SMART GLOVE FOR ELDERLY PATIENTS

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

The world needs to be concerned about the elderly patients around and treat them the way they deserve to be treated. Despite having lots of orphanages, homes etc.… for them, it doesn't stop their insecurity to overcome, assaulters or molesters. This project suggests a smart glove that not only helps these patients to take care themselves but also help them be fearless. This project makes use of six parameters like GPS, GSM modules, Pulse oximeter, Touch sensor, Accelerometer, Bluetooth that are interfaced with Arduino. If elderly patients are facing any health related troubles or in any kind of danger, can immediately make use of this device, embedded in their glove to escape from the dangerous situation by alerting the caretaker .

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LIST OF ABBREVATIONS

AC	Alternating Current
BLE	Bluetooth
BPM	Beats Per Minute
C	Celsius
CP	Cerebral Palsy
DC	Direct Current
FIFO	First In First Out
GND	Ground
GPS	Global Positioning System
GSM	Global System For Mobile Communication
I/O	Input
IC	Integrated Circuit
IDE	Arduino Software
INT	Interrupt
IOT	Internet of Things SOC System On Chip
IR LED	Infrared Light Emitting Diode

LED	Light Emitting diode
M Health	Medical Health
MCU	Micro Control Unit
MIT	Mobile App
MS	Multiple Sclerosis
PWM	Pulse Width Modulation
SCL	Serial Clock
SD	Secure Digital
SDA	Serial Data
SMS	Short Message Service
TV	Television
UI	User Interface
USB	Universal Serial Bus
V	Voltage
VCC	Voltage Common Collector
VIN	Power Input

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND STUDY

Ageing is a universal process and it affects each human being in the World by physically and psychologically. The mental health of elderly people, has become an issue of increasing concern with the rapid growth of the ageing population. The raising proportion of elderly people in the population in both developed and developing countries is creating new health care challenges.

As people gets older, changes occur in all parts of the body, including the brain. Brain cell connections and the cells themselves degenerate and die, eventually destroying memory and other important mental functions. Here Memory loss and confusion are the main symptoms and Forgetfulness can be a normal part of aging. They don't remember information so that they will lose their directions.

The problems faced by memory loss patients are Stress, Depression Difficulty in concentrating and other problems that disrupt daily activities. These Problems make them physically and mentally unstable. They need full care and attention but it is quite impossible in this busy world. At this stage the elderly peoples are allowed to old age homes, nowadays old age homes are increasing rapidly, there are 728 old age homes in India today. In this evolving lifestyle many of their children are not able to take care of their elderly parents, although there are many homes ,these patients are not able to be monitored 24/7 at this stage we are facing so many circumstances. Due to their stress, depression their heart beat, temperature, blood pressure rate increases suddenly. This situation even causes death.

1.2 NEED FOR THE PROJECT

To overcome all these problems, smart glove has been designed which helps to monitor aged people in an old age home or diseased patients or for all those who need 24 hours care and attention. As it continuously monitors patient's health, it will help to reduce the death in old age homes. Its aim is to reduce the death rate caused mainly due to sudden health issues like heart attack, stroke etc. Since it analyses body’s change at its beginning stage itself, it is very easy to diagnose the patients as soon as possible.

1.3 SMART GLOVE APPLICATIONS

1.3.1 24/7 hospital usage

Smart glove plays a major role in hospitals and healthcare unit where the patients need 24-hour attention. It is designed in such a way that it can monitor patient’s health, heartbeat, body temperature, etc. continuously with the help of sensor. It collects the patient’s data and sends it to the caretaker.

Fig 1.3.1.1 Hospital usage

1.3.2 Aged people in old age homes:

It is very much useful in old aged homes where aged people need more care and attention. Since it is very difficult to take care of them continuously for 24 hours, Smart glove helps them a lot. It continuously monitors the aged people’s heart rate, pressure, breathing capacity, or any difficulties they are facing in their body and sends the data immediately to the caretaker.

Fig 1.3.2.1 Old age homes

1.3.3 Alzheimer's patients

It helps in patients who is suffering from memory loss and forgets their way to home. In this condition, the smart gloves detect the changes in the body and send the information to the caretaker.

1.3.4 Stroke patients

Stroke patients mainly suffer from long term disability which is more due to Neuro damage than muscle weakness. For these patients smart gloves help to aid the movements of the disabled body parts and analyze the condition of patients and helps in faster diagnosis.

1.3.5 Women's safety

Smart glove also helps in women's safety by automatically monitoring the heartbeat level, which is increased due to the release of epinephrine hormone (mainly released during the time of fear, anxiety or any kind of nervousness). It sends the information through the GSM to the caretaker.

1.4 TECHNICAL ASPECTS OF DIGITAL HEALTH

The Smart glove assessment requires a data acquisition system that will collect sensor data relevant to important analysis for the purpose of alerting the catheter.

The technical acceptance of the sensing system is mainly important, as the lack of this sensing system may lead to insufficient motivation to use the system and reduced data quality.

Particularly, an efficient management of power is important to reduce the frequency of required charging of the devices, which is closely related to all the technical acceptance of the system. Wireless transmission of all the data that has been collected helps to avoid technical manipulation of the device by patients, and simultaneously acts as a gateway of data to push the obtained data to the cloud. This area and data has been intensively studied in the field of Body Sensor Networks.

1.5 MEDICAL ASPECTS OF DIGITAL HEALTH

Low BLOOD PRESURE and HIGH BLOOD PRESSURE is a common symptom in several diseases, and affects activities of daily living and quality of life.

Among diseases of other types, diseases with typical gait impairments are PD, multiple sclerosis (MS), cerebral palsy (CP), osteoarthritis, rheumatism, spinal cord disorders, and sarkopenia. Quantitative assessment of activity patterns has the potential to support clinical diagnostics and therapeutic decisions, compensating for the fact that clinical motor assessments are subjective in that they vary between investigators and depend on the experience clinicians.

Sensor-based, mobile heart rate monitoring systems are able to provide objective, parameters recorded in a flexible environment without being in tension the caretaker can monitor. Wearable sensors have been shown to provide congruent results in patient cohorts with good accuracy and good precision compared to gold standard laboratory systems.

1.6 OBJECTIVE

- Smart glove usually helps to recognize hand gestures besides the signal languages in deaf and dumb patients.

- It helps to measure the heart beat and helps in diagnosis of patients at the right time.

- It helps to measure the temperature of the patients continuously.

- It measures the hand movement in stroke patients and helps in diagnosis.

1.7 NEED FOR THE PROJECT

This project mainly works with patients who need 24/7 medical care, deaf and dumb patients, Patients who suffer from heart problem and stroke, patients who are under ventilation and in old age people.

CHAPTER 2

LITERATURE SURVEY

D.Sunehra, VS Sretha, V shashank (2020) proposed a work Security has become a major concern for women, children and even elders in every walk of their life. Women are getting assaulted and molested, children are getting kidnapped, elder citizens are also facing many problems like robbery, etc. In this study, a smart security solution called smart wearable device system is implemented using the Raspberry Pi3 for enhancing the safety and security of women/children. It works as an alert as well as a security system. It provides a buzzer alert alert to the people who are nearby to the user (wearing the smart device). The system uses GPS to locate the user, sends the location of the user through SMS to the emergency contact and police using the GSM / GPRS technology. The device also captures the image of the assault and surroundings of the user or victim using USB Web Camera interfaced to the device and sends it as an E-mail alert to the emergency contact soon after the user presses the panic button present on Smart wearable device system.

R.I.Rajkumar, P.E.Sankaranarayanan, G.sundari(2013) study on a very important issue around the world is to track traffic violations and the resulting accidents, particularly in the railways sector. It is felt that this issue will be under control if somebody could properly monitor/track the individual trains. But this is not possible by individuals manually and so tracking of trains using a special device integrated in the train seems to be a possibility. This integrated device would then warn the train driver to drive safely and also enable periodically updating its location status in a remote controller. In this paper we propose such a real time train tracking system using GPS and communication of information through Ethernet Concepts.

Rifki Wijaya, Ary setijadi, Tati L.Mengko, Richard K. L.Mengko (2014)presented a work on Data collecting is important issue for health care problem. Many people are used heart rate for identify how much calories burned. Heart rate data is collected using direct observation method. Direct observation method using tools calls smart watch. This data is used for further research in heart rate time series.sensing systems are based on mhealth technology and combination of communications, sensing and human mobile interaction technologies targeted at treatment and monitoricng patients. The aim of the smart insole system is to provide a remote surveillance for illness patient and enhance athletes' performances, through helping medical professionals in diagnosis and analysis. While our foot, support all the weight of our body and have a complex structure, a bad foot position can often cause pain in the legs, knees, hips. In some cases, a walk analysis may be useful. Indeed, it is not always obvious to precisely locate the problem while standing. But once in mobility, it can increase sharply when walking or running

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K Aziz, S Tarapiah, Sh Ismail (2016) presented propose of a smart system to monitor patient current health conditions, as a smart healthcare system based on the widely spread available technologies; namely, GSM and GPS. Statistics shows that hypertensive heart disease and blood pressure are risk factors for high death rate to decrease it a preventive measures should be applied providing a real-time health monitoring system, to save patients life at acceptable time. The objectives of this paper is to provide an effective system model, that will track, trace, and monitor patient vital readings in order to provide efficient medical services in time. By using sensors, the data will be captured and compared with a predefined threshold. The study focuses on heartbeat rate, and body temperature, thus in case of emergency an SMS will be sent to the Doctors mobile containing measured values and position. Moreover, the paper demonstrates the possibility of building a complete end-to-end smart healthcare monitoring system by using wide range of available sensors for more vital human health parameters to connect patient with doctors in cases of emergency.

CHAPTER 3

HARDWARE AND SOFTWARE

In the proposed work the seven main hardwares used are Arduino NANO board, pulse oximeter, an accelerometer, capacitive touch electrodes, GPS module, Bluetooth and temperature sensor. These hardware are integrated through the software Arduino.

3.1 HARDWARE

The Hardwares used are Arduino microcontroller, pulse oximeter, an accelerometer, capacitive touch electrodes, GPS module, Bluetooth, temperature sensor. The description of all the hardware used is given below.

