

# Wireless ECG Monitoring System using Mobile Platform PandaBoard

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## Abstract

Doctors usually rely on ECG during decision of heart health. An ECG is measures regularity of heartbeats identify any damage to the heart and devices used to regulate the heart. It is very useful for monitoring people with impairments in their cardiac activity. The current death rate due to heart attack is about 25% of the total deaths in India. The main cause of heart attack death is the lack of proper diagnosis at the right time. For on sight a diagnosis doctor has to carry a bulky instrument which plots ECG of patient. The proposed work helps to overcome this problem. With the advancement in Arduino and mobile technology, it is possible to design a portable ECG device which capture ECG of patient and monitor it on mobile platform. This paper goes over low power Lilypad, mobile platform Panda board and zigbee technology to couple ECG over mobile board.

## Keywords

*ECG electrodes, ECG amplifier, Lilypad Arduino, Lilypad zigbee, Pandaboard.*

## 1. Introduction

Electrocardiograms have long been used in the hospitals and many health care centers to diagnose cardiac activities and screen for heart disease. ECG is used to measure the heart rate and regularity of heartbeats, as well as the size and position of the chambers, the presence of any damage to the heart, with impairments in their cardiac activity and the effects of drugs or devices used to regulate the heart, such as a pacemaker [1].

Throughout the decades, there were a number of attempts to develop clinical information systems which are reliable, affordable and accessible over the entire hospital. The situation is made possible today with the development in the wireless technology, powerful personal computer technology, and international standards. These factors also have enabled data from a wide range of medical equipment, such as electronic stethoscope and ECG machine, to be connected into a common information system environment. Research which aims to provide continuous monitoring of patients anywhere within the hospital environment needs to be developed [2]. For generating an ECG signal requires the use of electrodes to be in contact with the human body where these electrodes measures the bio potentials emanating from the heart. The ECG sensor measures voltages that are produced by the

heart. These small voltages can be measured at the skin of the wrists (Right, left) and leg through electrodes. The voltages are amplified by the amplifier and transferred to a measurement interface [3].

Electrocardiogram (ECG) is one of the most frequently used and accurate methods for measuring the heart regularity. ECG is an expensive device and its use for the measurement of the heart rate only is not economical. The devices in the form of wrist watches are also available for the measurement of the heart rate. Such devices can give accurate measurements but their cost is usually in excess of several hundred dollars [4,5,6].

The aim of this paper is to give overview of developing a small wireless sensor system to make the patient more mobile without losing the reliability of the ECG sensor. Wireless patient monitoring has become a advance technology and a next step in this progress is to develop a reliable, flexible ECG system that contributes to the cable reduction in clinical and physiotherapy environments. The main focus is to create a reliable small wireless ECG sensor system at low cost [9]. The proposed work is focused to design Portable ECG monitoring system with a wireless transfer of ECG data. With the advancement in Arduino and mobile technology, it is possible to design a portable, low power ECG monitoring instrument which captures an ECG of patient and display it on mobile platform. The proposed work uses low cost & low power Lilypad, mobile platform Panda board for monitoring of ECG.

## 2. Literature Survey

The recent year has emerging a significant surge of interest in sensing, monitoring and diagnosis in healthcare. The monitoring and acquisition of patients' physiological information are quite important for the further treatment. Many patients can benefit from continuous monitoring as a part of a diagnostic procedure, optimal maintenance of a very bad condition or during supervised recovery from an acute event or surgical procedure [2].

Now-a-days cardio vascular diseases are a serious problem to almost everyone. The reasons for it can be many, from the current lifestyle of people all around the

world to the reluctant or genetic problems. Nevertheless the need of a proper care and medication has been felt to the people who are suffering from such illness. We have seen through various researches that most of the deaths and impairments in human activity caused by these diseases are due to untimely treatment or lateness of help through emergency medical services. [12]

The monitoring of absolutely necessary physiological signals has proven to be one of the most efficient ways for continuous monitoring of health status of patients [13]. Electrocardiogram monitors are often used in many health care centers and hospitals to diagnose and monitor a person's health status by measuring and detects any abnormal changes occurs in their cardiac activity. An Electrocardiogram is noninvasive monitors, which can be utilized to evaluate the heart related activity, measure the heart rate, regularity of heartbeats, the position of the chambers, and identify any damage to the heart. This procedure is very useful for monitoring people susceptible to impairments in their cardiac activity. In addition, during surgical procedures, the Electroencephalogram is measured along with his/her ECG to track the consciousness level of a patient during diagnosis. Other physiological parameters such as electromyography and blood pressure, oxygen saturation in hemoglobin, similarly provide vital information about the health of a given person when continuously monitored.

The most relevant challenges are related with wireless technology and portable systems intelligence. Related to applications, the survey remarks the idea of zigbee as the base of the wireless and portable paradigm, but other technologies are expected to emerge in order to bring the paradigm to real-life applications. Electrocardiogram is one of the crucial aspects when it comes to monitoring health and conditions of human body. Identifying two ones which they believe can play a leading role in the adoption of wireless technologies related to ECG: Health Monitoring system and Hospitals. An already implemented solution is presented by Chulsung Park and Pai H. Chou as Portable electrocardiograph monitoring systems today use electrodes that require skin preparation in advance, and require gels to make proper electrical contact to the skin [14]. Moreover, they are not suitable for subjects at high levels of activity due to high noise spikes that can appear in the data. To address these problems, a new class of miniature, ultra-low noise, capacitive sensor that does not require direct contact to the skin, and has comparable performance to gold standard ECG electrodes, has been developed. In [14] Naazneen M. G describes the design of a simple 3-lead Electrocardiogram (ECG) monitoring and heart rate measurement system with LCD output. Due to the characteristics of wireless networks, they are getting an important place in e-Health applications and assisted living. Portable and wireless systems are flexible to

integrate into health environments, not intrusive, not high priced, small, easily portable, and, in some cases, wearable.

