

Real Time Situational Awareness System (RTSAS)



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ABSTRACT

Our undertaking goes for making Real Time Situational Awareness System (RTSAS) for administrators inside the field. Armed force being a basic piece of any country's security framework. Amid, wars and hunt tasks officers get injured and a lot of them wind up lost. Fighter's wellbeing is exceptionally fundamental just like the friend in need of our nation which shield country from adversary assaults, fear monger exercises and from a few suspicious exercises which may hurt a gathering of individuals and our country as well. This task gives an ability to track the circumstance of troops including their position and screen the wellbeing of the fighters continuously who have turned out to be injured or lost amid activities in the fight ground. It diminishes the ideal opportunity for seek activity and endeavors of Army checking unit. RTSAS licenses Army checking unit in observing the circumstance and wellbeing of troops utilizing GPS module and different sensor systems, similar to temperature detecting module, heart beat detecting module, and so on. The data returning from sensors and GPS module is imparted remotely by RF handset. Besides an officer can likewise request assistance from observing unit and can caution other kindred trooper inside the scope of remote gathering and transmission.

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DEDICATION

We dedicate our work to the Martyred students of Army Public School (APS),
Peshawar (May their souls rest in Peace)

ACKNOWLEDGEMENTS

This project would not have been accomplished without Allah Almighty's will. We humbly thank Him for His blessings and giving us the wisdom, knowledge and understanding, without which we would not have been able to complete this thesis research work.

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We also thank our colleagues for helping us in designing the project and appreciate the individuals who have enthusiastically helped us with their capacities. Last but not the least; we are extremely appreciative to our parents and instructors, who held on for us during trouble and helped us conquering deterrents. Without their predictable help and consolation, we couldn't have achieved our objectives effectively.

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1. PROJECT DESCRIPTION

1.1 Introduction

Modern infantry soldier guarantees to be technically very advanced that network centric warfare will ever see. Around the Globe, numerous research and analysis programs are presently being conducted, like the USA's Future Force Warrior, with the goal of making totally integrated combat systems. Huge enhancements in weaponry and protective defensive subsystems, additional main feature of the RTSAS is its capability to offer information dominance at the operative edge of military systems by arming the infantry/SSG soldier with innovative communication means. Future gadgets will improve real time situational awareness, not only for the user, along with for Army Monitoring unit wirelessly. The task was to assimilate the modules in a compact and robust system that can accomplish the required outcome and not being excessively large and bulky or without utilizing more power resources for operation. One of the ultimate challenges in armed operations remains, that the soldiers are not able to connect and communicate with monitoring unit. Secondly the proper navigation between troops play significant role for careful preparation and synchronization. In RTSAS we are focused on tracking the position of soldier with GPS module, the knowledge of soldier's exact location is very useful for monitoring unit consequently they will guide them in further operation and evacuation as well. It include short-range, high-data rate, soldier-to monitoring room wireless RF module to communicate parameters on real time awareness, GPS positioning, and various sensors.

1.2 Problem Statement

Modern network centric combat is a significant element in any State's security in today's world. Armed forces of the country play this significant and dynamic role. Presently many worries regarding the protection and safety of the soldiers exist in the minds of the commanders. Whenever any troops leaves for battle field the it is very important for the army monitoring unit to know the position and health parameters of the men in the field .

Current difficulties which Army is facing right now are listed as:

- a. Troops want to communicate about their location but unable to do so.
- b. Troops are not track able.
- c. Soldiers will not get help during panic situation.

1.3 Proposed Objectives

In practical application the main objectives of our work is to:

- a. Design the hardware architecture of a system by using RF module to enhance the connectivity between troops and Army Monitoring unit by the use of highly efficient, advance and powerful modules.
- b. Use of GPS module will enable us to provide exact information about the position of troops when it is required.
- c. Soldiers will be able to get help in panic situations or when it is asked.
- d. System will enable monitoring unit to locate the soldiers at any instance.

1.4 Methodology

The design of the project planned by us consists two parts, one is army monitoring unit and other is compact and robust unit for soldiers. The soldiers unit comprises of an Arduino Microcontroller, GPS module, RF module, heart rate device, temperature device, buzzer, LCD etc. Global Positioning System module being used to acquire the position of the troops by the support of satellite tracking. Heart rate module being used for the heart beat sensing of user's heart and to sense the human body temperature, temperature sensor is used. All the sensed data is processed are communicated through a RF transceiver used receive to transmit and the parameters wirelessly. RF transceiver can be used for wireless connectivity that is required to communicate parameters for creating the awareness on real time situations during various military operations. So by the use of RTSAS we will try to make the enhanced life-protecting mechanism for troops using very small cost and providing higher reliability.

1.5 Organization of the Document

The document is divided into four main parts:

- a. First part introduces the project.
- b. Second part describes about background studies and projects related to this field, and how our developing project is better than existing designs.
- c. Third part is about design, specification and technical parameters.
- d. Final part is about references and bibliography.

2. Background Study

2.1 Existing Literature

a. Mountaineers Wrist Watch:

Initial idea for the project is visualized from the watch which mountaineers wear on their wrists now days while their expeditions. This wristwatch shows location, bearing, altitude, and also the surrounding temperature.

b. GPS Tracking with Radio Collars:

Recently in the United States and UK certain understudies were implemented to have a Radio Collar lashed with their lower legs, so their area can be followed by the authorities. We are building up a comparative framework which will show the fighter's constant area with the help of GPS coordinates at Army Monitoring Unit.

c. Trailing the Tigers:

India has pronounced policies to develop and implement system for locating the tiger for reducing the dependence wildlife officials and guard. New system includes usage of radio collars for tigers. A GSM device, and desktop software, will be used to trace the location of the tigers.

