A Smart Device For Soldiers Using IoT

Chaithanya J Umashankar[1], Kavya V[2], Shreya N Bhat[3],Soukhya Rajaram Hegde[4], Dr Pusphalatha S[5]
[5] Assistant professor, Dept of ISE
[2, 3, 4, 5]Dept of ISE
[1, 2, 3, 4, 5] DrAmbedkar Institute of Technology

Abstract- *Soldiers are the backbone to the security of the nation. It is necessary to improve the safety and security of a soldier. Soldiers have to face different climatic environments, and need to face different emergencies 24/7. With various advancements in technology, wearable sensors have developed for monitoring various health parameters of the soldier. The soldiers may face difficulty in border surveillance all day or in the night and there may not be proper communication between the soldiers and the control unit during various emergency scenarios. Taking all these things into consideration, here it is aimed to design an advanced smart wearable device for soldier safety that is enabled with GPS (Global Positioning System),and various advanced sensors to determine the state of the soldier during an emergency and to maintain live communication between soldiers and a base station.*

Keywords- Smart device for soldiers, IOT, Military device

I. INTRODUCTION

The primary objective of this project is to design and implement an IoT device tailored specifically for soldiers focusing on enhancing their safety and security during military operations. The proposed system consists of two essential units: the Responder and the Initiator. The Responder unit integrated into a soldier's body arm transmits a status message indicating the soldier's presence. Simultaneously the soldier carries an Initiator unit stationed at the army base which detects and analyzes images of soldiers. Leveraging the high accuracy and non intrusiveness of face recognition the Initiator unit verifies and identifies the soldiers in real time.
The Responder unit serves as a compact and intelligent device deployed on a soldier's body arm. It employs various sensors and communication technologies to continuously monitor vital parameters and relay critical information. This data includes the soldier's status ensuring timely updates regarding their wellbeing and location. Meanwhile the Initiator unit stationed at the army base functions as a central hub for monitoring and control. Utilizing advanced image processing techniques it swiftly detects and analyzes images of soldiers within its range. By employing robust face recognition algorithms the Initiator unit accurately verifies the identity of soldiers by matching their faces against an extensive database of authorized personnel.

1.1 Problem statement

In military operations, there is a critical need for a smart wearable device that utilizes IOT technologies to enhance the effectiveness and safety of soldiers. The current equipment and systems lack comprehensive monitoring and communication capabilities resulting in limited situational awareness, delayed response times, and increased risks for soldiers in the field. Existing devices often lack seamless integration with IOT networks, hindering real time tracking of soldiers, vital signs location, and environmental conditions. Therefore, there is an urgent requirement to develop a smart wearable device that harnesses the power of IOT to enable continuous monitoring, efficient communication and data driven decision making, ultimately ensuring the well-being and operational success of soldiers in dynamic and challenging environments.

1.2 Objective

The purpose is to develop equipment for monitoring the pulse rate, metal detection, face recognition, and tracking the position of a soldier. This monitoring system is intended to provide continuous information about the soldiers to the personnel stationed at the base camp. The soldier's position will be transmitted to the base camp using a GPS module. Moreover, an added functionality includes an emergency switch that enables the soldier to request assistance by sending a distress signal to the military if they find themselves in a dangerous situation. Pulse sensors and metal sensors will also contribute to some added features.

II. LITERATURE SURVEY

[1]The primary focus of the paper is to propose a comprehensive system that not only continuously monitors the health parameters of soldiers, such as pulse rate and body temperature, but also incorporates advanced bullet detection technology to enhance their safety and survivability in combat situations. By integrating health monitoring capabilities into the vest, the paper aims to enable real time tracking and

analysis of vital signs, providing valuable information to both the soldiers and medical personnel at the base camp. This data can help in early detection of any health anomalies or injuries, allowing for prompt medical intervention and potentially saving lives. Additionally, the vest incorporates bullet detection technology, which enhances soldier safety by alerting them to the presence and direction of incoming bullets. This feature can provide critical seconds for soldiers to take evasive actions, seek cover, or respond effectively to potential threats.