3.1.1 Arduino NANO Board

The Arduino NANO is an open-source microcontroller board based on Microchip ATmega328p microcontroller and developed by Arduino.cc. It is very compact because of its simplicity and less complexity. The board is equipped with the sets of digital and analog input/output(I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital Pins(I/O) pins, 8 Analog pins(I/O) and it is programmable with the Arduino IDE, via a type B USB cable. The function of each pin is shown in 3.1.1.1 It can be powered by the USB cable or by an external 9-volt battery, through it accepts voltages between 7 and 20 volts. It is also similar to Arduino UNO and Leonardo. The hardware reference design is distributed under a

Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino Website. The ATmega328 on the board comes pre-programmed with a bootloader that allows uploading new code to it without the use of external hardware programmer.

Pin Category	Pin Name	Details
Power	**Vin, 3.3V, 5V, GND**	**Vin:** Input voltage to Arduino when using an external power source (6-12V). **5V:** Regulated power supply used to power microcontroller and other components on the board. **3.3V:** 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. **GND:** Ground pins.
Reset	**Reset**	Resets the microcontroller.
Analog Pins	**A0 – A7**	Used to measure analog voltage in the range of 0- 5V
Input/ Output Pins	**Digital Pins D0 - D13**	Can be used as input or output pins. 0V (low) and 5V (high)
Serial	**Rx, Tx**	Used to receive and transmit TTL serial data.
External Interrupts	**2, 3**	To trigger an interrupt.
PWM	**3, 5, 6, 9, 11**	Provides 8-bit PWM output.
SPI	**10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)**	Used for SPI communication.
Inbuilt LED	**13**	To turn on the inbuilt LED.
IIC	**A4 (SDA), A5 (SCA)**	Used for TWI communication.
AREF	**AREF**	Toprovidereferencevoltageforinputvoltage.

Table 3.1.1.1 Arduino Pin Function

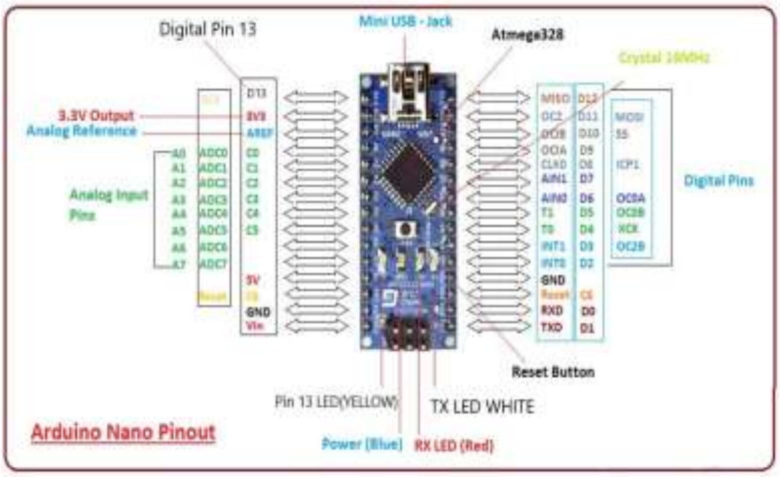


Fig 3.1.2 Arduino NANO Pinout

While the NANO communicates using the original STK500 protocol, it differes from all preceding boards in that it does not use the FTDI USB to serial driver chip. Instead, it uses the ATmega16U2 (ATmega8U2 up to version R2) programmed as a USB to serial converter. The Arduino board technical specification are given in table 4.1.1.2,

Microcontroller	Atmega328 P 8-bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage for Vin pin	7-12V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (2 KB is used for Boot loader)

Table 3.1.1.2 Arduino technical specification

3.1.2 Sensor

Based upon the elderly patient's condition the following sensors will implement their particular function to alert the caretaker. The specific functions of the sensor used in this project are i.Accelerometer (fall detection sensor) and ii.Pulse oximeter iii.Capacitive touch sensor iv.Temperature detection sensor

3.1.2.1 Accelerometer

The ADXL335 is a small, thin , low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale rang ±3 g. It can measure static acceleration of gravity in tilt- sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using C_X , C_y and C_z capacitors at the X_{out}, Y_{out} and Z_{out} pins. Bandwidth can be aelected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm x 4 mm x 1.45 mm, 16 led, plastic lead frame chip scale package(LFCSP_LQ).

Pin Name	Description
VCC	The Vcc pin powers the module, typically with +5V
GND	Power Supply Ground
X	X-axis Analog Output Pin
Y	Y-axis Analog Output Pin
Z	Z-axis Analog Output Pin
ST	Self-Test Pin. This pin controls the Self-Test feature.

Table 3.1.2.1 ADXL 335 Pin descriptions

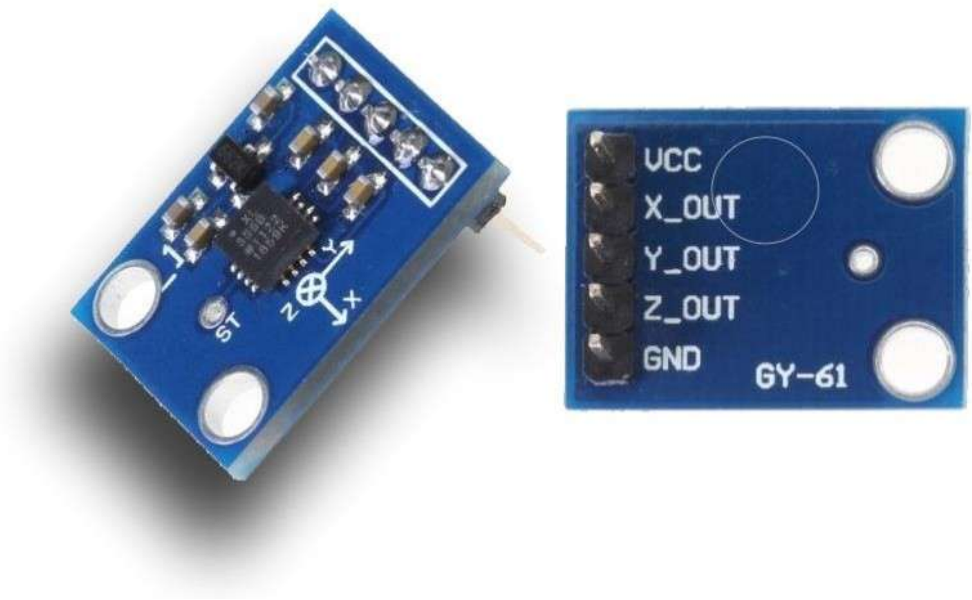


Fig 3.1.2.1 ADXL 335

3.1.2.2 Pulse oximeter

The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. It is a complete pulse oximetry and heartrate sensor system solution designed for the demanding requirements of wearable devices. The MAX30100 provides very small total solution size without sacrificing optical or electrical performance. Minimal external hardware components are needed for integration into a wearable device. It is fully configurable through software registers, and the digital output data is stored in a 16-deep FIFO within the device. The FIFO allows the MAX30100 to be connected to a microcontroller or microprocessor on a shared bus, where the data is not being read continuously from the device's registers. The MAX30100 pin and description is given in Table 3.1.2.2

Pin No.	Signal Name	Description
1	VIN	1.8V – 5.5V Power Input
2	SCL	I2C Serial Clock
3	SDA	I2C Serial Data
4	INT	MAX30100 Interrupt
5	IRD	IR LED Cathode and LED Driver Connection Point. Leave floating in circuit.

