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DEVELOPMENT OF IoT BASED HEART ATTACK MONITORING SYSTEM WITH SMART GLOVE CONTROL

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Abstract: In recent days copious persons are mislaying their life owing to heart attack and shortage of medical attention to the patient at the correct stage. Hence in this paper we are projecting development of heart rate monitoring and heart attack recognition system using IoT. The patient will accompany hardware unit having sensors with android application. The heart beat sensor will allow checking heart beat readings and transmit them over internet using cloud open source platform. The user will set low and high level of heart beat. Once these level limits are set the system will start monitoring the patient's heartbeat and as soon as the heartbeat readings goes above or below the level set ,the system will alert about the chances of heart attack. In this system a smart hand glove is also included that helps disabled people to live among normal spaces. The main objective of this smart hand glove is to develop a reliable, easy to use, light weight system which can curtail the obstacles for disabled people .

Index Terms **- AD8232, Arduino, IoT, LabVIEW, LM35, ThingSpeak**

• Introduction

In recent times a number of people are losing their life owing to heart attack. Heart attack occur when the flow of blood to heart is blocked. Due to delayed diagnosis of heart attack we are not able to save the lives of many humans. In this paper, we are suggesting a system that could detect heart attack by monitoring the heart rate based on IoT (Internet of Things). It is estimated that over 20 million deaths occur all over the world due to cardio vascular problems. Many people are also disabled due to cardio vascular disease. The fatal consequences occur due to late provision of medical assistance. The severity increases due to delayed deployment of resources in early detection and treatment. In this developed system, analog sensors are used to measure the heart rate. The heart of patients suffering from fatal heart conditions is monitored continuously. The control system reads and processes the monitored signal. The processed signal is then alerted to the system as a precaution to the patients or detection of heart failure of the patient. This paper aims to reduce number of deaths due to heart failure and heart related diseases. The Internet of things is the inter-connection of devices, applications, sensors and network connectivity that enhances these units to collect and transfer data. The outstanding characteristic of

Internet of Things in the healthcare system is the constant monitoring of a patient through checking various parameters and also depicting a good result from the constant monitoring. Now a days ICUs are equipped with many such devices using medical sensors. Inspite of 24 hours of monitoring , there could be instances where the concerned doctor couldn't be alerted in time when an emergency occurs. Also there might occur issues in sharing the information with the specialist doctors and the concerned family members. Ordinary heart rate is 60 to 100 bpm (beats per minute) for a healthy adult. Depending on fitness an athlete's heart beat generally ranges from 40 to 60 bpm . When a person's heart rate is constantly over 100 beats per minute then the person is said to be in higher risk category which is medically termed as tachyarrhythmia. It can slump the efficiency of heart by letting down the amount of blood pumped through the body which can result in chest pain and light headedness. With the recent advancements in technology it is easy to monitor the patient's heart rate even at home. IoT is an interconnected network mechanism for intellects to gather information from world ubiquitously and to share the information through the internet [1].

In our life we get acquainted with many disabled people, some of them are partially disabled while others are completely disabled. The partially impaired people like dumb, deaf, paralysed in one leg or hand advocates their life with little difficulties . Here communication plays a major role to make someone feel better and letting them indulge in activities where they can manage themselves as an independent person. With this thought in our mind, the project smart hand gloves for disabled people is developed so that disabled persons can live their life as they want. In this hardware unit micro contact/copper ring plays the major role which is positioned in the fingers.A reference voltage is taken from the microcontroller and is given to the copper plate placed at the palm. When the finger bends and touches the reference voltage the microcontroller detects the exact finger bended which is connected to the analog pin of the controller and corresponding actions will be taken accordingly (eg: to on/off the fan /light). The controlling actions takes place in microcontroller using P controller, that is when error increases the output also increases and thus the controller output increases which is connected to the input of L293D motor drive controller/speed controller[2].

