

## **GSM BASED PERSONAL MEDI-KITS**

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### **ABSTRACT**

From today's world of automation, the field of biomedical is no longer aloof. Application of engineering and technology has proved its significance in the field of biomedical. It not only made doctors more efficient but also helped them in improving total process of medication. The Patient monitoring system is also a new step in the automation of supervision for doctors.

The basic idea behind this project is, it implies that whether a person is at home, on a trip, or at his work place, he/she can stay connected with the doctor 24x7 and doctor can take immediate action if necessary.

The Patient monitoring system for doctors provides solution for this. It continuously provides following information to doctors.

1. Heart pulse rate
2. Temperature
3. Body Position

As used in hospital the same system can be used for a person who is not under the continuous observation of doctor.

The normal body temperature of a healthy and resting human being is stated to be at 98.4°F or 37°C. Though the body temperature measured on an individual can vary, a healthy human body can maintain a fairly consistent body temperature that is around the mark of 37.0°C. An indication is sent to the doctor when the pulse rate starts fluctuating just above or below the normal pulse rate which is 72 pulse/min., for a normal human body. Body positioning plays a significant role in determining the pressure on heart. Since GSM endows its users with a voice and data channel and the possibility of sending an indication to other terminals. Thus GSM find its use and adaptability in our project.

### **1. INTRODUCTION**

Biomedical field serves as the boon for human society. But in today's rashly running world people care less about their health. Cases of heart attacks and deaths due to lack of help are increasing. For this purpose personal medi-kits are best solution.

Few years ago, there was joint family system hence patients were able to get medical help within time. But nowadays one may lose his life because of not getting proper help within time. For such heart patients this kit gives indication to their doctors and they immediately get medical help. Whenever beat rate of person exceeds more than 72 pulse/min., doctor get immediate indication and help will be sent as fast as can.

Cardiovascular diseases are often very critical and serious condition, the change is so rapid, the one attack can bring about great suffering to patients, and even lead to syncope or sudden death. Especially coronary heart disease, cardiomyopathy, and arrhythmia history, family history of sudden cardiac death, heart transplantation and other medical conditions, history, the disease has a sudden, random, high rate characteristics of sudden death, usually after the acute onset of symptoms within 1 hour may cause death and malignant ventricular fibrillation within 12 minutes and even cause sudden death in patients suffering from serious heart disease in patients with the above mentioned is attack patients.

Heart related disorders resulting from lack of coronary circulation, such as a heart attack, have been and likely will continue to be the most common cause of death in the industrialized world. An estimated 3-4 million people suffer from heart attack per year. Approximately half of heart attacks are SILENT meaning they are not felt by the patients. Half of the patients who sustain heart attacks die prior to arrival to hospitals. The present innovation, therefore relates to early detection and long term monitoring of heart related disorders.

### **Drawbacks of present electrical method and the wireless system:**

The present electrical method provides a bulky strap around one's chest. Monitoring patients with serious cardiovascular problems is invaluable in preventing further crises and achieving a faster, more effective attention. To this end, noninvasive cardiologic tests such as dynamic electrocardiography (ECG) have proven useful in clinical practice. These methods though very useful, still require modification so that it is easier for the patients to benefit from these methods when they have recovered from the attack, which urges

to think on this issue very carefully and seriously, leading to the present wireless heart rate monitoring system.

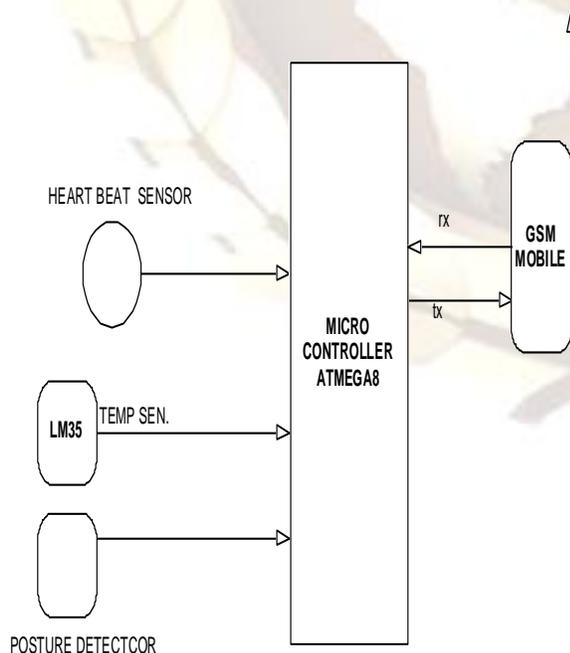
The current heart rate monitoring system uses a heavy and bulky setup at both ends i.e. at the patient's as well as at the doctor's. This in turn causes convenience problems for the patient and any defect occurring at any stage may result in loss of information which may result in improper diagnosis.

