APPLICATION OF WIRELESS BIOMEDICAL SENSOR NETWORK (AWBSN) HEART RATE MONITOR

A PROJECT REPORT

Submitted by

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In partial fulfillment for the award of the degree

Of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY
WAKNAGHAT

JULY-JUNE 2011-12

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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY WAKNAGHAT

CERTIFICATE

This is to certify that the work titled "**APPLICATION OF WIRELESS BIOMEDICAL SENSOR NETWORK HEART RATE MONITOR**" submitted by **SHIVAM GARG** and **RAJAT JAIN** in partial fulfillment for the award of degree of B.TECH at Jaypee University of Information Technology, Waknaghat has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Date 28.05.2012

SIGNATURE

MR. RAVINDARA BHATT

PROJECT GUIDE

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WAKNAGHAT, HP

ACKNOWLEDGEMENT

Apart from the efforts, the success of any project depends largely on the encouragement and guidelines of many others. Therefore we take the opportunity to express our gratitude to the people who have been instrumental in the successful completion of this project.

We would also like to show our appreciation to our project guide Mr. Ravindara Bhatt. Without his able guidance, tremendous support and continuous motivation the project work would not be carried out satisfactory. His kind behavior and motivation provided us the required courage to complete our project.

Special thanks to our project panel because it was their regular concern and appreciation that made this project carried out easily and satisfactorily.

Rajat Jain (081211)

Shivam Garg (081217)

Date: 28-5-12

SUMMARY

The relentless development of wireless technology paves the way to novel applications, based on sensor networks or wireless systems .To save life, casualty care requires that trauma injuries are accurately and expeditiously assessed in the field. This report describes the initial bench testing of a wireless heart rate monitor developed based on a heart rate sensor. The battery operated device employs a lightweight sensor and the use of a 8051 microcontroller for its computations. The System also has short range wireless communication capabilities which has been achieved with the help of a RF 434 Mhz module to transfer heart Rate (HR) to a PC and then to a mobile phone. This certainly helps in reducing the load on hospital resources as well as provides a new window of opportunity in a whole new world of AT-HOME CARE. The whole approach followed in development of the above mentioned application is synonymous with the modular project development. The project has been basically separated into three independent modules the integration of which gives us the most exciting results we could have hoped for.

Signature of Student
SHIVAM GARG (081217)
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Date 28.5-12

Signature of Supervisor
MR. RAVINDARA BHATT

Date 28.05.2012

OBJECTIVES

DESIGN OF A WIRELESS HEART RATE MONITOR

To design a 8051 microcontroller based circuit to count the pulse rate and display the same at LCD (liquid crystal display) unit.

- To link the above circuit using 8051 UART circuit to make this as wired pulse monitor
- To link the above circuit using RF transmitter/receiver circuit to make this as wireless pulse monitor.
- To interface this circuit with PC for pulse monitoring and display at PC screen.
- To send the pulse rate to the family member of the patient via SMS in case of an anomaly.

CHAPTER 1: INTRODUCTION

1.1 MOTIVATION

Considerable effort has been made to deploy IT and other technologies into the medical environment, particularly the hospital arena. Much of the prevalent focus is on administrative technologies such as patient record management systems, information integration systems, etc., and high-tech hospital equipment but the deployment of technology in support of At-Home Care has the potential to radically dilute the pressure on hospital resources but remains a significant challenge, because many of the required technology solutions do not yet exist or are in early prototyping stages.[6]

At-home care can potentially provide many advantages in terms of financial benefits, improved quality of life for patients, and more effective prevention or monitoring of many long-term diseases At-home healthcare solution must detect and respond to the activities and/or characteristics of a patient.

A network of sensors or a sensor simply for starters is an ideal technology platform for detecting and responding to health-relevant parameters such as movement, breathing, ECG, and social activity. Sensors, strategically placed on the human body, create a wireless body area network (BAN) that can monitor various vital signs while providing real-time feedback to the user and medical personnel.

Wireless sensors can be deployed in a patient's home environment to provide real-time and extended monitoring of activity and well-being. When coupled with communications technologies such as mobile phones and the Internet, the sensor network can keep family, caregivers and doctors informed, while also establishing trends and detecting variations in health.[2]

1.2 WIRELESS NETWORKS

It is relevant to assess the role of wireless networks, in order to determine in which ways a certain type of wireless heart rate monitor can be superior to other types of the same device. This section reviews the use of wireless networks in medical settings. The information covered here should provide an appropriate context for the design decisions made regarding the wireless function of the project.

1.2.1 WIRELESS EQUIPMENT IN HOSPITALS

Wireless technologies have been maturing and expanding over the last few decades, most notably in the form of wireless telephones or computer networks. Wireless devices have invaded many other sectors of commerce and industry, from RFID tags replacing scan barcodes to long-range Wireless Area Networks connecting computer users over longer and longer distances. These technologies are being depended on more and more for critical tasks, in military, scientific, and most important to this project, medical applications.[5]

Considering the above postulates in mind there's a research opportunity in the Medical field using wireless sensor networks. The primary use for wireless technology in a medical environment is to aid in patient monitoring. This can range from simply providing a way to track the location of patients, as in RFID tag systems, to advanced EKG and remote status viewing of multiple patient vitals. The advantages to making these systems wireless are: [4]

- Allows for mobility of patient without disconnecting monitoring equipment
- Allows medical staff to remotely keep track of patients" well-being, including remotely informing staff of emergency conditions for a patient
- It reduces the burden of hospital staff and resources
- They are easy to test and deploy.
- The patient information can be continuously collected and deposited in hospital data banks, providing an excellent record of a patient's medical status for data mining [1].

This brings us to the very basic architecture of a Wireless Biomedical Sensor Network. It is always really helpful to understand the things with help of a diagram. Figure

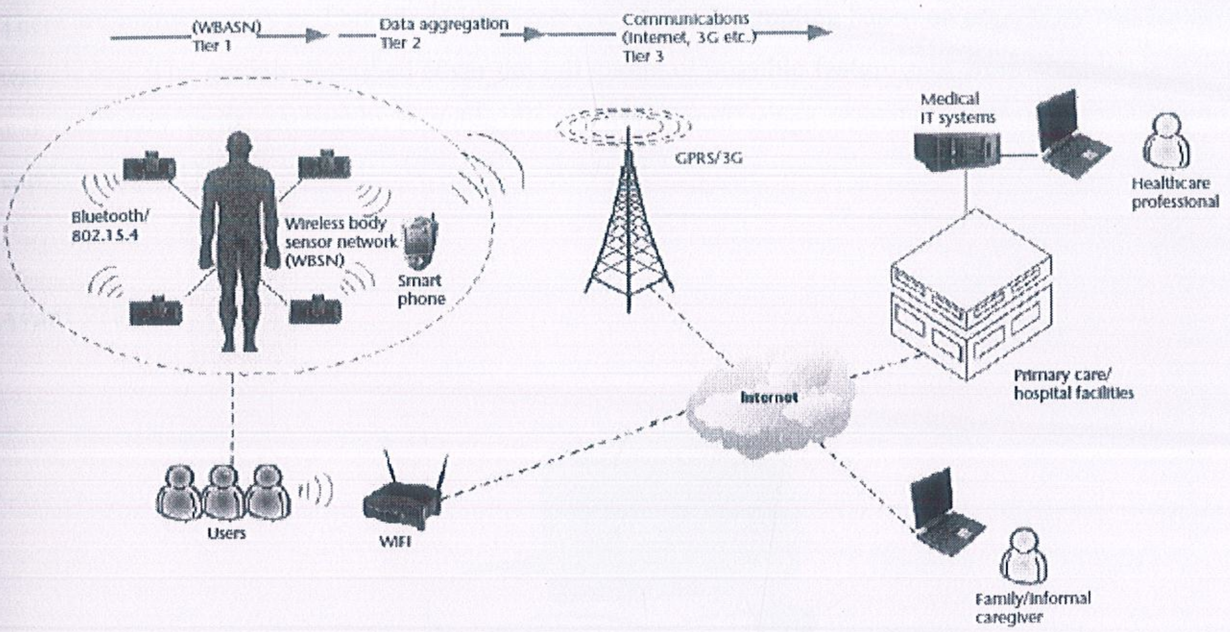


Figure-1 The architecture of Wireless Biomedical Sensor Network

Here is the figure broadly explaining a wireless Biomedical Sensor Network. There are sensors placed on the body of the patient or in his environment which make up a BAN i.e. Body Area Network working in collaboration with each other collecting various vital signs of the patient and thereby sending the priceless data to various users and to the healthcare personnel using the communication technologies like GPRS/3G so that an appropriate action can be taken if the personnel suspect any kind of anomaly.[3]

1.3 PRIOR ART

There are many models and brands of heart rate monitors. A sampling based on popularity and features was chosen. The models described cover the full gamut of possible feature sets, from completely wired and stationary units, to highly portable disaster-relief and triage models, to Bluetooth-compatible wireless units.[1]

Avant 9700

The Avant 9700 is an industry leader heart rate monitor. The sensor is connected to the display via a wire. Oxygen saturation, pulse, and plethysmograph are displayed in bright LED displays. The unit can be either AC powered or battery powered.[1]

GE TruSat

The GE TruSat heart rate monitor is a durable model that displays oxygen saturation and pulse. The LCD display is backlit for easy viewing. It can either be powered by AC or battery power.[1]

This is a chart depicting the various models available in the market and their various features so as to compare them.