Table 3.1.2.2

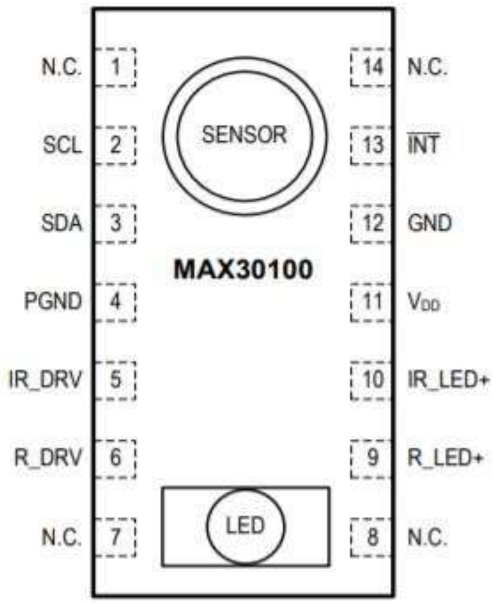


Fig 3.1.2.2 MAX30100 Pin configuration

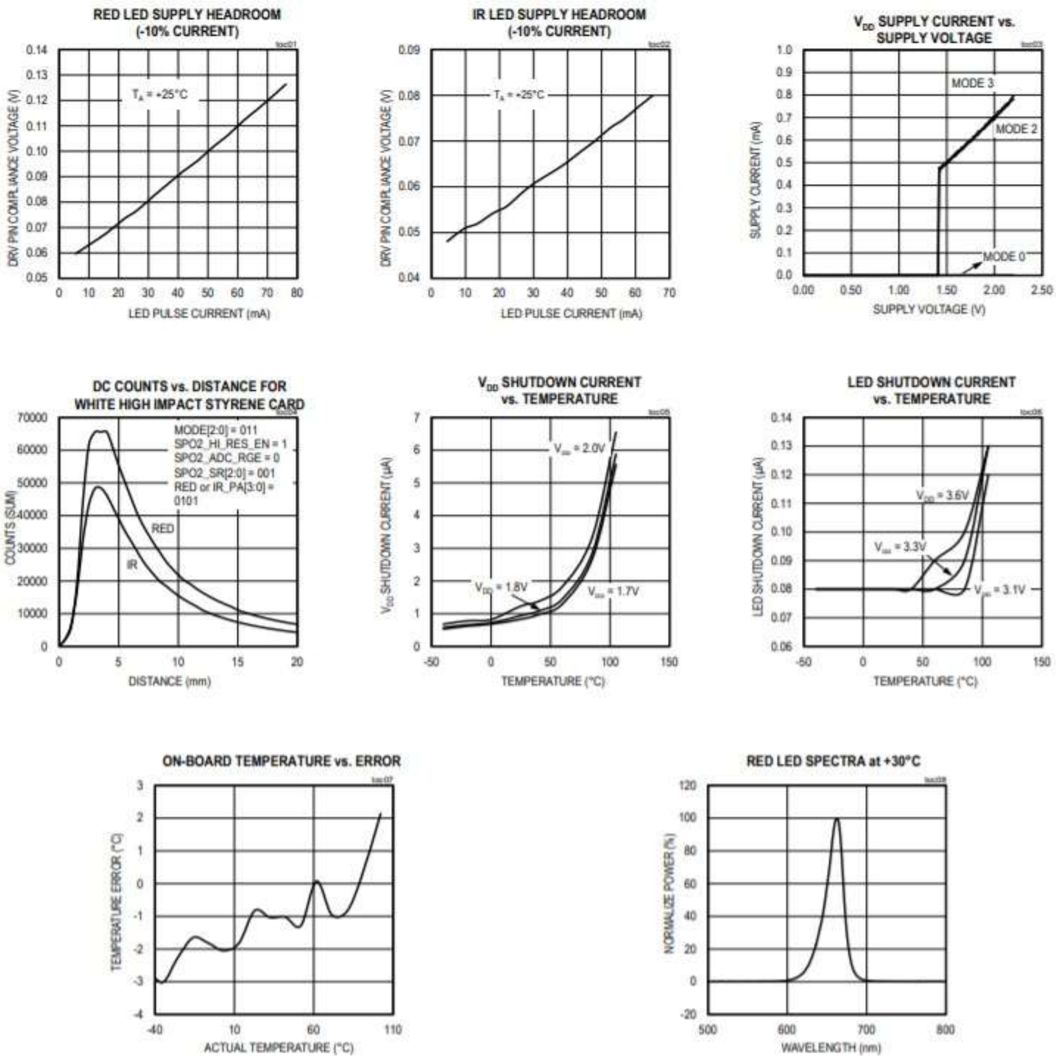


Fig 3.1.2.2 Typical operating characteristics

3.1.2.3 Capacitive touch electrodes

Capacitive sensors work by detecting the charge of capacitance introduced by the finger touching near the electrode. Such change is so small that detecting it unambiguously is challenging and has become the primary task for the design of electrode. Being the front end of the sensor, the electrode's ability to pick up the signal from the finger has a direct and significant impact on the overall performance. The reason an external object would increase the capacitance of the transducer, is that the electric field projected from the transducers polarize the object, and polarize the charges in return attract more changes from the source to join the transducer. The increase in the charge storage on the electrode means the increase in the capacitance. The Arduino pins are connected to a capacitive sensor, which sense the electrical capacitance of the Human body. The sensor setup requires a medium to high value resistor and a piece of wire and a small (to large) piece of copper conductive foil tape on the end as shown in Fig 3.1.3.3.1

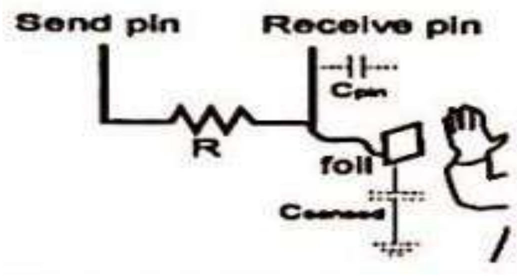


Fig 3.1.2.3 Capacitive touch sensor circuit

At its most sensitive, the sensor will start to sense a hand or body inches away from the sensor, So, with the high resistor it acts like a proximity sensor. Thye sensor designed with he help of copper conductive foil tape on the end is shown in Fig 3.1.2.3

Fig 3.1.2.3 Capacitive touch sensor

3.1.2.4 Temperature detection sensor

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino. Power the IC by applying a regulated voltage like +5V (V_S) to the input pin and connected the ground pin to the ground of the circuit. The pin configuration of LM35 sensor is shown in Fig 3.1.2.4

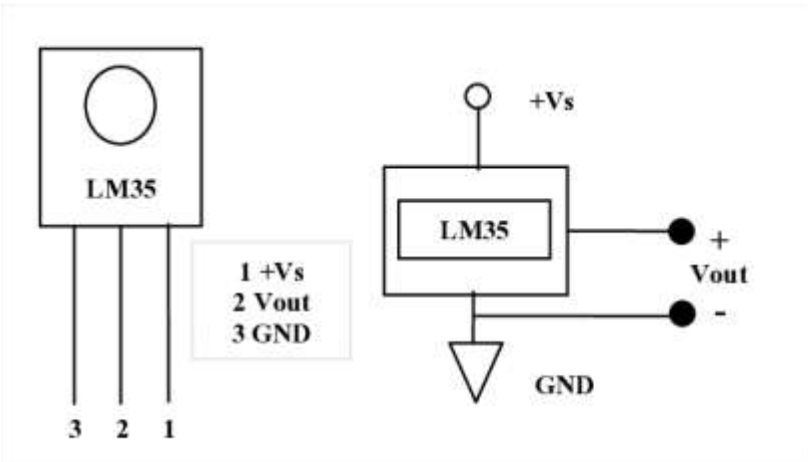


Fig 3.1.2.4 Pin configuration of LM35

3.1.3 Modules

3.1.3.1 GPS module

The NEO-6MV2 is a GPS (Global Positioning System) module and is used for navigation. The module simply checks its location on earth and provides output data which is longitude and latitude of its position. It is from a family of stand- alone GPS receivers featuring the high-performance u-box 6 positioning engine. These flexible and cost-effective receivers offer numerous connectivity options in a miniature (16 x 12.2 x 2.4 mm) package. The compact architecture, power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and space constraints. Its Innovative design gives NEO-6MV2 excellent navigation performance even in the most challenging environments. The module has four output pins and the function of each pins are given in Table 3.1.3.1

Pin Name	Description
VCC	Positive power pin
RX	UART receive pin
TX	UART transmit pin
GND	Ground

Table 3.1.3.1 NEO-6MV2 GPS Module Pin Configuration

This module is one of popular GPS modules on the market and is also cheap to buy. The location data provided by it is accurate enough to satisfy most applications. And for it to be included in smart phones and tablets design points out its efficiency. This module is famous among hobbyist and engineers altogether who want to work on applications involving navigation. The GPS module is shown in Fig 3.1.3.1

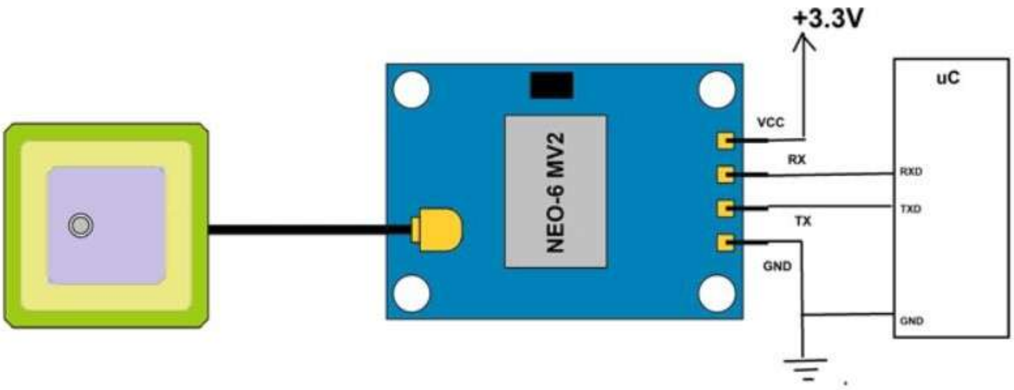
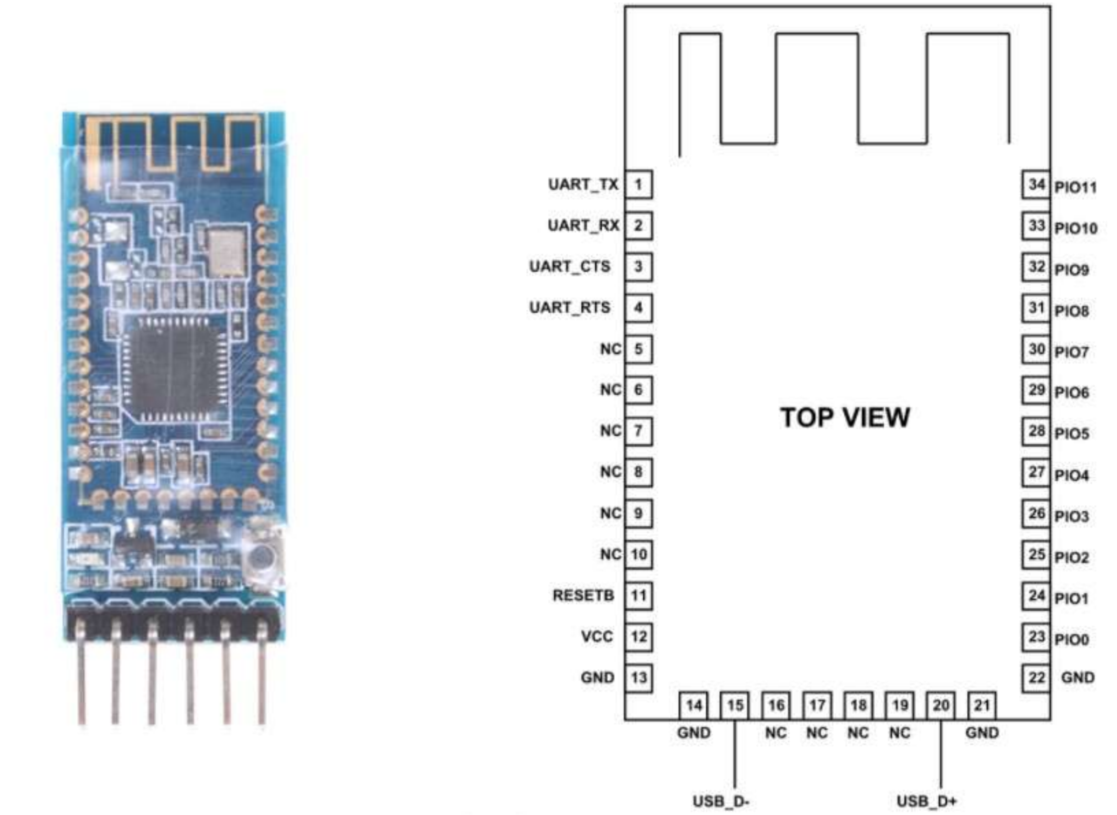


Fig 3.1.3.1 NEO-6-MV2 GPS MODULE

3.1.3.2 Bluetooth Module

This HM 10 BLE 4.0 module is used for establishing wireless data communication. The module is designed by using the Texas Instruments CC2540 or CC2541 Bluetooth low energy (BLE) System on Chip (SoC). The module design and firmware originated from the Jinan Huamao Technology Company. The HM-10 is a readily available Bluetooth 4.0 module (which is shown in fig 3.1.3.2) which can configure as either Master or slave. As the name suggests, BLE focuses on low energy consumption. Low energy focus comes with some sacrifices particularly around data transfer rates and the range of operation. With all the hype around IoT (Internet of Things) and the slew of technologies and devices out in the market, BLE is attempting to position itself as a leader for the future of IoT.