**Need of time:**

The monitoring of a patient round the clock, however, is clumsy because of the nature of equipment. Monitoring of the data generated by a patient throughout the day in a post recovery mode is not possible because it would otherwise require the patient to simply live in the hospital or in the adjunct exercise facility. That is not reasonably calculated to restore the patient to normal living as defined by the life of that patient.

The present monitor puts forward a novel system that benefits from GSM mobile telephony standard widespread technology. This design adds to the traditional capabilities, the attractive features of real time processing and possibility of monitoring the patient's heart anywhere, anytime. Apart from traditional typical capabilities, the new system presents additional features, both in automatic analysis and in the communications interface (GSM transmission).

**2. BLOCK DIAGRAM WITH TECHNICAL DETAILS OF GSM BASED PERSONAL MEDI-KIT SYSTEM**



**CIRCUIT DIAGRAM**

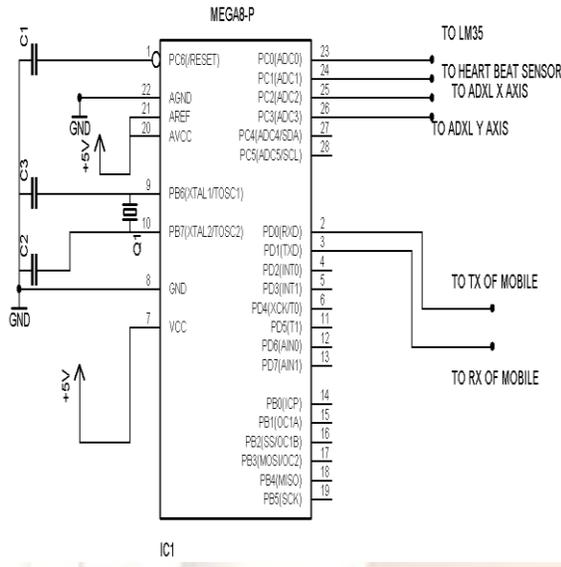
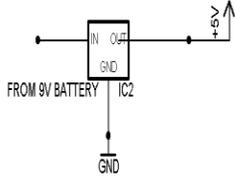
**2.1. Description of block diagram:**

The above figure shows the block diagram of GSM based personal medi-kit. Slight fluctuation in the normal heart rate, body temperature and change in body position of patient will be sensed by the heart sensor, temperature sensor and posture detector respectively, attached to the index finger. It will forward data to the microcontroller where it will be compared with the normal value of body temperature and heart rate. Depending upon the parameters considered by monitor, if it finds any parameter disturbed then the result is sent to the doctor and he may immediately take the necessary action. Thus without wasting the time patient can be treated whereas sending the report can be done using GSM. The device will compare the three parameters with the ideal parameters, if some fluctuations are noticed, the SMS is immediately sent to the doctor. This message may be in the form of beeps to indicate the doctor.

The system comprises an implantable medical device that includes a sensor operable to produce an electrical signal representative of heart sounds, a sensor interface circuit coupled to the sensor to produce a heart sound signal, and a controller circuit coupled to the sensor interface circuit. The heart sounds are associated with mechanical activity of patient's heart and the controller circuit is operable to detect a posture of the patient from a heart sound signal.

GSM based heart rate monitoring and the display system is a portable and a best replacement for the old model stethoscope, which is less efficient. It is a combination of a HIGH POWER LED based heart rate monitor interface with a GSM module to transmit the heart rate of patient to a remote location.

The functioning of this device is based on the truth that the blood circulates for every heartbeat that can be sensed by LED. Depending upon the rate of circulation of blood the heart beat per minute is calculated. This calculated value is communicated to the person through a GSM modem interfaced to it.



