AVN INSTITUTE OF ENGINEERING & TECHNOLOGY
AN AUTONOMOUS INSTITUTION
AFFILIATED TO JNTUH

Department Of Electronics & Communication Engineering

SMART SOIL ANALYSIS ROVER

Batch - 10

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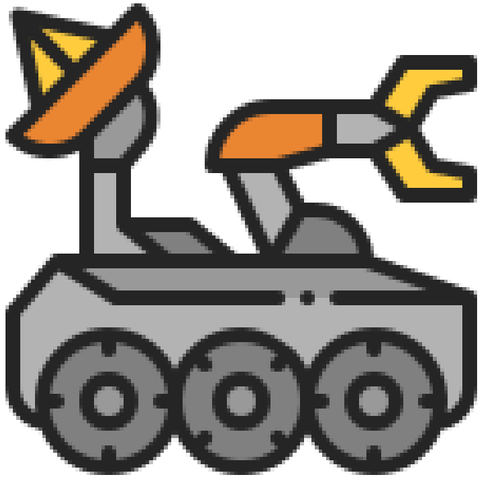
ABSTRACT

- The Smart Soil Analysis Rover is an advanced, mobile robotic system designed for efficient and accurate soil analysis in agricultural lands, construction sites, and environmental monitoring applications.

- Equipped with moisture, humidity, and metal detection sensors, the rover provides real-time insights into soil conditions. Its six-wheel chassis ensures smooth navigation over rough terrain, while a robotic jaw enables precise sample collection and manipulation.

- Data is transmitted via Bluetooth and cloud-based platforms, with ThinkView enabling visualization and analysis. Future enhancements include improved sensor accuracy, autonomous navigation capabilities, and durability upgrades for extreme environments, making the rover a valuable tool for precision agriculture, site analysis, and ecological research.



Literature Survey (Existing System)

- Traditional soil analysis methods involve manual sample collection and lab testing, which are time-consuming and labor-intensive.