- **System Design**

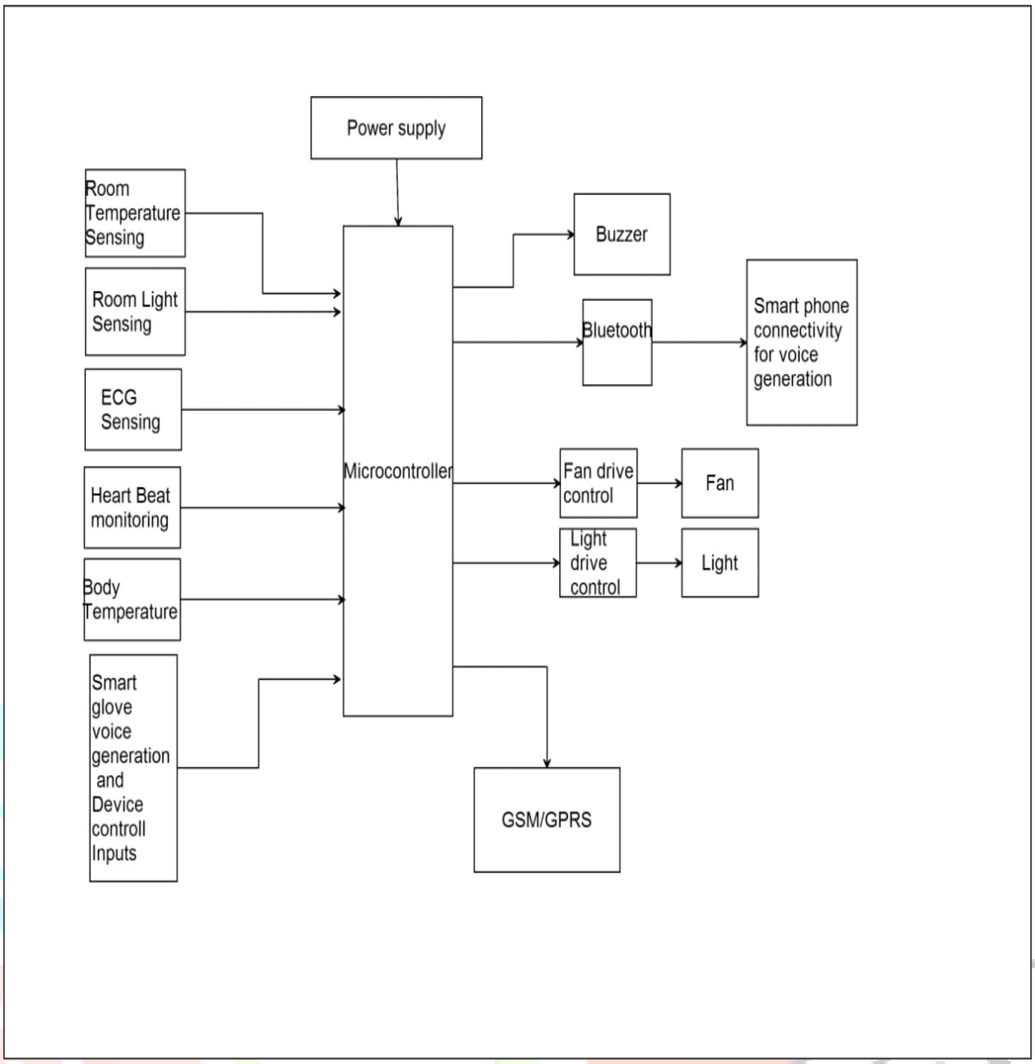

figure 1. Proposed Block Diagram

The proposed system have illustriousness of detecting heart attack with the help of observing heart rate based on Internet of Things. Our developed system uses an ECG sensor, Arduino board and a GSM/GPRS module. After setting up the system, the ECG sensor will start sensing heart rate readings and will display the heartbeat rate of the person monitored on the LCD screen. Also, with the use of GSM/GPRS module the proposed system can transmit the data over the internet. System fixes a set point which can help in determining whether a person is healthy or not by monitoring his/her heartbeat and comparing it with the fixed set point .If the heart rate goes above or below the fixed limit the system will send an alert message. In this an android application model is implemented that will track the heartbeat of a particular patient and monitor it correctly and give emergency messages on chances of heart attack. The activation of smart glove start with the movement of hand gloves where the micro contact/copper rings are attached, and the value of sensor changes when it experiences the bending. The copper ring act as a potentiometer when attached to the fingers and when we bend the finger, the value of the sensor changes. The changing value of the sensor depends upon the resistance and the applied angle of the bending. When we bend the sensor at a particular angle we can see the value of the resistance increases and accordingly the output get reduced. Here a reference voltage will be kept at the palms of the glove using a plate, when a finger touches the reference voltage by bending the fingers, the Arduino detects that particular finger bended and sends the command so that the required action can be taken. On the other hand we can say that it is inversely proportional i.e. when the resistance of the sensor is increased value of output decreases .

The smart glove acts with the movement of hand gloves where the micro contacts or copper rings are attached, and the value of copper ring changes when it experiences the bending. The changing value of the sensor depends upon the resistance and the applied angle of the bending .When we bend the sensor at some particular angle output value will change and this changed value is recorded by the Arduino and is showed on the display attached to it. Here the process gets started when the Arduino gets different values from the sensor. The output value can be continuously monitored on the LCD display attached to it

