ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 6, Issue 12, December 2017

Development of a Wireless Blood Pressure Monitoring System by Using Smartphone

Dr.R.Harini[1], Prof. B. Rama Murthy[2]

1. Teaching Assistant, Dept. of electronics, S.K. University, Anantapur, A.P, INDIA
2. Professor, ,Dept. of Instrumentation, S.K. University, Anantapur, A.P, INDIA

ABSTRACT--Telemedicine system is used for patient monitoring as well as diagnosis of diseases of remote area patients.Tele monitoring is a medical practice that involves remotely monitoring patients who are not at the same location as the healthcare provider. In emergency case of patient continuous monitoring of vital signs is necessary one of the most important vital sign is blood pressure. The proposed system objective is to develop a blood pressure monitoring device controlled by Arduino microcontroller. The software implementation is in a form of android app application.The proposed system attempts to design and implementation of patient monitoring in real time with wireless transmission via Wi-Fi.

Keywords--Blood pressure (BP), remote patient monitoring, Arduino, Android OS, Wireless health monitoring.

I. INTRODUCTION

Blood pressure is the pressure of the blood in the arteries as it is pumped around the body by the heart. When your heart beats, it contracts and pushes blood through the arteries to the rest of your body. This force creates pressure on the arteries [1]. Blood pressure is recorded as two numbers, the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats).

The systolic arterial pressure is defined as the peak pressure in the arteries, which occurs near the beginning of the cardiac cycle, the diastolic arterial pressure is the lowest pressure (at the resting phase of the cardiac cycle). The average pressure throughout the cardiac cycle is reported as mean arterial pressure, the pulse pressure reflects the difference between the maximum and minimum pressures measured [2]. The Blood Pressure values are reported in millimetres of mercury (mmHg)

Systolic Pressure (SP): The maximum pressure reached during peak ventricular ejection. Systolic pressure is the pressure generated when the heart contracts.

Diastolic Pressure (DP): The minimum pressure just before beginning of ventricular ejection Diastolic pressure is the Blood Pressure when the heart is relaxed.

Typical values for a resting healthy adult human are approximately 120 mmHg (16 kPa) systolic and 80 mmHg (11 kPa) diastolic written as, 120/80 mmHg. These measures of arterial pressure are not static, but undergo natural variations from one heartbeat to another and throughout the day, they also change in response to stress, nutritional factors, drugs, or disease. Hypertension refers to arterial pressure being abnormally high, as opposed to hypotension, when it is abnormally low along with body temperature. The Table-1 shows the normal healthy Blood Pressure ranges for adults aged 18 and older.

Age related normal healthy blood pressure range						
Age	Systolic BP (mmHg)			Diastolic BP (mmHg)		
	Mini	Average	Maxi	Mini	Average	Maxi
15 to 19	105	117	120	73	77	81
20 to 24	108	120	132	75	79	83
25 to 29	109	121	133	76	80	84
30 to 34	110	122	134	77	81	85
35 to 39	111	123	135	78	83	86
40 to 44	112	125	137	79	83	87
45 to 49	115	127	139	80	84	88
50 to 54	116	129	142	81	85	89
55 to 59	118	131	144	82	86	90
60 to 64	121	134	147	83	87	91

Table 1 Age related Blood Pressure range

The values of Blood Pressure vary significantly during the course of 24 hours according to an individual's activity. Basically, three factors namely, the diameter of the arteries, the cardiac output and the state or quantity of blood are mainly responsible for the Blood Pressure level.

In general the Blood Pressure measurement techniques are two types. They are

- Invasive (or) Direct Blood Pressure Measurement
- Non-invasive (or)In- Direct Blood Pressure Measurement
  a) Auscultator Method
  b) Oscillometric Method

II. DEVELOPMENT OF SYSTEM

The present design is a non-invasive Blood Pressure meter. The implementation of Blood Pressure meter device is by cascading several stages as shown in fig1 which depicts the system block diagram of Blood pressure measurement system. The block diagram consisting following blocks

