MULTIPURPOSE AGRICULTURAL ROBOTIC VEHICLE – AGRIBOT

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Abstract- This research paper introduces an advanced autonomous vehicle designed as a powerful agricultural tool with a significant capacity for soil management. This multifunctional system revolutionizes farming by integrating planting, plowing, watering, and trimming operations, significantly reducing labor and enhancing productivity. The vehicle autonomously cultivates farmland by adhering to specified rows and columns at predetermined distances tailored to the crop type. An Android smartphone facilitates remote operation via Bluetooth, interfacing with a microcontroller that manages the system's calculations, processing, and monitoring.

The primary motivation behind developing this robot was to simplify farming tasks for future farmers. Given the current advancements in robotics and large-scale agriculture, this study leverages both technologies. The control of the robot is achieved using the Dual Tone Multi-Frequency (DTMF) method, enabling robust and long-distance communication through a mobile phone. This allows farmers to efficiently manage their agricultural activities remotely, eliminating the need for physical presence in the field.

Index Terms- Agriculture, Sensors, Automation, versatility, suitability, data monitoring.

I. INTRODUCTION

Agriculture has long been the bedrock of the Indian economy, a role that remains indispensable and is projected to endure. Currently, the agricultural sector is under intense scrutiny regarding its environmental footprint, facing escalating demands for sustainable practices. A significant impediment to progress in this vital sector is the acute shortage of skilled labor across numerous Indian cities, a predicament that stymies the nation's developmental trajectory. In response, there is an urgent imperative for farmers to integrate cutting-edge technologies into their cultivation practices.

Traditional manual methods, such as the broadcasting of seeds and fertilizers by hand, are still widespread. However, to surmount these formidable challenges and elevate efficiency, it is critical to usher in a new era of agricultural automation. This project's groundbreaking concept focuses on automating essential processes: evaluating soil suitability for cultivation, seed sowing, land covering, and fertilizer application. The goal is to substantially minimize human labor and enhance operational efficiency.

The proposed system is a comprehensive suite encompassing sensing, monitoring, control, and communication functionalities. A diverse array of sensors is employed to detect critical parameters, including soil moisture and the presence of obstacles. Based on sensor data, the microcontroller executes the requisite actions. For example, the output from the moisture sensor determines the soil's suitability for cultivation, subsequently triggering the seed-sowing mechanism when conditions are optimal. Furthermore, operations such as fertilizer application can be scheduled and executed autonomously.

Additionally, the entire system's operations can be seamlessly managed via an Android application. This integrated approach aims to revolutionize agricultural practices, significantly boost productivity, and mitigate the limitations imposed by manual labor and resource scarcity.

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II. RESEARCH

1. IOT-Based Smart Agriculture and Automatic Seed Sowing Robot (2022): This project utilized wireless sensor networks to collect data and automate seed sowing, highlighting the efficiency gains from IoT integration in agriculture.

2. IoT and Solar Energy Based Multipurpose Agricultural Robot for Smart Farming (2022): A solar-powered, IoT-based robot performing various tasks including seed sowing and soil nutrition detection, demonstrating the potential of renewable energy in agriculture.

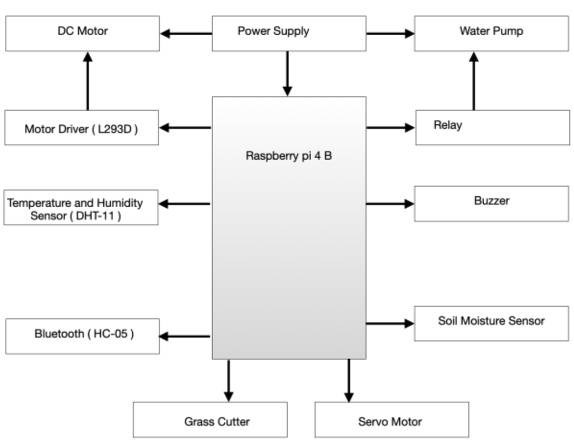
3. Smart Farming Robot for Detecting Environmental Conditions in a Greenhouse (2023): An autonomous robot for greenhouse environments, using unsupervised learning algorithms to optimize crop growth conditions.

4. Intelligent Farming using Delta Robot (2020): This study introduced a robot with a piezoelectric buzzer to deter birds and image sensors for crop health monitoring, employing machine learning for decision-making.

5. Design of Automated Seed Sowing Robot for BT Cotton Seed (2020): Focused on the chassis design and seed sowing mechanism for cotton, this research emphasized the mechanical aspects of agricultural robotics.

III. PROPOSED SYSTEM

A. BLOCK DIAGRAM



B. WORKING

<u>Initialization</u>: Power on the Raspberry Pi and initialize communication modules (Wi-Fi, Bluetooth).

<u>Environmental Monitoring</u>: Activate the DHT-11 sensor to measure temperature and humidity, Read and store the environmental data.

<u>Soil Moisture Monitoring</u>:Activate the soil moisture sensor to measure the soil's moisture level. Read and store the soil moisture data.