There are 2 modes which smart glove works: Mode 1 and Mode 2

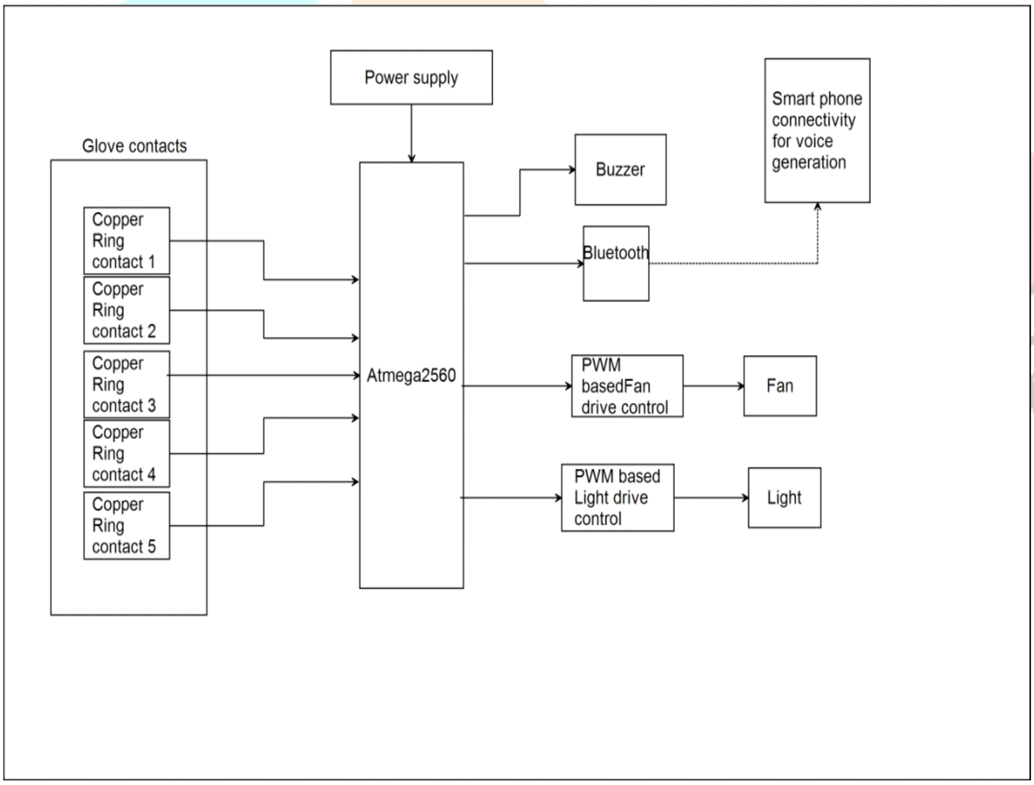

figure 2. Block Diagram of MODE 1 & MODE 2

2.1 MODE 1

In this Mode, user can use the features of voice and playback by generating desired gestures and then recorded voice can be played. When the mode gets activated, the sensor gives some value to the Arduino and according to the program the signal is passesed from the Arduino to the voice generation module via smart phone. The recorder will check which port or section is active at that point of time and sound which is already recorded in the recorder will be played. The sound from the speaker is heard via smart phone. Buzzer is used for alerting people at home. Bluetooth module is used for voice generation using smart phone[3].

2.2 MODE 2

In this mode a user can control the home appliances and this is the major part of the project. Here the output of the sensor is recorded in Arduino and this value is matched with the programmed value by the Arduino. The Arduino checks the sensor value and is matched with the programmed value and the output can be seen on the LCD screen on the Arduino and we are controlling fan and light through LabVIEW. The fan speed and intensity of light is controlled by using L293D motor drive control. For controlling the fan speed and light intensity we need to sense the room temperature and light of the room. LM35 is used as the room temperature sensor and LDR is used for sensing the light intensity. We place a reference voltage using a plate in the palms of the smart glove and when the fingers bends and touches the palm , the Arduino will identify the bended finger and do appropriate ON/OFF of the appliances accordingly. Here we are using prototype fan and light as the home appliances.We can also manage the speed and intensity of the appliances and for this we are using P controller. In P controller measured sensor value is subtracted from the desired value to calculate the error. This error is corrected by the control system. Proportional controller attempt to correct this error by multiplying it by a constant KP.

III. Measurement Of Parameters

3.1 ARDUINO MEGA 2560

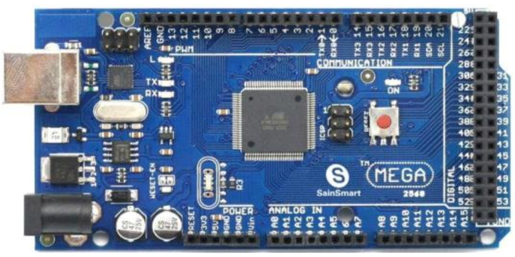

figure 3. Arduino Mega 2560

Arduino board is an open-source microcontroller board which is based on Atmega 2560 microcontroller. The development background of this board execute the giving out or wiring language. These boards have rejuvenated the automation industry with their uncomplicated to make use of platform wherever everybody with small or else no technical backdrop can start by discover some essential skill to program as well as run the Arduino Board. These boards are used to lengthen separate interactive items otherwise we can connect to software on your PC like MaxMSP, Processing, and Flash. The

