PATIENT MONITORING AND CARE SYSTEM

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May-2011

Project Report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

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Waknaghat, Solan, Himachal Pradesh

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CERTIFICATE

This is to certify that project report titled "**Patient Monitoring and Care System**", submitted by **Abhinav Gulhar** and **Prateek Barar** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan 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.

Signature of Supervisor

Name of Supervisor: Ms. Neeru Sharma

Designation: Sr. Lecturer, Electronics and Communication Department

Date:

ACKNOWLEGEMENT

"Nothing In This World Will Take Place Of Persistence. Talent Will Not; Nothing Is Uncommon Then Unsuccessful Man With Talent, Genius Will Not; Unrecorded Genius Is Almost A Proverb, Education Alone Will Not ; The World Is Full Of Derelicts, Persistence And Determination Are Omnipotent"

The zeal to accomplish the task of formulating the project report on "Biomedical Patient Monitoring System" could not have been realized without the support and cooperation of the members of the faculty of ECE Department.

We wish to express our gratitude and indebtness to our project guide Ms. Neeru Sharma (Sr. Lecturer, Electronics and Communication Department) for her encouragement, guidance and valuable assistance which helped us to complete this project successfully. She helped us develop novel solutions to every problem and helped us emerge with good engineering acumen.

We are at loss of words to express our deep gratitude towards our guide who made us realize the fact that stumbling blocks were in fact stepping stones to success. She motivated us to take this project as a challenge and come out with flying colours.

We would also like to thank Dr. D. S. Saini and Mr. Vipin Balyan for their valuable suggestions which helped us to complete the project work in time.

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Date:

SUMMARY

Patient Monitoring and Care System is the term for all the various devices that are used to supervise patients. One category of such devices are those that alert and react accordingly if the patient gets into a critical state. Examples of such devices are heartbeat and temperature monitors. To a large extent computer based monitoring and intensive care unit systems have become cheap enough to be deployed on a large scale in many intensive care units around the world. The bedside has become an important point of displaying data. Bedside, these devices have capabilities of intelligent monitoring, intelligent alarming and reacting accordingly depending upon the treatment prescribed.

Patient monitoring is vital to care in operating and emergency rooms, intensive care and critical care units. In our project, we aim at developing a prototype that simply the vital information of the patient will be displayed and henceforth develop a care system for the patient which prevents criticalities.

It measures various bio- medical parameters like body temperature and pulse rate and displays it on an LCD. Depending upon the treatment prescribed to the patient, if these parameters go out of a prescribed range then the Care System automatically responds in order to prevent a criticality. For example in case of a cardiac arrest, when the parameters go out of a prescribed range then the Care System automatically injects an anticoagulation medicine into the patient's body to prevent any further mishap.

Patient monitoring and care system can reduce the risk of infection and other complications, as well as assist in providing for patient comfort. Additionally, it helps improve patient health, thanks to early diagnosis and preventive care.

Signature of Students	Signature of Supervisor
Name: Abhinav Gulhar & Prateek Barar	Name: Ms Neeru Sharma
Date:	Date:

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PROJECT PROCESSES

The project idea has evolved over a period of one year and it is important that we discuss the efforts of the team and the process through which the project has evolved.

July 09	• Study conducted on the working of temperture sensor & heartbeat sensor
August 09	• Study conducted on the working of Microcontroller AT89252
November 15	• Designed a layout for the temperature sensing device section and implemented the hardware part of it.
January 10	• Designed a layout for the heartbeat sensor section and implemented the hardware part of it.
March 15	• Interfaced the heart beat and temperature sensors and the LCD display with the microcontroller
April 20	• Developed & interfaced the injection part with the Patient Monitoring System

CHAPTER 1

INTRODUCTION

1.1. Objective

It has been long recognized in the health care industry that long-term, continuous monitoring is a key element in preventive care for people with chronic conditions such as cardiovascular disease. A typical example of patient monitoring is a home care device, such as an electronic blood pressure or glucose meter. An ambulatory system that allows long-term monitoring of mobile patients is also desirable. The ambulatory electrocardiogram (ECG) Holter device, used since the 1960s, provides a reliable measurement of the wearer's heartbeat but is heavy and cumbersome to wear over an extended period of time. In addition, its substantial power consumption forbids continuous operation using low-capacity batteries. In recent years, lightweight devices have emerged as a viable technology for continuous measurement of vital biomedical parameters. Wearable, biosensors connected to self organizing allows physicians to continuously monitor vital signs, and helps in preventing any critical mishap and also helps physicians to record long-term trends and patterns that provide invaluable information about a patient's ongoing condition.

The availability of advanced sensing devices combined with sophisticated; self-organizing care system will enable new applications and represents a significant opportunity for remote health monitoring. This system will serve 3 requirements

1) The first is a portability factor so that these health monitoring devices can fit or attach easily to a wrist or arm band, ring sensor or other wearable or implantable device.

2) The second requirement is extremely low power so that small batteries can be used for an extended period of time.

3) The third requirement is a highly sophisticated protocol for low latency, high scalability and high responsiveness.

Continuous monitoring requires portable devices and a fast and efficient responsive protocol. All of these elements are now in place and ready to be adapted to numerous biomedical applications. Moreover cardiac patients can be regularly monitored without the physical presence of the doctor.

Biomedical Patient Monitoring and Care System is equipment used to monitor the patient and react according to hazardous critical situations. Patients admitted to hospitals often find themselves with dozens of wires and cables strung from their every extremity trying to roll over at night resulting in a very large, expensive cat's cradle with the strings ending at sticky pads affixed to sensitive areas. So a solution is, the Patient Monitoring and Care System, which would accept signals from sensors, beaming that data straight to the Care System to act accordingly and prevent the calamity to occur if the need arises without the actual presence of a doctor.

The need for patient monitoring and care is apparent in situations where the patient is:

- Patients with a suspected life-threatening condition; for example, a patient who has findings indicating an acute myocardial infarction (heart attack).
- Patients at high risk of developing a life-threatening condition; for example, patients immediately post open-heart surgery, or a premature infant whose heart and lungs are not fully developed.
- Patients in a critical physiological state; for example, patients with multiple trauma or septic shock.

Therefore, through this project we aim at developing a prototype that analyses various bio-medical parameters like temperature and heartbeat obtained from the sensors used & with the help of a microcontroller, all the parameters obtained are displayed on an LCD screen.

Based on the parameters obtained the patient is continuously monitored and if in case of any critical mishap when the parameters go out of a particular range then it is prevented by the Care System attached to the Patient Monitoring System. The primary function of this system is to monitor the temperature and Heart Beat of the Patient and the Data collected by the sensors are sent to the Microcontroller. The Microcontroller transmits the data over to the display and if the biomedical parameters go out of a particular range prescribed by the doctor, the Care System reacts accordingly.

Some of the Patient Monitoring and Care Systems already available n the market are:

FIGURE 1.1: Patient Monitoring and Care System

1.2 Description

Various biomedical parameters of the patient such as temperature and heartbeat are measured by sensors and the data is fed to Microcontroller, which is then displayed over the LCD display. If there is a dangerous change in patient's status and if the parameters go out of the prescribed range then the care system automatically responds in order to prevent any criticality.

To enhance time-to time monitoring of patients in clinical and hospital atmosphere in order to provide the patient with accurate and relevant medication and proper care. It also helps doctors have access to the entire database of patient's present status and track their recovery even when the doctor is not able to physically monitor the patient.

Block Diagram Description

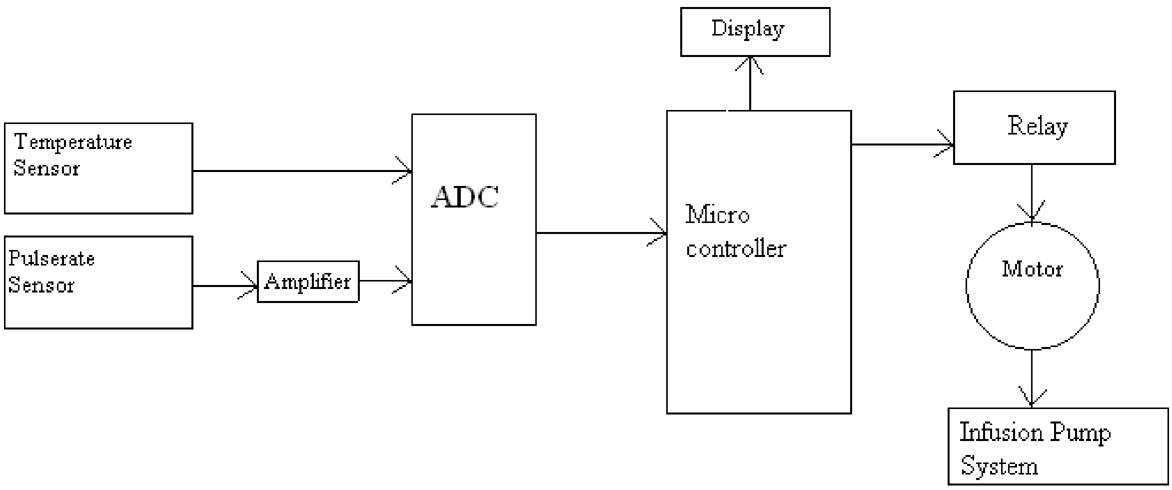


FIGURE 1.2: Block Diagram

1.2.1 Microcontroller

89c52 from ATMEL is being used. The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (EPROM). The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer.

