



Intelligent ECG Diagnostic Decision Support System with Low-Cost Cardio-Care System

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Abstract: *Electrocardiogram gives detailed information about cardiac health of the person. The deviations in the normal electrical patterns indicate various cardiac disorders. Medical treatments given to patient are totally depend upon diagnosis of ECG signal. But there are several limitations while Diagnosis of ECG signal is performed. Now day's medical communities facing major problems regarding ECG diagnosis are: Real time monitoring and short time span for diagnosis. In this study, design of system is proposed to overcome these problems with aid of technology. The system mainly consists of two parts: real time ECG monitoring and computerised diagnosis decision support system (DDSS). Real time ECG monitoring includes ECG acquisition module, wireless transmission module and doctor's workstation. At doctor's workstation, diagnostic decision support system is built on MATLAB platform which helps in clinician for diagnosis.*

Keywords: ECG, ECG Diagnosis, Real time ECG monitoring, DDSS.

I. INTRODUCTION

As the health problems are unpredictable in this polluted environment, it is better to keep an eye on our health. Now a day's advanced technologies are used in medical fields at greater extent to provide better diagnosis. As far as cardiovascular disease is concerned, it is the main cause of death across the world. According to estimate given by world health organisation (WHO), 23.3 million people will die annually from CVD to 2030[1]. Cardiovascular diseases kill almost seventeen million people over globe each year, out of these 80% deaths takes place in low and middle income countries. The death rate is high at the remote places of these countries because of inadequate number of medical expertise, inaccurate diagnosis and poor medical facilities. Basically to resolve these problems, there is need to design such a system which gives real time diagnosis within short period of time without visiting to doctors workstation. The proposed system in this study consists of mainly two parts: Real time ECG monitoring with help of low-cost cardio-care system and Diagnosis decision support system. ECG data communication of the patient located at remote place with doctors is done with GPRS platform. The GPRS is preferred over other due to its advantages such as range, data rate, efficiency etc. Low cost cardio-care system consists of ECG acquisition module, wireless transmission module, doctor workstation module. While at the time of diagnosis to reduce time constraint, diagnosis decision support system is used which helps clinician for diagnosis.

II OVERALL SYSTEM DESIGN

Figure 1 shows the basis block diagram of proposed system. The system is divided into two parts: cardio-care system and diagnosis decision support system.

III. HARDWARE DESIGN AND IMPLEMENTATION

Low-cost cardio-care system is used real time ECG monitoring and transmission at the doctor workstation. This consists of ECG acquisition system, wireless transmission module.

A. ECG Acquisition Module

The ECG Acquisition module is used to acquire ECG signal from three lead connected to patient body. To make system cost effective only three leads are used. The ECG signal is acquired through leads is processed by cardio care unit. Figure 2 shows ECG Acquisition module. It include following parts:

1. Instrumentation Amplifier

The ECG signal acquired from body is quite weak, so that amplifier is required. But at this stage noise along with the ECG signal is present. The amplifier gain is kept low so that noise is not getting amplified to greater extent. The IC AD620 is used as instrumentation amplifier having high accuracy, low power design. Gain of AD620 is controlled by only one register.

2. High Pass Filter

Baseline noise affects ECG signal and it has frequency of 0.5 Hz. Hence it is required to pass all the frequency components above 0.5 Hz and block all components below 0.5 Hz. For this high pass filter is designed with IC

OP07 having cut-off frequency 0.5 Hz.

3. Notch Filter

In order to remove power line noise of 50 Hz frequency, notch filter is designed with IC OP07.

4. Low Pass Filter

ECG signal has bandwidth 0.05 Hz to 150 Hz. So, it is necessary to block all the frequencies above 150 Hz and pass all the frequency components below 150 Hz. So low pass filter is designed with OP07.