The above circuit shows the working of the heart rate monitoring system using GSM. Here at pin no. 1, 9 and 10 are connected to 3 capacitors in parallel. A crystal oscillator is placed between pin no. 9 and 10. Pin no. 7, 20 and 21 are connected to +5v. The capacitors are connected to GND at one terminal, also pin no. 8 and 22 also to ground.

The output of the microcontroller is given at PORT C from PC0 to PC3 as LM35, Heart Beat Sensor, to ADXL X axis from Pin no. 23 to 26. The RXD and TXD of microcontroller is connected to TXD and RXD of mobile. A voltage regulator is used to regulate the voltage which is supplied form a 9v battery and gives an output of 5v. This gives the entire working of heart rate monitoring system using GSM.

### 3. Components of block diagram:

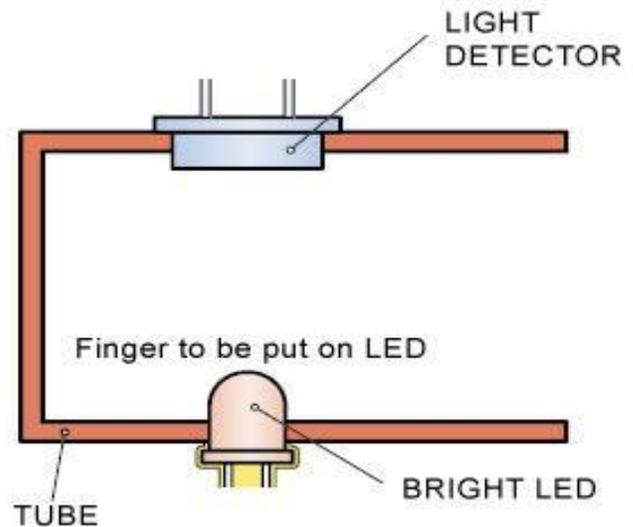
- HEART SENSOR
- LM35
- POSTURE DETECTOR
- MICROCONTROLLER ATMEGA8
- GSM MODEM

### 3.1.Heart sensor:

The heart sounds are the noises a physician listens by using a stethoscope over the heart. They are the noises of the heart valves shutting. These noises are

not the same as the pulse or the artery turbulence noises listen to when taking blood pressure. There are two distinct heart sounds called a lub and a dub. Heart is an amazing organ which continuously pumps oxygen and nutrient rich blood throughout the body to sustain life.

### 3.1.1.Working:

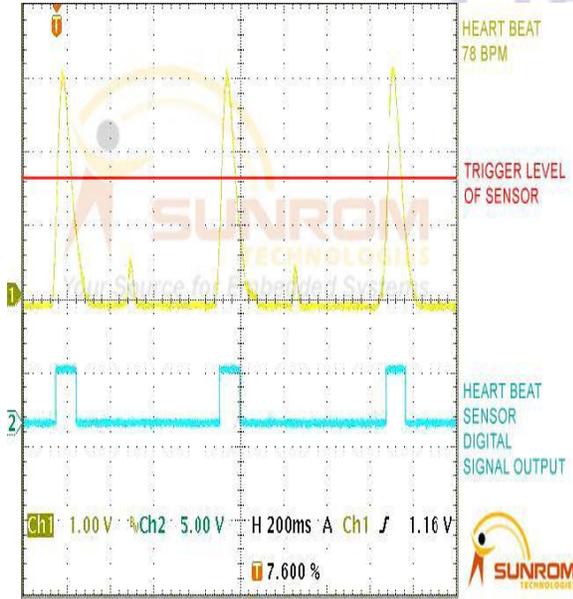


Heart beat is sensed by using a high intensity type LED and LDR. The finger is placed between the LED and LDR. As Sensor a photo diode or a photo transistor can be used. The skin may be illuminated with visible (red) using transmitted or reflected light for detection. The very small changes in reflectivity or in transmittance caused by the varying blood content of human tissue are almost invisible. Various noise sources may produce disturbance signals with amplitudes equal or even higher than the amplitude of the pulse signal. Valid pulse measurement therefore requires extensive preprocessing of the raw signal.