COMPARISON TABLE 1 [1]

MODEL	POWER	BATTERY LIFE	TELEMETRY STANDARD	TELEMETRY RANGE	ACCURACY	COST
AVANT 4000	Two AA batteries	>120 hours	Point to Point BlueTooth, 2.4GHz	10m	3 % Pulse	$1,650
WristOx	Two 1.5V N-cell	24 hours	NA	NA	3 % Pulse	$725
Avant 9700	AC/Rech Bat	12 hours	NA	NA	3 % Pulse	$1,995
SPO 7500	3.6V Lithium	300 hours	NA	NA	3 % Pulse	$499
GE TruSat	AC/Rech Bat	20 hours	NA	NA	2 % Pulse	$1,895
Philips Intellivue	Two AA batteries	17 hours	1.4GHz	35 m	3 % Pulse	Unknown

The rest of this report describes our systematic approach towards developing a low cost and small size Wireless Heart Rate Monitor. Chapter 2 and Chapter 3 describe the design of the product using Modular approach as we thought it would be best to split the monitor into three parts thereby to get a perfect vision and feel of it .With Chapter 4 we describe our facts and findings, we also take up a look at some of the bottlenecks that we had to loosen to unlock the great potential in this field and how sticking together within the team is the best way to go for things about which one has a very little knowledge We wind up then by suggesting some of the things that can be done to enhance our work and by leaving a large research area open to discussion. . Some Well-known research activities in the field of WSN are UCLA's WINS [7], Berkeley's smart-dust [8], WEbS [9], and PicoRadio [10]. Some European research activities are the EYES-Project [11]. Detailed surveys on sensor networks can be found in [12] and [13].Further the paper "Software Engineering and Wireless Sensor Networks:Happy Marriage or Consensual Divorce" by Gian Pietro Picco acts as a strong inspiration for our project.

CHAPTER 2: THE PRODUCT

2.1 VISION

The main operation of a Heart Rate Monitor is the determination of a Heart Rate. Heart rate is the number of heartbeats per unit of time, typically expressed as beats per minute (bpm). Heart rate can vary as the body's need to absorb oxygen and excrete carbon dioxide changes, such as during exercise or sleep. The measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions. It is also used by individuals, such as athletes, who are interested in monitoring their heart rate to gain maximum efficiency from their training.

Possible points for measuring the heart rate are:

- The ventral aspect of the wrist on the side of the thumb (radial artery).
- The ulnar artery.
- The neck (carotid artery).
- The inside of the elbow, or under the biceps muscle (brachial artery).
- The groin (femoral artery).
- Behind the medial malleolus on the feet (posterior tibial artery).
- Middle of dorsum of the foot (dorsalis pedis).
- Behind the knee (popliteal artery).
- Over the abdomen (abdominal aorta).
- The chest (apex of heart), which can be felt with one's hand or fingers. However, it is possible to auscultate the heart using a stethoscope.
- The temple (superficial temporal artery).
- The lateral edge of the mandible (facial artery).
- The side of the head near the ear (basilar artery)

So this gives a lot of options to us and we have based our Heart Rate Monitor on the radial artery which is ever present in the finger.[b]

2.2 ARCHITECTURE

The development of the monitor involves a lot of choices and dilemmas when it comes to architecture such as what type of technology to use .Whether to go for component reuse or build your own devices. What's the best for the project taking a holistic view in mind? A perfect way to answer these questions is to spend some time trying to seek out the architecture by using various UML tools available at the helm.

