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REAL-TIME EMBEDDED LOCATION TRACKING AND HEALTH MONITORING SYSTEM FOR SOLDIERS

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ABSTRACT

The main objective of this project is to monitor the health conditions of a soldier, through which a soldier's heartbeat can be monitored. Temperature, humidity, and location through live video is also monitored at the control room. This technology can be helpful in providing accurate location information of missing soldiers in critical condition, overcoming the drawback of soldiers going missing in action.

In this project, the soldier's location can be tracked using the Global Positioning System (GPS), while health parameters such as pulse rate and temperature can be monitored. If a soldier is injured, fluctuations in their heartbeat and pulse rate will be measured, and that data will be transferred to the military base station. Through GPS, we can locate wounded soldiers and provide necessary medication to them at their location. Hence, it is possible to implement a low-cost mechanism to protect valuable human life on the battlefield. The major components used in this project are Arduino UNO, ESP32, DHT11 sensor and GPS.

Keywords: Heart beat monitoring, Location tracking, Global Positioning System (GPS), ESP32 camera module, Arduino UNO and DHT11 sensor.

I. Introduction

In the midst of wartime special operations, safeguarding the health and security of soldiers is a top priority. To meet this crucial objective, an integrated monitoring approach has been developed in this project. This cutting-edge system entails capturing vital health parameters, including heartbeat, utilizing GPS technology to track soldier's location, and monitoring environmental factors such as humidity and temperature. The collected data is meticulously processed and presented in both graphical and numerical formats via the Thingspeak website. Prompt responses from the control room are triggered in case of any anomalies in the soldier's data, which may include providing essential medication to injured soldiers. Real-time live video surveillance through web cameras and network scanner applications enables continuous observation and provision of backup support to soldiers.

Moreover, this system facilitates comprehensive soldier tracking, navigation, and monitoring of key parameters like speed, distance, and health status, which empowers military decision-makers to formulate effective warzone strategies. Leveraging GPS technology, the control room can pinpoint the location of soldiers and guide them along safe routes to mitigate the risk of them going missing in action. The system also employs advanced biological sensors

to monitor the health status of soldiers, while GPS modules track their precise location and movement. Collectively, this integrated monitoring approach provides critical data and support to ensure the safety and security of soldiers during wartime operations, thereby enhancing their well-being.

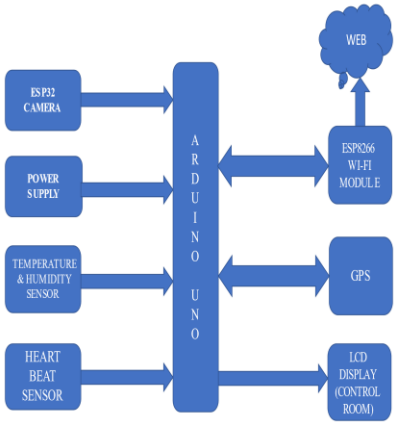

Figure. 1 Block Diagram

II. Existing system

In The existing system utilizes ESP32, Arduino, and Raspberry Pi microcontrollers for data transfer between soldiers and the base station. Zigbee and GSM are used for communication, and health and environmental parameters such as heart rate, body temperature, atmospheric temperature, and humidity are measured using analog-to-digital converters connected to Raspberry Pi. However, some of these devices are expensive and not fully utilized in their standard performance. Most of the existing systems lack location tracking and live video monitoring capabilities. Despite using GSM for communication, location tracking is limited or absent in many systems. Live video monitoring, which is crucial for remote surveillance and communication, is also not present in most systems.