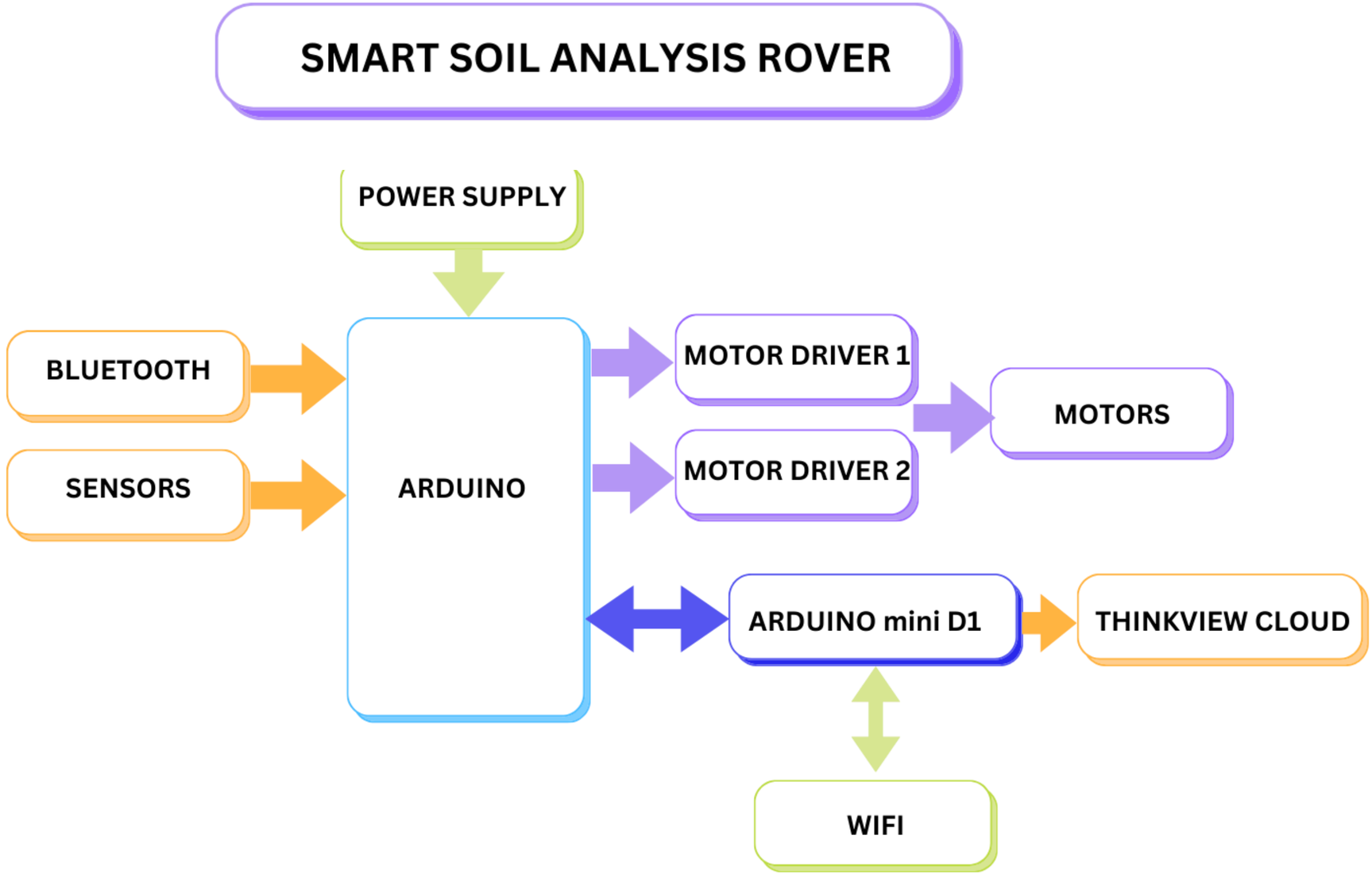
- **Smith et al. (2020):** Developed a soil monitoring robot with moisture and pH sensors, but it lacked terrain adaptability and cloud integration.

- **Kumar & Patel (2021):** Proposed a rover with Bluetooth-based data transmission for real-time soil analysis, limited by short-range communication and no sample collection mechanism.

- **Lee et al. (2022):** Introduced a multi-sensor rover for environmental monitoring, but lacked autonomous navigation and durability in extreme conditions.

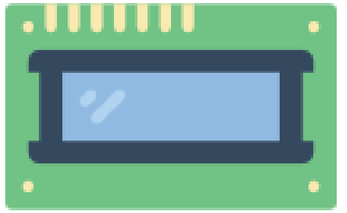
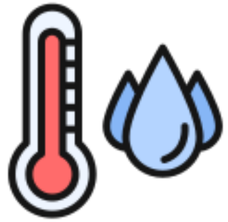
- **Gupta & Sharma (2023):** Explored cloud-based platforms for soil data visualization, similar to ThinkView, but without mobility or real-time sample collection.

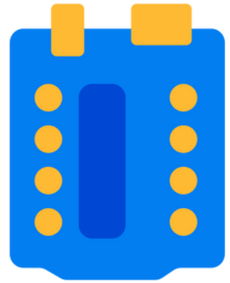
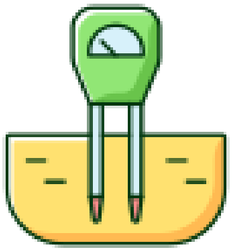
BLOCK DIAGRAM



HARDWARE USED :

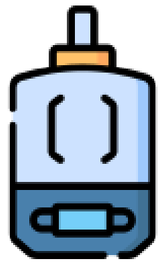
- Arduino UNO
- Bluetooth Module(Hc-05)
- Soil Moisture Sensor
- Metal Detector
- DHT Humidity and Temperature sensor
- Motor Drivers
- Motors
- LCD
- Buzzer
- D1 Mini (WIFI Module)