2.2 Different Existing Designs with Deficiencies

There are numerous advancements which offer capacity to track the area of fighters at any minute at wherever. The point of these tasks is to give medicinal checking to officers progressively. In these current advancements or frameworks, Bluetooth innovation, GSM innovation, and so forth to be intended for remote broadcast of location data and sensors information of warriors. There exist numerous weaknesses in these current frameworks. A portion of these current frameworks utilize GSM innovation to transmit information remotely. The utilization of GSM innovation is limited in war zone. Hacking of GSM's convention load can be effectively done by the expert programmer. In this way, it turns out to be simple for foes to get the data that is being transferred via GSM module. Subsequently due to country's security reason, we need to have our armed force monitoring room's

correspondences, data secret and private information safe from adversaries, hackers and programmers. Mobile phone networks will be jammed during the conflicts in the warzones by using mobile jammers.

At the point when the battle takes place in uneven territory, bumpy locale or in mountainous terrain at that point generally GSM innovation have no system access and it ended up futile for information transmission, which is an intense downside of GSM innovation.

2.3 Problem Formulation

Most of the work which has been already done on tracking systems use GSM technology in their designs which do not operate in war zones. We will be using RF module and Arduino to design the project with enhanced features of microprocessors for control. Mobile phone networks are not beneficial due to safety features, reliance will be on RF transceiver for connectivity. A RF module is a communication wireless device which is used to form WPANs which is made from low-power; compact digital transceivers. It is our aim to design a system that uses features of GPS to provide a faster and efficient solution for locating and rescuing of soldiers in hours of need.

3. PROPOSED DESIGN AND FEATURES

The proposed system will have following features which address deficiencies in existing designs:

- a. Provide more Safety and Security to Soldiers.
- b. Real time monitoring and Continuous tracking is possible.
- c. Low Power consumption.
- d. Any army/organization can utilize the implemented Compact, reliable and low budgeted system.
- e. Can be implemented/ suitable for all environmental conditions.
- f. Telemedical records of each soldier can be stored.
- g. Continuous communication is possible.
- h. Continuous data recording can provide the monitoring for different users.
- i. By the usage of modern technology and up-to-date equipment, RTSAS has the capability to meet the futuristic requirements of technology.
- j. Novel Design.

4. DETAILED DESIGN

The Design of system proposed consists of two units:

4.1 Soldiers Unit

Soldiers unit comprises of various sensor systems, for example, temperature sensor and heart beat sensor. Temperature sensor will detect the body temperature of officer and pass the detected information to Arduino. Heart rate sensor will detect the beat rate or heart pulsates of fighters in every moment (BPM) and transmits to the Arduino for further processing. The detected simple signs is changed over into advanced flags and afterward contrasted and the typical condition signals. What's more, if any disparity happens between detected flags and characterized typical signs, at that point it will be considered as a crisis.

GPS module is being utilized to follow the location of solders' at any instance from anyplace. GPS beneficiaries are space-based satellite route frameworks which give area and time data in every climate condition from anyplace on or close to the globe. The information originating from GPS beneficiary will be passed to Arduino. Every one of the information originating from sensors and GPS module will be prepared by Arduino Microcontroller.

Arduino is one of the major components in this system and is working as the brain of RTSAS. The utilization of the Arduino is to gather the information about position, body temperature and heartbeat of the soldier and then send this data to monitoring unit through RF module.

RF module is utilized to transfer the information, originating from GPS and sensors recipient through Arduino, to the checking unit remotely. A RF module is minimal effort, low power, remote work organizes standard particularly composed and created for extended battery lifetime gadgets in remote guiding and observing applications. RF gadgets have little dormancy that can additionally decrease normal current. Furthermore, an alphanumeric LCD is utilized to show the wellbeing parameters (i.e. body temperature and heartbeats) and area data of officer. Likewise, a ringer and a frenzy change are given. A warrior can press the frenzy change to request help in panic circumstance from observing unit and from another kindred trooper inside the

remote range. Signal of nearby kindred trooper will sound when freeze catch is squeezed by the officer in panic situation.