Mega 2560 is a microcontroller board. It has 54 digital input/output pins of which 15 pins can be used as PWM outputs, 16 pins are available for analog inputs, 4 UART pins used for serial ports. It has a 16 MHz crystal oscillator, and USB connection. It can be simply connected to a personal computer with the USB cable or it can be powered up by using any AC-to-DC adapters or batteries. The ATmega 2560 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By the powerful instructions in a single clock cycle, the ATmega2560 achieves throughputs approaching 1 MIPS per MHz allowing the system designer for optimize power consumption versus processing speed. It also has features of 64K/128K/256K bytes of In-System Programmable Flash with Read-While-Write capabilities, 4 Kbytes EEPROM, 8 Kbytes SRAM, 54/86 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), six flexible Timer/Counters with compare modes & PWM, four USART's, a byte oriented 2-wire Serial Interface, a 16 channel, 10-bit ADC with optional differential input stage of a programmable gain, programmable Watchdog Timer with an Internal Oscillator, a SPI serial port. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power down mode which is used to saves the register contents but freezes the Oscillator, by disabling all other chip functions until the next interrupt or Hardware Reset. In Power-save form, the asynchronous clock continue to run by making the consumer to keep a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to reduce switching noise during ADC conversions. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run In Standby mode, the Crystal/Resonator Oscillator is running while the rest of the device is sleeping. This makes fast start-up and of low power utilization[5]

3.2 LM 35

LM35 is an integrated analog temperature sensor in which its electrical output is comparative to Degree Centigrade. LM35 Sensor do not need an external calibration to give distinctive accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. Temperature is one of the most commonly measured parameter in the world. They are used in our every day household devices from Microwave, fridges, AC to all fields of engineering. Temperature sensor essentially measures the heat/cold generate by an purpose to which it is connected. It then provides a proportional resistance, current or voltage output which is then measured or process as for each our application. Temperature sensor are classified into two types

- Non Contact Temperature Sensors: These temperature sensors use convection & radiation to monitor temperature
- Contact Temperature Sensors: Contact temperature sensors are then further sub divided into three type:
- Electro-Mechanical(Thermocouples).
- Resistive Resistance Temperature Detectors (RTD).
- Semiconductor based. (LM35, DS1820 etc).

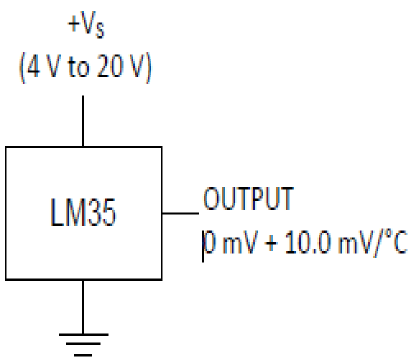

figure 4. LM35 sensor Block Diagram

- The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-leadNsurface-mount small-outline package and a plastic TO-220 package.

3.3 ECG Sensor AD8232

figure 5. ECG sensor

The AD8232 is a chip used to measure the electrical impulse of the heart. This electrical impulse can be easily viewed as an ECG or Electrocardiogram. Electrocardiography is used to help and identify various heart condition. ECG records the electrical activity generate by heart muscle depolarisations, which broadcast in pulsating electrical waves towards the skin.ECG electrodes are typically wet sensors, requiring the use of a conductive gel to increase conductivity between skin and electrodes. During an ECG, sensors(electrodes) that can detect the electrical activity of your heart are attached to your chest and sometimes your limbs. These sensors are more often than not left on for just a few minutes. This sensor is a productive board used to calculate the electrical action of the heart. This electrical achievement can be viewed as an ECG or Electrocardiogram and output as an analog analysis. ECGs can be enormously noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help get a obvious signal from the PR and QT Intervals without complication. The AD8232 is an included signal conditioning block for ECG and other bio-potential dimension application. It is intended to take out, strengthen, and filter minute bio-potential signals in the being there of noisy circumstances, such as those created by movement or remote electrode placement. The AD8232 module break out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use our own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm format of a heart beat.

3.4 SIM800 GSM/GPRS MODULE

figure 6. SIM800 GSM/GPRS Module

SIM800 is a complete Quad-band GSM/GPRS solution in a SMT type which can be embedded in the customer applications. SIM800 support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. GPRS is the abbreviation of General Packet Radio Service. The most fundamental difference between GPRS and GSM system is that GSM is a circuit switching system, and GPRS is a packet switching system. GSM can only use SMS to transmit data, and it can't be "real-time online" or "charged by volume". A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. General Packet Radio Service (GPRS) is 2.5G GSM technology. It introduces packet switching network in the existing GSM core network. Thus packet switched GPRS reduces connection time of the mobile device on the network. Also the data from many devices is multiplexed in the time slot for GPRS. Communication via GPRS is cheaper than through the regular GSM network. Instant-messenger services and mobile email facilities allow you to send longer messages for cheaper rates through the GPRS connection, as opposed to transmitting messages in SMS or short message service. At the heart of the module is a SIM800L GSM cellular chip from SimCom. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LiPo battery supply.

3.5 Thing Speak

ThingSpeak is an IoT analytics platform service that allows us to aggregate, visualize and analyse live data streams in the cloud. We can send data to ThinkSpeak from our devices, create instant visualizations of live data and send alerts using web services like Twitter and Twilio. With MATLAB analytics inside ThingSpeak, we can write and execute MATLAB code to perform pre-processing, visualizations and analyses. ThingSpeak enables engineers and scientists to prototype and build IoT systems without setting up servers or developing web software. Key capabilities of ThingSpeak include:

· Configure devices to send data to ThingSpeak using a REST API or MQTT.

· Aggregate data on-demand from devices and third – party sources.

· Get instant visualizations of live or historical sensor data.

