VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI-590018

A Project Report(18ECP83)

On

“SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR MILITARY PURPOSE”

A Project report submitted in partial fulfillment of the requirements for the award of the degree of
***Bachelor of Engineering in Electronics and Communication Engineering** of*
Visvesvaraya Technological University, Belagavi

Submitted by

KARTHIK G NAYAK (1DT18EC040)
LIKITH KUMAR K (1DT18EC045)
MAHESH G (1DT18EC048)
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Under the Guidance of

Mrs. KALPAVI C Y
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Department of Electronics and Communication Engineering
DAYANANDA SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT
Accredited by NBA, New Delhi, Accredited by NAAC with Grade A+
Udayapura, Kanakapura Road, Bengaluru-560082

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Signature of Guide	Signature of Coordinator	Signature of HOD
Mrs. Kalpavi C Y	Dr. Siddalingappagouda Biradar	Dr. R. Manjunatha Prasad

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Department of Electronics and Communication Engineering

CERTIFICATE

This is to certify that the project work entitled **"SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR MILITARY PURPOSE"** is carried out by **KARTHIK G NAYAK (1DT18EC040), LIKITH KUMAR K (1DT18EC045), MAHESH G (1DT18EC048), MANOJ D L (1DT18EC049)** bonafide students of **DAYANANDA SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT** in partial fulfilment for the award of the degree of **Bachelor of Engineering in Electronics and Communication Engineering** of the **Visvesvaraya Technological University, Belagavi** during the year **2021-2022**. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited the departmental library. The project report has been approved as it satisfies the academic requirements with respect of project work prescribed for the award of Bachelor of Engineering Degree.

Signature of the guide	Signature of the HOD	Signature of the Principal
Mrs. Kalpavi C Y	Dr. R. Manjunatha Prasad	Dr. Ravishankar M.

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2.		

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ABSTRACT

The nation's safety or security is extremely important in the current world situation. It's been observed that the country's security is primarily dependent on the soldier's unit or army force. In battleground or clandestine operations, troops communication and health monitoring are critical. Technologies such as walkie-talkies or GSM modules were often used methodologies for communication and tracking soldiers' lives on the battlefield in the last few decades. These studies suggest an effective way to use an electronic device that can transform sign language hand gestures into speech to allow effective interaction among soldiers to adapt to the current technology. The technology involves converting hand signals into voice signals, which can subsequently be transmitted via wireless modules. The 'Hand Talk' glove is a regular driving glove with electrode sensors built in. The sensors produce a stream of data that varies depending on finger's flexibility. The sensor's output is converted to digital and processed with an Arduino, after which it reacts to voice commands over Zigbee. It is also necessary for the control station to know the health condition of soldiers along with the location on the battlefield. To track the current situation, the device is mounted in a hand glove and data can be transferred to the base station with help of IoT (Internet of things). The main motivation in this research is to know how to build effective communication between soldiers along with their health monitoring system.

Keywords: Flex senor, GSM (Global System for Mobile Communication), Zigbee, IoT (Internet of Things).

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CHAPTER I

INTRODUCTION

1.1 OVERVIEW

India has 26,10,550 number of soldiers at present survey of 2022 where broadly sector group into navy, broader security, air force and some special troops sector. Communication is way of expressing the message or conveying to the people of all the aspects of message, where army network is a busy complimentary network communication could be a barrier in some active state of condition.

As the most of battles or search operation happens or tends to be in more critical path sceneries, where communication would be a not effective done, as the result the mislead of operation or the failure of the mission takes place, along with this where health condition of the soldiers are also top most important priority where if any circumstance approach happen to the soldiers in the warfare operation the basic necessity for emergency evacuation of that particular is needed through navigation. By using implementation of smart network by associating some of the digital and analog operational devices the effective solution can be granted to the critical problems. The solutional approach can be given by effective implementation or fabrication a materialistic thing as smart gloves in which smart gloves is nothing but a normal cloth glove fitted with flex sensors and other modularity of circuits, the main principle behind this is “real time communication”.

Real time communication defines to be conversion of specific hand gesture signal into specific message signal and received via wireless module at the receiver part as the received output where encryption of data can happen, which was major part of the communication ratio. The soldier’s health modernization can be implemented by associated some medic sensors into the digital circuitry of smart gloves like temperature sensors and heartbeat sensors where the instantaneously health report can be monitored where the main application of usage can be optimized and effective utilization. Along with this a GPS tracker is also installed in wearable smart gloves where the exact navigation bar or coordinates of position can be monitored in the ratio where it will be added advantage for evacuation of the solders in a greater extent.

The goal ratio of strategizing of the project implementation was to demonstrate of versatile network of electronics to give optimistic approach to society called as “army” by various means of aspects like communication, medical aspects, navigation bar also standardization of core aspects of effective methodology by IOT and embedded systems.

1.2 ARMY HAND GESTURES

Hand and Arm signals are one of the most widely recognized types of correspondence utilized by fighters or gathering of warriors when a radio quiet is active or on the other hand if the troopers need to stay undetected. Using these signs military pioneers, like group pioneers, crew pioneers and unit pioneers, can keep Command and control (C2) over their specific component. All newcomers are educated to utilize the legitimate hand and arm signals tracked down in the FM. Nonetheless, it is entirely expected for units to embrace or potentially make their own signs. These signs eventually become known as SOP or standard working system.

Visual signs are any method for correspondence that require sight and can be utilized to communicate coordinated messages quickly over brief distances. This incorporates the gadgets and means utilized for acknowledgment and distinguishing proof of well-disposed powers.

1.2.1 TYPES OF HAND SIGNALS

Heads of gotten off units use arm and hand signs to control the development of people, groups, and crews. These signs are utilized by infantry and furthermore by battle backing and battle administration support components coordinated for infantry missions.

Heads of mounted units use arm and hand signs to control individual vehicles and company development. At the point when distances between vehicles increment, banners (wrapped and tied) can be utilized as an augmentation of the arm to give the signs. From certain vehicles (for instance, Bradley, M2), the arm and hand signs will be twisted.

Figure 1.1**:** Army Hand Gesture

1.3 INTRODUCTION TO IOT

The Internet of Things (IoT) is the network of physical objects containing electronic components embedded in their architecture to communicate and detect interactions with each other or with the external environment. In the coming years, IoT-based technology will provide advanced services and practically change the way people go about their daily lives. Advances in medicine, energy, gene therapies, agriculture, smart cities and smart homes are just a few of the categorical examples where the IoT is firmly established.

IoT is a network of interconnected computing devices embedded in everyday objects, assisting in enabling them to send and receive data. More than 9 billion physical objects are currently connected to the Internet as of now. In the near future, that number is expected to rise to a whopping 20 billion.

Components used in IoT are Low consumption embedded systems: Less battery consumption, high performance are the reverse factors that play an important role in electronic system design and Sensors – Sensors are the backbone of any IoT application. It is a physical device that measures and detects a physical quantity and converts it into a signal that can be provided as input to the processing or control unit for analysis.

1.3.1 WORKING WITH IOT DEVICES

- Collecting and transmitting data: Sensors are widely used for this and are used in different application areas as required.
- Activation of the device based on triggers generated by sensors or processing devices: If a certain condition is met or according to the user's requirements, when a certain trigger is activated, then the actuator devices will indicate what action to perform.
- Obtain information: From network devices, the user or the device can also take certain information for analysis and processing.
- Communication Support: Communication support is the phenomenon of communication between 2 networks or communication between 2 or more IoT devices on the same or different networks. This can be achieved through various communication protocols such as MQTT, Application Restricted Protocol, ZigBee, FTP, HTTP, etc.

1.3.2 FEATURES OF IOT

Massively scalable and efficient IP-based addressing will no longer suffice in the near future. There are many physical objects that do not use IP, so IoT is possible. devices typically use less power. When not in use, they should automatically go to sleep. A device that is connected to another device at this time must no longer be connected at another time.

Intermittent connectivity: IoT devices are not always connected. To save bandwidth and battery consumption, devices are regularly turned off when not in use. Otherwise connections can become unreliable and thus inefficient.

1.3.3 MODERN APPLICATION SECTORS OF IOT

- Smart Grids & Energy Saving
- Smart Cities
- Smart Homes/Home Automation
- Health
- Earthquake Detection
- Radiation Detection/Explosive Gas Detection
- Smartphone Detection
- Water Flow Monitoring
- Traffic Monitoring
- Wearables
- System of Smart Door Lock Protection
- Robots and Drones
- Health and hospitals, telemedicine applications
- Security
- Biochip transponders (for livestock)

1.4 INTRODUCTION TO CLOUD COMPUTING

Cloud computing is the delivery of computing resources as a service, meaning that the resources are owned and managed by the cloud provider rather than the end user. These resources can include anything from browser-based software applications (like

Netflix), third-party data storage for photos and other digital media (like iCloud or Dropbox), or third-party servers used to support the computing infrastructure of a business, research, or personal project.

Before cloud computing became widespread, businesses and general computer users generally had to purchase and maintain the software and hardware they wanted to use. With the increasing availability of cloud-based applications, storage, services, and machines, businesses and consumers now have access to large amounts of computing resources on demand as services accessed over the Internet. The move from on-premises software and hardware to distributed, remote network resources means cloud users no longer have to invest the labor, capital, or expertise to purchase and maintain those computing resources themselves. This unprecedented access to computing resources has spawned a new wave of cloud-based businesses, transformed IT practices across industries, and transformed many everyday computing practices. With the cloud, people can now collaborate with colleagues via video conferencing and other collaboration platforms, access on-demand entertainment and educational content, communicate with devices using, call a cab using a mobile device, and rent a hotel room at home.

1.4.1 TYPES OF CLOUD COMPUTING SERVICES

1) Infrastructure as a Service (IaaS)

Also known as utility computing, this is the on-demand delivery of computing infrastructure. That means everything from operating systems and storage to networks and components is outsourced to a cloud computing company or service. As a private person or company, you buy what you need on a pay-as-you-go model.

2) Software as a Service (SaaS)

This is when you use a complete application on a third-party server or system. Users can access these applications on-demand over the Internet without downloading or maintaining software. SaaS cloud technology is very popular among businesses and general users as it is often easy to adopt. It can also be accessed from any device and there are often a variety of paid or free options to choose from.

3) Platform as a Service (PaaS)

This form of cloud computing is often used by software developers who want to focus on development rather than DevOps and management. It's effectively a way to develop an application without having to worry about installing, configuring, and maintaining any infrastructure. This is provided by the server as a standardized environment.

1.4.2 TYPES OF CLOUD ENVIRONMENTS

1) Public Cloud

Public Cloud environments are operated by third parties. They provide computing resources such as servers and storage options over the Internet. While this type of cloud service isn't necessarily best suited for regulated industries like healthcare, it might be suitable for smaller businesses.

2) Private Cloud

This type of cloud environment is owned and managed by a customer. This means that only the customer's employees can access this cloud system. A private cloud allows you much greater control over your computing environment data and is often implemented in regulated industries such as finance.

3) Hybrid Cloud

Sometimes referred to as multi-cloud, hybrid clouds are basically a combination of public and private clouds. These clouds basically allow you to move information and data between public and private clouds. This can give your organization much more flexibility and streamline your infrastructure.

1.5 EMBEDDED SYSTEM

An embedded system is a computer system—a combination of a computer processor, computer memory, and input/output peripheral devices—that has a dedicated function within a larger mechanical or electrical system. It is embedded as part of a complete device often including electrical or electronic hardware and mechanical parts. Because an embedded system typically controls physical operations of the machine that it is embedded within, it often has real-time computing constraints. Embedded systems control many devices in common use today. Ninetyeight percent of all microprocessors manufactured are used in embedded systems. Modern embedded systems are often based on microcontrollers (i.e. microprocessors with integrated memory and peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in a certain class of computations, or even custom designed for the application at hand.

A common standard class of dedicated processors is the digital signal processor (DSP). Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting economies of scale. Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic light controllers, programmable logic controllers, and large complex systems like hybrid vehicles, medical imaging systems, and avionics. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large equipment rack.

1.5.1 CHARACTERISTICS OF EMBEDDED SYSTEMS

Some of the key characteristics of Embedded Systems are as mentioned below.

- All Embedded Systems are task specific. They do the same task repeatedly continuously over their lifetime. An mp3 player will function only as an mp3 player.
- Embedded systems are created to perform the task within a certain time frame. It must therefore perform fast enough. A car's brake system, if exceeds the time limit, may cause accidents.
- They have minimal or no user interface (UI). A fully automatic washing machine works on its own after the program is set and stops once the task is over.
- Some embedded systems are designed to react to external stimuli and react accordingly. A thermometer, a GPS tracking device.
- Embedded systems are built to achieve certain efficiency levels. They are small sized, can work with less power and are not too expensive.
- Embedded systems cannot be changed or upgraded by the users. Hence, they must rank high on reliability and stability. They are expected to function for long durations without the user experiencing any difficulties.
- Microcontroller or microprocessors are used to design embedded systems.
- Embedded systems need connected peripherals to attach input & output devices.

- The hardware of an embedded-system is used for security and performance. The Software is used for features.

1.5.2 APPLICATIONS OF EMBEDDED SYSTEMS

- Consumer electronics – Televisions and digital cameras; computer printers; video game consoles and home entertainment systems like PS4.
- Household appliances – Refrigerators; washing machines, microwave ovens, air conditioners.
- Medical equipment – Scanners like those for MRI, CT; ECG machines; devices to monitor blood pressure and heartbeat.
- Automobiles – Fuel injection systems, anti-lock braking systems, music and entertainment systems, controls for air-conditioner.
- Industrial applications – Assembly lines, systems for feedback, systems for data collection.

CHAPTER II

LITERATURE SURVEY

L. Vijay Anand *et* al [1] It describes the health monitoring and tracking of soldiers and its responsibility with the GPS to guide the losing direction in the correct direction. Whenever it is necessary the control unit can access the information of the soldier with help of Internet of things (IoT) based on tracking parameters. The proposed system is divided into two sections i.e., Soldier unit and Control room unit. The below circuit diagram shows the proposed model. The information received is stored in Cloud and can be extracted on the PC of the base station. Based on the information the immediate action is taken with necessary medical aids and back force for the help.

Bhavana Madabathula *et* al [2] There are various ways to detect the sign language such as Data glove approach, Vision-based approach and Virtual button approach. This paper highlights the advantages of sign language using Data glove approach i.e., Flex sensor-based glove that has high level of reliability, consistency, harsh temperature resistance, with stationary surfaces for mounting, an Infinite number of resistance possibilities and with specific value of bend ratios. The each bent in the finger the different values are obtained. The IMU (Inertial Measurement Unit) is used to identify the hand position. When the output of the respective hand gesture is obtained the voice, output is given through the mobile application with the help of Bluetooth module.

Shigeru Shimamoto *et* al [3] The proposed methodology was on sensor-based data acquisition glove with hand gesture recognition. Flex sensors and Force Sensing Resistors (FSRs) are used to detect bending movement in the gloves. Then data will send to the computer by Arduino micro for the further simplification. By using Support Vector Machine (SVM) and the Dynamic Time Wrapping (DTW) based algorithm we can find the average accuracy of the hand gesture recognition for a single subject.

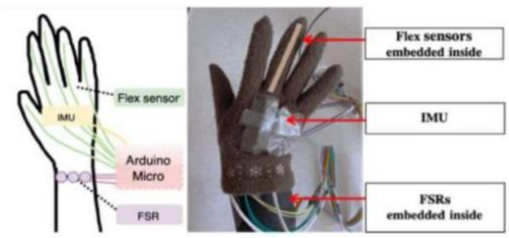

Figure 2.1**:** The Data Acquisition Glove With 3 Kinds of Sensors

In this project 3 subjects are asked to put on the glove and make 7 gestures 100 times each. The collected data will separate into 100 segments by using the automatic data segmentation method. In Single Subject Hand Gesture Recognition, SVM for each gesture a twenty-eight-dimensional feature vector is fetched from sensor data. In this 80 of group vectors are used for training the model, rest twenty is used for testing. Using DTW based algorithm for each gesture. the first group of data is selected as the template, and rest twenty groups are used as test samples. The average accuracy of the three-subject using SVM and DTW based algorithm are e 96.9% and 94.5% respectively. Here two different method is used for each gesture, will give a different recognition result for the same gesture. For the further verification, in Cross-Subject Hand Gesture Recognition the training data will be maintained by one user and hand gesture recognition is done by another user. Same procedure of single subject hand gesture recognition will be followed here. When doing gestures there will be bending movement on fingers it will result in some deviation in the recognition. So, by this accuracy value got decreased. The accuracy can be improved by increasing collecting of subjects as well as training of subjects.

Albert Mayan J *et* al [4] In the reality, even dumb people want to talk like normal people. They don’t have proper communication facility available. So, in this paper smart gloves used with flex sensors and mem sensor attached to it. This type of model is used to convert Indian sign gesture into understandable voice. Artificial mouth is implemented to overcome from the complexity. Motion sensors are helpful to detect motion. Database stores messages and templates. Also, the speaker and microphone are used as input devices.

In this system gloves with flex and MEM sensors are more flexible and accurate. The microcontroller stores all the data that is send from sensors. Database which stores messages and templates which transfer or store copy of templates in the microcontroller as well. Motion sensors reacts to every action made by the user and it is placed on hand. Motion sensors which will activate only if there is any motion detected. For every action the motion detector gets high and fed to the microcontroller. Now the microcontroller has copy of templates which compared with the fetched motion signals. Microcontroller will match both of this and convert hand gesture into suitable speech signals. After this speech signals transferred to the artificial mouth to retrieve the data and now dumb people can talk with their artificial mouth. The result of the model or message of the model shown on the display also it will be played on speaker as well.

Sambhav Jain *et* al [5] The way through which a smart glove can be used to aid the visually impaired. They have designed the glove using USB (Universal Serial Bus) camera using built-in microphone. Here gloves are used to point out the object which a visually impaired person says to the microphone. Whenever the input of audio is given by the user it is converted to respective text format using “pyttsx3” – speech to text module. Using keyword Extraction technique, the name of the object needed by the user is extracted. Which is passed through running DNN (Deep Neural Networks) which processes the real-time video and locates the required object and tags the same. The micro-vibrating motors is used to guide the user to move his hand in such a way that the object is brought back to the center of the frame when object is not pointed to center of the glove. Till the object is pointed to center of the glove micro-vibrating motor keeps vibrating to guide the user forward. Thereby the required object is fetched by user of smart glove.