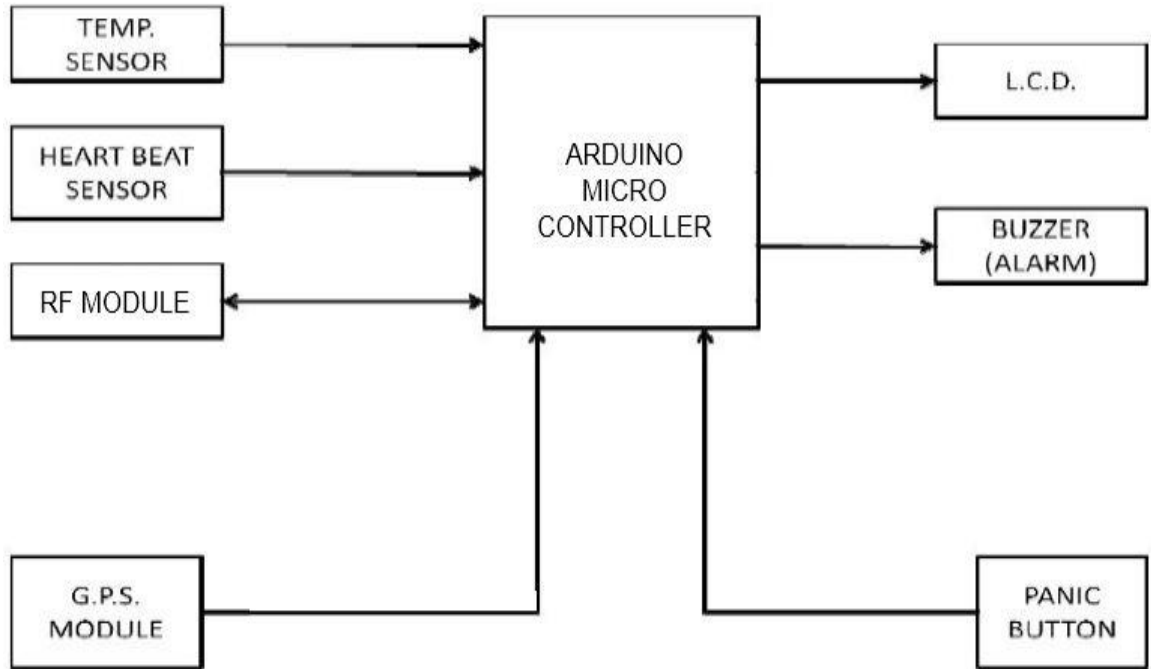


Figure 1 – Block Diagram Soldier`s Unit

4.2 Monitoring / Control Room`s Unit

The monitoring unit contains a PC/Laptop and a RF Module . RF transceiver will be associated with PC/Laptop by means of USB module of Arduino and then to Laptop`s USB port. The information originating from RF module will be shown on work area application on PC/Laptop with the assistance of Desktop application utilizing C Sharp language for its implementation.

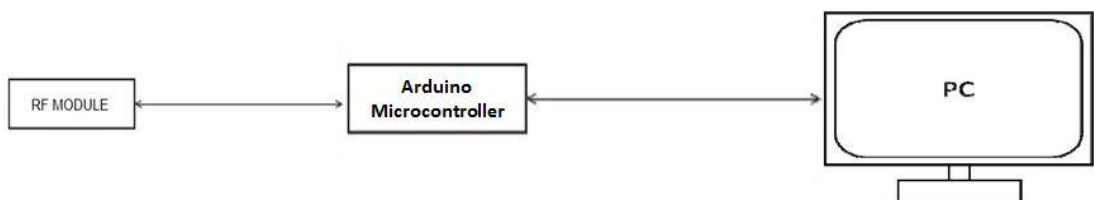


Figure 2 – Block Diagram Monitoring / Control Room`s Unit

4.3 Technical Specification / Hardware Description

The project consists of the following modules/components for hardware design:

4.3.1 Arduino Pro Mini

- a. ATmega328P based microcontroller board.
- b. Digital input-output pins are 14.
- c. Power output pins are 6.
- d. 6 analog pins for input.
- e. Quartz crystal of 16 MHz
- f. USB connection
- g. Power jack
- h. Button for Reset.

It's a complete package for a microcontroller, need is to connect it to a laptop/PC with a USB port or power it with battery or an AC-to-DC connector for its functioning.

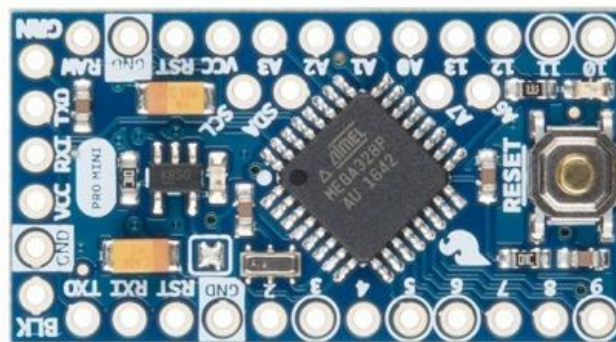


Figure 3 – Arduino Pro Mini

4.3.2 RF Module (Radio Telemetry 433 Mhz - 3DR)

It is a long-range wireless data transmission module, Radio telemetry permit your ground station PC to speak with your client unit (trooper, airplane, quad-rotor, ground robot) remotely, giving simple approach to survey constant information, changing missions on the utilization.

This radio telemetry is little size, light weight and have a correspondence scope of in excess of 2 km. The framework furnishes a full-duplex connection with firmware having open source. Connection is made to module is by use of

standardized FTDI 5V- TTL serial USB. Arrangement for additional changes through and AT commands.

Its features are:

- a. Size is very small
- b. Weight is very light without antenna it is less than 10 grams
- c. Frequency: 433 MHz
- d. -117 dBm is the sensitivity level of Receiver
- e. Power transmission can be up to 100mW equal to 20 dBm
- f. Serial-link is transparent
- g. Data-rate is up to 256kbps.
- h. Built-in error correcting code (can correct up to 25% data bit errors)
- i. Hundreds of meters range can be achieved with Omni directional antenna
- j. Open source firmware
- k. Voltage : 4.5 ~ 6.5 V

