B.Sc. in Computer Science and Engineering Thesis

An IoT Based Troops Locating System for Military Operation

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CERTIFICATION

This thesis paper titled **”An IoT Based Troops Locating System for Military Operation”**,submitted by the group as mentioned below has been accepted as satisfactory in partial fulfillment of the requirements for the degree B.Sc. in Computer Science and Engineering in December 2017.

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CANDIDATES’ DECLARATION

This is to certify that the work presented in this thesis paper, titled, **”An IoT Based Troops Locating System for Military Operation”**,is the outcome of the investigation and research carried out by the following students under the supervision of Major Muhammad Nazrul Islam, PhD, Instructor Class-B, CSE Department, Military Institute of Science & Technology.

It is also declared that neither this thesis paper nor any part thereof has been submitted anywhere else for the award of any degree, diploma or other qualifications.

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ABSTRACT

Military is the most vital asset for any country where manpower is considered as most effective resource. The success of a military operation depends on careful planning, uninterrupted communication and conservation of the manpower till the last. In reality the operation commander does the planning and execute the operation as per the that plan. The operation commander can execute his planning properly if and only if he is conversant with the latest situation and location of his under command. From past several decades, with the use of technology, a numerous number of military system was developed to solve military related problem. We have been able to develop some systems to make our life easy and technology can also be helpful to solve military related problem. Our objective was to develop some ICT related system which will be able to solve some critical problem related to locating soldiers during military operation comparing to present practice system. Our developed system, **'LocSoldier'** aiming to provide soldiers locating service during military operation that consist of two devices one Master and multiple slave module, one central server and an android application. The slave modules are capable of sending their location to the master device using GPS and GSM technology. The Master device upload the data to the central server. Using an Android application the operational commander can see the location of every individual using database of central server. The system is also able to detect under commands active or inactive state using GYRO sensor. It is capable of tracking soldiers path for a duration of time period by using the database. This thesis discusses the development of the system **LocSoldier** , evaluate the system in various environment to find out its effectiveness in operation. In reality **LocSoldier** will continuously update the commander about overall situation and help him to take correct decision in critical situation which will lead to the ultimate success of operation.

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CHAPTER 1
INTRODUCTION

1.1 Preliminaries

In early 21th centuries the mechanical machine dominated every sector of human race. All research work and implementation were done basing on the physical machines. In mid of the centuries after the birth of semiconductor, Information Communication Technology (ICT) supersede mechanical theme and dominate the human race till now. Today ICT facilitate our life in a way that we cannot think a single aspect of our life without this. From the cookhouse to business, ground to space, agricultural ground to top research lab we are now dependent on technology.

Today researchers are trying to figure out the future development methodology. According to [1],[2]and[3] ICT conquer every sector of human race. [1] gives us an idea about the upcoming technology for human betterment and all these technologies are dependent on ICT. Ten Futurist Predictions in the World of Technology is discussed in [2], those also basically ICT.

As research shows us the dazzling future of ICT, human already adopted it in his lifestyle. Like all other sector military also use ICT. History says that the successful armies of the world used the best technology. From the beginning of this centuries US, Britain and other developed armies enjoy the blessing of technology for better success of military operation to safeguard the country and nation. Moreover, the future soldiering system will highly depend on the modern tools and techniques in Future [4]. Though maintaining an army with highly equipped technology demands a huge cost. But to remain updated with the developed army and meet the challenges of the present centuries it has become a crucial concern for the defense forces to adopt ICT.

By virtue of the nature military need to operate in own and enemy territory. Each assignment performs by a team demand a unique concern. As military is the most vital/critical asset so preservation of strength is important. The strength may be defined as the armament, manpower and effective use of manpower and resources. If the resources cannot be employed in correct time and in right place the overall operation may turn in to a failure. By effective use of ICT, we can establish uninterrupted voice and visual communication, can be updated about the recent development of situation which may help the commander to take right decision in right time.

1.2 Problem Statement

Military operation is very much risky and complicated job. History says that the most successful military operations are the one which is simple in terms of order and execution. In military we conduct many types of operations. Mainly this are major operation and minor operations. Both the types have its own nature and merit.

The major operations are conducted in a bigger aspect where the number of participants are more so as the effect of the operation. Here the number of casualty, planning, logistics requirements are also higher. Most importantly the duration of the major operation is much more longer than the minor one. Typically, these are named as Defense, Attack, Advance and Tactical re-deployment.

On the other hand, the minor operations are comparatively smaller is nature, so as the name is. The number of participants are less. The number of casualty, logistic requirement, planning all are smaller in scale. The duration is also for very short, compare to the major operations. Typically, this are known as RAID, AMBUSH, PATROLLING etc.

Whatever may be the name of the operation and type, the correct deployment of troops is of immense important. If any individual fail to correctly position himself or fail to complete the assign task to him may bring disaster for the whole team and may jeopardize the whole operation. So, it is of immense importance for the commander to ensure that all his man has correctly positioned themselves and perform their assigned task. Moreover, the commander has to take the right decision at the right time to where he has to launch his reserve. So, the commanders have to have a clear idea about the position of all his men and the overall progress of the battle. But history says that it is the most difficult part for the commander to remain updated and launch his reserve at the right time to the right place.

In both the type of military operation the commander assesses the ground for the type of operation he has to conduct. Then he goes for reconnaissance with the sub-commanders. After doing the reconnaissance he makes his plan, then he delivers the plan in front of the participants of the operation with the help of a model or sketch. Finally, the operation is launched.

It is difficult part for the under-command troops to exactly get the clear picture of the operational area as they did not visit the area physically. So, many a times they may go wrong as positioning themselves. At the immense pressure of the battle it may not be possible for the commander to visit each and every individual and give necessary correction. So, failure in proper positioning may cause a total failure in the operation.

At present the commander shows the position to the sub-group commanders, sub-group commanders are then responsible for the troops under his command. But situation may always arise when commander has to directly see the position and give correction to individual troops. But presently the commander does not have any tools to understand where an individual is exactly located other than voice communication which is mostly a complicated and erroneous one. In a big area, at night, without any conspicuous feature it is difficult for someone to make understand his position by voice communication. So, the commander badly need some device where he can see the location of every individual participating in a particular military operation. So that he can observe and give necessary correction.

Once the operation is over, before falling back from the operation site, the commander has to ensure the accountability of every individual soldiers. So that he can define the state of casualty and damage of the operation which is called All Correct Report in military terminology. So, while taking the all correct report if the commander find that someone is missing so the commander has to take decision whether he will be left or time will be wasted to search and rescue him. In that time if his location and physical state (dead/alive) of the soldier is known, it requires less time to rescue him and time is not wasted to find him. Or if the soldier is dead the decision making for the commander become easier as it is a morale factor for rest of the troops to leave an alive soldier unattended in the battle field. But presently the military commanders do not have any tools of such type.

1.3 Thesis Objective

The objective of this thesis is to develop a system which will be able to

1. Assist the commander to locate his troops during a military operation.
2. Determine the active/inactive state of a soldier
3. Assist the commander to find the location of any missing soldier onece the operation is over.

1.4 Overview of the System

Now a day the communication between man to man mainly depend on the mobile network which is easily available and less expensive. Wide coverage of mobile and satellite network offers us various useful application that make our life more purposeful. One of such application is Global Positioning System. The real-time position of a person or anything that carry the GPS module can be detected by this GPS system [6]. Basing on this feature we can track a persons movement or his current position.

At present system the GPS can give the location of the individual who carry the GPS module but location of others cannot be found by existing system. Again, the Global System for Mobile Communication (GSM) is widely used for various forms of communication. One of the communication feature is Short Message Service (SMS) where the user can send a massage to another in text form. Using this feature, we can easily can send the own location to other using the SMS.

We develop a System comprise of GSM and GPS technology where the individual location is detected by his GPS module and send the Longitude and Latitude to another by SMS using GSM technology. The system has an additional feature that is the status of the individual. Primarily The status indicates the active or inactive state of a person. The system uses GYRO Sensor to detect a movement of a person. The GYRO sensor can easily detect 1.452 degree of rotation without any error [7] which ultimately a very slight movement. The System use this feature to detect a persons status as an active person must have some movement until otherwise he is unconscious. The system has mainly two part the client and supervisor and the both part is connected by a central server.

The client part collects all the required information from the various sensors and convert it to data then send the data to server via SMS. The server regularly updates its database basing on received data. The supervisor gets the updated data from server using an android application. Moreover, the supervisor can easily track a selected person all movement basing one the server data.

1.5 Thesis Scope

In our thesis we are going to use the existing tools and make new integrated system to solve the above mentioned problems. Our thesis is confined targeting the military use only. Though we restrict the beneficiary group to be the military, but it can also be used for other general purpose if seems suitable. We mainly focused the military operations, especially the minor operation carried out by military. In minor operation the number of participants are less and accurate positioning of the every individual is very important. Moreover, in minor operation there is no separate group to find the casualty and the wounded soldiers and take care of them. There, time is very short and the commander has to take very quick decision. So he may not have the luxury of time to spent for searching some missing individual. In that situation this tools can aid the commander to take decision by showing the location and state of the missing person.

1.6 Organization of the Remaining Chapter

The thesis will describe the overall system with some breakdown where Chapter 2 will elaborately analyze background and related work on this sector. The chapter will highlight the present operating system in this sector and give a brief idea about the previous work done on same area.

Chapter 3 will discuss the systems design and development. In this chapter the conceptual design, various key features and development of the hardware and software will be discussed. The discussion of circuit design, required component, Algorithm development, database design and Android app development will be discussed under development of physical system.

Chapter 4 will provide a detail overview about the evaluation process, data collected during the evaluation and the analysis of the collected data.

Chapter 5 present the discussion and conclusion that includes overview of the main outcome, implication of the thesis, limitation of the thesis and direction for future research.

CHAPTER 2
BACKGROUND AND RELATED WORK

2.1 Introducing the Background Theory and Related Work

2.1.1 Existing Tools and Techniques

For identifying a persons location mostly there are two popular methods those are location via GSM and location via GPS technology. Here the GSM technology can give a location on a broader aspect but GPS can provide pin point location with a very less error. Both the technologies are briefly discussed in subsequent paras.

The radio mobile network is made up of a number of adjacent radio cells, each of which is characterized by an identifier consisting of four data: a progressive number (Cell ID), a code related to the area in which that given cell is (LAC, or Local Area Code), the code of national network to which the cell belongs (MCC, an acronym for Mobile Country Code), and finally the company code (MNC, or Mobile Network Code), which obviously identifies the phone company itself [16]. Now every mobile phone operator provides the network via Base Tower Station (BTS) at root level. Again, all the BTS are under a Main Tower Station (MTS). All the location of each BTS and MTS are pre-determined by the network provider. Now when a mobile is turned on it is registered with the network provider via BTS and MTS. All the data transfer is done through these BTS and MTS. So, the mobile need to be under at least one BTS to transfer data. By knowing the cell ID, the company of network provider can be identified and from the network provider it is very easy to find out the BTS of that mobile. As the location of BTS are pre-determined so the location of individual is the location of the adjacent BTS. The process is lengthy and costly thus this is a less used technology now a day.

The Global Positioning System (GPS) is a network of about 30 satellites orbiting the Earth at an altitude of 20,000 km. The system was originally developed by the US government for military navigation but now anyone with a GPS device, be it a SatNav, mobile phone or handheld GPS unit, can receive the radio signals that the satellites broadcast [17] [18]. The GPS does not require the user to transmit any data, and it operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS provides critical positioning capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS Receiver. A GPS unit takes radio signals from satellite in space in orbit around the Earth. There are about 30 satellites 20,200 kilometers (12,600 mi) above the Earth. The orbital period is 11 hours and 58 minutes. Each circle is 26,600 kilometers (16,500 mi) radius due to the Earth's radius. Far from the North Pole and South Pole, a GPS unit can receive signals from 6 to 12 satellites at once. Each satellite contains an atomic clock which is carefully set by North American Aerospace Defense Command (NORAD)[19] several times every day.

The radio signals contain very good time and position of the satellite, including its ephemeris The GPS receiver subtracts the current time from the time the signal was sent. The difference is how long ago the signal was sent. The time difference multiplied by the speed of light is the distance to the satellite. The GPS unit uses terminology to calculate where it is from each satellite's position and distance. Usually there must be at least four satellites to solve the geometric equations [18]. A GPS receiver can calculate its position many times in one second. A GPS receiver calculates its speed and direction by using its change in position and change in time. Many inexpensive consumer receivers are accurate to 20 meters (66 ft) almost anywhere on the Earth.