<u>Decision Making</u>: Analyze the environmental and soil data to determine the optimal conditions for grass cutting, seed sowing, or irrigation.

<u>Grass Cutting</u>: If grass cutting is required: Activate the DC motor connected to the grass cutting mechanism. Move the agribot to cut the grass.

<u>Seed Sowing</u>: If seed sowing is required: Activate the servo motor to control the seed dispensing mechanism. Move the agribot to sow seeds in designated areas.

<u>Soil Moisture Adjustment (Irrigation)</u>: If soil moisture is below a certain threshold: Activate the water pump to irrigate the soil. Monitor soil moisture continuously during irrigation.

<u>Communication and Remote Control</u>: Utilize Wi-Fi or Bluetooth to enable remote control and data transmission. Receive commands or send data to a central control system.

<u>Shutdown</u>:Safely shut down the Raspberry Pi and other components.

C. HARDWARE

Raspberry Pi 4b:

Processor: 1.2GHz Quad-Core ARM Cortex-A53
RAM: 1GB LPDDR2
Wireless Connectivity: Wi-Fi (802.11n) and Bluetooth 4.2
GPIO Pins: 40
USB Ports: 4 x USB 2.0
Ethernet: 10/100 BaseT Ethernet socket
Storage: microSD card slot

DHT11 (Temperature and Humidity Sensor):

Operating Voltage: 3.3V - 5.5V
Temperature Range: 0°C to 50°C
Humidity Range: 20% to 90%
Accuracy: ±2°C, ±5% ○ Digital Signal Output

Soil Moisture Sensor:

Operating Voltage: 3.3V - 5V
Detection Area: 38mm x 38mm

Working Current: 35mA
Output Voltage: 0 - 4.2V

HC-05 Bluetooth module:

Bluetooth protocol: Bluetooth V2.0 protocol standard.
Power Level: Class2(+6dBm)
Band: 2.40GHz—2.48GHz, ISM Band.
Receiver sensitivity: -85dBm

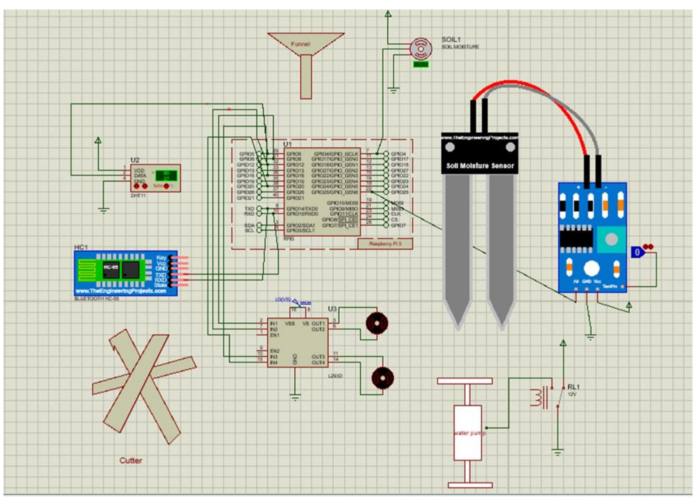
Motor driver(L293D):

Operating Voltage: 4.5 V to 36 V
Working Current: up to 600-mA

DC motor:

Rpm - 300 shaft.
Diameter - 6mm (with internal hole)
Voltage: 6 to 24 (nominal voltage - 12v)
Load current: 9 a(max)

D. CIRCUIT DIAGRAM



IV. EXPERIMENTAL RESULTS

A. READINGS

FIELD 1: Soil Moisture Sensor

created_at	entry_id	Soil Moisture	Pump (ON/OFF)
2024-03-05T05:36:47	86	1	OFF
2024-03-05T05:37:26	87	1	OFF
2024-03-05T05:37:50	88	1	OFF
2024-03-05T05:38:10	89	1	OFF
2024-03-05T05:38:36	90	0	ON
2024-03-05T05:38:51	91	0	ON
2024-03-05T05:39:07	92	0	ON