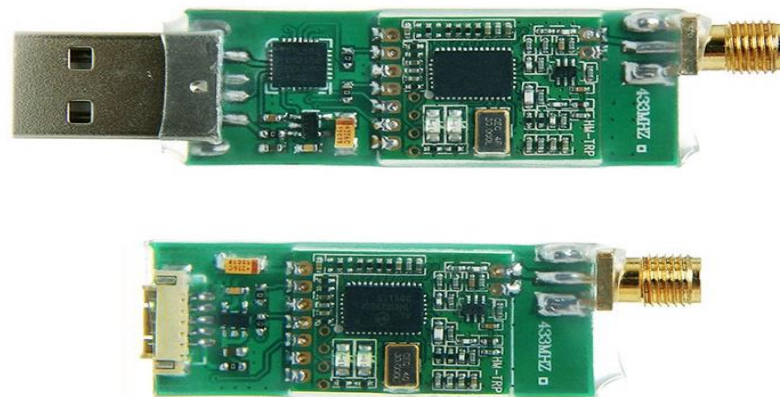


Figure 4 – RF Module (Radio Telemetry 433 Mhz -3DR)

4.3.3 SKM53 GPS module

The SkyNav SKM53 arrangement with implanted GPS receiving components empowers superior route in the most severe operations and strong fix even in unforgiving GPS reception circumstances. Its features are as follows:

- a. Sensitivity is very high : -165dBm

- b. 22 tracking / 66 acquisition channel Rx
- c. Protocols used are NEMA having 9600 bps as default speed
- d. Having backup battery internally available
- e. Having 1 serial port
- f. Patch antenna is embedded 18 x 18 x 4 mm
- g. Range of temperature for its operation is : - 35 to 80 °C
- h. Miniature form : 35 mm x 25 mm x 7.5 mm



Figure 5– GPS Module (SKM53)

4.3.4 One Wire Temperature Sensor

- a. It has water resistant test and long-wired form, appropriate for humid / wet temperature location. The chip inside this sensor is DS18B20 which is generally embraced.
- b. It requires only one wire for data interface
- c. Waterproof.
- d. 3.0-5.5V is accepted Power-supply.
- e. It has extensive operating temperature which ranges from: -50°C to +120°C.
- f. Higher Accuracy: $\pm 0.5^{\circ}\text{C}$ (-15°C to +80°C).
- g. The cable part cannot be put under temperature higher than 70°C for a



Figure 6– One Wire Temperature Sensor

4.3.5 IC LM358 Heart-Rate Sensor

- a. Heart-Rate Sensor being used consists of IC LM 358.
- b. Designing of Heart rate sensor is such that when it is placed on the artery it gives output of heart rate in digital form.
- c. Principle of working is by light modulation of blood flow through artery at every beat.
- d. It consists two low power operational amplifier one is a very bright red LED and second is light detector.
- e. One of them plays the role of amplifier and second is being utilized as comparator.
- f. LED requires being very bright for passing of light through artery and its detection on other end.
- g. When heart pumps a pulse of blood through blood arteries, and those becomes marginally more opaque so lesser light reaches to the detector.
- h. Through every heart beat detection signal changes and the change is transformed to electrical pulsation.



Figure 7 – Heart Beat Sensor (LM-358)

4.3.5 Other Components

- a. 16 X 2 LCD Display
- b. Buzzer
- c. Panic Button
- d. Power Supply / Battery
- e. Wires
- f. Resistors

4.4 Software Implementation

Software being the fundamental structure for the each framework that outlines the activities and handling of various programs. Following are the product's utilized as a part of outlining of the proposed framework. For programming of Arduino microcontroller, Arduino software is used. The Arduino Software has been intended to upgrade engineer's profitability, likewise empowering quicker and more effective program improvement. The Graphical user interface (GUI) coding is being done using C sharp language. C sharp is one of the programming dialects intended for the Common Language Infrastructure. The language is proposed for use in creating programming segments reasonable for organization in dispersed conditions. The frame work of C sharp will be used for making desktop application. To show the data user has received by RF module on servers PC the RF module is connected PC via USB port. For designing the schematic circuit diagram Proteus programming is utilized. This product is less perplexing, simple to learn and outlines circuit graph in proficient way.