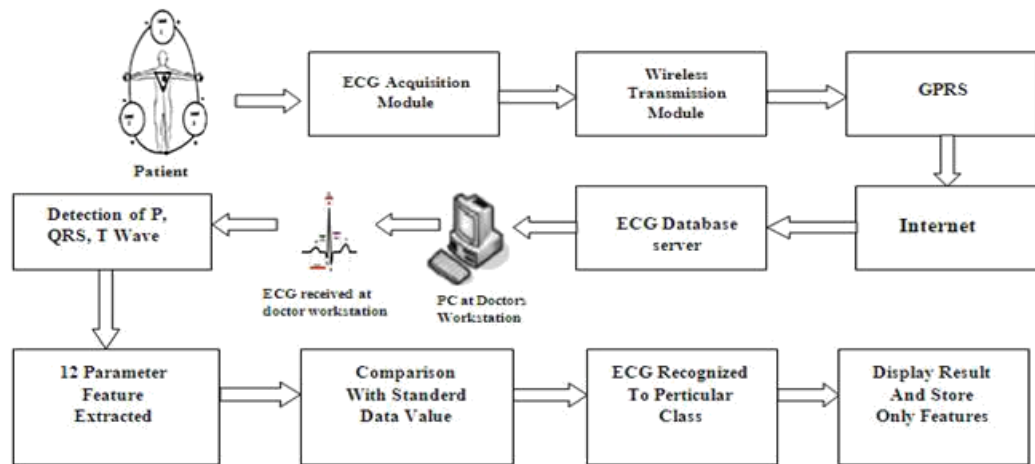


Fig.1 Design of Proposed System

B. Wireless Transmission Module

The wireless transmission of ECG data is realized through SIM900 module controlled by PIC 16F877A controller. SIM900 set up wireless connection between doctor's Workstation and remote located patient.

1. PIC 16F877A Controller

The PIC16F877A having excellent features like 256×8 byte EEPROM, 368×8 byte RAM, 8000×14 word flash data memory, only 35 instructions which make it ideal for more advanced level applications.

2. SIM 900 Module

SIM 900 is designed by SIMCom Company with tiny configuration $24 \text{ mm} \times 24 \text{ mm} \times 3 \text{ mm}$, operated by AT commands. During transmission, SIM900 set up connection between doctors workstation and remote located patient.

IV. DISEASE DIAGNOSIS SUPPORT SYSTEM

When the ECG data is received at the doctor's workstation, analysis of ECG is done with the help of disease diagnosis support system (DDSS). This system extracts the features of ECG signal on the basis of amplitude and time. It is compared with the standard values of extracted parameter.

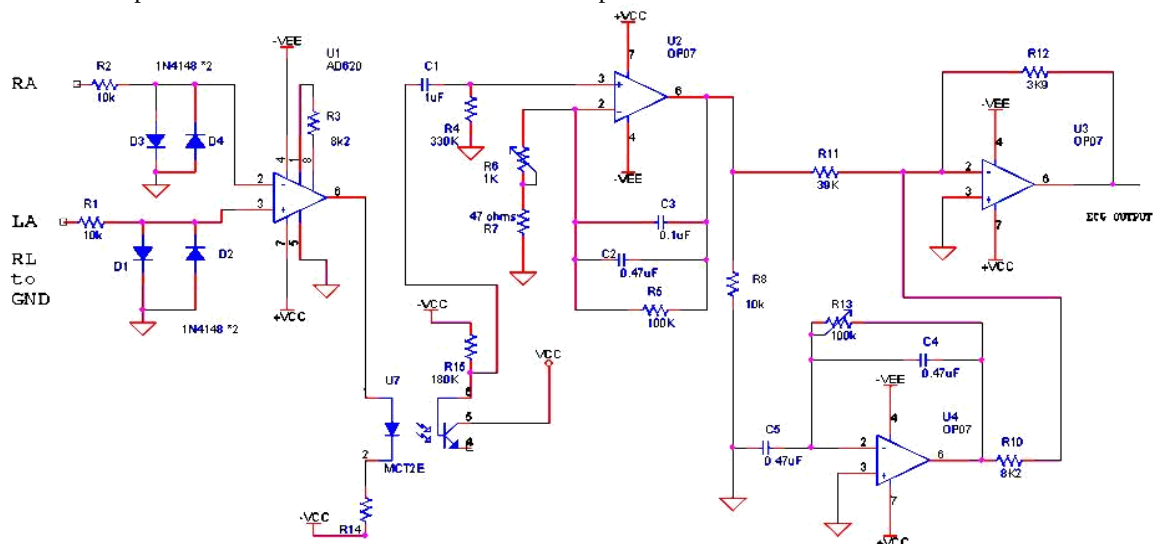


Fig.2 ECG Acquisition Module

According to comparison, ECG is classified into particular class of disease. This system contains following steps.

A. Detection of P, QRS, T Wave

For extraction of the features, reference points are to be selected. Basic parameter is P wave, QRS complex, T wave. In this stage detection of P, QRS, T waves is done. The interval between different waves (R-R, S-S, Q-Q, and T-T) is calculated in terms of the no of samples. This no of samples is calibrated in terms of time.

B. Feature Extraction

After detection of different waves and its intervals of ECG signal, features are extracted with their amplitude and time.

