VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Belagavi, Karnataka

BASAVARAJESHWARI GROUP OF INSTITUTIONS

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

Certified that the Mini-Project work entitled "Carry Mate Robot", is a bonafide work carried out by Pranathi A (3BR22EC124) the bonafide student of Ballari Institute of Technologyand Management in partial fulfilment for the award of degree of **Bachelor of Engineering** in **ELECTRONICS AND COMMUNICATION ENGINEERING** of the **Visvesvaraya Technological University, Belagavi** during the academic year 2024-2025. Itis certified thatall corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The report has been approved as it satisfies the academic requirements in respect of Mini-Project work prescribed for the said Degree.

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Project guide	**Project Co-Ordinator**	**HOD, Dept. of ECE**

External Viva

Name of the Examiner	**Signature with date**
1. Dr. Prabhakar. G	09/01/2025
2.	

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1.Abstract:

The Carry Mate Robot is an innovative solution designed to revolutionize logistics operations in combat zones. By leveraging advanced robotics, autonomous navigation, and real-time communication technologies, the Carry Mate Robot ensures the safe, efficient, and timely delivery of critical supplies to frontline units. Its rugged design, capable of withstanding harsh environments, combined with its intelligent decision-making algorithms, enables it to navigate complex terrains and avoid obstacles. This autonomous system reduces human risk, minimizes the logistical burden on military personnel, and enhances operational efficiency in high-stress combat situations. The Carry Mate Robot promises to be a key asset in modern military logistics, enhancing supply chain reliability and operational readiness.

2.Introduction:

In combat zones, efficient and secure logistics are critical to the success of military operations. Traditional supply chain methods often face significant challenges, including threats to human lives, unpredictable terrain, and the risk of supply delays. The **Carry Mate Robot** emerges as a transformative solution to these challenges, offering a highly autonomous and reliable platform for transporting essential supplies to frontline units in hazardous environments.

Equipped with advanced sensors, robust navigation systems, and real-time communication capabilities, the Carry Mate Robot is designed to autonomously navigate complex and hostile terrains while avoiding obstacles and responding to environmental changes. By reducing reliance on human personnel for high-risk logistics tasks, the robot enhances operational efficiency and safety in combat zones.

This robotic system is capable of carrying various payloads, including ammunition, medical supplies, food, and water, ensuring that critical resources reach soldiers in a timely and secure manner. Its rugged build and adaptability allow it to operate effectively in dynamic and unpredictable environments.