2.2.1 USE CASE

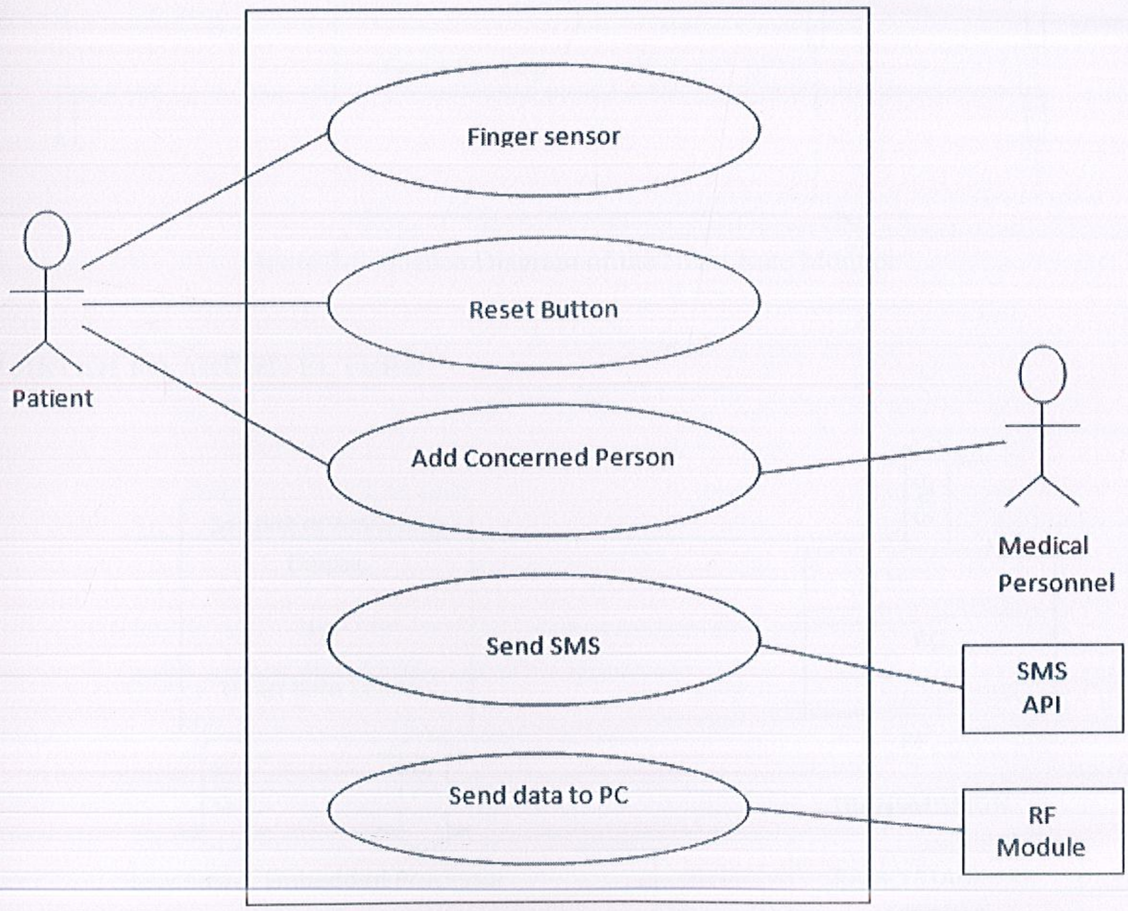


Figure 2-Use Case Diagram of the Heart Rate monitor

2.2.2 SEQUENCE DIAGRAM

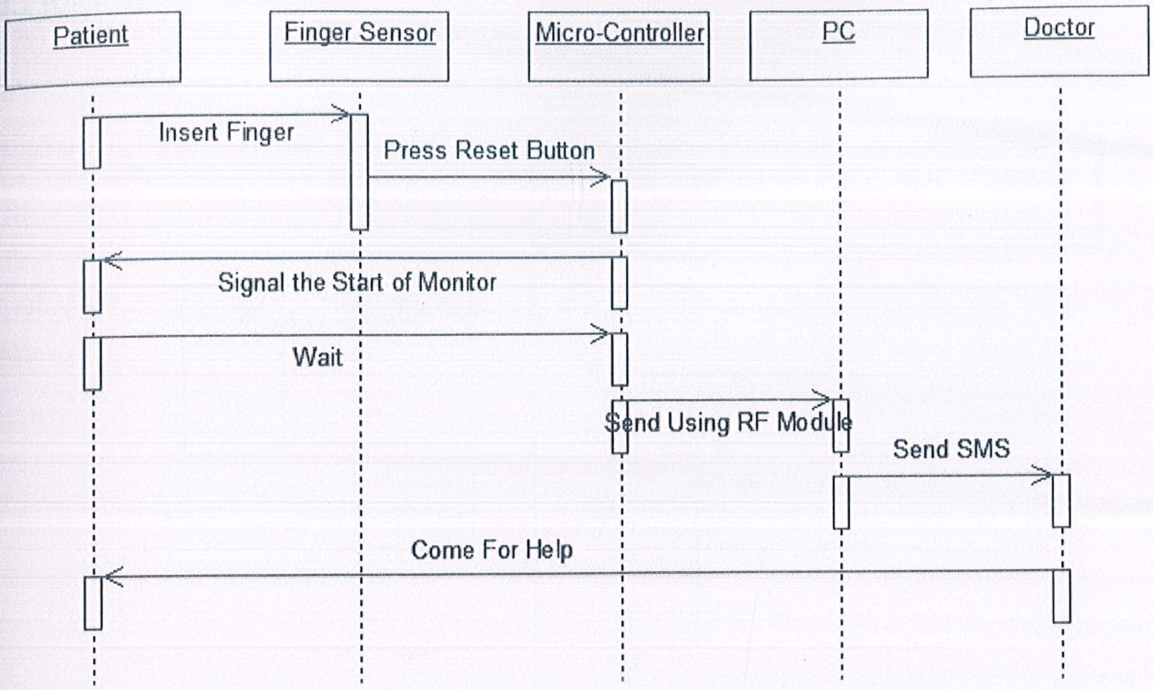


Figure 3-Sequence Diagram of the Heart Rate Monitor

2.2.3 DETAILED ARCHITECTURE

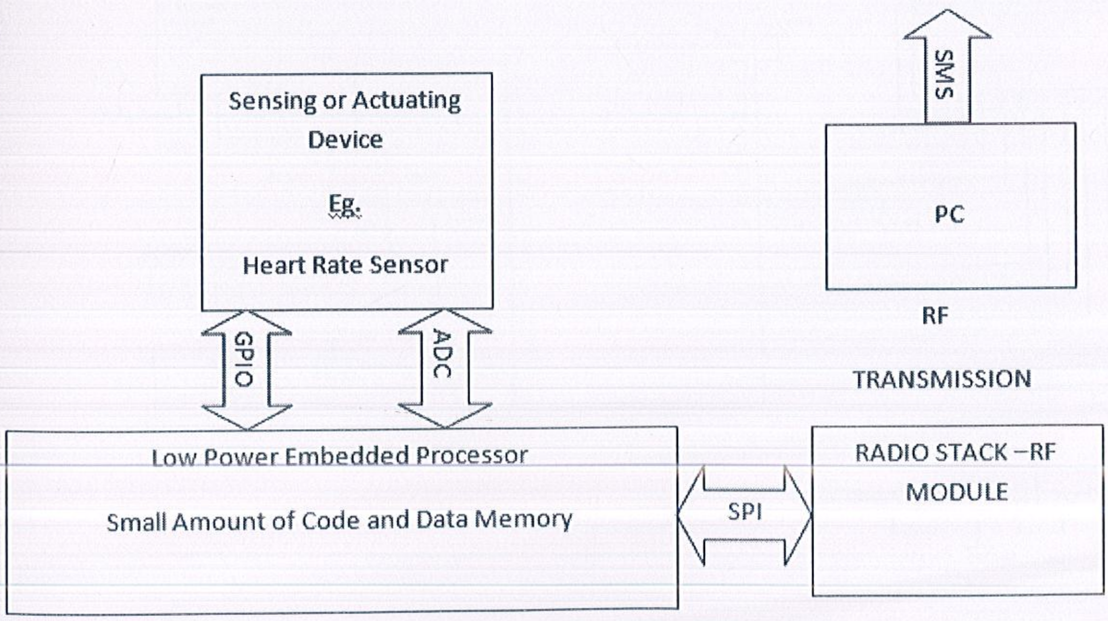


Figure 4-Architecture of Heart Rate Monitor

2.3 DESIGN OF MODULE 1

2.3.1 BLOCK DIAGRAM

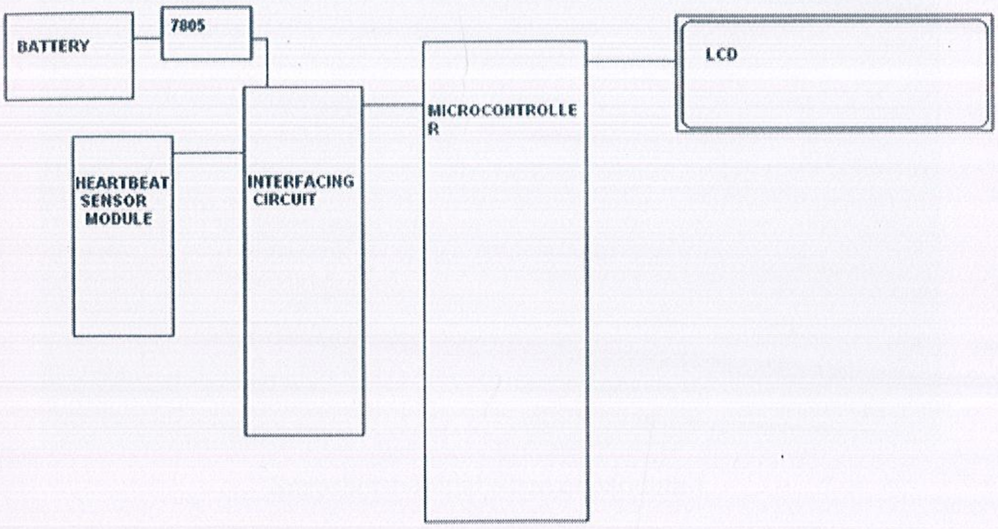


Figure 5-Block Diagram of Module 1

2.3.2 CIRCUIT DIAGRAM

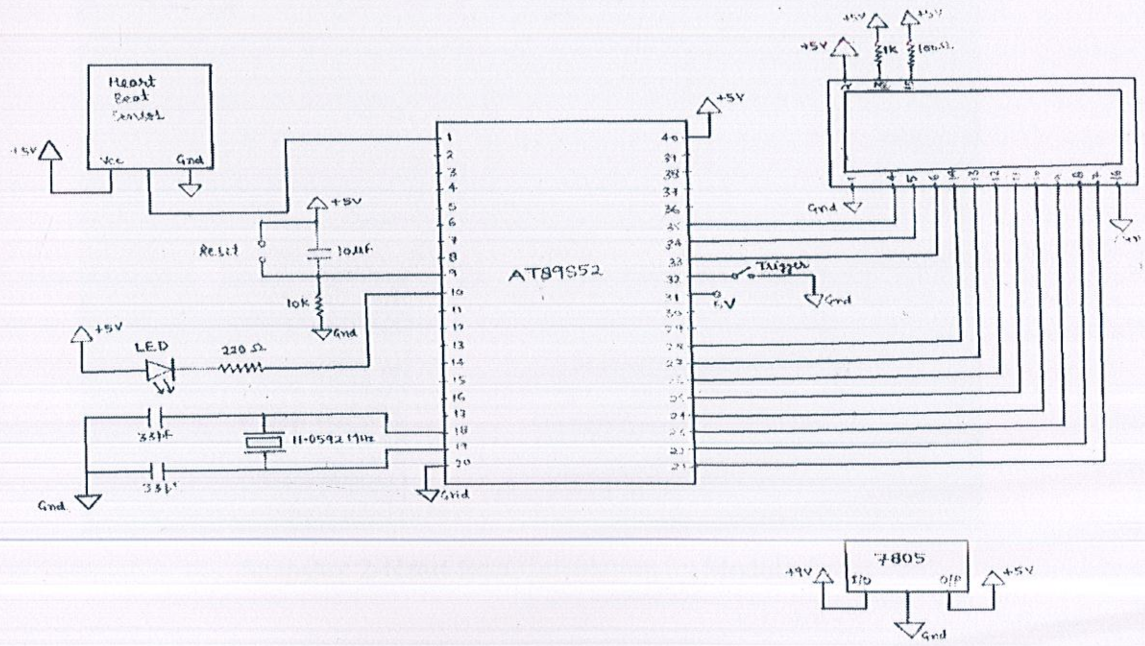
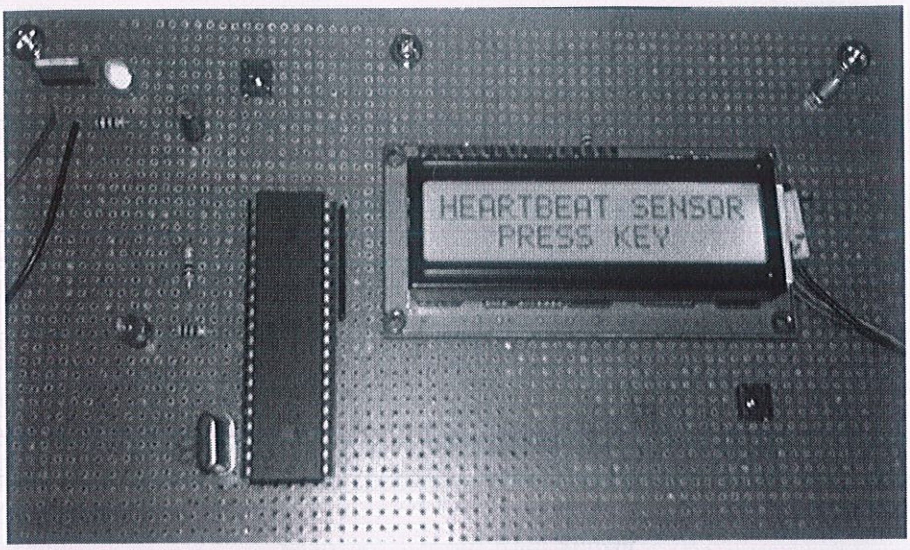
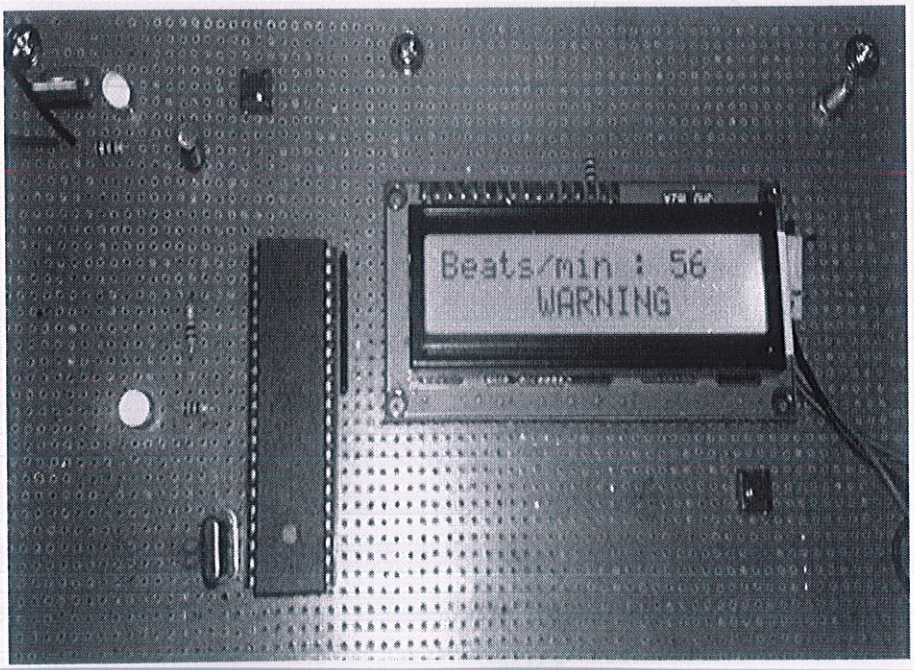


