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Implementation of a Real Time Soldier Tracking with Health Monitoring and Radar System

Tabasum Guledgudd[1], Kavyanjali Diddimani[1], Harsha Marabi[1],
Shrinidhi Mahabalshetti[1], Prerana Patil[1]
[1] *Dept. of ECE, SECAB I.E.T, Vijayapura*
[1]tabuag85@gmail.com

Abstract: This paper introduces a comprehensive system for real-time soldier tracking and health monitoring using modern technologies such as GPS, radar, biomedical sensors, and wireless communication. The system is designed to provide live updates on soldiers' location and vital health parameters like heart rate, body temperature, and movement status. By collecting and transmitting data from wearable sensors to a central command center, it enables remote monitoring of soldiers, improving coordination and operational efficiency during missions. The integration of radar technology offers a significant advantage, particularly in GPS-denied or complex terrains, ensuring high-precision tracking indoors and in challenging environments. This enhanced tracking, combined with continuous health monitoring, allows commanders to respond swiftly in case of medical emergencies. The ability to visualize soldier locations and receive real-time health alerts not only ensures the well-being of the personnel but also supports strategic decision-making, faster medical intervention, and improved mission outcomes.

By delivering timely data and situational awareness, the system enhances the safety and responsiveness of military operations. It proves especially useful in large-scale battlefield engagements, disaster rescue missions, or any scenario requiring constant surveillance and rapid action. Ultimately, this technology strengthens command capabilities, protects troops more effectively, and represents a significant advancement in intelligent defense systems.

Index Terms **- Arduino-based radar, ultrasonic sensor, GPS module, GSM module, Health monitoring sensors, location tracking.**

INTRODUCTION

Modern warfare and defense strategies increasingly rely on advanced technologies to enhance situational awareness, operational effectiveness, and personnel safety. Among these innovations, the integration of Soldier Tracking and Health Monitoring Systems with Radar Systems represents a significant advancement in military command and control.

The Soldier Tracking and Health Monitoring System is designed to provide real-time data on the location and vital signs of soldiers in the field. Through the use of GPS, biometric sensors, and secure wireless communication, commanders can monitor each soldier's position and physiological status, enabling faster response to injuries and more informed tactical decisions.

Complementing this, the Radar System offers robust surveillance capabilities by detecting and tracking airborne or ground-based threats across vast distances and varying weather conditions. By combining radar data with soldier monitoring, military operations benefit from a comprehensive view of both internal personnel status and external threat environments. This integration not only enhances battlefield awareness but also ensures better coordination, threat detection, and mission execution.

The Soldier Tracking and Health Monitoring System is an advanced solution developed to ensure the safety, effectiveness, and real-time supervision of military personnel during missions. It employs a combination of Global Positioning System (GPS) modules, biometric sensors, and wireless communication protocols to continuously monitor each soldier's location and vital physiological parameters such as heart rate, body temperature, blood oxygen level, and fatigue status. This data is transmitted to a central command center, enabling real-time assessment of each soldier's health and status, rapid medical response in emergencies, and better strategic deployment based on personnel readiness.

In today's rapidly evolving defence landscape, the integration of cutting-edge technology into military operations is crucial to maintaining strategic superiority and safeguarding personnel. Two critical technological advancements that significantly contribute to modern battlefield awareness and operational efficiency are the Soldier Tracking and Health Monitoring System and the Radar Surveillance System.

LITERATURE REVIEW

C. V. Mahamuni [1] proposed a wireless sensor network (WSN)-based surveillance system for military use, designed to monitor remote and hostile areas while optimizing energy efficiency through node scheduling. The prototype plans to integrate motion sensors and cameras that send alerts via GSM when activity is detected. Due to limitations in data transmission and power in harsh environments, image streaming poses challenges. Future work aims to deploy camera-equipped sentry nodes at perimeters with simpler motion sensors inside, enhancing overall system reliability and effectiveness for military surveillance.

