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Digital Stethoscope using IOT

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Abstract

Stethoscope is an important device for detecting and analyzing heartbeat. For this respect we've developed a tool that would show heartbeat graphically on computer also as in Android OS based cell phones. Analyzing the data software would tell Heartbeat per minute and prescribe initial steps to do. The device is especially developed for a user-friendly cardiac monitoring system. Using this, heart disease and pulmonary diseases would be possible from the analysis of the software. The main goal of this project, the patient and the doctor can hear the patient heartbeat and doctor can identify the patient health. This would also help doctors maintaining regular check-up and release patients from the value and complexity of diagnosis. This is a price efficient, user-friendly and reliable biomedical system.

Keywords: Digital stethoscope, heart sound, ECG, Mel frequency cepstral coefficients (MFCC).

I. INTRODUCTION

The information of myocardial contractility and also to the blood vessels present in the body is provided by it, which cannot be received by the use of Electro cardiogram (ECG). The conventional method of analyzing heart sounds is known as phonocardiography (PCG) where a microphone, normally placed on the chest, is used to record the sounds, which can be analyzed by a doctor. Each heart cycle consists of two major sounds: S1 followed by S2. Other sounds and murmurs can indicate abnormalities.PCG has been used broadly for diagnosis of certain cardiac conditions and, in the later part of the 20th century, has received attention by the engineering community with the goal.

Thus, the purposed of this study is to develop portable digital electronic stethoscope that can objectify and quantify heart sound as well as murmur. The stethoscope is the basic tools for diagnosing in the present medical world. The heart sounds are being generated by the beating of heart and the flow of blood during the circulation in it. It then collects and analyses the basic information of patient's related to cardio respiratory system. Heart Diseases are the reason of untimely death and it has been termed to be the reason behind the high mortality factor that comes second to the stroke that prevailed in the present day's world. A Heart sound stethoscope is the most primary stage to access for a physician.

Generally a stethoscope is an acoustic instrument used in medical world for listening to internal sounds that are produced in a human body. Some present day researchers have concluded that a heart-rate profile which is abnormal during the time of exercise may lead to sudden death sometimes. Nowadays the cardiovascular diseases that keep on increasing every year, and it has become worldwide concern that is common and very high prevalent disease.An electronic stethoscope that will work digitally will change the way of auscultation the sounds related to heart. Then it will show the analyzed results on the screen.

II. PROPOSED SYSTEM

In the proposed system, the vital health parameters like Electrocardiograph (ECG), Heart Beat rate, and heart beat sound of patient are collected and evaluated through the use of smart devices. Next the android application of the system displays this data

about vital statistics on a Smartphone of a doctor enabling him to receive the current status of the patient by receiving the corresponding PQRST waves received via IOT.

Whenever there is a variation in any physiological parameter of a patient beyond a pre-assigned threshold value, an automated notification will pop up in doctors' android mobile application. The user can hear the heart beat sounds of the patient through a speaker connected with microcontroller.

Advantages:

Cost effective and reach maximum number of users using android OS. Just by using mobile App we will monitor heart beat and obtain suggestions on situation.Now a day, ECG report and heart beat signals are the most prioritized input for detecting heart diseases and other health issues. Stethoscope plays a major role in detecting heart disease. Here we are using IOT as a technology for minimizing travel and cost for analyzing ECG reports. It is helpful for doctors to listen the heartbeat and analyze the ECG for the registered patients.

1. Heart Beatacquistation and Listening Module

   The heart beat sound once recorded in stethoscope and amplified and then send to the Arduino microcontroller. The heart beat signals are removed from noise for getting a clear sound is done by using MFCC (Mel Frequency Cepstral Coefficient) programmed in Arduino microcontroller. The sound signals are then send to the speaker so the care takers and patients can hear it.

2. Heart Beat Listening Via Gsm Module

   Once the sound signals are pre-processed the signals are transfer to the GSM module. The doctors can hear the heart beat sound by getting a voice call from the GSM sim connected to the GSM module.

3. Generating ECG Using Think Speak Iot Module

   Here we are using Thing Speak IOT platform to connect to the doctor's dashboard that are present in the remote location. So this is a cloud link preferably used for processing IOT data. The patient should hold the pulse rate sensor which works on the principle of light modulation by blood flow through finger at each pulse. The sensor data is sent to the microcontroller which is connected to the doctor's mobile paired with node MCU. The corresponding PQRST waves are generated for each pulse and it is showed in the doctor's dash board.

III. EXPERIMENTAL WORK AND RESULT

A real-time wireless stethoscope system was designed. The initial requirements were:

1. The system must send audio over IP networks, requiring an Internet connection.
2. It must preserve the standard of cardio-respiratory sounds, allowing adapting the binaural pieces and therefore the chest-piece of ordinary stethoscopes.
3. Cardio-respiratory sounds should be recordable at both sides of the communication.