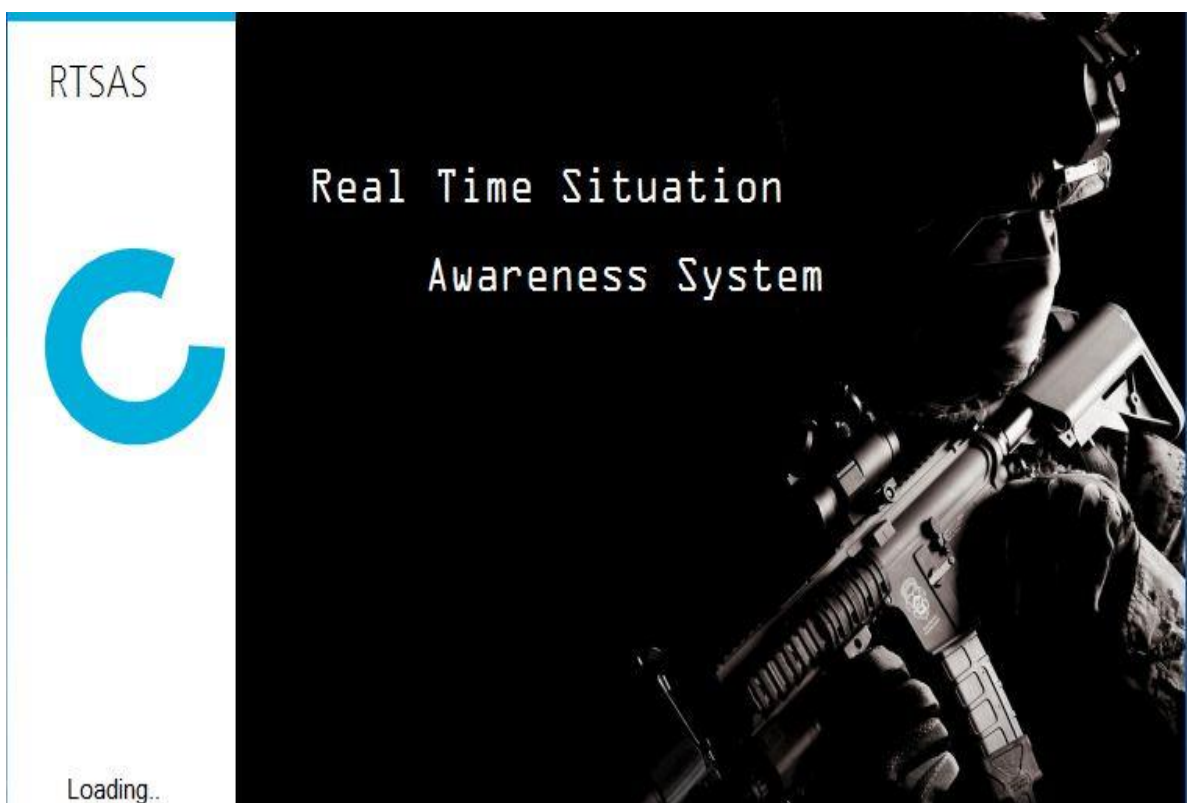


Figure 8– RTSAS

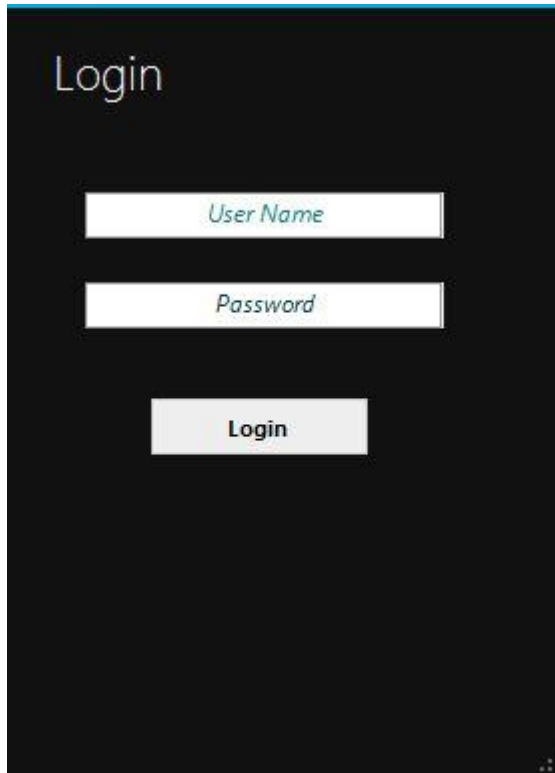


Figure 9 – Login Window

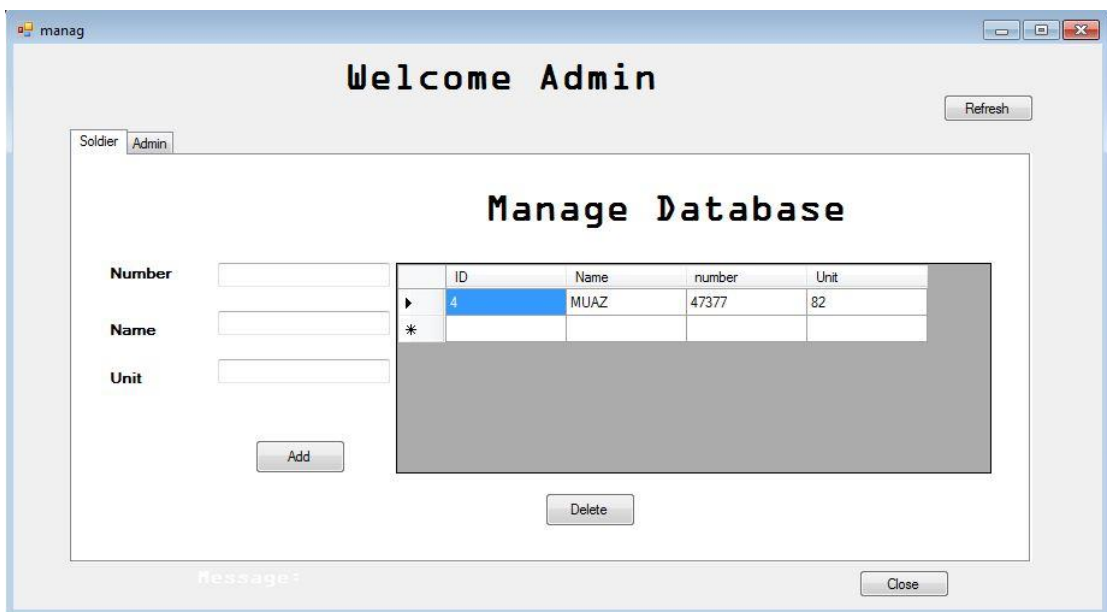


Figure 10 – Management Window

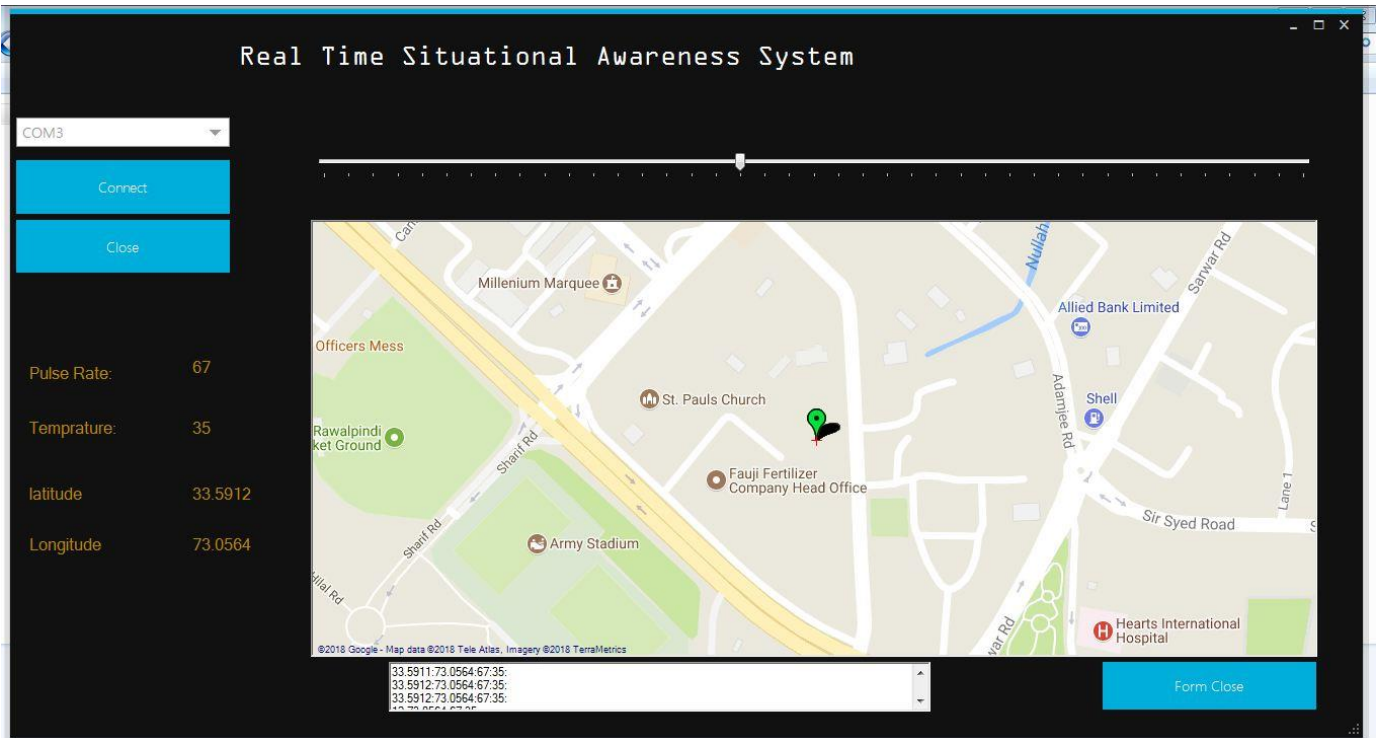


Figure 11 – Software Implementation

4.5 Flow Diagram

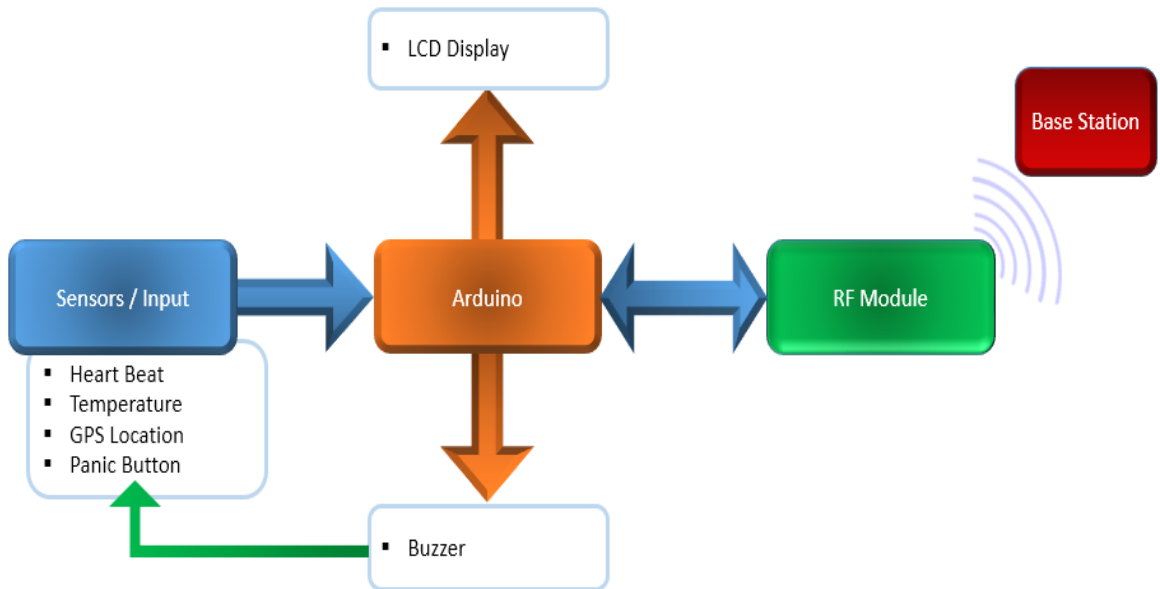


Figure 12 – Flow Diagram

4.6 Hardware Integration

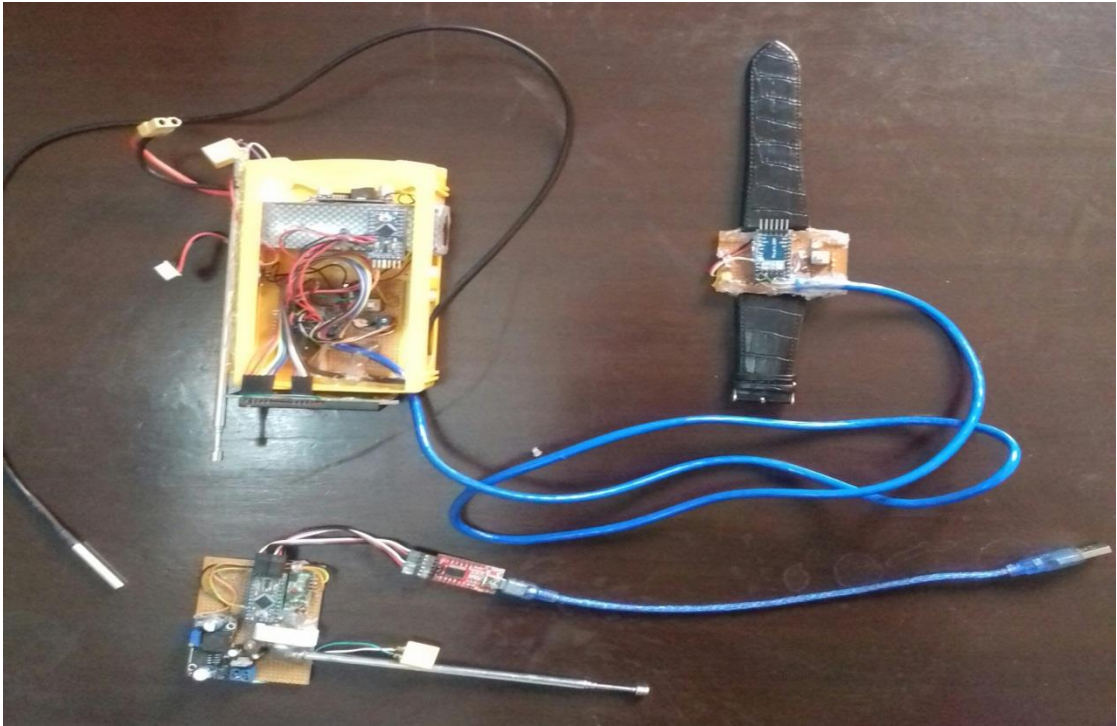


Figure 13 – Hardware Integration

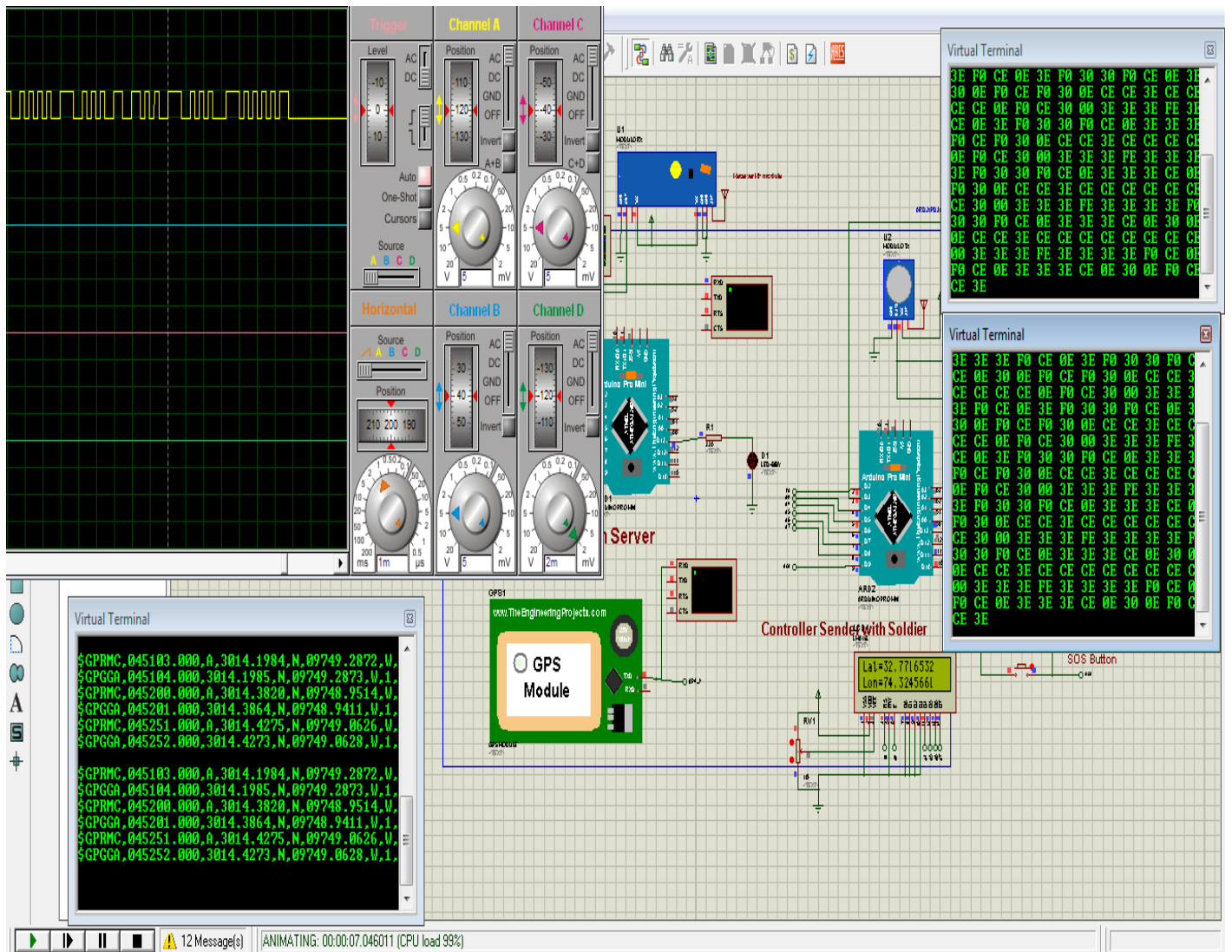


Figure 15 – Proteus Simulation Results

5. SEQUENCE OF EVENTS:

Project Timeline

Sequence	July - Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Literature Review	Yellow								
Simulation ,Programming,Designing	Light Yellow	Light Yellow	Dark Blue	Dark Blue	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Light Yellow
Hardware implementation	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Yellow	Yellow	Yellow	Light Yellow	Light Yellow
Optimizations And Testing	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Blue	Blue	Blue
Results and End product	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Light Yellow	Cyan	Cyan

KEY MILESTONES OF THE PROJECT

Week No	Work done during the week
Week 1 & 2	Basic understanding of Arduino Software
Week 3	Basic examples of coding like blinking of LED
Week 4	Basic understanding of C Sharp coding
Week 5 & 6	Hardware circuit designing on PROTEUS
Week 7 & 8	GPS Interface
Week 9 & 10	RF Module Interface
Week 11 & 12	Temperature Sensor & LCD interface