Lim et al. [2] study explored the development of a Body Sensor Network (BSN) comprising wearable physiological and biomedical sensors for real-time health monitoring of soldiers. The proposed system involves interconnected BSNs placed on or near the body to continuously track vital parameters. A preliminary prototype has been implemented, including a blast source localization feature to enhance situational awareness during missions. The system demonstrates potential for improving soldier safety and operational response through continuous, real-time monitoring in high-risk environments.

Julan et al. [3] addressed the limitations of traditional reversing radar in terms of range and measurement accuracy, a high-precision radar detection system was developed using dual STC89C52 microcontrollers and eight-channel ultrasonic sensors. The system incorporates real-time environmental temperature sensing and applies temperature-compensated ultrasonic wave velocity to enhance accuracy. It features customizable alarm thresholds via five control buttons, a buzzer with distance-based frequency variation, and visual alerts through an LCD1602 display and LEDs. Test results demonstrate a linear detection range of 0.01 to 7 meters with an accuracy of 0.01 meters, making the system highly reliable for precise distance measurement."

Thakre et al. [4] proposed system integrates GPS, GSM, and biosensors to facilitate real-time tracking and health monitoring of soldiers during special missions or operations in enemy territory. It leverages mobile health (mHealth) technologies—comprising mobile computing, medical sensors, and healthcare communication tools—to monitor soldiers' wellbeing remotely. The system addresses not only physical threats but also physiological challenges such as fatigue and sleep deprivation. It enhances national security by enabling continuous surveillance of soldier location and health, ensuring timely response in critical situations and providing strategic support during warfare

Khan et al. [5] proposed a system that ensures soldier safety by integrating GPS, GSM, and biomedical sensors to monitor real-time location and health parameters such as heart rate and body temperature. The system is designed to be worn on the soldier's body, enabling continuous health monitoring and wireless communication with the base station. Abnormal physiological readings trigger automatic alerts via the GSM module, and an emergency button allows soldiers to manually transmit their location in critical situations. The system enhances situational awareness and supports quick response through mobile health (mHealth) technology

Khan et al. [6] proposed system enhances soldier safety by integrating GPS and GSM technologies with biomedical sensors to monitor real-time location, heart rate, and body temperature. The wearable device transmits vital signs and location data wirelessly to the base station, displaying heart rate on an LCD screen. Abnormal temperature readings automatically trigger alerts to the control room via GSM, and an emergency button allows soldiers to manually send distress signals with location information. This system provides continuous health monitoring and rapid response capabilities during critical situations."

Shakti et al. [7] proposed IoT-based system enables real-time tracking and health monitoring of soldiers by integrating GPS, biomedical sensors, and wireless communication modules. The wearable device continuously measures vital signs such as heart rate and body temperature, transmitting data to the command center over the Internet of Things (IoT). It includes an emergency alert feature, allowing soldiers to manually request assistance during distress. The system is designed to reduce response time in critical situations and minimize casualties by ensuring timely medical support. Its cost-effective design also supports deployment in extreme environments, enhancing operational safety and mission efficiency."

Rajeswari et al. [8] presented a cost-effective radar system utilizing Arduino microcontrollers and ultrasonic sensors to overcome the limitations of traditional radar technologies, which are often costly and complex. This innovative design leverages the affordability and flexibility of Arduino to enable efficient object detection and tracking. The system aims to democratize radar applications across various domains by offering an accessible alternative suitable for real-time monitoring and surveillance tasks."

Bauder et t al. [9] highlights In response to rising concerns about contact-transmitted diseases and the expansion of telemedicine, the study proposes a multi-functional remote health monitoring system that integrates camera-based and radar-based technologies. Camera systems are employed to estimate heart rate, blood pressure, SpO_2, and temperature under proper lighting conditions, while radar systems provide robust, contactless measurement of heart and respiration rates. The combined approach enables comprehensive and accurate monitoring of major vital signs, supporting remote diagnostics with high reliability."