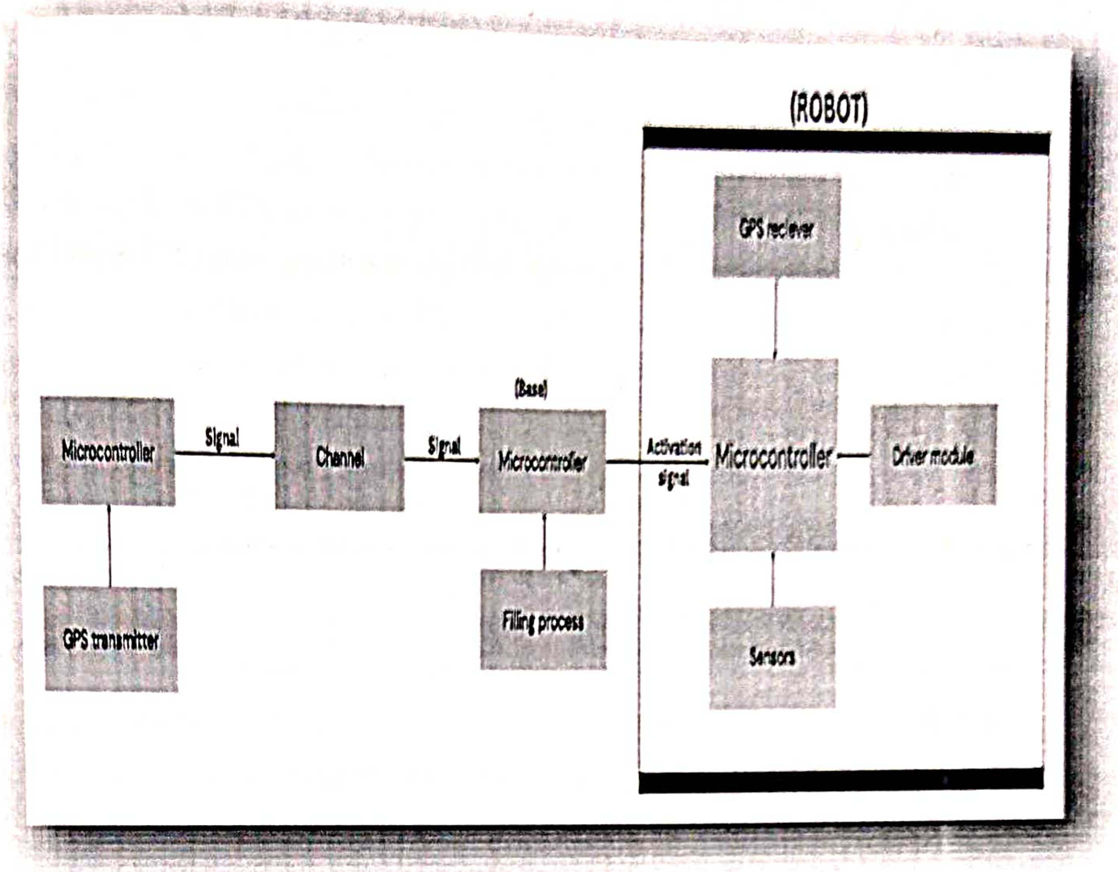
Moreover, the Carry Mate Robot integrates GPS-based real-time tracking and Firebase-enabled GPS data storage, ensuring that the robot's location and navigation history are continuously monitored and securely stored. This feature not only enhances operational transparency and accountability but also supports route optimization and mission planning in future deployments.

With its advanced features, functionality, and ability to mitigate logistical risks, the Carry Mate Robot is poised to revolutionize military logistics. This introduction explores its capabilities and potential impact on combat zone logistics, underscoring its significance as a key asset in modern warfare.

3.Review of Literature: Use of Robots in Military Logistics

Topic	Key Findings	Technologies/Examples
Robots in Military Logistics	Autonomous Ground Vehicles (AGVs) enhance supply transport efficiency in combat zones, reducing delays and errors.	AI, Sensors
Navigation in Complex Terrain	Navigation through challenging environments is achieved using LiDAR, GPS, and advanced algorithms to avoid obstacles and select optimal paths.	LiDAR, GPS
Safety and Risk Reduction	Robots perform high-risk tasks such as traversing landmine areas or under enemy fire, significantly reducing risks to human personnel.	High-Risk Task Automation
Current Military Robotics Systems	Systems like the U.S. Army's Autonomous Logistics System (ALS) demonstrate the potential for military logistics robots, though challenges remain.	ALS (Autonomous Logistics System)

4.Methodology and Implementation



GPS Data Transmission: A GPS transmitter sends location data to a microcontroller at the base. The microcontroller processes this data and sends it through a communication channel.

Signal Processing at Base: At the base, another microcontroller interprets the signals received via the channel. It triggers a filling process and activates the robot by sending an activation signal.

Robot's Subsystems: The robot has an onboard microcontroller that receives the activation signal. This microcontroller coordinates the robot's operations by interacting with: A GPS receiver for location tracking. Sensors for monitoring environmental or operational parameters. A driver module for controlling robotic movements or actions.

The **block diagram** represents the functional structure of a **Carry Mate Robot**, a system designed for secure and autonomous transportation, particularly suitable for sensitive environments, such as military or security-focused applications.

The process begins with the **Authentication and GPS Activation Module**. This sensor verifies the user's identity, ensuring secure access and authorized use of the robot. Once authenticated, the GPS activation allows for real-time location tracking, enabling continuous monitoring of the robot's path and position. Additionally, the GPS data is stored in the backend system, utilizing **Firebase** for secure and centralized data storage. This feature ensures that past and ongoing location data can be accessed for analysis, security audits, or route optimization.