· Pre-process and analyze your collected data using integrated MATLAB

· Run your IoT analytics automatically based on schedules or events.

· Act on the data and communicate using third – party services like Twilio or Twitter

In order to send data to ThingSpeak using an Arduino, we require an Arduino with network connectivity either onboard or with a shield. We have an official library for ThingSpeak. This library needs to be installed and used by the Arduino device in order to send data to ThingSpeak. ThingSpeak requires a user account and a channel. A channel is where you send data and where ThingSpeak stores data. Each channel has up to 8 data fields, location fields, and a status field. You can send data every 15 seconds to ThingSpeak, but most applications work well every minute[4].

3.6 LabVIEW

LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) is a graphical programming language that uses icons to create applications. LabVIEW uses dataflow programming and the flow of data determines its execution order. LabVIEW also includes several applications to help us to quickly configure the computer-based instruments and build applications. We can build a user interface in LabVIEW by using a set of tools and objects. Code is then added by using graphical representations of functions to control the front panel objects. This code is contained in the block diagram. The block diagram resembles a flowchart in some ways. When the program is running, we use front panel for interaction. By controlling the program, we can change inputs, and see data updated in real time. A corresponding terminal is available on the block diagram for every front panel control or indicator. When a VI is activated, values from controls flow through the block diagram, where they are used as the functions on the diagram, and the results are passed into other functions or indicators through wires. National Instruments extends a variety of third-party devices to be interfaced with the LabVIEW. software which includes an Arduino UNO. The VISA (Virtual Instrument Software Architecture) driver part of a LabVIEW enables us to connect with the Arduino board with PC. LabVIEW is used to fetch the temperature, humidity, air quality and pH parameters through Arduino. After the fetching session the following data are stored in the cloud database through ThingSpeak application service. The values can also be displayed on our mobile phones through App Inventor applications installed in the phones.

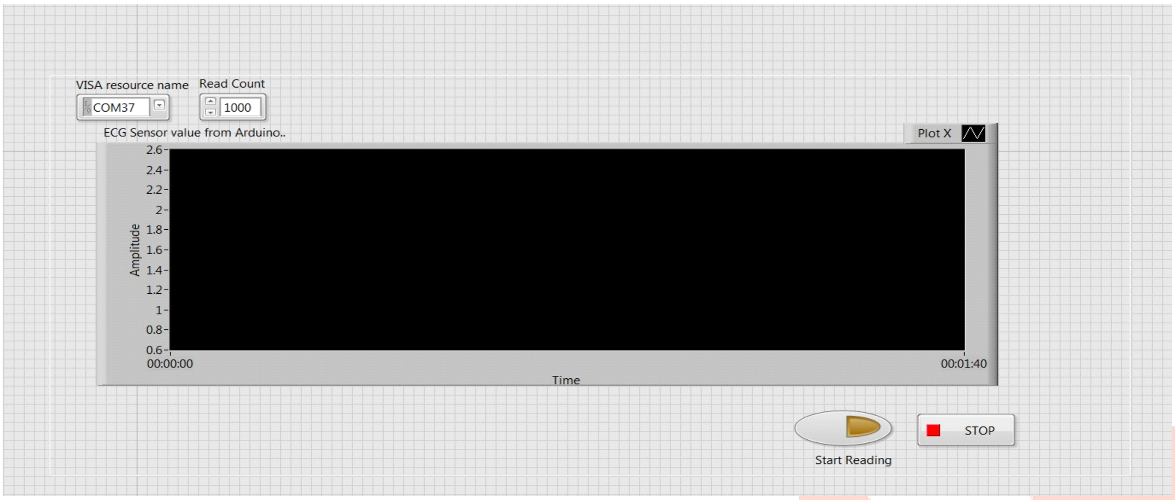

figure 7. Front Panel View of LabView

3.7 Hardware Setup

Fig. 8 shows the hardware setup of the proposed system. For temperature sensor the standard temperature has been set as 35 degree C. Hand gestures are used to ON and OFF the light and fan. If the temperature goes higher than 35 degree C, the fan speed increases. For light sensor we are using LDR and based on the light availability, the intensity of the bulb varies. Proportional controller is doing the control action in the microcontroller. That is, as error increases output also increases and also based on the hand gestures the voice will be generated using a smart phone via Bluetooth accordingly.