2.2 Overview of Present Military System and Practices

At present in our military we do not use any locating device for locating an individual. The GPS is used for navigation or finding out own position. If someone needs to know the location of others he has no means other than voice communication or physically visiting that place. Actually the commanders do not have any means to physically see the location of his every individual as the battle progress.

In a typical military operation, the commanders of all level physically visit the location of the operation area. For maintaining the safety and secrecy it is suggested to take as less possible number of men as possible. So only the commanders have a clear idea of the real ground of operation. Rest of the troops are briefed on a sketch or model. So it is most likely that the individual soldier will go wrong while positioning themselves. As the time is also very short so it may not be possible for the commander to visit individual soldiers location physically and give necessary correction. Only the person can confirm their location over voice communication using Portable Radio Communication (PRC). But in a bigger area of operation it is difficult for someone to understand his position by hearing over PRC.

In a typical military operation, a faulty position of single individual may cause the failure of the whole operation. Moreover, the life of that individual also may be in danger.

As the operation is progressing the commander may have to launch his reserve by seeing the overall progress of the battle. In this regard at present he does not have any assisting tools other that listening from the party commanders and physically observing. But a human cannot observe the whole area at a time. So if the commander can have an idea of overall number of active and inactive soldiers in a particular area he can have an assessment of the progress of the operation and where to launch his reserve. At present so such tools assist him in this regards.

After the operation before coming back from the operation area the commander has to take the report about the loss and accountability of every individual. If someone is missing the commander has to decide whether he is to be recovered or left behind. In that situation time is the most important factor. Time cannot be wasted to search someone. But if his location is not known things become easy. But presently there is no such device which can help to find the location of someone who is injured/dead or in a state that he cannot join the main group. This are the present drawbacks of military operations that are in practice.

2.2.1 A Scenario Based Present System

The figure 2.1 shows a vary typical scenario of a a minor operation in military.

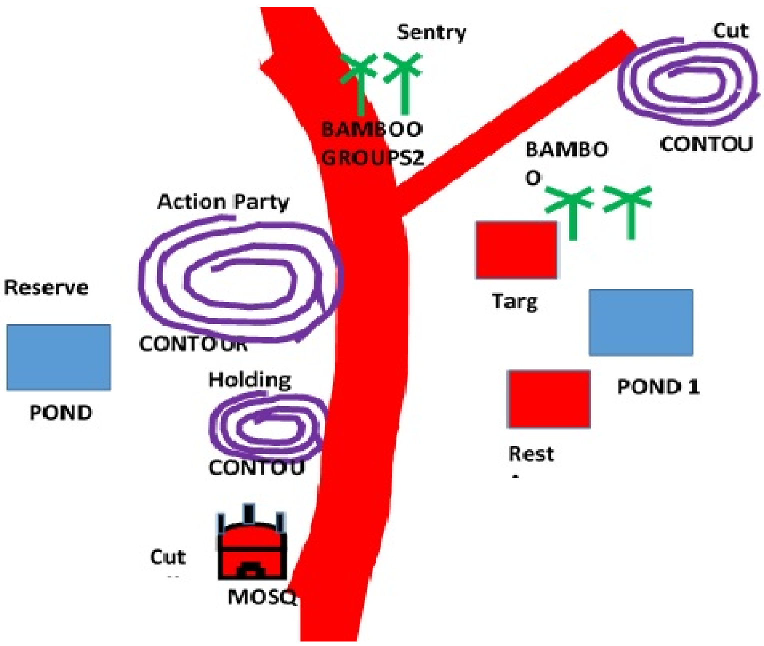

Figure 2.1: Ideal Layout of a Minor Operation

In the above model there in a Y-shaped route. Few land features in the model are mosque, three contours, two ponds, and two bamboo grooves. Two red rectangle represents enemy position.

Description of Various party

- **Action Party:**It is the Main action group. Commander himself located within this group.
- **Reserve Party:**Second in command is located here. They are here to aid any party who needs troops or support. Basing on the situation commander orders this group to merge with a group.
- **Holding Party:**This group is detailed to engage the troops of enemy and make them pinned down. Taking this advantage main/action party carry out their main task.
- **Cut off Party:**They are there to protect the area of operation from outside help. They prevent enemy reinforcement to come into aid. At a same time they block the exit route for the enemy and made sure no enemy gets in or out from the operation area.
- **Sentry Disposal:**They are there to take out the enemy sentries silently so that surprise is achieved. With their action the operation get started.

2.2.2 Problem of Present System

Our present system is sort of old fashioned. Where almost everything of the operation depends on commanders accuracy of brief and personnels skills. When operation started commander has less control over the changing situation. The problems can be sited as following:

- Commander along with all party commander perform recconisense before an operation. They go to the operation area and from a hideout examine the area. At a same time try to decide where to put/ deploy various parties.
- After returning from the recconisense Commander develop a plan and briefed the troops regarding the details of the operation to the troops and the party commanders.
- Basing on that during operation time troops take position.
- Commander can never be sure that they have taken position at his desired location.
- As he cannot monitor their movement he cannot able to give any correction. Which may not bring the desired result of the operation.
- After the operation he have to check the personnel physically. Which is time consuming.
- If anyone missing he has to search the whole area for finding wounded persons

2.2.3 Probable Solution of Present System

Prior developing out system at first we worked out to find the limitation of present system. Then we carried out detail studies and sorted out few probable solution. We want to make the operation smooth and fruitful one. Our probable solutions are as follow:

- During operation commander need to monitor live movement of troops. So that he can make sure troops are getting deployed in the accurate location.
- He need to monitor troops movement so that he can able to give required correction. Because getting deployed in the right location is very vital. Deviation from this may bring disaster for an operation.
- After the operation he need to check the location of all his personnel's. So he need a device which will help him in this regards. This device will show him the exact location of the troops. After re-organization if any one missing commander can carry out rescue operation in pin point location. He also need to determine who is dead and alive. Because alive troops gets most priority.

2.2.4 Previous Work in this Field

Vehicle Tracking

The paper[1] focuses on the use of the GPS system for the security purpose of the vehicle owners. Whenever any unauthorized person tries to gain access of the vehicle the sensor senses it and the signal is sent to the owner through GSM. The scope of the system[19] is limited to the use of microcontroller and GPS system for preventing vehicle theft. Whenever the actual user gets the message or signal of the unauthorized access, then the control is shifted to the microcontroller and owner can handle it. The system[19] uses GPS system to pin point where the vehicle is placed and the GSM network works in a way to send signal to the authorised user. When the authorized owner gets the control, the system developed[19] goes to sleeping mode. In other case the system goes to active mode. When any message is sent from the user to gain the access the engine motor stops. For restarting, user needs passwords that work as security concern. Hence the system[1] developed has used GPS,GSM module, MCU as a relay circuit. The user gets the SMS from the system implemented in the vehicle and responds through SMS. By putting the longitude and latitude, the user can view the location on the Google map. The second system[2] about vehicle tracking works on the same field as the first one but has some added features. This system[20] is more cheaper compared to others. The system[20] will continuously monitor and give the data about the vehicle position and other related data in real time. Here[20] the microcontroller used is an AT89C51 which is interfaced serially with a GPS receiver. When the user sends request to the system through GSM, the GSM sends data to the requested mobile number. For the security concern police can monitor the log of the stolen vehicle and point out where the vehicle is. The system[20] works in real time to view where the vehicle is currently positioned. The microcontroller works in a way that it responds through SMS whenever it gets stimulated by the user signal.The system can also be used as asset tracking to trace the asset for safety issue and also for wildlife tracking for research purpose. This system can also be used as route finding and monitoring path log for the security concern in case of finding exact location or for police purpose. The system is not concerned about the power issue. As the system[20] is focused on to be less expensive, alternate way of power consumption should be thought of regarding huge power is needed for the microcontroller and the vehicle engine can provide some of that. The system is mainly designed for two wheelers so it will be difficult for the system to manage power efficiently. Another system[21] which also focuses on the vehicle tracking in real time works in the procedure where the GPS receiver is integrated by the microcontroller. The received signal can be shown in the digital way that is with software or web interface. The added feature that the system[21] works on is the monitoring of field sales personnel. Easily the sales officers can be monitored by the system[21] by providing ventured vehicle. Thus it can cause less driving time and more productive time with the customers. The focus of the work[21] was to build a system that can get data from vehicle like speed, location,time and project the information in the monitoring device. For this, they have impaired the GPS with AVR microcontroller and microcontroller with GSM integration. There was a research work found regarding vehicle monitoring which was expensive compared to the system developed[21]. The scope of the system[22] was to develop a system for fleet owners to properly monitor and log the data of the fleets.The project[22] wanted to give service to the vehicle owners new feature that is the data log about their own vehicle to trace any unauthorized movement of their own vehicle. For this a system was designed to serve the purpose. For tracking and putting in a removable device, a memory flash card was introduced for the user. For user friendliness microcontroller used in the system works in two ways. It can take message request or phone call from the user and answer to the user correctly.The main scope of the proposed system[22] was to design controller which will cooperate with the GPS receiver and GSM module to log the data received from GPS receiver and show in the appropriate display device and user will be able to see the logged data. Before developing the system[22], analysing was done in the respective field and it was found that there existed one or two kind of system that were available. It was found that the car chip pro logger cannot log the position of the vehicle and the data storage capacity is also insufficient. The other one named Shadow tracker expert do not have two way communication using GSM.

People positioning System

The proposed system[23] works towards the implementation of low cost people tracking system for finding lost people or to trace people. The transmission is done using GPS integrated mobile which works as an independent module to send data to server side and the processing is done mostly in client side. General packet radio system(GPRS) is used instead of SMS.GPS system does not always place accurate data and the log data is not applicable to trace a person. For people tracing, real time data display is needed. For this the system[23] uses a server that gets data from the GPS all the time and gets uploaded. The system[5] focuses on the cost effectiveness and non complex network architecture like 2G.The scope of the system was limited to the android mobile and GPS availability. The outcome of the research was examined and it was found that the starting point and the ending point was shown in marker on the web interface. For the same route, GPS Device Tracker TK103 was used.The number of positions sent to the server increased as the processing as done in the server rather than the mobile.For log data, the developed system can use mobile memory.Group of people of different ages were given mobile that can project data to server as client and reduce the cost to 35 percent because of the less transmission point.The study for research[23] shows that the mobile device data and independent GPS system gives almost same accuracy level.Google map API, wifi instead of GPRS,HTTP protocol,intelligent logging, intelligent position calculation has limited the cost drastically.The system[23] has some limitations. It can give false GPS position if confined in a building or under a bridge.Enough memory space was provided as absence of memory would halt the application and hinder to work properly.

Situational Awareness operational Purpose

For situational person, relief works or humanitarian purpose , different organizations have to operate in certain situations. The commander sometimes fails to communicate properly as different organizations use different medium of communication.To communicate properly and give a common operational view the system was developed[24].The main purpose of the system[25] was to provide the operational commander android view of the operation by using the commercial means of communication. The position of the team members are displayed graphically by GOOgle APIs. The previous methods for communication of the commander with the mission team members were like cellular radio or updating personal maps by computer signal.The proposed system[25] uses android based operation and cloud based computing. The previous methods like Blue Force Tracker works in a way to graphically represent the friendly troops.The system uses Google datastore, sqlite for remote IP connection with the database.Smartphone assisted Readiness Command and Control System contribute to view the overall mission.User can join or edit any mission information.Google

App Engine site is collaborated with the system.The system is efficient in a way thatincorporates data to Google data store and uses Google API to plot the positional view.The tracking enables the responders to view the other fellow members and the command center can monitor how the mission is going.

Wearable device

The system[26] incorporates to develop a user friendly wearable device for the users so that any kind of interaction between the user and the environment can be depicted as context awareness.The system works in a way that it can easily fit with the outfit of the user and does not hinder users movement.The system[26] should be self operatable that is it can monitor and efficiently send proper data to the server.Four layers are used for system architectural purpose.They are functional textiles,embedded microsystems, attachable peripherals,carry on appliances.

2.3 Chapter Summary

At present in our military there is no such device that can locate troops. Though there are some system the missing person, stolen vehicle ect but those are not for military use. As troops locating is vital in any military operation so there are scope on this sector to develop.

CHAPTER 3
DESIGN AND DEVELOPMENT

This chapter will describe the overall design and development process of the system. The design and development includes conceptual design, key feature, development of physical system and development of android application.