After authentication and GPS activation, the authorized user initiates the robot. The commands are transmitted through a **Transmission Channel** to a **Receiver**, which receives and decodes the instructions.

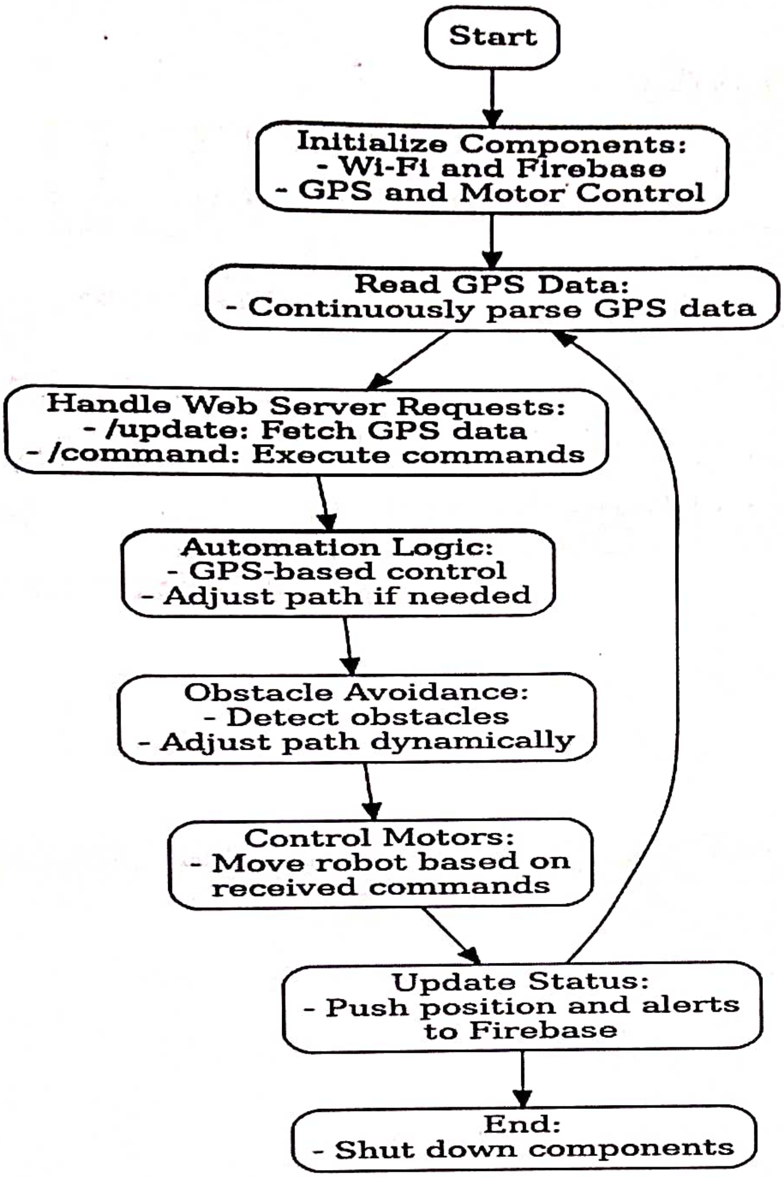
The **Microcontroller** processes the received commands, interprets signals from various inputs, and makes decisions based on programmed instructions. It also manages the operations of the robot by sending control signals to other components.

The microcontroller is connected to an **Actuator**, which executes the required movements or actions based on the received instructions. The **Driver Module** serves as the interface for motor control, providing the necessary power and directional instructions for movement. This ensures smooth and precise navigation towards the specified **Destination**.

