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AUTOMATIC WIRELESS HEALTH MONITORING SYSTEM

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ABSTRACT

This project describes the development of a wireless heartbeat and temperature monitoring system based on microcontroller ATmega 328 (Arduino uno) at a reasonable cost with great effect. Most monitoring systems that are in use in today's world works in offline mode but it is of a great need that a system must be designed so that patient can be monitored remotely in real time. The project consists of sensors which measures heartbeat and body temperature of a patient which is controlled by the microcontroller. Both the readings are displayed on the LCD monitor. Wireless system is used to transmit the measured data to a remote location. The heartbeat sensor counts the heartbeat for a specific interval of time and estimates Beats per Minute while the temperature sensor measures the temperature. Both these data are sent to the microcontroller for transmitting to the receiving end. Finally, the data is displayed on the LCD at the receiving end.

KEYWORDS: Arduino Uno, Body Temperature Monitoring, Fingertip Monitoring, Heartrate Monitoring, Remote Monitoring.

INTRODUCTION

In today's world, the employment of wireless technology is increased to fulfill the requirement of remote observance. Remote Patient Monitoring (RPM) is a technology that allows us to watch patient outside of clinic or hospital, while not having to visit the patient. It's going to increase access to health services and facilities whereas decreasing expenditures. RPM saves time of both patient and doctor, therefore increasing potency and responsible ness of health services.

Heartbeat and temperature are the foremost signs that are essentially measured by physicians. The heartbeat refers to a number of times a heart contracts and relaxes during a unit of the time (usually per minute). Heartbeat, thus a vital sign, varies for various age teams. For a person's age more than eighteen, a traditional resting vital sign is around seventy-two beats per minute (bpm). A lower vital sign at rest implies additional economical heart operate and higher vessel fitness. Babies have a far higher rate than adults, around a hundred and twenty beats per minute and older youngsters have vital sign around ninety beats per minute.

The heart rate increases gradually during exercise and returns to its normal value after exercise. The rate at which the pulse returns to its normal value is an indication of the fitness of a person.

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If the heart rate is lower than the normal heart rate, it is an indication of a condition known as bradycardia and if the heart rate is higher than the normal heart rate, it is an indication of a condition known as tachycardia. Like heart rate, normal body temperature also varies from person to person and changes throughout the day. The body temperature is lowest in the early morning and highest in the early evening. The normal body temperature is about 37° C or 98.6 ° F. However, it can be as low as 36.1° C (97°F) in the early morning and as high as 37.2° C (99° F) and still be considered normal. Thus, the normal range for body temperature is 97 to 100 degrees Fahrenheit or 36.1 to 37.8 degrees Celsius. Temperature can be measured by using different types of sensors. These sensors come in different forms such as thermocouples, thermistors, resistance temperature detectors (RTD), and integrated circuit (IC) sensors. The temperature sensor produces analog output voltage which is proportional to the temperature. The temperature sensor requires analog to digital (A/D) converter so that the analog output voltage can be converted to digital form. The output of the temperature sensor is connected to the Port A of AT MEGA328R-PU arduino uno. The arduino uno processes this data and displays it in LCD as well as sends it to the receiving end for displaying at the remote place. This project describes the design of a very low-cost remote patient monitoring system which measures heart rate and body temperature of a patient and sends the data to a remote end where the data will be displayed and physician or doctor will be able to examine him/ her. This device will be much needed during emergency period or for saving time of both patient and doctor.