Nalla et al. [10] presents a 360-degree object detection system using ultrasonic sensors, designed to meet the growing demand for efficient detection in robotics, autonomous vehicles, and smart surveillance. The system enables continuous environmental scanning to detect both metallic and non-metallic objects in real time. Experimental results highlight its capability to accurately identify objects at varying distances and orientations while minimizing measurement errors. This approach enhances detection reliability and efficiency, particularly in dynamic and rapidly changing environments

Tabasum et al. [11] presents an in-depth analysis of the Internet of Healthcare Things (IoHT) systems, emphasizing their role in transforming healthcare delivery through remote monitoring, disease prediction, and surgical assistance. It highlights the integration of cutting-edge technologies such as Blockchain, Cloud Computing, Encryption, and Artificial Intelligence within IoHT frameworks to ensure secure and reliable data communication. The research evaluates the synergistic benefits of combining these technologies to improve healthcare outcomes and proposes a comprehensive framework addressing gaps in traditional healthcare approaches. Additionally, the study reviews historical and recent advancements of these technologies within the African healthcare context."

METHODOLOGY:

Conceptual Diagram

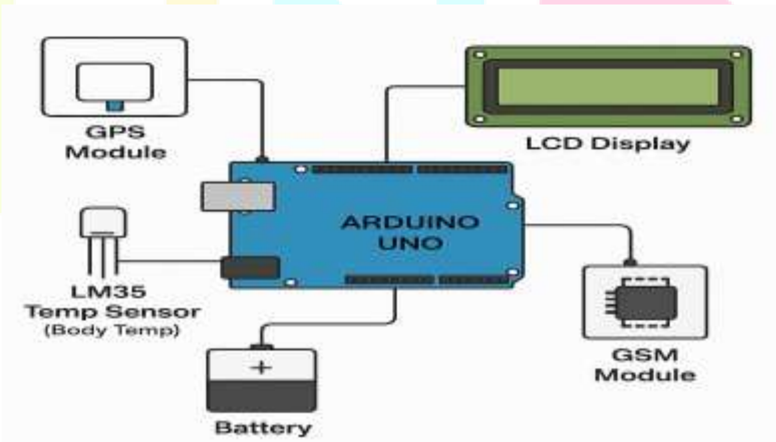

Fig 3.1: Solider tracking and health monitoring system

The Radar System is developed for real-time environmental scanning and obstacle detection using ultrasonic sensing technology. It also utilizes the Arduino Uno R3 as its central controller. This system controls a servo motor to enable angular movement of the HC-SR04 ultrasonic sensor, typically sweeping from 0° to 180° to cover a wide detection area. The servo is actuated via PWM signals, generally through digital pin D9 on the Arduino. The HC-SR04 sensor operates by emitting ultrasonic pulses via its Trig pin and detecting echoes through its Echo pin. The Arduino computes object distances by measuring the time delay of the returned pulse. This data is either output through the serial monitor or visualized using software tools such as the Processing IDE to simulate a radar display. Power is supplied through the Arduino's 5V and GND pins, distributed via a breadboard for modular and solder less connections [10].