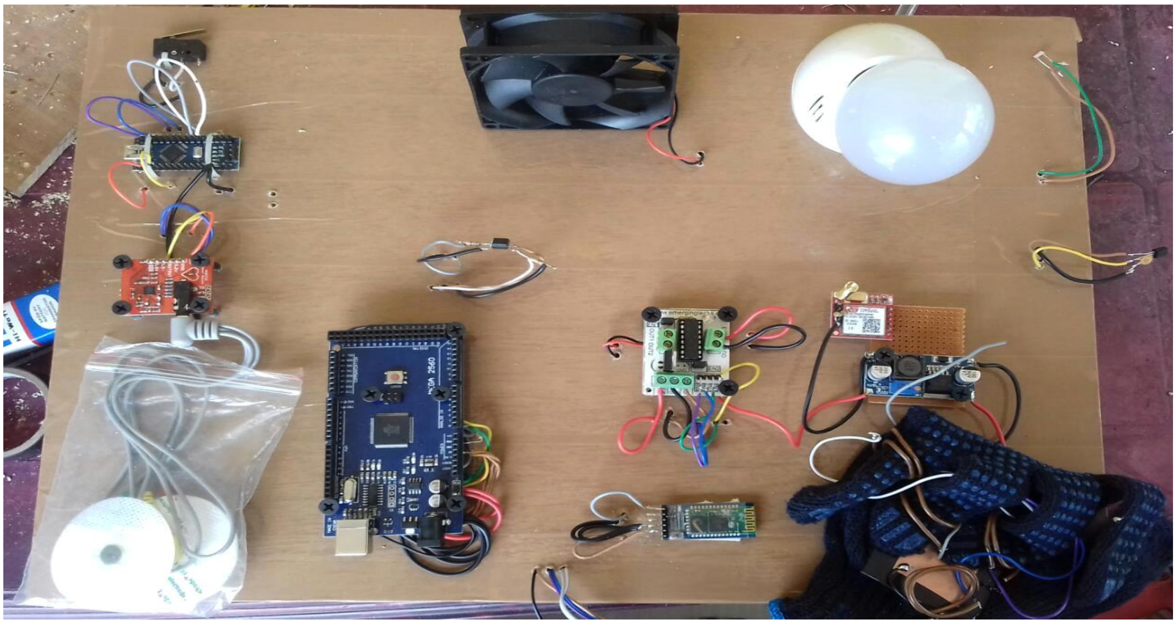

figure 8. Hardware Setup

IV Results

The Front Panel design of the work is shown in figure 9. In this paper we have discussed the step by step procedure used to design the hardware and software parts of the proposed system. The hardware is implemented for the acquisition of real time heart beat, temperature and a Smart Glove is used for controlling home appliances and for voice generation. Using LabVIEW programming software part has been developed for real time monitoring of heart pulses. The results of the measured and studied parameters are displayed on the front panel which act as the graphical user interface of the proposed system hardware. The real time view of the LabVIEW is also given in figure 10, which shows the real time heart pulses of the user. This project invokes low-cost custom-built control system. Thus, this work can be modified to suit any hospital and home requirements. The proposed work starts with the monitoring section. The data is fetched from the sensors when request in form of string datatype is send from LabVIEW to Arduino board. The Sensors are connected to the Arduino board. In the coding section, when the serial input is given to the Arduino board, it fetches the data from the sensor. The serial input is provided to the Arduino board by LabVIEW. Next, the data collected from the Arduino board is sent to cloud storage database using the ThingSpeak analytical tool. The normal heart beat is set in the Arduino and if it goes above that, emergency alert is shown in the ThingSpeak platform by the signal received from LabVIEW. Once the parameter values are observed they are sent to the cloud database through ThingSpeak platform. The observed values can be viewed through this platform and the doctors or the hospital staffs analyze the current status of the patient's heart condition and if it's an emergency situation they can take appropriate actions suddenly before the condition becomes complicated and thus we can avoid many fatal conditions leading to death. Similarly the temperature can also be monitored and analyzed. In the controlling section, the patient itself can control some home appliances like fan , light etc. and can generate the voice using smart phone using a Smart Glove. We set a temperature of 39 degree Celsius as room temperature and if the temperature goes below that the fan automatically decreases its speed. Similarly a particular set point is given for light intensity and if the light increases in the room, automatically the bulb turns off. All these is controlled using a P controller, that is when error increases/decreases, output also increases/decreases. As room temperature decreases the error decreases, so the controller output decreases. Controller output is connected to the speed controller L293D with PWM output. As error increases, microcontroller PWM output increases, and as its width increases, average voltage too increases.