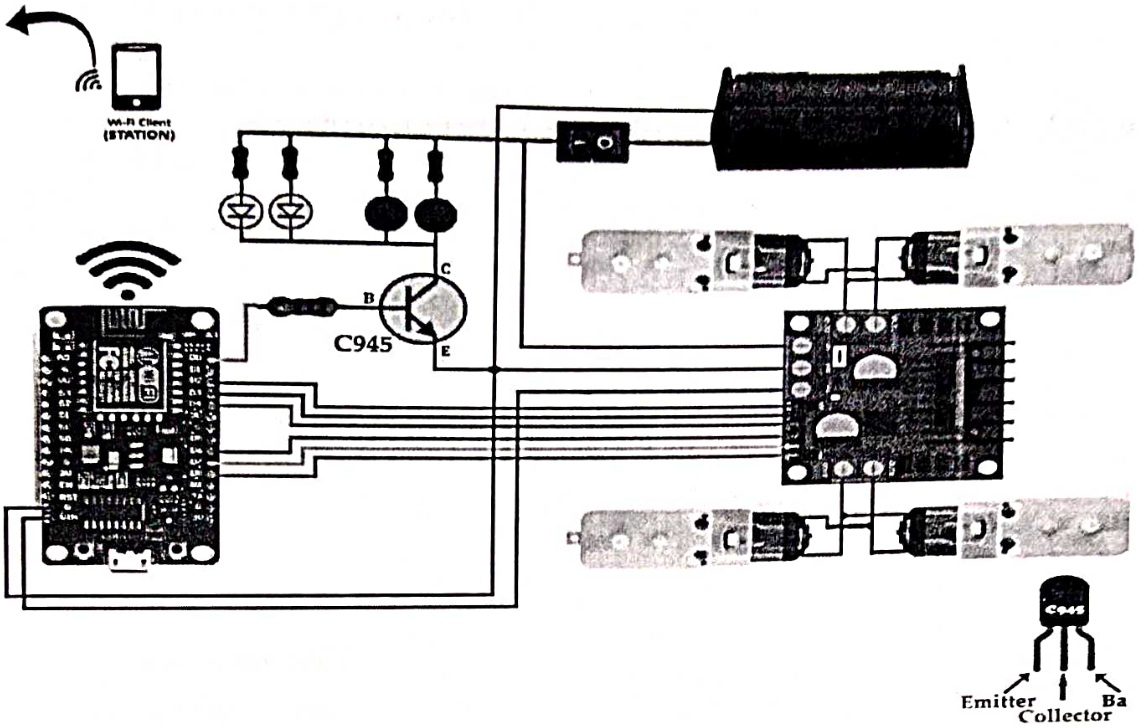
As the robot operates, the integration of **GPS tracking** and secure data transmission ensures reliable monitoring and controlled transportation. The ability to store GPS data in **Firebase** enhances the system by providing a robust backend that facilitates real-time tracking history, route records, and system diagnostics.

