Bluetooth-Based Remote Monitoring of Medical Condition

Tejashree Vaidya[1], Pradnya Patil [2], Shwetali Rajput[3], Swapnila Saindane[4], Kavita Thorat[5]

[1, 2,3,4,5] B. Tech Student, Veermata Jijabai Technological Institute, Matunga, Mumbai, 400019, India
tejashree.vaidya@gmail.com
pradnyapatil100@gmail.com
shwetalirajput27@gmail.com
swapnila61@gmail.com
kavitathorat124@gmail.com

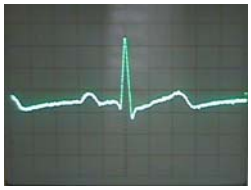
Abstract: ***Remote monitoring through wireless devices is bringing about rapid development in the field of technology for biomedical applications. This system is designed to keep a check on the patient's temperature and to monitor his or her electrocardiograph, from a relatively remote location using Bluetooth. This enables the doctor to keep a check on the patient from time to time, from the convenience of his cabin. The doctor can monitor the medical condition of a multiple number of patients at a time, from a Bluetooth-enabled device. Further, up gradation of the system is possible, to measure blood sugar level, blood pressure. Wireless communication maybe achieved over a larger range by using suitable wireless communication methods.***

Keywords: Remote, Wireless, Bluetooth, Medical, ECG, Monitoring

1. Introduction

An ECG converts heart's electrical activity into a waveform which enables us to read and comprehend electrical activity of the heart. The ECG helps us to find the cause of chest pain which may be due to impending heart attack, inflammation of sac surrounding the heart or other such reasons. It also helps us to monitor the working of mechanical device such as pace makers which are implanted in heart to ensure the normal heart beat. Further, it helps to check the health of heart in presence of conditions like high blood pressure, high cholesterol and diabetes. In general, more than two electrodes are used for ECG measurement, and they can be combined into a number of pairs. Left arm (LA), right arm (RA) and left leg (LL) electrodes form the three pairs LA+RA, LA+LL, and RA+LL). The output from each pair is called as a **lead**. Each lead surveys the heart from a different angle. Different types of ECGs are based on the number of leads that are recorded, for example 3-lead, 5-lead or 12-lead ECGs. A 12-lead ECG is one in which 12 different electrical signals are recorded at approximately the same time. Three- and 5-lead ECGs are usually monitored continuously and viewed on the screen of an appropriate monitoring device, in an Intensive Care Unit, during an operation or in the process of being transported in an ambulance.

In this system, a 3-lead ECG has been used. Further temperature monitoring is done so that fever maybe detected by the doctor from a distance. A general ECG waveform is depicted as shown.



The normal cardiac cycle begins with spontaneous depolarization of the sinus node. The sinus node is an area of specialized tissue situated in the high right atrium (RA). A wave of electrical depolarization then spreads through the right atrium and across the inter-atrial septum into the left atrium (LA).

The atria are separated from the ventricles by an electrically inert fibrous ring. As a result, the only route of transmission of electrical depolarization from atria to ventricles is through the atrioventricular (AV) node. The AV node delays the electrical signal for a short time, and then the wave of depolarization spreads down the interventricular septum (IVS) into the right (RV) and left (LV) ventricles. Hence the two ventricles contract simultaneously. This is important in maximizing cardiac efficiency.

After complete depolarization of the heart, the myocardium re polarizes, before it can be ready to depolarize again for the next cardiac cycle. Due to the leftward orientation of the heart in the chest and the greater muscle mass of the left ventricle, the direction of the wave of depolarization is normally towards the left. When the wave of depolarization travels toward a recording lead this results in a positive deflection. When it travels away from a recording lead this results in a negative deflection. This is the fundamental principle of ECG recording.

For temperature measurement, temperature sensor LM35 gives an uniform variation in ADC values with rise or fall in temperature.