3.1 Conceptual Design

At present commander do reconnaissance and show the bounds to his troops on a model before any operation. During operation, his various parties occupy the bounds shown in the model which may not be accurate. Our device will help the commander to monitor and check to see that where troops are getting deployed and if he finds anomaly he can give the correction via wireless sets. At present system, it is pretty difficult for commander to launch his reserve at right place. Our module will help him to see where manpower is much needed basing on dead/injured personnels numbers. After operation for rescue commander has to launch a deliberate rescue operation. Location and troops locations remain unknown. So, searching takes more time. Our module will give the pin point location of the troops so time will be saved.

We planned our system where there will be i) A master device ii) Few slave devices (based on operational requirement) iii) A secured Server. Slave devices are wearable devices that will be carried by the troops taking part in an operation. Commander will carry the master device. The server will host the database and will be working in between the master and slave devices. Master device and the server should be with in a same network. We planned for open BTS that is being used by Bangladesh army at a limited scale. Open BTS will provide us network through which master device will be connected with server.

In our proposed system, there will be two types of device, one is the master device which will be connected to the central database and the slave device which will be carried by every individual in the operation. The slave device will send their location and state of the carrier in a regular interval basis through GSM connectivity. The master device will collect the information from all the salve device and send it to the central database through desktop application. Database will preserve, secure the data and send it to the android application (within the same network) which will be used by the operation commander. Using the

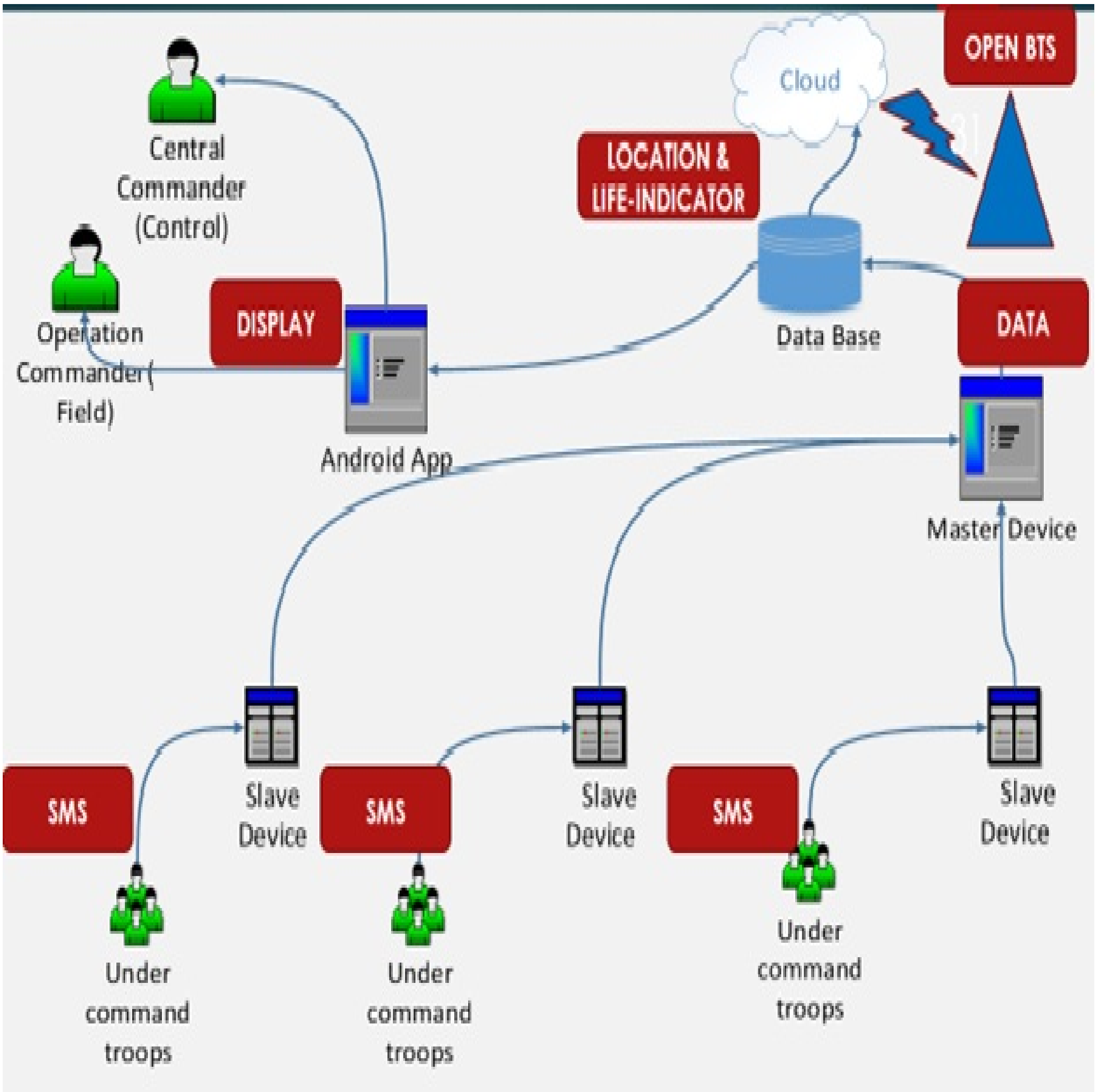

Figure 3.1: Conceptual Design

google map API the android application will plot the location of every individual on the Google map. Thereby the commander will know the location of every individual under his command. At a same time he can see the travelled area by every individual.
The sequence of operation:

1. Slave device (carried by troops) sends their location (latitude longitude) and dead or alive state (Gyro sensing) via sms to the master device.

2. Master device (commander) receives all these sms and sends the data to a secured server which is under a secured network (open BTS).

3. These datas are stored into the database (local host Database).

4. Using the network provided by the open BTS, database sends location and life-indicator signal to the control/ master devices modules.

5. The android application will allow the commander to observe these signals into the display of his module.

Along with the GPS module we will use a Gyro sensor which will detect the death or alive state of the carrier through motion detection. Gyro sensor detect the movement of every individual. If there is no movement for a certain period of time we assume that individual is dead. This data will also be send to the master device along with the location which will indicate the state of the individual.
Every solders are shown in the android application. Thus commander can monitor and check his under command troops. He has to log in using his unique number (BA number). Separate color are used for differentiating between the live and dead state of individual in the application. Red colour represents solder is dead and green colour represents soldier is alive and ready to action.

3.2 Key Feature

Any military operation can be divided into three phases.

- **Before Operation:** During this phase commander carry out planning and positioning of his troops. He created a model of the operation area and briefed individual about deployment.

- **During Operation** Main action takes place during this phase. Commander has less control over his troops during this period. He has to assume, everybody takes place accurately and will perform next action as briefed earlier.

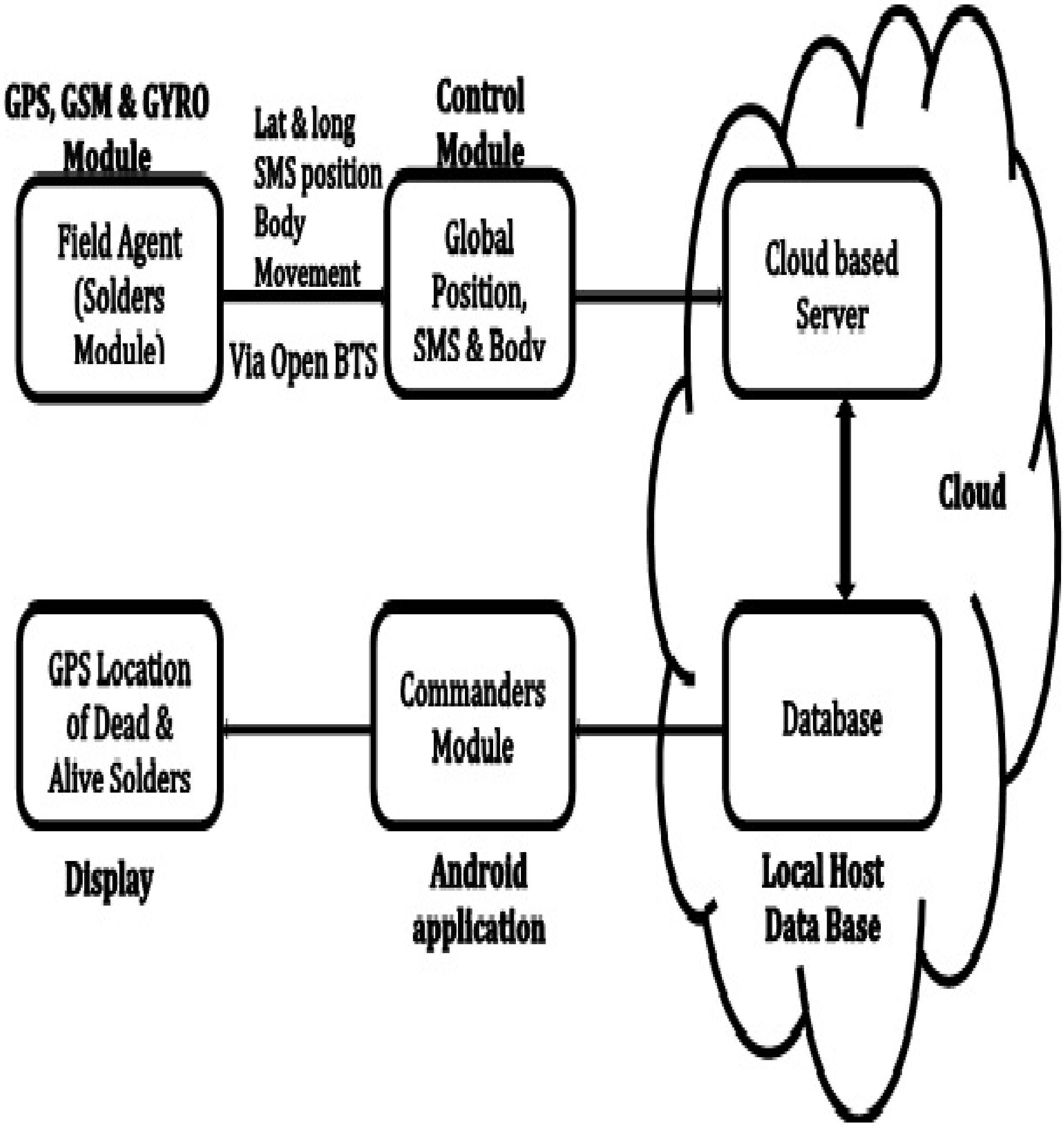

Figure 3.2: Block Diagram System

- **After Operation** The main operation is completed. Reorganization and counting takes place during this phase. Commander also decide his next move like Rescue operation or return to base.

At present System Commander can never be sure that parties have taken position at his desired location. In our system during operation commander can monitor live movement of troops. Commander can make sure troops have taken position at his desired location. He can also able to monitor their movement and can able to give required correction. But in existing system he have to assume and cannot provide any correction. As example reserve party supposed to take position in the far bank of pond2, instead they have occupied near bank. From commanders module he can see that and give correction. Using our system commander after the operation commander is able to check the location of all his personnel's in his module. If anyone missing he can carry out rescue operation in pin point location. He can also determine who is dead and alive. In present system after the operation he have to check the personnel physically and if any one gone missing he has to search the whole area for finding wounded persons.
Thus we can sort out the following key features for our system:

1. **Accurate Deployment of Troops (Before Operation):** Troops can be deployed accurately. And after deployment commander can check their location in his device and be able to give any minor correction basing their coordinates. With the help of this device he can get the assurance that everybody is in right place and any body found wrong can be corrected by informing that individual via wireless sets.

2. **Effective use of Reserve (During Operation):** Commander can see the injured personnels and able to launch reserve at right time and right place. Every action group need enough manpower and fire power. More injured person results less fire power and effectiveness. So launching of reserve is very vital. Our module helps commander in this regards, which is a vital helping feature for any commander.

3. **Observe and Guide Movement of Own Troops (During operation):** While occupying bounds before operation or falling back from bounds after execution of operation commander can monitor the movement of his troops and can able to guide him by giving correction via wireless sets. In many times it is found that main operation plan needs to be adjusted according to the development of situation. Our device helps commander in this regards as he can change location of his troops during operation too.

4. **Helps Next Movement After Operation (after operation):** After reorganization commander can find the strugglers or lost/injured/dead peoples location which ulti-

mately help him to decide his future action like rescue operation. He can determine the exact location of every individuals and can determine number of alive troops who can be used in next operation.