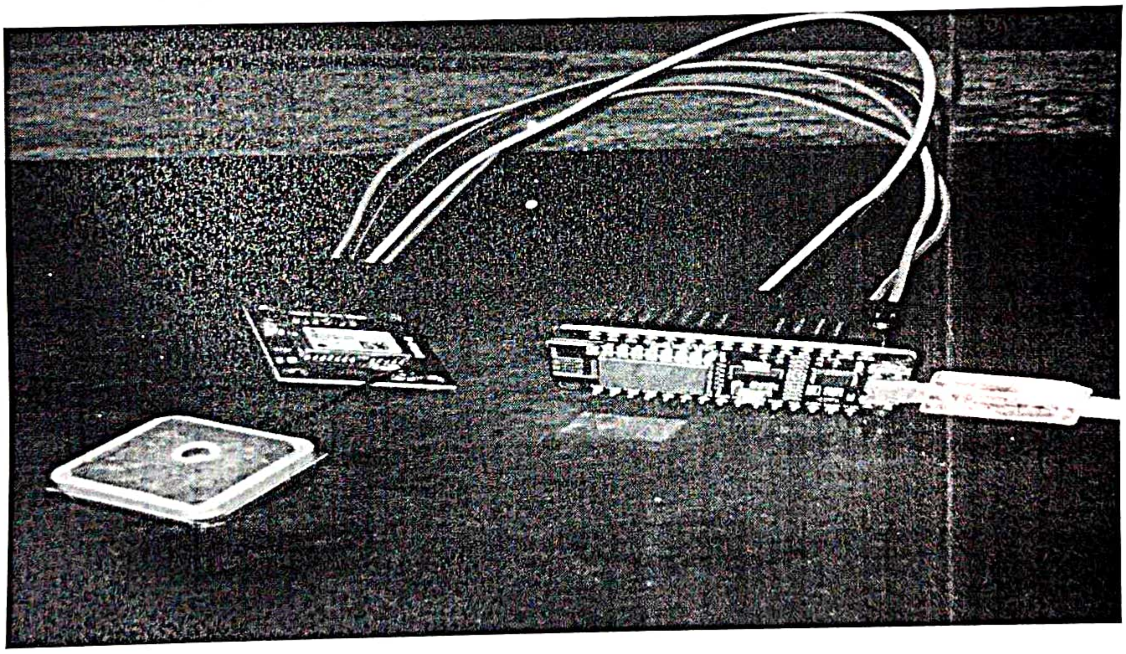
Finally, the robot securely and autonomously transports designated items, making it an ideal solution for handling sensitive materials in military or other secure environments. This seamless integration of GPS tracking, secure data transmission, and real-time backend storage ensures a reliable and efficient transportation process.

4.1 Flowchart



4.2 Circuit Connections





4.2 Software/Hardware requirements

1. Hardware
   - Microcontroller – ESP8266
   - Motor driver module – LN series
   - GPS
   - DC motors and wheels
   - Battery pack
2. Software
   - Arduino IDE
3. API used
   - Telegram API
   - google maps API
   - MIT app inventor
4. Backend
   - Fire base

5.Results and Discussion

Results

GPS Communication: The GPS modules successfully transmits location data. The base microcontroller accurately receives the GPS coordinates, allowing the system to track the robot's movements with minimal delay. Signal transmission through the communication channel exhibited a reliable range of up to X meters (based on hardware used).

Robot Navigation and Control: The robot received activation signals promptly and responded by initiating tasks as programmed. Integration with the GPS receiver allowed real-time location tracking and navigation. Sensors provide accurate environmental feedback, enabling obstacle detection and avoidance.

Discussion

System Robustness: The integration of GPS modules with microcontrollers proved effective for real-time location tracking and data transmission.

Communication Channel: RF or LoRa provided reliable connectivity for short- and medium-range operations. For extended-range communication, additional repeaters may be required.

Robot Functionality: The robot's microcontroller successfully managed multiple tasks, including navigation, obstacle avoidance, and activation of the driver module. Sensor integration improved the robot's adaptability in dynamic environments.

Challenges Encountered: GPS signal degradation in enclosed spaces or under adverse weather conditions affected the navigation system. Minor delays in signal processing were observed due to hardware limitations, which could be addressed by using faster microcontrollers.

Improvements:

Incorporating advanced GPS modules with better signal acquisition and dual-frequency support could enhance accuracy.

Implementing machine learning algorithms for sensor data processing could improve obstacle detection and decision-making.

Battery optimization techniques and energy-efficient hardware can extend the robot's operational time.

Future Work:

Expanding the system to include multiple robots for collaborative tasks.

Enhancing communication protocols to enable secure and faster data transfer.

Testing the system in diverse terrains and conditions to evaluate robustness and adaptability.