Meghana H S *et* al [6] Generally, in this paper smart gloves are named as “Hand Talk”. The movements are detected based on the electrode sensors attached to it. To convert to digital signals Arduino is used. Use of voice kit will produce voice signals. Also, Wi-Fi module is used to take advantage from internet for the model. Whenever it is necessary to compact the integrated circuit with specific operation microcontroller is used in embedded system. For the computing power embedded system is used because as day by day there is increasing requirement for the embedded software.

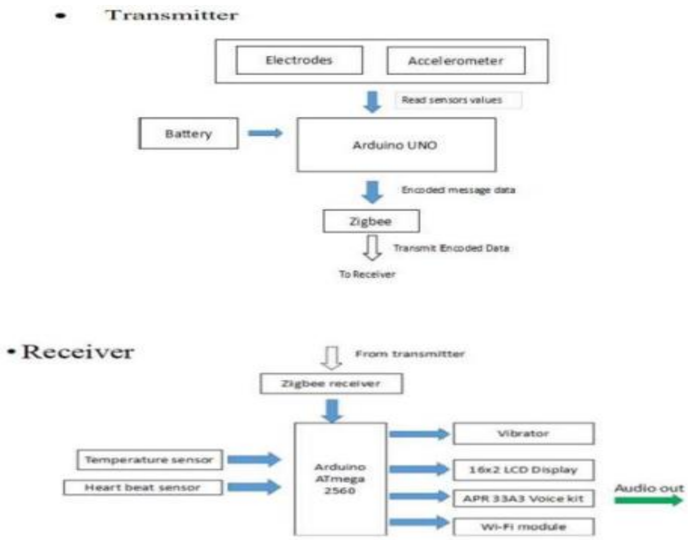

Figure 2.2**:** Block Diagram of Working of Smart Glove

Smart gloves are attached with the electrodes and accelerometer which will record the values for the different hand gestures did by user. Accelerometer helps to analyse the position of the hand gesture. The copper electrodes or sensors what we used will collect the values and send to the Arduino UNO for the further process. Now the Arduino UNO will help to convert the sensors collected values into digital signals. Zigbee helps to transfer converted digital signals to the Arduino ATmega2560. Now the heart beat sensors and temperature sensors are connected to this for the health monitoring system. Converted Digital signals will compare with the pre-defined data stored in the memory at receiver side. Now by using this the following hand gesture are converted into voice message and send to the nearby devices.

Dr. Golda Jeyasheeli P *et* al [7] It suggests the way how deaf and dumb people can use alphabets in mobile devices through the use of smart glove which converts the gesture to relevant alphabet. Flex sensors are connected to all ten fingers of with different sizes based on the fingers and pressure sensor is implemented to invoke the use of flex sensor which in turn is attached to Arduino mega microcontroller. The proposed methodology has two HC-05 Bluetooth modules. Predefined data for various movements of flex sensors are recorded which is used to compare the output when gesture is done using all the fingers. Based on both the hand movements and predefined data the output is recorded and sent to mobile device using inbuilt Bluetooth.

Anshula Kumari *et* al[8] In this methodology it tells how Smart gloves is helpful to the communication for deaf and dumb people. The main intension of a smart glove is to convert hand gesture into sound message. Smart gloves which are attached with the flex sensors. And the microcontroller is used for the further communication. So, in the output side Bluetooth module is used to hear the voice signal.

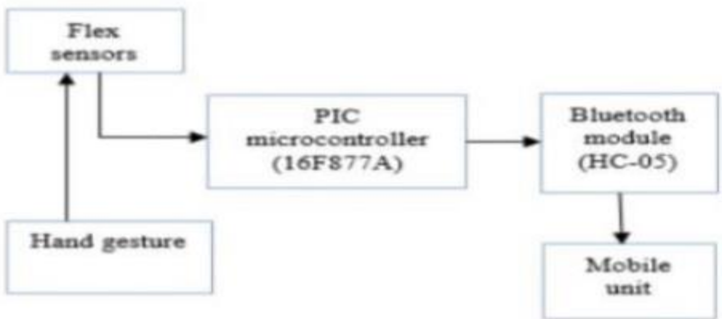

Figure 2.3**:** Block Diagram Explaining the Operation

This model is used mainly for the translating hand gesture into suitable voice system so that there will be no any problem for deaf and dumb people during communication. Movement detected in flexes sensors which can rotate in any direction. The signals that are sensed are send to the PIC Microcontroller (16F877A). Microcontroller matches sensed signals with threshold frequency. If the sensed value is above 150 then output state as 1, if it is below then it says as 0. This will be done for all hand gestures. After converting to zeros and ones the microcontroller coded in such a way that it decodes the message from it and sends it to the Bluetooth module. Now module will recognize the message and output it through voice message.

Ateequeur Rahman *et* al [9] As referred to the work has put forward the way of designing gadget put on a hand with sensors fit for assessing hand signals thereby communication via gestures interpretation. This arrangement plans Human Computer Interface (HCI) gadget that can be easily used by any hard of hearing and quiet people with the capacity to easily speak with anybody. Here they made use of flex sensors, Arduino nano, accelerometer/gyroscope sensors, graphic LCD display and a speaker.
The major benefit of the design is that Real time translation approximately happens in no time delay and the system can be developed with Wi-Fi connection thereby extending database as a future scope so that special symbols and characters can be made supported and also to provide compatibility for multiple international languages, Microsoft Text to Speech (TTS) engine can be utilized.

CHAPTER III

PROBLEM STATEMENT

Most of the surgical strikes demands for silent operation, Since the soldiers cannot equip walkie talkie as a medium of communication which can alert their presence to intruders or enemies. Tactical hand symbols are using most of the time it is not received by others due to low visibility of light during night. Lack of communication miss gap leads to the huge destruction. Concerning about the health and to reduce failure of soldiers due to health issue it a difficult task to physically monitor the health status of the soldier during the war. If a soldier moves out of the located range it should be recognized and respective action to be taken which can be a struggle.

CHAPTER IV

OBJECTIVES

- In order to reduce the impact mentioned in the problem statement the main objective is to overcome the complications during the war fare both in day as well as night.
- The main intent of the project is to design a wearable smart hand gloves for communicating among the soldiers, besides for health monitoring as well.
- Objectives includes to adopt different sensors and components for enhancing the workability and hence, analyzing the health condition of the soldiers.
- Aim is to track the location of the soldier using cloud and providing the basic health status. Using cloud and IoT to improve the effectiveness of the model which are considered as the growing recent technologies.

CHAPTER V

SYSTEM DESIGN

Design is the technique which is used to do the system analysis, it would be necessary to identify the data that is required to be processed to produce the outputs. Design features can ensure reliability of the system and generate correct reports from accurate data. It is also possible to determine whether the user can interact efficiently with the system.

System design deals with transforming the customer requirements into set of documents that is suitable for implementation in a programming language. It is the process of defining the architecture interface components and other characteristics of a system. The design stage takes the requirements identified in the approved requirements document (SRS) its initial input.

5.1 DESIGN GOALS

The following are the design goals to every application regardless of application domain, size or complexity.

- Simplicity
- Consistency
- Identity
- Visual appeal
- Compatibility

5.2 APPROACH

The total system is divided into 6 modules – Interfacing of sensors, Generating Digital code, Zigbee Transmission, Speech Conversion, Health monitoring and GPS location, Cloud transmission.

1) Interfacing of sensors
    - Interfacing of Flex sensor, temperature sensor and pulse sensor on to the glove.
    - Thresholding of flex sensor

- Generation of analog values from flex sensor, temperature sensor and pulse sensor.

2) Generating digital code
    - Analog signals are generated by sensors.
    - Signals are converted into equivalent digital code using ADC converters

3) Zigbee Transmission
    - Digital codes are generated using ADC converters in Arduino UNO R3.
    - Digital codes are transmitted from Arduino Uno R3 transmitter to Arduino Uno R3 receiver using Zigbee.

4) Speech conversion
    - Program is dumped in Arduino Uno
    - Using the Program digital code are transferred to APR module.
    - APR module is set with pre-recorded voice signals and compared with the digital code.

5) Health Monitoring and GPS location
    - The pulse sensor and temperature sensor generate analog data.
    - The Analog values are converted into Digital values with the help of ADC in Arduino Uno.
    - The GPS module fetches with the Longitude and Latitude Co-ordinates.
    - The Arduino fetches with Co-ordinates are converted to digital.
    - The digital values are transferred to cloud with the help of ESP8266.

6) Cloud Transmission
    - The values fetched from ESP8266 are tracked in gauge for the pulse sensor and temperature sensor.
    - The indication is seen when the value crosses its limit.
    - The GPS location is feed into Livefeed and tracks helps to detect the exact location of the soldier.

5.3 SYSTEM ARCHITECTURE

System Architecture is a conceptual model that defines the structure, behaviour, and more views of the system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviour of the system. A system architecture can comprise system components that will work together to implement the overall system.

5.3.1 FUNCTIONAL BLOCK DIAGRAM

The block diagram for system architecture is shown in the Figure 5.1.

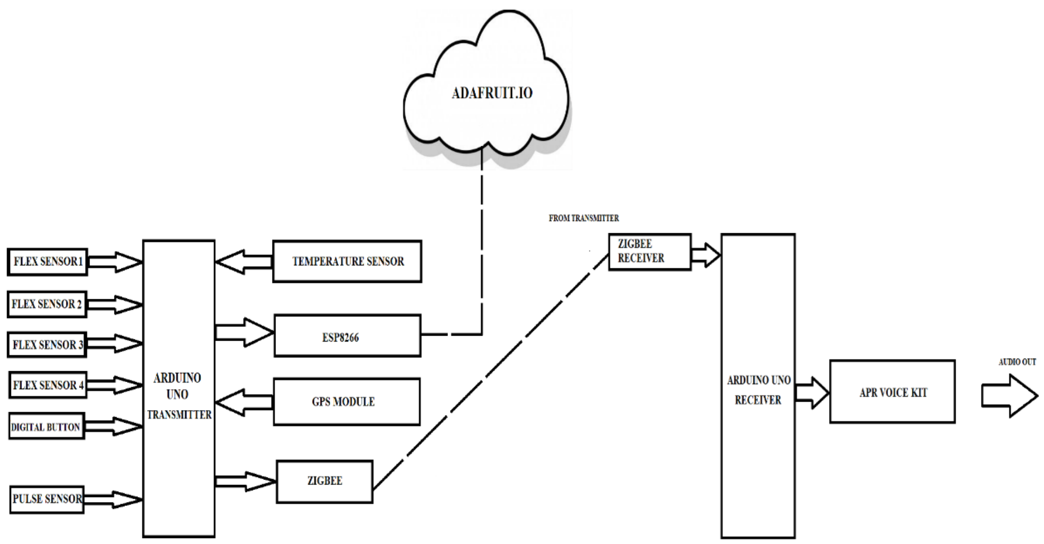

Figure 5.1**:** Block Diagram of The Project

In the figure 5.1 that is the block diagram of the project. Here there will be four flex sensors of 4.5cm each length. These four flex sensors which is connected to the Arduino UNO transmitter. These sensors which generates the data whenever the gestures are made. These gestures are in the form of analog data. These analog data fed to the Arduino UNO transmitter to transfer data from source to destination. Also, there will be ZigBee transmitter which is connected to transmitter Arduino so send data to the receiver.

Now the ZigBee transmitter send data to the ZigBee receiver which is implemented in the receiver. Now this ZigBee receiver also connected to the Arduino UNO receiver. This Arduino UNO receiver coded in a such way that it will convert the analog data into digital data. The main purpose of converting analog into digital is audio playing and recording only supports digital data. Now APR (Audio playing and recording) kit has an 8bit predefined voice. This is connected to the Arduino UNO receiver. Whatever the converted digital data will be checked with the predefined data in Arduino, if it matched with that then the voice output will be send to the APR kit from here the voice will be spoken out from speaker. Also, there will be digital button which will only activates when there is transfer of data taking place.

Also, there will be temperature sensors and pulse sensors which will continuously sense the health status of the solider and send data to the Adafruit.io cloud platform using ESP8266 Wi-Fi module. There we have used NEO-6M GPS module to detect live location of the solider. As we login to the cloud platform we can see the live health status of the solider. Also, we have set the threshold range, whenever the solider get wounded the main pulse rate and body temperature of solider will get low. As it crosses the defined threshold range then automatically the live location of the solider sent it to the military base station. In future if want solider health status then we can download his data from cloud in the form of Excel sheet. So, by doing this we can save the solider by getting harm.

5.3.2 CIRCUIT DIAGRAM

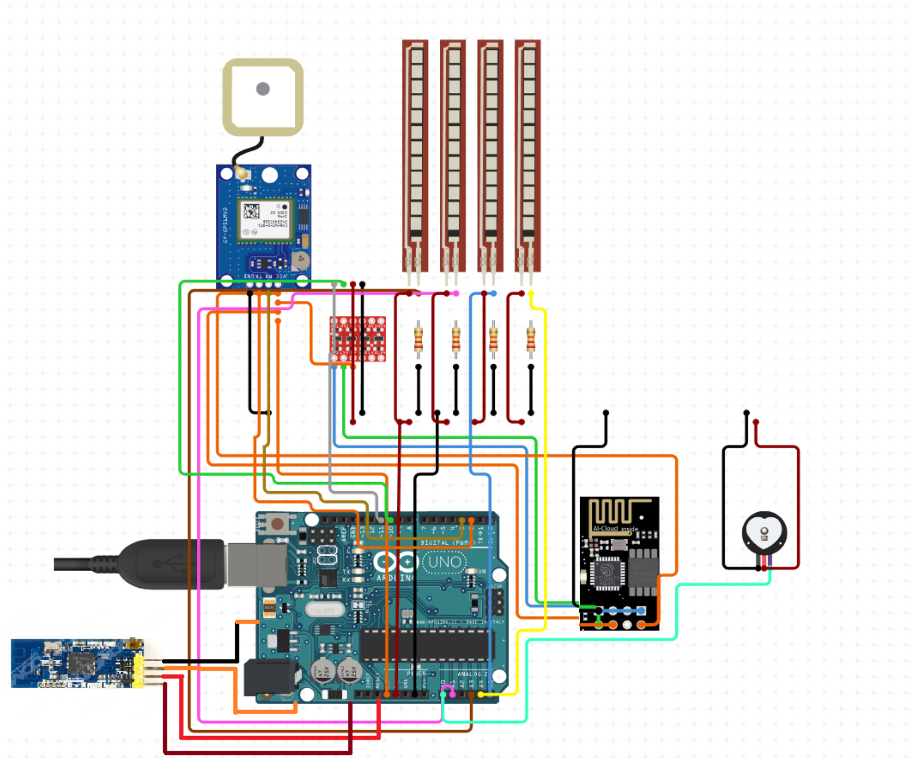

Figure 5.2**:** Transmitter Circuit Diagram

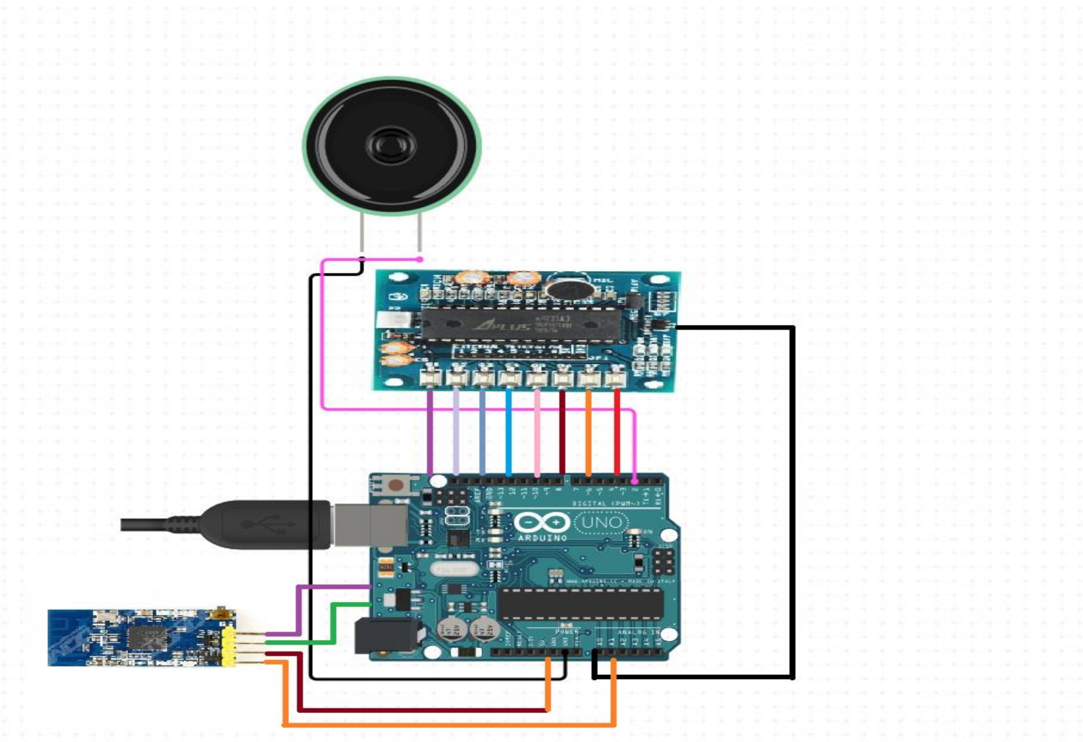

Figure 5.3: Receiver Circuit Diagram

5.3.3 PINS USED

In this system, the features are extracted from the hardware sensor inputs and the targets are the speech in hand gesture. To realize several hardware components were considered during prototyping. Much of the hardware was selected due to their ease of use and accuracy. the flex sensor required additional analog pins, careful planning allowed us to fit the circuit in an agreeable manner on the hand glove. Space was managed to add in the 2.4G Zigbee module onto the device. All the sensors must be placed in a way as to not make contact with each other causing short circuits which and disruption of measurement readings. Electrical tape was necessary to provide insulation for our sensors.

