Improving the Healthcare Performance using Wireless Devices

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Abstract- A real time monitoring the health condition of patients, that utilises sensor wireless devices, collect, analyse and record patients health status. The term bio-signal refers to all the signals that are being generated in the human body or any other living organism or more specifically it is used to represent all those signals from living organisms that are monitored to obtain certain useful information. Primarily, the term refers to signals that are electrical in nature but, some non-electric signals are monitored as well. Typically, the changes in potential difference across a certain tissue in the body are measured in case of bio-electric signals. Wearable all sensor based home monitoring system for elderly performance includes functional assessment of daily activities. The maximum amount of bio-medical signals can be sent through the extended wireless network combining IPv6 technique and mobile technology for daily lifestyle to users appropriately. A visualization module of the Microcontroller function give the storing bio-medical signals. This opportunity for cardiac, blind patients and child have constantly be monitored their health condition at any place. Patient information stored in the system within help of PIC Microcontroller. Server system will get patient bio-signal values from IPV6 Techniques. In case of emergency situation, the Ambulance is automatically called with the help of the mobile IP Address and the patient is also informed about the abnormality prevailing in health condition.

Keywords - Sensors,Microcontroller,LCD,GSM, IPV6 or Ethernet, Bio-signal values, server and client system, Emergency condition, Healthcare application

I. INTRODUCTION

In medicine and biotechnology, sensors are tools that detect specific biological, chemical, or physical processes and then transmit or report this data. Mainstream investigation has learned toward the development of biomedical devices. Furthermore, almost all observation positions of human health (eg. ECG, EEG, Blood and Pressure) can be monitored by the related bio-microsystem device [25]. Some sensors work outside the body while others are designed to be implanted within the body. Some monitoring devices consist of multiple sensors that measure a number of physical or biological parameters. Other devices may be multifunctional, incorporating sensors and then delivering a drug or intervention based on the sensor data obtained. Sensors may also be components in systems that process clinical samples, such as increasingly common "lab-on-a-chip" devices.

Sensors help health care providers and patients monitor health conditions and ensure that they can make informed decisions about treatment. Sensors are also often used to monitor the safety of medicines, food, environmental conditions, and other substances we may encounter.

The LCD's are connected from wireless devices. All bio-signal values are give the LCD Module. Incase of emergency condition it is inform the abnormal status.

In particular, the continuous storing of bio-signals is critical for the advancement of diagnosis as well as treatment by using sensor networks. Collectively sensors are enabling new applications across a wide variety of domains, such as healthcare, social networks, safety, environmental monitoring and transportation, and give rise to a new area of research called mobile phone sensing [1-2], [4]. In addition, it is conceivable that further automated analyze of stored bio medical signals could support doctors in their daily practices and allow the development of warning systems. This would bring many benefits day by day increasing in the health observability, collaboration among doctors, and doctor-to-patient efficiency and thereby, reduce the medical costs [11], [13]. Moreover, such non stop monitoring would grow early detection of abnormal health conditions and bio signal values and therefore supply a great potential to raise, the quality of life [2], of patients.

This project presents a remote healthcare patient monitoring system, that utilizes the World Wide Web infrastructure to monitor, collect, analyse and record patients' health status [19]. The data is stored in the hospital database and can be accessed from anywhere through the internet. When a patient is in an alarming situation, the doctor sends SMS messages to the mobile of the designated health personnel via through public GSM network. The novelty of the system lies in its security and its ability to use both the internet and the GSM, GPRS network as communication media. Doctors can access the database server to compare the patient's current status with his/her medical history. It can be used by one physician to monitor a group of patients simultaneously, or by a group of physicians who all monitor the same patient.

II. SENSORS

A. *EEG Sensor*

Electroencephalography (EEG) is the recording of electrical activity along the scalp produced by the firing of neurons within the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp. In neurology, the main diagnostic application of EEG is in the case of epilepsy, as epileptic activity can create clear abnormalities on a standard EEG study. A secondary clinical use of EEG is in the diagnosis of coma and encephalopathies. EEG used to be a first-line method for the diagnosis of tumors, stroke and other focal brain disorders, but this use has decreased with the advent of anatomical imaging techniques such as MRI and CT. Neurons, or nerve cells, are electrically active cells which are primarily responsible for carrying out the brain's functions. Neurons create action potentials, which are discrete electrical signals that travel down axons and cause the release of chemical neurotransmitters at the synapse, which is an area of near contact between two neurons. EEG Sensor circuit diagram shown in Figure1. For long-term and portable monitoring, the features of low power and miniaturization are necessary [25].