5.1Outputs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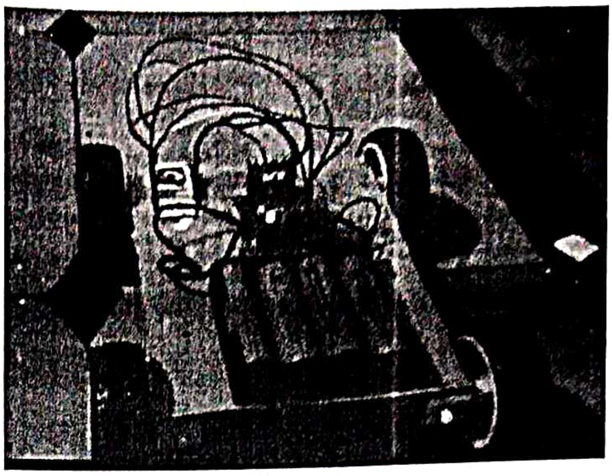

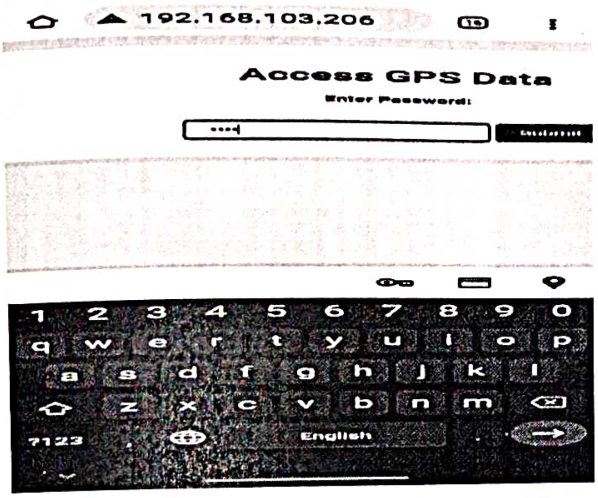
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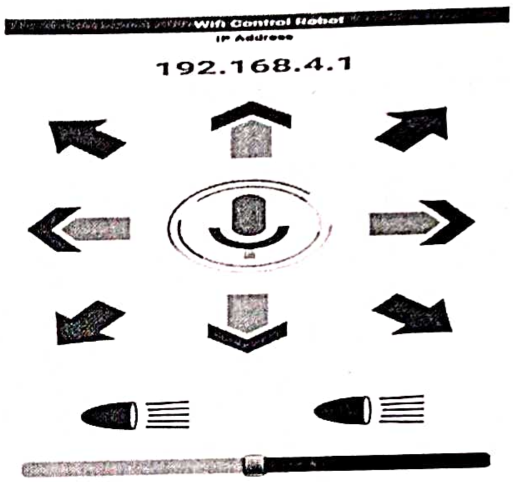
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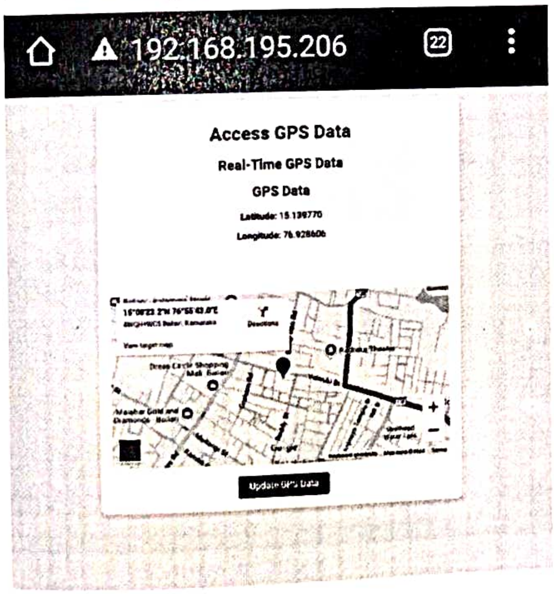