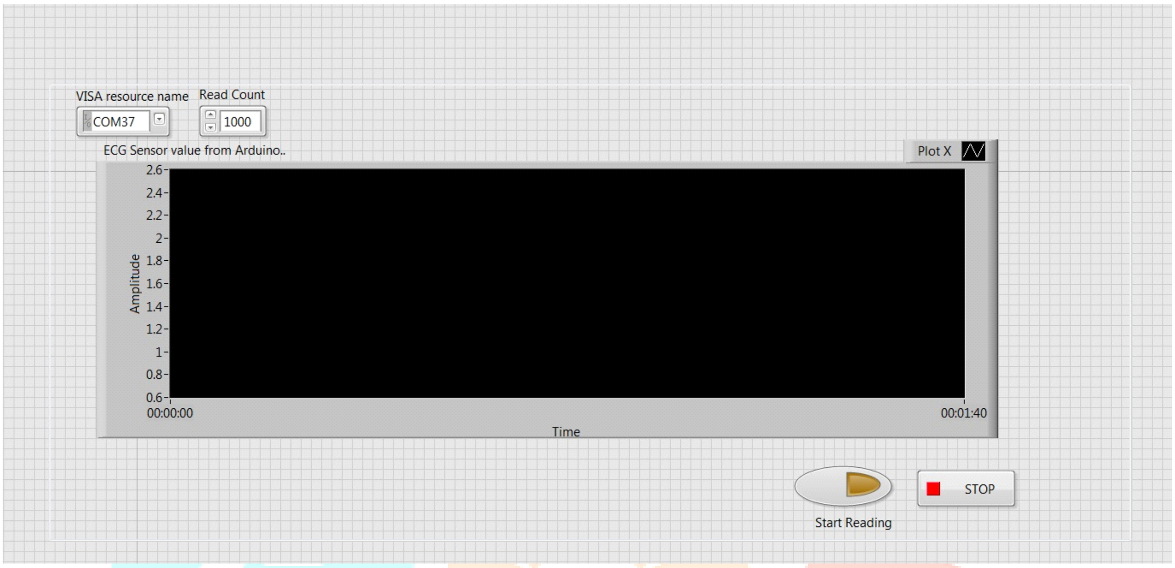

figure 9. Front panel view of LabVIEW

figure 10. Real time view of LabVIEW

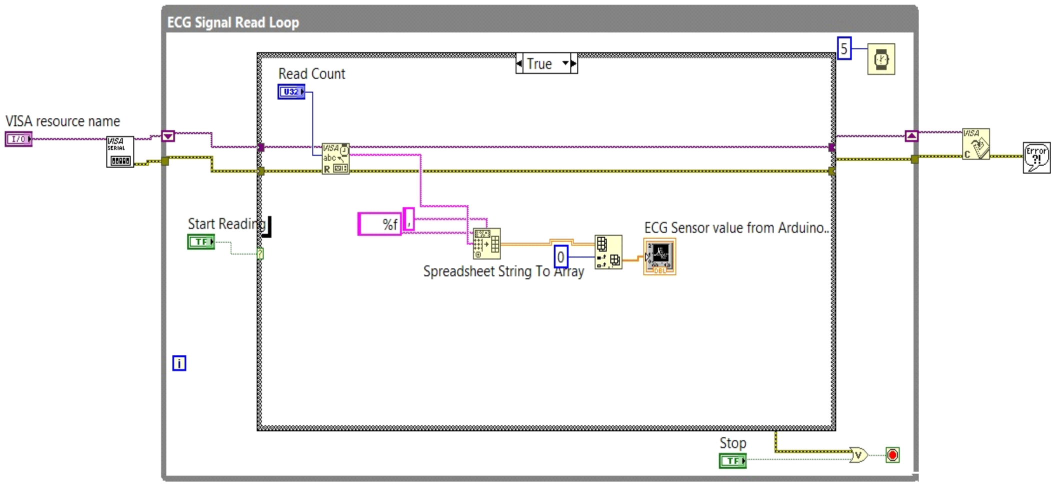

Figure 10. Block Diagram of LabVIEW

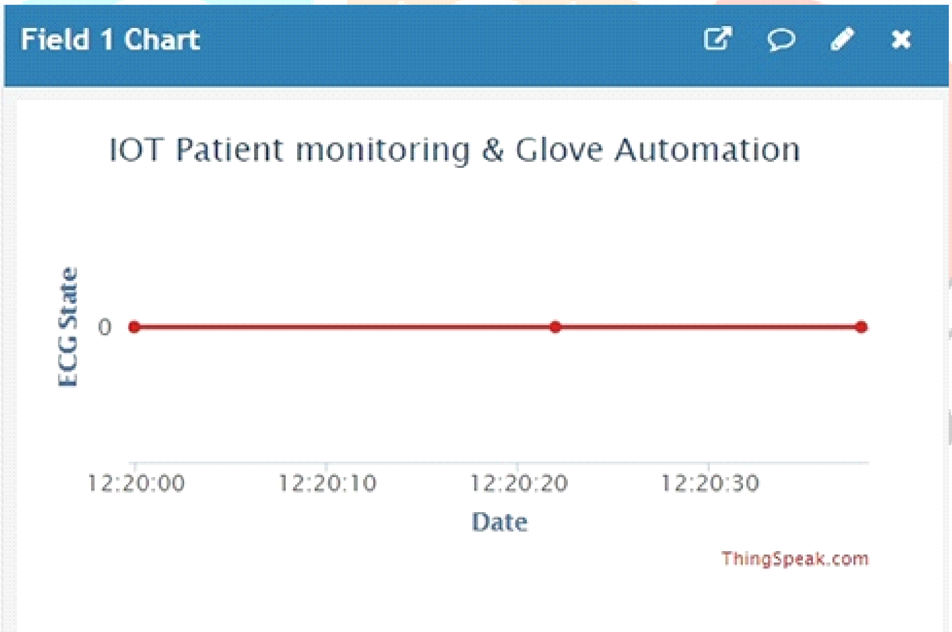

figure 11. ECG State monitoring

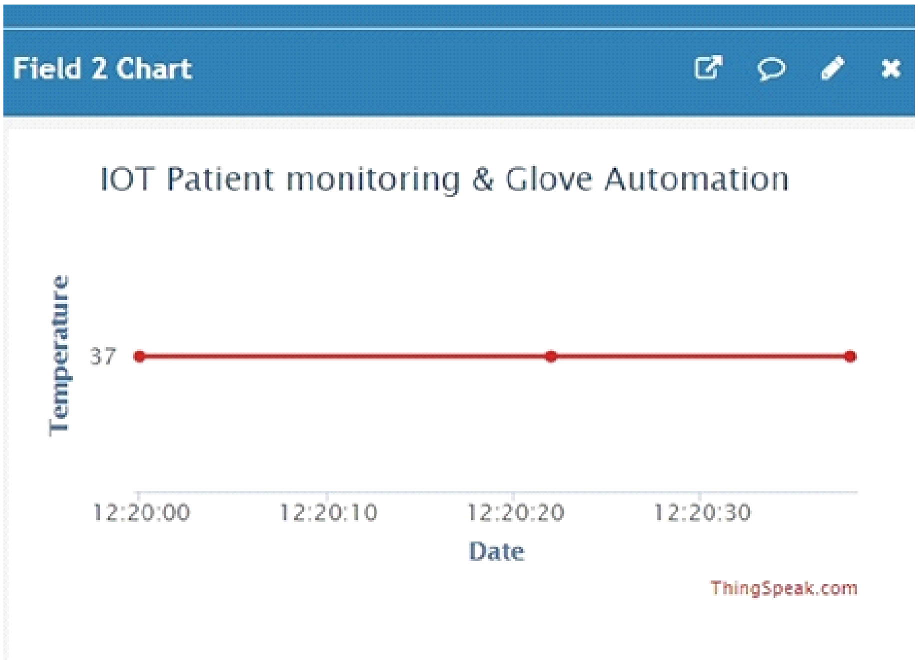

figure 12. Tempeature monitoring

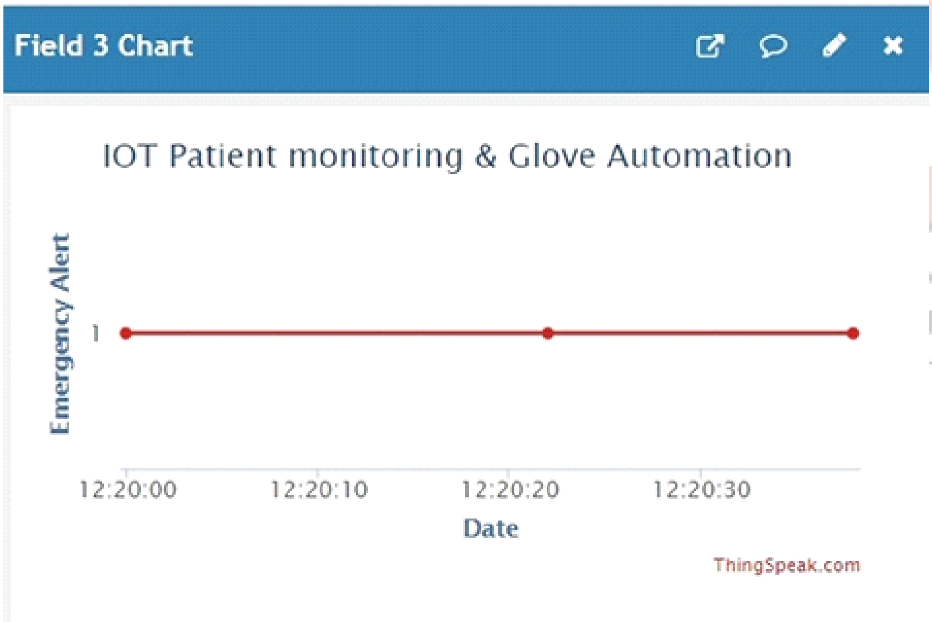

figure 13. Emergency Alert monitoring

V. Conclusion And Future Scope

In this paper we have attempted to propose a system on detecting heart attack by monitoring the heartbeat of a person and also to help the differently abled people among us. The heart beat sensor senses the heartbeat of a person and passes them through the internet using a Wi-Fi module. System sets up particular limit level of heart beat. After setting these set points the system start monitoring the heart beat and whenever the person's heart beat goes above or below the set points, doctors are alerted . The system measures and detects human heartbeat and body temperature of the patient, sends the data to user or server end by using microcontroller with reasonable cost . For Human Heartbeat measurement we use fingertip as a suitable place, it's in bpm (beats per minute). These calculated rates will have stored in cloud and it gets transferred through a Wi-Fi module of GPRS/GSM module via internet. To measure the human body temperature, use LM35 sensor, and ECG sensor is AD8232. Finally, the stored data in cloud will be displayed for future analysis by physician or specialist to provide better first aid. From experimental results, proposed system is user friendly, reliable, economical and more practicable.

Smart glove will provide the more reliable, efficient, easy to use and light weight solution to users.During the implementation of this paper we faced various types of challenges and we have tried to minimize the problem. One challenge is to make it wireless, light weight and handy. Since this was a prototype our focus was to build a model, which can solve or minimize the communication problems of the differently abled people.

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