We use this because it reduces the amount of external hardware or internal software necessary to process the sensory data. Functions of micro controller in this are:

1. Used to do display Biomedical Parameters on LCD.
2. It is also used to interface the temperature sensor, the heartbeat sensor, the LCD and the Infusion Pump.

1.2.2 Liquid Crystal Display

Display used here is the LCD display. It is an intelligent LCD. It is a 16*2 LCD, which displays 32 characters at a time 16 will be on the 1st line and 16 will be on the 2nd line. There are two lines on the LCD and it works on extended ASCII code i.e. when ASCII code is send it display it on the screen. On the LCD total no of pins are 16 out of which 14 pins are used by the LCD and 2 are used for backlight. LCD is an edge trigger device i.e. from high to low.

1.2.3 Temperature Sensor

In this a precision centigrade temperature sensor LM35 is used. It is a precision integrated-circuit temperature sensor, 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. For every ^{o}C change in temperature, it shows a variation of 10mV in the output.

1.2.4 Heart Beat Sensor

In this we implemented a Heart Beat Sensor with a pair of LED and LDR. This transducer works with the principle of light reflection, in this case the light is infrared.

1.2.5 Medicine Injection System

In this part we have implemented syringe to a DC motor with help of a screw such that, when the relay is switched on, the DC motor starts, which in turn moves the screw n the screw changes the rotatory motion of the motor into linear motion which moves the piston of the syringe back & forth.

CHAPTER 2

THEORY OF SENSORS

In our project we will be using two sensors: Temperature Sensor and Heartbeat Sensor. Starting with temperature sensors, temperature sensors come in a wide variety and have one thing in common: they all measure temperature by sensing some change in a physical characteristic.

The seven basic types of temperature sensors to be discussed here are thermocouples, resistive temperature devices (RTDs, thermistors), infrared radiators, bimetallic devices, liquid expansion devices, and molecular change-of-state and silicon diodes.

2.1 Thermocouples Sensor

Thermocouples are voltage devices that indicate temperature by measuring a change in voltage. As temperature goes up, the output voltage of the thermocouple rises - not necessarily linearly.

Often the thermocouple is located inside a metal or ceramic shield that protects it from exposure to a variety of environments. Metal-sheathed thermocouples also are available with many types of outer coatings, such as Teflon, for trouble-free use in acids and strong caustic solutions. A variety of thermocouples are available, suitable for different measuring applications (industrial, scientific, food temperature, medical research, etc.).

1. Type K (Chromel (Ni-Cr alloy) / Alumel (Ni-Al alloy)): The "general purpose" thermocouple. It is low cost and, owing to its popularity, it is available in a wide variety of probes. They are available in the −200 °C to +1200 °C range.

2. Type E (Chromel / Constantan (Cu-Ni alloy)): Type E has a high output (68 µV/°C) which makes it well suited to low temperature (cryogenic) use.

Another property is that it is non-magnetic.

3. Type J (Iron / Constantan): Limited range (−40 to +750 °C) makes type J less popular than type K. The main application is with old equipment that cannot accept modern thermocouples. J types cannot be used above 760 °C as an abrupt magnetic transformation causes permanent decalibration.

4. Type N (Nicrosil (Ni-Cr-Si alloy) / Nisil (Ni-Si alloy)): High stability and resistance to high temperature oxidation makes type N suitable for high temperature measurements without the cost of platinum (B, R, S) types. They can withstand temperatures above 1200 °C.

Thermocouple types B, R, and S are all noble metal thermocouples and exhibit similar characteristics. They are the most stable of all thermocouples, but due to their low sensitivity (approximately 10 µV/°C) they are usually only used for high temperature measurement (>300 °C). Thermocouples are most suitable for measuring over a large temperature range, up to 1800 K. They are less suitable for applications where smaller temperature differences need to be measured with high accuracy, for example the range 0--100 °C with 0.1 °C accuracy. For such applications other sensors are more suitable.

2.2 Resistive Temperature Detector Sensor (RTD)

A basic physical property of a metal is that its electrical resistivity changes with temperature. All RTD's are based on this principle. The heart of the RTD is the resistance element. Several varieties of semi-supported wire-wound fully supported bifilar wound glass, and thin film type elements are shown here.

Some metals have a very predictable change of resistance for a given change of temperature; these are the metals that are most commonly chosen for fabricating an RTD. A precision resistor is made from one of these metals to a nominal ohmic value at a specified temperature. By measuring its resistance at some unknown temperature and comparing this value to the resistor's nominal value, the change in resistance is determined. As the temperature vs. resistance characteristics are also known, the change in temperature from the point initially specified can be calculated. We now have a practical temperature sensor, which in its bare form (the resistor) is commonly referred to as a resistance element. Through years of experience, the characteristics of various metals and their alloys have been learned, and their temperature vs. resistance relationships is available in look-up tables. For some types of RTD's, there are also equations that give us the temperature from a given resistance. This information has made it possible for instrument manufacturers to provide standard readout and control devices that are compatible with some of the more widely accepted types of RTD's.

Platinum RTD's can measure temperatures from -200°C to 650°C. (IEC says -200°C to 850°C).

2.3 Bimetallic Devices Sensor

The Bimetallic strip is a mechanical temperature sensor element. It converts temperature to a mechanical displacement. This displacement may be coupled to a switch for simple on-off function, to a needle of an indicator, or to a position detector for electronic output. The most common application of the bimetallic strip is as a thermostat switch used for temperature and energy control. A bimetallic strip is simply constructed from two strips of different metals bonded together. Typically a welding process is used for bonding, but rivets, bolts, adhesive and other fasteners can also be used. The operation of the bimetallic strip relies on the different expansions rates of the two metals to temperature change (the different coefficients of thermal expansion of the metals).

As a matter of interest, the bimetallic strip can be scaled up or down. On a large scale, it can provide literally tones of force for mechanical control or other purposes. On a smaller scale, it can provide the force and movement for micro machine integrated circuits (MMIs).

Advantages of bimetallic devices are portability and independence from a power supply. However, they are not usually quite as accurate as are electrical devices, and you cannot easily record the temperature value as with electrical devices like thermocouples or RTDs; but portability is a definite advantage for the right application.

2.4 Thermometers

Thermometers are well-known liquid expansion devices. Generally speaking, they come in two main classifications: the mercury type and the organic, usually red, liquid type. The distinction between the two is notable, because mercury devices have certain limitations when it comes to how they can be safely transported or shipped. For example, mercury is considered an environmental contaminant, so breakage can be hazardous. Be sure to check the current restrictions for air transportation of mercury products before shipping.

2.5 Change -of- State Sensors

Change-of-state temperature sensors measure a change in the state of a material brought about by a change in temperature, as in a change from ice to water and then to steam. Commercially available devices of this type are in the form of labels, pellets, crayons, or lacquers.

For example, labels may be used on steam traps. When the trap needs adjustment, it becomes hot; then, the white dot on the label will indicate the temperature rise by turning black. The dot remains black, even if the temperature returns to normal. Change-of-state labels indicate temperature in °F and °C. With these types of devices, the white dot turns black when exceeding the temperature shown; and it is a nonreversible sensor which remains black once it changes color. Temperature labels are useful when you need confirmation that temperature did not exceed a certain level, perhaps for engineering or legal reasons during shipment. Because change-of-state devices are nonelectrical like the bimetallic strip, they have an advantage in certain applications. Some forms of this family of sensors (lacquer, crayons) do not change color; the marks made by them simply disappear. The pellet version becomes visually deformed or melts away completely.

Limitations include a relatively slow response time. Therefore, if you have a temperature spike going up and then down very quickly, there may be no visible response. Accuracy also is not as high as with most of the other devices more commonly used in industry. However, within their realm of application where you need a non reversing indication that does not require electrical power, they are very practical.

Other labels which are reversible operate on quite a different principle using a liquid crystal display. The display changes from black color to a tint of brown or blue or green, depending on the temperature achieved. For example, a typical label is all black when below the temperatures that are sensed. As the temperature rises, a color will appear at, say, the 33°F spot - first as blue, then green, and finally brown as it passes through the designated temperature. In any particular liquid crystal device, you usually will see two color spots adjacent to each other - the blue one slightly below the temperature indicator, and the brown one slightly above. This lets you estimate the temperature as being, say, between 85° and 90°F.