The system recognizes gestures made by the hand movements by wearing the glove on which two sensors are attached, the first sensor is to sense the bending of five fingers, the flex sensor of 2.2 inches for thumb. Since the output of flex sensor is resistive in nature the values are converted to voltage using a voltage divider circuit. The resistance values of 4.5-inch flex sensors range from 7K to 15K and for 2.2-inch flex sensor, it ranges from 20K to 40K, as shorter the radius the more resistor value. Another 2.5K ohm resistor is utilized to build a voltage divider circuit with VCC supply being 3.3volts taken from Arduino Nano processor, the voltage values from the voltage divider circuit being analog in nature are given to the Arduino UNO R3 processor which has an inbuilt ADC. The values of the flex sensors are processed in the Arduino UNO which is interfaced with 2.4G Zigbee module embedded on the glove which provides the approximate range of 100 meters. The Arduino UNO R3 at the receiver end checks with the pre-defined values. In accordance with the digital value received the voice is set with APR module of (M1-M8). The specific voice command is received. The pulse sensor and temperature sensor values transferred with ESP8266 to Adafruit. The MQTT protocol is used to publish the data across the Adafruit. It helps to set the threshold limit, the values received across helps to check the limit and show the data.

TABLE I**: -** Pins Used in Circuit Design

COMPONENTS	**PINS USED**
Arduino	Transmitter Analog pins -A0, A1, A2,A3 GND-2, 3.3V, 5V,Tx->1, Rx-> 0 Receiver Digital pins- 2,3,4,5,6,7,8,9,10 GND-2, 3.3V, 5V, Tx->1, Rx-> 0
Flex sensor	Pin P1 & Pin P2 +Ve Terminal of Power [P1], Gnd [P2]
Zigbee Module (2.4 GHz)	Tx, Rx, GND, Power.
Pulse sensor	s, GND, Power
Temperature Sensor	GND, Data, Power
GPS Module	Tx, Rx, GND, Power
APR33A3	M0, M1, M2, M3, M4, M5, M6, M7, M8

5.4 SYSTEM IMPLEMENTATION

Implementation is the stage/phase of the undertaking where the hypothetical outline, dreams and plans are changed over to a working framework. Along these lines it is considered as a standout amongst the most imperative stage in building another framework effectively and giving certainty to the client that the new framework fabricated will be viable and works faultlessly. The major steps involved in implementation stage are analyzing the problem, planning, and careful investigation of implementation constraints, evaluating and optimizing the design.

5.4.1FLOW CHART

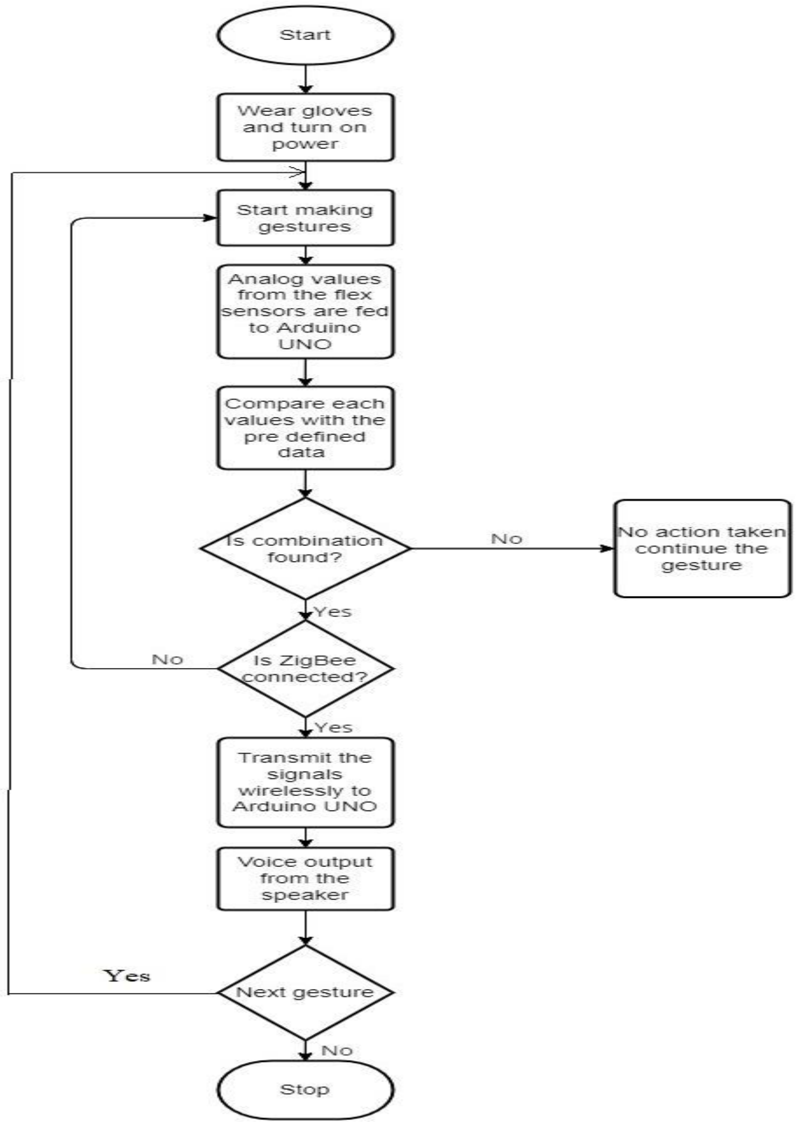

Figure 5.4**:** Flow Chart of the Gesture Recognition

Step 1: Start of the flow chart

Step 2: Wear smart gloves with flex sensors and switch on the power supply

Step 3: Start making different gestures according to our need

Step 4: Gestures are in the form of analog and fed into the Arduino UNO to convert it too digital.

Step 5: Now converted digital data is compared with the pre-defined data in the Arduino

Step 6: If combination not found then it checks for next gestures. If found, then it checks for ZigBee

Step 7: If ZigBee connection not found then it checks for gestures, If ZigBee connection found then it transmits the signal wirelessly to the Arduino UNO receiver.

Step 8: Transmitted signals send it to the audio playing recording kit to speak the voice

Step 9: Now the voice is spoken out through speaker which is connected to APR

Step 10: After all this process, it again checks for next gestures and process flow continuously

Step 11: Terminate the process

5.4.2 METHODOLOGY

Gesture Recognition

The smart glove is fixed with the flex sensor, which is more flexible and accurate for measuring hand gesture. For recognition of gesture through finger action of all the fingers needs to be analyzed. Hence, Gloves is fixed with flex sensors which records different values for various hand gestures. Sensed values of various bends of flex sensors corresponding to different action and positions of all the fingers transferred to Arduino UNO. These values of output are converted to digital values in Arduino UNO and sent via Zigbee. Zigbee is used as the both transmitter and receiver in both the ends. Near Zigbee receives the digital value of output at receiver end. At the receiver, these values are compared with pre-defined data, which are stored in memory of Arduino UNO. Based on different hand gesture pre-defined messages for vocalized version is received at receiver end. APR module produces the audio with respective input hand gesture.

Figure 5.5**:** Hand Symbols

Health Monitoring

Temperature sensor parallelly records the temperature and indication are given when the temperature of glove user is out of defined range. With addition to temperature sensing heart beat sensor is adopted to record heart beat which works on principle of photoplethysmography. Google positioning system locates the coordinates of glove which is based on trilateration mathematical principle there by locating continuously the location of the glove user. At receiver end these values are compared with predefined data which is stored using cloud computing software. Stored Data in cloud can be accessed by military base station reference.

The information received is stored in Cloud and can be extracted on the PC of the base station. Based on the information the immediate action is taken with necessary medical aids and back force for the help. The proposed system can monitor pulse, body temperature, and oxygen level in an area, as well as the location tracking of soldiers using GPS. The Internet of Things (IoT) is used to send these parameters to the control room. The position and orientation of the soldier are transmitted to the control room through GPS. Furthermore, soldiers can use GPS to steer them in the right route during operations.

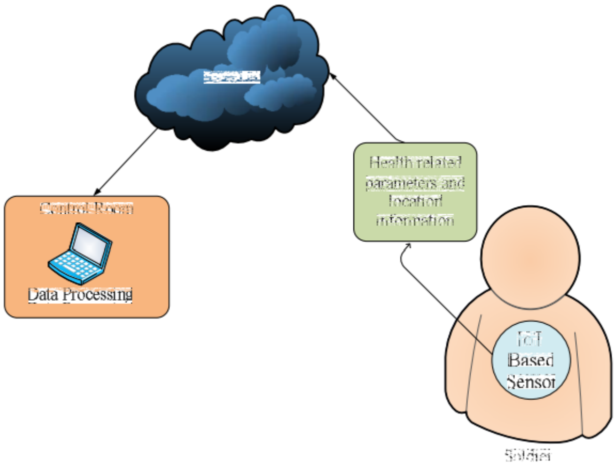

Figure 5.6: Soldier Health Monitoring Flow Diagram

CHAPTER VI

HARDWARE SYSTEM REQUIREMENTS

A requirement analysis is a written document that contains a detailed information about a complete evaluation of requirements that is needed for a specific field or subject. It is applied in the various industries of business analysis such us employment, software engineering, and network designs. Requirements analysis is critical to the success or failure of a systems or software project. The requirements should be documented, actionable, measurable, testable, traceable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design

6.1 HARDWARE

6.1.1 ZIGBEE

ZigBee is a specification for a suite of high-level communication protocols using small, low –power digital radios based on the IEEE 802.15.4-2003 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio frequency (RF) application that requires a low data rate, long battery life, and secure networking. The ZigBee Alliance is a group of companies that maintain and publish the Zigbee standard. ZigBee is a a low cost, low power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the lower power usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. The ZigBee Alliance, the standards body that defines ZigBee, also publishes application profiles that allow multiple EM vendors to create interoperable products.

Serial Communications: The X Bee-PRO OEM RF Modules interface to a host device through a logic-level asynchronous serial port. Through its serial port, the module can communicate with any logic and voltage compatible UART; or through a level translator to any serial device.

ART Data Flow: Devices that have a UART interface can connect directly to the pins of the RF module as shown in the figure below. System Data Flow Diagram in a

UART -interfaced environment (Low-asserted signals distinguished with horizontal line over signal name.)

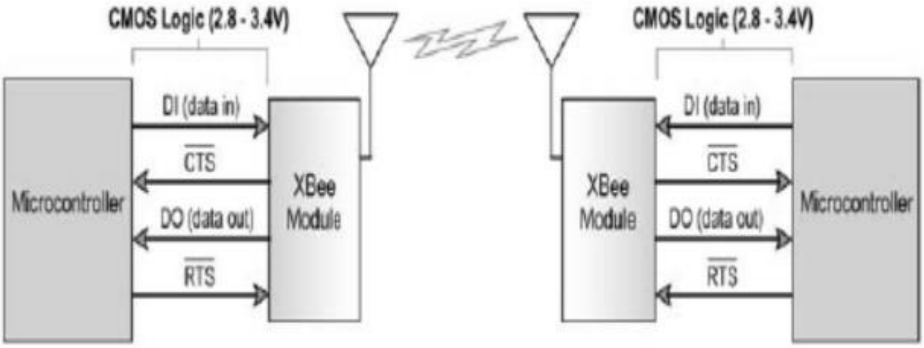

Figure 6.1**:** Zigbee Transmission of Data

Serial Data

Data enters the module UART through the DI pin (pin 3) as an asynchronous serial signal. The signal should idle high when no data is being transmitted. Each data byte consists of a start bit (low), 8 data bits (least significant bit first) and a stop bit (high).

Features

- High performance, Low cost and low power.
- Long Range Data Integrity.
- Indoor/Urban: up to 300’ (100 m)
- Outdoor line-of-sight: up to 1 mile (1500 m)
- Transmit Power: 100 mW (20 dBm) EIRP
- Receiver Sensitivity: -100 dBmRF Data Rate: 250,000 bps.
- TX Current: 270 mA (@3.3 V)
- RX Current: 55 mA (@3.3 V)
- Power-down Current: < 10 µA

Figure 6.2: Zigbee Pin Configuration Diagram

6.1.2 APR33A3 Voice Record & Playback Module

APR33A3 is a 8 Channel Voice Record & Audio Playback Board integrated with APR33A series IC which is a powerful audio processor along with high-performance audio analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).

Figure 6.3: APR33A3 Voice and Record Module

The IC is a fully integrated solution offering high performance and unparalleled integration with analog input, digital processing, and analog output functionality.

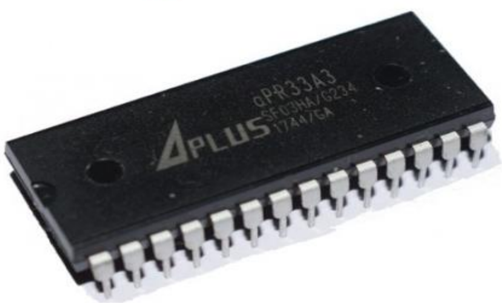

Figure 6.4**:** IC Used in APR33A3

The APR33A series is uniquely intended for the straightforward key trigger. The client can record and play the message moderately for 1, 2, 4, or 8 voice message(s) by a switch and be changed the example rate by utilizing various upsides of resistors. It is reasonable in a basic connection point or needs to restrict the length of a solitary message, for example toys, leave messages framework, replying mail, and so on.

APR33A3 Features

- Operating Voltage Range: 3V ~ 6.5V
- Single-Chip, High-Quality Audio/Voice Recording & Playback Solution
- No External ICs Required
- Minimum External Components
- User Friendly, Easy to Use Operation
- Programming & Development Systems Not Required
- 680 sec (11 Minutes) Voice Recording Length in APR33A3-C2
- Non-volatile Flash Memory Technology
- No Battery Backup Required
- External Reset pin
- Powerful Power Management Unit
- Very Low Standby Current: 1Ua
- Low Power-Down Current: 15uA
- Supports Power-Down Mode for Power Saving
- Built-in Audio-Recording Microphone Amplifier
- No External OPAMP or BJT Required
- Easy to PCB layout
- Configurable analog interface
- Differential-ended MIC pre-amp for Low Noise
- High-Quality Line Receiver
- High-Quality Analog to Digital and PWM module
- Simple and Direct User Interface
- Averagely 1,2,4 or 8 voice messages record & playback

Recording the Voice using APR33A3

1. The device can be power up in two ways, either by a 5V or by a 12V supply. Slide the power switch for determination.
2. We can utilize 8 channels (M1 TO M8) for sound recording, each channel having 1.3 minutes recording length.
3. Installed MIC will naturally be utilized for recording.
4. Switch on the board power LED(LD1) will on.

5. There is a slide button called REC/PLAY, and that implies you can choose the recording or play mode.
6. While in record mode, select a channel(M1-M8) to record the message. Allow us to expect we need to keep messages in channel M0, Connect M1 to GND. Or on the other hand you can press and hold the M1 button straightforwardly.
7. Presently anything we talk will be caught by MIC and recorded, status LED(LD2) will on in record mode showing that the chip is as of now recording. When the span is full the LED(LD2) will off implies that the section is full.
8. You can deliver the M1 button to quit recording or just detach it from the GND.

Record Message

During the/REC pin headed to VIL, chip in the record mode. At the point when the message pin (M0, M1, M2 … M7) headed to VIL in record mode, the chip will playback "signal" tone and message record beginning. The message record will go on until message pin delivered or brimming with this message, and the chip will playback "signal" tone twice to show the message record wrapped up. Assuming the message as of now exists and client record once more, the former one's message will be supplanted. A common record circuit for 8-message mode. We associated a slide-switch between/REC pin and VSS, and associated 8 politeness switches between M0 ~ M7 pin and VSS. At the point when the slide-switch fixed in VSS side and any tact-switch will be pressed, chip will begin message record and until the client releases the tact-switch.

Playback Message

During the /REC pin drove to VIH, chip in the playback mode. When the message pin (M0, M1, M2 … M7) drove from VIH to VIL in playback mode, the message playback starting. The message playback will continue until message pin drove from VIH to VIL again or end of this message. A typical playback circuit for 8-message mode. We connected a slide-switch between /REC and VSS, and connected 8 tact-switches between M0 ~ M7 and VSS. When the slide-switch fixed in float side and any tact-switch will be pressed, chip will start message playback and until the user pressed the tact-switch again or end of message.

