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Earlier known as
B. V. B College of Engineering and Technology

School of Computer Science and Engineering

An Internet of Things(22ECSC303) Course Project Report

On

Multipurpose Agriculture Bot

submitted in partial fulfillment of the requirement for the degree of

Bachelor of Engineering

In

School of Computer Science and Engineering

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1. Introduction:

An agricultural bot is a mechanism deployed for agricultural purposes. In agriculture, robots are used for weed control, seeding, and harvesting. The use of robotics and artificial intelligence is also helping farmers with soil analysis and environmental monitoring.

In the coming years there is an expectation of an expanding market for robotics in agriculture applications. The technology assists farmers in increasing their productivity, reducing operations costs, lowering maintenance costs, and increasing their overall development.

Multipurpose agricultural robots will definitely be helpful to all farmers across the globe because they will reduce the amount of manpower needed to complete tasks, while increasing farmers' efficiency.

2. Motivation:

In agriculture, the main problems include the lack of labor availability, lack of knowledge about soil testing, increased labor wages, wastage of seeds and the waste of water. A robot for agriculture has been developed to overcome all these disadvantages. A primary objective of agricultural robots is to apply robotic technology to agriculture.

In agriculture, the opportunities for robot-enhanced productivity are immense and robots are appearing on farms in various guises and in increasing numbers. It is expected that robots will carry out agriculture operations autonomously, such as spraying and mechanical weed management. Additionally, they will monitor farms night and day to compile an effective report.

Agribot increases the speed and accuracy of the work. It performs the elementary functions of farming, such as harvesting, spraying, seeding and removing weeds. In addition, agricultural robots designed for agricultural purposes are showing benefits. Using such technology farmers can maximize the use of resources and maximize their output (reducing the work, increasing productivity, improving application accuracy, and increasing handling safety). The agricultural robot is one of these machines, efficient work with the help of several computation algorithms. With improved specifications, agriculture can be designed, controlled smartly, and made safe and suitable for everyone.

3. Problem Statement:

To design an IoT multi-objective robot for agriculture purposes that can perform ploughing, sowing operations and can also check the temperature and humidity of the surroundings.

4.1 Literature survey:

Sl.no	Author	Year	IEEE Paper title
1	G Vijaykumar, K Vijayalakshmi ,CH Pujitha, DN Sandhya Ran	2020	Automatic arduino controlled agribot for multi-purpose cultivation
2	Chetan Kumar S, Tarihal Nandeesh, P Naveen, M Vineet K, Gokhale	2015	Multipurpose agricultural robot
3	Hayato Suzuki	2022	Development of Agriculture Robot for Plant Detection and Fertilizer Dispense
4	Hari Mohan Rai	2022	AgriBot: Smart Autonomous Agriculture Robot for Multipurpose Farming Application Using IOT.
5	Muhammad Ayaz	2017	Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk
6	R. Poovendran; B. Ambrish Kumar; V. Bhuvaneshwari; R.N. Aswini; K.T.Lakshmi Priya	2019	Multi-Purpose Intelligent Drudgery Reducing Ecobot
7	B R Jerosheja; C Mythili	2020	Solar Powered Automated Multi-Tasking Agricultural Robot
8	Nived Chebrolu	2017	Agricultural robot dataset for plant classification, localization and mapping on sugar beet fields
9	Pratiksha K. Deshmukh, Prafull S. Mehetre, Suyash C. Kokane, Pavan E. Joshi	2020	Multi-Tasking Agricultural Robot
10	Chandana R, Nisha M, Pavithra B, Sumana Suresh, Nagashree R N	2020	A Multipurpose Agricultural Robot for Automatic Ploughing, Seeding and Plant Health Monitoring

[1] Multipurpose Agriculture Robot:

- The goal the above project is to design and develop a multipurpose machine used for digging soil, sowing seeds, and leveling mud. Also, a water sprayer for spraying water with the least amount of changes in accessories and at the least cost. The whole robot is powered by solar and battery power.
- The base frame is made for the robot with 4 wheels connected and driven by a DC motor at the rear.
- At one end of the frame, a cultivator is fitted which is also driven by a DC motor and designed to dig the soil.
- Sheet metal funnels are used to store the seeds and the seeds flow through the funnels through the drilled holes in the shaft to the dug soil.
- The end of the machine has a leveler to close the seeds to the soil and a water pump sprayer to spray water.
- During charging, a solar panel is placed on top of the robot and connected to the battery.
- By using the solar panel and the battery together, maximum efficiency from the sun is achieved.
- Batteries of 12V are necessary to operate the robot.