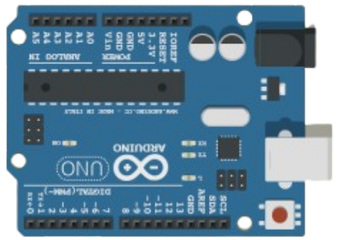

SOFTWARE USED :

- Arduino IDE(Embedded C)
- Arduino Bluetooth app
- Thinkview App

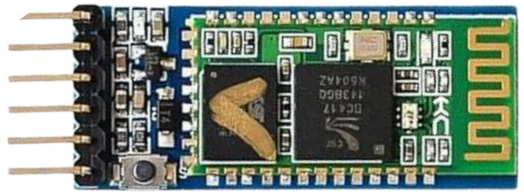



COMPONENTS DESCRIPTION

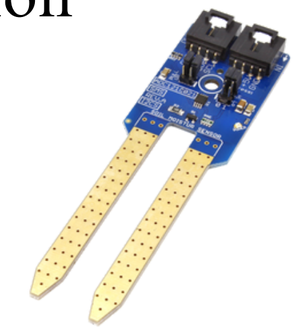
Arduino UNO: A microcontroller that processes sensor inputs and controls motor operations for the rover.



Bluetooth Module (HC-05): A wireless module that transmits sensor data to devices like smartphones in real-time.



Soil Moisture Sensor: Detects soil water content to assist with irrigation management in agriculture.

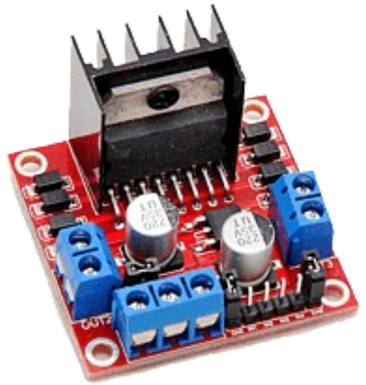


COMPONENTS DESCRIPTION

Metal Detector: Identifies metallic objects in soil, aiding in mining and contamination detection.

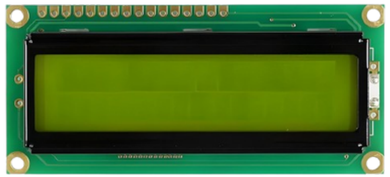
DHT Humidity and Temperature Sensor: Measures ambient conditions to provide environmental context for soil analysis.

Motor Drivers: Regulates motor speed and direction to ensure smooth rover navigation.



COMPONENTS DESCRIPTION

LCD: Displays live sensor data on the rover for on-site monitoring.

