ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 3, pp: (299-308), Month: July - September 2015, Available at: www.researchpublish.com

Patient Monitoring System Using Android APP

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Abstract: **Aim of our work is to monitor the human body temperature, blood pressure (BP), Pulse Rate ,GSR, Glucose, Body position, ECG. The human body temperature, BP, Pulse Rate and ECG are detected in the working environment. This can be sensed by using respective sensors. The sensed information is send to the microcontroller through signal conditioning circuit in the patient unit. A desired amount of sensor value is set and if it is exceeded preliminary steps should be taken by the indicating by buzzer. The sensor information will be transmitted from the patient unit to the main controller unit with the help of Zigbee communication system which is connected with the microcontrollers in the both units. The main controller unit will send those sensed data as well as the location of that patient by the help of GPS Module to the observer/doctor. The observer/doctor can receive the SMS sent by GSM module and further decision can be taken. The message is sent to a mobile phone using Global system mobile (GSM) Modem. MAX232 was a driver between microcontroller and modem.**

Keywords: **microcontroller, blood pressure, sensor, Zigbee, GPS, GSM.**

1. INTRODUCTION

Monitoring vital signs and locations of certain classes of ambulatory patients can be useful in overcrowded emergency departments and at disaster scenes, both on-site and during transportation. To be useful, such monitoring needs to be portable and low cost, and have minimal adverse impact on emergency personnel, e.g., by not raising an excessive number of alarms. The SMART (Scalable Medical Alert Response Technology) system integrates wireless patient monitoring (ECG, SpO2), geo-positioning, signal processing, targeted alerting, and a wireless interface for caregivers. A prototype implementation of SMART was piloted in the waiting area of an emergency department and evaluated with 145 post-triage patients. System deployment aspects were also evaluated during a small-scale disaster-drill exercise.

2. BLOCK DIAGRAM WITH COMPONENTS REQUIRED

2.1 BLOCK DIAGRAM:

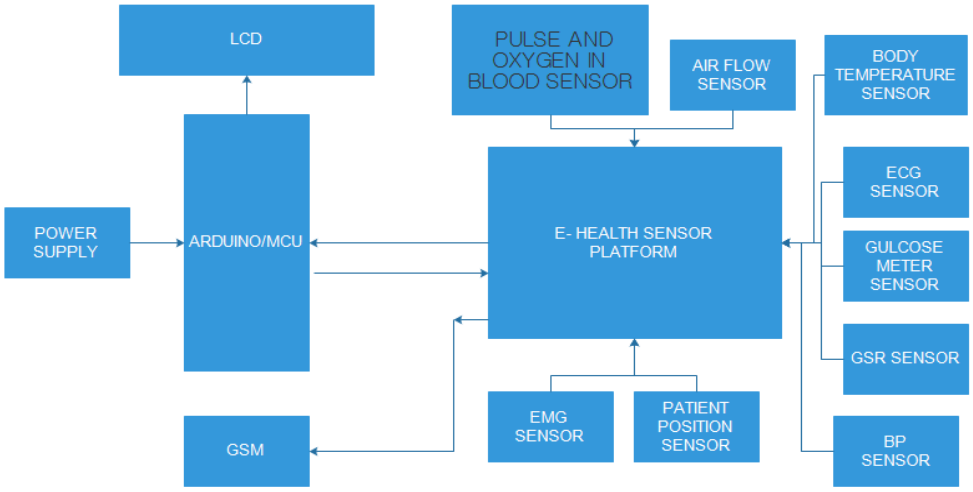

Fig 2.1 block diagram

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2.2 COMPONENTS:

1. Power supply
2. Microcontroller
3. LCD
4. E-health sensor platform
5. GSM module
6. Air flow sensor
7. Body temperature sensor
8. Body position sensor
9. Bp sensor
10. Glucose meter sensor
11. EMG sensor
12. GSR sensor
13. Pulse and oxygen in blood sensor
14. ECG sensor