Figure 6-Circuit Diagram of Module 1

2.3.3 SNAPSHOTS



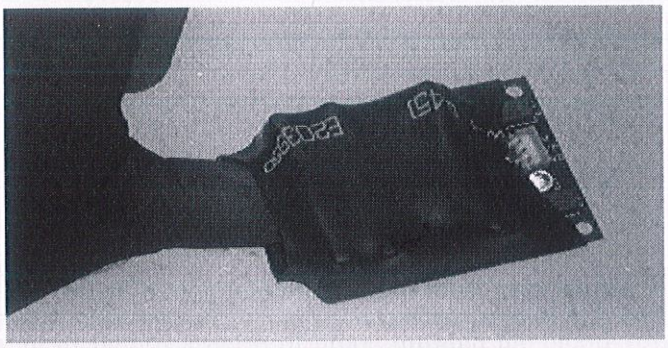
Snapshot 1-Initial State of Module 1



Snapshot 2-Heart Beat Calculation by Module 1

2.3.4 COMPONENTS USED

2.3.4.1 HEART RATE SENSOR



Snapshot 3-Heart Rate Sensor

The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through Finger. As the heart forces blood through the blood vessels in the Finger, the amount of blood in the Finger changes with time. The sensor shines a light lobe (small High Bright LED) through the ear and measures the light that is transmitted to LDR. The signal is amplified, inverted and filtered, in the Circuit .By graphing this signal, the heart rate can be determined

Features:

- Heart Beat Indication by LED
- Instant output digital signal for directly connecting to the microcontroller
- Compact size
- Working voltage +5v

Specifications

Parameter	Value
Operating Voltage	+5V DC regulated
Operating Current	100 mA
Output Data Level	5V TTL level
Heart Beat detection	Indicated by LED and Output High Pulse
Light source	660nm Super Red LED

Pin Details

Pin	Name	Details
1	+5 V	Power supply Positive input
2	OUT	Active High output
3	GND	Power supply Ground

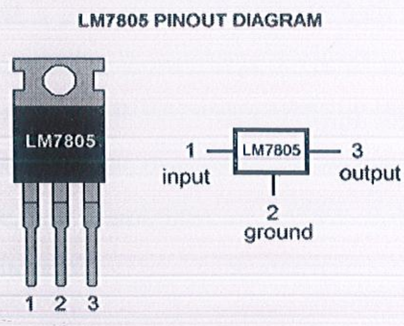
[c]

Working

The sensor consists of a super bright red LED and light detector.

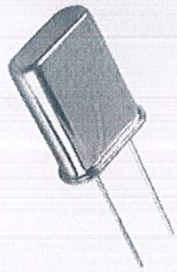
The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

2.3.4.2 7805



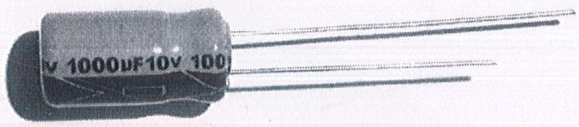
We can get a constant high-voltage power supply using inexpensive 3-terminal voltage regulator 7805. Depending upon the current requirement, a reasonable load regulation can be achieved. Rectified and filtered unregulated voltage is applied at VIN and a constant voltage appears between pins 2 and 3 of the voltage regulator. This IC takes VIN from 7 volts to 35 volts and gives constant 5 volt supply[b]

2.3.4.3 CRYSTAL OSCILLATOR



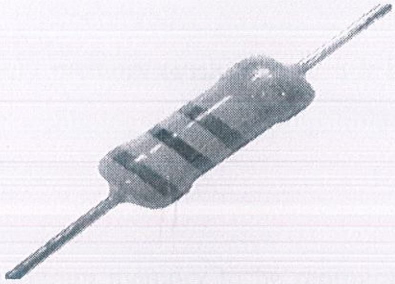
Crystal oscillators are oscillators where the primary frequency determining element is a quartz crystal. Because of the inherent characteristics of the quartz crystal the crystal oscillator may be held to extreme accuracy of frequency stability.[b]

2.3.4.4 CAPACITORS



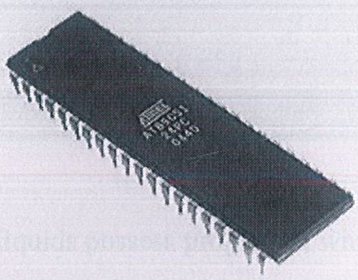
It is an electronic component whose function is to accumulate charges and then release it.To understand the concept of capacitance, consider a pair of metal plates which all are placed near to each other without touching. If a battery is connected to these plates the positive pole to one and the negative pole to the other, electrons from the battery will be attracted from the plate connected to the positive terminal of the battery. If the battery is then disconnected, one plate will be left with an excess of electrons, the other with a shortage, and a potential or voltage difference will exists between them. These plates will be acting as capacitors[b]

2.3.4.5 RESISTOR



Resistance is the opposition of a material to the current. It is measured in Ohms (□). All conductors represent a certain amount of resistance, since no conductor is 100% efficient. To control the electron flow (current) in a predictable manner, we use resistors. Electronic circuits use calibrated lumped resistance to control the flow of current[b]

2.3.4.6 AT89C52



Features

- Compatible with MCS-51™ Products
- 8K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

Description

The AT89C52 is a CMOS 8-bit microcontroller having low-power and high-performance Flash programmable and erasable read only memory (PEROM) of 8 k bytes. This device is manufactured using Atmel's nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set.[b]

The Flash on the chip grants the program memory to be reprogrammed by a traditional nonvolatile memory programmer. The device is a powerful microcomputer which combines a 8-bit CPU with Flash on a monolithic chip and provides a highly-flexible cost-effective solution to many embedded applications.

2.3.4.7 LCD

Certain large size molecule types of liquids possess properties, which cause them to interfere with light passing through them. The twisted nematic type is becoming more useful in LCDs these days. In this, the liquid crystals look like threads, lengthy chains are formed by the units joining head to tail for million molecules. pyrimidines, phenyl cyclohexanes, bicyclohexane and 4-(4' methoxy benzylidine) - n-butylaniline are some of the recent chemicals of this variety are made of. They exhibit a crystalline structure even in liquid form at ordinary temperatures.[b]

Interface to the 8051

These LCD's are quite easy to interface with the controller as well as cost effective.

The most commonly used ALPHANUMERIC displays are

- 1x16 (Single Line & 16 characters),
- 2x16 (Double Line & 16 character per line),
- 4x20 (four lines & Twenty characters per line)

The LCD requires 3 control lines (RS, R/W & EN) & 8 (or 4) data lines. The number on data lines depends on the mode of operation. If operated in 8-bit mode then 8 data lines + 3 control lines i.e. total 11 lines are required.