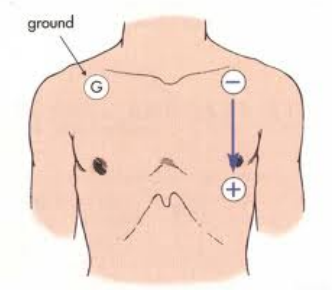
2. Ease of Use

While the conventional ECG monitor is an excellent heart monitoring device, it has certain challenges associated with it. In recent times, healthcare wireless systems are being developed. In an ECG monitoring system, when patients are tethered to their bedside ECG monitor, their movement is naturally restricted. Patient safety is compromised during ambulation. Another limitation of conventional ECG is improper acquisition of data due to the lead wires rubbing against each other. There may be poor transmission signal in lead wires. Tangling of lead wires may pose a problem and considerable time maybe spent in attaching and detaching lead wires.

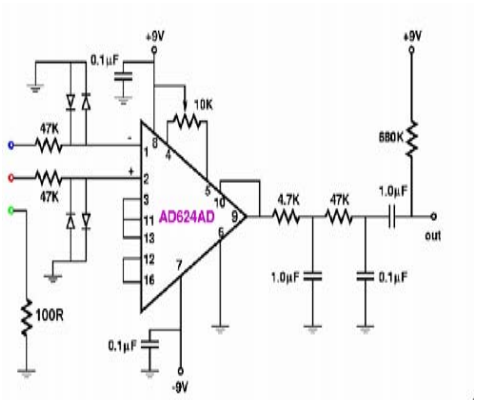
A wireless ECG monitoring system, on the other hand, would do away with the use of wired communication. It will allow mobility of the patient and provides reliable data through wireless communication. Monitoring of other medical parameters is also done, from a remote place, to allow the patient to move freely. This ensures that medical monitoring is possible whenever required.

3. Design and Operation

This system is designed to remotely monitor medical parameters, temperature and electrocardiograph, by transmitting the required data through Bluetooth.



The instrumentation amplifier AD624 circuitry provides a pin programmable gain of 1000. This is obtained by connecting Pin 3 to Pin 11. Pins 13 and 11 are shorted. Pins16 and 12 are shorted. Since AD624 provides a high CMRR (130 dB minimum for gain= 500 to 1000), noise rejection is sufficient for this application.



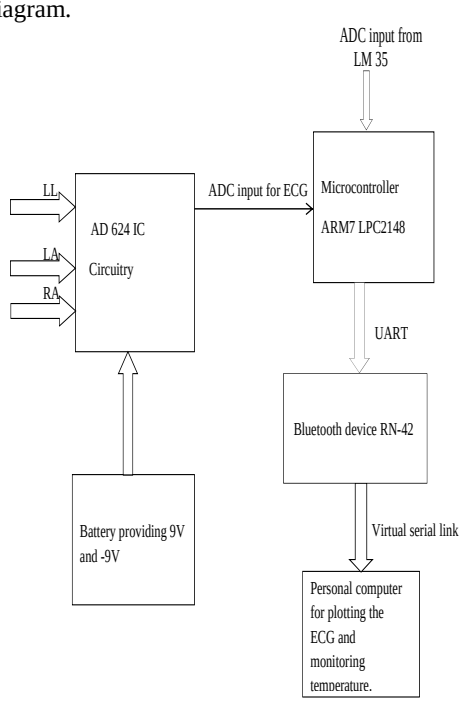
The diodes are used for overvoltage protection. A high voltage may appear at the input because of shorting it to the supply voltage. Any high voltage picked up at the inputs may cause damage to the circuit. This high voltage maybe transient, in the form of a spike or it may last over a longer period. To provide protection from such voltages, the diodes are connected, to shunt the current, on application of a large voltage. 100R indicates a resistance between the terminal and ground. Low pass filters are used at the output to filter the higher frequency signals in the output.

At the output of the AD624 circuitry, we get differential amplified signal which maybe fed as the ADC input to the processor ARM7LPC2148. This signal is found to be in the range of 900mV-1200mV. Hence it is suitable to be processed by the ADC of the ARM processor. It is connected to the pin 28 of port 0.