3. POWER SUPPLY UNIT

3.1 POWER SUPPLY UNIT: The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units. Fig 3.1.1

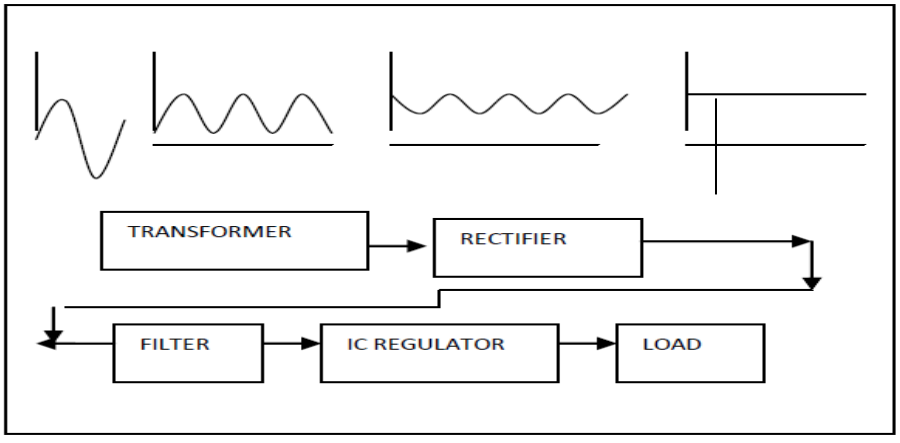

Fig 3.1.1 block diagram

3.2 TRANSFORMER:

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

3.3 BRIDGE RECTIFIER:

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

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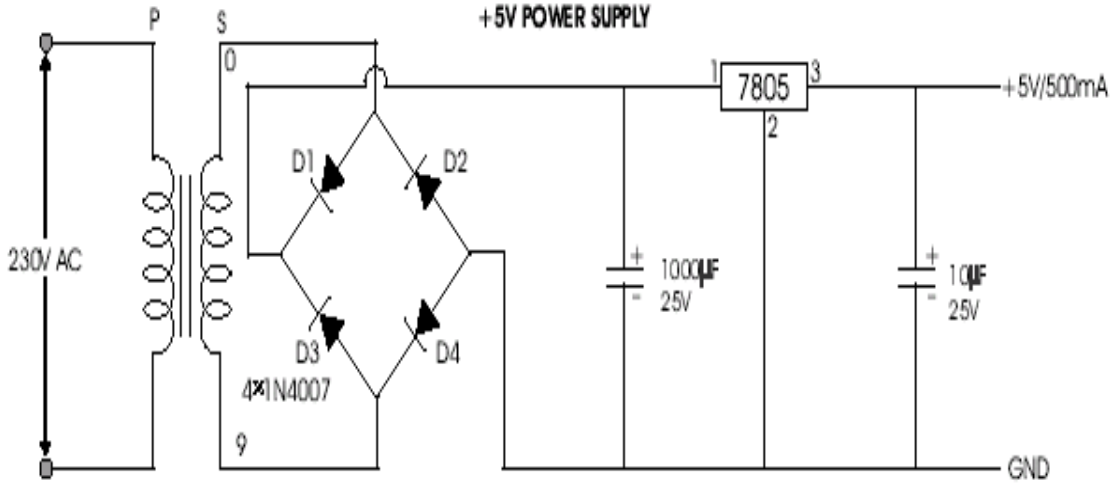
Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

3.4 IC VOLTAGE REGULATORS:

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage. The regulators can be selected for operation



with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

Fig 3.4.1 Circuit Diagram of Power Supply

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

- For ICs, microcontroller, LCD --------- 5 volts
- For alarm circuit, op-amp, relay circuits ---------- 12 volts

4. MICROCONTROLLER UNIT

4.1 VARIOUS:

MICROCONTROLLERS:

1) 8031:

It is Intel's product neither a microprocessor N or a microcontroller, It is a 8-bit controller, and Internally no ROM is provided i.e. code is outside the chip and microcontroller.

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2) 8051 FEATURES:

- It is a first complete 8- bit micro controller.
- It is a name of a family. In which the instruction set, pin configuration, architecture are same, only memory storage capacity is different.
- Internally PROM (programmable read only memory) is provided so it called one time programmable (OTP).