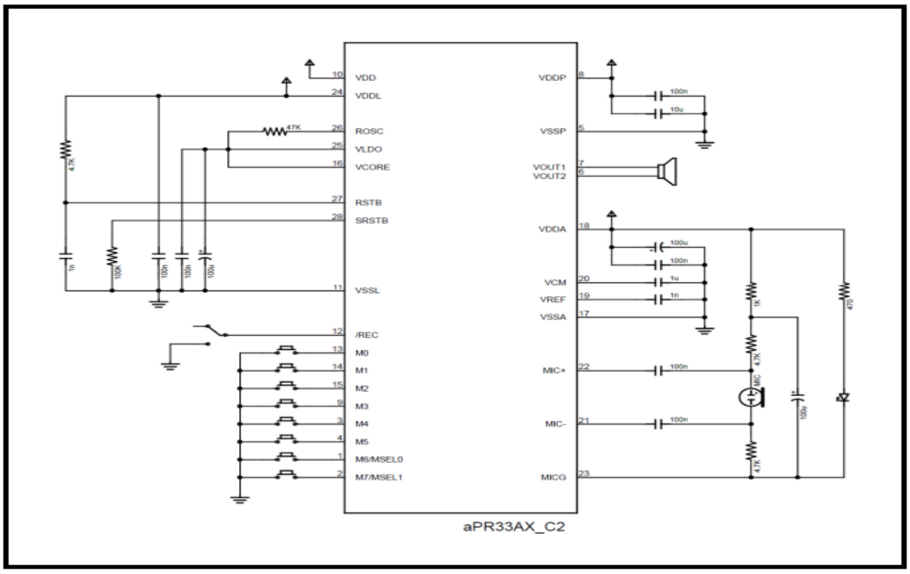

Figure 6.5**:** APR33A3 Pin out Diagram

TABLE II: Pin Description of APR33A3

Pin Names	Pin No	Type	Description
VDDP VDD VDDA VDDL	8 10 18 24		Positive power supply
VSSP VSSL VSSA	5 11 17		Power ground
V_{LDO}	25		Internal LDO output
V_{CORE}	16		Positive power supply for core
V_{REF}	19		Reference voltage
V_{CM}	20		Common mode voltage
Rosc	26	INPUT	Oscillator resistor input
RSTB	27	INPUT	Reset (Low active)
SRSTB	28	INPUT	System reset , pull-down a resistor to VSSL
MIC+ MIC-	21 22	INPUT	Microphone differential input
MICG	23	OUTPUT	Microphone ground
VOUT2 VOUT1	6 7	OUTPUT	PWM output to drive speaker directly
/REC	12	INPUT	Record Mode
M0	13	INPUT	Message-0
M1	14	INPUT	Message-1
M2	15	INPUT	Message-2
M3	9	INPUT	Message-3
M4	3	INPUT	Message-4
M5	4	INPUT	Message-5
M6/M_{SEL0}	1	INPUT	Mesasage-6, Message select 0
M7/M_{SEL1}	2	INPUT	Message-7, Message select 1

6.1.3 ARDUINO UNO

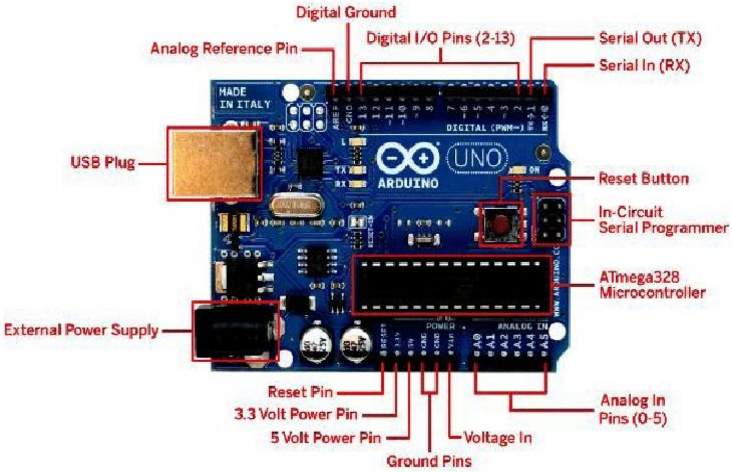

Figure 6.6: Arduino Uno Pin Configuration Diagram

In the figure 3.2 we have used Arduino UNO which is Arduino’s processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories- Program memory and the data memory. The code is stored in the flash program memory, whereas the data is stored in the data memory. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader), 2 KB of SRAM and 1 KB of EEPROM and operates with a clock speed of 16MHz.

A typical example of Arduino board is Arduino Uno. It consists of ATmega328- a 28 pin microcontrollers. Arduino Uno consists of 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

- Power Jack: Arduino can be power either from the pc through a USB or through external source like adaptor or a battery. It can operate on a external supply of 7 to 12V. Power can be applied externally through the pin Vin or by giving voltage reference through the IO Ref pin.
- Digital Inputs: It consists of 14 digital inputs/output pins, each of which provide or take up 40mA current. Some of them have special functions like pins 0 and 1, which act as Rx and Tx respectively, for serial communication, pins 2 and 3- which are external interrupts, pins 3,5,6,9,11 which provides pulse width manipulation output and pin 13 where LED is connected.
- Analog inputs: It has 6 analog input/output pins, each providing a resolution of 10 bits.

- Reset: It resets the microcontroller when low.

How to program an Arduino?

The most important advantage with Arduino is the programs can be directly loaded to the device without requiring any hardware programmer to burn the program. This is done because of the presence of the 0.5KB of Bootloader which allows the program to be burned into the circuit. All we have to do is to download the Arduino software and writing the code.The Arduino tool window consists of the toolbar with the buttons like verify, upload, new, open, save, serial monitor. It also consists of a text editor to write the code, a message area which displays the feedback like showing the errors, the text console which displays the output and a series of menus like the File, Edit, Tools menu.

Few of basic Arduino functions are:

- digitalRead(pin): Reads the digital value at the given pin.
- digitalWrite (pin, value): Writes the digital value to the given pin.
- pinMode (pin, mode): Sets the pin to input or output mode.
- analogRead (pin): Reads and returns the value.
- analogWrite (pin, value): Writes the value to that pin.
- serial.begin (baud rate): Sets the beginning of serial communication by setting the bit rate.

6.1.4 FLEX SENSOR

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to the amount of bend it is used as goniometer, and often called flexible potentiometer.

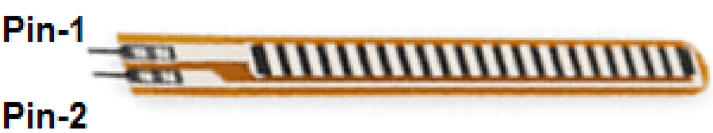

Figure 6.7: Flex Sensor

Flex sensor are in two sizes

a. 2.2 inch (Model: FS-L-0055).
b. 4.5 inch.

Although the sizes are different the basic function remains the same. They are also divided based on resistance. There are LOW resistance, MEDIUM resistance and HIGH resistance types. Choose the appropriate type depending on requirement.

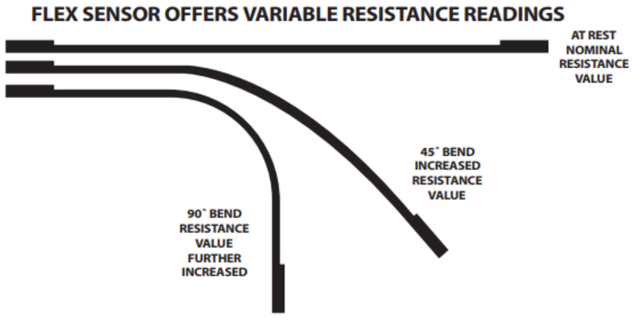

Figure 6.8: Flex Bend Levels

Flex sensor is a basically a variable resistor whose terminal resistance increases when the sensor is bent. So, this sensor resistance increases depends on surface linearity. So, it is usually used to sense the changes in linearity.
Flex sensor is a completely linear it will be having its nominal resistance. When it is bent 45º angle this resistance increases to twice as before. And when the bent is 90º the resistance could go as high as four times the nominal resistance. So, the resistance across the terminals rises linearly with bent angle. So, in a sense the Flex sensor converts flex angle to resistance. For convenience we convert this resistance into voltage.

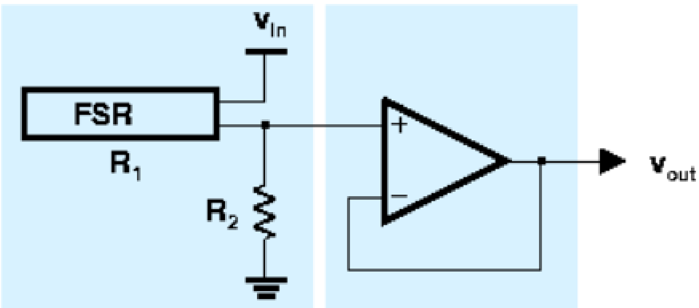

Figure 6.9: Voltage Divider Circuit Diagram

In this resistive network we have two resistances. One is constant resistance (R1) and other is variable resistance (RV1). Vo is the voltage at midpoint of VOLTAGE DIVIDER circuit and is also the output voltage. Vo is also the voltage across the variable resistance (RV1).
So when the resistance value of RV1 is changed the output voltage Vo also changes. So, we will have resistance change in voltage change with VOLTAGE DIVIDER circuit.

Pin Configurations:

Basically Flex sensor is a two terminal resistor type. So, it is not a polarized terminal like diode.

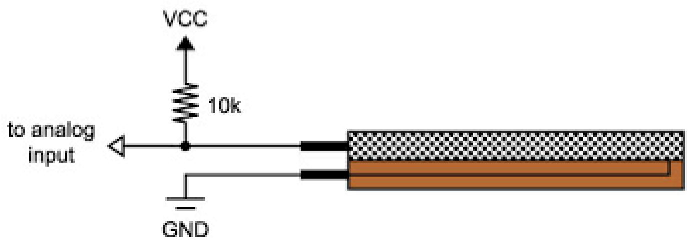

Figure 6.10: Flex Pin Diagram

PIN-1: Connected to positive of power supply.

PIN-2: Connected to ground.

Thresholding of Flex Sensor: The resistance of flex sensors increases on bending but each sensor has its own range of values of resistance. The typical range of flex sensor is 30k-80k ohms, but some sensors may have a smaller range of 30k-50k ohms or may have a larger range of 30k-110k ohms. Therefore, each flex sensor needs to be given a threshold value individually. The analog pin readings vary from 0 to 1000 depending upon the voltage at the center point. The range of resistance can be measured using a multi-meter and the resistor to be used in series can be decided accordingly. The resistor is chosen such that its resistance lies close to the mean value of the bent and unbent resistance of the flex sensor to keep the threshold value near 500 for all sensors.

6.1.5 Heart Rate Sensor

This sensor is designed to measure heart beat when finger is placed on it. The digital output of this sensor will be interfaced to Microprocessor and it will directly measure heartbeats in beats per minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. For adults 18 and older, a normal resting heart rate is between 60 and 100 beats per minute (bpm), depending on the person's physical condition and age. Hence, the measurement threshold is set from 60 to 100 bpm. Whenever heartbeat of soldier will deviate from the threshold value, the system will transmit information to control room.

Figure 6.11: Pulse sensor pin diagram

Pin Configuration

The heartbeat sensor includes three pins which discussed below.

- Pin-1 (GND): Black Colour Wire – It is connected to the GND terminal of the system.
- Pin-2 (VCC): Red Colour Wire – It is connected to the supply voltage (+5V otherwise +3.3V) of the system.
- Pin-3 (Signal): Purple Colour Wire – It is connected to the pulsating o/p signal.

Pulse Sensor Specifications

- The main specifications of this sensor mainly include the following.
- This is a hear beat detecting and biometric pulse rate sensor
- Its diameter is 0.625
- Its thickness is 0.125
- The operating voltage is ranges +5V otherwise +3.3V
- This is a plug and play type sensor
- The current utilization is 4mA
- Includes the circuits like Amplification & Noise cancellation
- This pulse sensor is not approved by the FDA or medical. So, it is used in student-level projects, not for the commercial purpose in health issues applications.

6.1.6 GPS (Global Positioning System)

Introduction

The Global Positioning System (GPS) is radio location using navigation satellites. These systems provide round the clock information on the three-dimensional position, velocity and time for users with the appropriate equipment and are at or near the earth's surface (and sometimes outside it). The first system GPS, widely available to civil users, has become NAVSTAR, serviced by the Ministry of Defense. Applications include portable guidance on the location, trajectory tracking of ships, as well as the system of driving wireless communication devices, which are designed for the car, the driver provides a personalized and promotional information, receive messages, and use the specific local conditions of travel information and services Security. GPS technology is used in a large number of applications, including maritime, environmental, navigational applications for tracing and monitoring. The GPS consists of three main parts as shown in Figure 6.12

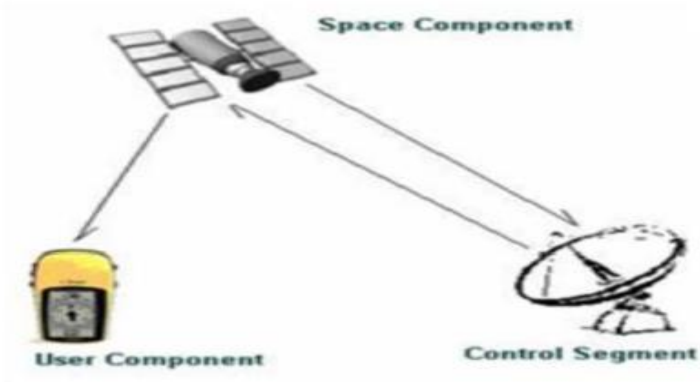

Figure 6.12: GPS Working Parts

The GPS has three components namely:

1. The space segment: consisting of 24 satellites orbiting the earth at an altitude of 11000 nautical miles.

2. The user segment: consisting of a receiver, which is mounted on the unit whose location must be determined.

3. The control segment: consists of various ground stations controlling the satellites.

The GPS is owned and operated by the U.S Department of Defense but is available for general use around the world. Briefly, here’s how it works:

1. 21 GPS satellites and 3 spare satellites are in orbit at 10,600 miles above the earth. The satellites are spaced so that from any point on earth, 4 satellites will be above the horizon.
2. Each satellite contains a computer, an atomic clock and a radio. With an understanding of its own orbit and the clock, it continually broadcasts its changing

position and time. (Once a day, each satellite checks its own sense of time and position with a ground station and makes any minor correction).

3. On the ground, any GPS receiver contains a computer that "triangulates" its own position by getting bearings from 3 or 4 satellites. The result is provided in the form of a geographic position- Longitude and latitude, for most of the receivers, within 100 meters.
4. If the 4th satellite can be received, the receiver/computer can figure out the altitude as well as the geographic position.
5. If you are moving, your receiver may also be able to calculate your speed and direction of travel and give the estimated times of arrival to specified destinations.

Figure 6.13: GPS Pin Configuration diagram

For a GPS receiver to function, it needs to lock onto satellite signals. Each satellite broadcasts two signals at 1.57542GHz and 1.2276GHz, denoted as L1 and L2, respectively. A satellite specific code, known as the course acquisition (C/A) code, is used to discern satellites. Correlation of the transmitted codes against local codes is needed to locate satellites in frequency space. The 1023-bit C/A code modulates the L1 at 1.023MHz, repeating every millisecond. Accumulation of this 1000Hz data is required for a receiver to operate. Once the GPS receiver made the calculation, it can tell the latitude, the longitude and the altitude of its' current position. This doesn't tell much to the average user. So, in order to make use of the GPS receiver more user-friendly many receivers send this data to a program which displays a map and can show the position on it.

Geographical Information System (GIS) is a computer-based software capable of handling maps and various details given on the map. Data generated by the GPS use spatial data referenced to the earth. In other words, this data is the coordinates of its own position expressed in latitude and longitude. This data needs to be positioned on a map of the area for any useful analysis. GPS is being used in science to provide data that has never been available before in the quantity and degree of accuracy that the GPS makes possible. GPS receivers are becoming consumer products. In addition to their outdoor use, receivers can be used in cars to relate the driver's location with traffic and weather information.

6.1.7 DHT 11 Temperature sensor

The DHT11 is a usually used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

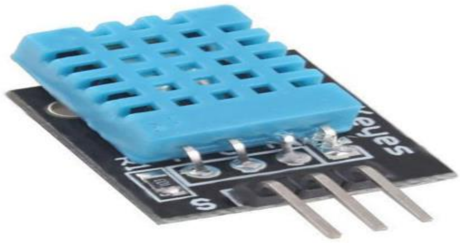

Figure 6.14: DHT 11 Sensor

DHT11 Specifications

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

Table III: Pin configuration of DHT 11 sensor

NO:	Pin Name	Description
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	Ground	Connected to the ground of the circuit

CHAPTER VII

SOFTWARE SYSTEM REQUIREMENTS

A software requirements specification (SRS) is a description of a software system to be developed. It lays out functional and non-functional requirements and may include a set of use cases that describe user interactions that the software must provide. Software requirements specifications establishes the basis for an agreement between customers and contractors or suppliers (in market driven projects, these roles may be played by the marketing and development divisions) on what the software product is to do as well as what it is not expected to do. Software requirements specification permits a rigorous assessment of requirements before design can begin and reduces later redesign. It should also provide a realistic basis for estimating product costs, risks and schedules. The software requirements specification document enlists enough and necessary requirements that are required for the project development. To derive the requirements, we need to have a clear and thorough understanding of the products to be developed or being developed. This is achieved and refined with detailed and continuous communications with the project team and customer till the completion of the software.

7.1 SOFTWARE REQUIREMENTS SPECIFICATION

A software requirements specification (SRS) – a requirements specification for a software system– is a complete description of the behavior of a system to be developed. In addition to a description of the software functions, the SRS also contains non-functional requirements. Software requirements are a sub-field of software engineering that deals with the elicitation, analysis, specification, and validation of requirements for software. The Software Requirements Specification (SRS) is a communication tool between stakeholders and software designers. The specific goals of the SRS are:

- Facilitating reviews
- Describing the scope of work
- Providing a reference to software designers (i.e., navigation aids, document structure)
- Providing a framework for testing primary and secondary use cases
- Linking features to customer requirements
- Providing a platform for ongoing refinement

The SRS Document is useful in various contexts:

- Statement of User needs: Elaborates the needs of the customer.
- Contract Document: Done Between the Developer and customer.
- Reference Documents: SRS will be review and signed off by stakeholders and feedback will be given, so it should be in a format that can be easily readable by people with little or no technical knowledge as well.
- Definition for implementation.

7.2 FUNCTIONAL REQUIREMENTS

1) Mean Time Between Failures

The definition of a failure must be clear. Also, don’t confuse reliability with availability which is quite a different kind of requirement. Be sure to specify the consequences of software failure, how to protect from failure, a strategy for error detection, and a strategy for correction.

2) Security

One or more requirements about protection is the security of your system and its data. The measurement can be expressed in a functional requirement that defines a function of a system or its component. A function is described as a set of inputs, the behavior, and outputs. Functional requirements may be calculations, technical details, data manipulation and processing and other Sign Language Assisting Embedded System for military specific functionality that define what a system is supposed to accomplish. Behavioral requirements describing all the cases where the system uses the functional requirements are captured in use cases. Functional requirements are supported by non-functional requirements (also known as quality requirements), which impose constraints on the design or implementation (such as performance requirements, security, or reliability). Generally, functional requirements are expressed in the form "system must do ", while non-functional requirements are "system shall be ". The plan for implementing functional requirements is detailed in the system design.

7.3 NON-FUNCTIONAL REQUIREMENTS

A non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions. The plan for implementing functional requirements is detailed in the system design. The plan for implementing non-functional requirements is detailed in the system architecture, because they are usually Architecturally Significant Requirements.

1) Performance requirements

Requirements about resources required, response time, transaction rates, throughput, benchmark specifications or anything else having to do with performance.

2) Usability

Simple is the key here. The system must be simple that people like to use it, but not so complex that people avoid using it. The user must be familiar with the user interfaces and should not have problems in migrating to a new system with a new environment. The menus, buttons and dialog boxes should be named in a manner that they provide clear understanding of the functionality. Several users are going to use the system simultaneously, so the usability of the system should not get affected with respect to individual users.