LITERATURE SURVEY

- For patient monitoring, wearable sensors are used with emerging wireless techniques like Bluetooth and Zigbee technology for mobility and low power consumption by the system [1].
- The advantages are treatment can be given to the patient in priority to the disease they have when comparing with other patients, when in critical situation they can be hospitalized.
- These types of communication will only work for shorter distance and duration. A study was done to determine the types of vital signs that are routinely measured for a patient by doctor.
- The very important and most common signs are heart rate and detection of temperature. Blood pressure and sugar levels are also very important.
- Direct temperature measure of peripheral tissue is a lot of complicated than core temperature measure. A very important signal of patient health is monitored by medicine system Zigbee [1].
- The system is 2 layered, used for gathering and process medicinal signals.
- First the device with variety of biosensors should be placed on the body and then the signal is processed by a neighborhood base station processing the information transmitted by the mobile device.
- Smart wearable remote health monitoring systems are augmented in usage in health services, by avoiding superfluous hospitalizations and to confirm imperative care.
- System contributes with value effective telemedicine platform. For physiological parameters measure the network is approached to trot out observance and analysis of patient health. information from sensors are uninheritable and transmitted to server by the network. Physiological parameters are processed automatically by the system and displayed on the monitor. The figures 1 and 2 shows the block diagram of the transmitter and receiver sections respectively [1].