3.3 Development of Physical System

3.3.1 Circuit Diagram

The Circuit designed circuit diagram of our client device is given below: It is a high-

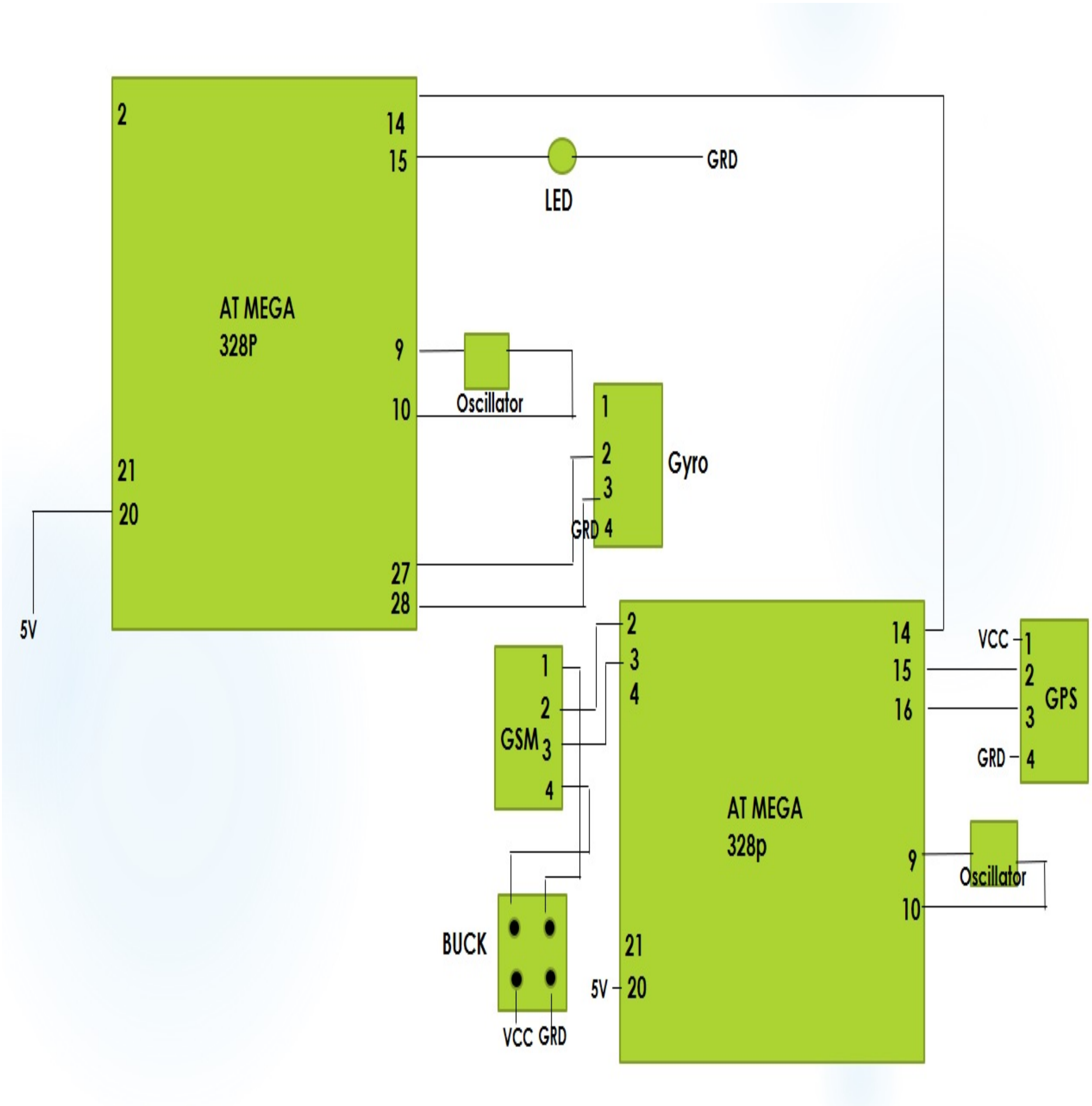

Figure 3.3: Circuit Diag (Client Device)

3.3.2 Required Component

ATmega328

ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. The most common implementation of this chip is on the popular Arduino development platform, Arduino Uno and Arduino Nano models. The ATmega328 is a single-chip micro controller created by Atmel in the megaAVR family.

Figure 3.4: ATmega328

It is a high-performance Microchip 8-bit AVR RISC-based microcontroller combines

- 32KB ISP flash memory with read-while-write capabilities.
- 1KB EEPROM
- 2KB SRAM
- 23 general purpose I/O lines
- 32 general purpose working registers
- three flexible timer/counters with compare modes
- internal and external interrupts
- serial programmable USART
- a byte-oriented 2-wire serial interface
- SPI serial port
- 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages)
- programmable watchdog timer with internal oscillator
- Five software selectable power saving modes.

The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

SIM 800A GSM Module

This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily.

Figure 3.5: *SIM 800A GSM Module*

GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI(International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

- Receive, send or delete SMS messages in a SIM.
- Read, add, search phonebook entries of the SIM.
- Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different

AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

Ublox NEO-6M gps module

The Ublox NEO-6M gps module is a module with high precision binary output. It has also high sensitivity for indoor applications. UBLOX NEO-6M GPS MODULE has a battery for power backup and EEprom for storing configuration settings.

The antenna is connected to module through ufl cable which allow for flexibility in mounting the gps such that the antenna will always see the sky for best performance. This makes it powerful to use with cars and other mobile applications. The Ublox gps module has serial TTL output, it has four pins: TX, RX, VCC and GND.

GYRO sensor

Vibration gyro sensors sense angular velocity from the Coriolis force applied to a vibrating element. For this reason, the accuracy with which angular velocity is measured differs significantly depending on element material and structural differences. Here, we briefly describe the main types of elements used in vibration gyro sensors.

Figure 3.6: GYRO Sensor

We used it to detect the body movement of the troops. When every there is any slight change in any of X,Y,Z axis it gives signal.

Buck converter xl6009

Auto start voltage will be pulled down to 7V less or smaller engine at high speed when the voltage up to 15V or higher. For 12V electrical work hard at work, this automatic buck module solves this problem, regardless of the input voltage is 5V or 12V or 32V, the output can be stabilized at 12V.

1. Wide input voltage 5V 32V
2. Wide Output Voltage 1.25V 35V (with automatic buck , scope of work, any voltage inputs can be arbitrarily regulated voltage output)
3. Built- 4A efficient MOSFET switches enable efficiency up to 94%; (LM2577 current is 3A) high switching frequency of 400KHz, the ripple is smaller and smaller . (LM2577 frequency only 50KHz)

We used buck converter to convert the output voltage of lipo battery. Our device need 5v 1amp and the buck converter convert this required power from lipo battery.

Lipo Battery 10000mah

Lithium Polymer batteries are used in many RC hobby industries. Over the last few years, Lipo batteries have become the most popular battery choice for anyone looking for a longer run time and higher power.

battery.jpg

Figure 3.7: Lipo 10000mah

Lipo batteries weigh less and can be made into almost any size or shape. Lipo batteries have higher capacities, hold more power and have a higher discharge rate, meaning they pack more punch. For safe use and storage of Lipo batteries, you need to follow the rules and treat the batteries with the respect they deserve.

Advantages over traditional Lipoly batteries

- Power density reaches 7.5 kw/kg.
- Less Voltage sag during high rate discharge, giving more power under load.
- Internal impedance can reach as low as 1.2mO compared to that of 3mO of a standard Lipoly.
- Greater thermal control,pack usually does not exceed 60 C.
- Swelling during heavy load does not exceed 5%, compared to 15% of normal Lipoly.
- Higher capacity during heavy discharge. More than 90% at 100% C rate.
- Fast charge capable, up to 15 C on some batteries
- Longer Cycle Life, almost double that of standard lipoly technology

The nano-core technology in lithium ion batteries is the application of nanometer conductive additives. The nanometer conductive additives form ultra-strong electron-conducting networks in the electrodes which can increase electronic conductivity.

These additives create the ability for imbibition in the carrier liquid to supply more ion channels. This improves the ability of ion transmission and ion diffusion. Through improving electronic conductivity and ion transmission, the impedance is reduced and the polarization of high rate discharge decreases greatly.

Capacitor 1000micro farad

Capacitor is used for charging and discharging capability, in a word Power conditioning. It is also used for the power supplies where they smooth the output of a full or half wave rectifier. Another reason for using capacitor is it can charge pump circuits as the energy storage element in the generation of higher voltages than the input voltage.

A Client Device

3.3.3 Algorithm Development

Gyro sensor will sense the body movement of the soldiers. It measures and maintains orientation and angular velocity. It contains a spinning wheel or disc where axis of rotation is free to assume any orientation. So whenever there is body movement of the troops gyro sensor will give movement detection signal. It will act as life indicator parameter.

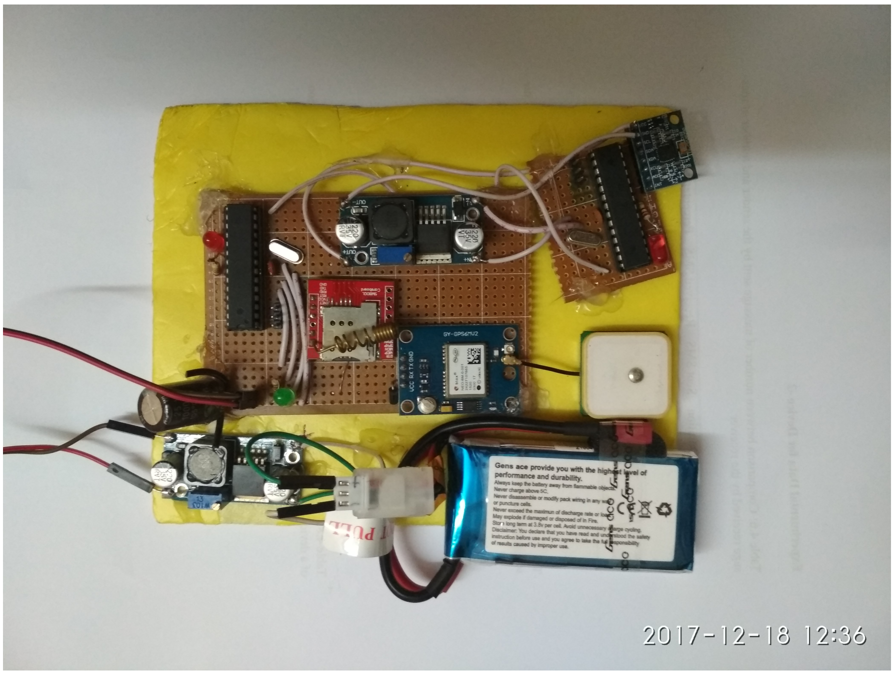

Figure 3.8: Client Device With Connection

GPS sensor is a receiver with antennas that uses satellite-based navigation system to provide position, velocity, and timing information. GPS will keep on transmitting latitudes and longitudes that will indicate the present location of the solders.

GSM network is used as the carrier. There are two types of devices- master and slave. Via GSM network sms will be sent to server from slave devices showing the pin point location of the soldiers (data feed from GPS module) and their life status (data feed from GYRO sensor). Server in turns update the commander/ master device about slaves location and their life indicator by Green/ Red blink in the master devices android application.

Description of Our Algorithm

Gyro sensor will sense the body movement of the soldiers. Which will act as life indicator parameter. GPS will keep on transmitting latitudes and longitudes. Finally using GSM network sms will be sent to commander device showing the pin point location of the soldiers and their status as red or green blink in to android application.

Gyro sensor will sense the body movement of the soldiers. Which will act as life indicator parameter. GPS will keep on transmitting latitudes and longitudes. Finally using GSM network sms will be sent to commander device showing the pin point location of the soldiers and their status as red or green blink in to android application.

Algorithm 1 LocSoldier

```
Result: Longitude, Latitude and Status
Sense  Output
  Function LocSoldier (GyroSense; GPS; GSM)
  Sensing:  GSM
  Reading:GPS
  while (GPS and GSM) do
      Sence:BodyMovement
        if true then
          return "Green and GPS Reading"
      else
          return "Red Blink and GPS Reading"
      end
end
return "INVALID "
```

Our algorithm uses a function called LocSoldier. Data from GYRO sensor, GPS module and GSM module is used as the parameter of this function. These parameters are used as the input and build the output LifeIndicator and GenerateSMS. If the solder is Static for a certain period of time, gyro sensor will give no signal. According to the received signal from gyro signal we will assume that soldier as dead and he will be shown in the application as RedBlink and if body movement is detected he will be identified in the application as alive and represented by GreenBlink.