Week 13	Heartbeat Sensor interface
Week 14, 15 & 16	Final Hardware interfacing
Week 17 & 18	Desktop application development
Week 19 & 20	Troubleshooting of Google Maps integration
Week 21 & 22	Offline working of Google Maps
Week 23, 24 & 25	Interfacing application with Hardware
Week 26 & 27	Testing the complete Module
Week 28 & 29	Complete Thesis with Plagiarism removal
Week 30	Proofread of Thesis
Remaining Weeks	Final Testing of Project as hardware modules power backing

6. REFERENCES

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(PROJECT SYNOPSIS)

Real Time Situational Awareness System

Extended Title: Design and development of the Real Time Situational Awareness System for Soldiers in Battlefield

Brief Description of The Project / Thesis with Salient Specs:

Soldiers are very essential part of any nation's security system. During, wars and search operations soldiers get injured and many of them become lost. As, soldiers health is important because they are the savior of our country who protects us from enemy attacks, terrorist activities and from many suspicious activities which can harm us as well as our nation too. This project gives an ability to track the location and monitor health of the soldiers in real time who become lost and get injured in the battlefield. It helps to minimize the time, search and rescue operation efforts of army control unit. This system enables to army base monitoring station to track the location and monitor health of soldiers using GPS module and body area sensor networks, such as temperature sensor, heart beat sensor, etc. RF module can be used for High-speed, short-range, soldier-to-soldier wireless communications that will be required to relay information on situational awareness, tactical instructions, and covert surveillance related data during special operations reconnaissance and other missions .So by using these equipment we are trying to implement the basic life- guarding system for soldier in low cost and high reliability. Also, a soldier can ask for help from base monitoring station and can communicate with other fellow soldier present within the wireless transmission and reception range.

Scope of Work :

The project basically involves the design of hardware architecture of a system by using RF module to improve the communication between soldiers and Base Monitoring Station by using advance and highly efficient, powerful systems. By using GPS device, it will be possible to provide proper information about the location of soldiers when it is needed. It will become possible to help the soldiers in panic situations when it is asked. The final design will be tested and practically implemented for Real Time Battle Situation. The project will be completed by May 2018.

Academic Objectives :

The project will involve:

- Understanding and use of Arduino Microcontroller
- Understanding and use of Proteus Software
- Understanding and use of RF & GPS modules
- Understanding and use of C sharp language
- Understanding and use of various sensors