HM-10 Bluetooth Module HM-10 Bluetooth Module Pinout

Fig 3.1.3.2 HM 10 Bluetooth module and pinout configuration

3.1.3.3 Mobile App

The MIT app inverter is used to create an app which is connected to the Bluetooth module to communicate easily with the Bluetooth which is connected to the Arduino, sensor and the Bluetooth.

The MIT App Inventor user interface includes two main editors: the design editor and the blocks editor. The design editor, or designer, is a drag and drop interface to lay out the elements of the application’s user interface (UI). The blocks editor is an environment in which app inventors can visually lay out the logic of their apps using color-coded blocks that snap together like puzzle pieces to describe the program. To aid in development and testing, App Inventor provides a mobile app called the App Inventor Companion (or just “the Companion”) that developers can use to test and adjust the behavior of their apps in real time.

In this way, anyone can quickly build a mobile app and immediately begin to integrate and test.

Unlike many programming languages, App Inventor limits runtime creation of new entities. This provides multiple benefits. First, by explicitly positioning all components in the app, the user can visualize it clearly rather than having to reason about things that will not exist until a future time. Second, it reduces the chances of users introducing cyclic memory dependencies in the user interface that would eventually cause the app to run out of memory. This encourages app inventors to think about how to appropriately structure their applications and reuse components to avoid overloading the system or their end users.

3.1.4 Hand Glove Model

The main hardware component for this entire project is the hand gloves. The hand gloves along with the sensors integrated forms the glove model. The sensors used are accelerometer, capacitive touch sensor, pulse oximeter, Temperature sensor. This project requires a hand glove for the convenient of the elderly patients. The detailed hand glove model of this project shown in Fig 3.1.4

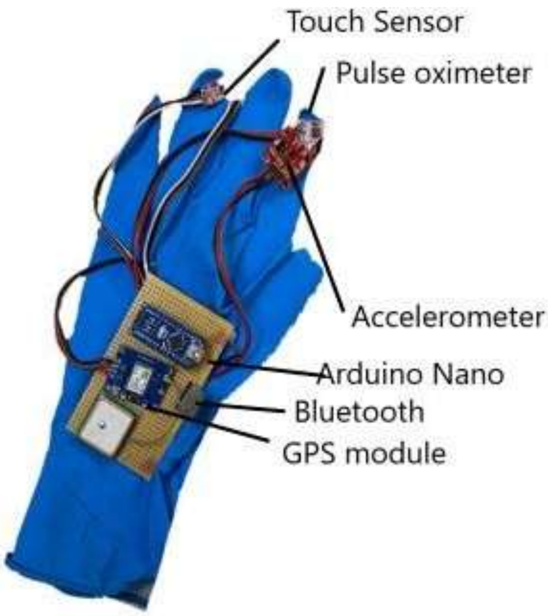


Fig 3.1.4 Hand Glove Model

3.2 SOFTWARE

The software used to build up this project are Arduino. The description of all the software used is given below.

3.2.1 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are easy to read inputs -light on a sensor, Finger on a button, or a twitter message- and turn it into an output-activating a motor, turning on an LED publishing something online. By sensing a set of instructions in the microcontroller on the board the operations are controlled. To do it, the Arduino programming language (based on wielding), and the Arduino software (IDE), based on processing shout be used. Over the years Arduino has been the brain of thousands of prajects, from everyday objects to complex scientific instruments. A world-wide community of makers like students, hobbies, artist, programmers, and professionals have gathered around this open-source-platform, to provide their contributions which sums up an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or the TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects. There are many varieties of Arduino boards that can be used for different purposes. In addition, part of being open-source hardware means that others can modify and produce derivatives of Arduino boards that provide even more form factors and functionality.

The Arduino Integrated Development Environment or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension (.ino). The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow verifying and uploading programs, creating, opening, and saving sketches, and open the serial monitor.

	Verify Checks your code for errors compiling it.
	Upload Compiles your code and uploads it to the configured board. See uploading below for details. Note: If you are using an external programmer with your board, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"
	New Creates a new sketch.
	Open Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.
	Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the File | Sketchbook menu instead.
	Save Saves your sketch.
	Serial Monitor Opens the serial monitor.

Table 3.2.1 Arduino command symbols

Additional commands are found within the five: File, Edit, Sketch, Tools, and Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available. The entire Arduino IDE screen is given in Fig 3.2.1

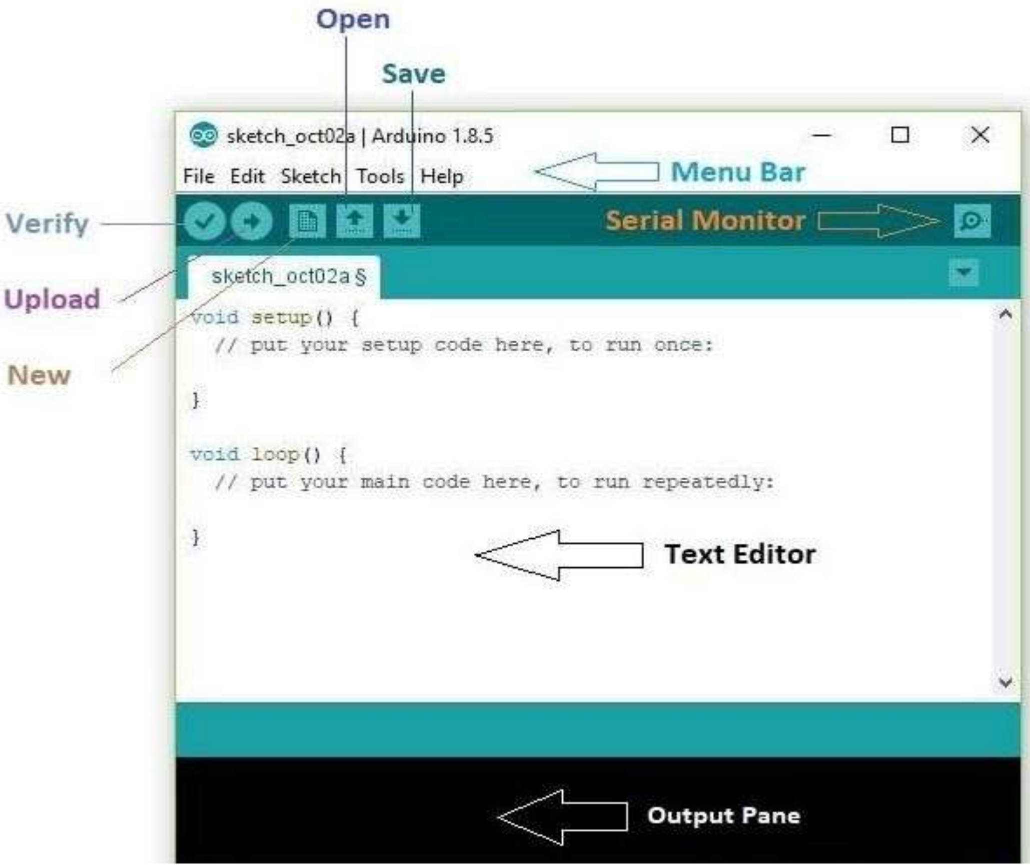


Fig 3.2.1 Arduino Screen

The Arduino board started to changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable,3D printing, and embedded environments. All independently Arduino boards are completely open-source, empowering users to built them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

CHAPTER 4

METHODOLOGY

4.1 PICTORIAL REPRESENTATION

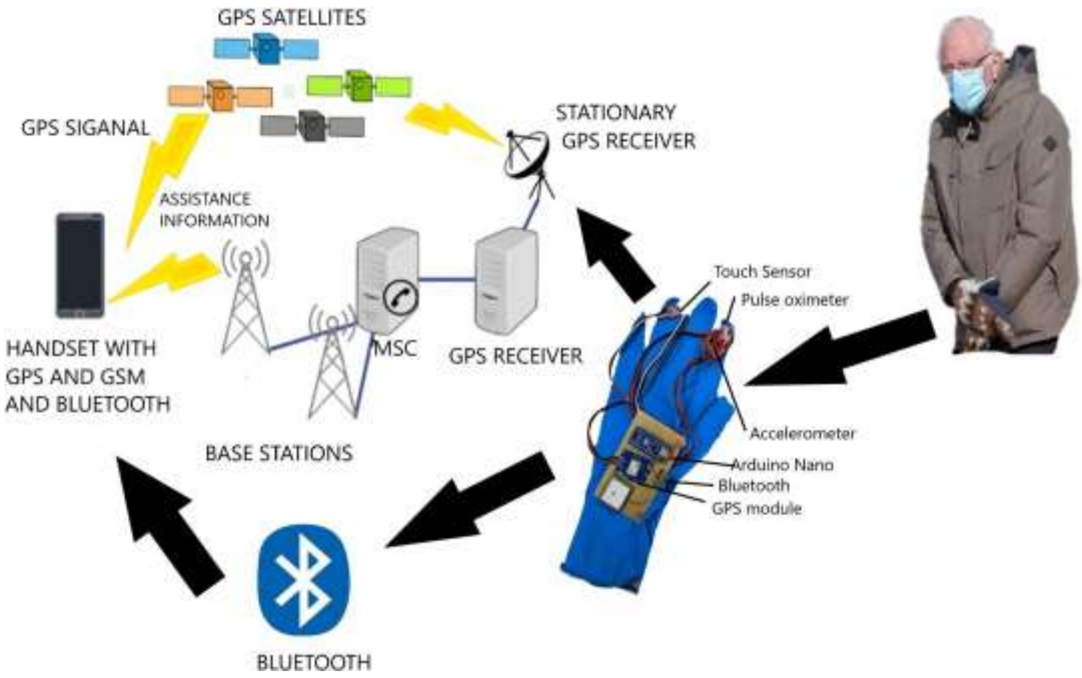


Fig 4.1 Smart Glove Pictorial Representation

The above Fig 4.1 clearly describes the transmition of data from elderly person to a care taker. This can achieved in two different modes namely

i. Sending location via GPS Module
ii. Sending SMS via Bluetooth Module.