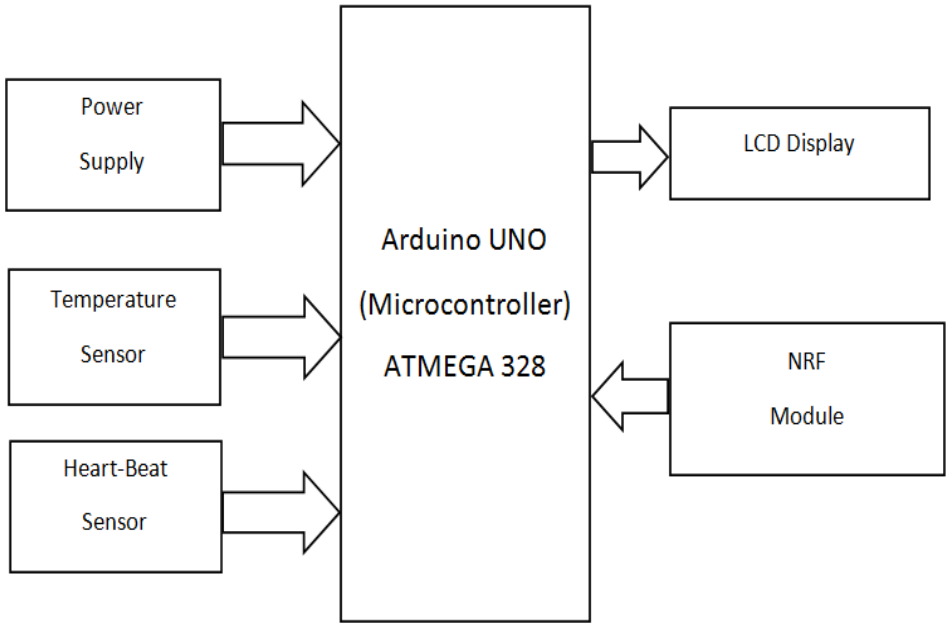

Figure 1.Block diagram of transmitter section

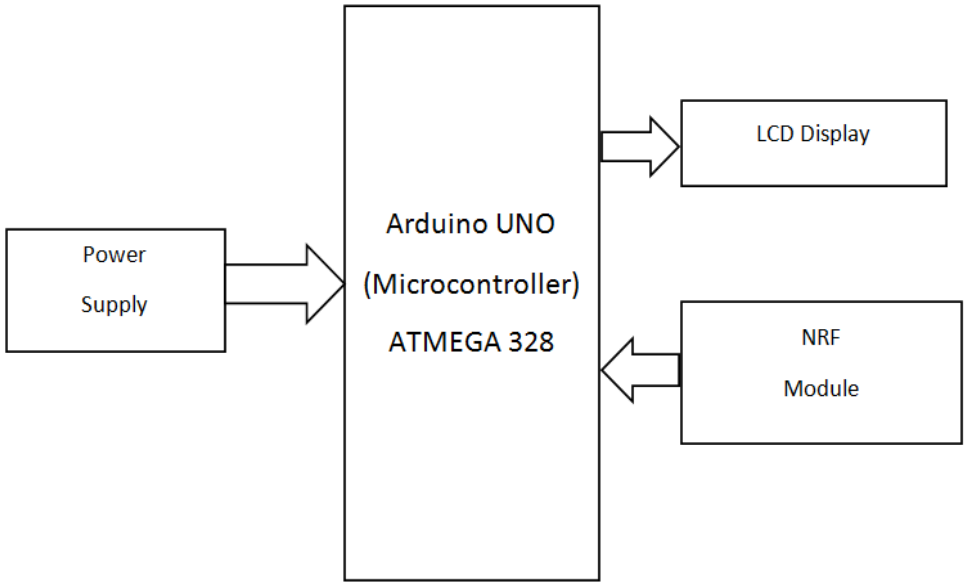

Figure 2.Block diagram of Receiver section

COMPONENTS USED

ARDUINO ATMEGA328

The Atmel AVR® core architecture is code efficient. Figure 3 shows the Arduino UNO ATmega328 kit used in the project. It is found that it can achieve throughputs up to 10 times faster than conventional CISC microcontrollers and is more affordable cost wise and efficiently programmed as well. The Pin configuration is also provided as shown in Figure 4.

FUNCTIONS

DIGITAL I/O

- Pin Mode (pin, mode) pin 0~13, mode is input or output.
- Digital Write (pin, value) pin 0~13, value is HIGH or LOW.
- int digital Read (pin) pin 0~13, value is HIGH or LOW.

The programming cycle on Arduino is basically as follows

- Plug your board into a USB port on your computer.
- Write a sketch that will bring the board to life.
- Upload this sketch to the board through the USB connection and wait a couple of seconds for the board to restart.
- The board executes the sketch that you wrote.

INSTALLING THE INTEGRATED DEVELOPMENT ENVIRONMENT (IDE)

- The windows download it in the form of Zip file.
- Unzip the file to any convenient directory Program Files/Arduino is a sensible place.
- The directory contains the executable file (named Arduino.exe), along with various other files and folders.
- Be patient, as it can take some time for the software to load.

USING THE IDE TO PREPARE AN ARDUINO SKETCH

- Use the Arduino IDE to create, open, and modify sketches that define what the board will do.
- You can use buttons along the top of the IDE to perform, or you can use the menus or keyboard shortcuts.