To address these limitations, our proposed system integrates multiple sensors and functionalities into a single platform. This consolidation optimizes costs and improves efficiency. Advanced microcontrollers and communication modules are utilized to provide robust performance at a lower cost. Location tracking capabilities are integrated into the proposed system, allowing for real-time monitoring of soldiers' movement and location. This enhances situational awareness and enables better decision-making in the field. Live video monitoring is also incorporated, providing real-time visual feedback for improved assessment and communication among soldiers and with the base station. The proposed system aims to provide a comprehensive solution for monitoring and communication in military operations. It is designed to be scalable, customizable, and cost-effective, meeting the specific requirements of military operations while optimizing resource utilization.

III. Proposed System

As a proposed system, our solution builds upon the existing system by integrating all the sensors and functionalities into a single platform for enhanced performance and ease of use. The Arduino Uno continues to serve as the central interface to which all the sensors are connected, while the ESP32 camera module is utilized for live video monitoring. To improve the live video monitoring capabilities, we propose to integrate a more advanced ESP32 module with enhanced Wi-Fi capabilities for seamless video streaming. This will enable real-time observation of the soldier's surroundings, providing critical visual feedback for situational awareness. In addition to the existing health and environmental parameters, we propose to expand the sensor capabilities to include additional relevant data points such as blood oxygen levels, stress levels, and location tracking. This will provide a more comprehensive picture of the soldier's health and well-being, allowing for better monitoring and timely intervention, if needed.

To further enhance the data recording and visualization, we propose to utilize a more robust and scalable data logging platform, such as a cloud-based database. This will allow for efficient storage, retrieval, and analysis of the recorded data, with the ability to generate graphical representations with month, date, and time stamps for easy interpretation. In terms of location tracking, we propose to integrate a GPS module with higher accuracy and real-time tracking capabilities. This will enable precise tracking of the soldier's location, which can be displayed on a web-based map for easy visualization and monitoring by the base station. Overall, our proposed system aims to provide a more comprehensive and advanced solution for monitoring and communication in military operations. By integrating advanced sensors, enhanced video monitoring, and robust data logging capabilities, we aim to improve situational awareness, health monitoring, and communication between soldiers and the base station for more effective and efficient operations.

IV. Working

The embedded device is designed to be worn by a soldier for health and environmental monitoring, as well as location tracking. It includes sensors for measuring heart rate, temperature, and humidity, and utilizes GPS for real-time location tracking. Additionally, an ESP32 camera module enables live video monitoring of the soldier's surroundings. The device is connected to Wi-Fi via an Arduino-based controller coded for internet connectivity, and it is also connected to a network scanner application for live video viewing. The collected sensor data, including heartbeat, humidity, and temperature, along with the soldier's location, is displayed in graphical patterns on the ThingSpeak website for easy monitoring and analysis.

The major interface of the device is Arduino, while an ESP8266 module is used for Wi-Fi connectivity. The ESP32 camera module allows for capturing images and recording videos for live video monitoring through the network scanner application. Overall, the embedded device provides comprehensive monitoring of the soldier's health parameters, location, and surroundings through live video, with data displayed on the ThingSpeak website. It is a valuable tool for enhancing situational awareness and communication capabilities in military operations.

The flowchart clearly outlines the step-by-step operation of the device. Upon powering ON, the sensors begin reading data and sending it to the microcontroller at regular intervals. The microcontroller then displays the collected data on an LCD screen at the soldier's end. Simultaneously, the ESP32 camera module initiates live video monitoring, which is uploaded to a network scanner application with the assistance of the ESP8266 Wi-Fi module. The sensor outputs, including heartbeat, humidity, temperature, and location, can be observed and stored on the ThingSpeak website for further analysis and storage.