The new signal processing approach presented here combines analog and digital signal processing in a way that both parts can be kept simple but in combination are very effective in suppressing disturbance signals. The setup described here uses a red LED for transmitted light illumination and a LDR as detector. With only slight changes in the preamplifier circuit the same hardware and software could be used with other illumination and detection concepts. The detectors photo current (AC Part) is converted to

voltage and amplified by an operational amplifier (LM358). Output is given to another non-inverting input of the same LM358; here the second amplification is done. The value is preset in the inverting input, the amplified value is compared with preset value if any abnormal condition occurs it will generate an interrupt to the controller

The figure shows actual heart beat received by detector (yellow) and the trigger point of sensor (red) after which the sensor outputs digital signal (blue) at 5v level.



### 3.1.2 Features:

- Heart beat indication by LED
- Instant output digital signal
- Easily available and less costly
- Compact size
- Working voltage +5v DC

### 3.2. LM35:

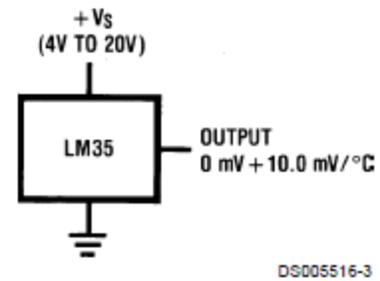


FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of  $\pm 1/4^\circ\text{C}$  at room temperature and  $\pm 3/4^\circ\text{C}$  over a full  $-55$  to  $+150^\circ\text{C}$  temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only  $60\ \mu\text{A}$  from its supply, it has very low self-heating, less than  $0.1^\circ\text{C}$  in still air. The LM35 is rated to operate over a  $-55^\circ$  to  $+150^\circ\text{C}$  temperature range, while the LM35C is rated for a  $-40^\circ$  to  $+110^\circ\text{C}$  range ( $-10^\circ$  with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

### 3.2.1 Features:

- Calibrated directly in ° Celsius (Centigrade)
- Linear  $+ 10.0\ \text{mV}/^\circ\text{C}$  scale factor
- $0.5^\circ\text{C}$  accuracy guarantee-able (at  $+25^\circ\text{C}$ )
- Rated for full  $-55^\circ$  to  $+150^\circ\text{C}$  range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than  $60\ \mu\text{A}$  current drain
- Low self-heating,  $0.08^\circ\text{C}$  in still air

- Nonlinearity only  $\pm 1/4^{\circ}\text{C}$  typical
- Low impedance output, 0.1 W for 1 mA load

### 3.3. Posture detector using tilt sensor:

The motivation to include posture detector in this project comes from the basic need to support the independent living of elder people and smart personal alarm system to detect deviation in health status. The earlier the fall is reported, the lower is the rate of morbidity-mortality. The use of automatic fall detector decreases the fear of falling and improves the independence and the security. It increases the quality of life of elder people.

The measurement of movement of body is made with the help of tilt sensor and accelerometer and the processing and analysis of movement is done with the help of microcontroller. The graph shows the percentage of falling people which is likely to increase every year.

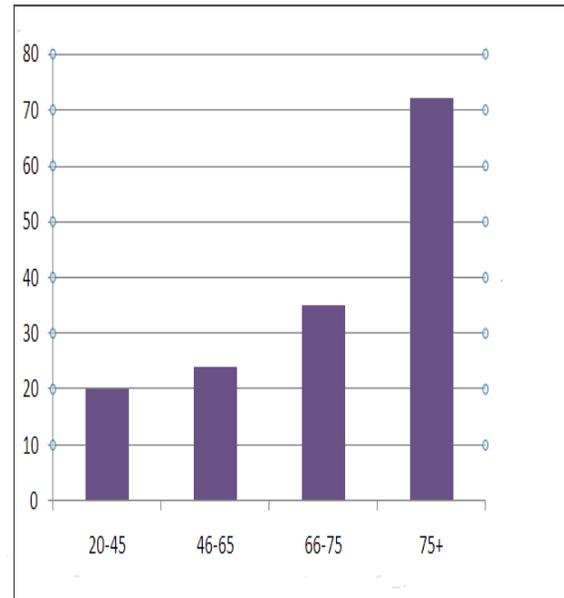
Patient's posture is an important factor in the diagnosis of certain medical disorders and may also be used to enhance therapy delivery. Posture detection involves determining an orientation of the patient's body, such as determining if the patient is in vertical position, determining if the patient is in a horizontal position (lying on the back, lying on the stomach, lying on left or right side), or determining if the patient's body is tilted to right, left, forward or backward.