4.1.1 Sending Location via GPS Module

A GPS receiver module is a device that receives information from GPS satellites and obtains the geographical position of the device. This kind of transmition of data occurs when the care taker is far away from the subject. This is helpful in locating the subject whenever they are not found.

The GPS receiver obtains the data as a whole NMEA format text. Only the latitude and longitude coordinates are taken from it; using the Arduino TinyGPS library. Then the GSM module sends SMS to the number specified in the code. The switch input based GPS needs a manual action to operates or send SMS.

4.1.2 Sending SMS via Bluetooth Module

Here the Bluetooth Module is connecting with the Arduino via the UART- Interface. Every message the Arduino wants to send, is firstly given to the bluetooth module, which sends the message wirelessly. This kind of transmition of data occurs when the subject is near to the care taker. This is helpful in getting the infrormation in the form of a text message.

4.2 BLOCK DIAGRAM

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that shows the relationship of the blocks. Here we are using microcontroller to control all the components used in this system which is connected to the pulse oximeter sensor to sense the heart rate, temperature sensor for detecting body temperature, Touch sensor for alerting purpose and GPS-Bluetooth module for sending location and text. The general arrangements of the parts or components of a smart glove is shown in Fig 4.2.

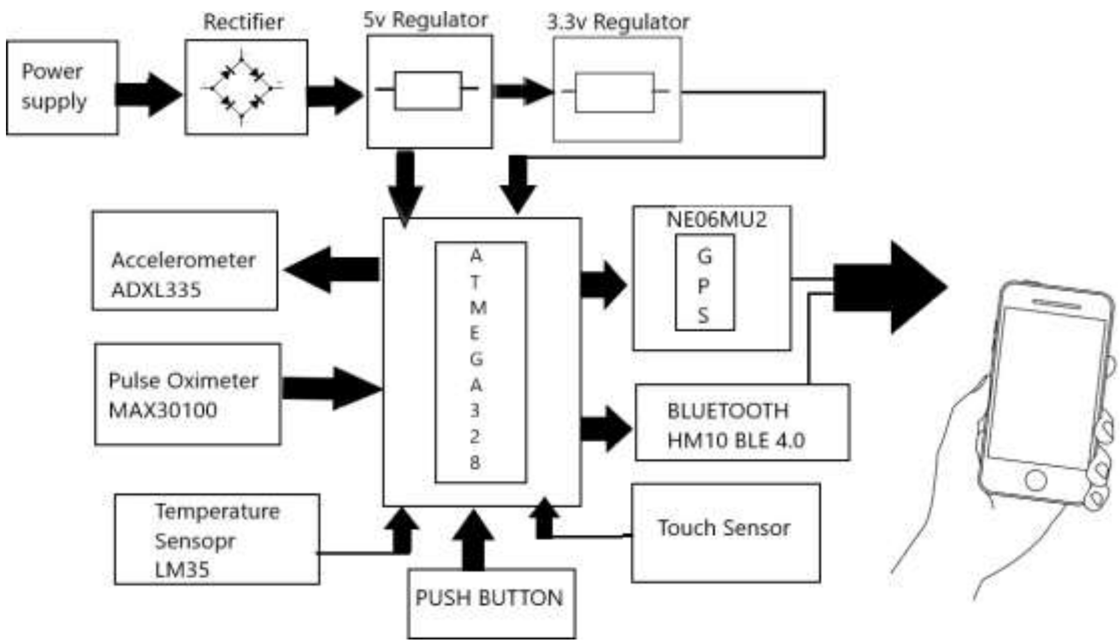


Fig 4.2 Block Diagram

Here the Rectifier and Regulators are inbuilt in the microcontroller, the job of a rectifier is to provide variable DC voltage from AC source to control the system. It improves the accuracy rate, which can drive the control and regulator basically cuts the connection between input and output. If input voltage is below the reference, input and output are connected. This function performs when the power supply is given to the microcontroller and it should be programmed with the proper code, which is shown in ANNEXURE 1 . Furthermore, the pulse oximeter, temperature sensor, touch sensor will detect the fall or raise in the threshold level and send the data to the microcontroller then it will trigger the GPS and Bluetooth and sends location and data via messages using mobile app. The battery used here is lithium-ion battery which will provide power supply to the entire system.

4.2.1 Application of sensors from the block diagram

4.2.1.1 Pulse Oximeter

The sensor used here is MAX30100 Pulse oximeter. Pulse oximeters are low- cost non-Invasive medical sensors used to continuously measure the Oxygen saturation (SPO2) of hemoglobin in blood. The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. The device has two LEDs, one emitting a red light, another emitting infrared light. For pulse rate, only the infrared light is needed. Both the red light and infrared light is used to measure oxygen levels in the blood. When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood.

As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined. It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. This is the main function of the MAX30100: it reads the absorption levels for both light sources and stored them in a buffer that can be read via I2C. Inside the sensor each pulse oximeter sensor probe contains two light emitting diode one emitting red light and the other emitting near infrared light, it also has a photo-detector. The photo-detector measures the intensity of transmitted light at each wavelength. And using the differences in the reading the blood oxygen content is calculated. The probe is placed on a suitable part of the body, usually a fingertip or ear lobe.

The Heart rate or Pulse rate or Heart beat is measured in BPM which is also known as the beats per minute while the **Blood Oxygen** Concentration is measured in percentage. So, basically the **max30100 sensor** is a **Pulse Oximetry and heart rate monitor** which is used to check the health of a person with any condition that affects blood oxygen levels, such as:

- Heart Attack
- Heart failure
- Lungs Cancer
- Asthma etc.

Pulse Oximetry is a test used to measure the oxygen level i.e. oxygen saturation of the blood. It is an easy, painless measure of how well oxygen is being sent to parts of your body furthest from your heart, such as the arms and legs.

No doubt the **Max30100 Pulse Oximeter** is an amazing sensor. The ambient light falling on the sensor can affect the final reading. While using the Max30100 Oximeter, make sure your finger is not moving because it can result in an incorrect reading. One more thing that you really need to take care of while using the Max30100 Sensor is that, never press the sensor too hard as this affects the blood flow and as a result you will get incorrect readings. Try to place your finger softly and make sure your finger does not move, this way you can get the most accurate reading.

4.2.1.2 Fall detection sensor

If the elderly person falls down, it may be difficult for them to request for help. This integrated system consists of the fall detecting sensor that detects the body position of the subject whether it is on a falling mode and send information.

The Algorithms used in this fall system is based on the thresholds of sum acceleration and rotation angle information. When a real fall happens, Collison between human's body and ground will produce obvious peak value at the sum acceleration **a** which has a magnitude as

$$|\mathbf{a}| = \sqrt{{a_x}^2 + {a_y}^2 + {a_z}^2},$$

Where a_x,a_y,a_z present accelerometer measurements of three axis. This system uses the sum acceleration, but normal motions like jumping, sitting also produces peak values, which mean that additional detection features is required.

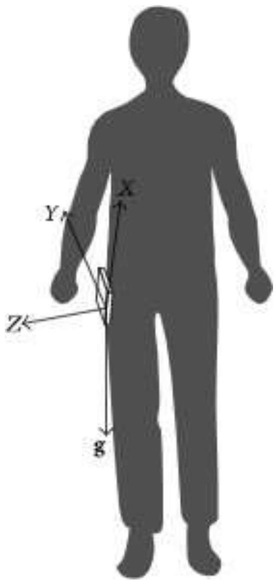


Fig 4.2.1.2 Accelerometer measurement axis

Some of the risk factor for falls in elderly persons,

- Immobilty
- Impaired strength
- Injury
- May even cause death

4.2.1.3 Temperature sensor

The temperature sensor will indicate when the human body becomes too hot or cold and preventative action can be taken to ensure that the entire device is not compromised.

Rise in temperature is the first and for most symptom for many viral, bacterial diseases, These can even put them to death, some of them are listed below,

- Corona virus
- Sarc virus
- Food poisoning
- Malaria etc.,

4.2.1.4 Touch sensor

Touch sensors work similar to a switch. When they are subjected to touch, pressure or force they get activated and acts as a closed switch. This will help the elderly patients send a hint message to the caretaker that they are in danger.

This Touch sensor is not only helpful for the elderly persons but also for the safety purpose of women, men etc... There are some cases that the patients or common person can avoid themselves from dangerous situations, These kind of situation can change a life in a minute, some of it are :

- Molester
- Heart attack
- Stroke
- Asthma
- Kidnap etc.…

4.3 CIRCUIT DIAGRAM

The circuit diagram consists of ATmega328, it is that is the heart of the project. It is used to control the entire system and furthermore the microcontroller consist of four kinds of sensors and two kinds of modules namely, Pulse oximeter, Fall detection sensor, Temperature sensor , Touch sensor, GPS and Bluetooth module.

