mobile application, there are two options in the MIT app inventor to deploy the mobile application. One is the app can be directly used for once by scanning the QR code through the AI companion application in the mobile and the other one is our application can be installed in our mobile for a permanent use

6. SYSTEM DESIGN AND DIAGRAM

This multipurpose agricultural robot is build using Arduino UNO microcontroller. To sense the parameters of the soil sensors are used in this project, to monitor the crop camera is used and as actuators servo motors and DC motors are incorporated. After the incorporation of these sensors and actuators , the Arduino coding is uploaded to the Arduino UNO using Arduino IDE software. This Agrobot can be controlled by a mobile.

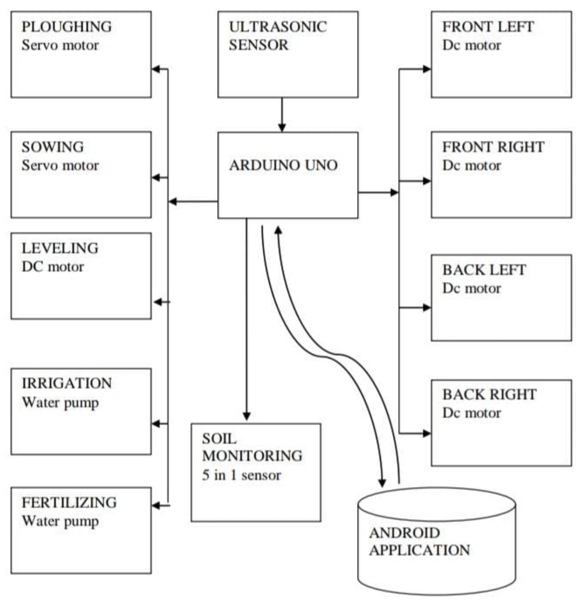
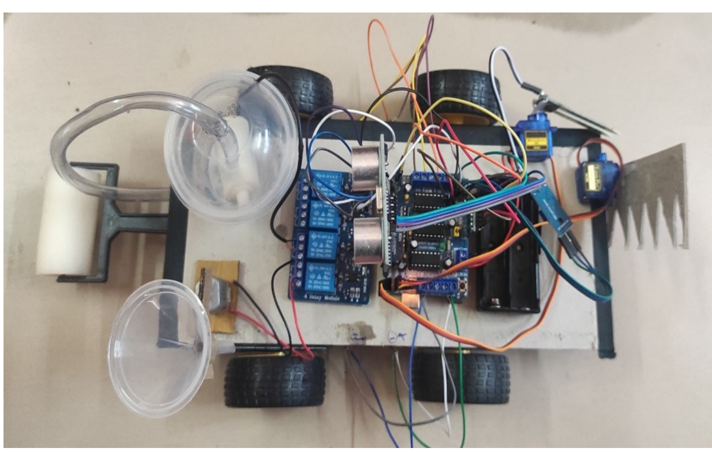


Figure 6.1Unit Diagram

7. OUTPUT SCREEN

After incorporation of all the specific equipments of each process in farming, the hardware is ready for the code insertion in the Arduino UNO. The complete structure of the Agrobot is displayed as given in the Figure.7.1. In this system the coding is uploaded in the Arduino UNO for the activation of this hardware product.



7.1.Hardware final product “Agrobot”.

At last the front-end and the back-end development is over, a user interface is ready as an android application to control the agricultural robot through the mobile.As an overall output the user can control the final hardware product “Agrobot” using the mobile application created using the MIT app inventor . The mobile application screen is shown in the given Figure.7.2

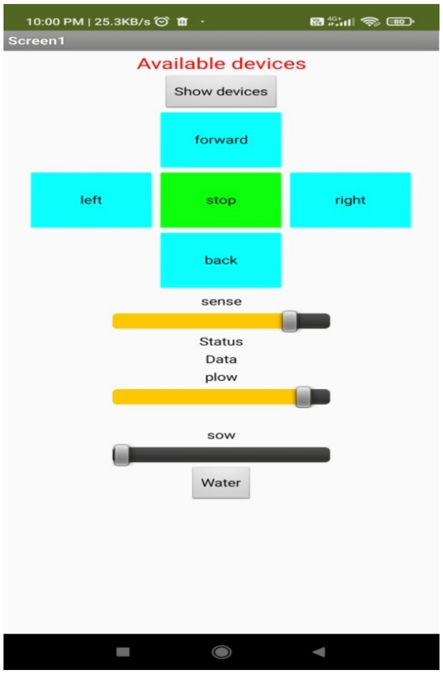


Figure 7.2.Agrobot mobile application screen.

8.CONCLUSION:

In the traditional farming method, there are totally 6 processes, those are plowing, sowing, land leveling, irrigating, fertilizing, and harvesting. Usually, farmers use huge machinery for doing these processes. They use each machine for each process, this machinery is so costly, it requires a lot of human intervention and it takes so much time. To overcome these obstacles there is asingle solution “Agrobot”. Agrobot is an agricultural robot that does multiple processes in farming . This will be definitely helpful for the farmers and also for the researchers who does research in agricultural robots.

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