Posture detection in accordance with embodiments describe herein may additionally include determining an angle of tilt of patient's body. Posture information may be tracked over time, stored, and /or correlated.

Information about patient posture may be evaluated with respect to the detection of various disorders to determine if an association between patient's postures and a particular disorder is present. The posture of patient's body, such as the inclination of the upper torso, may be linked to various medical disorders, including disorders affecting the respiratory and/or cardiovascular systems. Tracking patient's posture over time can be used to assess the general well-being of a patient.

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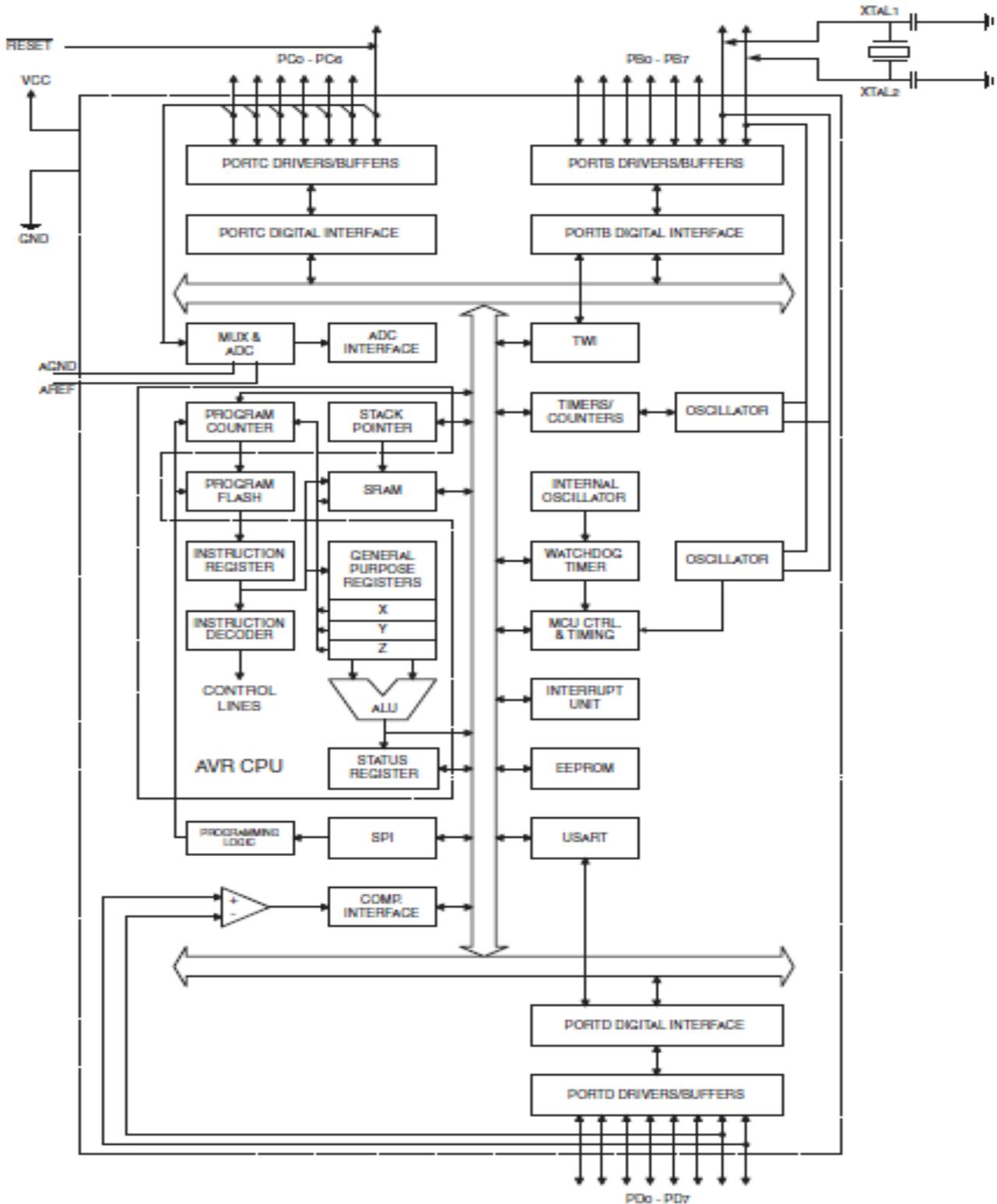
% fallers (within last 2 yrs)