3) Reliability

The system should be trustworthy and reliable in providing the functionalities. Once a user has made some changes, the changes must be made visible by the system. The changes made by the Programmer should be visible both to the Project leader as well as the Test engineer.

4) Performance

The system is going to be used by many employees simultaneously. Since the system will be hosted on a single web server with a single database server in the background, performance becomes a major concern. The system should not succumb when many users would be using it simultaneously. It should allow fast accessibility to all of its users. For example, if two test engineers are simultaneously trying to report the presence of a bug, then there should not be any inconsistency while doing so.

5) Scalability

The system should be scalable enough to add new functionalities at a later stage. There should be a common channel, which can accommodate the new functionalities.

6) Maintainability

The system monitoring, and maintenance should be simple and objective in its approach. There should not be too many jobs running on different machines such that it gets difficult to monitor whether the jobs are running without errors.

7) Portability

The system should be easily portable to another system. This is required when the web server, which hosting the system gets stuck due to some problems, which requires the system to be taken to another system.

8) Reusability

The system should be divided into such modules that it could be used as a part of another system without requiring much of work.

9) Flexibility

The system should be flexible enough to allow modifications at any point of time.

7.4 SOFTWARE

7.4.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

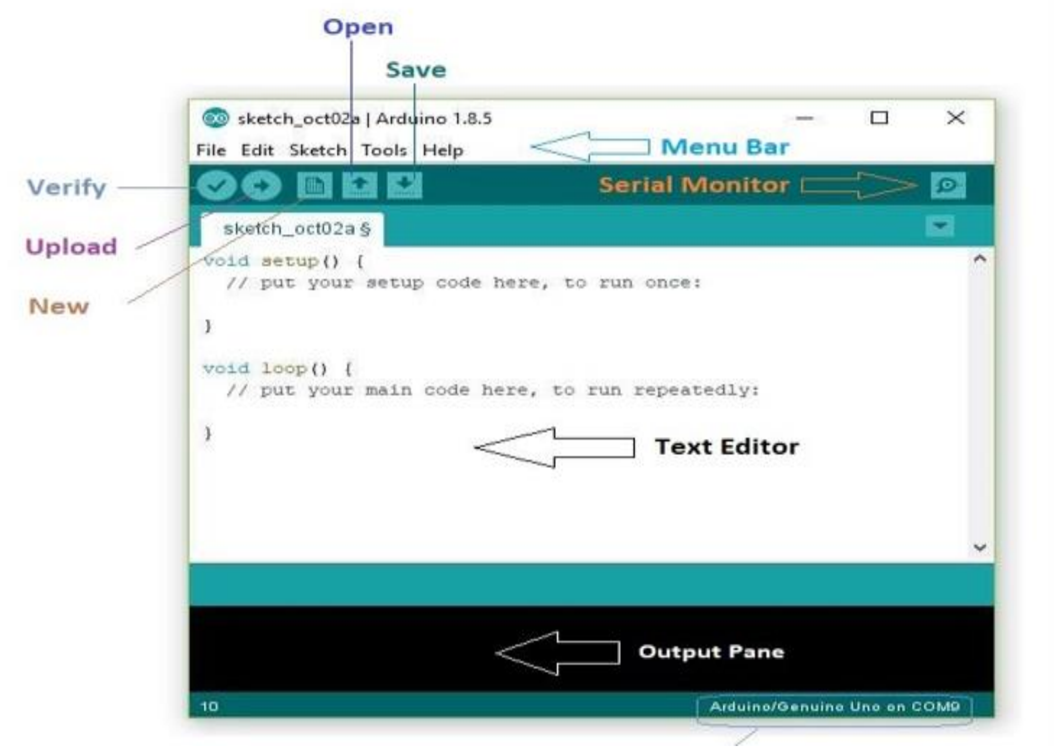

Figure 7.1: Arduino IDE Software

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program a to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, Arduino is used as the uploading tool to flash the user code onto official Arduino boards.

7.4.2 ADAFRUIT CLOUD

With the rise of digital transformation, cloud IoT deployments have become more common. By deploying IoT solutions in the cloud, we get the following benefits:

- Cost - Reduce compute and storage costs by using different cloud services.
- Scalability - The “pay as you go” pricing model allows for a flexible pay-as-you-go model that also allows for application scalability.
- Data control - Backup and restore data with high security.
- Server Uptime - Enables very minimal or zero downtime, with high server uptime. Adafruit IO is one of the cloud providers that focuses more on IoT deployment in the cloud. Adafruit IO supports various hardware such as Raspberry PI, ESP2866 and Arduino. IoT developers choose Adafruit IO over various IoT cloud providers for the below reasons:
- Powerful API - Provides libraries for different programming languages, also provides user interface support built-in use.
- Dashboards - Understanding data through charts and graphs allows us to make better decisions.
- Privacy - Data is secured in the cloud with better encryption algorithms.
- Documentation and Community - Many blogs with great support of community which eases the continuous development of the products.

Adafruit IO is a cloud service available on the Internet with which it is possible to control our devices, such as an Arduino board to connect. Its main function is to store the data acquired by one or more panels connected to sensors, to display them both in real time and later, but it can also perform other interesting functions.

In fact, this platform can be used to: view the generated data online in real-time using graphs and squares on a dashboard. Remotely control devices (motors, sensors, etc.) via web or mobile with buttons inserted into the control panel (dashboard) Connect your project to network services such as RSS feeds, IFTTT, email, etc. Insertion triggers the be triggered when data values cross certain thresholds or at a scheduled time.

To access Adafruit IO, one must have an Adafruit account or create one at io.adafruit.com.

Feeds are the foundation of how Adafruit IO works. Namely, these manage the different streams of data that the system uploads along with the corresponding metadata that contain other useful information such as: B. the sensor that generates them, date and time or the GPS coordinates of the data source.

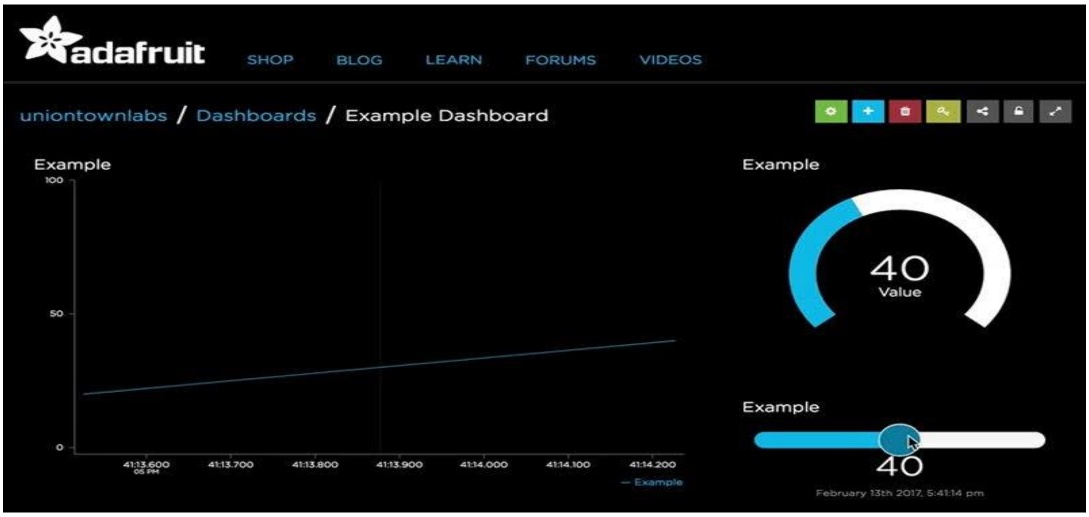

Figure 7.2: Dashboard in Adafruit

The feeds are then connected to the various graphical blocks to form the dashboards, actual control panels, which are another important feature of Adafruit IO. Bar charts, switches, maps, moving text or any other form of visualization of your data are the blocks with which you will create your personal control panels, accessible from any browser, both PC and mobile.

In terms of hardware compatibility, Adafruit IO is compatible with many boards, including Arduino boards. There are a number of libraries available for download on the website that allow you to connect our boards to Adafruit IO using the most popular connection interfaces such as Wi-Fi (ESP8266, ESP32, WINC1500 and WICED), Ethernet or Cellular.

ADAFRUIT IO ARDUINO LIBRARY: To help the operation of connecting to the network with Arduino boards, Adafruit provides the Adafruit IO Arduino Library.

Figure 7.3: Adafruit IO Arduino Library

This library allows to use the below network connection devices that can be connected to Arduino:

Adafruit Airlift: an external module provided by Adafruit, to be connected to Arduino and to be able to connect to the WIFI network

ESP8266: low cost WIFI chip

ESP32: low cost WIFI

ATWINC1500: chip WIFI

WICED: WIFI technology

Ethernet module

FONA: Mini Cellular GSM

DASHBOARD: Once after logging into Adafruit IO as personal user, a screen appears with all the dashboards that are created.

Figure 7.4: Creation of New Dashboard

By choosing the desired dashboard or selecting the New Dashboard button, access to the editor can be done, where edit and addition of blocks can be done in dashboard. These blocks are not more than different ways of visualizing our data in the form of graphs, graphs or gauges of various shapes and functions.

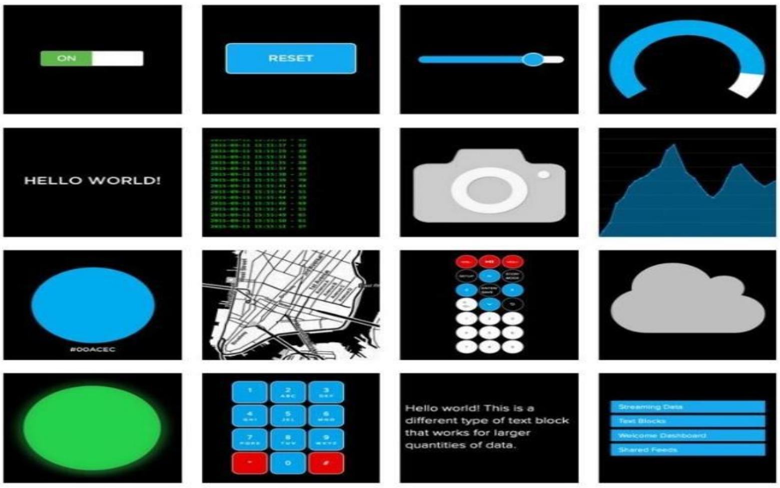

Figure 7.5: Blocks in Adafruit for Different Functions

There are hence different types of blocks, all of them with several functions. Select the one that suits best and configure its features according to the needs.

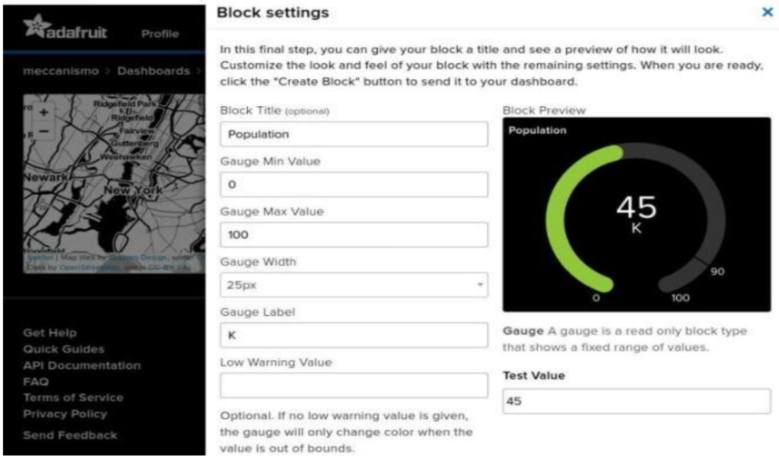

Figure 7.6: Block Settings

And so on, block by block one can create their own control panel, which will then be available on the network when completed. One will then have a real control panel with a lot of viewers, indicators and buttons, accessible from any browser, even from a mobile device.

FEEDS: Once the controls have been created on the dashboard, it will be very much necessary to create feeds that manage the inflow of the data remotely and display the data via control in real time.

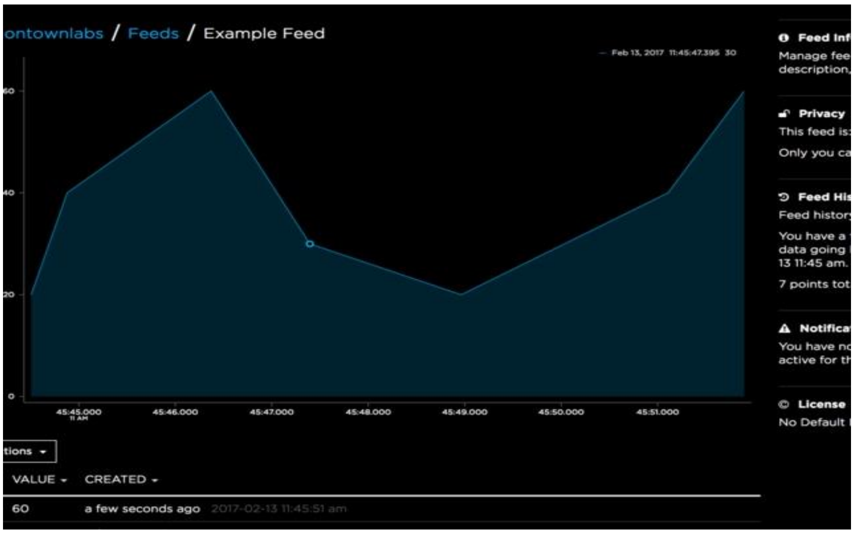

Figure 7.7: Feeds in Adafruit

OTHER SERVICES: After you have entered all quadrants (blocks) in the control panel (dashboard), you can use other services such as Use triggers. These are very useful automatisms as they are used to monitor some data streams independently. When a certain event occurs (e.g. a value exceeds a certain maximum or minimum threshold), an event can be triggered, e.g. E.g. sending a stop command to a device, email to an email address or activating a device etc. Triggers can also be programmed. That means that isn't triggered by a specific event, rather you can enter an exact date and time when it needs to be activated. Other available services are IFTTT and Zapier, which are very useful for publishing data on the web and can be connected to the Adafruit.IO platform.

CHAPTER VIII

RESULTS AND DISCUSSIONS

Hand gesture recognition and health monitoring system are the important step in the proposed system as it helps building an effective communication among the soldiers and health monitoring along with live tracing of location. Here we have used 8 different gestures with specific voice commands that are communicated among soldiers. The health status and live tracking of soldier is monitored with the help Adafruit cloud.

8.1 HAND GESTURE RECOGNITION

The flex sensor which are mounted on hand glove interfaced with Arduino Uno which to is identify the gesture made by specific soldier at the transmitter is shown in the figure 8.1. In which the gesture values are transferred with the help of Zigbee to receiver end. Based on the fingers bending angle and the gesture made the specific values generated is checked with specific flex condition values. The interpretation of specific voice is resulted based on pre-condition values, in which each flex sensor values are transferred to receiver end with a higher accuracy. The table with respect to specific gesture is depicted below.

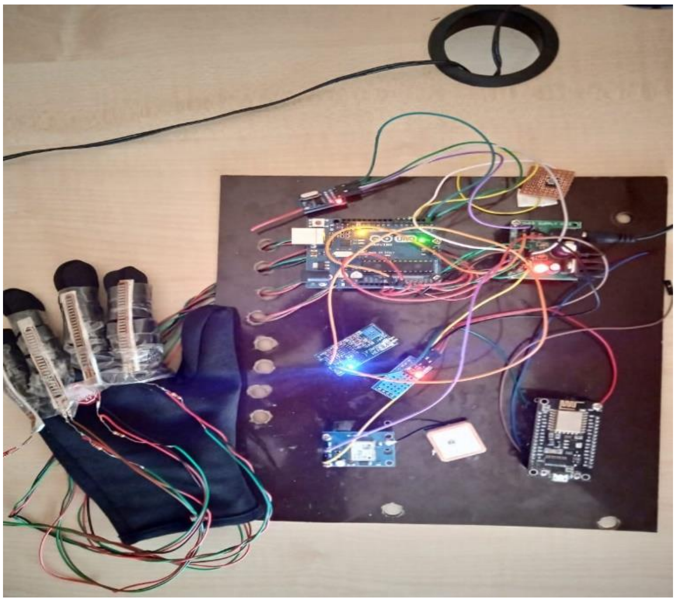

Figure 8.1: Transmitter End of the Designed System

The output with respect specific gesture is obtained in form of voice command at the receiver end. The speech is obtained with the help of APR module which is attached with the speaker. The APR module is compared with specific digital command obtained with Arduino Uno, based on its pre-set for each gesture the output is obtained. The figure 8.2 shows the receiver part with speaker, which obtains the voice command.

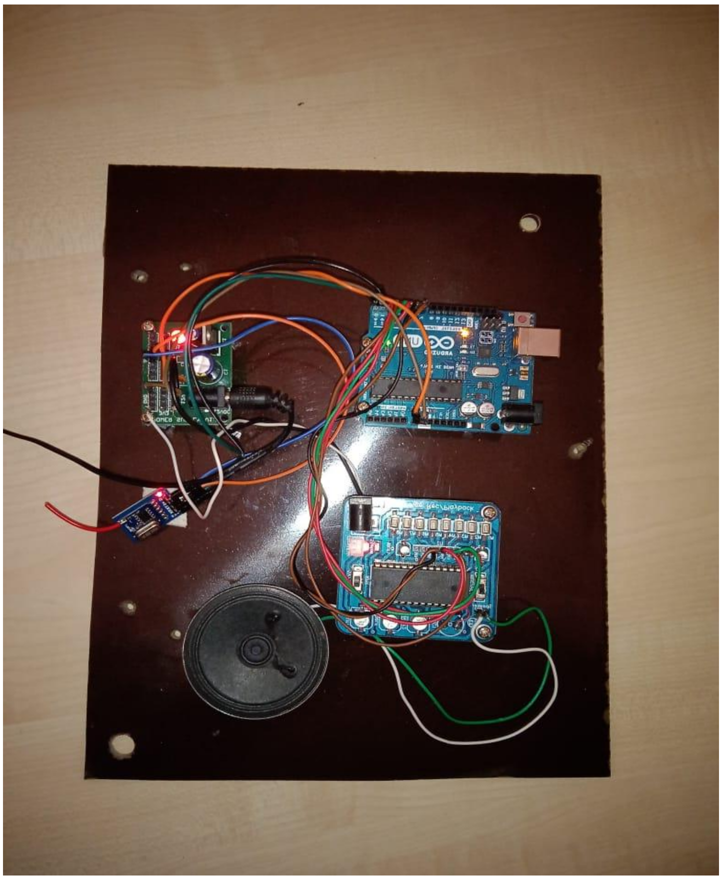

Figure 8.2: Receiver Part of the Designed System

Table IV: First Gestures with Corresponding Flex Values and Interpreted Voice Command

Hand Gesture	Flex sensor Threshold value Condition	Interpretation voice for gesture	Flex sensor Value Received at the receiver end	Voice Command Received with accuracy (%) (10 Different values)
	Flex 1 value >695	Hold	Flex 1 value = 697 Flex 2 value = 675 Flex 3 value = 673 Flex 4 Value = 678	Hold 98%

The table 8.1 shows the flex sensor threshold condition set for specific flex sensor, whenever the user makes the first gesture by bending index finger and keeping all other fingers straight. The condition shows that the gesture interpreted as ‘Hold’ from the user end. The values with respect specific gesture is set as Flex1 value greater than 695. The

Zigbee from transmitter sends the value to the receiver based on the condition for which the voice command as 'Hold' is obtained with an accuracy of 98%.