1. Sensor and signal conditioning unit
2. Motor control unit
3. ATMEGA328 Controller

4. LCD display unit

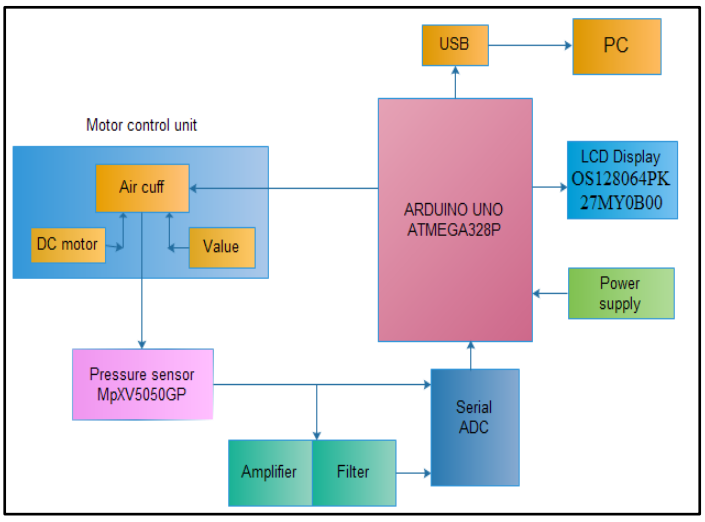

Fig 1 Block diagram of Blood Pressure monitor system

A. Sensor and signal conditioning unit

In this unit the pressure sensor senses the signals from the patient and transmits the signals to next stage of signal condition unit. The pressure transducer used is a piezoresistive pressure sensor, which generates a changing output voltage proportional to the applied pressure, with a measurement range from 0 to 50 kPa (0–7.3 PSI) with high accuracy. In present design MPXV5050GP pressure sensor is used [3]. The signals from pressure sensors are processed by using Arduino UNO ATMEGA328 micro controller. The processing unit consists of Amplifier with LM324, ADC and a comparator circuit for processing the signals from the sensor. The signal-conditioning unit consists of filter and amplifier circuits.

B. Motor control unit

In Blood Pressure measurement the motor control design is very important in this design, where we needed to on and off the motor at a correct time using micro controller ATmega328. The motor unit work with a Complementary power Darlington transistor MJD122T4, it is integrated anti parallel Collector-emitter diode and it is a form of complementary NPN - PNP pair. In this design MJD122T4 used as a switch to control a motor.

The system first turns on the motor and pump the air in to wrist cuff to maximum range. At this time, the micro controller processes the oscillation signal and records the pressure from the cuff pressure signal. The cuff is inflated and deflated using motors.

C.ATMEGA328 Controller

The present system atmega328 microcontroller is used to read the data which is read by the RFID reader and process further. Atmega328 is high performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter [4].The atmega328p any digital line is used for serial port read and write by software serial command. The serial lines are further connected to the Personal Computer through USB.

D. LCD display unit

The output of the device is sent to a liquid crystal display to display the data of systolic and diastolic Blood Pressure. In present design we are using LCD ofOS128064PK27MY0B00 OLED make. The display data sent to LCD through serially. The data line in the display is OSDIN and the clock for the device is OSCLK.

III. SOFTWARE IMPLEMENTATION

In present paper the ‘C’ and java languages are used for the development of Blood pressure meter. The ‘C’ programming language is growing in importance and has become the standard high-level language for real-time embedded applications. The PC is the standard computing device for the ‘C’ compiler. The development of C programs for an ATMEGA328 is executing on a PC by using Arduino IDE. The Android App and GUI development for Telemedicine system is implemented in Android studio. Fig2 shows the block diagram of implementation of present system.

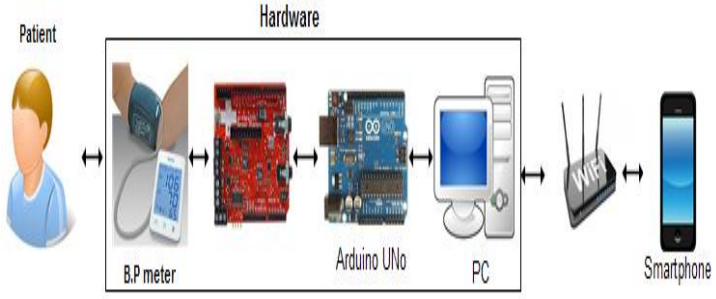

Fig 2 Block diagram of implementation of Blood Pressure monitor system

A.Arduino IDE

In present work The Arduino integrated development environment (IDE) is used to interface biomedical parameter ECG sensor. It is a cross-platform application written in C, and derives from the IDE for the Processing programming language [5] and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. Arduino programs are written in C or C++.

B.Android Studio

Android Studio is an integrated development environment (IDE) for developing on the Android platform with Android SDK tools. It is freely available and downloaded easily from internet. It is based on Jet Brains' IntelliJ IDEA software, the Studio is designed specifically for Android development. It is available for download on Windows, Mac OS X and Linux. Hardware’s that support Android is mainly based on AVR architecture platform [6].

The interface software program is written in Arduino IDE environment. The entire APP is developed using Android JAVA backend and front end is developed using XML on Android KitKat 4.4.2 Operating System.

C.XAMPP

XAMPP is used in present work for development of Database storage and maintenance of server. XAMPP stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing purposes. Everything you need to set up a web server – server application (Apache), database (MySQL), and scripting language (PHP) – is included in a simple extractable file [7]. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows.