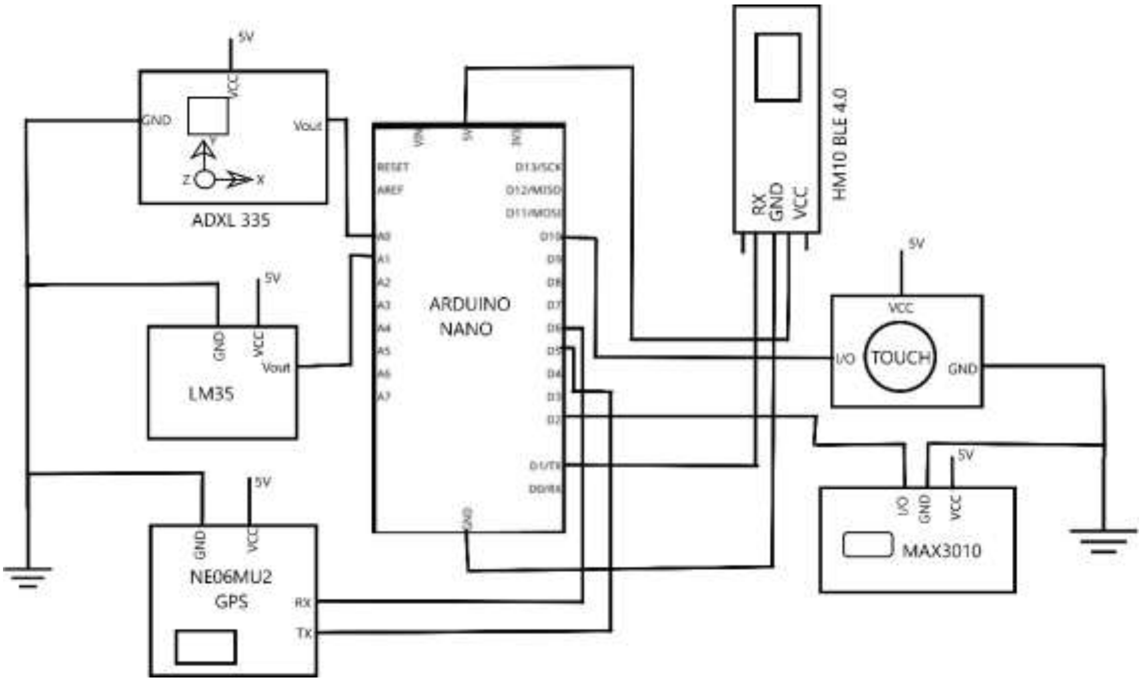


Fig 4.3 Circuit Diagram

Here all the sensors are connected to the Arduino NANO. The Arduino NANO is best for its simplicity and compatibility. All the sensors are given with the current supply of 5v and the grounds are grounded. The MAX30100 pulse oximeter's input is connected to the Digital Pin D2 and the touch sensor pin is connected with Digital Pin D6, Where LM35 fall direction sensor is connected to the Analog Pin A1 and the ADXL accelerometer is connected to the Analog Pin A0.

HM10 BLE4.0 is a Bluetooth, It's Rx is connected to the Tx and Tx is connected to the Rx of the Arduino NANO, and the NE06MU2 GPS, Rx pin is connected to the Digital Pin D6 and it's Tx pin is connected to the Digital Pin D5.

The Arduino is well programed and for the codes refer ANNEXURE 1.

In this entire system we are using 3.7v, 350 MAh lithium-ion battery to power up the whole system. If we supply below 3v it will not work and the Bluetooth works at 3.6v to 6.5v. Pulse oximeter is also connected to the microcontroller during the pulse difference value will change, which is connected to the analog side of the microcontroller. The pulse oximeter sends value to the microcontroller then it sends to the Bluetooth and it will send the information to the mobile app. This function is same for all the four sensors.

The person outside will receive the health status of the person. Through this entire system we can easily measure health status of the person who is working under the area or far away from them.

CHAPTER 5

PROPOSED SYSTEM ARCHITECTURE

5.1 SYSTEM OVERVIEW

The smart glove system is a wearable and affordable technology, which address the current issues in patient's health care and security. The smart glove system integrated the pulse. temperature and motion sensing components within the glove. With the intelligent analysis algorithm, all important human care analysis feature can be retrieved from sensing data. Therefore, the smart glove system can monitor all types of activities in free living without disturbing the normal life of the subject.

5.2 HARDWARE ARCHITECTURE

The smart glove system comprises a low cost sensory and application software on both smartphone and computer for getting alert. The smart glove consist of array of sensors, an low power micro control unit (MCU) and Bluetooth low energy (BLE) wireless transmission module, , and a micro-Universal Serial Bus (USB) connector module. The application software provides visualization and a real-time guided feedback to the user. The data stored in Secure Digital (SD) card will be used to study lifestyle and health behaviors that facilitate new understanding and effective intervention options to promote individual independence. Especially smart glove can measure pulse, temperature, fall detection, which further infer the status and potential fall risk in real life.

There are two main subsystems involved in this system, the first subsystem is low-cost sensor for detecting pulse, fall, and temperature. This can be efficiently integrated in the smart glove system. The accelerometer and gyroscope are inertial sensors, and can measure the movement information of the subject. The second subsystem is the signal acquisition and transmission module, the quantified sensor data is streamed in real-time to a data aggregator. With one 1200-mAh Li- battery, the system can continuously work for over 24 hours. Therefore, the Smart Glove system can be used daily without interruption and without charging the battery. The third subsystem is the sensor aggregation and processing module developed on a smart phone to store and analyze the raw data it receives.

5.3 COMPARATIVE STUDY OF SMART GLOVE SYSTEM

The analysis of blood pressure, temperature, fall during the daily life of the subjects based on wearing mobile systems, is able to measure with high precision, repeatable data throughout the subject's movement. The system design must be thin and flexible so that it will not be perceived by the subject. The sensor must be durable and capable of withstanding repetitive movements, yet small and thin in order to fit in the insole. It should have high sensitivity, yet be able to withstand large overloads. It should have a short response time and low power consumption. Many devices are available, and differ from each other by the size, sensors number, sensors type and therefore their response to loading and their accuracy for data analysis and treatment. The strengths and weaknesses of each system is measured in terms of validity and repeatability influence of each device for specific tasks in both clinical and research settings. There are many smart devices used for measuring the Pulse, Fall and Temperature by sensor types, sensor number, battery lifetime and communications mode. The key factors affecting sensors during dynamic activities: walking and running, gender (female, male), the race, age, size etc.,

CHAPTER 6

RESULT AND DISCUSSION

The scientific procedures undertaken on Smart Glove with five different subjects and hereby the outcome test results are to be demonstrated / discussed to get better understanding of the inferences made on the experiment.

Subject No	Age	Medical History	Image of the Subject
1	**78**	Dementia, Blood Pressure, Cholesterol.	
2	**68**	Blood Pressure, Asthma, Diabetics.	
3	**49**	Blood Pressure, Asthma, Diabetics, Cholesterol.	
4	**65**	Blood Pressure, Diabetics, Cholesterol, Eosinophilia.	
5	**54**	Blood Pressure.	

Table 6.0 Subject's Medical Details

6.1 TESTING

The results are taken once the subject wore with gloves, here the gloves is integrated with five different sensors and it’s threshold levels are shown in Table 6.1. Evaluation is done for three times on a periodical interval for 1min on each subject.

SENSOR NAME	THESHOLD LEVEL
FALL DETECTION	vout1>400
TEMPERATURE	t1>36
PULSE RATE	rate>100
TOUCH	Nil

Table 6.1 Threshold level

6.2 TEST ON SUBJECT 1

Trail	Pulse rate	Fall detection	Temperature	Touch
1	89	NIL	33	**ALERT!!**
2	**109**	NIL	34	NIL
3	**114**	NIL	32	NIL

Table 6.2 Test on subject 1

As the Table 6.2 indicates that the pulse is quite high than the normal rate. The subject 1 pulse rate is in between (100 – 115). Thus, the glove detects the abnormality and sends the emergency alert to the caretaker. The results are shown in Fig 6.2.

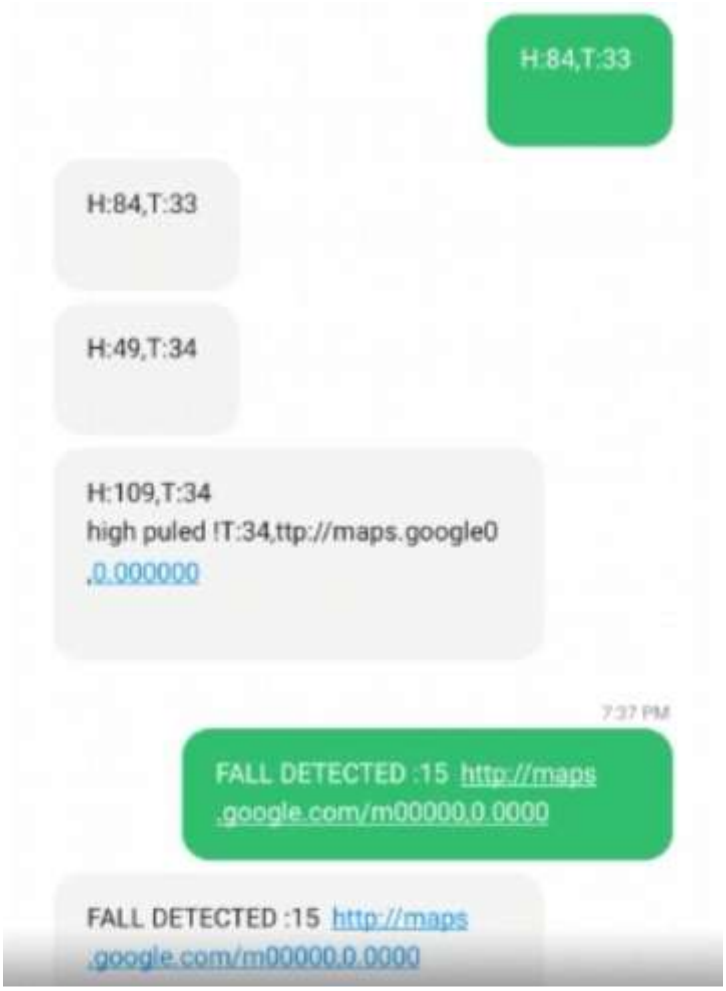


Fig 6.2 Subject1 alert message

The figure 6.2 shows that the emergency message received by the caretaker, so that he/she can reach them using GPS.