Table 2-LCD Pinout

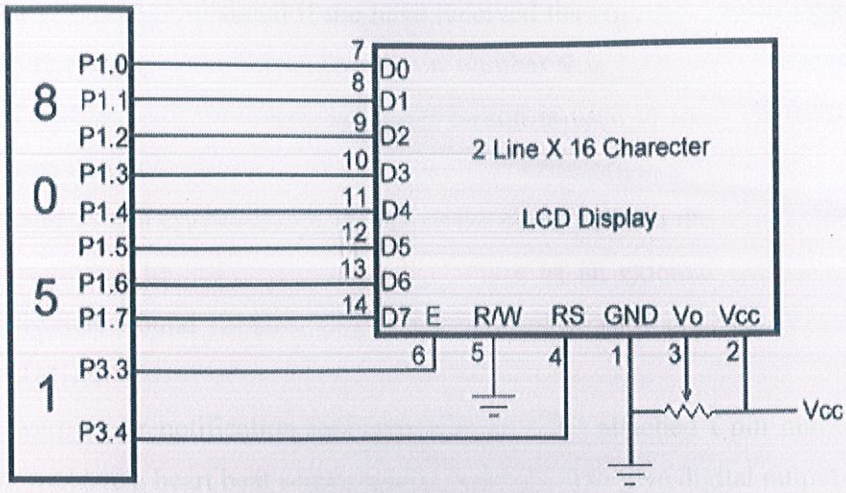
Pin	Symbol	Function
1	V_{ss}	Ground
2	V_{dd}	Supply Voltage
3	V_0	Contrast Setting
4	RS	Register Select
5	R/W	Read/Write Select
6	En	Chip Enable Signal
7-14	DB0-DB7	Data Lines
15	A/V_{ee}	Gnd for the backlight
16	K	V_{cc} for backlight

The data is to be treated as a command when *RS* is low (0),the data sent is considered as text data which should be displayed on the screen when RS is high (1),.

The information on the data bus is being written to the LCD, when *R/W* is low (0), The program is effectively reading from the LCD when RW is high (1). this line can directly be connected to Gnd thus saving one controller line Most of the times there is no need to read from the LCD

.

The pin called *ENABLE* is used to latch the data prevalent on the data pins. To latch the data we Require a High-Low signal. The LCD interprets and executes our command when the EN line is brought low. If we don't bring EN low, your instruction will never be executed.



For Contrast setting a 10K pot should be used as shown in the figure.

Display Data Ram (DDRAM) stores the display data. So when we have to display a character on LCD we basically write it into DDRAM. For a 2x16 LCD the DDRAM address for first line is from 80h to 8fh & for second line is 0c0h to 0cfh. So if we want to display 'H' on the 7th postion of the first line then we will write it at location 87h.[a]

2.3.4.8 PCB

Printed Circuit Board are used for housing components to make a circuit for compactness, simplicity of servicing and case of interconnection. Thus we can define the P.C.B. as : Prinked Circuit Boards is actually a sheet of bakelite (an insulating material) on the one side of which copper patterns are made with holes and from another side, leads of electronic components are inserted in the proper holes and soldered to the copper points on the back. Thus leads of electronic components terminals are joined to make electronic circuit. In the boards copper cladding is done by pasting thin copper foil on the boards during curing. The copper on the board is about 2 mm thick and weights an ounce per square foot.[b]

2.3.5 CONSTRUCTION

The whole circuit can be described as follows. We use a 6f22 9V battery in order to power the whole circuit. This battery is connected to the battery snapper which in turn is connected to a 3-terminal voltage regulator 7805 which is used to get a constant voltage power supply of 5 volts for the circuit. Red wire of the battery snapper is connected to the 1st pin of 7805 and to 2nd pin is grounded. We get a supply of +5V at the 3rd pin. To the third pin of the 7805 is connected an LED and resistance of 220 ohm as LED works on low voltage to signal if the have received the required 5 volt. This 5 volt is fed to the pin number 40 of the microcontroller. To the pin number 9 is connected a reset button and a capacitor of 10µf and resistance of 10Kohm. The reset button is used to reset the microcontroller's internal register and ports upon starting up.

At the pin number 18 and 19 is a crystal oscillator to provide clock pulse to the circuit. It has two 33pf capacitances connected to it. The 8051 requires the existence of an external oscillator circuit. The oscillator circuit usually runs around 12MHz. Each machine cycle in 8051 is 12 clock cycle, giving an effective cycle rate at 1MHz.

In case there is any warning or notification then we have an LED attached t pin number 10 of the microcontroller. Then we have a heart beat sensor which is designed to give digital output of heart beat when a finger is placed on it. This sensor has three pins. On pin 1 we give +5V power supply. Pin 3 is ground and Pin 2 gives up the Active high output which is connected to the Pin 1 of the microcontroller.

Next we have an LCD interfacing a 16*2 (16 character per line and 2 lines). The LCD requires 3 control lines (RS, R/W an EN) and 8 data lines if operated in 8-bit mode. When RS is low (0), the data is to be treated as a command. When RS is high (1), the data being sent is considered as text data which should be displayed on the screen.

When R/W is low (0), the information on the data bus is being return to the LCD. When R/W is high (1), the program is reading from LCD. The enable pin is used to latch the data present on the data pins. A high low signal is required to latch the data. The LCD interprets and executes the command at the instant EN line is brought low, if you never bring EN low, your instruction will never be executed.

We have used the port2 configuration of 8051. 35,34,33 pins are connected to RS, R/W, EN respectively. Pins 21-28 are connected to the D0-D7 of the LCD. A resistance of 1K is used on pin 3 of LCD for contrast setting.

2.3.6 WORKING

Connect the battery to the battery snapper.

Wait for led connected with 7805 to glow signalling that the required 5v is achieved.

Let the LCD display the message "HEARTBEAT SENSOR" and "PRESS KEY".

Now, put your thumb into the sensor and press the trigger of the microcontroller. You can view the beat led blinking on each heart beat.

The programmed microcontroller reads the high output of the sensor till 15 sec and multiplies it by 4 to get beats per minute and display it on the LCD.

If beats per min is greater than 90 or less then 60 then the LCD dsplays a warning message.

Use the reset button of the microcontroller to measure beats per min again and move back to step 2.

2.4 DESIGN OF MODULE 2 WIRED

2.4.1 CIRCUIT DIAGRAM

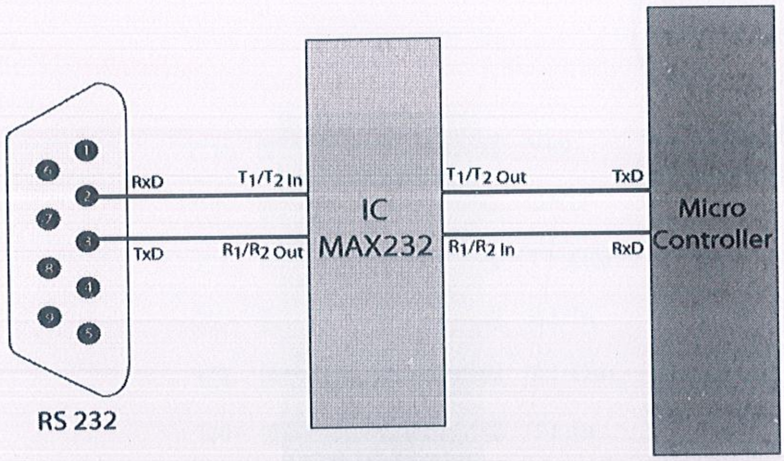
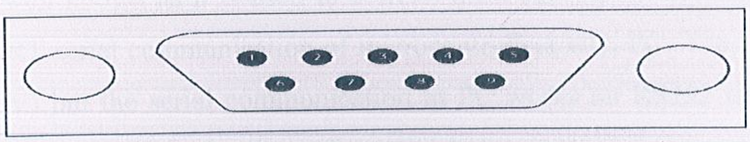


Figure 7-Interfacing of Microcontroller to RS 232

2.4.2 COMPONENTS

2.4.2.1 RS232 DB9



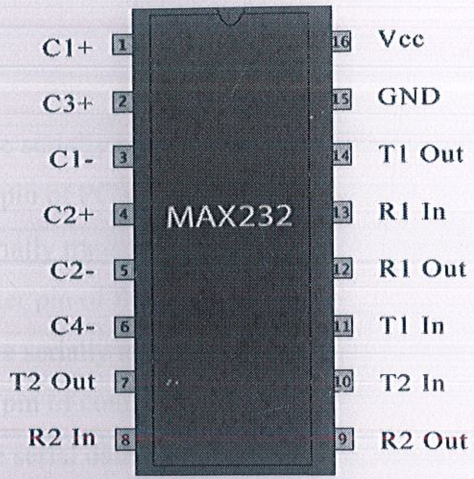
IBM's DB-**9** **RS-232** version of serial I/O standard is the one popularly used in PCs and several devices. In RS232, low and high bits are represented by flowing voltage ranges:

Table 3-RS232 Voltage Standards

BIT	VOLTAGE RANGE	
0	+3	+25
1	-25	-3

The range +3V to -3V is not defined. The inception of TTL standards took place a long time after the RS232 standard was set. Due to these circumstances RS232 voltage levels were not compatible with TTL logic. Therefore, to connect a RS232 to a microcontroller system, a voltage converter is required. This converter should convert the microcontroller output level to the RS232 voltage levels, and vice versa. IC MAX232, is very commonly used for this purpose.[a]

2.4.2.2 MAX 232



The MAX232 IC is well known as it is used to convert the TTL/CMOS logic levels to RS232 logic levels during the UART serial communication of microcontrollers with PC. The controller operates at TTL logic level (5-0V) but the serial communication in PC works on RS232 standards (+25 V to -25V). This makes it quite difficult to develop a direct link between them to talk with each other.