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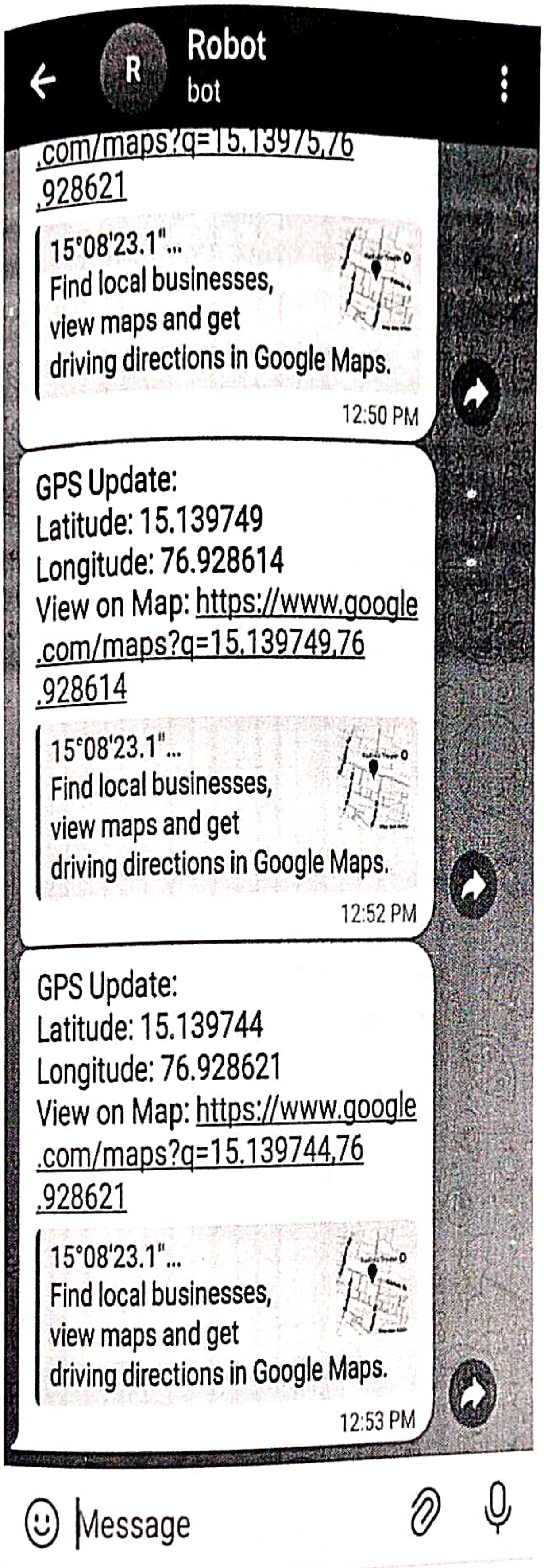
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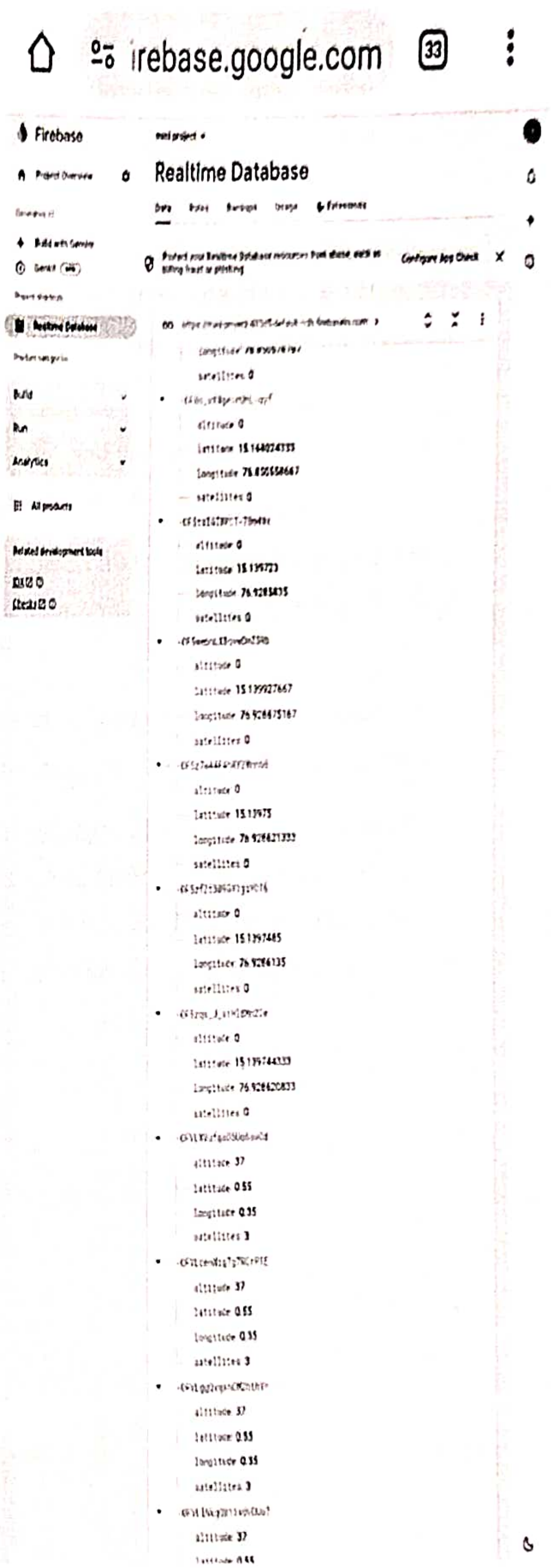
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Firebase
Realtime Database