Although it is not perfectly precise, it does have the advantages of being a small, rugged, nonelectrical indicator that continuously updates temperature.

2.6 Silicon Band gap Temperature sensor

Silicon band gap temperature sensor is a very ordinary form of temperature sensor or thermometer used in electronic equipment. The silicon band gap temperature sensor is able to measure temperatures on computer chips with accuracy and speed. What are the advantages of using silicon band gap temperature sensors?

One of the benefits of using the silicon band gap temperature sensor is that the band gap temperature sensor can be included in a silicon integrated circuit at a very low cost. Silicon temperature sensors are fast becoming important transducers in electronic systems because as the electronic systems become more complex, it is even more important to monitor critical temperatures. Silicon sensors are preferred because they are accurate, cheap, linear and can be integrated on the same IC as amplifiers and any other required processing functions. How does a silicon band gap temperature sensor works? The principle of the band gap temperature sensor is that the forward voltage of a silicon diode is dependent on the temperature. An electronic circuit, for example the Brokaw band gap reference, can be used to calculate the temperature of the diode. The results that you obtained will stay valid up to about 200°C to 250°C when leakage currents become strong enough to corrupt the measurement. Once you go above 250°C in temperature, silicon carbide is used to replace silicon.

2.7 Infrared Sensors (IR)

Infrared sensors are non contacting sensors. As an example, if you hold up a typical infrared sensor to the front of your desk without contact, the sensor will tell you the temperature of the desk by virtue of its radiation - probably 68°F at normal room temperature.

In a non contacting measurement of ice water, it will measure slightly under 0°C because of evaporation, which slightly lowers the expected temperature reading. Here in our project we are using LM35 IC which is a digital thermometer. The LM35 measures temperature using a band gap-based temperature sensor because at low temperatures (i.e. body temperature) band gap based temperature sensors work best.

In starting of our project we used LM35 temperature sensor IC but it has a drawback that it gives analog output so there is a need for an analog to digital converter (ADC) for converting the output to digital format before feeding it to microcontroller.

2.8 Sensors Used

The Sensors used in this are described in two parts:

2.8.1 Temperature Sensor LM35

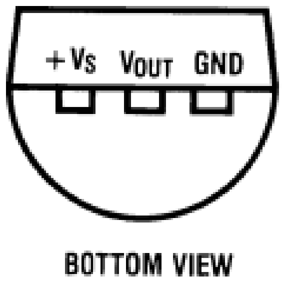


FIGURE 2.1: Temperature Sensor

Specifications of LM35 are:

1. +Vs – It is the pin for providing the power supply to the sensor.
2. Vout – It gives output from the sensor in terms of voltage.
3. GND – It grounds the device

Basic Description

- The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.
- Low output impedance, linear output, and precise inherent calibration.
- Easy interfacing to readout or control circuitry.
- Can be used with single power supplies.
- For every ^{o}C change in temperature, it shows variation of 10mV in the output.

Operation

A block diagram of the LM35 is shown in Figure 2.1 the LM35 measures temperature using a band gap-based temperature sensor. A delta-sigma analog-to digital converter (ADC) converts the measured temperature to a digital value that is calibrated in °C; for °F applications, a lookup table or conversion routine must be used. The LM35 can measure temperature over the range of -55_C to +125_C in 0.5_C increments.

For every °C change in temperature, it shows variation of 10mV in the output. Following is the Temperature Date Relationship for the Sensor.

TEMPERATURE	DIGITAL OUTPUT (Binary)	DIGITAL OUTPUT (Hex)
+125°C	01111101 00000000	7D00h
+25°C	00011001 00000000	1900h
+½°C	00000000 10000000	0080h
+0°C	00000000 00000000	0000h
-½°C	11111111 10000000	FF80h
-25°C	11100111 00000000	E700h
-55°C	11001001 00000000	C900h

TABLE 2.1: Temperature Data Relationship

2.8.2 Heartbeat Sensor

We implemented a heartbeat sensor based on a pair of LED and LDR. This transducer works with the principle of light reflection, in this case the light is infrared. The skin is used as a reflective surface for infrared light. The density of blood in the skin will affect on the IR reflectivity. The pumping action of heart causes the blood density rises and falls. So that we can calculate the heart rate based on the rise and fall of intensity of infrared that reflected by skin.

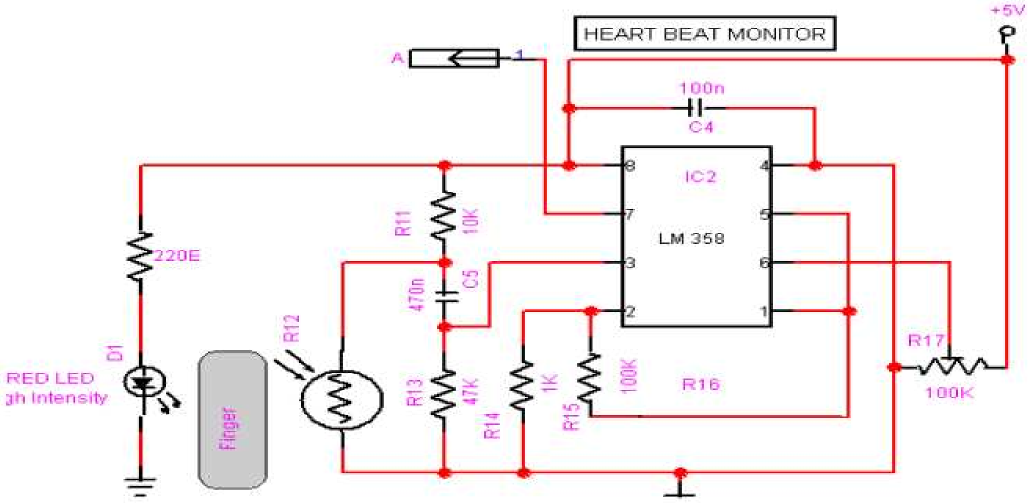


FIGURE 2.2: Heart Beat Sensor

CHAPTER 3

HARDWARE IMPLEMENTATION

In the Hardware Implementation of our prototype, we have calibrated the Temperature Sensor (LM35) and the Heart Beat Sensor (the LED and the LDR), fed the amplified analog values from these into ADC (ADC 0804) and interfaced these with the microcontroller. The LCD is also interfaced with the microcontroller and also the Medicine Infusion Pump is interfaced with the microcontroller through a relay driver card ULN 2003 and a relay which triggers the Infusion Pump when required.

The Circuit Diagram is explained further.