MAX232 provides the intermediate link. As it is a dual driver/receiver so it includes a capacitive voltage generator to supply RS232 voltage levels from a single 5 Voltage supply. Each of these receivers converts RS232 inputs to 5V TTL/CMOS levels. These receivers (R_1 & R_2) can accept ±30V inputs. The drivers (T_1 & T_2), also called transmitters on the other side, convert the TTL/CMOS input level into RS232 level.

The transmitters send the output to RS232's receiver after taking the input from controller's serial transmission pin. The receivers, on the other hand, take input from transmission pin of RS232 serial port and give serial output to microcontroller's receiver pin. MAX232 needs four external capacitors whose value ranges from 1μF to 22μF.[b]

Table 4-Max232 Pinout

Pin No	Function	Name
1	Capacitor connection pins	Capacitor 1 +
2		Capacitor 3 +
3		Capacitor 1 -
4		Capacitor 2 +
5		Capacitor 2 -
6		Capacitor 4 -
7	Output pin; outputs the serially transmitted data at RS232 logic level; connected to receiver pin of PC serial port	T_2 Out
8	Input pin; receives serially transmitted data at RS 232 logic level; connected to transmitter pin of PC serial port	R_2 In
9	Output pin; outputs the serially transmitted data at TTL logic level; connected to receiver pin of controller.	R_2 Out
10	Input pins; receive the serial data at TTL logic level; connected to serial transmitter pin of controller.	T_2 In
11		T_1 In
12	Output pin; outputs the serially transmitted data at TTL logic level; connected to receiver pin of controller.	R_1 Out
13	Input pin; receives serially transmitted data at RS 232 logic level; connected to transmitter pin of PC serial port	R_1 In
14	Output pin; outputs the serially transmitted data at RS232 logic level; connected to receiver pin of PC serial port	T_1 Out
15	Ground (0V)	Ground
16	Supply voltage; 5V (4.5V – 5.5V)	Vcc

[a]

2.4.3 CONSTRUCTION

There is an inbuilt UART in AT89C51 for carrying out serial communication. The serial communication with this controller is done in the asynchronous mode. A serial port as we know, like other PC ports, is a physical interface to establish data transfer between an external hardware or device and computer. This transfer, through serial port, takes place bit by bit serially.

A minimum of three pins for the simplest connection between a PC and microcontroller requires, RxD (receiver, pin2), TxD (transmitter, pin3) and ground (pin5) of the serial port of computer.

RxD pin of controller connects to TxD pin of serial port via MAX232. And similarly, to the TxD pin of controller connects RxD pin of serial port through MAX232.

MAX232 has two sets of line drivers for receiving and transferring data. T1 and T2 are the line drivers used for transmission whereas the line drivers for receiver are designated as R1 and R2. The connection of MAX232 with controller and the computer is shown in the circuit diagram.

Baud rate which is the speed at which data is transmitted serially is an important facet considered while interfacing serial port. It is number of bits transmitted or received per second. It is usually expressed in bps (bits per second). AT89C51 microcontroller can be set to transfer and receive serial data at disparate baud rates using the software instructions. Timer1 is used to set the baud rate of serial communication for the microcontroller. For this purpose, Timer1 is used in mode2 which is an 8-bit auto reload mode.[b]

The mode of serial communication is set by the SCON register. Our project uses Mode1, in which the data length is of 8 bits and there is a start and a stop bit.

2.4.4 WORKING

As we place our finger in the sensor the HRM computes the heartbeat and places the data in the SBUF. The data is sent from the SBUF to TXD , pin 11 of the controller .From pin 11 of the controller, data is sent to pin 11 of MAX 232 which converts the TTL logic to RS 232 standards.

The pin 14 of MAX232 is connected to pin 2 of RS 232 to send the data forwards

From RS232 we sent the data to PC using serial communication using java swing application.

Hyper Terminal, a Windows XP application, can be used to receive or transmit serial data through RS232. To open Hyper Terminal, go to Start Menu, select all programs, go to Accessories, click on Communications and select Hyper Terminal.

To start a new connection, go to File menu and click on new connection. The connection window opens up. Give a name to your connection and select 1st icon and click on OK. Connection property window opens here. Select Bit rate as 9600bps, Parity as none, Data bits 8, Stop bit 1, Flow control none and click OK. Now the serial data can be read on hyper terminal.

In program, there is an auto reload setting in timer1. Loading TH1 to 0xFD fixes the baud rate to 9600bps. SCON register is loaded with 0x50 initializing the serial port in Mode1. The program continuously receives a character (say 'b') from the serial port of the computer and sends it back.