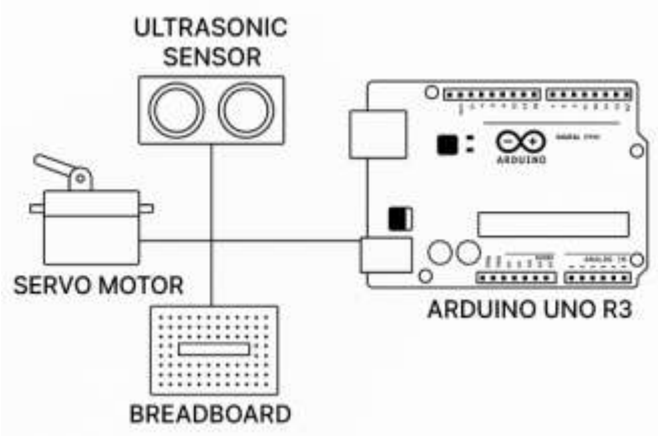

Fig 3.2: Radar System

The Radar System is developed for real-time environmental scanning and obstacle detection using ultrasonic sensing technology. It also utilizes the Arduino Uno R3 as its central controller. This system controls a servo motor to enable angular movement of the HC-SR04 ultrasonic sensor, typically sweeping from 0° to 180° to cover a wide detection area. The servo is actuated via PWM signals, generally through digital pin D9 on the Arduino. The HC-SR04 sensor operates by emitting ultrasonic pulses via its Trig pin and detecting echoes through its Echo pin. The Arduino computes object distances by measuring the time delay of the returned pulse. This data is either output through the serial monitor or visualized using software tools such as the Processing IDE to simulate a radar display. Power is supplied through the Arduino's 5V and GND pins, distributed via a breadboard for modular and solderless connections. The radar system is suitable for applications like robotics, autonomous navigation, and surveillance.

Table 3.1: Functional Comparison between Soldier Tracking and Radar Systems

Feature	Soldier Tracking with Health Monitoring	Radar-Based Object Detection System
Purpose	Monitors real-time location and health status of personnel	Detects and scans surrounding objects via ultrasonic sensing
Main Controller	Arduino Uno R3 (ATmega328)	Arduino Uno R3 with servo and ultrasonic control
Power Supply	Battery (5V) powering all modules including GSM, GPS, LCD, and LM35	5V supply via Arduino and breadboard
Sensor	LM35 temperature sensor	HC-SR04 ultrasonic sensor
Communication	GSM module (SIM900) with SMS and GPRS	Local data display; no remote communication
Tracking Capability	GPS module for location coordinates	Servo rotation (0°–180°) for area scanning
Visualization	LCD display for data	Radar-like interface via Processing IDE
Interfacing	5V logic level compatibility	Digital pins (D9 for servo, D7/D8 for HC-SR04)
Applications	Military, defence, health surveillance	Robotics, obstacle avoidance, surveillance

Table 3.2: Hardware and Software Specifications

Category	Parameter	Specification / Description
Hardware	Arduino Uno R3	Microcontroller board based on ATmega328P, 14 digital I/O, 6 analog inputs, 16 MHz clock
	Temperature Sensor	LM35 – Analog output, linear response (10 mV/°C), low power, accurate temperature monitoring
	GPS Module	Compatible module (e.g., NEO-6M) – receives satellite signals, outputs latitude and longitude
	GSM Modem	SIM900 module – quad-band, SMS and GPRS support, TTL interface compatible with Arduino
	LCD Display	16×2 character LCD – displays real-time temperature, status messages
	Ultrasonic Sensor	HC-SR04 – Measures distance using ultrasonic pulses (range: 2cm–400cm)
	Servo Motor	Standard servo (e.g., SG90) – rotational range 0° to 180°, controlled via PWM
	Battery	9V rechargeable or Li-ion battery pack – supplies power to the Arduino and modules
	Step-down Transformer	Converts higher voltage to 5V regulated output for Arduino and peripherals
Software	Arduino IDE	Used to write, compile, and upload code to Arduino Uno
	Processing 3	Visualization software to create radar-like UI and display distance data graphically

The system utilizes essential hardware components such as Arduino Uno, LM35 temperature sensor, GPS, GSM modem, ultrasonic sensor, servo motor, LCD display, and a step-down transformer, all powered by a battery. These modules enable real-time health monitoring, location tracking, and object detection. Software requirements include Arduino IDE for coding and Processing 3 for radar-like data visualization.