C. Comparison with Standard Values

For various diseases, these feature values are deviated from their actual values. Depending on this deviation, ECG signal compared with standard values for a disease. Then it is classified into particular class of the disease.

D. ECG Recognition

Depending on comparison, ECG is classified into particular class. In ECG recognition, ECG signal is recognized into particular class of disease and display that particular disease as result in o/p.

V. RESULTS

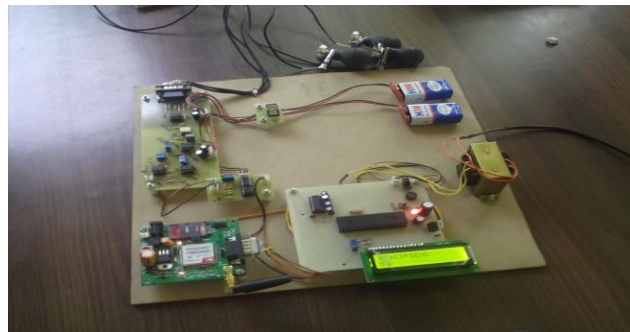


Fig. 3 Cardio Care System

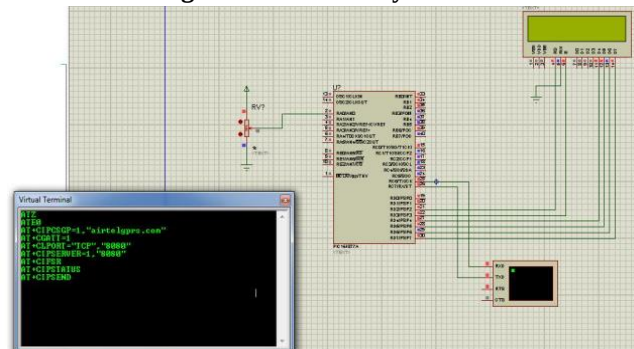


Fig. 4 Simulation Results of SIM900

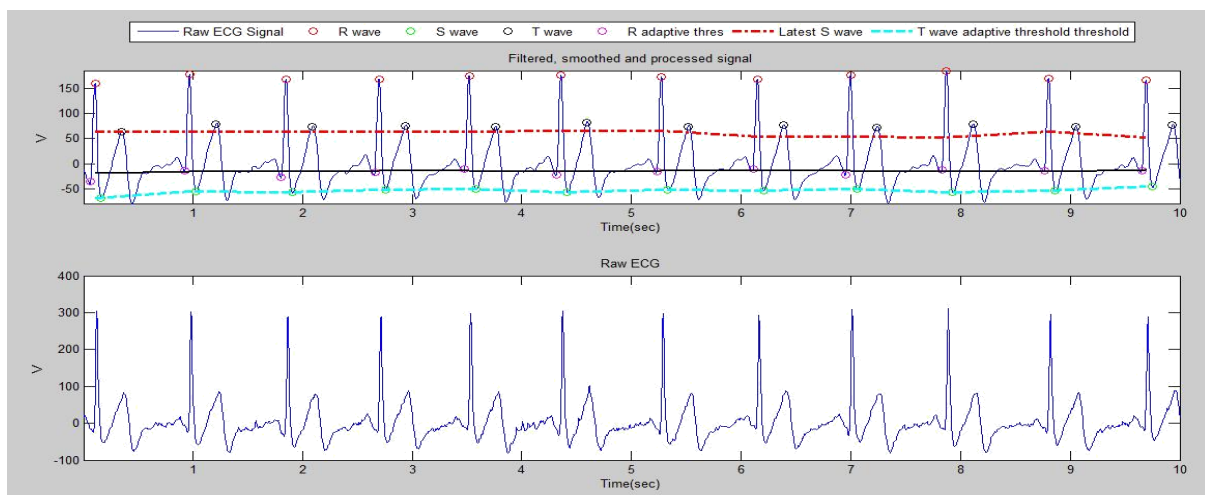


Fig. 5 Detection of P, Q, R, S, Points

VI. CONCLUSION

In this study, the complete low cost system for ECG monitoring and analysis is proposed. To make system cost effective and reliable, minimum no of resources are used such as 3 leads, IC AD620, IC OP07 etc. ECG signal is transferred to doctor's workstation successfully by using

GPRS platform. This system is suitable for remote located patient where medial experts are not available. To make analysis time consuming, diagnosis decision support system (DDSS) is designed at the doctor's workstation. This will extract the features from ECG signal. Depending on this feature ECG signal is analysed for various diseases. For various diseases we are using Database. With these facts, the proposed system is useful in financially weaker regions in developing countries.

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