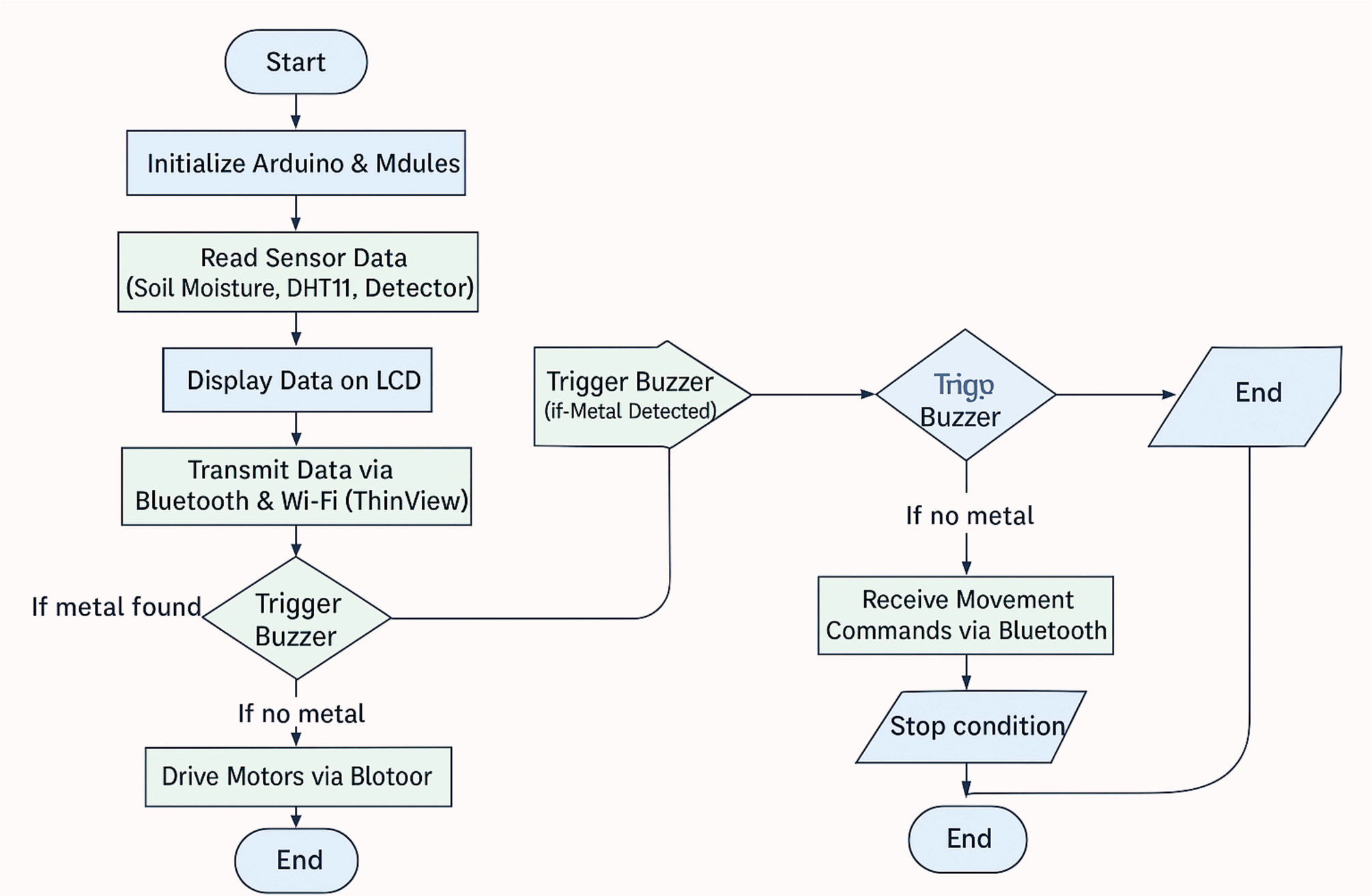


Motors: Drives the six-wheel chassis, enabling movement across uneven terrains.

Buzzer: Emits alerts for critical conditions like low moisture or metal detection.