Slave module sends Location feed from the GPS and life indicator feed from GYRO sensor to a central server via GSM network. The server updates them at a same time keeps a log of the datas. These datas are sent to master / the commander module via cloud. Where commander can get the final result or output as Location of individual soldier and their status (green/ red).

3.3.4 Database Design

A database management system is important because it manages data efficiently and allows users to perform multiple tasks with ease. A database management system stores, organizes and manages a large amount of information within a single software application. Use of this system increases efficiency of business operations and reduces overall costs.
Benefits of databases include:

- Reducing the amount of time spent managing data.
- Giving you the ability to analyze data in a variety of ways.

- Promoting a disciplined approach to data management.
- Turning disparate information into a valuable resource.
- Improving the quality and consistency of information.

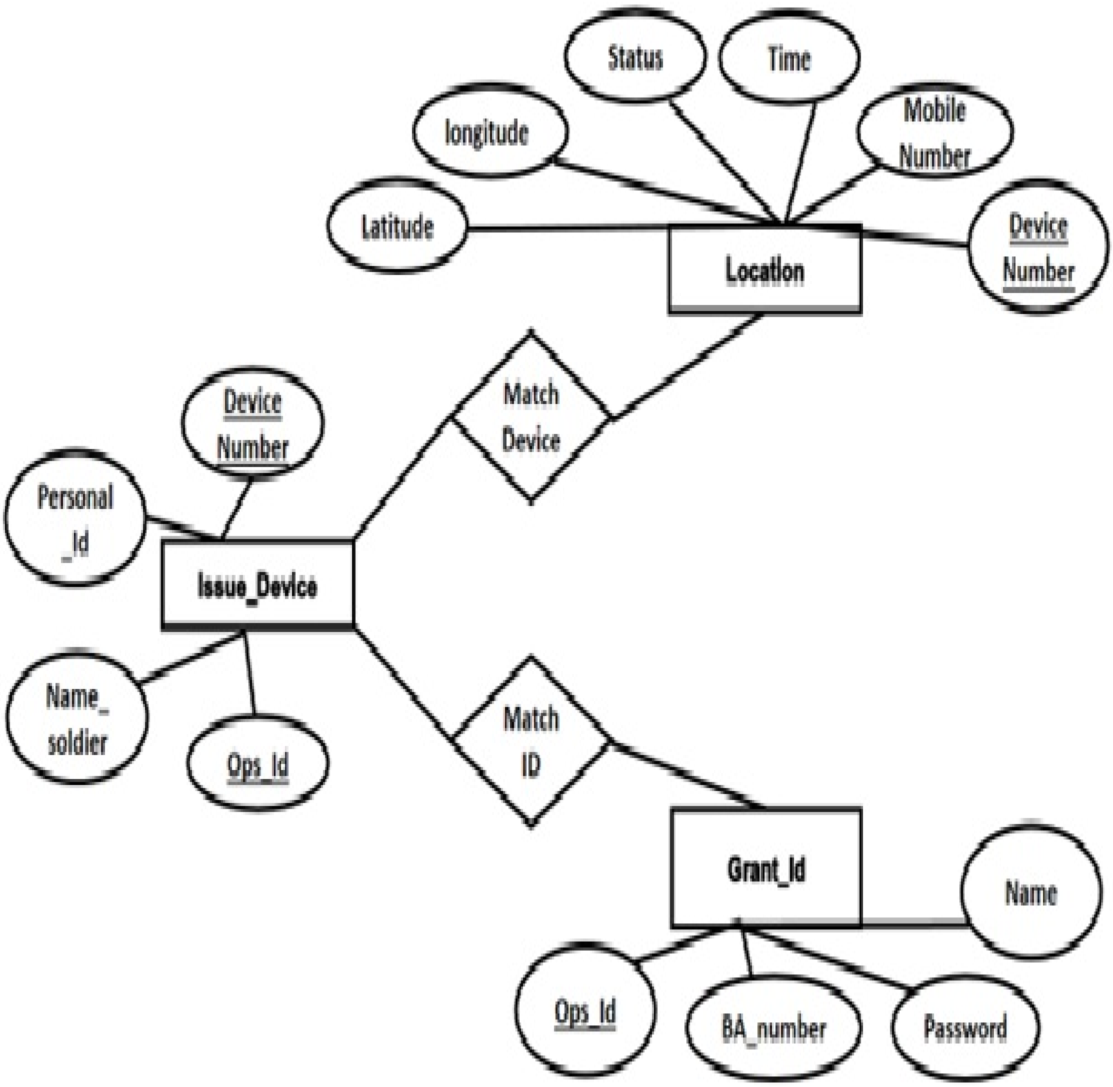

Figure 3.9: Database E-R Diagram

We have build a simple and crisp data-base. Three table named Location, Issue_Device and Grant_id .Datas sent by the slave devices are stored here Latitude, longitude, status(dead/ alive) etc. Location table is connected with Issue _ Device table via primary key Device number. Grant _id table is connected with Issue device via Ops_id primary key. Data base finally sends the Latitude, longitude and status to the android application.The Rest of the code for developing server and slave device is given in APPENDIX A,B,C,D,E,F,G J. Database security is more than just important: it is an absolutely essential part. It prevents the compromise or loss of data contained in the database, an event that could have serious ramifications for any system. Some of the functions of database security include:

- Blocking attacks from unauthorized users or hackers. This prevents the loss of sensitive information.
- Preventing malware infections and stopping viruses stealing data.
- Ensuring that physical damage to the server does not result in the loss of data.
- Prevents data loss through corruption of files or programming errors.

Basically, database security protects any sensitive information that any system may have stored in databases. It reduces the risk of this information being stolen, and protects you from the associated legal problems that would occur if it was to be stolen.

We are using local host database. Open BTS provides the network backbone, which is a secured medium. So external attackers will not get any access to the network thus blocking the hackers from database. The log-in feature will only allow the authorized person to access the data-base, thus prevents the loss of sensitive information. And we planned for a backup database in separate server that will be a redundant to the datas that are stored and Prevents data loss even if there is any physical damage.

3.3.5 Android Application development

The app will be used to monitor and trace the location of the troops accordingly in real time. It has two concerns. First concern will be pointing out the positional updated longitude and latitude and display them on the map on the basis of the signal received from the sensor. We are using the local server and mysql database to patch up with the app. The database entries are fetched through GSM module.

Two aspects of the app is described below:

- **Operation:** From the login page the user will be redirected to the intermediate page where the user can choose about operation or single device information. The operation portion will cover the updated position of the troops within the range. The wounded ones will be colored red means they are in critical condition. The available ones will be colored green meaning they are safe.
- **Information** From the login page the user will be redirected to the intermediate page where the user can choose about operation or single device information. The operation portion will cover the updated position of the troops within the range. The wounded

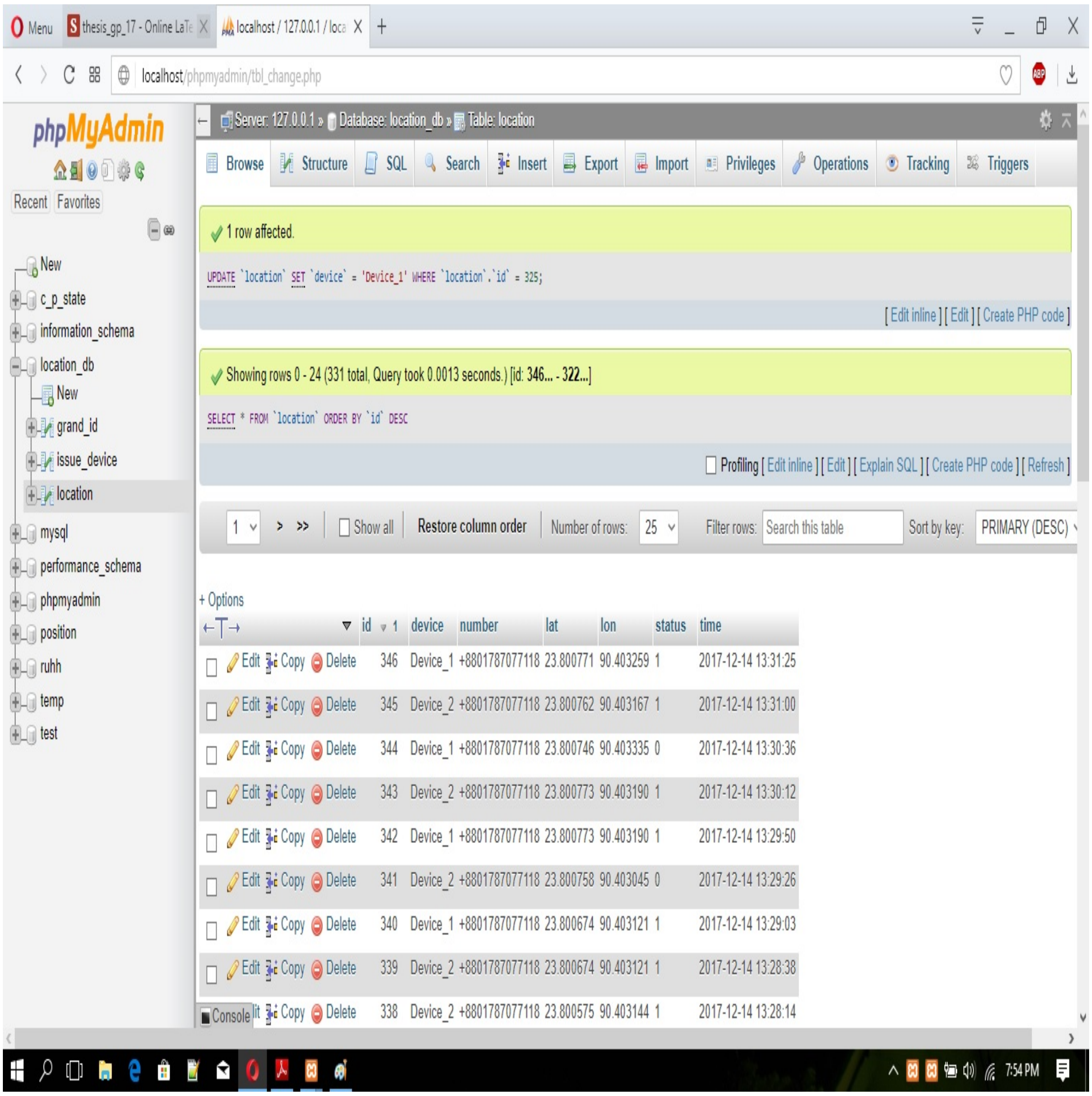

Figure 3.10: Location Table in Developed Database

ones will be colored red means they are in critical condition. The available ones will be colored green meaning they are safe.

The landing page is the homepage that would take login id and password to go to the next stage and then the user can select the operation or information related page.

Overview Of App

The app for our project works as an integrated part of the whole system. The data that are collected by the hardware implementation is presented and given a form to operate through the app. The main features of our app are discussed below with some screen shots:

- **Splash Screen:**The first part of the app is the launching of the app. It consists of a splash screen With the logo of BD army see figure 3.12.

Figure 3.11: Splash Screen of Developed App

- **Objective of the app:**The next screen of the app will give direction to the user about the information and the operation . The information part will manage the different aspects of the operation. The operation part will direct to a screen which is a login screen for on ground commander figure 3.13.

- **Login with username and password :**The next screen that will be directed from the option operation is login screen. Here the on ground commanders and the high profile authority will be given access by entering their BA No and protected password figure 3.14.