6.3 TEST ON SUBJECT 2

Trail	Pulse rate	Fall detection	Temperature	Touch
1	**107**	NIL	34	NIL
2	77	NIL	33	NIL
3	96	NIL	31	NIL

Table 6.3 Test on subject 2

As the Table 6.3 indicates that the pulse is quite high than the normal rate. The subject 2 pulse rate is in between (95– 110). Thus, the glove detects the abnormality and sends the emergency alert to the caretaker. The results are shown in Fig 6.3

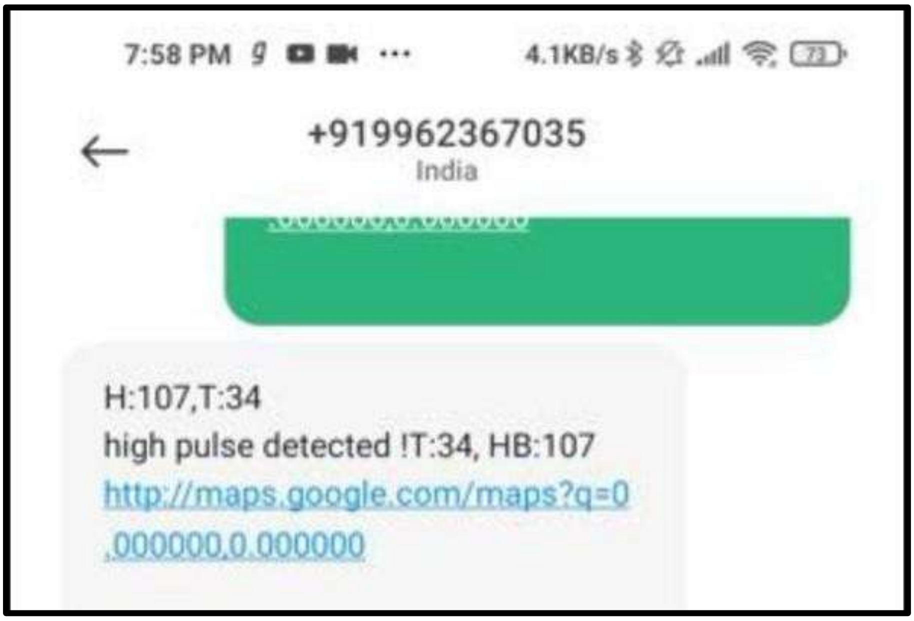


Fig 6.3 Subject2 alert message

The figure 6.3 shows that the emergency message received by the caretaker, so that he/she can reach them using GPS.

6.4 TEST ON SUBJECT 3

Trail	Pulse rate	Fall detection	Temperature	Touch
1	95	NIL	34	NIL
2	87	**FALL DETECTED**	33	NIL
3	96	NIL	31	NIL

Table 6.4 Test on subject 3

As the Table 6.4 indicates that the subject has fallen down. The subject 3 pulse rate, temperature are normal, due to the fall the caretaker receives an emergency message. Thus, the glove detects the fall and sends the emergency alert to the caretaker. The results are shown in Fig 6.4

Fig 6.4 Subject3 alert message

The figure 6.3 shows that the emergency message received by the caretaker, so that he/she can reach them using GPS.

6.5 TEST ON SUBJECT 4

Trail	Pulse rate	Fall detection	Temperature	Touch
1	86	NIL	34	NIL
2	83	NIL	33	**ALERT!**
3	97	NIL	31	NIL

Table 6.5 Test on subject 4

As the Table 6.5 indicates that the subject have touched the TOUCH sensor to call the caretaker. The subject 4 pulse rate, temperature are normal, because the subject wants to the caretaker that's the reason he receives an emergency message. Thus, the glove detects the touch and sends the emergency alert to the caretaker. The results are shown in Fig 6.5

Fig 6.5 Subject4 alert message

The figure 6.5 shows that the emergency message received by the caretaker, so that he/she can reach them using GPS.

6.6 TEST ON SUBJECT 5

Trail	Pulse rate	Fall detection	Temperature	Touch
1	88	NIL	34	NIL
2	87	NIL	33	NIL
3	92	NIL	34	NIL

Table 6.6 Test on subject 5

As the Table 6.6 indicates that, all the parameter are normal for the subject 5 but here the caretaker wants to locate the subject5, in this case he is checking their position through the message. Thus, the glove identified the position of the subject and sends the location to the caretaker. Thus, the results are shown in Fig 6.6

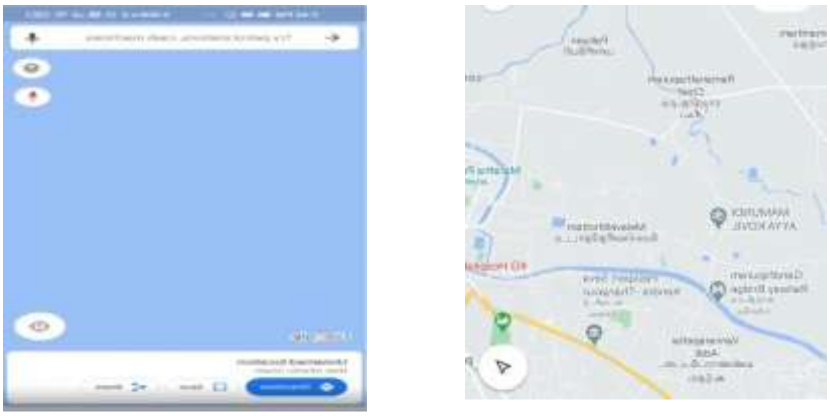


Fig 6.6 Subject5 alert message

The figure 6.5 shows the position of the subject which received by the caretaker, so that he/she can reach them using GPS.

6.7 GRAPH

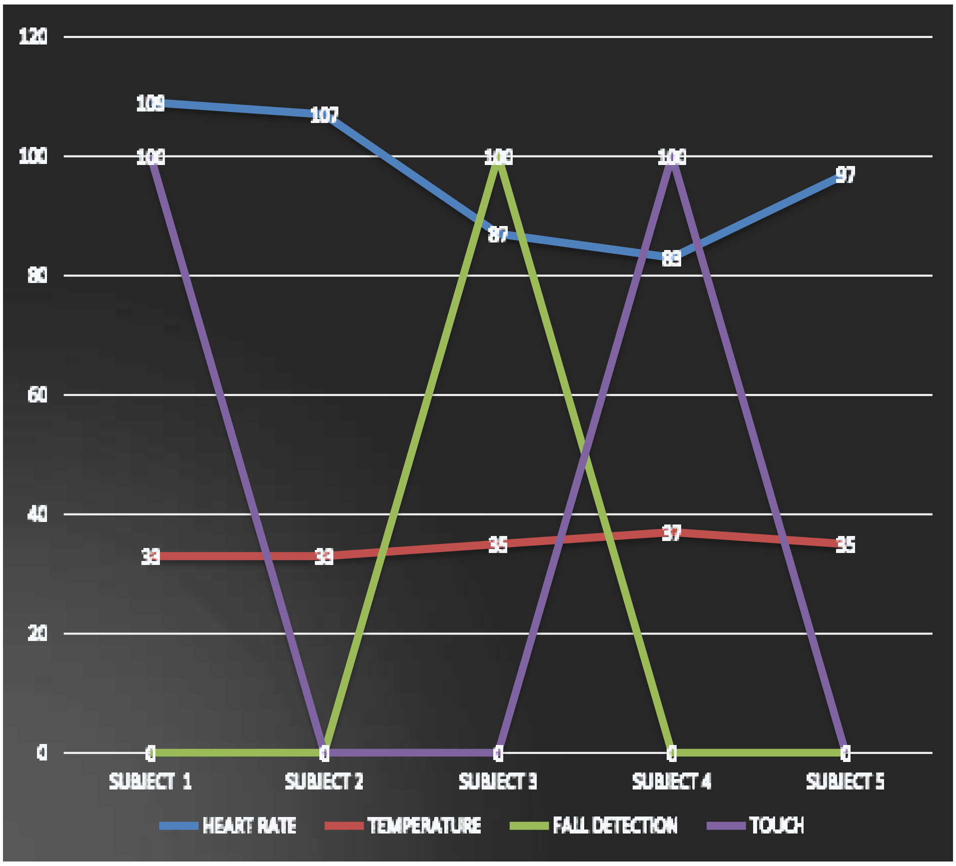
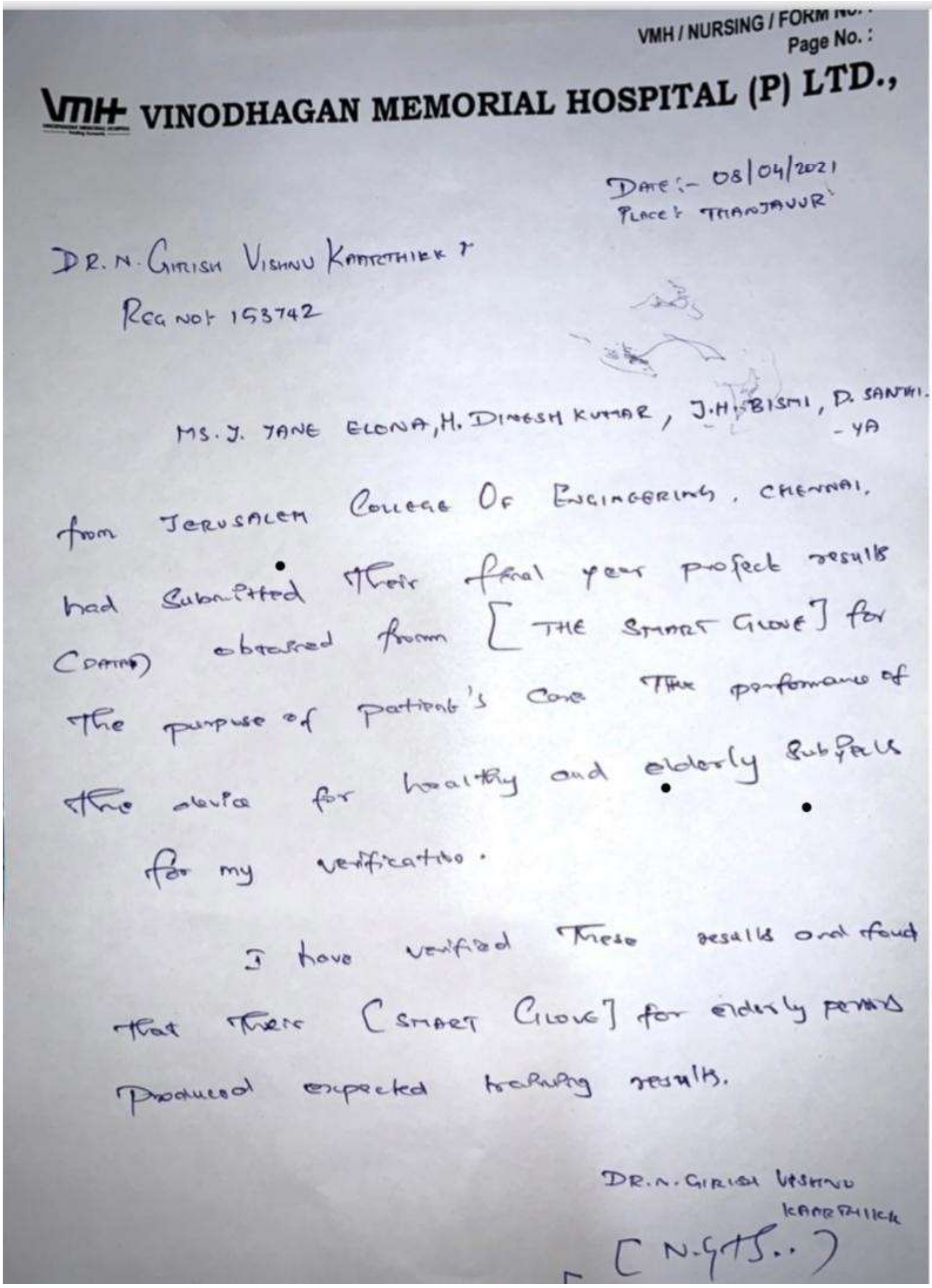