[2] Automatic Arduino Controlled Agribot for Multipurpose Cultivation:

- This is a robot mainly designed for agricultural purposes. All forming techniques can be performed by Agribot. It is a free designed prototype robot that can help farmers.
- This is an Arduino-controlled robot that can plough, plant, and harvest moisture from the soil. It can also determine how much moisture the soil needs in order to water the crops.
- It can be accomplished with the help of a single switch. The robot can move from one farming to another using the ultrasonic detection within a few moments.
- This can be used to alert the user when the tank is empty of water. In this way, the robot will contribute significantly to the development of farming strategies and will reduce farmers' cost of cultivation as well as increase their profit margins.

[3] Development of Agriculture Robot for Plant Detection and Fertilizer Dispense:

- With the growing world population, limited agriculture resources and the reduced number of people working in the agriculture sector, the need for intelligent robots is increasing.
- Agriculture robots must perform a wide range of operations like spraying pesticides, dispensing fertilizers, and removing weeds.
- This paper describes in detail an agriculture robot developed by Hosei University's Assistive Robotics Laboratory.

- It consists of three subsystems:
  - The wheel-type actuated system.
  - A parallel link arms.
  - Fertilizer system.
- The robot uses visual information and Convolution Neural Networks to recognize the target plants.
- To evaluate the performance of the developed robot, we performed experiments for spinach recognition, fertilizer dispenser and robot spraying.

[4] AgriBot: Smart Autonomous Agriculture Robot for Multipurpose Farming Application Using IOT:

- The Internet of Things (IoT) connects things across the globe.
- IoT is a term broadly used for devices that are connected to each other via embedded sensors or with the use of wireless networks such as cellular or Wi-Fi.
- Agricultural robots (or "AgriBots") are used to increase the productivity and quality of crops as well as to reduce labor costs.
- The system describes the network of sensors and the applications of different sensors in agricultural fields.
- Agricultural robots already exist, but they are used only on a small scale.
- Monitoring parameters, such as soil moisture and temperature, is done manually in the existing system.
- This proposed system combines IoT with Arduino UNO to enhance agricultural fields.
- Details collected by the Robot from the agricultural field will be stored in the cloud and can be monitored without human intervention.

[5] Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk:

- Despite the perception people may have regarding the agricultural process, the reality is that today's agriculture industry is data-centered, precise, and smarter than ever. The rapid emergence of Internet-of-Things (IoT) based technologies has redesigned almost every industry including “smart agriculture” which moved the industry from statistical to quantitative approaches.
- In this article, we will discuss the role wireless sensors and the Internet of Things can play in agriculture. We will also discuss the challenges of integrating this technology into traditional farming practices. IoT devices and communication techniques associated with wireless sensors encountered in agriculture applications are analyzed in detail.
- Sensors for specific agriculture applications, such as soil preparation, crop status, irrigation, insect and pest detection, are listed.
- Finally, based on this thorough review, we identify current and future trends in IoT in agriculture and highlight potential research challenges.

4.2 Gap Identification:

- According to research conducted by [11], the technological gap in adoption of pomegranate cultivation practices viz., recommended spacing and proper water management was 100 percent each followed by pit filling (40.90%) and inter culturing operations (40.10%).
- Goswami, K.K. et al., (2003) revealed that high technological gap in potato cultivation was observed in case of application of manure and fertilizers and use of pesticides.
- Sharma, A. and Sharma, A.K. (2003) reported that overall technological gap was found to be 82.4% in recommended gram production technologies.
- Jahagirdar et al., (2012) revealed that highest technological gap was observed with respect to the practice 'sowing time' (3%).
- Majority of the respondents (94%) expressed 'inadequate knowledge was the main reason for technological gap in Chemical weed control' practice and 'high cost of herbicide.
- So, from this, we observe a significant gap between agriculture and technology.

5. Objectives:

The IoT model should be able to:

- Move on the field according to the user's input.
- Plough the field.
- Sow the seeds into the field.
- Monitor temperature and humidity.
- Save all the operational data in the cloud.