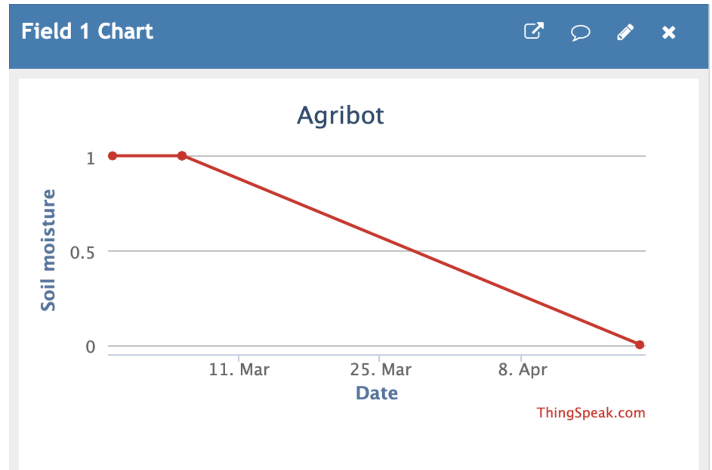
FIELD 2 : Temperature

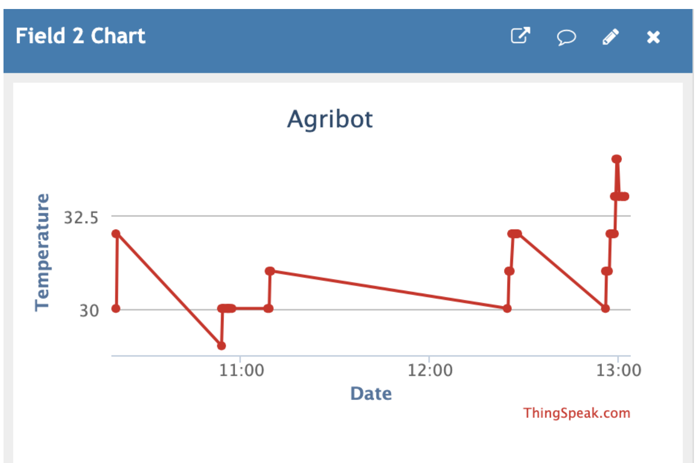
created_at	entry_id	Temperature
2024-03-05T06:57:34	104	32
2024-03-05T06:57:52	105	32
2024-03-05T06:58:08	106	32
2024-03-05T07:25:56	107	30
2024-03-05T07:26:11	108	31
2024-03-05T07:26:32	109	31
2024-03-05T07:26:48	110	31

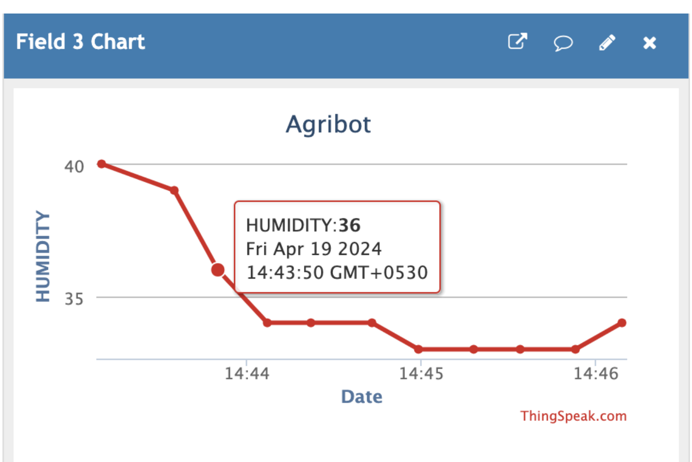
FIELD 3 : Humidity

created_at	entry_id	Humidity
2024-03-05T05:38:51	91	33
2024-03-05T05:39:07	92	36
2024-03-05T05:39:26	93	35
2024-03-05T05:39:42	94	33
2024-03-05T06:54:53	95	31
2024-03-05T06:55:11	96	32
2024-03-05T06:55:27	97	32

B. GRAPHS







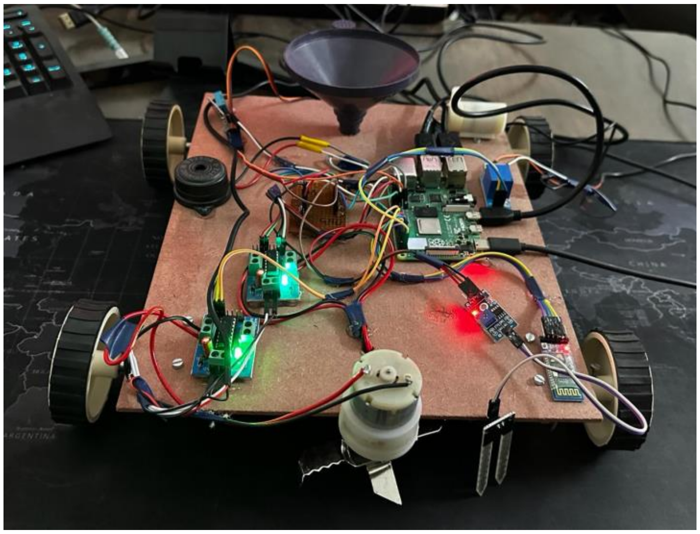
V. CONCLUSION

Our proposed autonomous multipurpose agricultural robot represents a paradigm shift in modern farming practices. This sophisticated system, capable of executing complex tasks such as seed sowing, grass cutting, and pesticide spraying, demonstrates exceptional versatility by accommodating different seed sizes. The robot's mobile platform ensures high portability, allowing seamless transportation across various farm locations. By employing predefined operational patterns, it guarantees consistent and efficient performance without manual intervention.

Bluetooth communication enhances operator safety by eliminating direct human contact, while an intuitive Android app facilitates remote management, streamlining the user experience for farmers. This technological advancement promises to revolutionize agriculture by significantly reducing manual labor and optimizing resource utilization. The adoption of renewable energy sources further underscores its commitment to environmental sustainability.

Ultimately, our design offers a transformative, automated solution for agriculture, poised to elevate productivity, reduce labor costs, and foster sustainable farming practices, thereby delivering substantial economic and ecological benefits.

VI. MODEL



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