The consequences of falling lead to sudden death or may lead to severe harm to the person which can be listed to a few as follows:

- 30% of home-dwelling elderly (65+) fall each year
- 0-20% of elderly people fall recurrently (at least twice within 6 months)
- Mean incidence of fall is about 650/1000 person years
- 860 older people (65+) died because of fall-related accidents

**BLOCK DIAGRAM OF ATmega8:**



### **3.4. Microcontroller ATMEGA8**

By executing powerful instructions in a single clock cycle, the ATMEGA achieves throughputs up to 16 MIPS. The ATMEGA is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture, approaching 1MIPS per MHz, allowing the system designer to optimize power consumption versus processing speed. This microcontroller works in 5 different modes which enhance its working.

The ATMEGA8 AVR is supported with a full suite of program and system development tools, including C compilers, macro assemblers, program debugger/stimulator, in-circuit emulators, and evolution kits.

#### **3.4.1. Features:**

- High performance, Low power AVR 8 bit microcontroller
- Advanced RISC Architecture
- High Endurance Non-volatile Memory segments Peripheral Feature
- Two 8-bit Timer/Counters with Separate Pre-scaler, one Compare Mode
- One 16-bit Timer/Counter with Separate Pre-scaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Three PWM Channels
- 8-channel ADC with 10-bit Accuracy
- 6-channel ADC with 10-bit Accuracy
- Byte-oriented Two-wire Serial Interface
- Programmable Serial USART
- External and Internal Interrupt Sources
- Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and
- Power Consumption at 4 Mhz, 3V, 25°C
- Active: 3.6 mA
- Idle Mode: 1.0 mA

**THE SALIENT FEATURE OF THIS MICROCONTROLLER IS THE ADC**

#### **ADC:**

The ATmega8 features a 10-bit successive approximation ADC. The ADC is connected to an 8-channel Analog Multiplexer which allows eight single-ended voltage inputs constructed from the pins of Port C. The single-ended voltage inputs refer to 0V (GND). The ADC contains a Sample and Hold circuit which ensures that the input voltage to the ADC is held at a constant level during conversion.

#### **Feature of ADC:**

- 10-bit Resolution
- 0.5 LSB Integral Non-linearity
- $\pm 2$  LSB Absolute Accuracy
- 13 - 260  $\mu$ s Conversion Time
- Up to 15 kSPS at Maximum Resolution
- 6 Multiplexed Single Ended Input Channels
- 2 Additional Multiplexed Single Ended Input Channels (TQFP and QFN/MLF Package only)
- Optional Left Adjustment for ADC Result Readout
- 0 - VCC ADC Input Voltage Range
- Selectable 2.56V ADC Reference Voltage
- Free Running or Single Conversion Mode
- Interrupt on ADC Conversion Complete
- Sleep Mode Noise Canceler

#### **USART:**

The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART) is a highly-flexible serial communication device.

The main features are:

- Full Duplex Operation (Independent Serial Receive and Transmit Registers)
- Asynchronous or Synchronous Operation
- High Resolution Baud Rate Generator
- Supports Serial Frames with 5, 6, 7, 8, or 9 Databits and 1 or 2 Stop Bits
- Odd or Even Parity Generation and Parity Check Supported by Hardware
- Data OverRun Detection
- Framing Error Detection
- Noise Filtering Includes False Start Bit Detection and Digital Low Pass Filter
- Three Separate Interrupts on TX Complete, TX Data Register Empty and RX Complete
- Multi-processor Communication Mode
- Double Speed Asynchronous Communication Mode.