6.1 Software requirements:

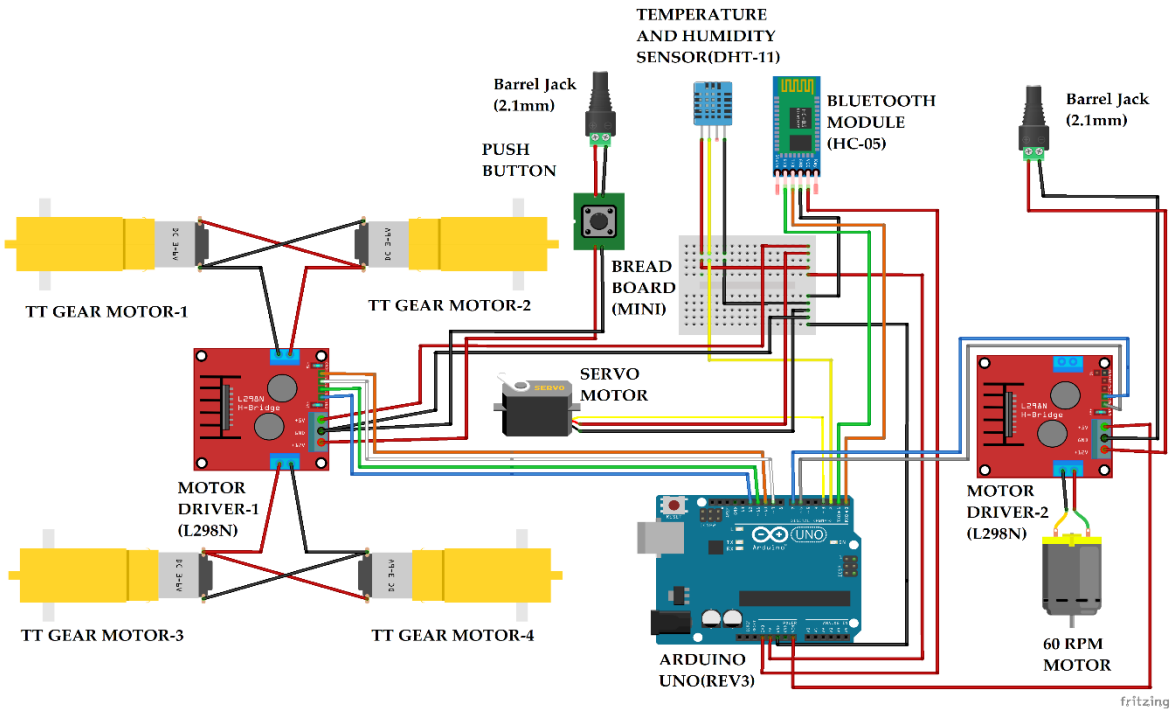
- Arduino IDE:

  Arduino is an open-source Arduino Software (IDE) that makes it easy to write code and upload the same to the board.
- MIT app inventor:

  MIT App Inventor is a web application integrated development environment originally provided by Google.
- Firebase:

  Firebase is an app development platform that helps you build and grow apps and games users love. Backed by Google and trusted by millions of businesses around the world.

6.2 Updated circuit diagram:



7. Hardware requirements:

- Controller (Arduino Uno Rev3)
- TT Gear motors
- 60 RPM Motor
- Servo motor
- DHT temperature and humidity sensor
- Bluetooth module (HC-05)
- Motor driver (L298N)
- Jumper wires
- 12V DC Adapter
- 5V DC Adapter
- Breadboard

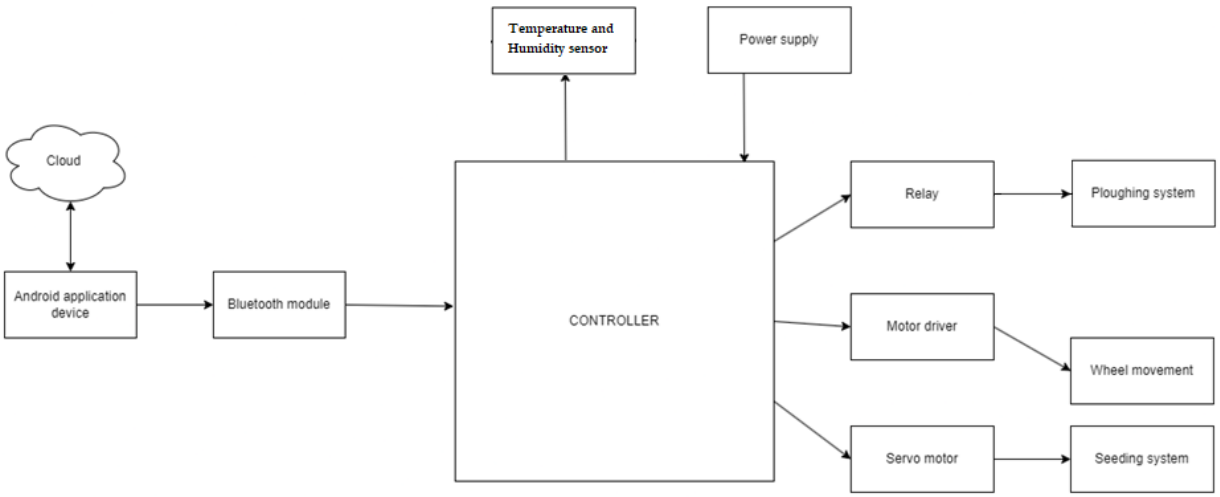
8. Cost estimation:

Component	Quantity	Cost per item	Total cost (In ₹)
Arduino Uno	1	₹1100	₹1100
TT Gear motor	4	₹80	₹320
60 RPM motor	1	₹140	₹140
Servo motor	1	₹150	₹150
DHT sensor	1	₹120	₹120
Bluetooth module (HC-05)	1	₹250	₹250
Motor driver	2	₹120	₹240
12V DC Adapter	1	₹150	₹150
5V DC Adapter	1	₹150	₹150
Breadboard	1	₹80	₹80
Jumper wires	Few	₹100	₹100
Total Cost:			**₹2800**

9. Functional requirements:

1. The user shall be able to operate the robot appropriately.
2. The robot shall be able to plough the land.
3. The robot shall be able to help in seed sowing.
4. The robot shall be able to monitor the temperature and humidity.
5. The robot shall be able to save the data in the cloud.
6. The robot shall be consistent with the work.
7. The system shall be user friendly.
8. The system shall be environment friendly.

10. Proposed system:



11. Implementation:

- Power is supplied to the whole model using 2 DC adapters, one of 12V and other of 5V.
- The 5V DC adapter power ups 4 TT gear motors used for the movement of the bot and also to power the DC motor used in ploughing operation.
- The 12V DC adapter powers the Microcontroller, Bluetooth module i.e., HC-05, DHT temperature and humidity sensor and the servo motor used in sowing operation.
- Microcontroller is connected and controlled using the mobile app developed with the MIT App Inventory tool.
- TT Gear Motors help to provide movement to the bot.
- Servo motor helps in sowing operation.
- 6- rpm DC motor helps in ploughing operation.
- Temperature and humidity are monitored using DHT11 sensor.

A. Client Side:

- Above app was made using MIT app inventory.
- Client can connect to the bot using the above shown application which uses Bluetooth for connection. Once the app is connected to the bot, all the above-mentioned operations can be performed.
- All the operations performed by the user is stored in the Firebase Database along with the time and the operation that was performed.

B. Server Side:

a) Movement:

- In the client side, when any input is given using the app after connection is set up, the bot moves forward, backward, left, right or any possible combinations of the above.
- When any command is given, TT gear motors actuate accordingly to help the bot move.
- The delay in processing the command sent is less than 10ms.

b) Temperature and Humidity sensing:

- When the client chooses to see temperature or humidity of the surrounding the bot, he can click on "Show Humidity & Temp" button on the app than show the exact humidity in percentage and temperature in degree Celsius (°C).
- This functionality is achieved with the help of DHT11 temperature sensor that senses the surrounding humidity and temperature.
- The displayed data (humidity and temperature) is stored in the Firebase database.

c) Sowing:

- When the user selects sowing operation, the Servo motor starts rotating to-and-fro motion (60°) moving forward.
- When the holed platform gets aligned with the hole in the funnel containing seeds, the seeds fall on the ground. After certain movement, the servo motor returns back to its original position, thus stopping the seeding from falling.
- The bot keeps moving forward since seed are to be sowed at certain distance.
- This operation is performed until the user selects to stop the same.

d) Ploughing:

- When the user chooses ploughing operation, the rotatory motion of the DC motor is converted into linear motion (Rack and Pinion mechanism). The plough that was not in contact with the ground is then moved down until it touches the ground.
- The user can move the bot accordingly after that.
- When the user choses to stop ploughing, the plough return back to its initial position.

12. Conclusion:

- The main advantage of our multi-objective agricultural robot is multitasking and maneuverability.
- It ensures the safety of workers.
- It can be used to reduce human efforts.
- Work consistency. Unlike human resources, agricultural robots never get tired.
- By carrying out multiple activities at the same time, the farmer can increase his income which results in economic growth.
- The developed model is thus able to achieve the below functionalities:

i. Move on the field according to the user's input.
ii. Plough the field.
iii. Sow the seeds into the field.
iv. Monitor temperature and humidity.
v. Save all the operational data in the cloud.

13. References:

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