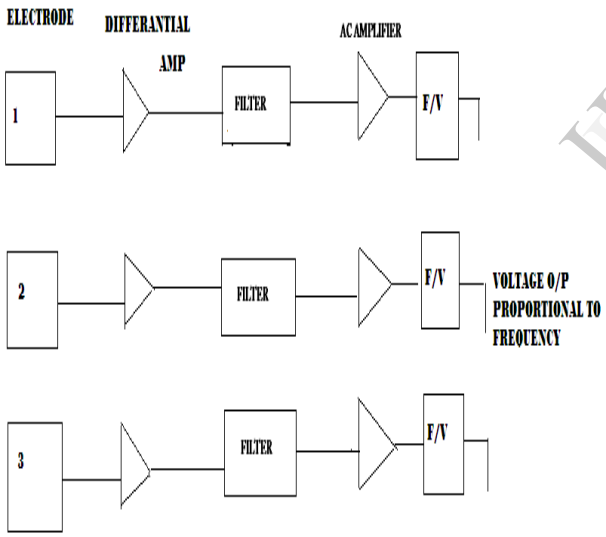

Figure 1 EEG Sensor Circuit Diagram

This neurotransmitter then fits into a receptor in the dendrite or body of the neuron that is on the other side of the synapse, the Post-synaptic neuron. The neurotransmitter, when combined with the receptor, typically causes an electrical current within dendrite or body of the post-synaptic neuron. Thousands of postsynaptic currents from a single neuron's dendrites and body then sum up to cause the neuron to generate an action potential.

B. *Temperature Sensor*

A thermistor is a type of resistor used to measure temperature changes, relying on the change in its resistance with changing temperature. Thermistor is a combination of the words thermal and resistor. In this circuit the thermister is used to measure the temperature. Thermister is nothing but temperature sensitive resistor.

The first stage is a comparator in which the variable voltage due to thermister is given to inverting input terminal and reference voltage is given to non-inverting input terminal. Initially the reference voltage is set to room temperature level so the output of the comparator is zero. Temperature Sensor symbol below the figure 2. When the temperature is increased above the room temperature level, the thermister resistance is decreased so variable voltage is given to comparator [24]. Now the comparator delivered the error voltage at the output.

Then the error voltage is given to next stage of preamplifier. The feedback resistor is adjusted to get desired gain. Then the AC components in the output are filtered with the help of capacitors

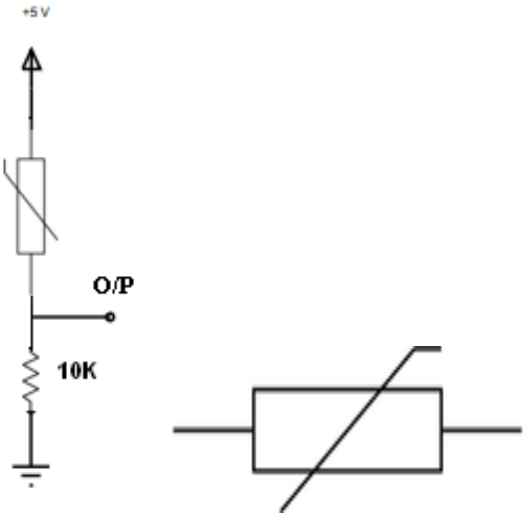

Figure 2 Temperature Sensor Symbol

Then output voltage is given to final stage of DC voltage follower through this the output voltage is given to ADC or other circuit.

C. *ECG Sensor*

The electrocardiogram (ECG) is a simple but crucial tool in clinical practice. It is a non-invasive recording produced by an electro-cardiographic device, and particularly useful in diagnosing rhythm disturbances. Electrodes are placed on different parts of the skin over different parts of the heart to measure the electrical activity mentioned above. An ECG displays the voltage difference between pairs of electrodes which not only indicates the rhythm of the heart, but weaknesses or damage in certain parts of the heart muscle.

Its importance is undisputed. The following sections of the chapter introduce a normal ECG tracing, briefly discuss the importance of lead placement and summarise the signal conditioning techniques. The ECG is composed of three positive and two negative waves [1]. Single systolic and diastolic activities of atria and ventricles of the myocardium [1].