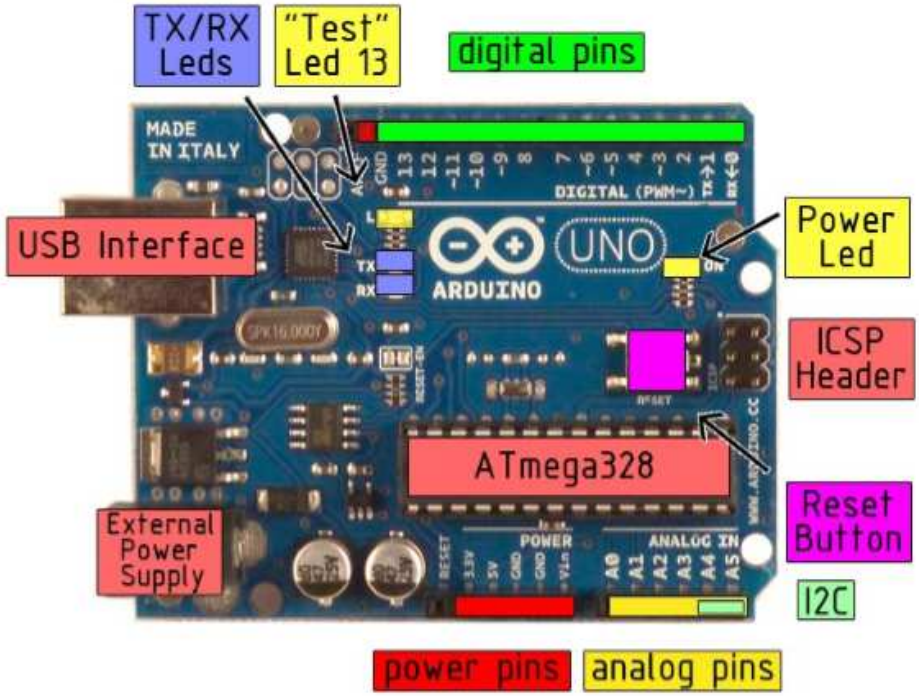

Figure 3.Arduino UNO ATmega328

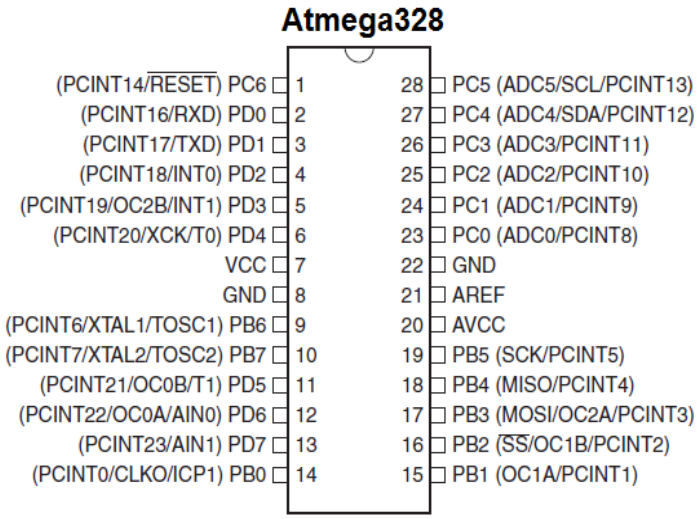

Figure 4.ATmega328 pin configuration

TEMPERATURE SENSOR LM35

This temperature sensor has linear output, low output impedance and provides accurate inbuilt calibration so that the control circuit is becomes easy. Only single power supply is needed to operate this temperature sensor. It is rated to operate over a temperature range of -55°C to +150°C. Since, the temperature sensor LM35 does not have moving parts, it is accurate, does not require calibration, works under many environmental conditions and is consistent between readings. It is cheap and easy to use. The Figure 5 shows the LM35 temperature sensor.

For measuring body temperature, the left pin of LM35 is connected to the power (5V) and the right pin is connected to the ground. The middle pin will give us an analog voltage that is directly proportional (linear) to the temperature as shown in Fig. 5. The analog voltage is independent of the power supply. Thus, the middle pin is connected to the microcontroller PIC16F72 at port A (pin 2) for further processing. The scaling factor for LM35 is 0.01V/°C. Body temperature is measured by holding LM35 with finger and corresponding change in temperature is converted into analog voltage which is then fed to microcontroller by the middle pin of LM35. The microcontroller has ADC in it and it does further processing and sends the measured data to the remote end via RF transmitter. At the remote end, the RF receiver receives the data and sends it to the microcontroller which then processes and displays the data in the LCD.

Figure 5.Temperature sensor

HEART BEAT SENSOR (LM358)

The use of microcontroller is in every field even we can use it in the design and fabrication of biomedical equipment. A little example is here. The microcontroller ATmega328 is here used to develop a heartbeat monitoring system. By placing your finger in between, a LED and photo resistance, She/ he can detect the pulses of heart, the analog voltages are further processed with an operational amplifier LM 358, this chip has two built in OPAMPs. [6] The TTL pulses or digital pulse are then feed to the external interrupt of microcontroller ATmega 328. By using a software counter in the code, they can count the pulses, and the result the process is displayed on an LCD (2 line 16 characters). Figure 6 shows the Pin Configuration of LM358 IC.