2.5 DESIGN OF MODULE 2 WIRELESS

2.5.1 ARCHITECTURE

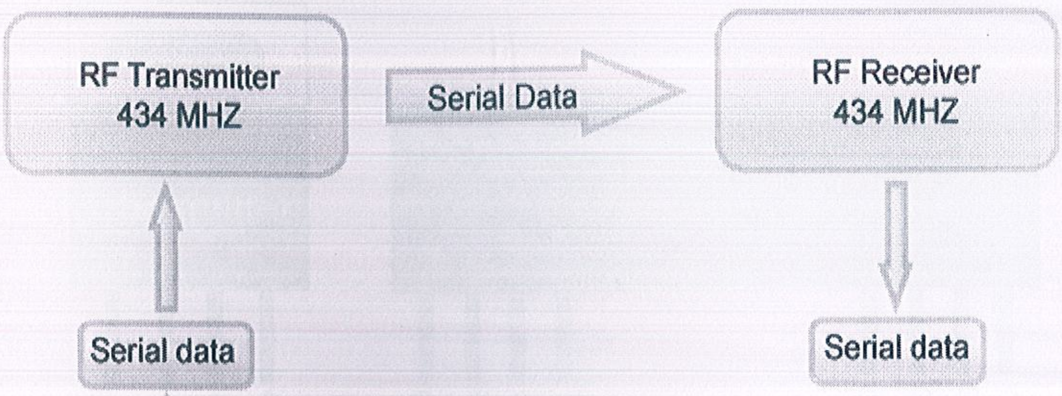


Figure 8-Architecture 0f Module 2 Wireless

2.5.2 CIRCUIT DIAGRAM

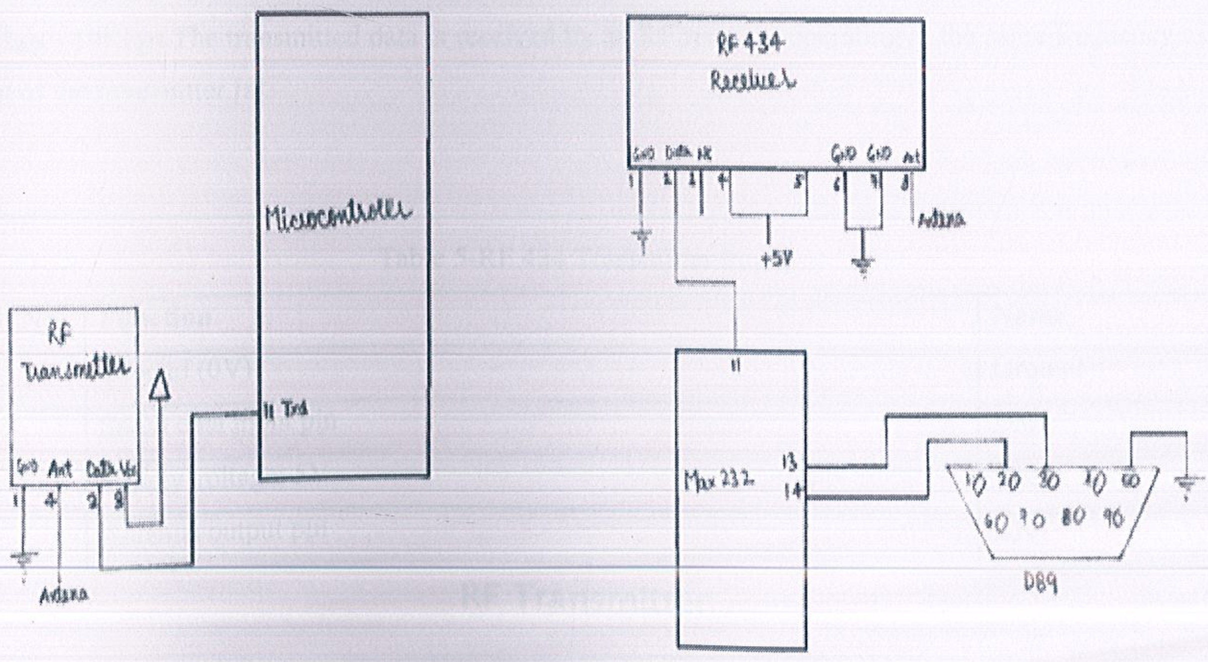
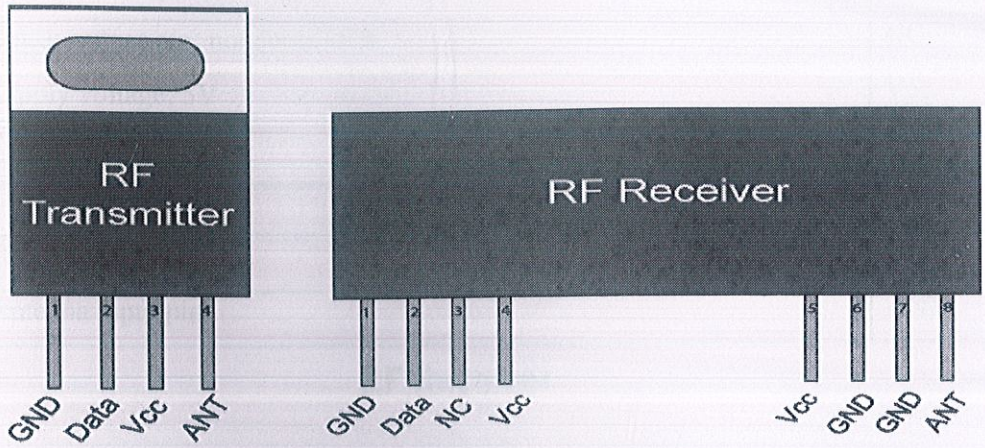


Figure 9-Circuit Diagram of Module 2 Wireless

2.5.3 COMPONENTS

2.5.3.1 RF 434 (TRANSMITTER & RECEIVER)



This **RF module** comprises of an **RF Transmitter** and an **RF Receiver**. The transmitter/receiver (Tx/Rx) pair operates at a frequency of**434 MHz**. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.[a]

Table 5-RF 434 Transmitter Pinout

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

RF Transmitter

Table 6-RF 434 Receiver Pinout

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT

RF Receiver

2.5.3.2 Antenna

An antenna (or aerial) is an electrical device which converts electric currents into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. In transmission, a radio transmitter applies an oscillating radio frequency electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). In reception, an antenna intercepts some of the power of an electromagnetic wave in order to produce a tiny voltage at its terminals, that is applied to a receiver to be amplified. An antenna can be used for both transmitting and receiving.

2.5.4 CONSTRUCTION

The microcontroller AT89C51 has an inbuilt UART for carrying out serial communication. The serial communication is done in the asynchronous mode. A serial port, like other PC ports, is a physical interface to establish data transfer between computer and an external hardware or device. This transfer, through serial port, takes place bit by bit.

The simplest connection between a PC and microcontroller requires a minimum of three pins, RxD (receiver, pin2), TxD (transmitter, pin3) and ground (pin5) of the serial port of computer.

11 pin of the controller i.e. TXD is connected with the Pin 2 i.e. Data Pin of the Transmitter of RF 434.An Antenna is connected at 4^{th} pin of transmitter.

The Receiver's 2nd pin is connected to Pin 11 of MAX232.The 13th and 14th pins of MAX232 is connected to the 3rd and 2nd pin of the DB9 port respectively.

Baud rate which is the speed at which data is transmitted serially is an important facet considered while interfacing serial port. It is number of bits transmitted or received per second. It is usually expressed in bps (bits per second). AT89C51 microcontroller can be set to transfer and receive serial data at disparate baud rates using the software instructions. Timer1 is used to set the baud rate of serial communication for the microcontroller. For this purpose, Timer1 is used in mode2 which is an 8-bit auto reload mode.[b]

The mode of serial communication is set by the SCON register. Our project uses Mode1, in which the data length is of 8 bits and there is a start and a stop bit.

2.5.5 WORKING

As we place our finger in the sensor the HRM computes the heartbeat and places the data in the SBUF. The data is sent from the SBUF to TXD , pin 11 of the controller. From pin 11 of the controller, data is sent to pin 2 of the transmitter of RF 434 Module. The data is sent to the receiver with the help of the antenna which is connected at the pin 4 of the transmitter of RF 434.

Pin 2 i.e. Data Pin of the Receiver of RF 434 is connected with the 11th pin of MAX 232 which will convert data into TTL logic.

The pin 14 of MAX232 is connected to pin 2 of RS 232 to send the data forwards

From RS232 we sent the data to PC using serial communication using java swing application.

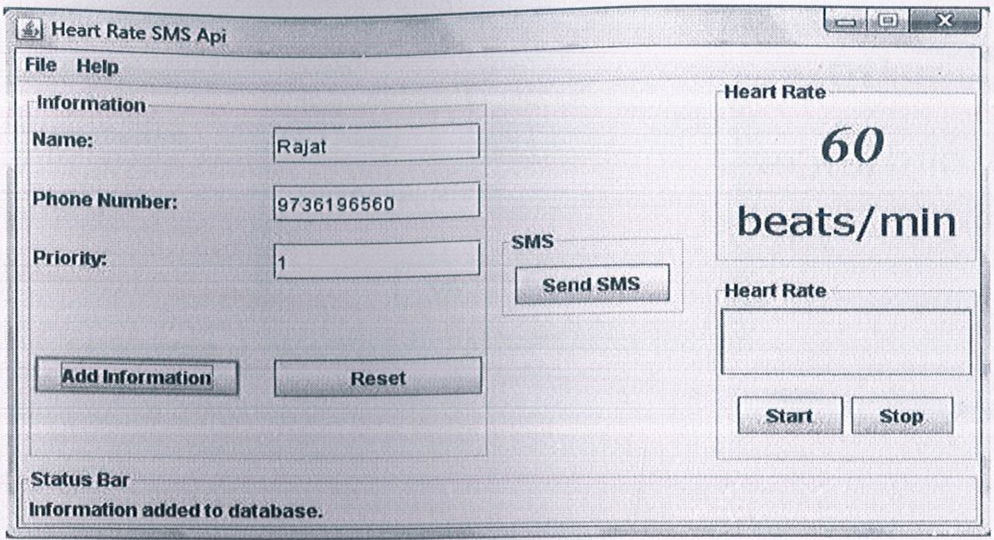
Hyper Terminal, a Windows XP application, can be used to receive or transmit serial data through RS232. To open Hyper Terminal, go to Start Menu, select all programs, go to Accessories, click on Communications and select Hyper Terminal.

To start a new connection, go to File menu and click on new connection. The connection window opens up. Give a name to your connection and select 1st icon and click on OK. Connection property window opens here. Select Bit rate as 2400bps, , Parity as none, Data bits 8, Stop bit 1, Flow control none and click OK. Now the serial data can be read on hyper terminal.

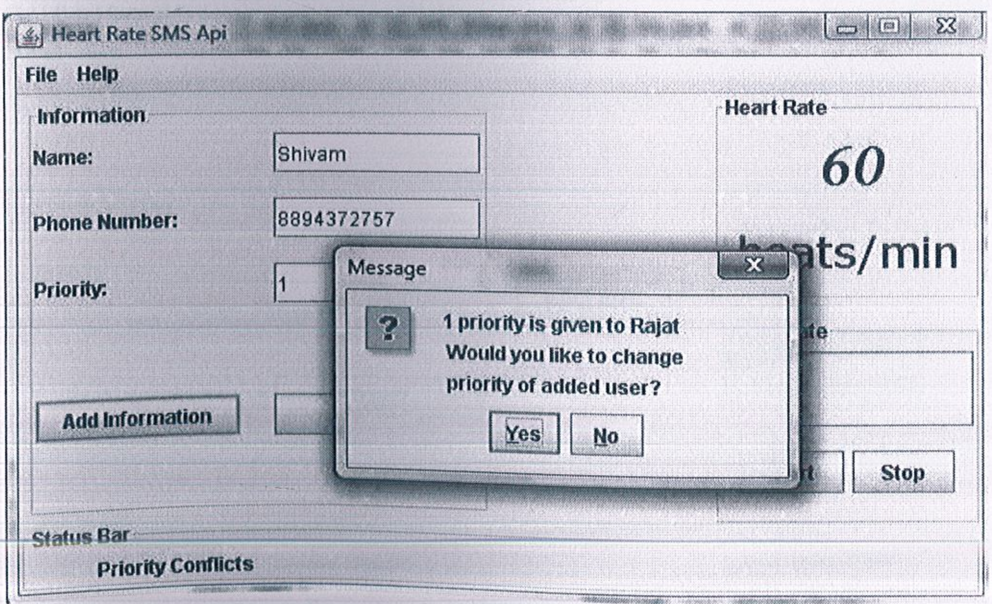
In program, there is an auto reload setting in timer1. Loading TH1 to 0xFD fixes the baud rate to 9600bps. SCON register is loaded with 0x50 initializing the serial port in Mode1. The program continuously receives a character (say 'b') from the serial port of the computer and sends it back.