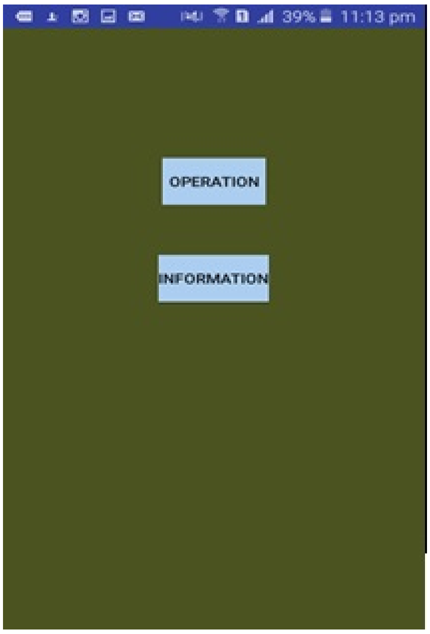

Figure 3.12: Option of Developed App

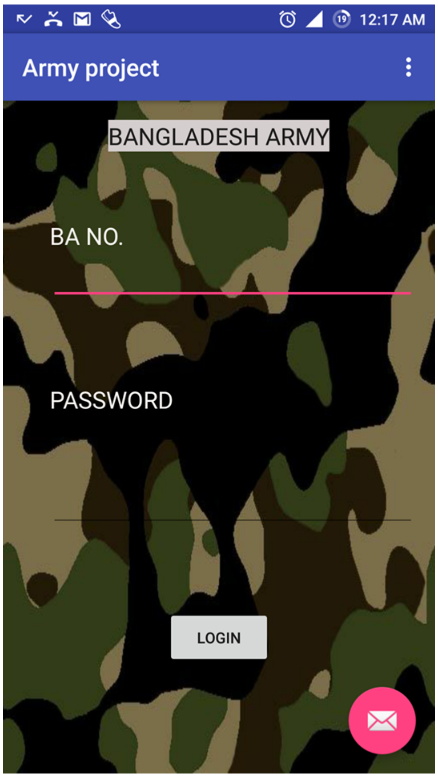

Figure 3.13: Login Page of Developped App

- **Personal window :**The next screen will welcome the user and direct to the map view or table view of the real time operational situation and positional information of the troops.
- **Map view:** The real time GPS coordinates of the deployed troops will be shown in the map view and the soldiers who are injured or off the track can be pointed out by differentiable color figure 3.15.

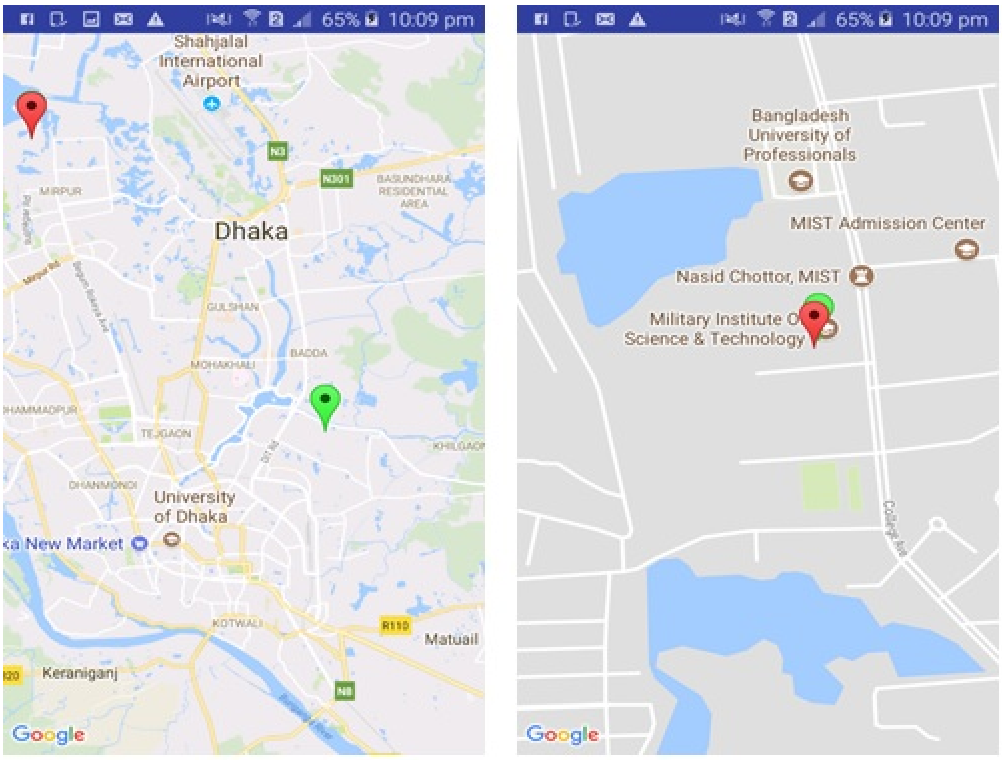

Figure 3.14: Map View Page of Developped App

CHAPTER 4
EVALUATION OF THE SYSTEM

The system need to be sound in both in theoretical and practical environment so the evaluation process shall contain both environment. This chapter will evaluate the developed system in two aspect to determine its effectiveness.

4.1 Evaluation in an Academic Environment

4.1.1 Experimental Environment

In this type of experiment, we have experimented the effectiveness of the system in the laboratory environment. Here all the situation is set as idle and no interruption is occurred during the experiment. The GPS connectivity was available there without any interruption, same as the GSM connectivity. There was no inclement weather effect and the device was handled with care as far as possible. There was no other interruption like the actual battle field.

4.1.2 Experimental Setup

Here we have invited few students from various level and allotted the devices to them. It was done two persons at a time as we had only two devices. They were told to carry one device each and move to a particular place in the field. Each of them were carrying a smart mobile also.

After reaching to a particular location they were told to stop and turn on the device. Once one message is received by the device they were told to take the longitude and latitude by the smart phone also. After doing that they were instructed to move to another landmark which is prominent on the ground and also on the Google map. They were instructed to do the same thing again. While in the process another person was employed to calculate that how many message is sent by the device. At the same time another person was employed to see how many was received by the receiver.

After completing the first part of the experiment then they were instructed to stand beside a prominent landmark and the location was taken from the Google map and compared with the location sent by the device. After that they were told to move around slightly by around 1 foot, 2 feet and gradually increase the distance. They were instructed to move till the time the location on the map showed a significant change in location. This thing was repeated for three to four location.

The Gyro sensor effectiveness was tested by seeing the movement of the individual and the status sent by the device. Here while the message was sent the persons movement was detected by the accompanying person and compared with the received result.

Finally, the battery life was checked by keeping the device on in a place for a duration till the battery is active. As the experiment was over we calculated how many massage was received by the master device and how many uploaded to the server.

Here throughout the operation the commanders device where the android application is active and the server was under the same network.

4.1.3 Experimental Result

The experimental result is shown on the table below.

Experimental Data for Device -1

From the experiment we can see the ratio between send and received SMS is more than 98% on average. There is no value less than 93.33% and highest value is 100%. So very less number of massage is missing.See table 4.1. Rest of the data for device 2 are shown to APPENDIX H I.

Table 4.1: Comparison of sent and received message (Academic Environment)

Ser	Duration	Sent SMS	Received SMS	Percentage
1	30 mins	120	118	98.33%
2	32 Mins	125	124	99.2%
3	35 Mins	127	127	100.00%
4	33 Mins	125	123	98.40%
5	36 Mins	130	128	98.46%

Out of five observation which last for 30 to 36 mins, the ratio between received massage and uploaded massage to the server is always 100%. None of the massage is missed to be uploaded to the server. See table 4.2

Table 4.2: Received message and uploaded data to server (Academic Environment)

Ser	Duration	Received SMS	Uploaded to Server	Percentage
1	30 mins	118	118	100%
2	32 Mins	124	124	100%
3	35 Mins	127	127	100%
4	33 Mins	120	120	100%
5	36 Mins	128	128	100%

The actual location and the location received from our device varies from 10-15 feet. From our experiment we found the average deviation of 12.5 feet. However, none of the locating device exists in our country can give the accuracy of less than 10-12 feet. So, the deviation is very well in the acceptance range. See figure 4.3 Table 4.4 shows the comparison of five operation and supported battery life. Here we see with 2 cell lipo battery we can get a support of more than 2.15 hours.

Table 4.3: Comparison of the received and actual Longitude,Latitude (Academic Environment)

Ser	lon-lat(Device)	lon-lat(Mobile)	Deviation(in feet)
1	90.3591555 , 23.838507	90.358781 , 23.838413	13.00
	90.359685 , 23.838516	90.358989 , 23.836848	11.00
	90.359263 , 23.837435	90.360069 , 23.838974	10.70
	90.360132 , 23.837321	90.360823 , 23.8370903	14.00
2	90.359154 , 23.838508	90.358781 , 23.838412	12.50
	90.359686 , 23.838528	90.358989 , 23.836849	14.00
	90.359273 , 23.837400	90.360075 , 23.838964	15.00
	90.360134 , 23.837326	90.360826 , 23.837094	10.00
3	90.359153 , 23.838590	90.358790 , 23.838450	15.00
	90.359684 , 23.838490	90.358989 , 23.836850	15.50
	90.359210 , 23.837395	90.360075 , 23.838970	14.00
	90.360136 , 23.837319	90.360820 , 23.837096	13.00
4	90.359155 , 23.838508	90.358779 , 23.838400	14.00
	90.359685 , 23.838528	90.358989 , 23.836849	15.00
	90.359272 , 23.837405	90.360075 , 23.838944	12.00
	90.360134 , 23.837326	90.360825 , 23.837094	14.00

Table 4.4: Table of battery life comparison (Academic Environment)

Ser	Duration
1	135 Mins
2	140 Mins
3	120 Mins
4	130 Mins
5	125 Mins

Table 4.5 shows GYRO sensor reading and actual state of an individual. In serial one observation number 2 we see a deviation from sensor reading and actual status. It happened because the individual was inactive just at the moment of sending the message. Same as the case for observation number two.

Table 4.5: Gyro sensor reading and actual state (Academic Environment)

Ser	GYRO Readin	Actual Status	Remarks
1	1 0 0 1	1 1 0 1	Sender was not Active
2	1 0 1 1	1 1 1 1	Sender was not active
3	1 0 1 1	1 0 1 1	
4	1 1 1 1	1 1 1 1	

4.2 Evaluation in an Operational

4.2.1 Study Environment

In this type of experiment, we have experimented the effectiveness of the system in the actual environment. Though it was not possible for us to create a battlefield environment but

Figure 4.1: Lat,lon Evaluation (Academic) By the System(Device-1)

we tried to take into consideration all the battlefield eventualities. The weather condition was a greater consideration here. We tried to move the devices to the location where it is likely that the GPS signal will be lost like places under cover, foggy weather, night time etc. The device was tied to a persons arm and less of consideration was given to the device. Rather the persons carrying it was concentrated on the operational activities.

4.2.2 Study Procedure

This study procedure was almost same as the laboratory environment. But we have done it in a bigger and operational like environment. Here we invited some military person to do the experiment. They were not carrying the device rather they were wearing it so that it does not hamper their other activities. After doing that they were told to do some tactical movement but also keeping in mind that this system is a prototype and not that robust as the actual one will be.

After the initial briefing they were asked to turn on the device and move to a particular place following a particular tactical movement procedure. After reaching to a particular landmark they were asked to hold and the reading of longitude and latitude was noted. The reading from their smart mobile was also taken for comparison. Accompanying person was keeping track of how many message was send by the device. The process was repeated for two to three more times.

Once the first part of the experiment was over again they were briefed for the second part of the operation. They were now asked to move to a particular location which is prominent on the ground and also on the Google map. Now they instructed to move 1 foot. 2 feet and so on till we notice a significant change on the Google map. Thereby the accuracy of the device data was determined.

The life time of battery and percentage of received data uploaded on the server was done the procedure stated earlier.

Experimental Data for Device -1

From the experiment we can see the ratio between send and received SMS is more than 98% on average. There is no value less than 93.33% and highest value is 100%. So very less number of massage is missing.See table 4.6.

