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Survey Paper on Tactical Soldier Monitoring and LoRa Communication System Using IoT

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Abstract - *Soldier safety is a major concern for military operations in remote and hazardous environments. Continuous health monitoring, location tracking, and reliable communication could be challenging. This paper presents the design of a Tactical Soldier Monitoring and Long Range (LoRa) Communication System using the Internet of Things (IoT). The proposed unit uses an ESP32 microcontroller to interface with a MAX30102 heart-rate sensor, a temperature sensor, and a Global Positioning System (GPS) module. The measured health parameters and location information are to be transmitted to a base station via a LoRa communication link chosen for its long-range capability and low power consumption. At the receiving end, the information could be displayed to aid situational awareness and rapid decision-making during emergencies. The design integrates health monitoring, location tracking, and wireless data transfer in one system and could potentially be applied to search-and-rescue activities, border monitoring, and remote-worker safety. The supplied project report describes the system architecture and planned implementation, but does not provide measured communication range, sensor accuracy, latency, or experimental results. These parameters must be validated via hardware testing before deployment.*

Key Words: Internet of Things, LoRa, ESP32, Soldier Monitoring, GPS Tracking, Heart-Rate Sensor, Body Temperature, Wireless Communication.

1.INTRODUCTION

Modern military operations could involve forests, mountains, border regions, and other locations where conventional communication infrastructure is limited. In such situations, commanders need timely information about a soldier's location and basic health status. Delayed information arrival could impact the coordination of rescue and medical assistance, particularly if a soldier is injured or encounters a sudden health issue.

The proposed project involves sensing, positioning, embedded processing, and long-range wireless communication. The ESP32 acts as the central controller, the sensors provide health-related measurements, GPS provides location information, and LoRa serves to transfer the collected data to a base station. The objective is to implement a compact and low-power monitoring arrangement suitable for remote operation.

1.1 Problem Statement

Existing monitoring approaches could use short-range links or require infrastructure that may not be consistently available in remote operating areas. Standalone health monitoring and location tracking devices could also create challenges in obtaining an integrated understanding of the soldier's status. A system is needed to capture basic health parameters and location data and transmit them via along-range, low-power communication link.

1.2 Objectives

- To monitor heart rate and body temperature using sensors interfaced with an ESP32 microcontroller.
- To obtain the soldier's position using a GPS module.
- To transmit sensor and location data to a base station using LoRa communication.
- To present the received information in a format to aid monitoring and emergency decision-making.

2. RELATED WORK

The project report's literature survey cites three areas of previous work: IoT-based wearable health monitoring, real-time soldier health and location monitoring, and sensors using an ESP32. The first study mentioned involves wearable devices for continuous health monitoring and abnormal-condition alerts. The second focuses on combining health and location monitoring for rapid response. The third describes an ESP32-based approach to collecting and transmitting sensor data. These themes inform the integration of an IoT-based solution that utilizes health sensing, GPS, and long-range communication. The supplied report contains abbreviated author and publication details for these studies; the citations below must be compared to the original publications before journal submission.

3. PROPOSED SYSTEM

The proposed system has two main components: a soldier-side monitoring unit and a base station. On the soldier side, the MAX30102 sensor measures heart-rate-related signals and a temperature sensor measures body temperature. The GPS module provides position data, and the ESP32 reads and prepares the available measurements for transmission via

a LoRa module. At the base station, a LoRa receiver captures the transmitted packet and displays the information.

4. IMPLEMENTATION METHODOLOGY

The project report's implementation plan is organized into 12 weeks. The first phase involves the literature survey, requirement identification, and component selection.

The next phase focuses on the system architecture and hardware integration. The ESP32 firmware is developed using the Arduino IDE to interface with the sensors, GPS, and LoRa modules. Finally, the transmitter and receiver are tested, errors are corrected, and the documentation is prepared.

- **Hardware integration**: Connect the selected sensors and communication modules to the ESP32 using their required interfaces and supply voltages.
- **Firmware development:** Implement sensor reading, GPS-data acquisition, data formatting, and LoRa transmission in the Arduino IDE.
- **Base-station setup:** Configure a compatible LoRa receiver and display/monitoring interface to receive and display the measurements.

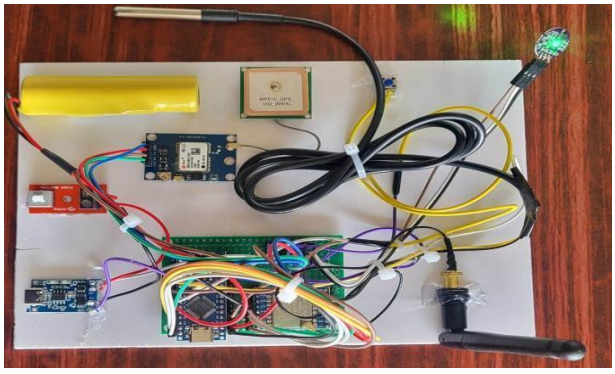

Fig.4.1. Hardware Integration of Proposed Soldier Monitoring System.

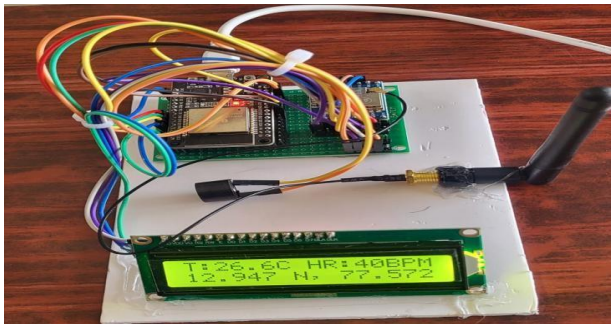

Fig.4.2 Base Station Setup for Soldier Monitoring and LoRa Communication.

- **System verification:** Check sensor readings, GPS availability, packet reception, and end-to-end behaviour under different test conditions.

These steps align with the implementation plan provided in the project report. The supplied report does not include source code, pin assignments, circuit diagrams, or test logs; these details should be added as available.

5. RESULTS AND DISCUSSION

The project report states the intended outcome as monitoring heart rate and body temperature, obtaining the soldier's GPS location, and transmitting the collected data to a base station using LoRa. The integrated arrangement allows improved visibility of a soldier's status in locations where conventional network coverage could be unreliable. Application areas identified in the report for the system include military operations, search-and-rescue operations, border-security monitoring, and remote-worker safety.

No screenshots of measured output, test tables, communication-range measurements, sensor comparisons, power-consumption readings, or latency results are included in the supplied report. Numerical performance claims cannot be taken from the available evidence. For a complete experimental evaluation, the system should be tested for

i. heart-rate and temperature reading accuracy against reference instruments,
ii. GPS acquisition and location error,
iii. packet delivery rate and received-signal quality at increasing distances,
iv. end-to-end update latency, and
v. operating time on the selected battery. Results should be reported with the test environment and LoRa configuration.

6. CONCLUSION

This paper presents an IoT-based tactical soldier monitoring concept involving an ESP32 microcontroller, heart-rate and temperature sensing, GPS location acquisition, and LoRa communication. The proposed architecture intends to transmit health and location information from a soldier-side unit to a base station, supporting monitoring in remote or hazardous environments. By integrating sensing and long-range communication, the system addresses the need for a unified monitoring approach. Future work should finalize hardware validation, document the circuit and firmware, evaluate communication reliability and power consumption, and report quantitative test results prior to assessing deployment readiness.

7. ACKNOWLEDGEMENT

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