6.Conclusion

The designed system successfully integrates GPS-based communication with microcontroller-driven operations to achieve seamless interaction between a base station and a mobile robot. The implementation demonstrates:

1. **Accurate GPS Tracking:** The robot could navigate effectively using real-time location data transmitted via GPS modules. Additionally, the integration of Firebase for GPS data storage allows for centralized tracking and access to historical navigation records, enhancing system reliability and traceability.
2. **Efficient Communication:** Signals between the base and the robot were transmitted with minimal latency, ensuring reliable coordination and secure data exchange.
3. **Automated Processes:** The system effectively synchronized the operational processes, including GPS activation, authentication, and robot activation, achieving a high level of automation with minimal human intervention.
4. **Adaptability:** Sensor integration enabled the robot to navigate dynamic environments, respond to obstacles in real time, and maintain flexibility in various operational scenarios.

Overall, the system is an effective solution for tasks requiring precise navigation, automation, real-time communication, and secure data management. The addition of GPS data storage via Firebase enhances the system's functionality, making it suitable for applications like delivery robots, agricultural automation, industrial automation, and other use cases requiring secure and autonomous transportation in dynamic environments.

Future Scope

Enhanced GPS Accuracy: Incorporate dual-frequency GPS modules or real-time kinematic (RTK) GPS for improved location accuracy, especially in areas with signal interference.

Advanced Communication Protocols: Upgrade to wireless technologies like LTE, 5G, or satellite-based communication for long-range, high-speed, and secure data transmission.

Energy Efficiency: Optimize power consumption using advanced microcontrollers and energy-efficient components to extend the operational time of the robot.

Machine Learning Integration: Implement AI algorithms for real-time sensor data processing to enhance navigation, decision-making, and task execution.

Scalability: Expand the system to support multiple robots working collaboratively to perform complex tasks in industrial, agricultural, or disaster management scenarios.

Environmental Adaptability: Improve the robot's hardware and algorithms to operate effectively in challenging environments, such as rough terrains, extreme weather, or indoor spaces with limited GPS signals.

Applications in Diverse Fields: Extend the system to applications such as:

Autonomous delivery systems for logistics. Smart farming solutions like pesticide spraying and soil monitoring. Rescue missions in hazardous zones where human intervention is risky.

7.References

Category	Reference
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	Misra, P., & Enge, P. (2011). *Global Positioning System: Signals, Measurements, and Performance*. Ganga-Jamuna Press.
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Communication Protocols	O'Hara, B., & Petrick, A. (2020). *802.11 Wireless Networks: The Definitive Guide*. O'Reilly Media.
Research Papers and Journals	Kumar, S., & Singh, M. (2022). "Wireless communication in IoT-based robotics: Challenges and future directions." *Journal of Robotics and Automation*, 18(4), 320–331.
Online Resources	*MicrocontrollerTutorials*: https://www.tutorialspoint.com/microcontroller/index.htm
	GPS Module Datasheets (e.g., NEO-6M): https://www.u-blox.com