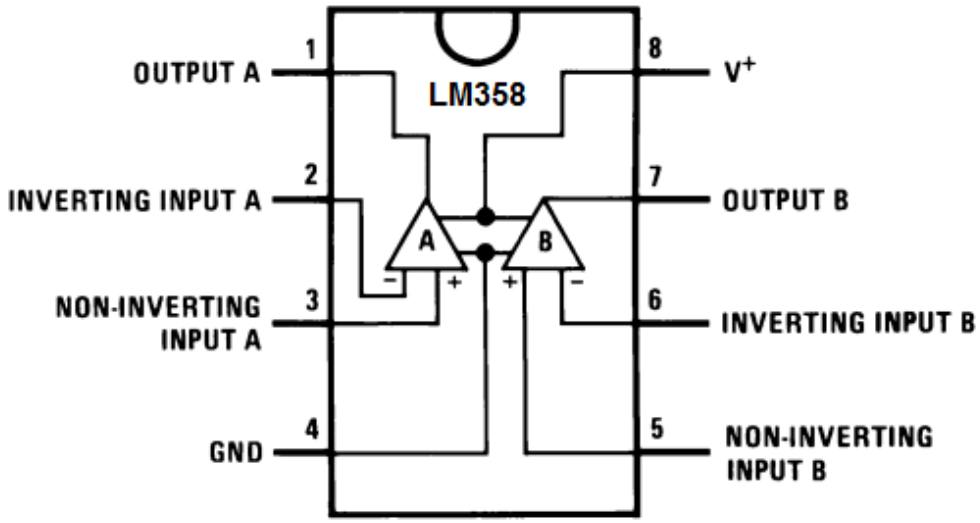

Figure 6.Pin Configuration of IC Lm 358

NRF24L01 MODULE

The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced ShockBurst™), designed for ultra-low power wireless applications [1]. The nRF24L01 Module is as shown in Figure 7.

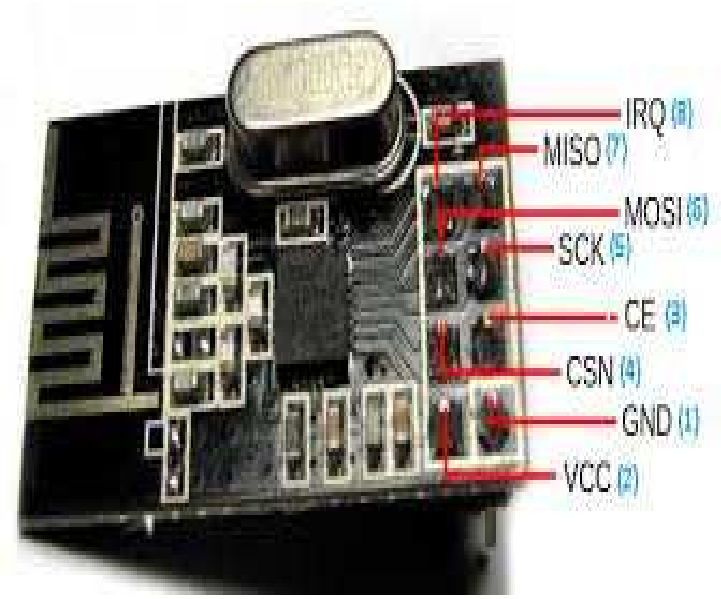

Figure 7.nRF24L01 Module

LIQUID CRYSTAL DISPLAY (LCD)

The LCD used in the project is as shown in Figure 8. The Table 1 shows the pin configuration of the LCD.

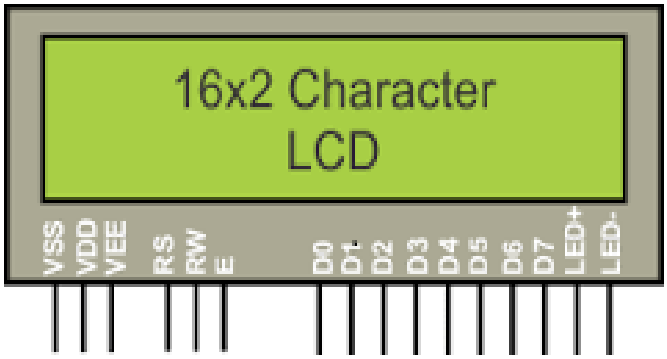

Figure 8.LCD

Table 1.LCD pin configuration

Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

JHD162A LCD controller is one of the most common dot matrix liquid crystal display (LCD) display controllers available. Hitachi developed the microcontroller specifically to drive alphanumeric LCD display with a simple interface that could be connected to a general purpose microcontroller or microprocessor. Many manufacturers of displays integrated the controller with their product making it the informal standard for this type of displays.