D. *Respiration sensor*

The respiration sensor is fixed to a long hook and loop strap that is placed around the chest or abdomen. For most applications, placing one sensor around the abdomen is necessary. Optionally, you can place a second respiration sensor around the chest. Using two sensors is helpful for abdominal breathing exercises.

Unravel the strap and attach it around the abdomen (or torso) so that the sensor is in the front. Ask the client to breathe out as fully as possible and attach the sensor so there is minimal tension. The fit should be snug enough that the strap stays fixed when the subject is relaxed.There should also be enough slack in the rubber strap of the sensor so that expansion of the abdomen causes this rubber strap to expand without being overextended. The respiratory signal is usually recorded with techniques like spirometry, pneumography, or plethysmography [17].

\Recommended Connectivity for Electrical Safety:

Thought Technology recommends the use of TT Sensor Isolator ST9405AM when interfacing patient connected sensor(s) to line powered equipment(s) or devices. The TT Sensor Isolator ST9405AM is an interface device providing medical grade electrical isolation between the patient connected sensors and the acquisition system. It provides the equivalent of Two Means of Patient Protection under IEC 60601-1, and supplies battery power to the sensors. Using this device ensures Thought Technology sensors are safely interfaced to the analog inputs of line-powered systems such as computers with DAQ cards.

E. *Heart Beat Sensor*

The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through ear lobe. As the heart forces blood through the blood vessels in the ear lobe, the amount of blood in the ear changes with time. The sensor shines a light lobe (small incandescent lamp) through the ear and measures the light that is transmitted. At rest, an adult man has an average pulse of 72 per minute. Athletes normally have a lower pulse rate than less active people. Children have a higher heart rate (approx. 90 beats per minute), but also show large variations. The heart rate rises during exercise and returns slowly to the rest frequency after exercise. The rate at which the pulse returns to normal can be used as an indication of fitness.

F. *Blood Pressure Sensors*

The MPX10 and MPXV10GC series devices are silicon piezoresistive, Bloodpressure sensors [25], providing a very accurate and linear voltage output — directly proportional to the applied pressure. These standard, low cost, uncompensated sensors permit manufacturers to design and add their own external temperature compensation and signal conditioning networks. This Sensor circuit shown in figure 3. Compensation techniques are simplified because of the predictability of Motorola's single element strain gauge design.

The digital measurements of pressure and heart rate are performed by the microprocessor. Measurements results are stored in EEPROM or FLASH memory as a data log that can be uploaded to a PC via USB. The analog circuit is used to amplify both the DC and AC components of the output signal of pressure transducer so that we can use the MCU to process the signal and obtain useful information about the patient's health.

Figure 3 Blood Pressure Sensor

III. WIRELESS DEVICE

A. *PIC Microcontroller*

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complimentary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques. The Pin Diagram of PIC Microcontroller shown in figure 4.

PIN Diagram:

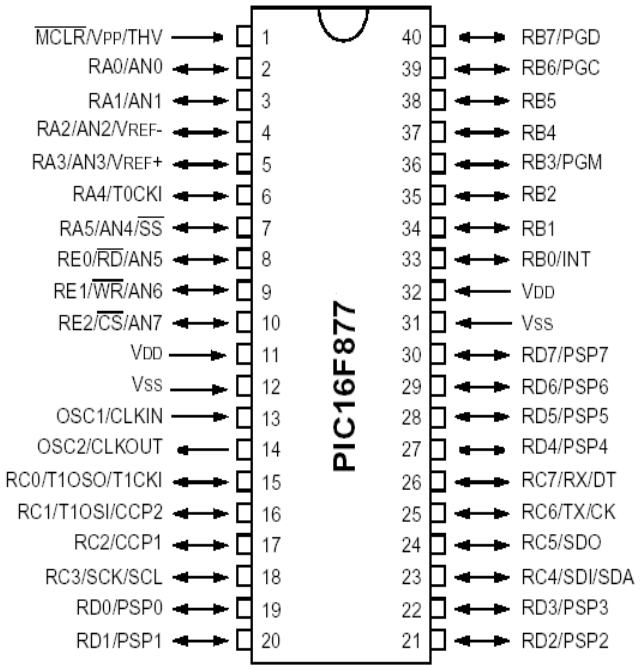

Figure 4 PIC Micocontroller Pin Diagram

Analog to Digital Converter (ADC):

There are two types of analog to digital converter is present in this IC. We use 10-bit ADC. The ADC [16], module can have up to eight analog inputs for a device. The analog input charges a sample and hold capacitor. The output of sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation.