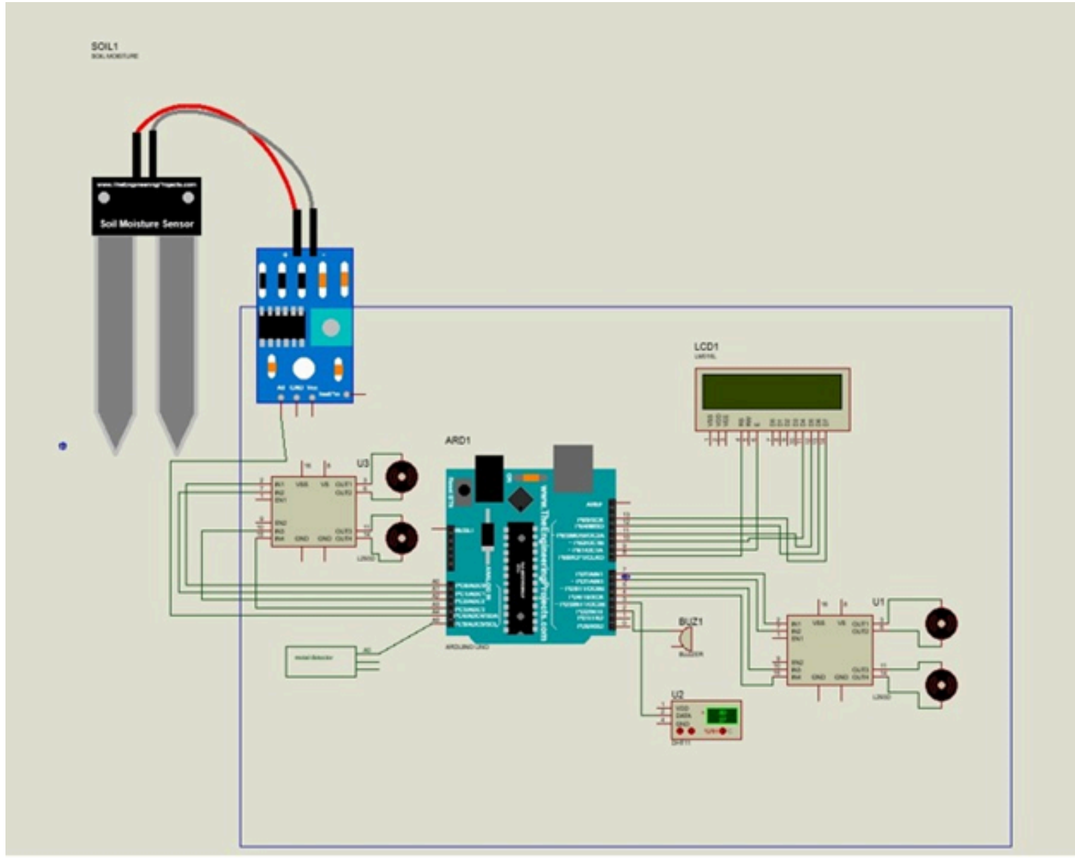
D1 Mini (WiFi Module): Connects the rover to the cloud for remote data storage and visualization