Table 4.6: Comparison of sent and received message (Operational Environment)

Ser	Duration	Sent SMS	Received SMS	Percentage
1	35 mins	124	122	98.33%
2	40 Mins	130	129	99.20%
3	42 Mins	134	130	97.01%
4	38 Mins	128	128	100.00%
5	45 Mins	138	135	97.82%

Out of five observation which last for 30 to 36 mins, the ratio between received message and uploaded message to the server is less than that we found in laboratory environment. Here we found few message is missing which is on average 5%.It is because, during the operational environment sometimes the GPS reading was unavailable. Which cause an INVALID message generation by the GSM module so, the receiver failed to upload it to the server. always 100%. None of the message is missed to be uploaded to the server. See table 4.7

Table 4.7: Received message and uploaded data to server (Operational Environment)

Ser	Duration	Received SMS	Uploaded to Server	Percentage
1	35 mins	122	114	93.44%
2	40 Mins	129	120	93.02%
3	42 Mins	130	125	96.15%
4	38 Mins	128	120	93.75%
5	45 Mins	135	128	94.81%

The actual location and the location received from our device varies from 10-15 feet. From our experiment we found the average deviation of 12.5 feet. However, none of the locating device exists in our country can give the accuracy of less than 10-12 feet. So, the deviation is very well in the acceptance range. See figure 4.8 Table 4.9 shows the comparison of

Table 4.8: Comparison of the received and actual Lon,Lat (Operational Environment)

Ser	lon-lat(Device)	lon-lat(Mobile)	Deviation(in feet)
1	90.359155 , 23.838507	90.358781 , 23.838413	13.00
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	90.360132 , 23.837321	90.360823 , 23.837090	14.00
2	90.359154 , 23.838508	90.358781 , 23.838412	12.50
	90.359686 , 23.838528	90.358989 , 23.836849	14.00
	90.359273 , 23.837400	90.360075 , 23.838964	15.00
	90.360134 , 23.837326	90.360826 , 23.837094	15.00
3	90.359153 , 23.838590	90.358790 , 23.838450	15.00
	90.359684 , 23.838490	90.358989 , 23.836850	15.50
	90.359210 , 23.837395	90.360075 , 23.838970	14.00
	90.360136 , 23.837319	90.360820 , 23.837096	10.00
4	90.359155 , 23.838508	90.358779 , 23.838400	14.00
	90.359685 , 23.838528	90.358989 , 23.836849	15.00
	90.359272 , 23.837405	90.360075 , 23.838944	09.00
	90.360134 , 23.837326	90.360825 , 23.837094	16.00

five operation and supported battery life. Here we see with 2 cell lipo battery we can get a support of more than 2.15 hours.

Table 4.9: Table of battery life comparison (Operational Environment)

Ser	Duration
1	120 Mins
2	124 Mins
3	128 Mins
4	115 Mins
5	120 Mins

Table 4.10 shows GYRO sensor reading and actual state of an individual. In serial one observation number 2 we see a deviation from sensor reading and actual status. It happened because the individual was inactive just at the moment of sending the message. Same as the case for observation number two.

Table 4.10: Gyro sensor reading and actual state (Operational Environment)

Ser	GYRO Readin	Actual Status	Remarks
1	1 0 0 1	1 1 0 1	Sender was not Active
2	1 0 1 1	1 1 1 1	Sender was not active
3	1 0 1 1	1 0 1 1	
4	1 1 1 1	1 1 1 1	

4.3 Evaluation of the Result

From the study of the result we can see that the result varies from the laboratory result and the actual field experiment. The laboratory experiment was done in an ideal situation and the result also says that the device works better in that situation.

In laboratory situation we see that few little SMS are missed to be received by the receiver. But he percentage is less that two percentages. In almost all the experiment all the received data is successfully uploaded to the server. As the data contain the given format no data is missed.

Now about the accuracy of the device we see that there is small deviation of the location received by the device and by the location received by the mobile GPS. It is because both the device could not be kept exactly at the same place and also there might be some deviation in accuracy. But the deviation is below 3 feet which is very well in accepted range.

As the duration of the battery life concern the device could be supported for around 110-130 minutes on average.

The GYRO reading was correct but it need little more accuracy. Its result shows little more deviation as actually the carrier of the device need to be on movement just at the time the device is sending the message. Otherwise the sensor is giving an inactive state. Which may lead us to a misinterpretation.

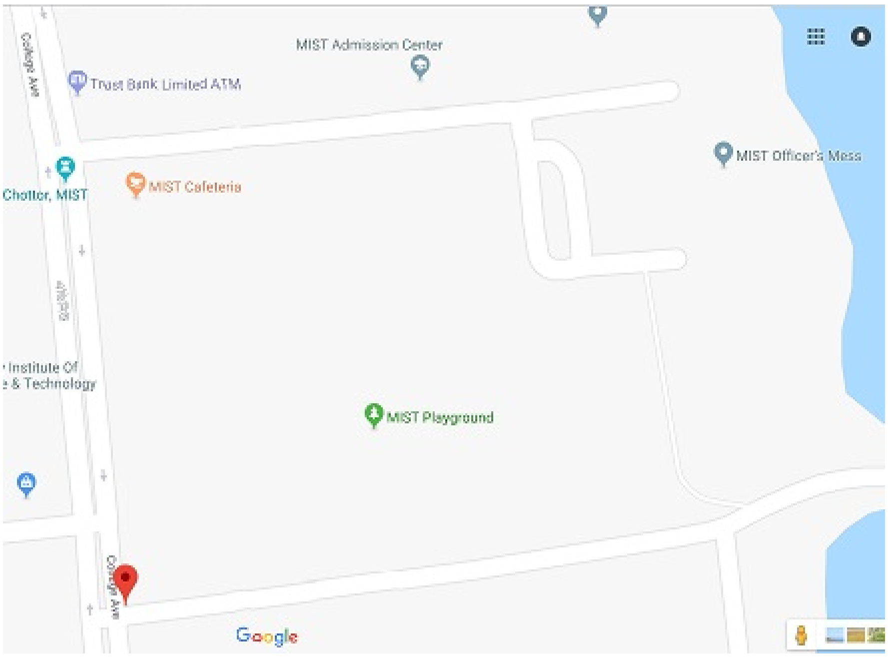

Figure 4.2: Lat,lon Evaluation(Operational) By the System(Device-1)

In case of the operational environment the few message was lost to be received by the receiver. It may be due to the network problem. But here also the percentage is les that 2 on average.

In the operational situation sometimes the GPS signal is lost ant the message contains an invalid format. So the data received by the receiver failed to upload to the server. So here we see a greater deviation from the laboratory result.

The deviation related to the accuracy of the device locating capability is almost same for both the case.
The battery life and the GYRO reading is also almost same for both cases.

CHAPTER 5
DISCUSSION AND CONCLUSION

During any military operation the positioning of soldier at correct place is very important. The success of the operation mostly depends on the placement on soldiers and their correct employment during the operation. The present practice procedure does not support to instant locating of individual and also dont be able to provide any tracking. Moreover, the operation commander has to rely on the verbal communication which is mostly interrupted by the enemy. Again, the operation commander does not get the current situation update in present system which is most vital to take a decision in a critical moment. More so after the operation the commander need to check the state of under command physically which takes a lot of time. As the time management is very critical in such operation so checking the status of individual may term as a wastage in many operations.

The developed system LocSoldier can easily locate an individual during and after the operation. It is also able to give the status (mostly active/inactive) of individual along with their location. By LocSoldier the commander also be able to track ones movement any time he wants. Our developed system LocSoldier is able to solve the maximum objective of the thesis, even though it has some drawback (discussed below) which may open a scope for future developers.

Firstly, the LocSoldier system is a prototype version, so the user may face some difficulty to use it. The LocSoldier uses the GPS technology to get ones location and then send it through a SMS by using GSM technology. During war time mobile operator are at the most vulnerable state. So using GSM technology at war time may useless. Again, for GPS we are fully dependent on foreign countries satellite. The satellite support of other country also depends on war and diplomatic situation.

The **LocSoldier** uses a 10000 mA LiPo battery to run the client device. In the evaluation it is found that a battery can run one client device for about 90 to 100 minutes. In most military minor operation time is prescribed but prescribed time could not be followed mostly. Mostly the minor operation takes longer time than that of expected. So, LocSoldier may not be useful for long tenure operation.

The system uses GYRO Sensor to detect individuals active or inactive state. A gyro sensor is a device used primarily for navigation and measurement of angular velocity [13] [14]

[15]. By using Gyro the movement of an individual can be easily detected. But in reality, in minor operation a soldier may has to take up position inside enemy territory so he need to hide himself. To avoid detection by enemy his movement become restricted sometimes he has to stay without movement for long period of time. The **LocSoldier** will identify the individual as an inactive state in such situation which is not desirable.

During the system development all kind of meteorological situation kept in mind. The circuitry was designed accordingly. But even though the client device is not water proof. Because the GPS modules antenna need to be in open sky so we could not cover the whole device. Again as the GPS module need to be in open sky so it is also not being able to detect individuals location inside a house. In this aspect the **LocSoldier** is unable to operate in any indoor military operation like Hostage rescue operation.

Military operation is always risky in nature. There is a good chance of apprehension by the enemy. If the enemy can capture the device, then they may simulate a situation which is not true.

As we have finished our research within the given timeframe, but there is scope open for future researcher for further research and development of the system. In future more research scope is open to carry forward the system for adding more feature and fine tuning.

Our prototype system has some limitations which can be further developed and eliminated in future. At first the system can be added with a feature of self-destruction which will ensure added safety to the device in case the carrier is a prisoner of war.

The devices can be made water proof in order to ensure uninterrupted service in inclement weather condition. Which can be done by providing a good water sealed casing or box. As a whole the box can be made much smaller so that it can be easily carried by the carrier without any difficulties.

The Gyro sensor used can give a prediction of the active/inactive state of the carrier, but it cannot correctly identify the life/death state of any individual. Using the heart rate monitor can solve this issue which will increase its efficiency and accuracy

Finally, few more sensor like mine field detection, emergency button can be added to the module so that the functionality gets improved and more accuracy can be provided to the users.

As the future battleeld and the future soldiering system is going to be highly dependent on technology we hope that our developed system can bring a signicant improvement for better command and control, better result in correct deployment and locate the soldiers, which will lead us to the ultimate success.

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APPENDIX A
Arduino Code for Slave Device

```
# include ≤ TinyGPS + +.h ≥
#include < SoftwareSerial.h >
char inchar;
static const int RXPin = 3, TXPin = 4;
static const uint32_t GPSBaud = 9600;
TinyGPSPlus gps;
SoftwareSerial ss(RXPin, TXPin);
char incomingByte;
String inputString;
intl ed = 12;

void setup()
{
ss.begin(GPSBaud);
pinMode(led, OUTPUT);
Serial.begin(19200);
while(!Serial.available())
{
Serial.println(”AT”);
delay(1000); } Serial.println(”AT+CMGF=1”); //Set SMS Text Mode
delay(1000);
Serial.println(”AT+CNMI=2,2,0,0,0”);
delay(1000); Serial.println(”AT+CMGL=R̈EC UNREAD”̈);
digitalWrite(12, HIGH);
delay(100);
digitalWrite(12, LOW);
delay(100);
digitalWrite(12, HIGH);
delay(100
{
digitalWrite(12, LOW);
}
void loop()
```

```
{
if(Serial.available())
{
delay(100);
while(Serial.available())
{
incomingByte = Serial.read();
inputString += incomingByte;
}
delay(10);
inputString.toUpperCase();
if (inputString.indexOf(”ON”) ¿ -1)

digitalWrite(led, HIGH);
sent();
}
delay(50);
if (inputString.indexOf(”OK”) == -1)

Serial.println(”AT+CMGDA=D̈EL ALL¨”);
delay(1000);

inputString = ””;

while (ss.available() ¿ 0)
if (gps.encode(ss.read()))
displayInfo();
}
void sent()
{
digitalWrite(12, HIGH);
delay(1000);
delay(1000);
Serial.print(”AT+CMGF=1 ̊”);
delay(1000);
Serial.println(”AT+CMGS=+̈8801617161716¨”);
delay(1000);
if (gps.location.isValid())
{
```

```
Serial.print(gps.location.lat(), 6);
Serial.print(F(”,”));
Serial.print(gps.location.lng(),6);
}
delay(1000);
Serial.write((char)26); //ctrl+z
delay(3000);
digitalWrite(12, LOW);
delay(2000);
Serial.println(”AT+CMGDA=ḊEL ALL̈”);
delay(1000);
Serial.println(”AT+CMGF=1”); //Set SMS Text Mode
delay(1000);
Serial.println(”AT+CNMI=2,2,0,0,0”);
delay(1000);
Serial.println(”AT+CMGL=R̈EC UNREAD̈”);
}
void displayInfo()
if (gps.location.isValid())

Serial.print(gps.location.lat(), 6);
Serial.print((”,”));
Serial.print(gps.location.lng(),6);
}
else
{
Serial.print(F(”INVALID”));
}
Serial.println();
}
```