Architecture

These LCD screens are limited to monochrome text. The screens come in a small number of standard configurations. Common sizes are 16x2 (two rows of sixteen characters). The pin out with description of each as shown in Table. 2.

The nominal operating voltage for LED backlights is 5V at full brightness, with dimming at lower voltages dependent on the details such as LED colour. Non LED backlights often require higher voltages. The JHD162A interface allows for two modes of operation, 8-bit and 4-bit. Using the 4 bit mode is more complex, but reduces the number of active connections needed. The chip starts in 8 bit mode, with the instruction set designed to allow switching without requiring the lower four data pins. Once in 4 bit mode, character and control data is transferred as pairs of 4 bit "nibbles" on the upper data pins, D4-D7.

Table 2.Pin Description of LCD

Pin No.	Symbol	Status	Action
1	Vss	GND	LCD Power Supply
2	Vcc	+5V	
3	Vee	PRESET	Adjust LCD Contrast
4	RS	0	Select COMMAND Register (Configure display setting)
		1	Select DATA register (write/read ASCII data)
5	RW	0	Write mode
		1	Read mode
7	DB0		
8	DB1		
9	DB2		
10	DB3		8 bit DATA
11	DB4		
12	DB5		
13	DB6		
14	DB7		
15	LED+	+5V	
16	LED-	Gnd	Backlight

INSTRUCTION SET

The JHD162A LCD controller instruction set is shown in Table 3.

Table 3.LCD controller instruction set

Instruction	Code										Description
	RS	R/W	B7	B6	B5	B4	B3	B2	B1	B0	
Clear display	0	0	0	0	0	0	0	0	0	1	Clears display and returns cursor to the home position (address 0).
Cursor home	0	0	0	0	0	0	0	0	1	*	Returns cursor to home position. Also returns display being shifted to the original position. DDRAM content remains unchanged.
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction (I/D); specifies to shift the display (S). These operations are performed during data read/write.
Display on/off control	0	0	0	0	0	0	1	D	C	B	Sets on/off of all display (D), cursor on/off (C), and blink of cursor position character (B).
Cursor/ display shift	0	0	0	0	0	1	S/C	R/L	*	*	Sets cursor-move or display-shift (S/C), shift direction (R/L).

											DDRAM content remains unchanged.
Write CGRAM or DDRAM	1	0	Write Data								Write data to CGRAM or DDRAM.
Read from CG/ DDRAM	1	1	Read Data								Read data from CGRAM or DDRAM.

POTENTIOMETER

A potentiometer is a three-terminal resistor which is used in the project comes with a sliding or rotating contact that acts as a variable resistor or rheostat. The potentiometer shown in the Figure 9 is used in our project.

Figure 9.Potentiometer

POWER SUPPLY

Power supply is the circuit from which we get a desired dc voltage to run the other circuits. The voltage we get from the main line is 230V AC but the other components of our circuit require 5V DC. Hence a step-down transformer is used to get 12V AC which is later converted to 12V DC using a rectifier. The output of rectifier still contains some ripples even though it is a DC signal due to which it is called as Pulsating DC. To remove the ripples and obtain smoothed DC power filter circuits are used. Here a capacitor is used. The 12V DC is rated down to 5V using a positive voltage regulator chip 7805. Thus a fixed DC voltage of 5V is obtained.

WORKING OF PROJECT

The main objective of is to design a wireless system for automatic health monitoring. The objective this is to monitor the temperature and heartbeat of the patient's body and using NRF technology, display the same to the doctor at the remote location. The required components used in this system include a portable power supply, a heartbeat sensor, a temperature sensor, ATmega328 micro controller an radiofrequency transmitter, an radiofrequency receiver module and an LCD display. The ATmega328 microcontroller is used as a CPU for monitoring the temperature of the patient's body. The main block diagram includes a power supply block and medical

sensors are used to sense the temperature and heartbeat of a patient's body.

The circuit diagram of the automatic wireless health monitoring system mainly includes transmitter section and receiver section as shown in the Figure 10 and Figure 11 respectively. The temperature and heart beat are sensed by the sensors and then the data is sent to ATmega328 in the transmitter section.