3) AT89C 51 FEATURES:

- It is similar to 8051 Family microcontroller i.e. having same instruction set, pin configuration, architecture.
- It is a also 8-bit microcontroller
- It uses EPROM (erasable programmable read only memory) or FLASH memory
- It is multiple time programmable (MTP) i.e. 1000 times. So it is better than 8051.

ATMEL 89C51:

It is a low-power, high-performance CMOS 8-bit microcomputer With 4K Bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and incompatible with the industry- standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in system or by a conventional nonvolatile memory programmer. By combining a versatile 8- bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful micro-computer, which provides a highly flexible and cost-effective solution to many embedded control applications

8051 Standard:

Microcontrollers' producers have been struggling for a long time for attracting more and more choosy customers. Every couple of days a new chip with a higher operating frequency, more memory and more high-quality A/D converters comes on the market.

Nevertheless, by analyzing their structure it is concluded that most of them have the same (or at least very similar) architecture known in the product catalogs as "8051compatible".

The whole story began in the far 80s when Intel launched its series of the microcontrollers labeled with MCS 051. Although, several circuits belonging to this series had quite modest features in comparison to the new ones, they took over the world very fast and became a standard for what nowadays is mend by a word microcontroller.

The reason for success and such a big popularity is a skillfully chosen configuration which satisfies needs of a great number of the users allowing at the same time stable expanding (refers to the new types of the microcontrollers). Besides, since a great deal of software has been developed in the meantime, it simply was not profitable to change anything in the microcontroller's basic core. That is the reason for having a great number of various microcontrollers which actually are solely upgraded versions of the 8051family.

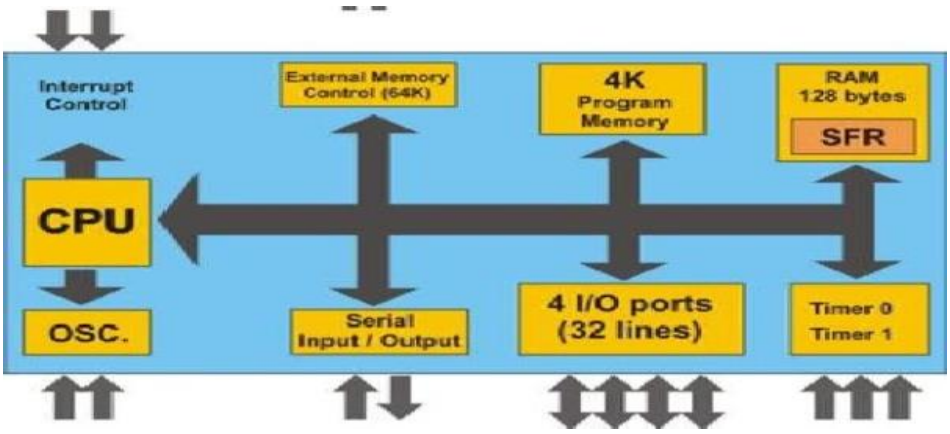

Fig 4.1 Block diagram of Microcontroller

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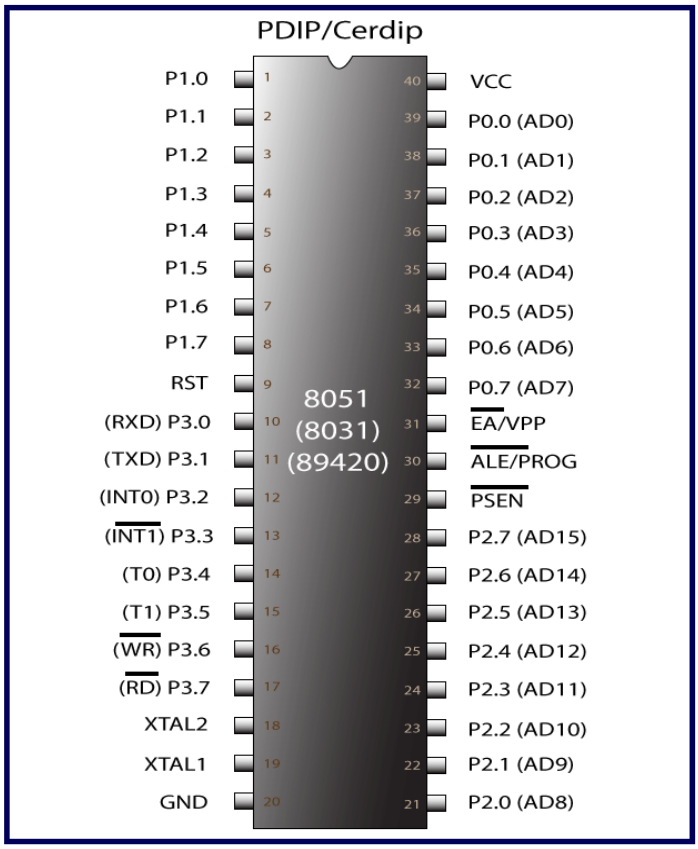
As shown on the previous picture, the 8051 microcontroller has nothing impressive at first sight:

- 4 Kb program memories is not much at all.
- 128Kb RAM (including SFRs as well) satisfies basic needs, but it is not imposing amount.
- 4 ports having in total of 32 input/output lines are mostly enough to make connection to peripheral environment and are not luxury at all.

As it is shown on the previous picture, the 8051 microcontroller have nothing impressive at first sight:

The whole configuration is obviously envisaged as such to satisfy the needs of most programmers who work on development of automation devices. One of advantages of this microcontroller is that nothing is missing and nothing is too much. In other words, it is created exactly in accordance to the average user‘s taste and needs. The other advantage is the way RAM is organized, the way Central Processor Unit (CPU) operates and ports which maximally use all recourses and enable further upgrading

4.2 8051 MICROCONTROLLER'S PINS:



8051 MICROCONTROLLER'S

- Pins 1-8: Port 1 Each of these pins can be configured as input or output.
- Pin 9: RS Logical one on this pin stops microcontroller’s operating and erases the contents of most registers. By applying logical zero to this pin, the program starts execution from the beginning. In other words, a positive voltage pulse on this pin resets the microcontroller.
- Pins10-17: Port 3 Similar to port 1, each of these pins can serve as universal input or output. Besides, all of them have alternative functions:
- Pin 10: RXD Serial asynchronous communication input or Serial synchronous communication output.
- Pin 11: TXD Serial asynchronous communication output or Serial synchronous communication clock output.

- Pin 12: INT0 Interrupt 0 input
- Pin 13: INT1 Interrupt 1 input
- Pin 14:T0 Counter 0 clock input
- Pin 15:T1 Counter 1 clock input
- Pin 16: WR Signal for writing to external (additional) RAM
- Pin 17: RD Signal for reading from external RAM
- Pin 18, 19: X2 X1 Internal oscillator input and output. A quartz crystal which determines operating frequency is usually connected to these pins. Instead of quartz crystal, the miniature ceramics resonators can be also used for frequency stabilization. Later versions of the microcontrollers operate at a frequency of 0 Hz up to over 50 Hz.
- Pin 20: GND Ground
- Pin 21-28: Port 2 If there is no intention to use external memory then these port pins are configured as universal inputs/outputs. In case external memory is used then the higher address byte, i.e. addresses A8-A15 will appear on this port. It is important to know that even memory with capacity of 64Kb is not used (i.e. note all bits on port are used for memory addressing) the rest of bits are not available as inputs or outputs.
- Pin 29: PSEN If external ROM is used for storing program then it has a logic-0 value every time the microcontroller reads a byte from memory.
- Pin 30: ALE Prior to each reading from external memory, the microcontroller will set the lower address byte (A0-A7) on P0 and immediately after that activates the output ALE. Upon receiving signal from the ALE pin, the external register (74HCT373 or 74HCT375circuit is usually embedded) memorizes the state of P0 and uses it as an address for memory chip. In the second part of the microcontroller's machine cycle, a signal on this pin stops being emitted and P0 is used now for data transmission (Data Bus). In this way, by means of only one additional (and cheap) integrated circuit, data multiplexing from the port is performed. This port at the same time used for data and address transmission.
- Pin 31:EA By applying logic zero to this pin, P2 and P3 are used for data and address transmission with no regard to whether there is internal memory or not. That means that even there is a program written to the microcontroller, it will not be executed, the program written to external ROM will be used instead. Otherwise, by applying logic one to the EA pin, the microcontroller will use both memories, first internal and afterwards external (if it exists), up to end of address space.
- Pin 32-39: Port 0 Similar to port 2, if external memory is not used, these pins can be used as universal inputs or outputs. Otherwise, P0 is configured as address output (A0-A7)when the ALE pin is at high level (1) and as data output (Data Bus), when logic zero (0)is applied to the ALE pin.
- Pin 40: VCC Power supply +5V.