[2]The authors have proposed a Soldier Health and Position Tracking System using Barometric pressure sensor, GPS, GSM and WBASNs (heartbeat sensor, temperature sensor). Microcontroller ATmega328p has been used for their prototype. Simple conditional statements have been used to identify the health of the soldier without any machine learning or training. GSM has been used as the means of communication which will not be useful at places with high altitude where network connectivity would be a big challenge. A message is sent after regular intervals containing the health status of the soldier using GSM. Overall, the main objective of the paper is to propose and develop an advanced tracking and health monitoring system for soldiers that combines GPS and GSM technologies. The system aims to enhance the situational awareness of military personnel, improve response times in emergency situations, and ensure the well being and safety of soldiers in the field.

III. METHODOLOGY

Face recognition: Face recognition is the process of identifying or verifying a person's identity using their face. In the military environment, it can be used for authorization purposes, so that only an authorized person can enter the military zone.

Support Vector Machines: SVM is a popular supervised learning algorithm used for classification and regression tasks in machine learning. SVMs are effective in solving both linearly separable and non linearly separable problems.

SVMs aim to find the best possible decision boundary (hyper plane) that separates data points belonging to different classes. The goal is to maximize the margin between the decision boundary and the nearest data points of each class.

Margin and Support Vectors: The margin is the distance between the decision boundary and the support vectors. Support vectors are the data points closest to the decision boundary and play a crucial role in defining the boundary. SVMs are highly dependent on support vectors and only rely on a subset of the training data.

Multi Class Classification: SVMs are inherently binary classifiers, meaning they can only separate two classes at a time. However, several strategies can be used to extend SVMs to handle multi class classification problems, such as one vs. one and one vs. rest approaches.

Robustness to Outliers: SVMs are generally robust to outliers due to the focus on maximizing the margin. Outliers have little effect on the decision boundary as long as they do not cross the margin.

IV. SYSTEM ARCHITECTURE

4.1 Implementation of Initiator module:

The block diagram of the initiator module is shown in Figure 4.1. It consists of power supply, micro controller, DC motor, image process MATLAB , LCD display. Face of the person can be captured using a webcam. MATLAB is used for image processing. If the face matches with the one in the database the gate of the base station opens else the buzzer goes off. Hence only an authorized person can enter the base station and the gate closes as soon as the person enters.

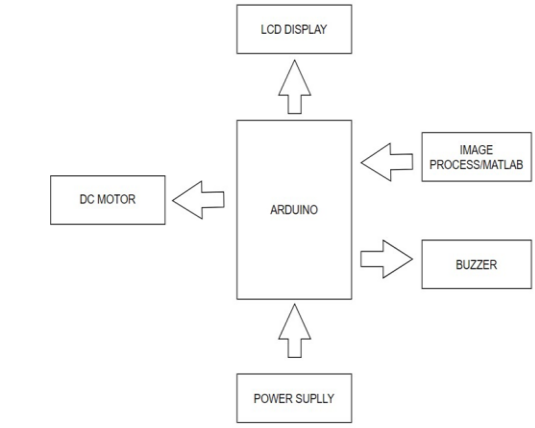

Figure 4.1 Block diagram of initiator module

4.2 Implementation of Responder module:

The block diagram of the responder module is shown in Figure 4.2. It consists of a power supply, GPS modem, metal detector, switch, micro controller, LCD display, wifi, pulse detector, keypad, server, web application.

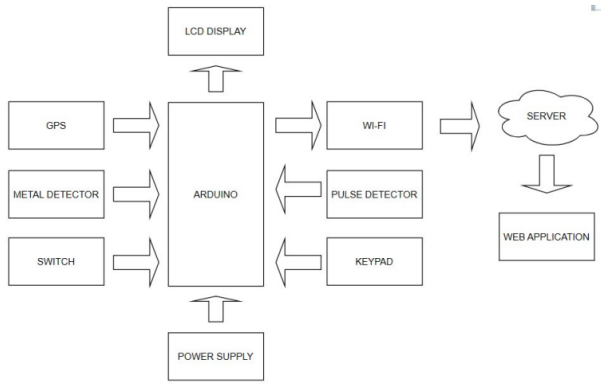

Figure 4.2 Block diagram of responder module

This Arduino Uno is powered through an external power supply. In this Arduino Uno acts as CPU. LCD display, emergency switch, wifi module, metal sensor, pulse sensor and Global positioning System are connected to Arduino and the readings from these are received by Arduino. An emergency button is there for sending emergency signals to the base station with location information.

The kit needs to be activated using the password. When the soldier enters the password using the keypad, the kit gets activated and the same message is shown on the display. If the entered password is incorrect, the kit cannot be activated.