### 3. METHODOLOGY

Proposed system overview is shown in Figure 1 & 2. A circuit uses LilyPad Arduino which will be connected to the ECG electrode and transmits using zigbee device. Pandaboard connected at receiver side. Detailed description of the sender and receiver is specified below

#### 3.1 At the sender

The data acquisition part of the monitoring system concerns with the development of ECG sensor board which consists of ECG electrodes and signal amplifying circuits. Sensor leads will detect the weak electric signal generated by the beating of the heart. Amplifier used to convert microvolt signals to millivolt. This task is to acquire the data from the human body, amplify and filter the signal before it is sent to LilyPad Arduino. A main board, which runs on 2.7-5.5 V and comprises an ATmega328V microcontroller, a reset switch, a 10-bit analog-to-digital converter. LilyPad Arduino circuit is for handling the acquired data and then transmits it to the data monitoring part. The LilyPad TX port is connected to zigbee breakout RX port. The zigbee breakout, which has been powered by same power supply as the LilyPad, carries out a zigbee module. Figure 1 represents sender section.

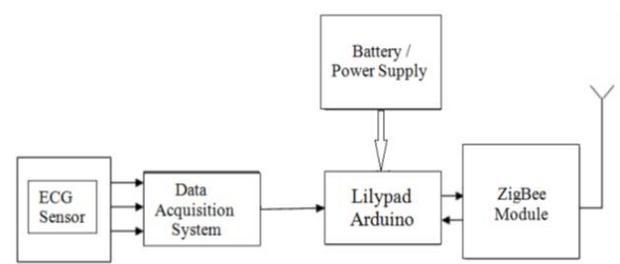


Fig.1 Sender (ECG monitor) Architecture

#### 3.2 At the receiver (Pandaboard)

Receiver function is shown in figure 2. The receiver receives the data send by the circuit using zigbee and it will display the ECG on its screen. Voltage rating of zigbee is 3.3V. But the output voltage from UART port is 5 V. Hence level shifter needs to drop voltage level from 5V to 3.3V. . The Pandaboard is an open source mobile software development platform and is a one-of-a-kind, low cost, open mobile software development platform that enables fast, easy and highly extensible development.

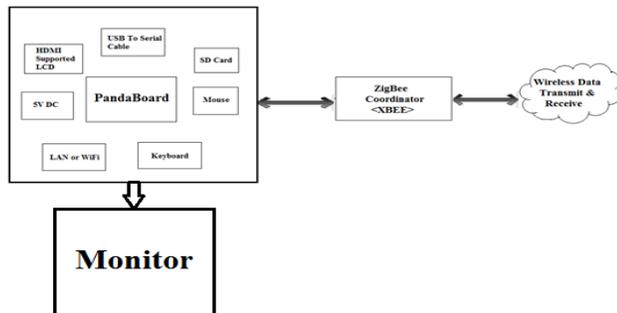


Fig2. Receiver (Android phone) Architecture

## 4. SYSTEM DESIGN

### 4.1 Drawbacks of Existing Systems

1. Somebody has to watch over the reports for abnormality which is time consuming process
2. Some of them take reading only at the time of heart attack by pressing a switch, which won't be of much helpful to detect person's cardiac activity.
3. Report should be uploaded to a computer for transferring it to the health care center.
4. The ECG monitor which has automatic detection algorithm is bulky and costly

The proposed prototype is a portable ECG monitor based on Pandaboard which is mobile platform device. A patient will wear the mobile ECG monitor that gathers heart rhythm data and transmits it wirelessly from Lilypad Arduino to Pandaboard for storing and monitoring. Since the Pandaboard is based on Linux it will be easy to port it to other Linux based platforms like PC or PDA etc.

### 4.2 Advantages

1. Monitoring the functioning of cardio vascular activity of a patient
2. Lilypad Arduino used for providing low cost solution & portable device.
3. For transceiver purpose zigbee protocol used which is superior to Bluetooth technology.
4. Mobile platform PandaBoard is used to provide mobility to the instrument.

## 5. Conclusion

For onsite diagnosis of a patient, doctor has to carry bulky ECG instrument. With the advancement in Arduino and mobile technology, it is possible to design a portable, low power ECG monitoring instrument which captures an ECG of patient and display it on mobile platform. This paper gives brief overview of portable ECG system which uses low cost & low power Lilypad, mobile platform Panda board for monitoring of ECG.

## Acknowledgement

I would like to express the deepest appreciation to all those who are involved directly or indirectly in this work. First and foremost, I am sincerely thankful to Dr. S. R. Gengaje, Head of Department of Electronics engineering Walchand Institute of Technology Solapur, for his invaluable support, suggestion and constant help to complete this work in a successful manner. I would like to convey our sincere thanks to management and supportive staff of Walchand Institute of Technology, Solapur for encouraging us to come up with this paper work.

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