5. SENSOR INTERFACING

5.1 PULSE AND OXYGEN IN BLOOD SENSOR:

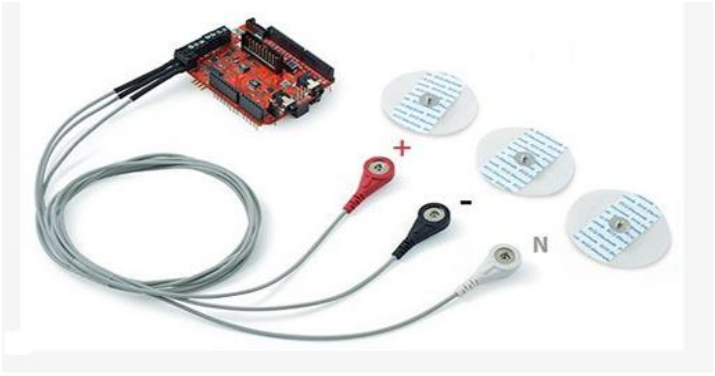
Fig 5.1.1pulse and oxygen in blood sensor

- SPO2 sensor features Pulse oximetry a noninvasive method of indicating the arterial oxygen saturation of functional hemoglobin.Oxygen saturation is defined as the measurement of the amount of oxygen dissolved in blood, based on the detection of Hemoglobin and Deoxyhemoglobin. Two different light wavelengths are used to measure the actual difference in the absorption spectra of HbO2 and Hb. The bloodstream is affected by the concentration of HbO2 and Hb, and their absorption coefficients are measured using two wavelengths 660 nm (red light spectra) and 940 nm (infrared light spectra). Deoxygenated and oxygenated hemoglobin absorb different wavelengths.

- Deoxygenated hemoglobin (Hb) has a higher absorption at 660 nm and oxygenated hemoglobin (HbO2) has a higher absorption at 940 nm. Then a photo-detector perceives the non-absorbed light from the LEDs to calculate the arterial oxygen saturation.

A pulse oximeter sensor is useful in any setting where a patient's oxygenation is unstable, including intensive care, operating, recovery, emergency and hospital ward settings, pilots in unpressurized aircraft, for assessment of any patient's oxygenation, and determining the effectiveness of or need for supplemental oxygen. Acceptable normal ranges for patients are from 95 to 99 percent, those with a hypoxic drive problem would expect values to be between 88 to 94 percent, and values of 100 percent can indicate carbon monoxide poisoning.

5.2 ECG SENSOR:



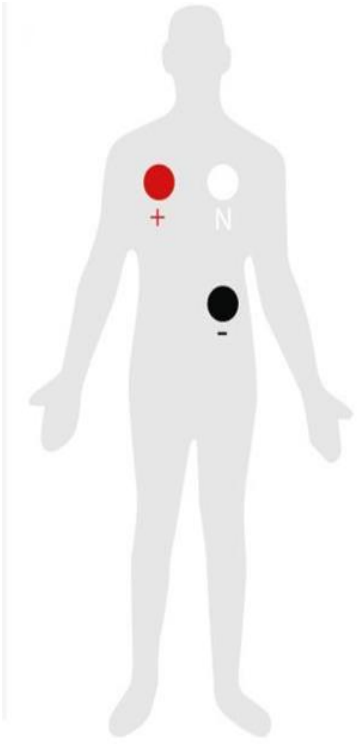


Fig 5.2.1 ECG SENSOR

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- ECG sensor features the electrocardiogram (ECG or EKG) is a diagnostic tool that is routinely used to assess the electrical and muscular functions of the hear. The Electrocardiogram Sensor (ECG) has grown to be one of the most commonly used medical tests in modern medicine. Its utility in the diagnosis of a myriad of cardiac pathologies ranging from myocardial ischemia and infarction to syncope and palpitations has been invaluable to clinicians for decades.