The transmitted information can be decoded into serial data using nRF module at the receiving end. The heartbeats and temperature of the patient is displayed on the LCD screen.

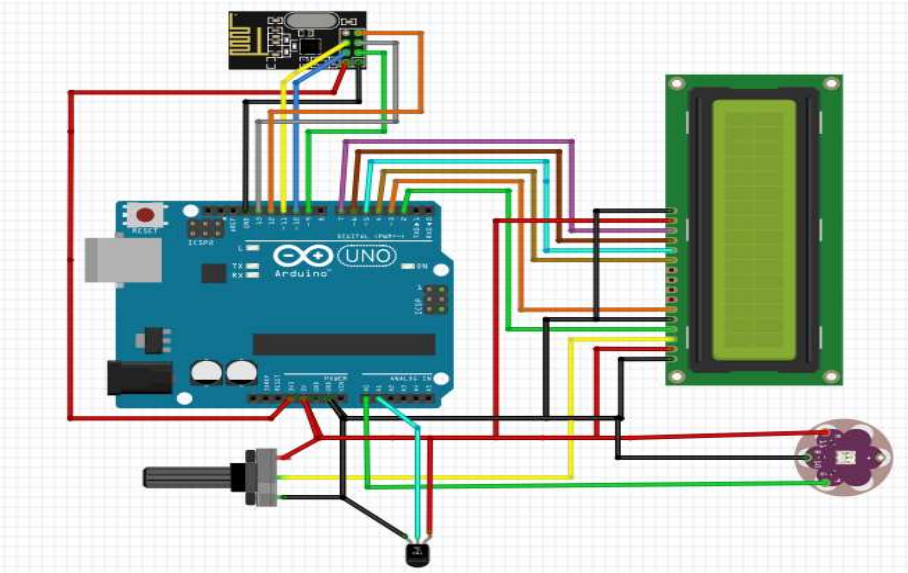

Figure 10.Circuit Diagram of Transmitter section

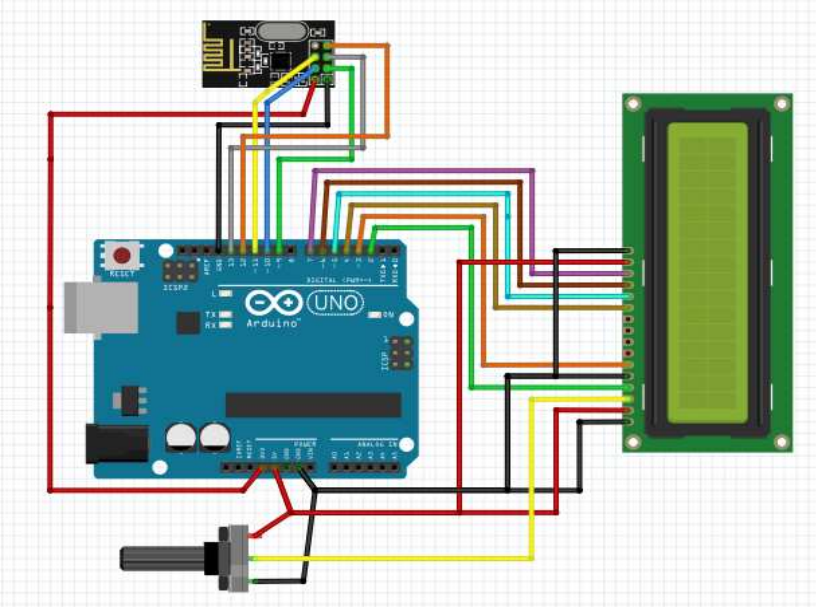

Figure 11.Circuit Diagram of Receiver Section

DESIGN FEATURES

Health Monitoring System is completed with modules of information sensing, processing and digital communication. 3 devices are contained in information sensing module like temperature sensor, pulse rate device. The output of every device is interfaced with Analog to Digital circuit (ADC) pins of microcontroller. Processing module consists of ATmega328, 28-pin 8-Bit

microcontroller of Harvard design that could be a superior nRF circuit accustomed solving issues in conversion of RS232 signal voltage to TTL voltage and required to speak the receiver and causation SMS through info entrance, show LCD display is employed as a display unit in reference to microcontroller for displaying the present details of physiological parameters.