Memory Organisation:

There are three memory blocks in each of the PIC16F877 MUC's. The program memory and Data Memory have separate buses so that concurrent access can occur.

B. *LCD*

Liquid crystal displays (LCD's) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarizes are pasted outside the two glass panels. These polarizes would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizes and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent.

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range.

C. *GSM Technology*

Instead of using analog service, GSM was developed as a digital system usingTDMA technology. The TDMA method GSM Modem shown in figure 5.Using TDMA, a narrow band that is 30 kHz wide and 6.7 milliseconds long is split time-wise into three time slots. Narrow band means channels in the traditional sense. Each conversation gets the radio for one-third of the time. This is possible because voice data that has been converted to digital information is compressed so that it takes up significantly less transmission space. Therefore, TDMA has three times the capacity of an analog system using the same number of channels.

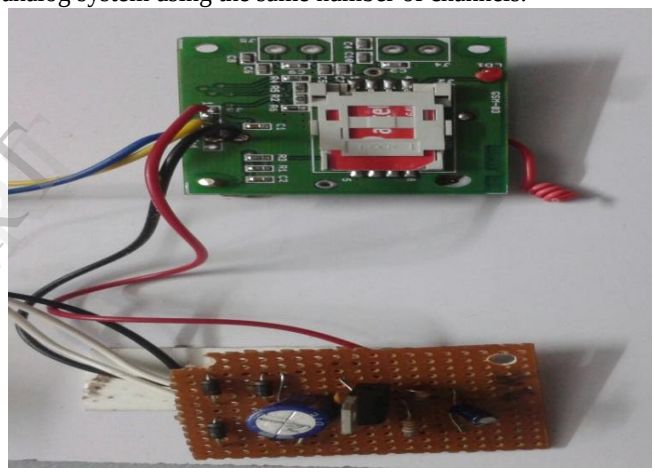

Figure 5 GSM Modem

TDMA is the access method used by GSM, as well as the Electronics Industry Alliance and the Telecommunications Industry Association for Interim Standard 54 (IS-54) and Interim Standard 136 (IS-136**)**. GSM implements TDMA in a somewhat different and incompatible way from IS-136. Think of GSM and IS-136 as two different operating systems that work on the same processor, like Windows and Linux both working on an Intel Pentium, The GSM Modem is a wireless modem [13].

GSM systems provide a number of useful features:

- Uses encryption to make phone calls more secure
- Data networking
- Group III facsimile services
- Short Message Service (SMS) for text messages

IV. DESIGN AND IMPLEMENTATION

A. *MPLAB*

MPLAB IDE is an integrated development environment that provides development engineers with the flexibility to develop and debug firmware for various Microchip devices

MPLAB IDE is a Windows-based Integrated Development Environment for the Microchip Technology Incorporated PICmicrocontroller (MCU) and dsPIC digital signal controller (DSC) families. In the MPLAB IDE, you can:

- Create source code using the built-in editor.
- Assemble, compile and link source code using various language tools. An assembler, linker and librarian come with MPLAB IDE. C compilers are available from Microchip and other third party vendors.
- Debug the executable logic by watching program flow with a simulator, such as MPLAB SIM, or in real time with an emulator, such as MPLAB ICE. Third party emulators that work with MPLAB IDE are also available.
- Make timing measurements.View variables in Watch windows.
- Program firmware into devices with programmers such as PICSTART Plus or PRO MATE II.
- Find quick answers to questions from the MPLAB IDE on-line Help.

B. *IC Programmer*

The PRO MATE II is a Microchip microcontroller device programmer. Through interchangeable programming socket modules, PRO MATE II enables you to quickly and easily program the entire line of Microchip PIC microcontroller devices and many of the Microchip memory parts.PRO MATE II may be used with MPLAB IDE running under supported Windows OS's (see Read me for PRO MATE II.txt for support list), with the command-line controller PROCMD or as a stand-alone programmer

C. *Compiler-High Tech C*

A program written in the high level language called C; which will be converted into PICmicro MCU machine code by a compiler. Machine code is suitable for use by a PIC Micro MCU or Microchip development system product like MPLAB IDE.