### **3.5.GSM MODEM:**

GSM (Global System for Mobile Communication; originally from Group Special Mobile) is the most popular standard for mobile telephony systems in the world. The implemented prototype utilizes a GSM modem. This modem can be operated by the micro-controller by means of straight forward Hayes (ATA) commands, which follow the ETSI GSM 07.07 standard [9]. Using those commands, all functionality provided by a GSM terminal (voice, data, SMS) can be exploited. It is easily available in the market and weighing less than 20gm, which is smaller than a matchbox, thus allowing system reduction and integration. A separate module can be demolished; especially suitable for the use of multiple machines at the same time. It is used to avoid high communication costs to be incurred in a month; it sends in clusters which can be sent automatically to a large number of goals the same information.

The purpose of this project is to measure the heartbeat and send the heart beat monitoring and display system is the portable and best replacement for the old model stethoscope, which is less efficient. It is a combination of high power LED and light detector sensor based heart rate monitor interfaced with a GSM module to transmit the heart rate of the patient to transmit the heart rate of the patient to a remote location. Depending upon the rate of circulation of blood, the heart rate per minute is calculated. This Calculated value is communicated to a doctor through a GSM modem interfaced to it. Based on several scenarios we present the functionality of a prototype we are building. The application is capable of monitoring the health of high risk cardiac patients. The smart phone application analyses in real-time sensor and environmental data and can automatically alert the ambulance and pre-assigned caregivers when a heart patient is in danger. It also transmits sensor data to a healthcare center for remote monitoring by nurse or cardiologists. The system can be personalized and rehabilitation programs can neither monitor the progress of a patient. GSM modem is interfaced with the microcontroller with the help of ATA commands.

#### **3.5.1.Feature of GSM:**

- Maximum transmission speed of 9.6 Kbps
- Coverage of 98% of the territory

- SMS of around 150 characters
- Cheap and are easily available
- Support tri band mobile phones, a feature available with very few modules.

#### **4.Advantages:**

- It is a small, low cost and a portable device which can be carried easily.
- Provides continuous monitoring.
- The mobility in the monitoring process is continuous.
- Low power consumption, by means Ni-Cd batteries.
- It is extremely useful to increase your exercise level in a graded and careful manner in order to avoid injuries, overexertion, and excessive stress on the cardiovascular system.
- Using a heart rate monitor is an ideal method of assessing one's cardiovascular condition, and gauging the level of intensity of the exercise session.
- The heart rate monitor is useful for individuals who have been advised not to exercise above a certain heart rate because the heart rate can be monitored continuously.
- It allows an athlete to be more in touch with your body and your heart rate.
- An added bonus is that heart rate monitors not only supervises a person's heart rate, it also keeps track of the calories burned that you can monitor your improvement over time.
- Heart rate monitor is an ideal is an ideal method in assessing your cardiovascular condition.

#### **5.Disadvantages:**

- Using this for long durations could lead to soreness and chafing of the skin.
- A sudden failure of network may hamper the working of the system

#### **6.Applications:**

- We can also observe the ECG report of a patient on the cell phone with the help of this system.
- By programming the GSM module with proper commands, the doctor as well as the family members will be informed simultaneously about the fluctuations in patient's condition. We can also observe the ECG report

of a patient on the cell phone with the help of this system.

- For keeping track of cardiac system of an athlete to give him proper training.
- In defense areas, where the remote location of a soldier can be determined.
- In hospitals, medical colleges, laboratories.

### **7.Future Aspects:**

The system can be further improved in several aspects. Once the system requirements have been clearly defined, the hardware can be optimized, especially regarding its size, weight and consumption.

- Together with clinical analyses, the protocols to optimize the system performance should be established. New technology such as Bluetooth, GPRS and UMTS could also enhance the performance of the final product.
- Furthermore works in progress to develop and integrate a real time multichannel mobile telemedicine system capable of simultaneously transmitting medical data such as ECG, Non Invasive Blood Pressure(NIBP) and SpO2 applying Bluetooth and GPRS technologies could be done, to make the system more flexible.

### **8.Conclusion:**

Wireless intelligent heart beat rate monitoring system have made possible a new generation of noninvasive, unobtrusive personal medical monitors applicable during abnormal activities. There are many ongoing researches on heart monitoring system using GSM and the main purpose behind these researches is to make this system more compact, easily available at affordable price and to include as many parameters as possible required for heart rate monitoring. New technologies could also enhance the performance of the final project.

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