The pulse sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body. Pulse sensors are placed either on the finger or the earlobe of the soldier. This tells us about the pulse rate of the soldier which is equal to heartbeat. So monitoring pulse rate is crucial in context of his/her health status. The BPM value will be displayed on the LCD so that the soldier can monitor his heart's status in real time.

The metal sensor is based on the principle of electromagnetic induction. It senses metals and sends messages to the arduino. The message is displayed on the LCD display.

GPS is a satellite navigation system that gets location and time information in all climatic conditions to the user. The GPS modem sends the latitude and longitude position with a link pattern so that the members at the base station can track the current position of the soldier.

LCD display is a very basic module and it is for displaying different messages to the soldier. An emergency button is there for sending emergency signals to the base station with location information.

4.3 Flowchart of face recognition module

The figure 4.3 shows the flowchart diagram of face recognition module. Face of the person can be captured using a webcam. If the face matches with the one in the database the gate of the base station opens else the buzzer goes off. Hence only an authorized person can enter the base station and the gate closes as soon as the person enters.

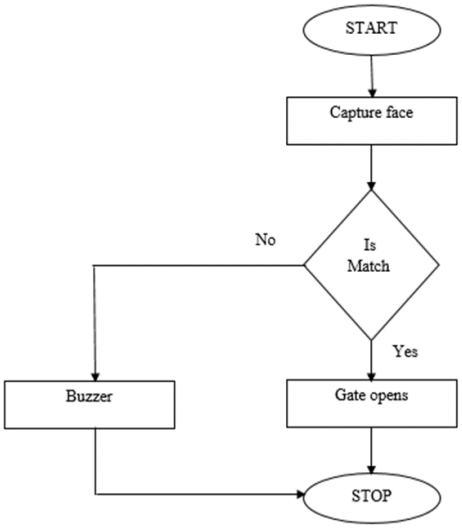

Figure 4.3 Flowchart of face recognition module

4.4 Flowchart of GPS and Emergency switch:

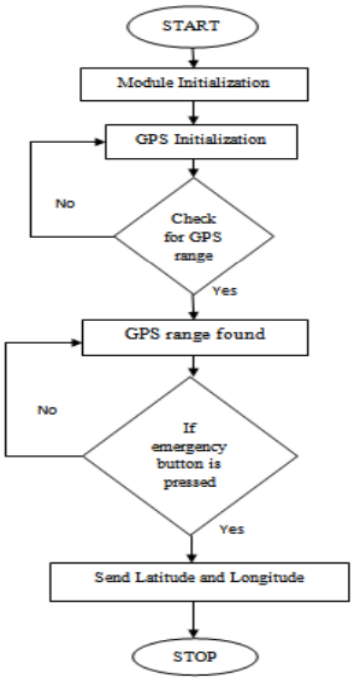

Figure 4.4 Flowchart of GPS and emergency switch

Figure 4.4 depicts the other flow chart of the project which starts with Module initialization in turn followed by the GPS initialization where GPS is based on trilateration mathematical principle. The GPS receiver takes the information from the satellite and uses the method of triangulation to determine the exact position after this GPS initialization it checks for the GPS range, if at all the range is found then latitude longitude will be displayed that is GPS receivers gives the quality of satellite geometry in terms of horizontal and vertical measurements which includes latitude, longitude.

4.5 Flowchart of sensors

The figure 4.5 depicts the flowchart of sensors. When the thumb or the index finger is placed on the pulse sensor it will sense the pulse rate and status of the soldier will be displayed on the LCD. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor heart beat as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflected by the blood, this minor change in received light is analyzed over time to determine our heart beats. If the pulse rate stops then the kit goes to sleep mode. The metal senses metal and sends notification if any metal is detected.