APPENDIX B
Arduino Code for Master Device

include ≤ *SoftwareSerial.h* ≥

SoftwareSerial mySerial(11, 12);
char msg;

void setup() {
mySerial.begin(9600); // Setting the baud rate of GSM Module Serial.begin(9600); // Setting the baud rate of Serial Monitor (Arduino) delay(100); Serial.println(”READY”); }

void loop() {
if (Serial.available()¿0) if(Serial.read()) {
RecieveMessage(); }

if (mySerial.available()¿0) Serial.write(mySerial.read()); }
void msg2owner() {
Serial.write(”msg ”); mySerial.println(”AT+CMGF=1”); delay(1000); mySerial.println(”AT+CMGS=+̈880
delay(1000); mySerial.println(”Your Vehicle reg no-1245632 is fined with tk 500 for unauth parking in MIST”);// The SMS text you want to send delay(100); mySerial.println((char)26); delay(5000); msg2MIST(); }
void RecieveMessage() {
Serial.write(”Incomming msg ”); mySerial.println(”AT+CNMI=2,2,0,0,0”); delay(1000); if (mySerial.available()¿0) {
msg=mySerial.read(); Serial.print(msg); }
}

APPENDIX C
PhP Code for Master to Server

```
from mysql.connector import (connection)
import serial.tools.list_ports

list = serial.tools.list_ports.comports()
connected = []
i=1
print "Connected Serial Devices:" for element in list:
connected.append(element.device)
print str(i)+'.',
print element.device
i = i+1
selection = input('Enter target device: ')
ser = serial.Serial(str(connected[selection-1]), 9600, timeout=5000)
while 1==1:
data = str(ser.readline())
if data[0] == '*':
data = data.split(',');
device = data[0][1:]
print device
conn = connection.MySQLConnection(user='root', password='',
host='localhost',
database='location_db')
cursor = conn.cursor()
sql = ("INSERT INTO location"
"(device, number, status, lat, lon)"
"VALUES(sql_data = (device, data[1], data[2], data[3], data[4])
try :
cursor.execute(sql, sql_data)
except Exception, e :
print e
```

APPENDIX D
PhP Code for server to Android Application

```
≤?php
$servername = ”localhost”;
$username = ”root”;
$password = ””;
$dbname = ”locationdb”;

// Create connection
$conn = new mysqli($servername, $username, $password, $dbname);
// Check connection
if ($conn-¿connect_error) {
die(”Connection failed: ” . $conn-¿connecterror);
}

$sql = ”SELECT location.lat,location.lon,location.status,location.
device,issuedevice.nameFROMlocation
INNER JOIN issuedevicewherelocation.idIN(SELECT MAX(id) FROM
locationGROUPBYdevice)ANDlocation.device = issuedevice.deviceid”;
$result = $conn− > query($sql);
$myarray = array();
if($result− > numrows > 0){
while($row = $result− > fetchassoc()){
$myarray['position'][] = $row;
}
$myJson = jsonencode($my_array);
echo$myJson;
}
else{
echo”0results”;
}
$conn− > close();
? ≥
```

APPENDIX E
PhP Code for Maching Various Slave device in Localhost

```
≤?php
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "location_db";
//Createconnection
$conn = newmysqli(servername, username,password, dbname);
//Checkconnection
if(conn-¿connect_error){
die("Connectionfailed : ".conn-¿connect_error);
}
$sql = "SELECT device_id from issue_device";
$result = conn− > query(sql);
$my_array=array();
if (result− > num_rows > 0){
while(row = result− > fetch_assoc()){
my_array['issued'][]=row;
}
myJson= json_encode(my_array);
echomyJson;
}
else {
echo "0 results";
}
$conn-¿close();
?≥
```

APPENDIX F
PhP Code for Fetch last location of Slave Device-1

```
≤?php
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "location_db";
//Createconnection
$conn = newmysqli($servername, $username, $password, $dbname);
//Checkconnection
if(conn-¿connect_error)
 die("Connectionfailed : ".$conn- > connect_error); }
$sql = "SELECT lat,lon,status,device FROM location where id IN(SELECT MAX(id) FROM location GROUP BY device) ";
$result = $conn-¿query($sql);
$my_array = array();
if($result- > num_rows > 0){
while($row = $result- > fetch_assoc()){
$my_array['position'][] = $row;
}
$myJson = json_encode($my_array);
echo$myJson; }else{
echo"0results";
}
$conn- > close();
? ≥
```

APPENDIX G
PhP Code for Fetch last location of Slave Device-2

```
≤?php
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "location_db";
//Createconnection
$conn = newmysqli($servername, $username, $password, $dbname);
//Checkconnection
if(conn-¿connect_error){
die("Connectionfailed : ".conn-¿connect_error);
}
$name = trim($_POST["device_name"]);
//echo$name;
$sql = "SELECT lat, lon FROM location where device =' $name'";
result = $conn-¿query($sql);
my_array = array();
if(
result-¿num_rows > 0){
while($row = $result-> fetch_assoc()){
$my_array['point'][] = $row;
}
$myJson = json_encode($my_array); echo$myJson; }
else{
echo"0results";
}
$conn-> close();
? ≥
```

APPENDIX H

Experimental Data for Device -2 Tables (Evaluation on Academic Environment)

Table 5.1: Comparison of sent and received message (Academic Environment)

Ser	Duration	Sent SMS	Received SMS	Percentage
1	30 mins	120	118	98.33%
2	32 Mins	125	124	99.2%
3	35 Mins	127	127	100.00%
4	33 Mins	125	123	98.40%
5	36 Mins	130	128	98.46%

Table 5.2: Received message and uploaded data to server (Academic Environment)

Ser	Duration	Received SMS	Uploaded to Server	Percentage
1	30 mins	118	118	100%
2	32 Mins	124	123	99.02%
3	35 Mins	127	125	99.00%
4	33 Mins	120	120	100%
5	36 Mins	128	128	100%

Table 5.4: Table of battery life comparison (Academic Environment)

Ser	Duration
1	135 Mins
2	140 Mins
3	120 Mins
4	130 Mins
5	125 Mins

Table 5.3: Comparison of the received and actual Lon,Lat (Academic Environment)

Ser	lon-lat(Device)	lon-lat(Mobile)	Deviation(in feet)
1	90.3591555 , 23.838507	90.358781 , 23.838413	13.00
	90.359685 , 23.838516	90.358989 , 23.836848	14.00
	90.359263 , 23.837435	90.360069 , 23.838974	9.70
	90.360132 , 23.837321	90.360823 , 23.8370903	17.00
2	90.359154 , 23.838508	90.358781 , 23.838412	11.50
	90.359686 , 23.838528	90.358989 , 23.836849	18.00
	90.359273 , 23.837400	90.360075 , 23.838964	11.00
	90.360134 , 23.837326	90.360826 , 23.837094	19.00
3	90.359153 , 23.838590	90.358790 , 23.838450	10.00
	90.359684 , 23.838490	90.358989 , 23.836850	16.50
	90.359210 , 23.837395	90.360075 , 23.838970	18.00
	90.360136 , 23.837319	90.360820 , 23.837096	10.00
4	90.359155 , 23.838508	90.358779 , 23.838400	10.00
	90.359685 , 23.838528	90.358989 , 23.836849	13.00
	90.359272 , 23.837405	90.360075 , 23.838944	14.00
	90.360134 , 23.837326	90.360825 , 23.837094	12.00

Table 5.5: Gyro sensor reading and actual state (Academic Environment)

Ser	GYRO Readin	Actual Status	Remarks
1	1	1	
	0	1	Sender was not Active
	0	0	
	1	1	
2	1	1	
	0	1	Sender was not active
	1	1	
	1	1	
3	1	1	
	0	0	
	1	1	
	1	1	
4	1	1	
	1	1	
	1	1	
	1	1	

APPENDIX I

Experiment on Data for Device -2 Tables (Evaluation on Operational Environment)

Table 5.6: Comparison of sent and received message (Operational Environment)

Ser	Duration	Sent SMS	Received SMS	Percentage
1	35 mins	124	122	98.33%
2	40 Mins	130	129	99.20%
3	42 Mins	134	130	97.01%
4	38 Mins	128	128	100.00%
5	45 Mins	138	135	97.82%

Table 5.7: Received message and uploaded data to server (Operational Environment)

Ser	Duration	Received SMS	Uploaded to Server	Percentage
1	35 mins	122	114	93.44%
2	40 Mins	129	120	93.02%
3	42 Mins	130	125	96.15%
4	38 Mins	128	120	93.75%
5	45 Mins	135	128	94.81%

Table 5.9: Table of battery life comparison (Operational Environment)

Ser	Duration
1	120 Mins
2	124 Mins
3	128 Mins
4	115 Mins
5	120 Mins

Table 5.8: Comparison of the received and actual Lon,Lat (Operational Environment)

Ser	lon-lat(Device)	lon-lat(Mobile)	Deviation(in feet)
1	90.359155 , 23.838507	90.358781 , 23.838413	13.00
	90.359685 , 23.838516	90.358989 , 23.836848	15.00
	90.359263 , 23.837435	90.360069 , 23.838974	12.70
	90.360132 , 23.837321	90.360823 , 23.837090	14.00
2	90.359154 , 23.838508	90.358781 , 23.838412	12.50
	90.359686 , 23.838528	90.358989 , 23.836849	14.00
	90.359273 , 23.837400	90.360075 , 23.838964	15.00
	90.360134 , 23.837326	90.360826 , 23.837094	15.00
3	90.359153 , 23.838590	90.358790 , 23.838450	15.00
	90.359684 , 23.838490	90.358989 , 23.836850	15.50
	90.359210 , 23.837395	90.360075 , 23.838970	14.00
	90.360136 , 23.837319	90.360820 , 23.837096	10.00
4	90.359155 , 23.838508	90.358779 , 23.838400	14.00
	90.359685 , 23.838528	90.358989 , 23.836849	15.00
	90.359272 , 23.837405	90.360075 , 23.838944	09.00
	90.360134 , 23.837326	90.360825 , 23.837094	16.00

Table 5.10: Gyro sensor reading and actual state (Operational Environment)

Ser	GYRO Readin	Actual Status	Remarks
1	1	1	
	0	1	Sender was not Active
	0	0	
	1	1	
2	1	1	
	0	1	Sender was not active
	1	1	
	1	1	
3	1	1	
	0	0	
	1	1	
	1	1	
4	1	1	
	1	1	
	1	1	
	1	1	

APPENDIX J

Experimental Data for Device -2 Tables (Evaluation on Academic Environment)

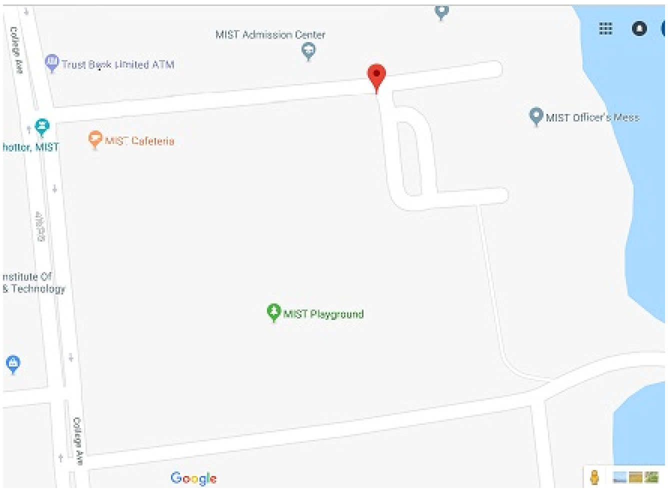

Figure 5.1: Lat,lon Evaluation By the System(Device-2)

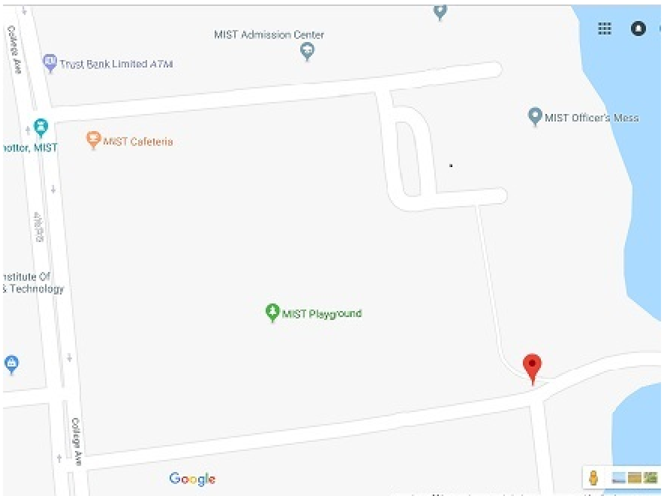

Figure 5.2: Lat,lon Evaluation By the System(Device-2)