D. Flow chart of Blood Pressure measurement development

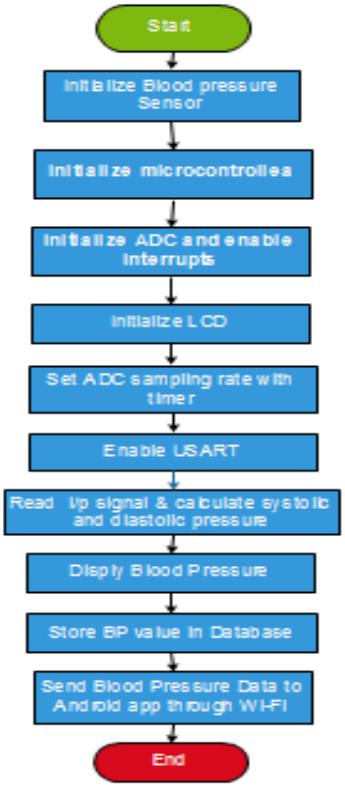

Fig 3Blood Pressure flowchart

E. Algorithm of Blood Pressure measurement development

1. Initialize Ports, LCD, Operational Amplifiers
2. Initialize LCD, memory
3. Initialize ADC sampling rate using timer
4. Initialize USART
5. Enable interrupts
6. Start the motor
7. Read the signals from the sensor and transmit signals to the amplifier
8. Convert analog signal to digital signal using inbuilt ADC
9. Calculate systolic and diastolic pressure
10. Display the signals on LCD
11. Store systolic and Diastolic pressure values in memory
12. Transmit signals to Personal Computer
13. Receive the sensor data in Arduino side and save it to the XAMPP database server.
14. To Start Receive the B.P value from XAMPP database and send it to GUI Android App.

IV. RESULTS AND DISCUSSION

Results are obtained using Arduino Uno, Android and a smartphone. The output of the B.P meter sensor is processed in Arduino Atmega328 controller and send to serial output in PC as shown in Figure-4.

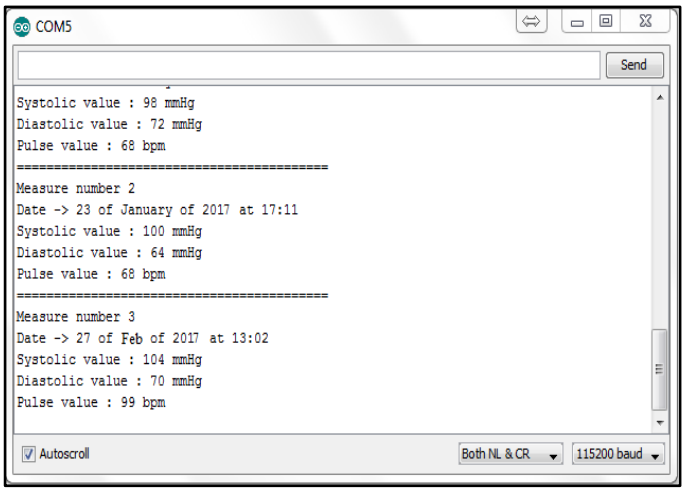

Fig 4 Arduino Uno serial output data

Practical tests have been conducted to evaluate the real time performance of the wireless Medical Diagnosis platform. The main aim and objective of this work is to develop an Android based Patient Care Monitoring system with B.P measurement. Hence an attempt has been made by the author to develop aB.P system using the advanced micro controller ATMEGA328 or Arduino UNO and Android development Tools.

The TCP/IP protocol suit is used to communicate between the server and Android mobile device to display the B.P values on a Smartphone screen in real time. The Blood pressure monitor displayed values on android Smartphone app is shown in figure5.

Fig 5B.P values display window on smartphone

V. CONCLUSION

The present paper presents remote patient monitoring system by using android Smartphone, which allows doctors to view his patient's vital parameter remotely and dynamically at real time. In present work the system used B.P meter sensor, microcontroller & Android technology to transmit data wirelessly in Smartphone, as great use in the field of medicine and helps the Doctor to keep a keen eye on the patient's health. So a system is used to monitor the overall health status of a patient, which needs constant care, the data at receiver which can be used to analyse the patients overall health condition. Thus the systolic, diastolic & pulse rate values measured from the sensor can be displayed on doctors Smartphone and simultaneously stored in database.

REFERENCES

[1] MacDougall JD, Tuxen D, Sale DG, Moroz JR, Sutton JR. Arterial blood pressure response to heavy resistance exercise. J Appl Physiol.; 58: 785-790. 1985.

[2] Wagner S., Toftegaard T. S., Bertelsen O., (2012) "Challenges in Blood Pressure Self-Measurement", *International Journal of Telemedicine and Applications*, vol. 2012, Article ID 437350,

[3] Motorola Inc. Pressure Sensor Device Data, 2003.

[4] Atmega328P controller alldatasheets.com

[5] http://arduino.cc/en/Main/arduinoBoard

[6] "Download Android Studio". *Android Developers*. Retrieved June 13, 2016.

[7] http://www.oracle.com/us/products/mysql/overview/index.html