D. *PIC Start Plus Programmer*

The PIC start plus development system from microchip technology provides the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The **pic** start plus development system includes PIC start plus development programmer and MPLAB IDE.

The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software running under MPLAB provides for full interactive control the programmer.

E. *Web Server*

It is a system which hosts a web site and provides services for any requesting clients. The general purpose web servers compose of an operating system, the web pages or the application and a huge amount of memory and sometimes a special hardware. It can refer to either the hardware (the computer) or the software (the computer application) that helps to deliver content that can be accessed through the Internet.The most common use of web servers is to host web sites but there are other uses like data storage or for running enterprise applications. The primary function of a web server is to deliver web pages on the request to clients. This means delivery of HTML documents and any additional content that may be included by a document, such as images, style sheets and scripts.

F. *Data Logger*

It is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). They generally are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers interface with a personal computer and utilize software to activate the data logger and view and analyze the collected data

G. *Server and Client System*

. Management center usually needs a public network IP address, which can configure server as FTP server. Its hardware system structure .SIM300 module is used for management center. Because there is no public IP for management center. The client accesses the server through the LAN router and the Internet. Whenever, the client wants to access the sever, it sends the request to the server, this request is taken by the router, which is connected to the Internet. The web processes the request made and finally connects to the desired web server, access the requested data and sends the data to the client. This all process shown in figure 6.

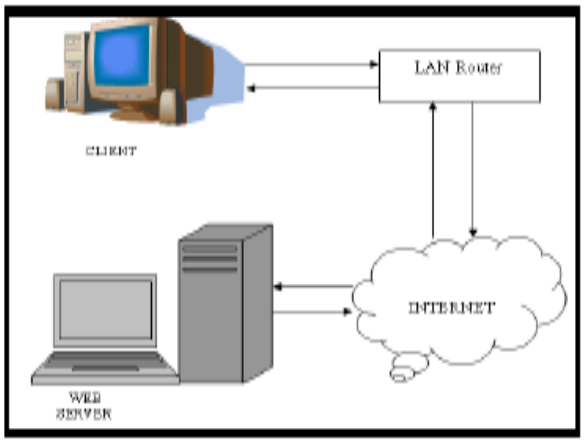

Figure 6 Client-Server architecture

V. RESULT AND DISCUSSION

A. *Block Diagram*

Sender Side

Figure 7 sender side Sensor Units are use calculate the Temperature, Respiration, pulse, ECG Signal, EEG Signal and Blood Pressure and monitoring the real time process. ADC units are convert the analog to digital signals through the PIC Micro controller [16]. LCD display connect from Microcontroller give the bio signals digital values. Incase of patient need to know the body condition via SMS by GSM Modem. The wireless link (IPV6) or wired connection Ethernet connected from PIC16F877A storing values are through the server system. Server system connected to multiple client system use wired and wireless links [19].

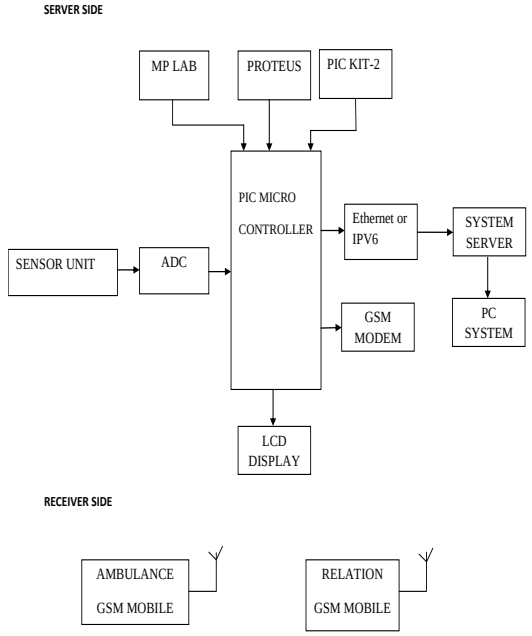

Figure 7 Block Diagram Of Sender and Receiver Side

Receiver side

Figure 7 receiver side GSM Modem is a connected from Microcontroller through the bio signal values to Doctor, Patient and Ambulance.

B.Proposed Methodology

The proposed Healthcare Monitoring system in this work is composed of two main components: the Patient unit (Transmission part), and the Mobile unit (Receiving unit).