Fig 6.7 Graphical representation of readings

The above Fig 6.7 shows the graphical representation of the test readings that are obtained by the subjects at different situations. Here the subjects are in X axis and their readings are in the Y-axis. This graph gives the clear-cut idea of subject's readings for which the alert message is given.



VMH / NURSING / FORM No. :
Page No. :

VMH VINODHAGAN MEMORIAL HOSPITAL (P) LTD.,

DATE :- 08/04/2021
PLACE :- THANJAVUR

DR. N. GIRISH VISHNU KARTHIKK T
REG NO :- 153742

MS. J. JANE ELONA, H. DINESH KUMAR, J.H. BISMI, D. SANTHIYA

from JERUSALEM COLLEGE OF ENGINEERING, CHENNAI, had submitted their final year project results obtained from [THE SMART GLOVE] for the purpose of patient's care. The performance of the device for healthy and elderly subjects for my verification.

I have verified these results and found that their [SMART GLOVE] for elderly persons produced expected training results.

DR. N. GIRISH VISHNU KARTHICK
[N.G.V.K..]

Fig 6.8 Hospital Validation Certificate

CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 CONCLUSION

In the context of medical supervision for patients. One of the approaches based on m-health technology, is using a smart glove to enable the caretakers or doctors to follow up and analyze the patient's physiological data history during his or her absence in the medical center or homes. These data will help them to take care the elderly patients in their hard times for their survival. Furthermore, this smart glove is useful for the women safety purpose to protect them from danger.

7.2 FUTURE WORK

In the future work, we will propose a design of a smart insole system which allows real-time monitoring of patient’s physiological conditions without disturbing the quality of lifestyle, comforting, easy to use, cheap, and the data storage as the sensing must be unobtrusive.

Our challenges are to make the system functional for twenty-four hours to control and monitor different human activities, through real-time processing and data transmission, healthcare suppliers will be able to monitor the subject’s motions during daily activities and also to detect unpredictable events that may occur, like a fall for elderly subject.

APPENDIX 1

ANNEXURE 1

ARDUINO CODES TO EXECUTE THE PROJECT

```
int a1=0;
int a2=0;
int a3=0;
int a4=0;
float flat, flon;
unsigned long age;
int vout1;
int x=0;
int in = 2;
int t1=0;
int cntt=0;
int count=0,i=0,k=0,rate=0;
unsigned long time2,time1;
unsigned long time;
SoftwareSerial ss(11,12);
TinyGPS gps;
void setup()
{
ss.begin(9600);
Serial.begin(9600);
```

```
pinMode(10,INPUT);
pinMode(in, INPUT);
delay(1000);
}

void loop()
{
 t1=analogRead(A0);
 t1=t1/2.2;

vout1=analogRead(A1);

Serial.print(t1);
Serial.print(",");
Serial.print(vout1);
Serial.print(",");
Serial.println(digitalRead(10));

bool newData = false;
unsigned long chars;
unsigned short sentences, failed;
 k=0;
```

```
cntt=cntt+1;
Serial.println(cntt);
while(k<5)
 {
 if(!digitalRead(in))
  {
   if(k==0)
   time1=millis();
   k++;
   while(!digitalRead(in));
  }
  }
  gps.f_get_position(&flat, &flon, &age);
  Serial.print("LAT=");
  Serial.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
  Serial.print(" LON=");
  Serial.print(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);


   time2=millis();
   rate=time2-time1;
   rate=rate/5;
   rate=60000/rate;
```

```
    Serial.print(rate);
    Serial.print(",");
    Serial.println(t1);
 if(cntt>10)
 {
 cntt=0;
  ss.print("H:");
  ss.print(rate);
  ss.print(",");
  ss.print("T:");
  ss.println(t1);
  Serial.println("sent");
 }
if((vout1>400)&& (a1==0))
{
ss.print("FALL DETECTED !");
a1=1;
ss.print("T:");
ss.print(t1);
ss.print(", HB:");
ss.print(rate);
ss.print("  ");
```

```
ss.print("http://maps.google.com/maps?q=");
gps.f_get_position(&flat, &flon, &age);
ss.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
ss.print(",");// The SMS text you want to send
ss.println(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);

}
if((t1>36) && (a2==0))
{
ss.print("*high temperature ! ");
a2=1;
ss.print("T:");
ss.print(t1);
ss.print(", HB:");
ss.print(rate);
ss.print("  ");
ss.print("http://maps.google.com/maps?q=");
gps.f_get_position(&flat, &flon, &age);
ss.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
ss.print(",");// The SMS text you want to send
ss.println(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
```

```
}
if((rate>100) && (a3==0))
{
a3=1;

ss.print("high pulse detected !");// turn the Buzzer off
ss.print("T:");
ss.print(t1);
ss.print(", HB:");
ss.print(rate);
ss.print("  ");
ss.print("http://maps.google.com/maps?q=");
gps.f_get_position(&flat, &flon, &age);
ss.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
ss.print(",");// The SMS text you want to send
ss.println(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
}
if((digitalRead(10)==1) && a4==0 )
{
ss.print("need help!");// turn the Buzzer off
a4=1;
ss.print("T:");
```

```
ss.print(t1);
ss.print(", HB:");
ss.print(rate);
ss.print("  ");
ss.print("http://maps.google.com/maps?q=");
gps.f_get_position(&flat, &flon, &age);
ss.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
ss.print(",");// The SMS text you want to send
ss.println(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);


}
    k=0;
    rate=0;
for (unsigned long start = millis(); millis() - start < 1000;)
  {
   while (ss.available())
   {
    char c = ss.read();
    if (gps.encode(c))
      newData = true;
   }
}
```

```
if (newData)
  {
   gps.f_get_position(&flat, &flon, &age);
   Serial.print("LAT=");
   Serial.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
   Serial.print(" LON=");
   Serial.print(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
   }
  }
```

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[2] MS Divya, T Sravani, V Pravallika, SK Shareef… - junikhyat.com … Arduino is used in thousands of different **projects**, thanks to its simple and accessible user experience … Upload button is used to upload the code to microcontroller. 5.SETUP 5.1. **Project** Schematics As we know there are three primary components in the **health monitoring glove** **http://www.junikhyat.com/no_3_may_20/23.pdf**

[3] P Patel, SK Rauniyar, T Singh, B Dwivedi… - … Research Journal of …, 2018 - academia.edu … And in 2013 the **paper GPS** and **GSM** child tracking system using smart phone, But it is not necessary to child have the with him. Now, we design **Arduino based** child tracking system using **GPS** and **GSM** which is economical … https://www.academia.edu/download/56794766/IRJET- V5I3969.pdf

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6659409/

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[9] OA Mohamad, RT Hameed… - 2016 8th International …, 2016 - ieeexplore.ieee.org Tracking and monitoring vehicles are coming vastly utilized based on Global Positioning System (GPS). In this paper a real time tracking system is proposed. The proposed framework would make great utilization of new innovation that basis on embedded board denotation Arduino Intel Galileo. This system acts on Global System for Mobile Communication (GSM), Global Positioning System (GPS) and General Packet Radio System (GPRS) which are utilized for vehicle tracking and monitoring. The SIM908 Module is … https://ieeexplore.ieee.org/ abstract/ document/ 7861114/

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[12] K Aziz, S Tarapiah, SH Ismail… - 2016 3rd MEC …, 2016 - ieeexplore.ieee.org … Figure 3 describes the flow chart of the suggested system, starting with reading the heart rate and body **temperature** by using specific **sensors**: pulse **sensor** and **temperature sensor**; the captured data will be compared via microcontroller ie Ar- duino with a given … https://ieeexplore.ieee.org/abstract/document/7460394/ AYC Tang, CH Ong, A Ahmad - International Journal of Advanced …, 2015 - researchgate.net

[13] Figure 3: Arduino UNO board 4.2 SIMCOM **SIM900** Quad-band GSM GPRS Shield Development Board The GPRS Shield is based on **SIM900** module from SIMCOM and compatible with Arduino and its clones. The GPRS … https://www.researchgate.net/profile/Alicia-Tang /publication/ 279064350_Fall_Detection_Sensor_System_for_the_Elderly/l inks/558cd5e908ae591c19da15f8/Fall-Detection-Sensor-System-for-the- Elderly.pdf

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