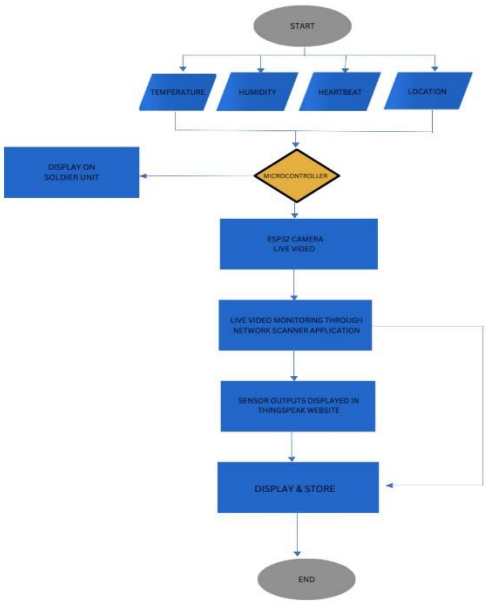

Figure 2 Flow chart of working

V. Implementation and results:

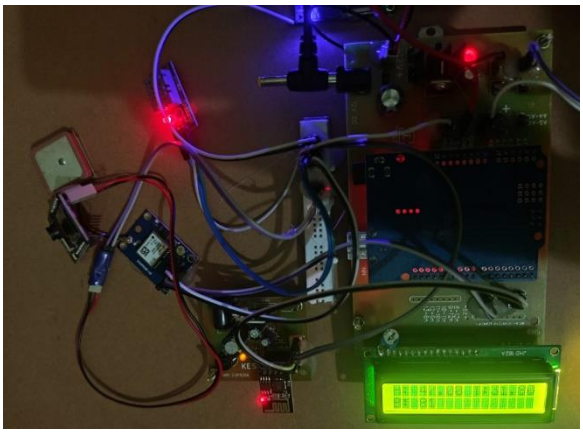

Figure 3. Outlook of the project

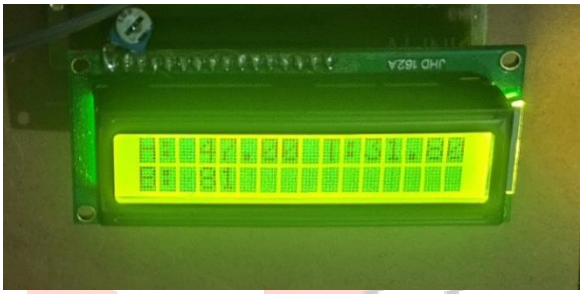

Figure 4. Sensor outputs on LCD

The sensor readings will be captured and displayed on the LCD. In the above figure 'H' represents humidity, 'T' represents temperature and 'B' represents heartbeat of the soldier. These values can be parallelly observed in Thingspeak website along with location of the soldier.

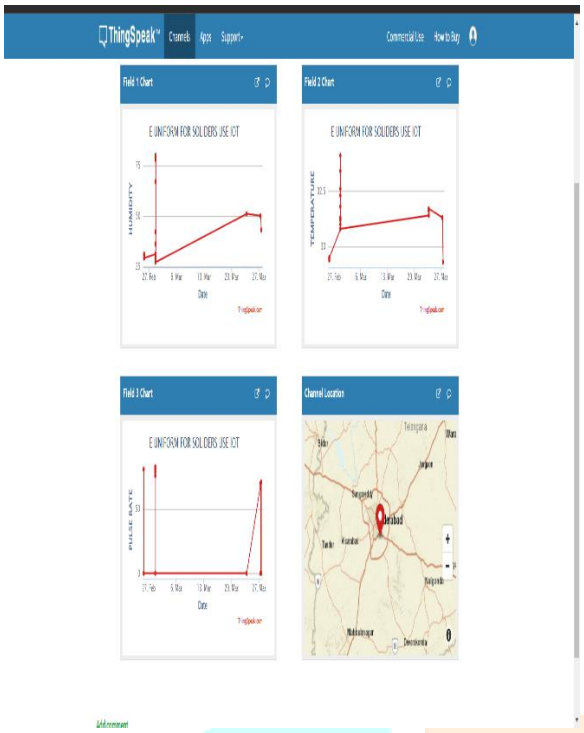

Figure 5. Sensor outputs in Thingspeak website

The above figure shows four different values recorded from the device, which are humidity, temperature, heartbeat and location of the soldier. It is represented in a graphical manner with date, time and month indicated in each section. By using this one can easily identify the health and environmental parameters around the soldier and can easily track his location through GPS.