CIRCUIT DESIGN:

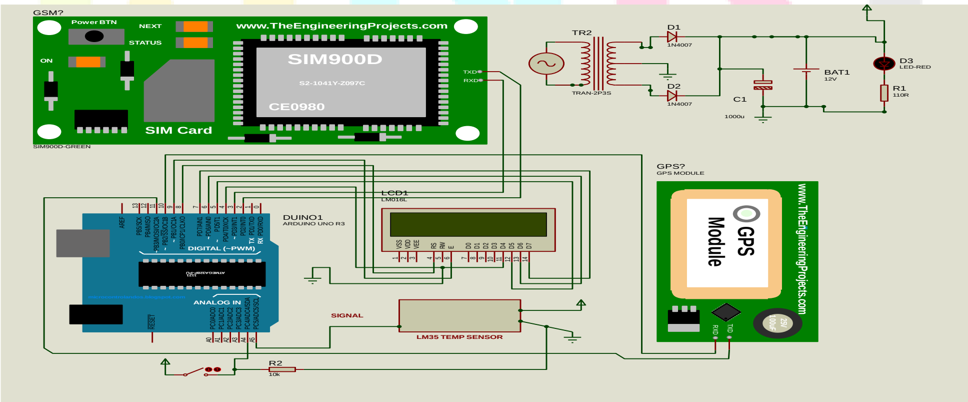

Fig 3.3: Working Procedure of Circuit Design

1. **Arduino Board :**

A blue board labeled "Arduino" is central to the system, acting as the main controller.It will process data from various sensors (not explicitly shown but implied for fault detection), control the display, and communicate with the GSM and GPS modules.Multiple wires are connected from the Arduino to the LCD and potentially to other components, indicating digital and/or analog I/O.

2. **GSM Module :**

   A green rectangular module labeled "SIM800 D" is visible at the top left.This is a common GSM/GPRS module used for cellular communication (sending SMS, making calls, or data transmission).It is likely connected to the Arduino for sending fault location alerts via SMS or data.

3. **GPS Module:**

   A green rectangular module labeled "GPS Module" is located on the right side.This module is responsible for obtaining the geographical coordinates (latitude and longitude) of the fault location.It will communicate with the Arduino to provide this location data.

4. **LCD Display:**

   A rectangular component with multiple pins connected to the Arduino is an LCD (Liquid Crystal Display).This display will likely show real-time information such as system status, fault presence, or even coordinates.

5. **Power Supply Circuit:**

   At the top right, there's a circuit involving a transformer, a bridge rectifier (likely diodes), capacitors, and a voltage regulator.This section is designed to step down AC voltage, rectify it to DC, and then regulate it to provide stable DC power to the various electronic components (Arduino, GSM, GPS, LCD).

6. **Switches and Resistors:**

   A push-button switch and a resistor are visible near the bottom left, connected to the Arduino. This could be a reset button, an input for manual triggering, or part of a sensor input.Other resistors are scattered throughout the circuit, used for current limiting, pull-up/pull-down configurations, or biasing.

RESULT AND DISCUSSION:

Fig 4.1: Model for Solider Tracking and Health Monitoring

Fig 4.2: Screenshot of SMS Received

The result of a soldier tracking and health monitoring system using Arduino, temperature sensor, GSM, GPS, LCD display, and a power supply is a compact, real-time safety and surveillance device designed to monitor the location and vital signs of soldiers in the field. The system continuously tracks the soldier's body temperature using a digital temperature sensor such as LM35 , and sends this data along with GPS location coordinates to a remote monitoring station via the GSM module. The GPS module provides accurate real-time latitude and longitude, enabling command centers to track the soldier's position. The GSM module transmits this data over mobile networks as SMS messages to a central server. An LCD screen is included in the system to display live temperature and location data locally, allowing the soldier to view their current status. Powered by a portable and stable power supply battery, the entire system functions autonomously in the field. The final outcome is a practical prototype that enhances soldier safety, enables real-time health and location monitoring, and provides critical data to military personnel for decision-making and emergency response [11].