Table V: Second Gestures with Corresponding Flex Values and Interpreted Voice Command

Hand Gesture	Flex sensor Threshold value Condition	Interpretation voice for gesture	Flex sensor Value Received at the receiver end	Voice Command Received with accuracy (%) (10 Different values)
	Flex 2 value>690 Flex 3 value >695 Flex 4 Value >690	Cover me	Flex 1 value = 678 Flex 2 value = 692 Flex 3 value = 698 Flex 4 Value = 692	Cover Me 98%

The table 8.2 shows the flex sensor threshold condition set for specific flex sensor, whenever the user makes the second gesture by keeping index finger straight and bending all other fingers. The condition shows that the gesture interpreted as 'Cover Me' from the user end. The values with respect specific gesture is set as Flex2 value greater than 690, Flex3 value greater than 695, Flex4 value greater than 690. The Zigbee from transmitter sends the value to the receiver based on the condition for which the voice command as 'Cover me' is obtained with an accuracy of 98%.

Table VI: Third Gesture with Corresponding Flex Values and Interpreted Voice Command

Hand Gesture	Flex sensor Threshold value Condition	Interpretation voice for gesture	Flex sensor Value Received at the receiver end	Voice Command Received with accuracy (%) (10 Different values)
	Flex 1 value >695 Flex 2 value>690 Flex 3 value >695 Flex 4 Value >690	Back	Flex 1 value = 695 Flex 2 value = 690 Flex 3 value = 695 Flex 4 Value = 690	Back 98%

The table 8.3 shows the flex sensor threshold condition set for specific flex sensor, whenever the user makes the third gesture by bending all fingers. The condition shows that the gesture interpreted as 'Back' from the user end. The values with respect specific gesture is set as Flex1 value greater than 695, Flex2 value greater than 690, Flex3 value greater than 695, Flex4 value greater than 690. The Zigbee from transmitter sends the value to the receiver based on the condition for which the voice command as 'Back' is obtained with an accuracy of 98%.

Table VII: Fourth Gesture with Corresponding Flex Values and Interpreted Voice Command

Hand Gesture	Flex sensor Threshold value Condition	Interpretation voice for gesture	Flex sensor Value Received at the receiver end	Voice Command Received with accuracy (%) (10 Different values)
	Flex 4 Value >690	Forward	Flex 1 value = 675 Flex 2 value = 675 Flex 3 value = 673 Flex 4 Value = 697	Forward 95%

The table 8.4 shows the flex sensor threshold condition set for specific flex sensor, whenever the user makes the fourth gesture by bending the little finger and keeping all other finger straight. The condition shows that the gesture interpreted as ‘Forward’ from the user end. The values with respect specific gesture is set as Flex4 value greater than 690. The Zigbee from transmitter sends the value to the receiver based on the condition for which the voice command as ‘Forward’ is obtained with an accuracy of 95%.

Table VIII: Fifth Gesture with Corresponding Flex Values and Interpreted Voice Command

Hand Gesture	Flex sensor Threshold value Condition	Interpretation voice for gesture	Flex sensor Value Received at the receiver end	Voice Command Received with accuracy (%) (10 Different values)
	Flex 2 value >694 Flex 3 value >695 Flex 4 Value >690	Shoot	Flex 1 value = 678 Flex 2 value = 692 Flex 3 value = 698 Flex 4 Value = 692	Shoot 97%

The table 8.5 shows the flex sensor threshold condition set for specific flex sensor, whenever the user makes the fifth gesture by keeping thumb and index fingers straight and bending all the other fingers. The condition shows that the gesture interpreted as ‘Shoot’ from the user end. The values with respect specific gesture is set as Flex2 value greater than 694, Flex3 value greater than 695, Flex4 value greater than 690. The Zigbee from transmitter sends the value to the receiver based on the condition for which the voice command as ‘Shoot’ is obtained with an accuracy of 97%.

Table IX: Sixth Gesture with Corresponding Flex Values and Interpreted Voice Command

Hand Gesture	Flex sensor Threshold value Condition	Interpretation voice for gesture	Flex sensor Value Received at the receiver end	Voice Command Received with accuracy (%) (10 Different values)
	Flex 3 value >695 Flex 4 value>690	Watch out	Flex 1 value = 675 Flex 2 value = 670 Flex 3 value = 698 Flex 4 Value = 692	Watch out 97%

The table 8.6 shows the flex sensor threshold condition set for specific flex sensor, whenever the user makes the sixth gesture by keeping thumb and index fingers straight and bending all the other fingers. The condition shows that the gesture interpreted as ‘Watch out’ from the user end. The values with respect specific gesture is set as Flex3 value greater than 695, Flex4 value greater than 690. The Zigbee from transmitter sends the value to the receiver based on the condition for which the voice command as ‘Watch out’ is obtained with an accuracy of 97%.

8.2 HEALTH MONITORING SYSTEM

Health condition of the soldiers is all a topmost necessity during the battleground where to effective consideration of that the heartbeat sensor and temperature sensor play an important role in the functionality where instantaneous health report will be generated. The Adafruit Cloud which give the interference of operation and shows the modularity values, the values are saved in the Excel sheet where data are updated every 10 seconds in the function. The navigation or the co-ordinates of the soldier’s location can also be searched in the function.

Figure 8.3: Heart Beat Output

The figure 8.3 and 8.4 shows the pulse values and temperature values received from sensor which is updated in Adafruit cloud. The pulse values and temperature values are set with specific limit whenever it crosses its range it can been observed in gauge. The data of the user is also downloaded in the form of Excel sheet for monitoring the health condition.

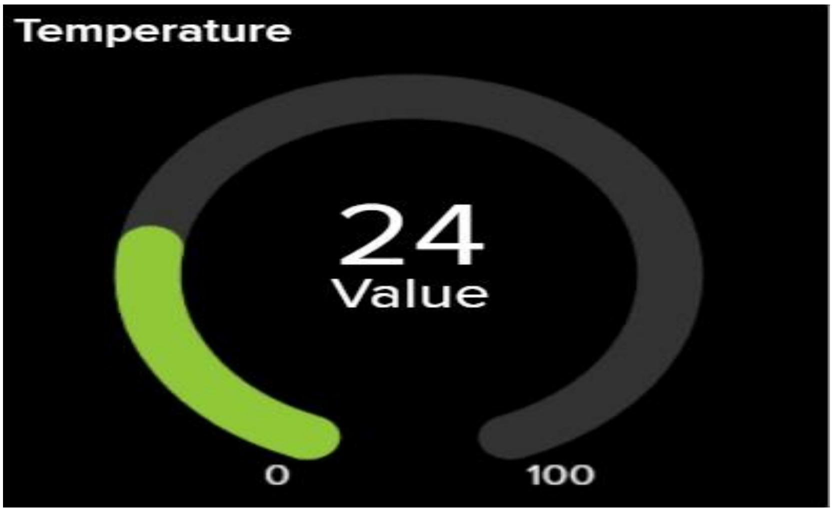

Figure 8.4: Temperature Output

The system designed also helps in tracking the live location with the help of GPS. The co-ordinates of the location get updated in Adafruit Live feed. The co-ordinates can be used to fetch the exact location by using the browser as shown in figure 8.6. The co-ordinates of the user gets updated every 10 seconds so whenever they have crossed the range it helps in indicating the soldier with the help of base station.

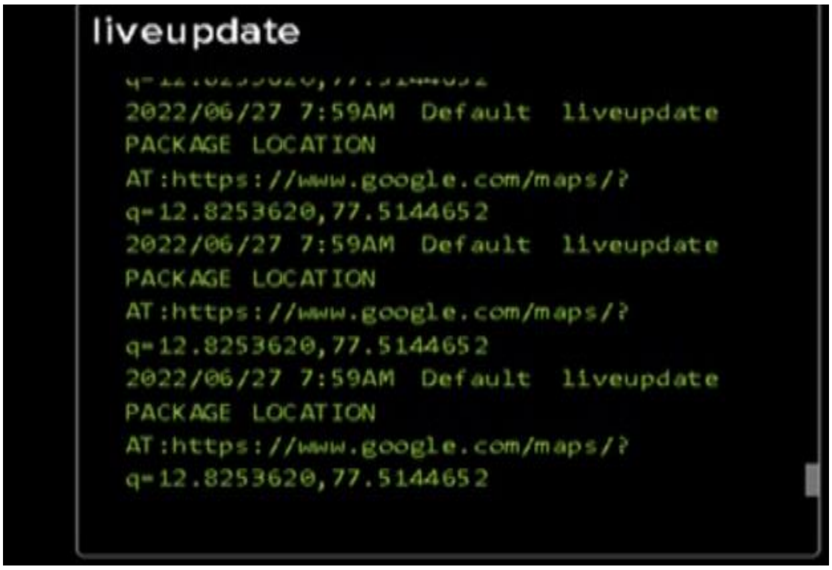

Figure 8.5: Live Feed Giving Coordinates of Location

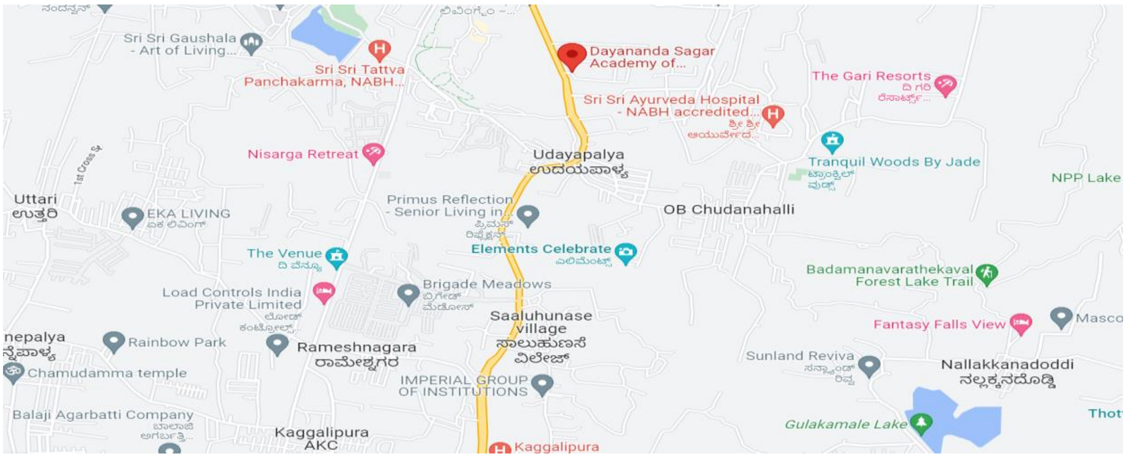

Figure 8.6: GPS Live Location

We expect to develop Smart Gloves for Surgical Strikes which are useful for our Defense Forces in the borders and in the surgical strikes as for all modes of application assignments like communication, Health Monitoring, Navigation aspects condition. In which a network approach of the critical problem can be given by various modes of action by effective utilization of modern aspects tools and operation of electronics as used in the project.

CHAPTER IX

ADVANTAGES AND APPLICATIONS

9.1 ADVANTAGES

1. The main versatile important added advantage is that it solves the general problems. Concentrating it is a social cause project as a greater extent.
2. Method of implement is easy; the modularity produce by the systems are greater in values of aspects.
3. It is most cost effective in nature where fabricating and maintenance of the desired systems are very much reliable good work Spain.
4.Taking about the Compactness of the systems where the system produces aspects ratio in compact, they are well concentrated in the actual standards.
5. The mode of functionality of the gloves is very much flexible to users and adapting to the systems take a leisure time.
6. The system produce a board range of Multipurpose usage in various brand of industry. In which can serve in different domain of fields as by adapting the technique.

9.2 APPLICATIONS

1. Simple data conversion from Gesture recognition to voice commands which can be more updated form of communication in the critical situation like “Army”.
2. The privacy aspects of communication is an added sense of important where “Encrypted Communication among the soldiers” using gesture could be easily accepted and progressed.
3. The standardization of health can also take into consideration in which action of to monitor the “health status and to generate its report” and continuous note and track can been seen.
4. The navigation aspects of ratio also can be achieved where by a logical GPS tracker which locate the exact “Co-ordinates of soldier in Warfield”.

CHAPTER X

CONCLUSION AND FURTURE SCOPE

As observed the various methods through which gesture is converted to required audio output, the same method can be implemented for the use of military purpose where two soldiers can talk with the use of gesture recognition in noisy environment. Also, in present scenario one of the difficulties faced knows the health condition and exact coordinate location of soldier in battleground.

Taking this into consideration our project intends to provide a device which provides effective communication by vocalizing audio input, knowing the health status and current position with the help of IoT (Internet of Things), flex sensors, medical sensors and GPS tracker. The whole system is made up of easily available electronic components and free function application which helped in reducing the overall cost. Such effective product will help soldiers to put forward their words through gestures and reduce the dependency of the risks.

The System can be made a two-way communication with respect to state of mode operation. The designed system can be developed in responding to soldier based on specific gesture at the transmitter. The soldier can be directed based on GPS location at time of Warfield by building effective communication using Bluetooth device. The near development of system can be made for hand movement by soldier along with gesture recognition.

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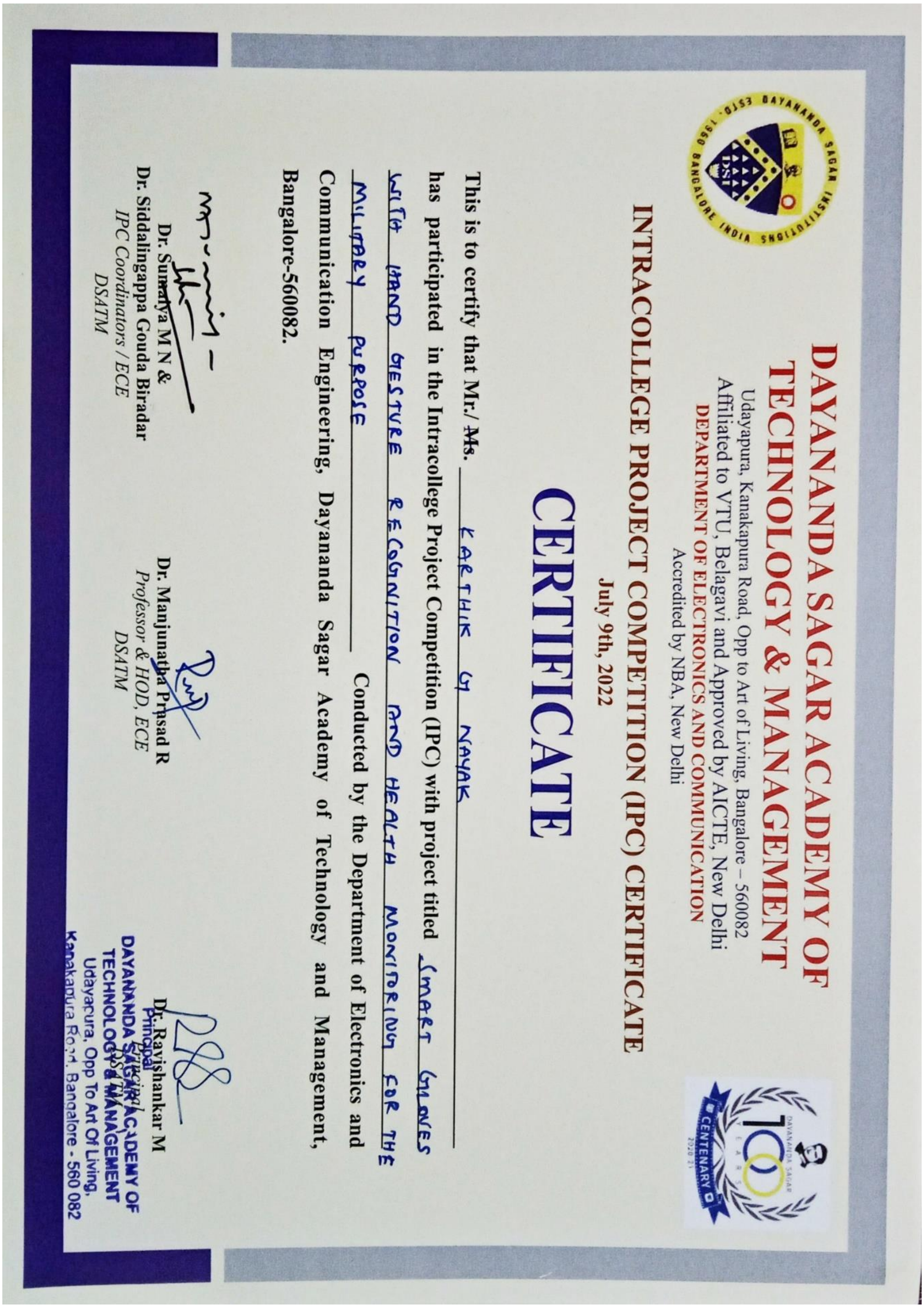
ANNEXURE I

CERTIFICATES & SURVEY PAPERS



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INTRACOLLEGE PROJECT COMPETITION (IPC) CERTIFICATE
July 9th, 2022

CERTIFICATE

This is to certify that Mr./ ~~Ms.~~ KARTHIK G NAYAK has participated in the Intracollege Project Competition (IPC) with project titled SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR THE MILITARY PURPOSE Conducted by the Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology and Management, Bangalore-560082.