- The accuracy of the ECG depends on the condition being tested. A heart problem may not always show up on the ECG. Some heart conditions never produce any specific ECG changes. ECG leads are attached to the body while the patient lies flat on a bed or table. What is measured or can be detected on the ECG (EKG).

- The orientation of the heart (how it is placed) in the chest cavity. Evidence of increased thickness (hypertrophy) of the heart muscle. Evidence of damage to the various parts of the heart muscle. Evidence of utely impaired blood flow to the heart muscle. Patterns of abnormal electric activity that may predispose the patient to abnormal cardiac rhythm disturbances. The underlying rate and rhythm mechanism of the heart.

5.2.2 PHYSIOLOGICAL FUNDAMENTALS:

This section provides some fundamentals about heart physiology, helping to understand how the applications are developed.

5.2.3 HEART AND FUNCTIONS:

The heart is the organ responsible for pumping blood throughout the body. It is located in the middle of the thorax, slightly offset to the left and surrounded by the lungs.

- The heart is composed of four chambers; two atriums and two ventricles. The right atrium receives blood returning to the heart from the whole body. That blood passes through the right ventricle and is pumped to the lungs where it is oxygenated and goes back to the heart through the left atrium, then the blood passes through the left ventricle and is pumped again to be distributed to the entire body through the arteries.

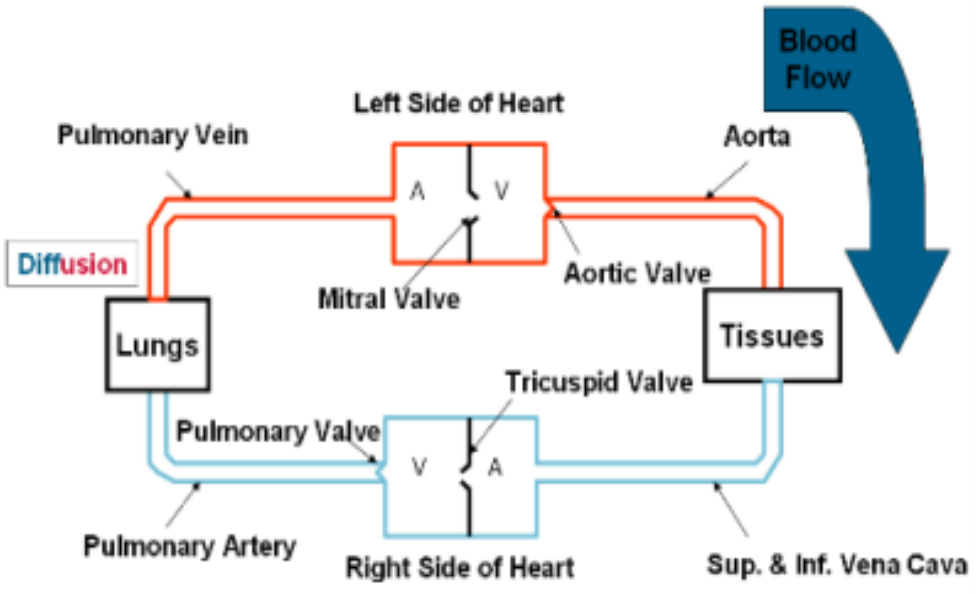

fig 5.2.3.1heart and functions

5.2.4 HEART—ELECTRICAL ACTIVITY:

- Electrical heart activity is based on depolarization and re-polarization of myocardial cells. The electrical impulse starts in the sinuatrial node (natural pacemaker) flowing through the atriums to reach the atrioventricular node and generating the atrium contraction. The current then flows through the Hiz Bundle reaches the ventricles and flows through them generating the ventricular contractions. Finally, the current reaches the Purkinje fibers and re-polarization of the heart tissue occurs.