- Patient Unit:
  - It permits continuous Patient monitoring through the sensors placed on the patient's body.
- Bio signals are analog values. So this values are converted analog to digital using PIC Microcontroller.
- Sensor to real time monitoring very fast calculate. These values give the LCD.
- Ethernet card or IPV6 Techniques includes transferring from Microcontroller to server PC. Server PC storing the all bio signal digital values. Retrieve the storing information using a LABVIEW Software.
- Mobile Unit:

This unit is used to intimate the Ambulance, Patient relative and the doctor if the health condition of the patient is abnormal.

The Temperature Sensor is used to measure the temperature. Temperature sensor is nothing but temperature sensitive resistor. There are two type of temperature sensor available such as positive temperature co-efficient and negative temperature co- efficient. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased. Bio signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the value is greater than assigning value then led on else led off. The bio signal values are updated for every 30 seconds.

The heart rate rises during exercise and returns slowly to the rest frequency after exercise. The rate at which the pulse returns to normal can be used as an indication of fitness. Bio-signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the pulse value less than or equal to 30 and greater than or equal 90 led on else off.

The Respiration Sensor is a sensitive girth sensor using an easy fitting high durability latex rubber band fixed with self-adhering belt. It detects chest or abdominal expansion/contraction and shows the respiration waveform and amplitude. Bio-signals require a digitization step in order

to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the value is smaller than assigning value then led on else led off. The bio signal values are updated for every 30 seconds .

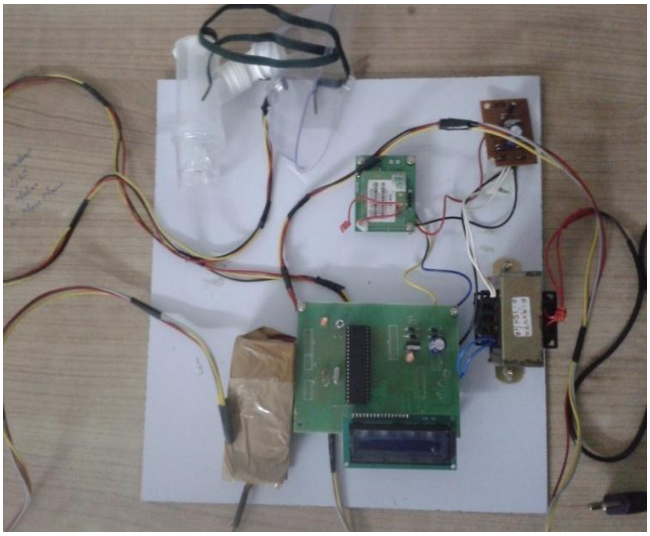

Figure 8 Hardware Design

Temperature, Heart Rate, Respiration Hardware Design Shown in Figure 8. This work can be extended in future, design the hardware function of EEG,ECG, Blood Pressure Calculating indicate Normal and Abnormal Situation. The figure 8 explain that , The 230 volt step down transformer give the AC Current. The Bridge Rectifier Convert AC to DC current. The Capictor and Regulator using this circuit give the Accurate values. Microcontroller working on only DC Current. To get timing, oscillation purpose 4MHZ Crystal Oscillator using in this circuit. The Transformer one end connect Microcontroller and another end connect GSM Modem. GSM Modem consist of SIM Card. Microcontroller Transmitter connect to the GSM Receiver. GSM transmitter connected to the microcontroller receiver. GSM Modem successful sending a message to doctor side. This work can be extended in future, Ethernet connect form PIC Microcontroller to hospital server.

VI. CONCLUSION

Thus the proposed system overcome the disadvantage of the existing system the proposed system has various salient features like measurement of various parameters such as ECG,EEG,Temperature,Blood Pressure, Hear Beat, Respiration and this analysed data are periodically updated in the data base of the doctor .The doctor can access the patients detail at any time. The remote patient monitoring system for patient physical states is based on wireless sensor network technology. It can be taken by patient and keep the patient movement intact because it is miniature and portable. The system can monitor and record the physical states and movement parameters real-time, and then provide an auxiliary means for the correct diagnosis of doctor. With the intelligent diagnosis software, the sign of acute disease for patient can be found early, and then the patient can be helped in time, the sudden death of patient can be avoided**.**This work can be extended in future, In Case of emergency Situation, the Ambulance is automatically called with the help of the mobile IP Address and the Patient is also informed about the abnormality prevailing in health condition.

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