2.6 DESIGN OF MODULE 3

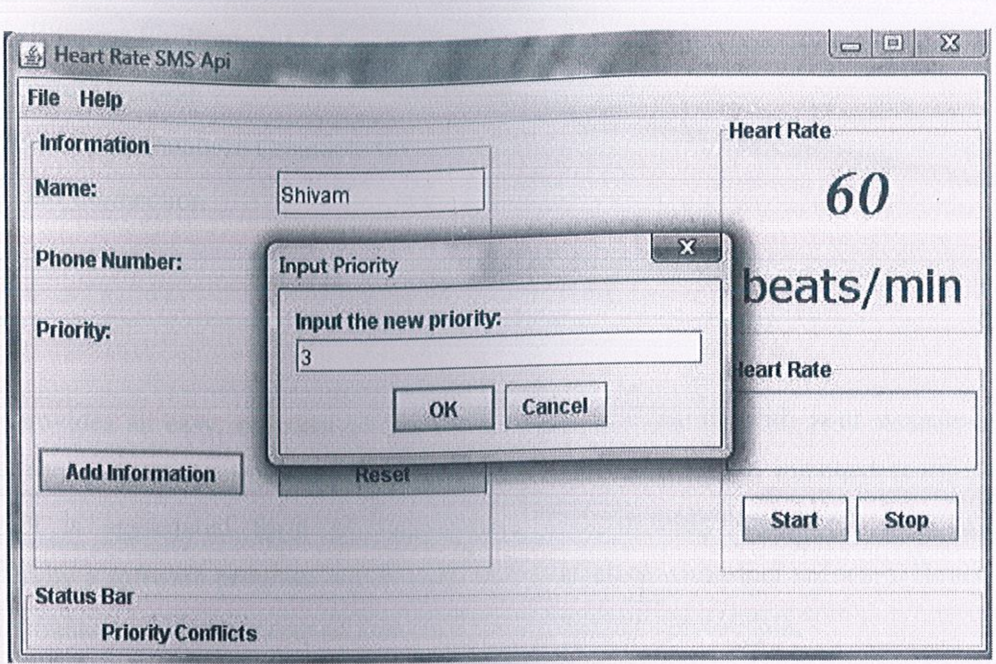
2.6.1. SNAPSHOTS



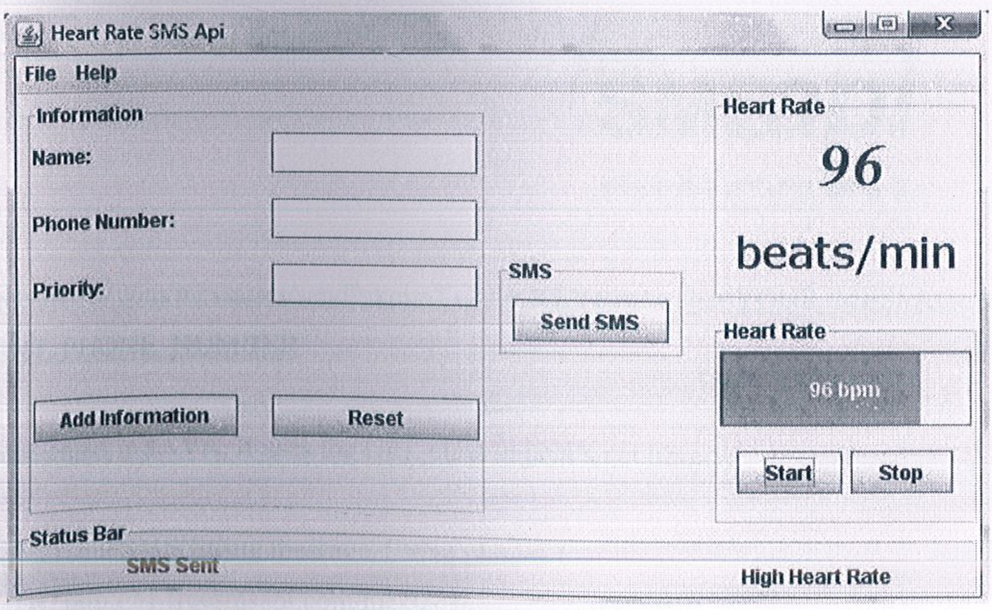
Snapshot 4-Adding Information



Snapshot 5-Priority conflict



Snapshot 6-Changing Priority



Snapshot 7-Showing Heart Rate

2.6.2 System Requirements

- Java Runtime Environment (1.5x and above)
- Microsoft Database
- ODBC (Open Database Connectivity)
- Internet Connection

2.6.3 SMS

SMS API provides an easy, efficient and flexible option to integrate with your website/application, facilitating auto-generated SMS Test Messages to be delivered to the intended recipient's mobile phones. API is aggregated form of "Application Programming Interface". It is an interface implemented by a software program which enables it to interact with other software. Hence SMS API used to communicate with the server of free SMS to send patient critical data.

2.6.4 Syntax for HTTP API Call

The website *freesmsapi.com* has been used to provide the Free API used in the application program.

The HTTP API call is made as follow:

http://s1.freesmsapi.com/messages/send?skey=YOUR_KEY&message=YOUR_MESSAGE&recipient=RECIPIENT_PHONE_NUMBER

When implemented in JAVA, it uses the URL class in java's net library.

```
private boolean sendSMS(String message, String phone) {
    String url = "http://s1.freesmsapi.com/messages/send?skey=YOUR_KEY&message=" +
            URLEncoder.encode(message, "UTF-8") + "&recipient=" +
            phone;
    /*
```

```
 * Generated URL for Sending specific SMS
 */
System.out.println(url);
URL myurl = new URL(url);
BufferedReader in = new BufferedReader(
new InputStreamReader(
myurl.openStream()));

String inputLine="";

while ((inputLine = in.readLine()) != null)
    System.out.println(inputLine);
in.close();

return true;
}
```

2.6.5 Database Tables

Name	Phone	Priority
Rajat	9736196560	1
Shivam	8894372757	2
Ankit	9805439526	3

Time	Pulse
26Nov, 01:35:07	70
26Nov, 10:40:33	57
23Nov, 23:42:40	96
01Dec, 12:55:01	79

CHAPTER 3: CONCLUSION

The project has been a real help in understanding and practical implementation of the various concepts learnt throughout the course of the graduation in the past 4 years. The emphasis has not been on learning new things but doing the already learnt things in a new way i.e. best practices methodology thereby cementing the understanding of the concepts in the mind.

The focus was on the most important concepts of the graduation such as working and programming of microcontrollers and Electronic components like capacitances, resistors, crystal oscillators, sensors etc., wired and wireless transmissions of data, programming in Java swings with a tinge of database systems. The only reward that one desires after doing this kind of dedicated work is a fully functional system and we are happy that we have been able to achieve all the set objectives with in the given frame of time with a bit of luck. Broadly speaking, the concepts which have become our forte after doing this wonderful journey are the following:-

- The complete understanding of the various functionalities of the 8051 microcontroller.
- The functioning of a Heart Rate Sensor.
- The interfacing of microcontroller to a PC using wired circuits.
- The interfacing of microcontroller to a PC using wireless RF 434 module.
- The sending of a SMS from PC to Mobile cellphones using SMS API.
- The JDBC ODBC connectivity between Swings framework and MS Access.

The concepts mentioned above are just some tangible results we received after completing this project but the true wisdom is not the end result but the means that have been deployed to achieve those objectives, it's in the journey itself. The team working and ethics that we imbibed in the project are the kind of values that no classroom in this world could teach us and it really helped in giving a new meaning to our graduation through practical experiences. We hope to build on this and try to achieve the heights in our career thereby exercising the skills acquired in this 4 year period. At the end, we really want to send our regards to Mr. Ravindara Bhatt, our Project Mentor who has helped us throughout the project development phase at times when we were on the verge of losing confidence in ourselves .Further we cannot really end this report without thanking Brig. (Retd.) S.P. Ghrera HOD Department of C.S.E., Mr. Salman Raju and Mr. Pramod Department of Electronics and Communication, who all played their parts in this wonderful journey.

FURTHER POSSIBLE IMPROVEMENTS

- Development of a text to speech conversion system.
- Further manipulating and studying the trends of heart rates of a patient stored in our database.
- Development of other sensor systems such as Temperature Monitor, Glucose Sugar Monitor etc.

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