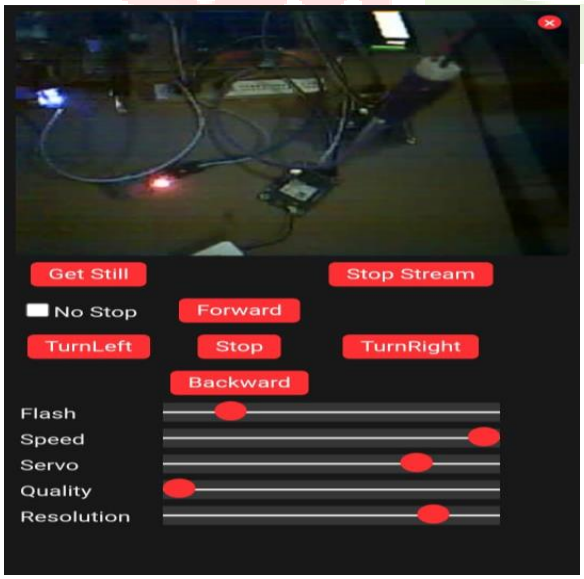

Figure 6. Live video monitoring

ESP32 camera module is used for live video monitoring of the soldier. This can be monitored with the help of network scanner application. The video captured by the camera at the soldier's end can be seen through this application at the same time. The camera module can also be controlled through this application, the flash can be turned ON and OFF whenever required while monitoring through this application. Quality, Speed and resolution can also be adjusted in this application, by which one can monitor every moment of the soldier and give necessary support or guidelines.

Advantages:

- This system gives accurate location of the soldier.
- Perfect health condition can be recorded time to time.
- Necessary medical precautions can be provided by resulting data.
- By using camera fall back or backup can be provided to soldiers.

Disadvantages:

- As this system needs internet connectivity it is difficult in few areas where there is less signal coverage.
- Supply power is required for functioning which may not be available all the time even when solar panels are used.

Applications:

- Used to know the heartbeat and body temperature.
- Used to find the location of an individual.
- Used to know the humidity around a person.
- Used to track and record the data through live video.

VI. Conclusion

In conclusion, the integration of this innovative device with IoT technology has the potential to offer significant benefits for monitoring the health and tracking the location of soldiers. The proposed project encompasses a wide range of features, including real-time calculation of humidity and temperature in the soldier's surroundings, as well as live video monitoring via an esp32 camera module. This device combines hardware and software components to create a sophisticated system that enhances soldier safety and security. The power of IoT technology plays a pivotal role in this project, providing graphical representation of sensor readings that are easily understandable. With this system, the control room can obtain vital information about the distance and position of soldiers, enabling them to guide soldiers to split up or gather during wars or missions. This technology has immense potential to revolutionize how soldiers are monitored and managed in various operational scenarios.

VII. Future scope

There are exciting possibilities for future developments and applications of this system, including the incorporation of additional features. For instance, integrating a heater/cooler component into the device could help stabilize its temperature, ensuring accurate functionality even in extreme environmental conditions. Another valuable addition could be a messaging feature that allows the control room to send non-voice guidelines to soldiers through an LCD display on the device. This could be especially useful in situations where voice communication may not be feasible. Furthermore, the use of portable cellular towers in remote, terrestrial, hilly, and border locations with weak signals could greatly enhance communication capabilities. Satellite communication could also be explored as a more reliable option for uninterrupted communication. Additionally, establishing a solar-based power supply for the device could serve as a backup during power outages or when regular power sources are unavailable. These enhancements could significantly improve the system's capabilities and make it even more robust for soldier health monitoring, location tracking, and communication in challenging environments. The potential for further innovation and expansion of this system is promising and could pave the way for advanced applications.

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