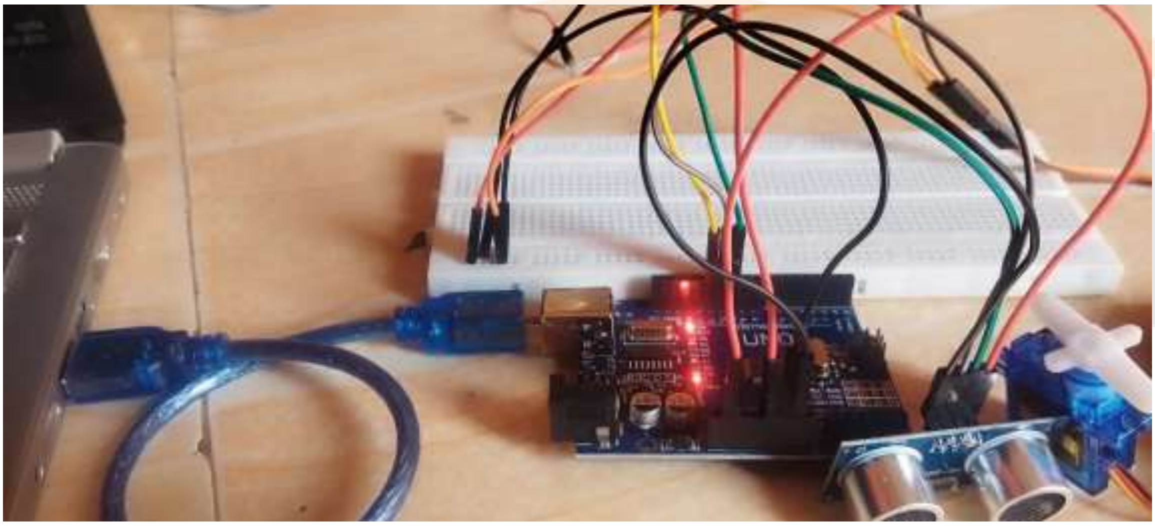

Fig 4.3: Radar System

Fig 4.4: Screenshot of Graphical Representation

A radar system built using a DC servo motor, an ultrasonic sensor, and an Arduino typically results in a simple yet effective object detection system that can scan its surroundings and identify nearby obstacles. The servo motor rotates the ultrasonic sensor across a defined range—commonly between 0° and 180°—allowing it to take distance measurements at various angles. At each position, the ultrasonic sensor emits a sound wave and measures the time it takes for the echo to return, calculating the distance to the nearest object. The Arduino processes this data in real time, recording both the angle of the sensor and the corresponding distance measurement. The result is a set of readings that map the environment in a semi-circular sweep. This data can be displayed in textual form via the Arduino serial monitor or visualized graphically using additional software like Processing or Python, simulating a radar screen where detected objects appear as blips. Overall, this system provides a foundational introduction to obstacle detection and environmental mapping, with applications in robotics, automation, and security systems.

CONCLUSION & FUTURE SCOPE:

CONCLUSION:

The soldier tracking and health monitoring system using Arduino, GPS, GSM, temperature sensor, LCD display, and power supply provides a reliable and cost-effective solution for real-time monitoring of soldiers in the field. By integrating location tracking and basic health data (such as body temperature), this system enhances situational awareness and safety, enabling quick response in emergencies or combat scenarios. The use of GSM communication allows remote data transmission to command centers, while the LCD display gives soldiers instant feedback on their condition. Although the system has limitations—such as limited sensor scope and dependency on network signals—it represents a significant step toward modernizing battlefield monitoring with accessible technology. With further development and the integration of additional sensors (e.g., heart rate, SpO_2), this system can become an even more comprehensive tool for military applications.

The radar system developed using a DC servo motor, ultrasonic sensor, and Arduino is a simple yet effective prototype for object detection and environmental scanning. It demonstrates how basic electronic components can be used to create a functional radar that detects obstacles by measuring distances at various angles. The rotating motion of the servo motor combined with the ultrasonic sensor enables the system to simulate a radar sweep, providing real-time spatial data. This data can be displayed textually or graphically to help visualize the surroundings. While the system has certain limitations—such as limited range, slower scanning speed, and 2D-only detection—it serves as a strong foundation for learning and prototyping in robotics, automation, and surveillance applications. With further enhancements, such as integrating more accurate sensors or faster processing units, the system can be expanded for more advanced real-world uses.