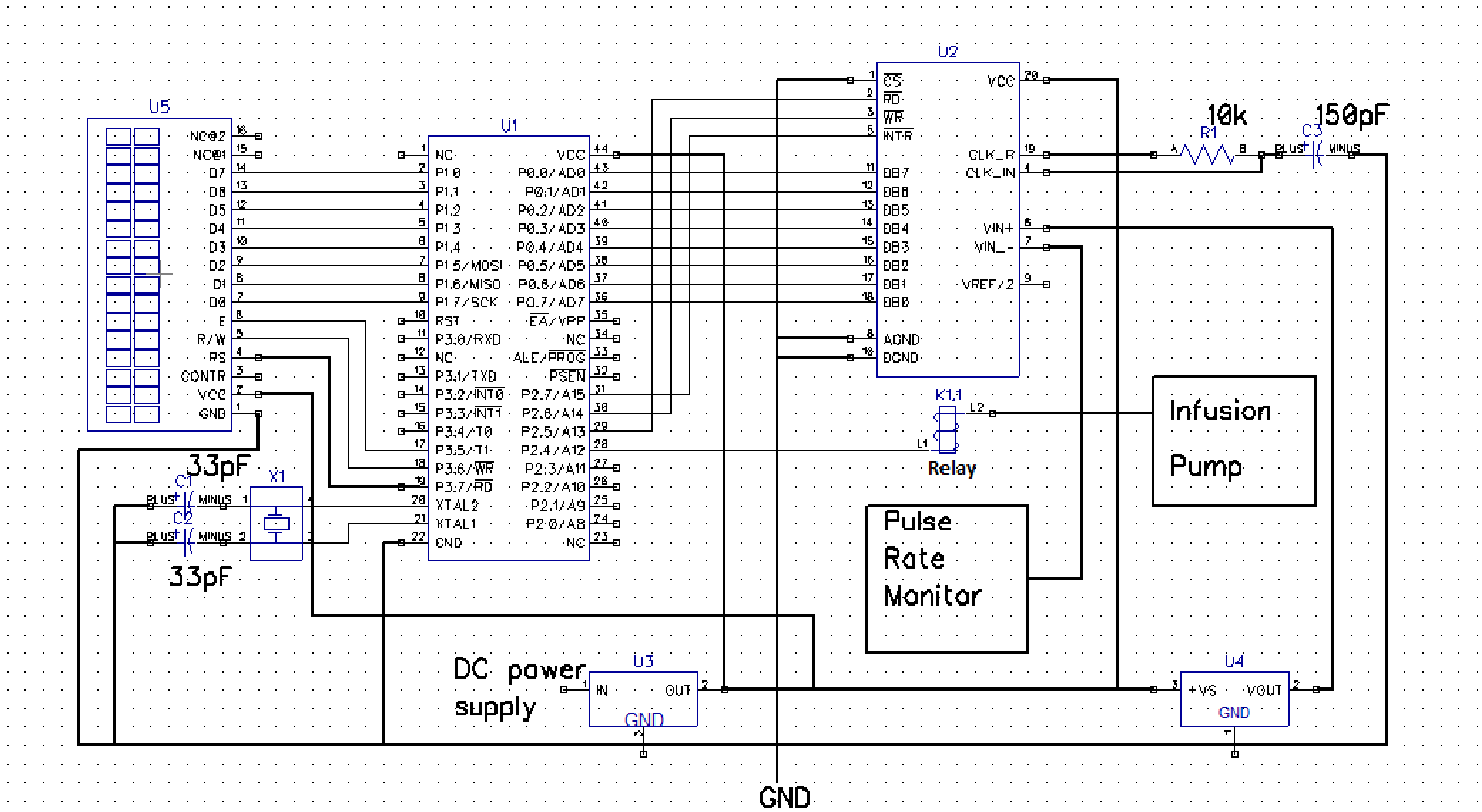


FIGURE 3.1: Circuit Diagram

3.1 Components

In our Prototype we have used following components:

1. AT89c52 Microcontroller
2. LM35(Temperature Sensor IC)
3. Heartbeat Sensor
4. ADC 0804(Analog to Digital Convertor)
5. LCD display (16*2)
6. Medicine Infusion Pump System
7. Power Supply

We will now discuss these components in detail.

3.1.1 AT89c52 Microcontroller

The criteria in choosing microcontrollers are as follows:

1. Meeting the computing needs of the tasks at hand efficiently and cost effectively
2. Availability of software development tools such as compilers, assemblers and debuggers.
3. Wide availability and reliable sources of microcontrollers.

Following are the criteria for selecting a microcontroller:

1. The first and the foremost criteria in choosing a microcontroller is that it must meet the task at hand effectively.

Among other considerations in this category are:

- Speed-It should be highest one that the microcontroller supports.
- Packaging-Check whether comes in 40 pin dual in line package or quad flat package or some other packing format. This is important in terms of space assembling technique and prototyping the end product.
- Power consumption- This is especially critical for battery powered products.

- The amount of RAM and ROM available on the chip.
- The number of I/O pins and the timers available on the chip.

2. The second criterion in choosing a microcontroller is how easy it is in developing products around it. Key considerations include the availability of an assembler, debugger code efficient C language compiler, emulator, technical support and both in house and outside expertise.

3. The third criterion in choosing a microcontroller is its ready availability in needed quantities both at present and in future. For some designers this is even more important than first two criteria.

Since AT89c52 is meeting all these requirements considerably well we have chosen this microcontroller.

a. Pin Diagram:

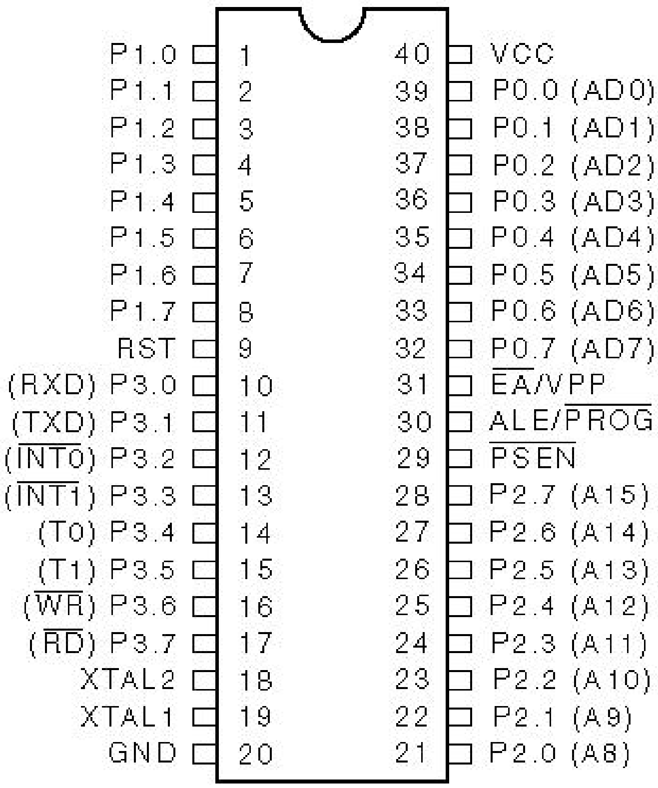


FIGURE 3.2: Microcontroller

b. Pin Description:

- **Pin 40**: Power supply (V_{CC})
- **Pin 20**: Ground
- **Pin 39- 32: PORT 0** - Port 0 is an 8-bit open drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. It also receives the code bytes during Flash programming and outputs the code bytes during program verification, for verification it requires external pull-ups.
- **Pin 1 – 8: PORT 1 -** It is an 8-bit bi-directional I/O port with internal pull-ups .The Port 1 output buffers can sink/source four TTL inputs. It also receives the low-order address bytes during. Flash programming and verification.
- **Pin 21 – 28: PORT 2 -** Port 2 is an 8-bit bi-directional I/O port with internal pull-ups .The Port 2 output buffers can sink/source four TTL inputs. It also receives the high-order address bits and some control signals during Flash programming and verification.
- **Pin 9: RST –** Resets the input.
- **Pin 30: ALE/PROG -** Address Latch Enable is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming.
- **Pin 10 – 17: PORT 3 -** Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. Port 3 output buffers can sink/source four TTL inputs. It also serves the functions of various special features:

- Port Pin Alternate Functions

P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt 0)
P3.3	INT1 (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	WR (external data memory write strobe)
P3.7	RD (external data memory read strobe)

- **Pin 29: PSEN -** Program Store Enable is the read strobe to external program memory.

- **Pin 19: XTAL1 -** Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

- **Pin 18: XTAL2 -** Output from the inverting oscillator amplifier.

3.1.2 Temperature Sensor LM35

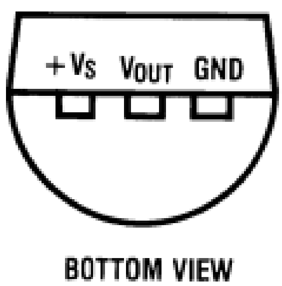


FIGURE 3.3: Temperature Sensor

Specifications of LM35 are:

1. $+V_s$ – It is the pin for providing the power supply to the sensor
2. V_{out} – It gives output from the sensor in terms of voltage
3. GND – It grounds the device

Basic Description

As discussed in the previous section

3.1.3 Heartbeat Sensor

As discussed in the previous section

3.1.4 ADC 0804(Analog to Digital Convertor)

Features

- Compatible with 8080µP derivatives no interfacing logic needed
- Easy interface to all microprocessors ,or operates “stand alone”
- Works with2.5V(LM336) voltage reference
- On-chip clock generator
- 0V to 5V analog input voltage range with single5V supply
- No zero adjust required
- 0.3"standard width 20-pin DIP package
- 20-pin molded chip carrier or small outline package
- Operates ratio metrically or with 5VDC ,2.5VDC,or Analog span adjusted voltage reference

a. **Pin Diagram:**

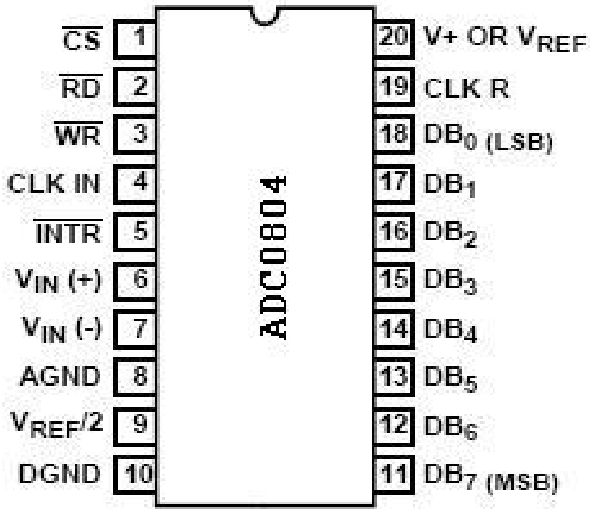


FIGURE 3.4: ADC 0804

b. **Pin Description:**

CS – Chip Select is an active low input, to access ADC0804, it must below.