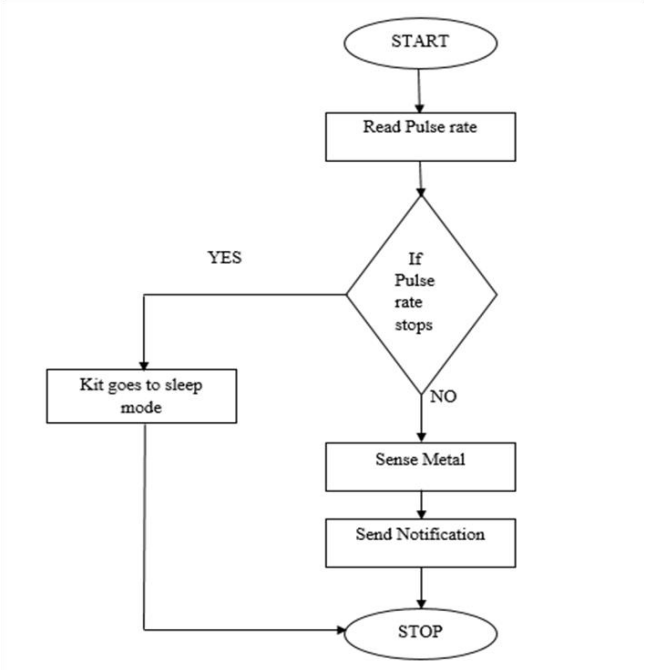

Figure 4.5 Flowchart of sensors

V. IMPLEMENTATION

The figure 5.1 shows the circuit diagram of the responder module. RS, EN, D4, D5, D6, D7 pins of the LCD are connected to A0, A1, A2, A3, A4, A5 pins of the arduino respectively. Emergency switch is connected to the fourth pin. Metal sensor is connected to the third pin of the arduino. The pulse sensor is connected to the second pin. C1,C2,C3,C4 and R1,R2,R3,R4 pins of the 4X4 keypad are connected to 6,7,8,9,10,11,12,13 pins of the arduino respectively. Tx and Qx are connected to the wifi module. GPS module is connected to pin number zero of the arduino.

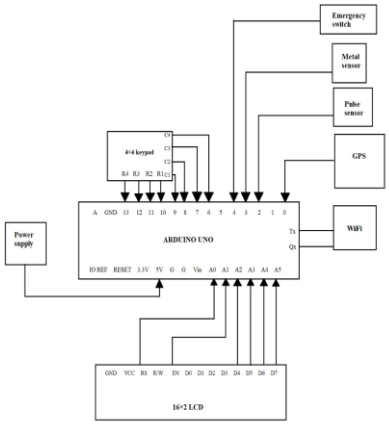

Figure 5.1 Hardware implementation of Responder module

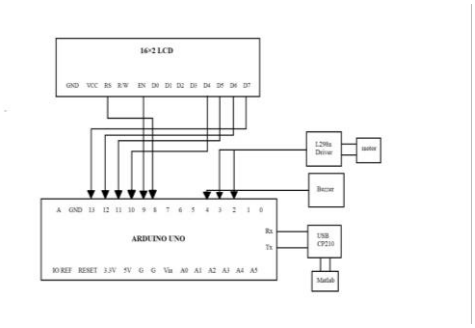

Figure 5.2 Hardware Implementation for face recognition

The figure 5.2 shows the circuit diagram of the initiator module.It consists of LCD, buzzer, L298 driver and USB CP210 interfaced to the arduino. RS, EN, D4,D5,D6,D7 pins of the LCD are connected to the 8,9,10,11,12,13 pins of the arduino UNO respectively. The fourth pin of the arduino is connected to the buzzer. The second and third pins of the arduino are connected to the L298 driver which is in turn connected to the motor. The four different combinations of the output of 2 and 3 pins are 00,01,10 and 11. These four combinations respectively refer to stop, clockwise, anti clockwise and stop which are the moving directions of the gate. Rx and Tx pins of the arduino are connected to USB CP210 which is used to connect matlab to the device.

VI. CONCLUSION

As intended, the system is designed to solve the problem of missing soldiers by tracking their accurate location and informing the base station to take necessary actions. The system takes into account the parameters such as pulse rate and metal sensors to meticulously monitor the health of the soldiers in sync with the location to take the possible steps. In case of emergency, an emergency switch is provided to explicitly alert about the situation. Upon pressing the switch, a message is sent to the base station for further actions. Face recognition module helps to authenticate the soldier that enters the base station. Thus the original intention of the project is achieved by making use of machine learning models for face recognition, GPS module and sensors such as Metal sensor and Pulse sensor which are used for sensing metal and pulse rate respectively. The project is efficient to solve the problem at hand.

VII. FUTURE SCOPE

Using Artificial Intelligence to smartly monitor health status, using a long range and cryptographically secure channel to communicate the sensitive data to the base station.Enhanced connectivity through advanced wireless technologies like 5G and beyond. Advanced health monitoring and biometrics for proactive health management.Robust cyber security measures to protect sensitive information and prevent cyber threats.

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