Application / End Goal Objectives :

The main goal of this project is to be able to transmit data which is sensed from remote soldier to Base Monitoring Station using RF Module transceiver as a wireless transmission technology with following objectives.

- The system will be completely integrated and can track the location of soldier at anytime from anywhere using GPS receiver module.
- This system will helps to monitor health parameters of soldier using heart beat sensor to measure heart beats and temperature sensor to measure body temperature of soldier.
- This system will helps the soldier to get help from army base station and/or from another fellow soldier in panic situation. This system provides the location information and health parameters of soldier in real time to the Base Monitoring Station.
- This system provides security and safety to our soldiers.

Previous Work Done on The Subject :

Following patents already exist on the subject :

- Ravindra B. Sathe, A. S. Bhide. 'GPS based soldier tracking system'. World Journal of Science and Technology, Issue 21, April 2012
- Dequincy A. Hyatt Tracking and monitoring system US 20120223834 A1 Sep 6, 2012

Material Resources Required :

RF Module, Arduino Controller, GPS module , Temperature Sensor , Heart Beat Sensor , LCD Display, Power supply

No of Students Required :4

Group Members: Capt Muaz Ashraf
Capt Ahsan Naveed Malik
Capt Fasih Ullah khan
Capt Muhammad Ali Amin

Special Skills Required :

Arduino - Software
Proteus - Software
C Sharp (C #) language