RD – Read, it is active low. It used to get converted data out of ADC0804.

WR – Write, it is an active low input. It tells the chip to start the conversion process

CLK in – Input pin connected to external clock.

INTR – It is an output pin & is active low. It is high when conversion is over.

V_{in} (-) – Connected to ground.

V_{out} (+) – Analog signal input to be converted.

V_{cc} – Power supply

V_{ref} – It is used for setting a reference voltage.

D0 – D7: They are the digital data output pins.

3.1.5 Liquid Crystal Display

A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of Liquid crystals (LCs). LCs does not emit light directly. LCDs therefore need a light source and are classified as "passive" displays. Some types can use ambient light such as sunlight or room lighting. There are many types of LCDs that are designed for both special and general uses. They can be optimized for static text, detailed still images, or dynamic, fast-changing, video content. They are used in a wide range of applications including: computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones.

The LCD we are using in our project is a 16*2 Alphanumeric LCD.

Characteristics:

- Intelligent, with built-in Hitachi HD44780 compatible LCD controller and RAM providing simple interfacing
- 61 x 15.8 mm viewing area
- 5 x 7 dot matrix format for 2.96 x 5.56 mm characters, plus cursor line
- Can display 224 different symbols
- Low power consumption (1 mA typical)
- Powerful command set and user-produced characters
- TTL and CMOS compatible
- Connector for standard 0.1-pitch pin headers

a. Pin Diagram

The LCD that we are using looks like as shown in figure 3.5 & 3.6

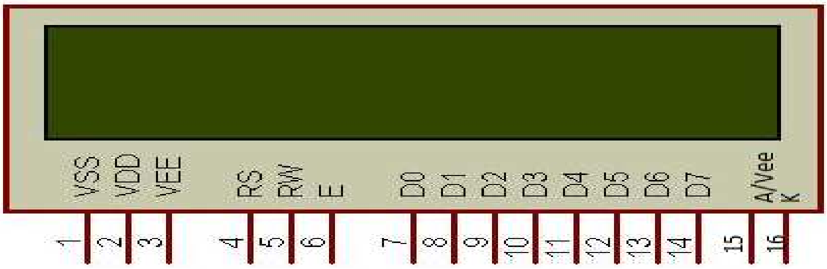


FIGURE 3.5: LCD Pin Diagram

FIGURE 3.6: LCD

b. Pin Description:

Pin	Symbol	Level	Function
1	V_{SS}	-	Power, GND
2	V_{DD}	-	Power, 5V
3	V_0	-	Power, for LCD Drive
4	RS	H/L	Register Select Signal H: Data Input L: Instruction Input
5	$R/\overline{W}$	H/L	H: Data Read (LCD->MPU) L: Data Write (MPU->LCD)
6	E	H,H->L	Enable
7-14	DB0-DB7	H/L	Data Bus; Software selectable 4- or 8-bit mode
15	NC	-	**NOT CONNECTED**
16	NC	-	**NOT CONNECTED**

TABLE3.1: Pin Description of LCD

3.1.6 Medicine Infusion Pump System

It is a mechanical device made with the combination of a syringe connected to a DC motor, with the help of a screw. As shown in figure 3.7, the piston of the syringe is connected to the screw which in turn is connected to the DC motor. When the motor starts, the rotatory motion of the motor is converted to linear motion by the screw, which helps the piston to move forward n backward accordingly.

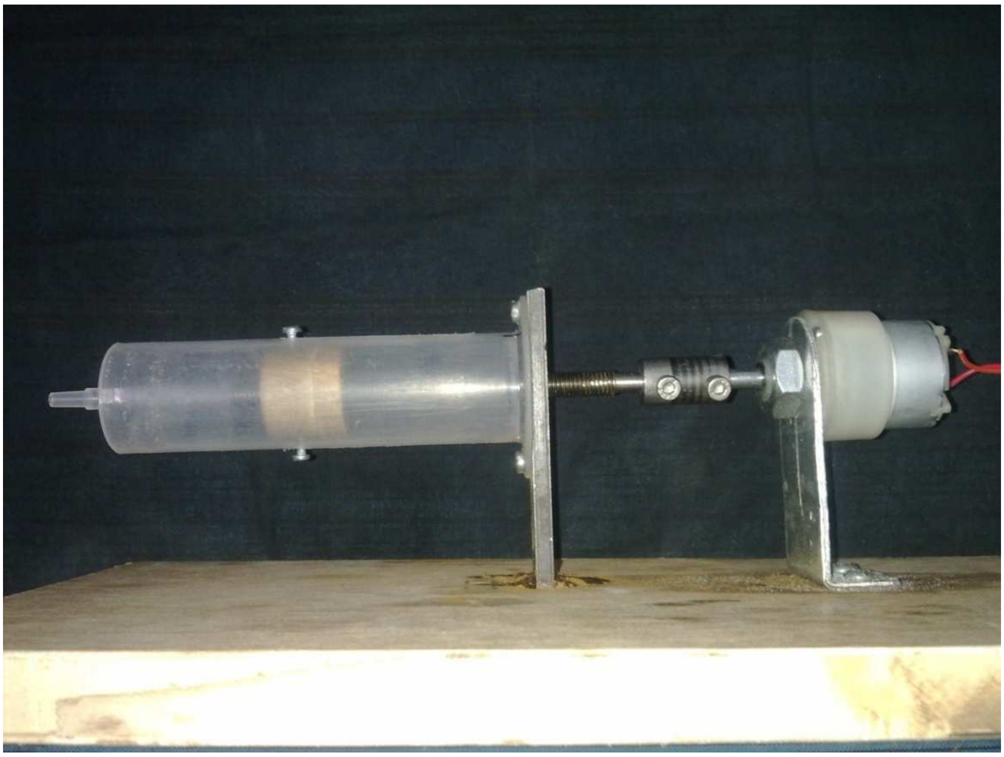


FIGURE 3.7: Medicine Infusion Pump

3.1.7 Power Supply

An AC powered unregulated power supply usually uses a transformer to convert the voltage from the wall outlet (mains) to a different, nowadays usually lower, voltage. If it is used to produce DC, a rectifier is used to convert alternating voltage to a pulsating direct voltage, followed by a filter, comprising one or more capacitors, resistors, and sometimes inductors, to filter out (smooth) most of the pulsation. A small remaining unwanted alternating voltage component at mains or twice mains power frequency (depending upon whether half- or full-wave rectification is used)—ripple—is unavoidably superimposed on the direct output voltage.

For purposes such as charging batteries the ripple is not a problem, and the simplest unregulated mains-powered DC power supply circuit consists of a transformer driving a single diode in series with a resistor.

Power supply circuit is shown in figure 3.8

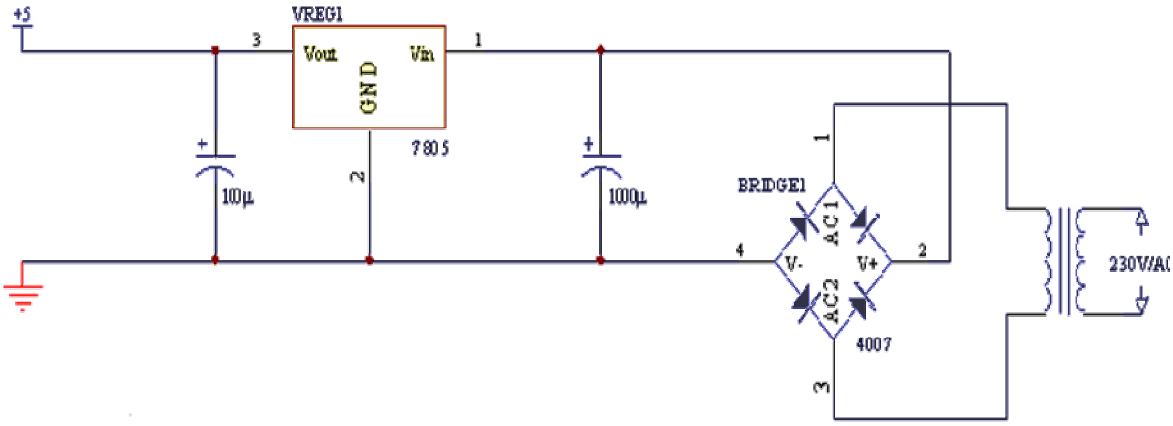


FIGURE 3.8: Power Supply

Voltage Regulator

In this circuit, after the rectifier circuit we have used a Voltage Regulator (L7805). It is a three terminal positive regulator & is used with external components to obtain a fixed voltage of 5V DC. The following is the figure of a power regulator.

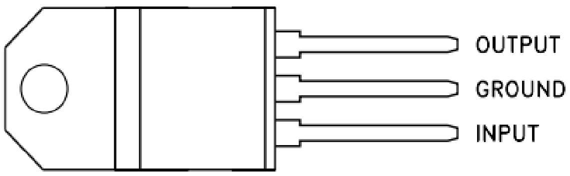


FIGURE 3.9: Voltage Regulator

3.1.8 Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts.

Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

One relay has been used in our hardware for switching on/off the motor of the medicine infusion pump.

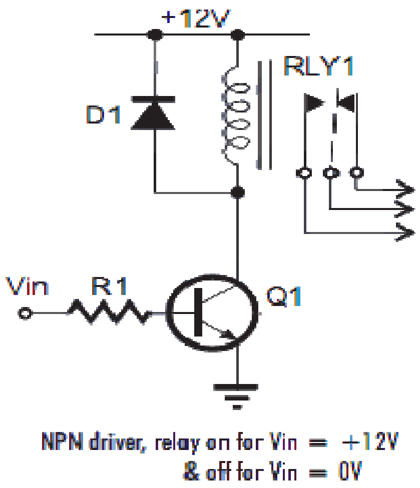


FIGURE 3.10: Relay Circuit Diagram

FIGURE 3.11: Relay

CHAPTER 4

TESTING AND SOFTWARE IMPLEMENTATION

4.1 Testing of Microcontroller

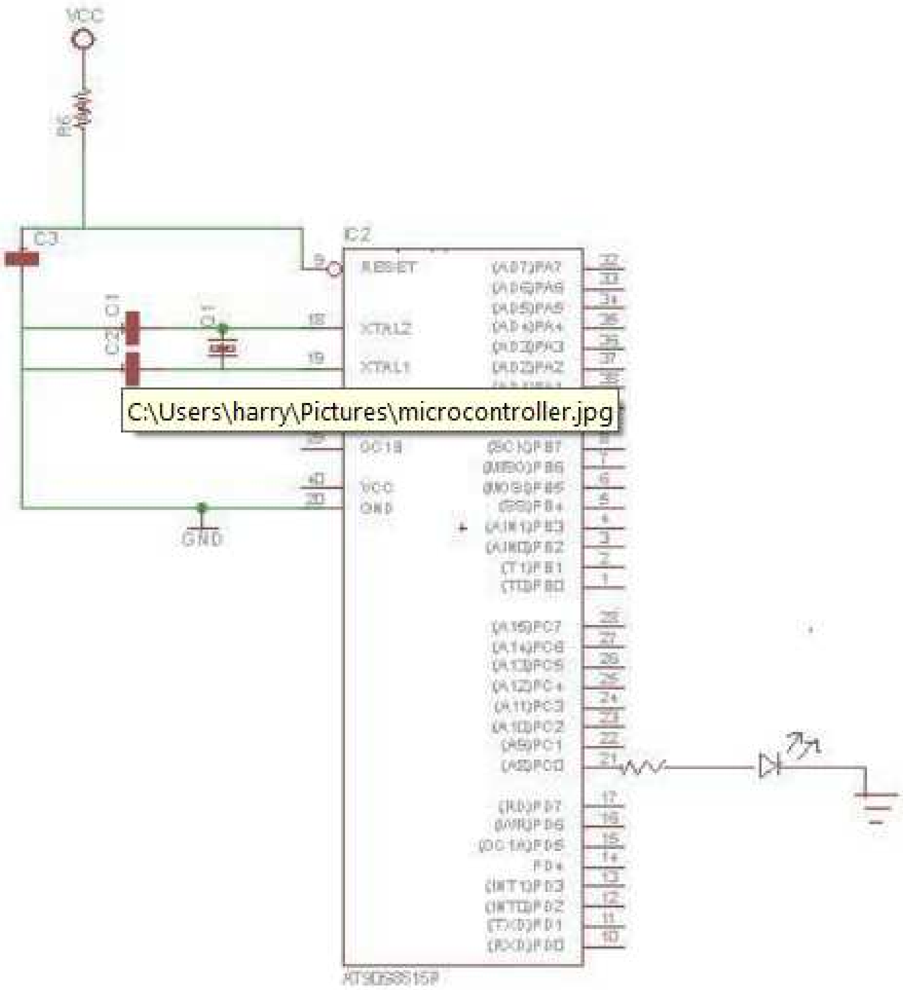


FIGURE 4.1: Testing of Microcontroller

Pin 40 provides supply voltage to the chip. The voltage source is +5V. Pin 20 is the ground. The Atmel89c52 has an on- chip oscillator but require an external clock to run it. A quartz crystal oscillator is connected to inputs XTAL1 (pin19) and XTAL2 (pin18). The quartz crystal oscillator connected to XTAL1 and XTAL2 also needs two capacitors of 33pF value. One side of each capacitor is connected to the ground. When the Atmel89c52 is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pin using the oscilloscope.Pin9 is the RESET pin. It is an input and is active high (normally low). Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities. EA pin must be connected to Vcc to indicate that the code is stored internally.(On-chip ROM to store programs).

For testing of microcontroller a series combination of resistor of 470 ohm and a LED is connected to port 3.0 of the microcontroller. A program for blinking of LED with 50%duty cycle was stored in the on chip ROM and blinking of LED along with a square wave of 50% duty cycle was observed on oscilloscope.

4.2 Testing of LCD with Microcontroller

As shown in figure 16*2 line LCD is used for the display, connected to port 1 of microcontroller. Liquid crystal displays (LCD) are widely used in recent years as compares to LEDs, as the ability to display numbers, characters and graphics, incorporation of a refreshing controller into the LCD, their by relieving the CPU of the task of refreshing the LCD and also the ease of programming for characters and graphics. Before sending commands or data to the LCD module, the Module must be initialized. Once the initialization is complete, the LCD can be written to with data or instructions as required. Each character to display is written like the control bytes, except that the "RS" line is set. During initialization, by setting the "S/C" bit during the "Move Cursor/Shift Display" command, after each character is sent to the LCD, the cursor built into the LCD will increment to the next position (either right or left). Normally, the "S/C" bit is set (equal to "1").LCD pins brief description described below.

V_{CC}, V_{SS}, V_{EE}

The voltage V_{CC} and V_{SS} provided by +5V and ground respectively while V_{EE} is used for controlling LCD contrast. Variable voltage between Ground and V_{CC} is used to specify the contrast (or "darkness") of the characters on the LCD screen.

RS (register select)

If RS=0, the instruction command code register is selected, then allowing to user to send a command such as clear display, cursor at home etc.. If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W (read/write)

The R/W (read/write) input allowing the user to write information from it. R/W=1, when it read and R/W=0, when it writing. 36

EN (enable)

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high power, a high-to-low pulse must be applied to this pin in order to for the LCD to latch in the data presented at the data pins.

D0-D7 (data lines)

The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD's internal registers. To displays the letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS =1. There are also command codes that can be sent to clear the display or force the cursor to the home position or blink the cursor. We also use RS =0 to check the busy flag bit to see if the LCD is ready to receive the information. The busy flag is D7 and can be read when R/W =1 and RS =0, as follows: if R/W =1 and RS =0, when D7 =1(busy flag =1), the

LCD is busy taking care of internal operations and will not accept any information. When D7 =0, the LCD is ready to receive new information.

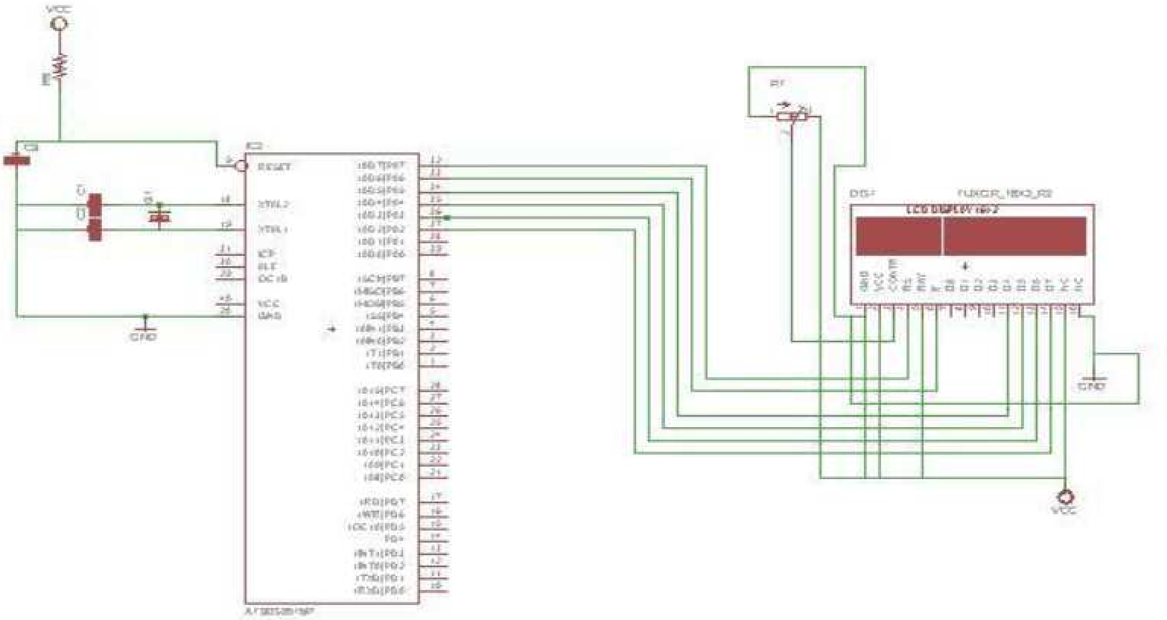


FIGURE 4.2: Testing of LCD with Microcontroller

4.3 Software

The software design is a key element in the development of a project. For visualization of the different parameter on the LCD display, the microcontroller is burnt in assembly level language. The microcontroller chosen for the development of the system was the Atmel89c52. The Atmel89c52 has 8K bytes of Flash programmable and erasable read only memory (EPROM) and has the capability to write to its own memory. The use of a FLASH device for development also provides the option to use FLASH microcontrollers in the final design making the system fully upgradable. This allows modification of the microcontroller software to support expansion.