SINGLE PARAMETER MONITORING SYSTEM

This system is used for measuring the blood pressure of a human body, monitoring ECG, monitoring SPO2 (oxygen saturation in blood), and so on.

MULTI PARAMETER MONITORING SYSTEM

A Multi parameter monitoring system is used for monitoring multiple critical medical signs of patients like ECG, respiration rate and blood pressure, etc.

RESULTS

TEMPERATURE MEASUREMENT

When she/he can power on the circuit shown in the figure 4, all the LEDs on PCBs are glowing, indicating that circuit is working properly shown in figure 5. Here there is a use of the industrial temperature sensor i.e. LM 35 which gives us room temperature in °C. That temperature is displayed on the LCD.

HEARTBEAT MEASUREMENT

There is a cavity for measurement of the heartbeat, which consist of a arrangement of LED and LDR. By placing your finger in between, a LED and LDR, we can detect the pulses of heart, the analog voltages are further processed with an operational amplifier LM 358, and this chip has two built in OPAMPs. Result is displayed on the LCD. This collected data is transmitted using nRF24L01 module. This data is received at the receiver section using same nRF24L01 module.

CONCLUSION

We have analyzed the wireless patient health monitoring system of temperature and heartbeat of humans using nRF24L01. The heartbeat was measured with the help of photodiode and bright LED while the temperature was measured by using precision integrated temperature sensor LM35. Both the data were processed in the arduino uno and sent to the remote end wirelessly by using NRF transmitter and received at the remote end by using nRF receiver. The received data was processed in the arduino uno and the data measured was displayed successfully with the help of LCD at the remote end. The wireless communication was preferred because it gives greater mobility to the sensor equipment and reduces the cost wherein there are multi-transmitting sections.

REFERANCES

[1]. Vikramsingh R. Parihar, Akesh Y. Tonge, Pooja D. Ganorkar."Heartbeat and Temperature Monitoring System for Remote Patients using Arduino", International Journal of Advanced Engineering Research and Science (ISSN: 2349-6495(P) | 2456-1908(O)),vol.4,no. 5, pp.055-058,2017.

[2]. Rajalakhshmi.S S.Nikilla, “Real Time Health Monitoring System using Arduino”, South Asian Journal of Engineering and Technology Vol.2, No.18 (2016) 52-60 , ISSN No: 2454-9614.

[3]. C. K. Das, M. W. Alam and M. I. Hoque, “A Wireless Heartbeat And Temperature Monitoring System For Remote Patients”, ICMERE2013-PI-197.

[4]. Media Aminian1 and Hamid Reza Naji2, “A Hospital Healthcare Monitoring System Using Wireless Sensor Networks”,

Aminian and Naji, J Health Med Inform 2013, 4:2.

[5]. Md. Asaduzzaman Miah, Mir Hussain Kabir, Md. Siddiqur Rahman Tanveer and M. A. H. Akhand, "Continuous Heart Rate and Body Temperature Monitoring System using Arduino UNO and Android Device". International Conference on Electrical Information and Communication Technology Volume 10. 1109/EICT.2015.7391943.

[6]. Harshavardhan B.Patil, Prof.V.M.Umale, "Arduino Based Wireless Biomedical Parameter Monitoring System Using Zigbee", International Journal of Engineering Trends and Technology (IJETT)-Volume 28 Number 7-October 2015 ISSN: 2231-5381.

[7]. Prof.Y.R. Risodkar. Prof. M. K. Sangole. Amruta.R. Vankhede. Ravi.S.Medhe. Jayashri.K. Shirsat, "Web Based Health Monitoring System", International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 4, Issue 1, January 2015, ISSN: 2278-909X.

[8]. Manisha Shelar, Jaykaran Singh, Mukesh Tiwari, "Wireless Patient Health Monitoring System", International Journal of Computer Applications (0975-8887) Volume 62-No.6, January 2013.