FLOW CHART

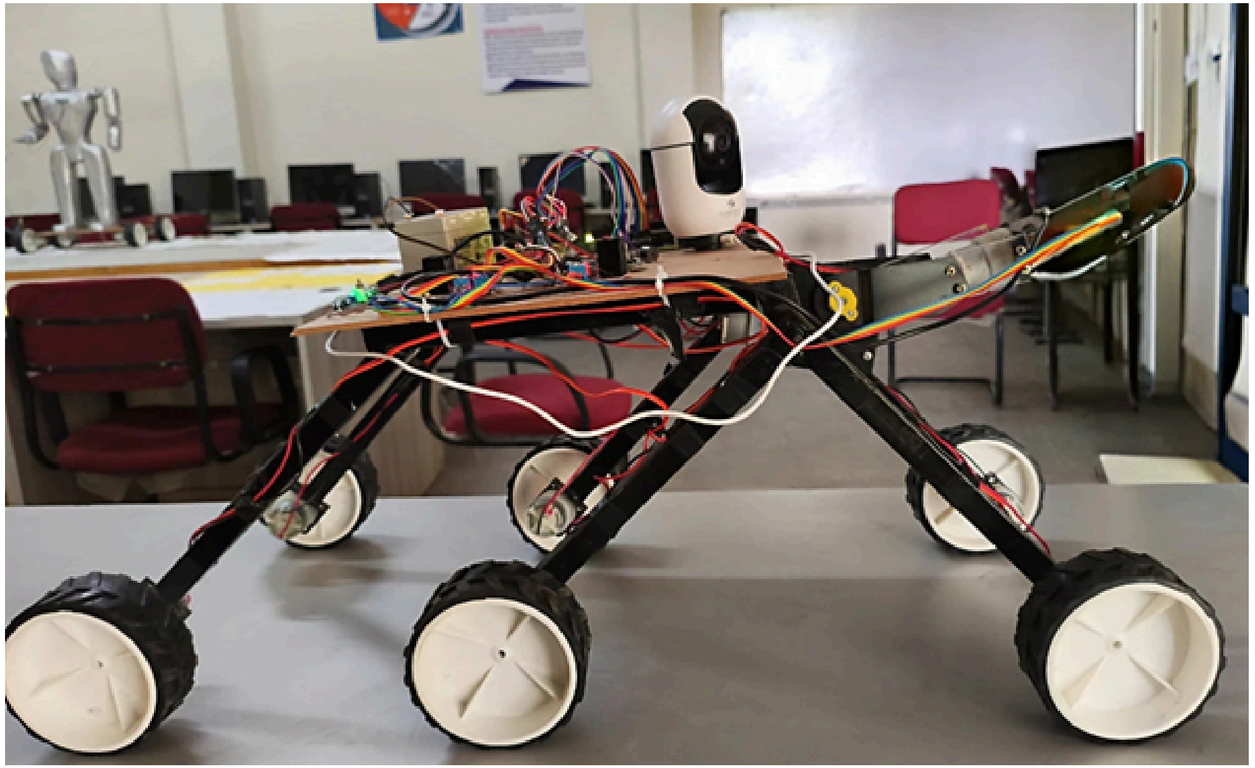

Start
Initialize Arduino & Mdules
Read Sensor Data
(Soil Moisture, DHT11, Detector)
Display Data on LCD
Transmit Data via
Bluetooth & Wi-Fi (ThinView)
If metal found
Trigger
Buzzer
If no metal
Drive Motors via Blotoor
End
Trigger Buzzer
(if-Metal Detected)
Trigo
Buzzer
End
If no metal
Receive Movement
Commands via Bluetooth
Stop condition
End