The scope of the digital tele-stethoscope, similar to the one used for examining the patient, allowing the user real time analysis of the captured sound at the other end. This destination is the recommended in telemedicine.

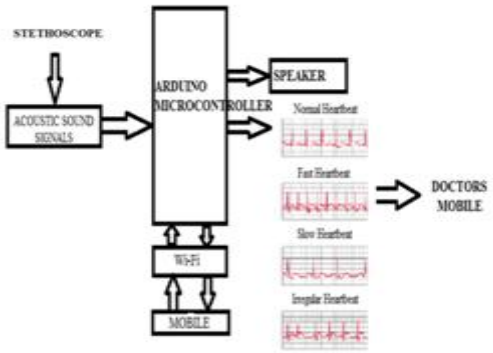

Figure1: Architecture diagram.

Stethoscope is to be placed on patient's chest. The amplifier connected to the stethoscope that amplifies the signals and sends the sound signals to the Arduino microcontroller. The sound signals are then forwarded to the GSM modem. The doctors can hear the corresponding heartbeat of the patient. The doctors can hear the heart beat sound and came to know about severity of the patient.

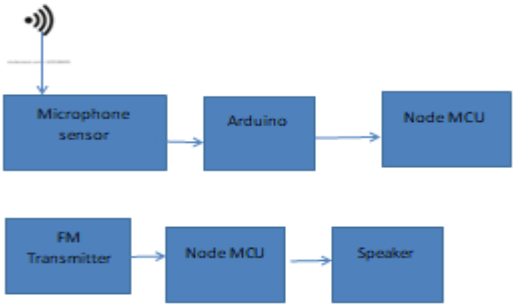

Figure 2: Block diagram digital stethoscope.

In our system Node MCU is used to facilitate IOT service by enabling Wi-Fi in it. Here the pulse rate sensor is used for analyzing ECG of the patient. The patient should hold pulse rate sensor for a pre-defined time for generating corresponding ECG in Thing Speak application. The doctors can open the link and can view the PQRST wave format of that particular patient pulse rate.

Figure 3: Experiment work.

Intern, the patients and care takers can also hear the heartbeat sound via speaker. The PQRST has 4 wave format, they are Normal heartbeat, Fast heartbeat, slow heartbeat and irregular heartbeat. So, the Doctors can know about the current status of the patient.

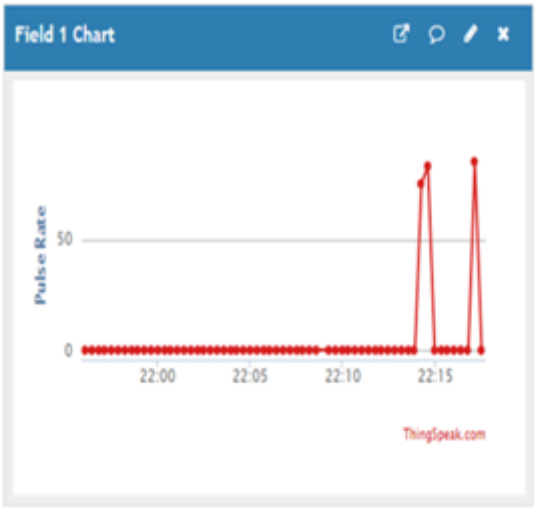

Figure. 4 ECG report display in the screen.

IV. REQUIREMENTS SPECIFICATION

1. Hardware Requirements
1. Node MCU
2. Amplifier
3. FM Transmitter or GSM board
4. Arduino UNO
5. Stethoscope
6. Power supply Adapter 5v
7. Extension Cables

2. Software Requirements
1. Arduino IDE

V. CONCLUSION

The project has described in detail the design, development and initial validation of a real-time wireless telestethoscope system created from scratch with open-source software, hardware and knowledge. This system was initially designed to be used in small clinics in rural areas where in- built computer Bluetooth coverage should be enough to cover the entire area. If the system was to be utilized in larger spaces like hospitals, a bedside bulky computer shouldn't be required. In such a clinical scenario, the stethoscope can be connected via Bluetooth to a Wi-Fi -3G smart phone with video-conference capabilities.

VI. FUTURE ENHANCEMENTS

In the recent future, we will make an online database of collected data. Data will be uploaded on a host website in the process of real time to the individual account of a patient. Appointed doctor would have access to his/her patient's account. Patient could find doctors from the web site of relevant disease.In this project, it is discussed about only a medical kit. Several devices are going to be added in total system as a full online based Medicare system.

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