The TXD pin (Pin 0 of Port 0) is connected to the RX of the RN42 and RXD pin (Pin 1 of Port 0) is connected to TX of RN-42. UART transmission functions are defined. On transmission through UART, data reaches Bluetooth. The Bluetooth device RN-42 is added on the computer. A virtual serial link is established on port COM3. Data from COM3 is used for plotting the ECG waveform. Microsoft Visual Studio is used, here, to check the ECG data in the form of a waveform.

The two pins of LM35 are connected to supply voltage and ground terminals. Its third pin, which gives output voltage, is connected as the ADC input of the processor. The change in digitized value is observed for a unit rise in temperature. Accordingly, calibration is achieved. It is then possible to display temperature.

A detailed layout of the system is as shown in the block diagram.



Block Diagaram.

After ECG data is transmitted to the computer, it is plotted in Microsoft Visual Studio.

4 Applications and Future Scope

Wireless monitoring of temperature keeps a check on the patient and helps the doctor know when the patient is ill. ECG monitoring finds applications in professional healthcare sector and consumer sector. Professional heath care sector involves applications like defibrillators, automatic external defibrillators, holter monitor etc. Consumer sector includes commercial fitness equipment, home products etc.

This system can be upgraded so that it is used in applications to monitor patients located in remote places using wireless devices such as GPRS depending upon how far the patient is located. According to the requirements of the patients, unique systems can be designed to measure only the required biomedical parameters such as blood pressure, blood sugar, temperature, heartbeat, ECG. Scaling down the system ensures that it is portable and the patient can carry it with him wherever he goes.

5. Safety Protocols

It is necessary that anyone who wishes to implement or use this application should pay heed to safety protocols. When you connect your body to any electronic device, you must be much more careful than you usually are with your standard home electronics, because it can be extremely easy to cause a serious and even fatal electric shock. Placement of the electrodes on the body provides an excellent path for current flow — the measured impedance between leads L1 and L2 is approximately 50 k ohms. Professionally built medical devices are built with significant overvoltage protection so that line power glitches do not represent a hazard to patients — for this application diodes are used to provide limited over–voltage protection. To further increase safety an opt isolator integrated circuit could be added to the existing circuit so that the subject is completely isolated from the power supply. It is not recommended that you use this ECG device during an electric storm. You should not attempt to use such a setup as that described here unless you are knowledgeable about and comfortable with using electricity in a safe and controlled manner.

6. Conclusion

This paper illustrates the system for Bluetooth based remote monitoring of medical condition in terms of Electrocardiograph and temperature of patients. The system provides medics with information about potential diseases or threatening cardiovascular conditions. Getting accurate measures is of the utmost importance in such instances, especially if the patient has history of heart disease. The doctor can monitor the medical condition of a multiple number of patients at a time, from the convenience of his cabin.

7. Acknowledgment

The authors would like to thank Prof. Amutha Jeyakumar, Electrical Engineering Department, Veermata Jijabai Technological Institute for her valuable guidance and support.

References

[1] .Hongjun, Sun ; Peng Xuange ; Fengling, Huang , “Bluetooth Data Acquisition System Based on ARM,” IEEE Trans. Education Technology and Computer Science, 2009. ETCS '09. Volume: 1. Publication Year: 2009 , Page(s): 872 – 875
[2] www.picotech.com
[3] www.southsudanmedicaljournal.com

Author Profile

Tejashree Vaidya pursuing BTech Electronics in Veermata Jijabai Technological Institute, Mumbai.

Pradnya Patil pursuing BTech Electronics in Veermata Jijabai Technological Institute, Mumbai.

Shwetali Rajput pursuing BTech Electronics in Veermata Jijabai Technological Institute, Mumbai.

Swapnila Saindane pursuing BTech Electronics in Veermata Jijabai Technological Institute, Mumbai.

Kavita Thorat pursuing BTech Electronics in Veermata Jijabai Technological Institute, Mumbai.