FUTURE SCOPE:

Future soldier tracking systems could integrate more health sensors (heart rate, SpO2) and use IoT-based communication (Wi-Fi, NB-IoT) with encryption, all within miniaturized, power-efficient wearables. For the Arduino-ultrasonic radar, future enhancements include adding a second servo for 3D mapping and upgrading to LiDAR or infrared sensors for improved range and accuracy. Wireless data transmission via Wi-Fi or Bluetooth to remote devices for real-time visualization is also a key improvement. Furthermore, integrating AI/machine learning could enable object classification and pattern detection, enhancing its utility in robotics and surveillance. Finally, using more powerful processing units like ESP32 or Raspberry Pi and dynamic scanning algorithms would significantly boost the radar system's performance and versatility.

REFERENCES

[1] C. V. Mahamuni, "A military surveillance system based on wireless sensor networks with extended coverage life," 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC), Jalgaon, India, 2016, pp. 375-381, doi: 10.1109/ICGTSPICC.2016.7955331.

[2] Lim, Hock Beng, Di Ma, Bang Wang, Zbigniew Kalbarczyk, Ravishankar K. Iyer, and Kenneth L. Watkin. "A soldie system for military applications." In 2010 International Conference on Body Sensor Networks, pp. 246-249. IEEE, 2010.

[3] Xiao, Julan, Junfeng Zhao, Fei Wu, Chengcheng Xie, Tao Chen, Hongli Liu, and Ying Chen. "Design of Ultrasonic Radar Detection System." In 2021 IEEE 15th International Conference on Electronic Measurement & Instruments (ICEMI), pp. 471-475. IEEE, 2021.

[4] Thakre, Laxman, Nayan Patil, Prashant Kapse, and Piyush Potbhare. "Implementation of soldier tracking and health monitoring system." In 2022 10th International Conference on Emerging Trends in Engineering and Technology-Signal and Information Processing (ICETET-SIP-22), pp. 01-05. IEEE, 2022.

[5] Khan, Ayub, and Dr Sabeenian RS. "Soldiers Health Monitoring and Position Tracking System." In Proceedings of the International Conference on Innovative Computing & Communication (ICICC). 2022.

[6] Khan, A., & RS, D. S. (2022, February). Soldiers Health Monitoring and Position Tracking System. In Proceedings of the International Conference on Innovative Computing & Communication (ICICC)

[7] Sakthi, P., T. Vishnuram, N. Satheeshkumar, and S. B. Sathishkumar. "IoT-based Real-Time System for Tracking and Monitoring the Health of Soldier." In 2023 Second International Conference on Electronics and Renewable Systems (ICEARS), pp. 531-536. IEEE, 2023.

[8] Rajeswari, Mummadi, J. Lingappa, Mulla Gouse Basha, Velagapuri Deepa, Vajrapu Sravani, and Kommidi Srilatha. "To Design and Implement a Radar System using Arduino and Ultrasonic Sensor." In 2023 2nd International Conference on Automation, Computing and Renewable Systems (ICACRS), pp. 208-212. IEEE, 2023.

[9] Bauder, Chandler J., Abdel-Kareem Moadi, Paul T. Theilmann, and Aly E. Fathy. "Development of a multi-functional remote health monitoring system." In 2023 International Microwave and Antenna Symposium (IMAS), pp. 103-106. IEEE, 2023.

[10] Nalla, Suresh, K. Rakshitha, K. Sai Kumar, and M. D. Samad. "Detection of Moving Objects with Ultrasonic Radar." In 2025 3rd International Conference on Intelligent Systems, Advanced Computing and Communication (ISACC), pp. 1251-1255. IEEE, 2025.

[11] Guledgudd, T., Noorullah Shariff, C. and Quadri, S.A., 2025. A comprehensive review: State of art integrated technologies in IoHT applications. African Journal of Science, Technology, Innovation and Development, 17(1), pp.32-55.