The programming of Atmel89c52 is done in assembly level language. It is used because of the following advantages:

- To speed up computer operation.
- To write programs for special situations.
- To have better understanding of the computer operation.

4.3.1 Software Code

The microcontroller along with its various interfaces requires software to work on. The logic involved in achieving the desired operation has been carefully prepared and is noted down in form of software code.

The Software Code is in the form of assembly language and is as follows.

```
; ---------------------------------------------TEMP LOGER..--------------------------------------------------------

; ------LCD at PORT1

; ------ADC at PORT0

;-----------------------------------------------------------------------------------------------------------------------

; ------------BELOW 20 DEGREE------COLD

; ------------UPTO 35 DEGREE------WARM

; ------------ABOVE 35 DEGREE------HOT


org 0000h

;-----------------------------------------------------------------------------------------------------------------------

mov a,#38h          ;initialise two line 5x7 matrix
```

```
acall command        ;sub routine

mov a,#38h          ;initialise two line 5x7 matrix

acall command        ;sub routine

mov a,#0ch          ;display on,cursor blinking

acall command        ;sub routine

mov a,#01h          ;clear lcd

acall command        ;sub routine


mov a,#80h          ;shift cursor TO 1st line

acall command                    ;


; -------------------------------------------------Temperature---------------------------------------
-----------------

mov a,#'P'

acall data1

mov a,#'a'

acall data1

mov a,#'t'

acall data1

mov a,#'i'

acall data1

mov a,#'e'

acall data1

mov a,#'n'

acall data1
```

```
mov a,#'t'
acall data1

mov a,#0c0h          ;shift cursor TO 1st line
acall command                    ;

mov a,#'M'
acall data1
mov a,#'o'
acall data1
mov a,#'n'
acall data1
mov a,#'i'
acall data1
mov a,#'t'
acall data1
mov a,#'o'
acall data1
mov a,#'r'
acall data1
mov a,#'i'
acall data1
mov a,#'n'
acall data1
mov a,#'g'
```

```
acall data1

acall delay2
acall delay2
acall delay2
acall delay2

; ----------------------------------------------------------------------Temp. ---------------------------------------------------------------------------
---------
mov a,#01h
acall command
mov a,#80h
acall command

mov a,#'T'
acall data1
mov a,#'e'
acall data1
mov a,#'m'
acall data1
mov a,#'p'
acall data1
mov a,#'.'
acall data1
mov a,#20h
```

```
acall data1
mov a,#'i'
acall data1
mov a,#'s'
acall data1

mov a,#0c0h        ;shift cursor TO 1st line
acall command              ;

mov a,#'H'
acall data1
mov a,#'/'
acall data1
mov a,#'R'
acall data1
mov a,#'='
acall data1


acall delay2
acall delay2
acall delay2
acall delay2
```

```
; ------------------------------------------------------------ADC------------------------------------------
--------------------

   mov p0,#0ffh

   go:

   setb p2.5


   clr p2.7          ; INTR=p2.6  ; start conversion

   setb p2.7          ; WR = p2.7

                    ; RD = p2.5 active low

   hee:jb p2.6,hee

         acall delay2


   clr p2.5


   mov a,p0              ; a contain temp in hex

         MOV 40H,A


; ---------------------------------------------HEX to BCD conversion---------------------------------
-------------------

  lop: cjne a,#35d,next             ; if a is smaller carry=1

          sjmp next


    next: jnc gom


setb p3.7                                        ; below 30  led on
```

```
sjmp hoi
gom:
                        MOV A,40H
            cjne a,#45d,next2                   ; if a is smaller than 35 c=1
            sjmp next2
            next2: jnc gom2

clr p3.7
SJMP HOI

gom2:
setb p3.7           ; above 40 led off

hoi:
    MOV A,40H
    mov b,#10d
           div ab
           mov r6,b                      ; 0ne
           mov b,#10d
           div ab
           mov r7,b          ; tens
           mov r2,a                      ;hundred

    mov a,#89h               ;shift cursor TO 1st line
    acall command          ;command subroutine
```

```
        mov a, r2
        orl a,#30h
    acall data1
        mov a, r7
        orl a,#30h
    acall data1
        mov a, r6
        orl a,#30h
    acall data1

        mov a,#20h
    acall data1
        mov a,#27h
    acall data1
    mov a,#'C'
    acall data1

;-----------------------------------------------------------------------------------------------------------
-------------------
setb p2.0
jb p2.0,kou

mov a,#0c4h          ;shift cursor TO 1st line
acall command                    ;
```

```
mov a,#'7'
acall data1
mov a,#'5'
acall data1

acall delay2
acall delay2
acall delay2
acall delay2
acall delay2
acall delay2
acall delay2

mov a,#0c4h          ;shift cursor TO 1st line
acall command                    ;

mov a,#'7'
acall data1
mov a,#'3'
acall data1

acall delay2
acall delay2
acall delay2
acall delay2
```

```
acall delay2
acall delay2
acall delay2

mov a,#0c4h             ;shift cursor TO 1st line
acall command                          ;

mov a,#20h
acall data1
mov a,#20h
acall data1

;--------------------------------------------------------------------------------------------------------
-------------------
                kou:
                        Ljmp go
;--------------------------------------------------------------------------------------------------------
-------------------
delay1:
      mov r3,#150d
h130: mov r4,#150d
h230: djnz r4,h230
      djnz r3,h130
      ret
delay2:
       mov r3,#255d
```

```
h1300: mov r4,#255d
h2300: djnz r4,h2300
       djnz r3,h1300
               ret

delay:
     mov r3,#60d
h13: mov r4,#40d
h23: djnz r4,h23
     djnz r3,h13
      ret
command:
mov p1,a
clr p3.2
clr p3.1
setb p3.0
clr p3.0
acall delay1
ret
data1:
mov p1,a
setb p3.2
clr p3.1
setb p3.0
clr p3.0
```

```
acall delay1

ret


END
```