Dr. Su[illegible]ya M N &
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Dr. Ravishankar M
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This is to certify that Mr./ ~~Ms.~~ LIKITH KUMAR K has participated in the Intracollege Project Competition (IPC) with project titled SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR THE MILITARY PURPOSE Conducted by the Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology and Management, Bangalore-560082.

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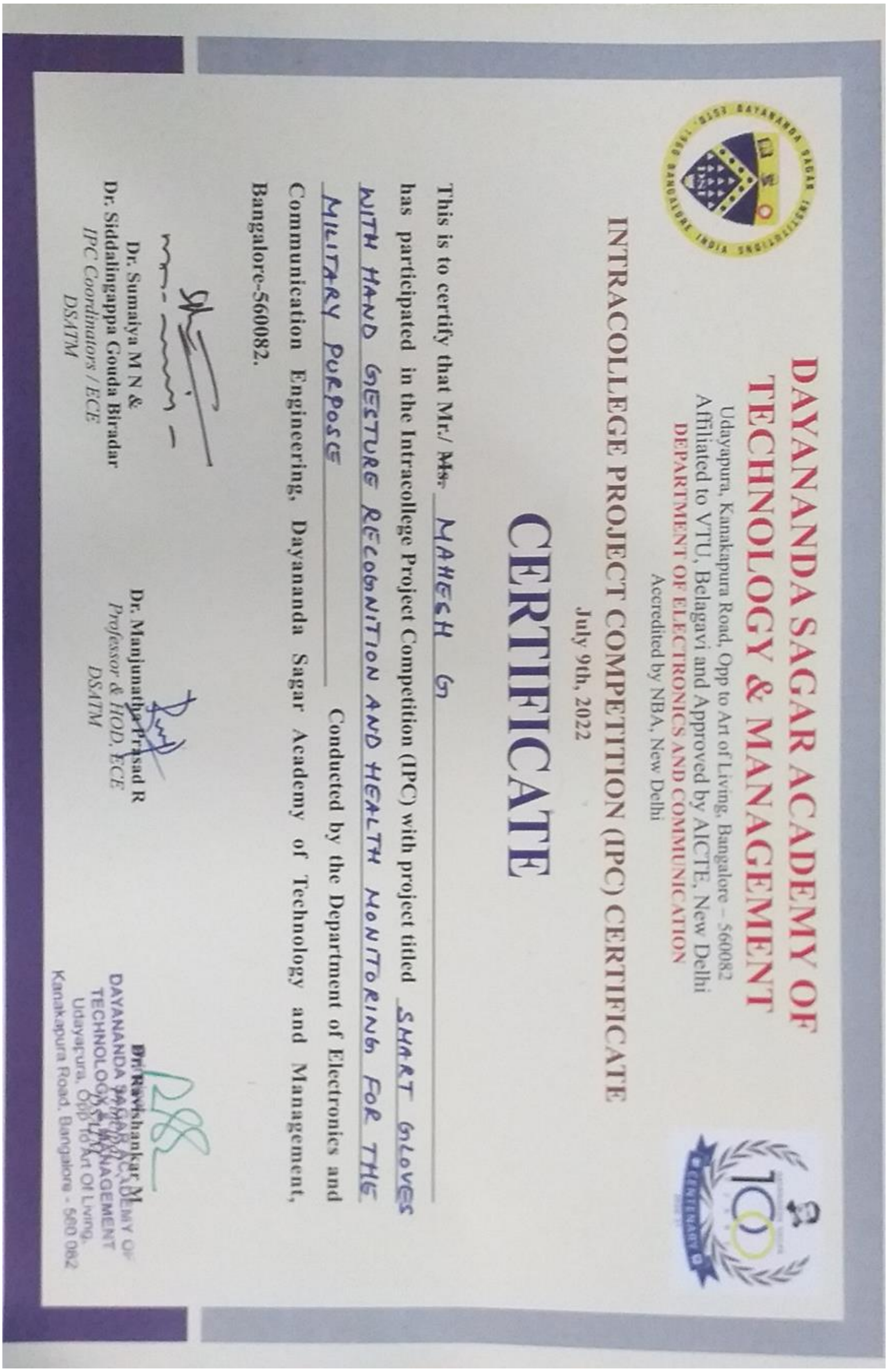

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This is to certify that Mr./ ~~Ms.~~ MAHESH G has participated in the Intracollege Projet Competition (IPC) with project titled SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR THE MILITARY PURPOSE Conducted by the Department of Electronics and Communication Engineering, Dayananda Sagar Academy of Technology and Management, Bangalore-560082.

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Dr. Ravishankar M

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Dr. Siddalingappa Gouda Biradar
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Dr. Manjunatha Prasad R
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SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR THE MILITARY PURPOSE

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Abstract: The nation's safety or security is extremely important in the current world situation. It's been observed that the country's security is primarily dependent on the soldier's unit or army force. In battleground or clandestine operations, troops communication and health monitoring are critical. Technologies such as walkie-talkies or GSM modules were often used methodologies for communication and tracking soldiers' lives on the battlefield in the last few decades. These studies suggest an effective way to use an electronic device that can transform sign language hand gestures into speech to allow effective interaction among soldiers to adapt to the current technology. The technology involves converting hand signals into voice signals, which can subsequently be transmitted via wireless modules. The 'Hand Talk' glove is a regular driving glove with electrode sensors built in. The sensors produce a stream of data that varies depending on finger's flexibility. The sensor's output is converted to digital and processed with an Arduino, after which it reacts to voice commands over Zigbee. It is also necessary for the control station to know the health condition of soldiers along with the location on the battlefield. To track the current situation, the device is mounted in a hand glove and data can be transferred to the base station with help of IoT (Internet of things). The main motivation in this research is to know how to build effective communication between soldiers along with their health monitoring system.

Keywords: Flex senor, GSM (Global System for Mobile Communication), Zigbee, IoT (Internet of Things).

I. INTRODUCTION

Indian army force is the world's third-largest standing force with 990,960 reserve troops and 1,200,255 active troops. The army suffers a lot due to the unavailability of information of injuries to its personnel and communicating with others while doing search operations and combing. Sometimes they use a specific hand gesture to communicate with each other due to some of the obstacles or low visibility communication breakage takes place neither they can use speak signal with a higher tone which helps the attackers. Hence, they use tactical signals. It is also observed there are many issues regarding the safety of soldiers. Knowledge of the current location of soldiers, the inability of continuous communication with the control room during the operations, lack of immediate medical attention, and operations under different geographical conditions are the few prominent safety issues.

It is observed from the past many years, technologies such as walkie-talkie, Zigbee, cable-based systems were the most used methodologies for communication and tracking of soldiers' life in the Warfield. However, all these technologies suffered from one or more reasons like high

In order to reduce all problems in this area, we can use real-time communication with tracking. This method provides us to convert the hand gesture to respective speech signals which are accessed through wireless modules. Here, we are developing a system with a 'Smart glove' which consists of sensors. This device helps to bridge the effective communication among the soldiers. The smart glove is developed with gesture recognition. The recorded values from the sensors are converted to digital values. The values are transferred to the receiver with help of a wireless channel when the value is received it is compared with predefined data. Based on the value it generates the voice signal for the specific gesture. Hence, the respective receiver receives the voice message. Pulse rate and body temperature can be monitored along with the location tracking of the soldiers using GPS can be monitored using the proposed system. The transmission of these parameters to the base station is carried out by IoT. The base station gets the specific position of soldier from GPS.

The remainder part of the paper is organized as follows. Section II explores some pieces survey work. Section III states the problem definition of proposed work. Section IV defines the objectives of the proposed project work. Section V introduces with the methodology used in implementing the proposed model. Section VI is described with the results obtained and analysis made with respect the proposed method. Section VII provides concluding remarks.

II. LITERATURE SURVEY

L. Vijay Anand *et* al [1] The method proposed by this paper, in which the soldiers are tracked and monitored for their well-being using live track applications. The continuous health monitoring of the soldiers is done such as temperature monitor, heart rate monitor GPS is used to find the real time location of the soldier. The data received from medic sensors and GPS receiver is collected using Arduino. Whenever there is difference in the threshold value, the system is cautioned, and data will be transmitted to the base station.

Meghana H S *et* al [2] It describes the health monitoring and tracking of soldiers and its responsibility with the GPS to guide the losing direction in the correct direction. The proposed system is divided into two sections i.e., Soldier unit and Control room unit. The information received is stored in Cloud and can be extracted on the PC of the base station. Based on the information the immediate action is taken with necessary medical aids and back force for the help.

Bhavana Madabathula *et* al [3] It highlights the advantages of sign language using Data glove approach i.e., Flex sensor-based glove that has high level of reliability, consistency, harsh temperature resistance, with stationary surfaces for mounting, an Infinite number of resistance possibilities and with specific value of bend ratios. The each bent in the finger the different values are obtained. The IMU (Inertial Measurement Unit) is used to identify the hand position.

Shigeru Shimamoto *et* al [4] the sensor-based data acquisition glove with hand gesture recognition. Flex sensors and Force Sensing Resistors (FSRs) are used to detect bending movement in the gloves. Then data will send to the computer by Arduino micro for the further simplification.

Albert Mayan J *et* al [5] In this system gloves with flex and MEM sensors are more flexible and accurate. The microcontroller stores all the data that is send from sensors. Database which stores messages and templates which transfer or store copy of templates in the microcontroller as well. Motion sensors reacts to every action made by the user and it is placed on hand. Motion sensors which will activate only if there is any motion detected. For every action the motion detector gets high and fed to the microcontroller. Now the microcontroller has copy of templates which compared with the fetched motion signals. Microcontroller will match both of this and convert hand gesture into suitable speech signals. After this speech signals transferred to the artificial mouth to retrieve the data and now dumb people can talk with their artificial mouth. The result of the model or message of the model shown on the display also it will be played on speaker as well.

III. PROBLEM STATEMENT

Most of the surgical strikes demands for silent operation, Since the soldiers cannot equip walkie talkie as a medium of communication which can alert their presence to intruders or enemies. Tactical hand symbols are using most of the time it is not received by others due to low visibility of light during night. Lack of communication miss gap leads to the huge destruction. Concerning about the health and to reduce failure of soldiers due to health issue it a difficult task to physically monitor the health status of the soldier during the war. If a soldier moves out of the located range it should be recognised and respective action to be taken which can be a struggle.

IV. OBJECTIVES

In order to reduce the impact mentioned in the problem statement the main objective is to overcome the complications during the war fare both in day as well as night. The main intent of the project is to design a wearable smart hand gloves for communicating among the soldiers, besides for health monitoring as well. Objectives includes to adopt different sensors and components for enhancing the workability and hence, analysing the health condition of the soldiers. Aim is to track the location of the soldier using cloud and providing the basic health status. Using cloud and IoT to improve the effectiveness of the model which are considered as the growing recent technologies.

V. METHODOLOGY

The smart glove is fixed with the flex sensor, which is more flexible and accurate for measuring hand gesture. For recognition of gesture through finger action of all the fingers needs to be analysed. Hence, Gloves is fixed with flex sensors which records different values for various hand gestures. Sensed values of various bends of flex sensors corresponding to different action and positions of all the fingers transferred to Arduino UNO. These values of output are converted to digital values in Arduino UNO and sent via Zigbee. Zigbee is used as the both transmitter and receiver in both the ends. Near Zigbee receives the digital value of output at receiver end. At the receiver, these values are compared with pre-defined data, which are stored in memory of Arduino UNO. Based on different hand gesture pre-defined messages for vocalized version is received at receiver end. APR module produces the audio with respective input hand gesture.

Fig 1: Hand symbols

Health parameters like body temperature and heart rate can also be measured. Temperature sensor parallelly records the temperature and indication are given when the temperature of glove user is out of defined range. With addition to temperature sensing heart beat sensor is adopted to record heart beat which works on principle of photoplethysmography. Google positioning system locates the coordinates of glove which is based on trilateration mathematical principle there by locating

- Transmitter

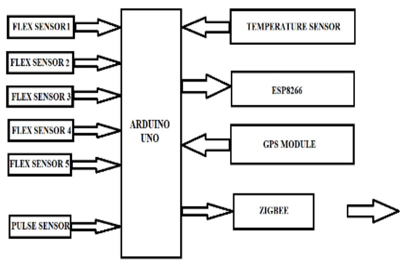

Fig 2: Block diagram of transmitter

- Receiver

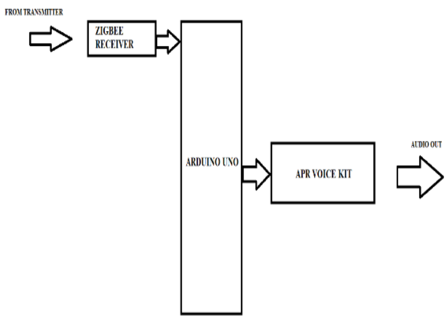

Fig 3: Block diagram of receiver

continuously the location of the glove user. Esp8266 Wi-Fi module is used to connect the device to IoT. At receiver end these values are compared with predefined data which is stored using cloud computing software. Stored Data in cloud can be accessed by military base station as a reference. The data will be stored in www.adafruit.io

VI. RESULTS

In the proposed system, the user forms a gesture and hold of period of 1 to 2 seconds to ensure a proper recognition has been obtained. Each gesture comprises of a bending the finger in a certain angle accordingly. Every bend of the sensor (finger) produces unique ADC value so that when different hand gesture is made, different ADC values are produced. Taking such ADC values for 4 different users, a table of average ADC values for each sensor is maintained where F1, F2, F3, F4.

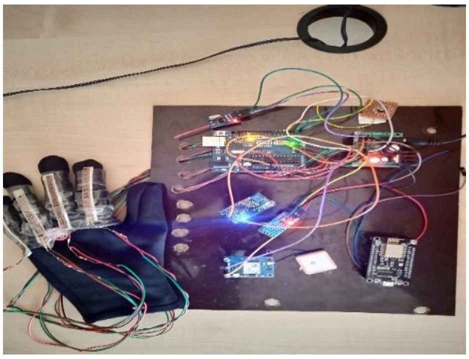

Fig 4: Smart gloves with transmitter

The hand gesture obtained from transmitter end receive the output in voice for different gesture.

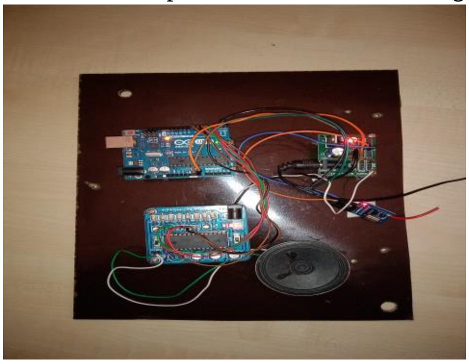

Fig 5: Receiver part of the project

Table I: -The average accuracy obtained in gesture

Hand gesture	**Accuracy (%)**
Hold	98
Watch out	91
Back	95
Cover me	89
Shoot	92
Forward	93
Down	85
Alert	95

The health monitoring system is developed in which the temperature and heart rate values are

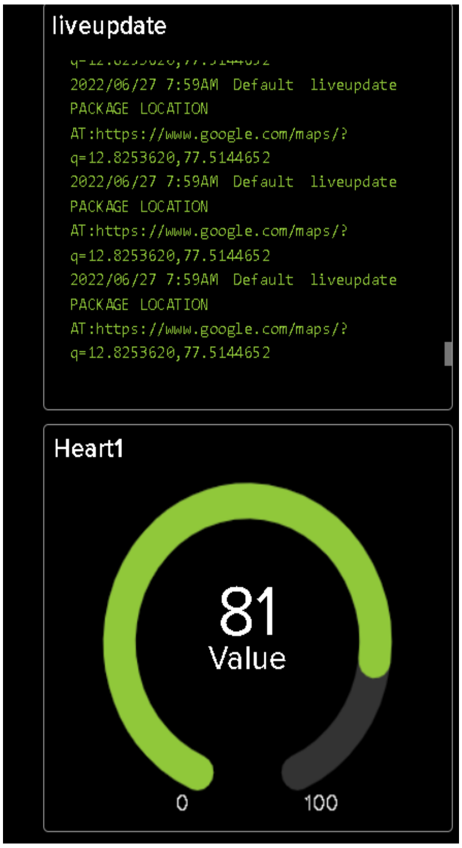

Table II: - The results obtained in cloud

Parameters	**Accuracy (%) obtained from sensor**	**Accuracy (%) transferred to Adafruit cloud**
Temperature	92	98
Pulse	88	98
GPS Location	86	97

VII. CONCLUSION

As observed the various methods through which gesture is converted to required audio output, the same method can be implemented for the use of military purpose where two soldiers can talk with the use of gesture recognition in noisy environment. Also, in present scenario one of the difficulties faced knows the health condition and exact coordinate location of soldier in battleground. Taking this into consideration a project is designed with a device which provides effective communication by vocalizing audio input, knowing the health status and current position with the help of IoT (Internet of Things), flex sensors, medical sensors and GPS tracker.