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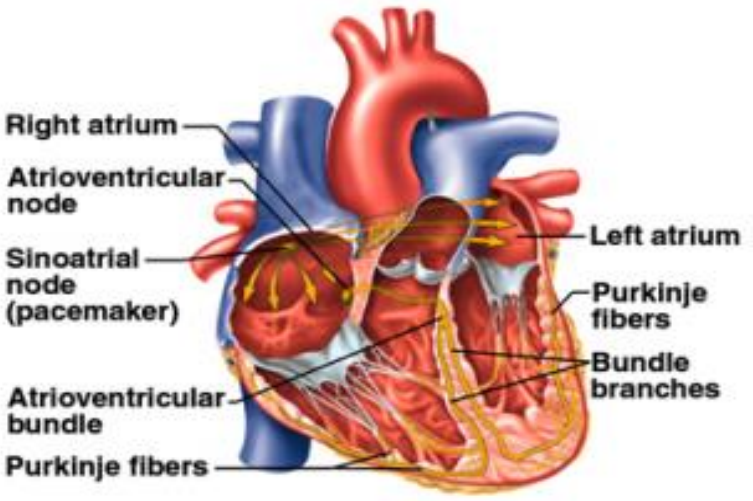

Fig 5.2.4.1heart behaviour

This is a of events that occur in the heart on each heartbeat.

- Figure shows heart behavior and part of the generated signal also known as QRS complex:
- Atrium begins to depolarize
- Atrium depolarizes
- Ventricles begin to depolarize at apex. Atrium repolarizes
- Ventricles depolarize
- Ventricles begin to repolarize at apex
- Ventricles repolarize

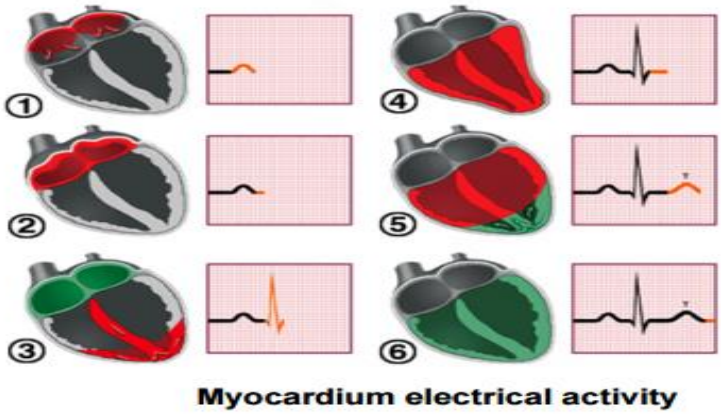

Fig 5.2.4.2 Atrium

6. GSM

6.1 GSM MODEM:

GSM module is base on SIM900A Quad-band GSM/GPRS module. SIM900 is a complete Quad-band GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions. GSM module is an compact and reliable wireless module. This module is compatible with Arduino and other MCU's. It is configured and controlled via its UART using simple AT commands.

The GPRS Shield provides you a way to use the GSM cell phone network to receive data from a remote location. The shield allows you to achieve this via any of the three methods:

- Short Message Service
- Audio
- GPRS Service

6.2 FEATURES:

- Based on SIMCom's SIM900 Module.
- Can interfaced via RS232 as well as TTL.
- Power, RING, STATUS and Network LEDs for easy debugging.
- Onboard buzzer for general audio indication.
- Quad-Band 850 / 900/ 1800 / 1900 MHz - would work on GSM networks in all countries across the world.
- Control via AT commands - Standard Commands: GSM 07.07 & 07.05 | Enhanced Commands: SIMCOM AT Commands.
- Short Message Service - so that you can send small amounts of data over the network (ASCII or raw hexadecimal).
- Embedded TCP/UDP stack - allows you to upload data to a web server.
- Speaker and Headphone connector - so that you can send DTMF signals or play recording like an answering machine.
- SIM Card holder and GSM Antenna - present onboard.

7. CONCLUSION

This system is designed to measure the parameters of human body. All the sensors are attached to the e- health sensor module so that the parameters are observed by the sensors and this information is given to the arduino or raspberry pi unit to do the data processing. Then all the observed parameters are viewed using a android app. This system is used as mobile service and gives comfortable to the patient to check their body even at home.

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