CHAPTER 5

WORKING OF THE PROTOTYPE

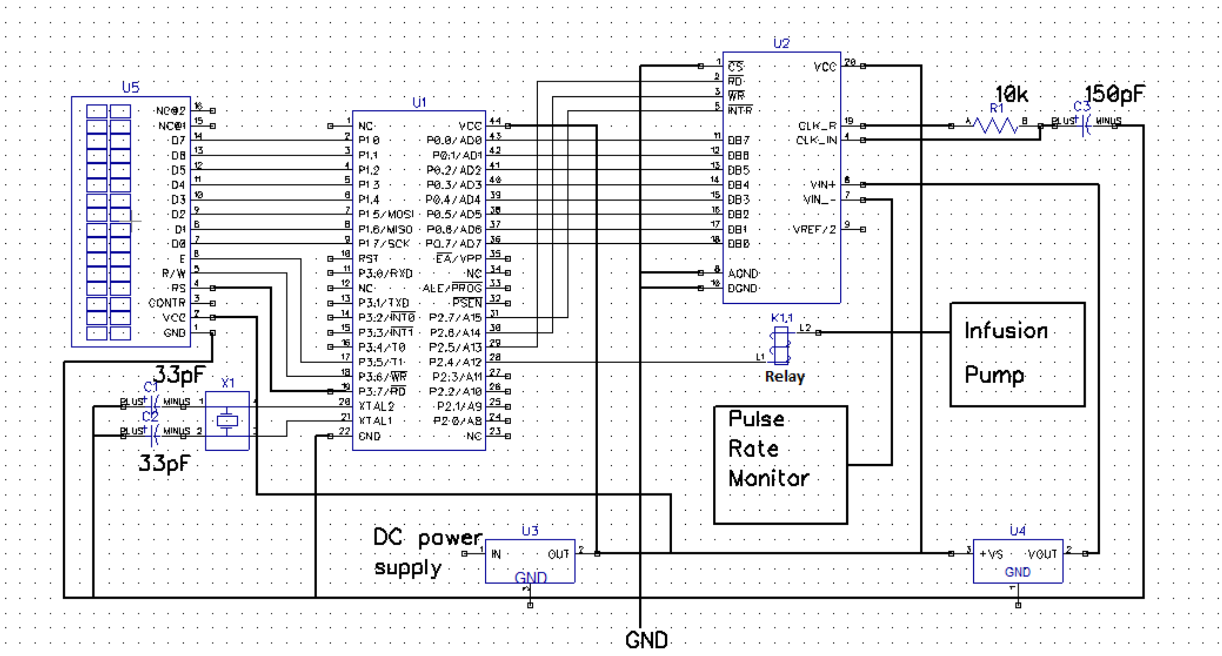
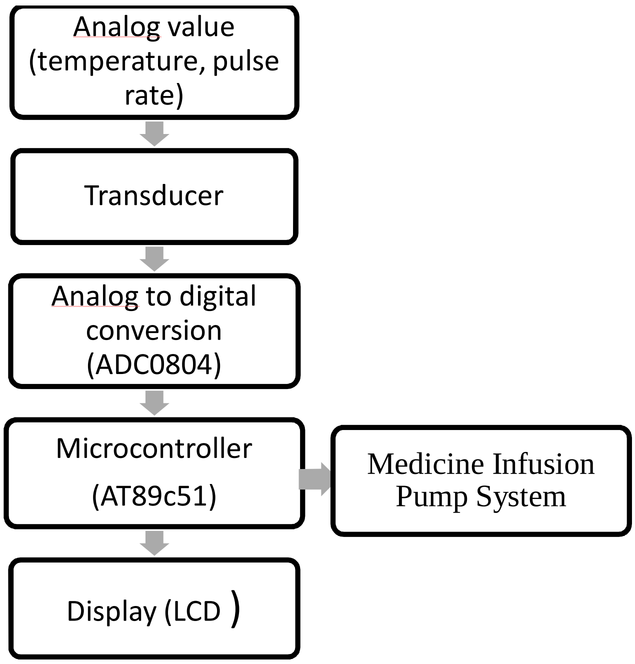


FIGURE 5.1: Circuit Diagram

By using various electrical circuits the bio-medical like temperature and heart beat parameters can be found. The output of the circuits is amplified by means of an amplifier and fed into an A/D converter. The digitized signal is then fed into the input port of the microcontroller. The microcontroller displays the parameters in digital value in the display device. And the injector connected to the prototype works accordingly.

FLOW CHART



We are focusing on the body temperature measurement device and heart rate measurement monitor, taking up the analog values using the sensor LM35 and LDR and LED; these signals were fed into an ADC (Analog to Digital Convertor) ADC0804. The digital value of the temperature measurement and heart rate measurement from the ADC is then fed to the microcontroller (AT89c52). The LCD (Liquid Crystal Display), is interfaced with the microcontroller which displays the value of the temperature sensed and the heart beat.

In case the values of the temperature and the heart beat goes out of a particular range prescribed by the doctor the relay gets triggered and hence the Care System responds accordingly.

CHAPTER 6

CONCLUSION AND FUTURE PROSPECTS OF THE PROJECT

The project has been successfully completed within the stipulated time frame with the prototype displaying bio- medical parameter and the Care System i.e. the Infusion Pump working accordingly. We have achieved the desired outputs of the body temperature and the heart beat of the patient on the LCD displays and according to which the Care System i.e. the Medicine Infusion Pump performs if these parameters go out of a particular set range.

Despite lots of research in this field of Monitoring and Care of patient, there has been very little effort in actual implementation of the concept which provides ample scope for the further developments of this project.

Over the past few decades, technology has touched lives, literally. While use of technology in healthcare has been made in a hospital environment, a larger scope lies for technology to become simple.

Patient Monitoring and Care today is fast becoming a common reality. From Cardiac Monitoring to Diabetes Management and more, healthcare services that were once restrained within doctors being around the patient 24 hours are now finding their spot under technologically sound and improved healthcare. That's a win-win for both doctors/caregivers and patients. Patient Monitoring and Care makes objective, pertinent information available to caregivers in a timely manner, or as and when the need arises, prevent any kind of critical disaster to occur. This way, the patients are taken care of and the doctors are able to perform their job effectively too. Also, this addresses the issue of ever-less-available resources like healthcare staff and physical presence of the doctor.

Additionally, it helps improve patient health, thanks to early diagnosis and preventive care.

Patient monitoring still needs a lot of improvement as there is still a need of mobility and real time monitoring. So, nowadays scope is shifting towards the wireless or remote patient monitoring.

Remote Patient Monitoring could be done through sensors on a medical device at the patient’s home. The patient interacts with the device (which is network-enabled), and based on pre-programmed tolerance limits, the device sends out the data to the patient’s caregiver(s). The doctor/caregiver can then responds with a modification in medication, or suggest some physical activity/exercises to the patient.

Also a concept called mHealth a term used for the practice of medical and public health, supported by mobile devices in reference to using mobile communication devices like mobile phones can be implemented by using the basic concept of wireless transmission of patient’s health status. This concept of m-Health can be integrated in larger scale implementations like public health management systems where database of a large number of patients can be stored and monitored through wireless communication which can also be retrieved to maintain a proper record of the patient’s health status and previous record. m-Health is a subdivision of e-Health Which deals with the usage of Information Coding Theory(ICT) like computers, communication satellites, patient monitors for health services and information. m-Health applications include the use of mobile devices in collecting community and clinical health data, delivery of healthcare information to practitioners, researchers, and patients, real-time monitoring of patient vital signs, and direct provision of care. While m-Health certainly has application for industrialized nations, the field has emerged in recent years as largely an application for developing countries, stemming from the rapid rise of mobile phone penetration in low-income nations. The field, then, largely emerges as a means of providing greater access to larger segments of a population in developing countries, as well as improving the capacity of health systems in such countries to provide quality healthcare. Within the m-Heath space, projects operate with a variety of objectives, including increased access to healthcare and health-related information (particularly for hard-to-reach populations); improved ability to diagnose and track diseases; timelier, more actionable public health information; and expanded access to ongoing medical education and training for health workers

The motivation behind the development of the m-Health field arises from two factors. The first factor concerns the myriad constraints felt by healthcare systems of 60 developing nations. These constraints include high population growth a high burden of disease prevalence, low health care workforce,large numbers of rural inhabitants, and limited financial resources to support healthcare infrastructure and health information systems. The second factor is the recent rapid rise in mobile phone penetration in developing countries to large segments of the healthcare workforce, as well as the population of a country as a whole. With greater access to mobile phones to all segments of a country, including rural areas, the potential of lowering information and transaction costs in order to deliver healthcare improves. The combination of these two factors has motivated much discussion of how greater access to mobile phone technology can be leveraged to mitigate the numerous pressures faced by developing countries' healthcare systems. We can also envisage concepts like **Telehealth** wherein the delivery of health-related services and information via telecommunications technologies. Telehealth delivery could be as simple as two health professionals discussing a case over the telephone, or as sophisticated as using videoconferencing between providers at facilities in two countries, or even as complex as robotic technology.

Clinical Uses of Telehealth Technologies

- Transmission of medical images for diagnosis(often referred to as store and forward telehealth)
- Groups or individuals exchanging health services or education live via videoconference (real-time telehealth)

- Transmission of medical data for diagnosis or disease management (sometimes referred to as remote monitoring)
- Advice on prevention of diseases and promotion of good health by patient monitoring and follow-up.
- Health advice by telephone in emergent cases (referred to as teletriage)

Telemedicine is simple as two health professionals discussing a case over the telephone, or as complex as using satellite technology and video conferencing equipment to conduct a real-time consultation between medical specialists in two different countries. Telemedicine is most beneficial for populations living in isolated 61 communities and remote regions and is currently being applied in virtually all medical domains. Specialties that use telemedicine often use a "tele-" prefix; for example, telemedicine as applied by radiologists is called Teleradiology. Similarly telemedicine as applied by cardiologists is termed as telecardiology; etc .Telemedicine is also useful as a communication tool between a general practitioner and a specialist available at a remote location. One more future prospect of the project is its utility in monitoring the status of the patient by doctors when any one or both of them are on the move. Patient being taken to hospital in an ambulance and doctor travelling to the hospital can get constant updates about the patient status even when both of them are on the move is where our project can be instrumental.

The shift is happening, or is about to happen. It’s not a question of ‘if,’ but ‘when.’ The earlier the stakeholders understand the importance of remote patient care and the difference it makes to lives of millions of people across the world, the sooner we move towards a healthier world.

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