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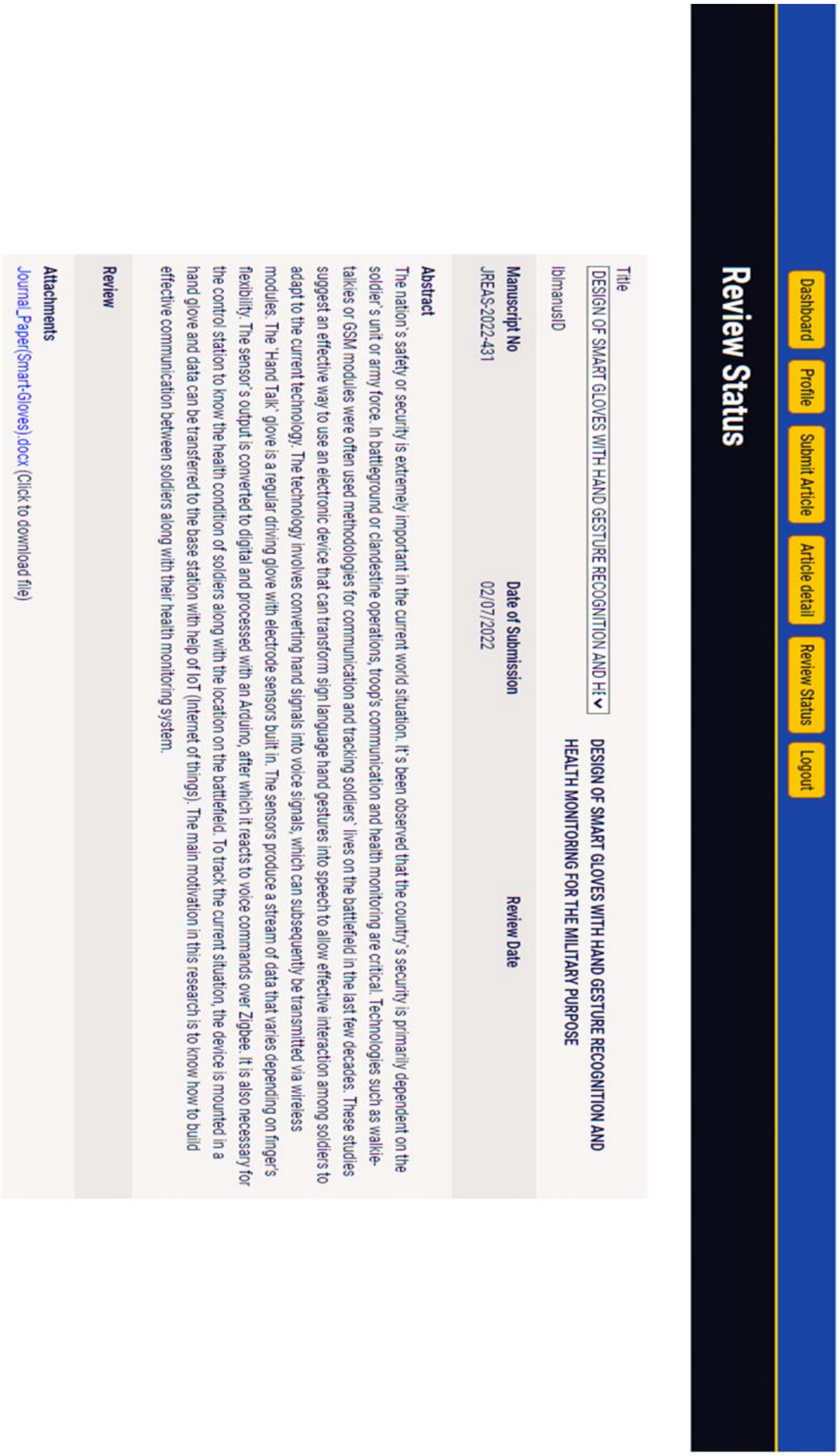

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lblmanusID	DESIGN OF SMART GLOVES WITH HAND GESTURE RECOGNITION AND HEALTH MONITORING FOR THE MILITARY PURPOSE

Manuscript No	Date of Submission	Review Date
JREAS-2022-431	02/07/2022	

Abstract

The nation's safety or security is extremely important in the current world situation. It's been observed that the country's security is primarily dependent on the soldier's unit or army force. In battleground or clandestine operations, troop's communication and health monitoring are critical. Technologies such as walkie-talkies or GSM modules were often used methodologies for communication and tracking soldiers' lives on the battlefield in the last few decades. These studies suggest an effective way to use an electronic device that can transform sign language hand gestures into speech to allow effective interaction among soldiers to adapt to the current technology. The technology involves converting hand signals into voice signals, which can subsequently be transmitted via wireless modules. The 'Hand Talk' glove is a regular driving glove with electrode sensors built in. The sensors produce a stream of data that varies depending on finger's flexibility. The sensor's output is converted to digital and processed with an Arduino, after which it reacts to voice commands over Zigbee. It is also necessary for the control station to know the health condition of soldiers along with the location on the battlefield. To track the current situation, the device is mounted in a hand glove and data can be transferred to the base station with help of IoT (Internet of things). The main motivation in this research is to know how to build effective communication between soldiers along with their health monitoring system.

Review

Attachments

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ANNEXURE II

PLAGIARISM REPORT

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The Internet of Things (IoT) is a network of interconnected computing devices embedded in everyday objects, enabling them to exchange data in a Machine-to-Machine approach.

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Wireless Glove for Hand Gesture Acknowledgment — 100%

hard of hearing and quiet people with the capacity to easily speak with anybody.

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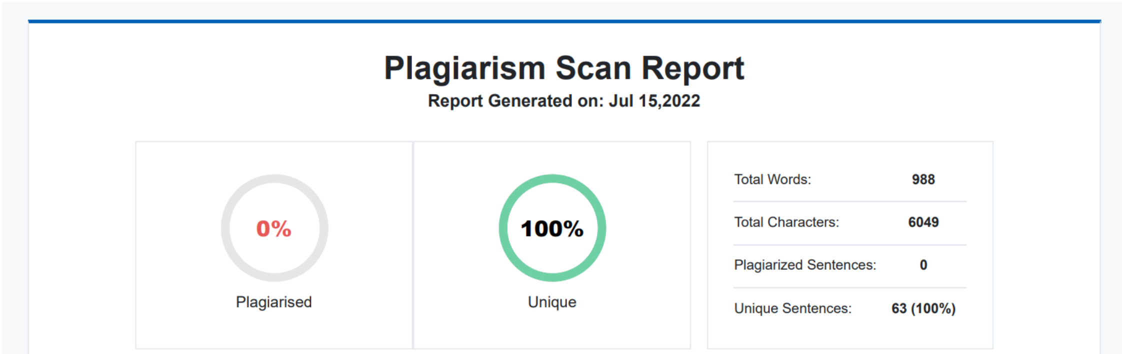

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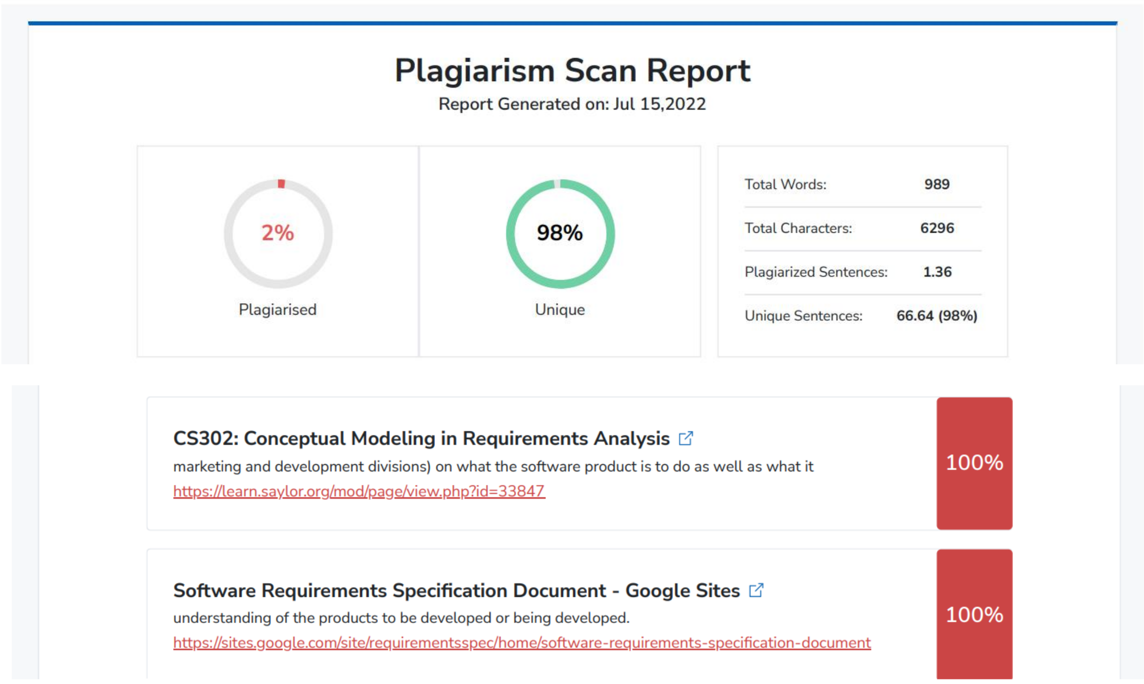

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marketing and development divisions) on what the software product is to do as well as what it

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Software Requirements Specification Document - Google Sites — 100%

understanding of the products to be developed or being developed.

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http://www.drhdmi.eu/dictionary/ieee-802-15-4.html#:~:text=ZigBee%20is%20targeted%20at%20radio,a%20sensor%20or%20input%20device.
100%

ZigBee: Wireless Technology for Low-Power Sensor ...
· The ZigBee Alliance is a group of companies that maintain and publish the ZigBee standard. Overview ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard' The low cost ...
https://www.bing.com/ck/a?!&&p=11dcb28e32d2008c9e5444bf75cd1457f697f22eb5381b7a4608a99c7de0bda6JmltdHM9MTY1Nzk0NTI4MyZpZ3VpZD05YzBiOGFiOS1jZDk2LTRkOWMtOTE0NS04OWJhMzkxMGZkMDEmaW5zaWQ9NTE5OQ&ptn=3&fclid=bfee7748-04be-11ed-8148-bedba9d44232&u=a1aHR0cHM6Ly93d3cucmVzZWFyY2hnYXRlLm5ldC9wdWJsaWNhdGlvbi8yNzg2ODUxODVfWmlnQmVlX1dpcmVsZXNzX1RlY2hub2xvZ3lfZm9yX0xvdy1Qb3dlcl9TZW5zb3JfTmV0d29ya3NfUmV2aWV3&ntb=1
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2 Capabilities | Making the Soldier Decisive on Future ...
Communication among the soldiers" using gesture could be easily accepted and
https://www.nap.edu/read/18321/chapter/4
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that are encoded can be used which can be decoded at the receiver and converted to voice
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In order to overcome the problems in these critical conditions, gesture-controlled commands
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system can be connected with the other devices for different applications.
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Android application can be done for displaying gesture
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OVERALL PLAGIARISM-3.85%

OVERALL UNIQUNESS-96.15%

ANNEXURE III

CODE OF THE PROJECT

Transmitter code

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
int Flex1_value=A0;
int Flex2_value=A1;
int Flex3_value=A2;
int Flex4_value=A3;
int SW=5;
void setup()
{
   Serial.begin(9600);
pinMode(SW,INPUT_PULLUP);
pinMode(Flex1_value,INPUT);
pinMode(Flex2_value,INPUT);
pinMode(Flex3_value,INPUT);
pinMode(Flex4_value,INPUT);
Serial.begin(9600);


   Serial.println("military gesture S/M");
   delay(2000);


}


void loop()
{
  if(digitalRead(SW)==0)
  {
   FLEX_READ();
  }
}
```

```
void FLEX_READ()
{
int  Flex1_value1=analogRead(Flex1_value);
int Flex2_value1=analogRead( Flex2_value);
int Flex3_value1=analogRead( Flex3_value);
int Flex4_value1=analogRead(Flex4_value);
  Serial.print("FLEX1:");
  Serial.println(Flex1_value1);

  Serial.print("FLEX2:");
  Serial.println(Flex2_value1);

  Serial.print("FLEX3:");
  Serial.println(Flex3_value1);

  Serial.print("FLEX4:");
  Serial.println(Flex4_value1);
  delay(1000);

  if((Flex1_value1>680))
  {
    Serial.println("A");

   delay(1000);

  }
 if((Flex2_value1>695&&Flex1_value1>680))
  {
    Serial.println("B");


    delay(1000);
  }
```

```
 if((Flex3_value1>69&&Flex1_value1>6805))
 {
   Serial.println("C");
    delay(1000);
 }
 if((Flex1_value1>680)&&(Flex2_value1>695))
 {
   Serial.println("D");
   delay(1000);
 }
 if((Flex1_value1>680)&&(Flex3_value1>695))
 {
   Serial.println("E");
   delay(1000);
 }
 if((Flex2_value1>695)&&(Flex3_value1>695))
 {
   Serial.println("F");
   delay(1000);
 }
 if((Flex1_value1>680)&&(Flex2_value1>695)&&(Flex3_value1>695))
 {
   Serial.println("G");
 }
  if((Flex4_value1>700))
 {
   Serial.println("H");
    delay(1000);
 }
}
```

Receiver Code

```
int M1=2;
int M2=3;
int M3=4;
```

```
int M4=5;
int M5=6;
int M6=7;
char ch;
void setup() {
pinMode(M1,OUTPUT);
pinMode(M2,OUTPUT);
pinMode(M3,OUTPUT);

pinMode(M4,OUTPUT);
pinMode(M5,OUTPUT);
pinMode(M6,OUTPUT);

digitalWrite(M1,LOW);
digitalWrite(M2,LOW);
digitalWrite(M3,LOW);
digitalWrite(M4,LOW);
digitalWrite(M5,LOW);
digitalWrite(M6,LOW);
Serial.begin(9600);
}
void loop() {
while(Serial.available()>0)
{
  ch=Serial.read();
 Serial.print(ch);
  delay(200);
 if(ch=='A'){
  digitalWrite(M1,HIGH);
  delay(200);
  digitalWrite(M1,LOW);
  delay(200);
 }
 if(ch=='B'){
```

```
  digitalWrite(M2,HIGH);
  delay(200);
  digitalWrite(M2,LOW);
  delay(200);
 }
 if(ch=='C'){
  digitalWrite(M3,HIGH);
  delay(200);
  digitalWrite(M3,LOW);
  delay(200);
 }
 if(ch=='D'){
  digitalWrite(M4,HIGH);
  delay(200);
  digitalWrite(M4,LOW);
  delay(200);
 }
 if(ch=='E'){
  digitalWrite(M5,HIGH);
  delay(200);
  digitalWrite(M5,LOW);
  delay(200);
 }
  if(ch=='F'){
  digitalWrite(M6,HIGH);
  delay(200);
  digitalWrite(M6,LOW);
  delay(200);
 }
 }
```

Health Monitoring and GPS code

```
#include <DHT.h>                    // Data ---> D3 VCC ---> 3V3 GND ---> GND
#include <ESP8266WiFi.h>
#include "Adafruit_MQTT.h"
```

```
#include "Adafruit_MQTT_Client.h"
#include <SoftwareSerial.h>
SoftwareSerial mySerial(12,14);
#define DHTType DHT11
// WiFi parameters
#define WLAN_SSID       "Project"
#define WLAN_PASS       "1234567891"
#define AIO_SERVER      "io.adafruit.com"
#define AIO_SERVERPORT  1883
#define AIO_USERNAME    "Project_B13"
#define AIO_KEY         "aio_EbTe60Yre3jzl8O4eQrRS3k8cL5c"
WiFiClient client;
Adafruit_MQTT_Client mqtt(&client, AIO_SERVER, AIO_SERVERPORT,
AIO_USERNAME, AIO_KEY);
Adafruit_MQTT_Publish temperature= Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/temperature");
Adafruit_MQTT_Publish Heart1 = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME
"/feeds/Heart1");
Adafruit_MQTT_Publish liveupdate = Adafruit_MQTT_Publish(&mqtt,
AIO_USERNAME "/feeds/liveupdate");
DHT dht(5,DHTType);
float tempC;
int Pulse=A0;
int Pulse_var;
String inputString="";

void setup() {
  pinMode(Pulse,INPUT);
  dht.begin();
  Serial.begin(115200);
  mySerial.begin(9600);
  Serial.println(F("Adafruit IO Example"));  // Connect to WiFi access point.
  Serial.println();
 Serial.println();
```

```
  delay(10);
  Serial.print(F("Connecting to "));
  Serial.println(WLAN_SSID);
  WiFi.begin(WLAN_SSID, WLAN_PASS);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(F("."));
  }
  Serial.println();
  Serial.println(F("WiFi connected"));
  Serial.println(F("IP address: "));
  Serial.println(WiFi.localIP());

  // connect to adafruit io
  connect();
}
// connect to adafruit io via MQTT
void connect() {
  Serial.print(F("Connecting to Adafruit IO... "));
  int8_t ret;
  while ((ret = mqtt.connect()) != 0) {
    switch (ret) {
      case 1: Serial.println(F("Wrong protocol")); break;
      case 2: Serial.println(F("ID rejected")); break;
      case 3: Serial.println(F("Server unavail")); break;
      case 4: Serial.println(F("Bad user/pass")); break;
      case 5: Serial.println(F("Not authed")); break;
      case 6: Serial.println(F("Failed to subscribe")); break;
      default: Serial.println(F("Connection failed")); break;
    }

    if(ret >= 0)
      mqtt.disconnect();
```

```
    Serial.println(F("Retrying connection..."));
    delay(10000);
  }
  Serial.println(F("Adafruit IO Connected!"));
}

void loop() {
  // ping adafruit io a few times to make sure we remain connected
  if(! mqtt.ping(3)) {
    // reconnect to adafruit io
    if(! mqtt.connected())
      connect();
  }
  Pulse_var=analogRead(Pulse);
  Serial.print("Pulsevalue:");
  Serial.println(Pulse_var);
  delay(5000);
      tempC=dht.readTemperature();
    Serial.print("Temperature:");
    Serial.print(tempC);
    Serial.println(" c ");
    delay(1000);
    delay(5000);
     if(mySerial.available())
  {
    //Serial.print("HI");
    inputString=mySerial.readString();
    Serial.println(inputString);
  //  liveupdate->save(inputString);



  }
    Serial.println(inputString);
 delay(5000);
```

```
 String one = "PACKAGE LOCATION AT:https://www.google.com/maps/?q=";
String two = "," ;
String message = one +"latitude" +two + "longitude";
// Convert String to char array
int str_len = message.length() + 1;
char textmessage[str_len];
message.toCharArray(textmessage,str_len);
    delay(500);

   if (! temperature.publish(tempC)) {                    //Publish to Adafruit
     Serial.println(F("Failed"));
    }
     if (! Heart1.publish(Pulse_var)) {                   //Publish to Adafruit
     Serial.println(F("Failed"));
    }
     if (! liveupdate.publish(textmessage)) {                    //Publish to Adafruit
     Serial.println(F("Failed"));
    }
    else {
     Serial.println(F("Sent!"));
    }
}
```