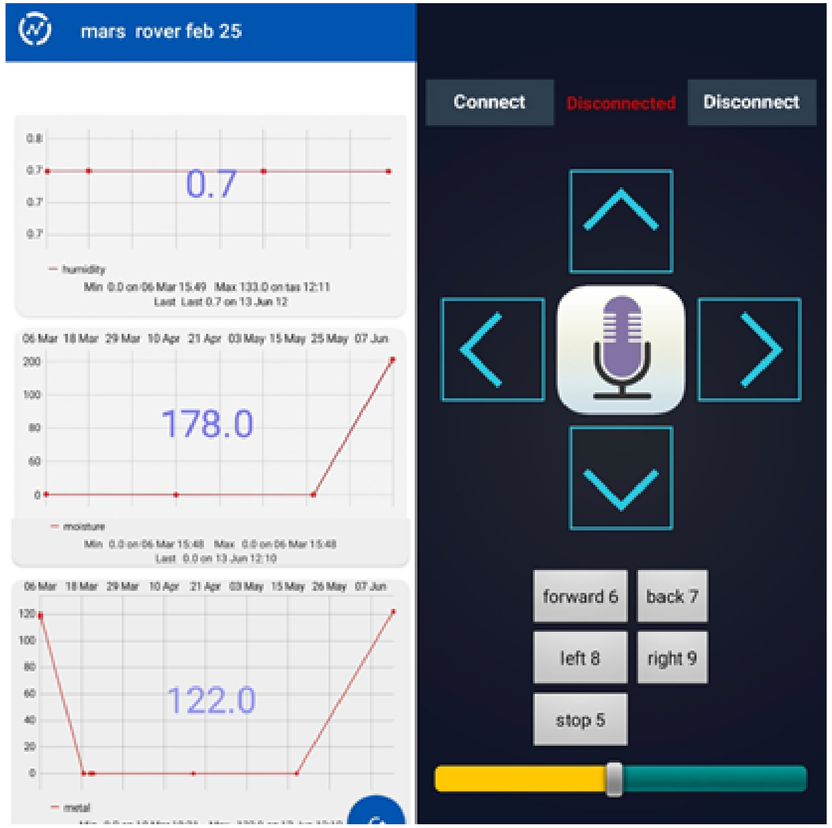
SCHEMATIC DIAGRAM

- Soil & Climate Sensing: Measures soil moisture, temperature, and humidity; data shown on LCD and uploaded to ThingSpeak via Wi-Fi.
- Metal Detection: Detects underground metals and alerts via LCD or mobile app.
- Navigation: Controlled by 6 DC motors using Bluetooth; supports all basic movements.
- Sample Collection: Front servo jaw collects soil/objects remotely.
- Power & Safety: Uses relays for protection; runs on a rechargeable battery and updates data in real time.



RESULT





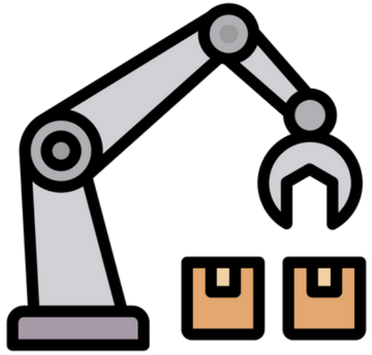
- The prototype successfully detected metal, soil moisture, and humidity while transmitting real-time data to the mobile app.
- Movement commands were accurately executed via Bluetooth, and sensor data visualization was achieved through the ThinkView platform.

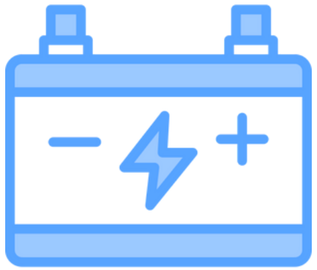
ADVANTAGES:

- Real-Time Soil Analysis
- High Mobility & Terrain Adaptability
- Remote Data Transmission & Cloud Integrati...
- Precise Sample Collection

APPLICATIONS:

- Precision Agriculture
- Construction Site Analysis
- Environmental Monitoring
- Mining & Metallurgy
- Research & Education





FUTURE SCOPE

- **Enhanced Sensor Accuracy:** Integrate sensors for pH, nutrient levels, and organic matter.
- **Autonomous Navigation:** Implement GPS and AI-based path planning.
- **Durability Upgrades:** Develop weather-resistant materials for extreme conditions.
- **Energy Efficiency:** Incorporate solar panels to reduce battery dependency.
- **Multi-Rover Coordination:** Enable IoT-based collaboration for large-scale mapping.
- **Integration with Drones:** Combine with aerial imagery for holistic land assessment.

CONCLUSION

- In conclusion, the developed rover system effectively demonstrates real-time environmental monitoring and remote-controlled mobility using Bluetooth and Wi-Fi. Its successful integration of sensors and communication modules proves its potential for agricultural, environmental, and industrial applications. With future enhancements, this prototype can evolve into a fully autonomous and intelligent field assistant.

REFERENCES

- Guruprasad Deshpande, A. A. Shinde, P. S. Jadhav, "**IoT-Based Low-Cost Soil Moisture and Soil Temperature Monitoring System**," International Journal of Engineering Research & Technology (IJERT), Vol. 11, Issue 5, May 2022.

- P. Kamble, S. Shinde, and V. Muley, "**Arduino Based Metal Detection Rover**," International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), Vol. 7, Issue 3, March 2019.

- Extensive research was conducted using multiple online resources including **Wikipedia, YouTube tutorials, ChatGPT, and other AI-powered tools** for technical guidance, coding support, and design inspiration throughout the project development.

Thank You!!