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IOT BASED TELEMETRY SYSTEM

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Abstract – Due to this Covid-19 pandemic, the hospital cases became crucial. We figure out two critical cases (i) Doctors or patients get virus infection due to the usage of conventional stethoscope (ii) non- Covid patients can get virus due to visiting hospital for regular check up. So in order to reduce the test positivity, we introduce an alternative design of wireless digital stethoscope based on internet of things called, IoT based telemetry system, in short IBTS.

1. Introduction

A stethoscope is an acoustic instrument used in medical world for listening to internal organ sounds produced by the human body. The basic working of a conventional stethoscope uses the concept that when the disc and the tube of the stethoscope amplify small sounds such as the sound of patient's lung, heart and other sounds inside the body, making them sound louder. The amplified sounds travel up the stethoscope's tube to the earpieces that the doctor listens through. Since wired stethoscope can act as a carrier or a medium for the pathogens & viruses and it needs the doctor and patient to be close, so we should find a way to transmit the information wirelessly.

In this modern era, real time patient monitoring can also be done virtually. This can be achieved using IoT platform. Some present day researches 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. A modern stethoscope which works on IoT will change the way of auscultation the sounds related to heart and lung.

This leads to the innovation of our device that sense heart and lung sounds of a patient and transmit them to doctor's smart device and doctor send his feedback to patients device, using IoT technology. It means we keep the patient-doctor relationship strong even if they are not physically available. This concept leads to the online consultation facility too. This facility has lot of advantages like no fear of virus, no waiting, no appointment and many more.

1.1 Objective

The objective of this project is to generate a device using IoT technology which allows Doctors to examine patients without using conventional stethoscope thereby reducing the risks of staying near to patients in covid-19 pandemic and it allows online consultation too.

1.2 Target User

Doctors or clinical expert and patients can use. There is a registration process which connects them virtually.

2. Literature Review

At present, the COVID-19 pandemic has led to the implementation and use of telemedicine and telehealth platforms and devices as part of current day-to-day standards of care in many hospitals and healthcare systems. As healthcare professionals are continuously exposed to COVID-19, especially during the auscultation process, traditional stethoscopes require a distance of less than 50cm between doctor and patient, increasing the risk of infection. One of the main symptoms the new disease is shortness of breath and difficulty in breathing that can lead to pneumonia; therefore auscultation is one of the main tests to be carried out on potentially infected patients. There are COVID-19 patients, especially the elderly, who might have abnormal heart or lung conditions. In that case, a regular stethoscope will be insufficient in closely monitoring those patients' current conditions. Also the ways of using the conventional stethoscope increase the risk for the doctors. As we know, due to the prevailing situation of COVID-19 pandemic, use of conventional stethoscope can be proven dangerous as the may act as a carrier for the pathogens or viruses and can spread the disease. An IoT based telemetry system that can monitor the condition of heart and lung related problems in real time to solve these problems. Basically the goal of the digital stethoscope is to improve sound resolution, allow variable amplification of the sound, minimize interference noise, and also provide data for visualization and storage.

Internet of Things (IoT) simply refers to a network of object that is connected to the internet. It provides devices with the

ability to transfer sensor data on the Internet without requiring intervention. The IoT encompasses many devices and is growing at a rapid rate, because it is such a broad category. A forecast states that in 2019, approximately 26.66 billion IoT devices will be active; by 2025, 75 billion IoT devices worldwide will be available and wirelessly connected to the internet. Among these connected devices, millions of wearable sensors are widely used in healthcare applications. The total global spending on the IoT in 2016 was 737 billion dollars and was projected to reach 1.29 trillion dollars in 2020. IoT is a prominent field that will increase and grow exponentially. The function of IoT control, real-time monitoring, and perform autonomy or autonomous function and optimization.

To make our idea into reality we have integrated IoT and it is achieved by selecting components that can support it. ESP8266 Node Micro-Controller Unit (Node MCU) Wi-Fi Based Controller Board is an open source platform, which can connect objects and let data transfer using the Wi-Fi protocol. ESP8266 has very low cost and high features which makes it can ideal module for internet of things (IoT). It can be used in any application that requires it to connect a device to local network or internet. The programming of the Node MCU can be performed using Arduino software, which is an Integrated Development Environment (IDE), where the code of instructions is written and the microcontroller is uploaded. MAX4467 captures minute sound signals (heart and lung) and sensed it. And the sensed signals directly converted to the Node MCU. MAX4467 Electric Microphone Amplifier with Adjustable Gain Module is fully assembled; tested board comes with a 20-20KHz. GSM Modem is a hardware device that uses GSM mobile telephone technology to provide a data link to remote network. GSM provides basic to advanced voice and data services including roaming services. Roaming is the ability to use your GSM phone number in another GSM network. SIM800L support Quad-band 850/900/1800/1900 MHZ, it can transmit voice, SMS, and data information with low power consumption. A lithium polymer battery or more correctly lithium-ion polymer battery is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. This battery provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, such as mobile device, radio- controlled aircraft and some electric vehicles. AMS1117 is a popular SMD package 3- pin voltage regulator that is available in many models for fixed and adjustable voltage requirements. The IC can deliver a maximum current of 1A and the output voltage can vary from 1.5V to 5V. It also has a low drop out voltage of 1.3V when operating at maximum current. OLED display driven by SSD1306 driver IC. SSD1306 is a CMOS OLED driver with controller for OLED dot-matrix graphic display system. OLED display has 256 steps for brightness control. OLED display in above image has resolution of 128*64 pixels.

3. Proposed System

The stethoscope has long been at the centre of patient care, as well as a symbol of the physician-patient relationship. While advancements in other diagnostic modalities have allowed for more efficient and accurate diagnosis, the stethoscope must evolve in parallel to address the needs of the modern era of medicine. The concept of IoT can be introduced into this. The risk of getting infected by disease is higher in the medical sector than any other sectors of the society. There by use IoT Based Telemetry System for stethoscope can reduce this risk to some extent. This will also help the patients and doctors during online consultations as using this device they can get more information about the health of the former.

3.1 Block Diagram

First, Switch ON the device. At that time the device displays its name as IBTS on OLED display. Bell or diaphragm of stethoscope takes the patient's heart and lung sound and passes to mic sensor, MAX4466, through tubes.. This sensor fully assembled and tested comes with a 20-20KHz electrets microphone soldered on. For amplification, use the max4466, an op-amp specifically designed for this task. The amplifier has excellent power supply noise rejection. Then the audio signal passes to ATmega328-P microcontroller. The ATMEGA provides UART TTL(5V) serial communication, which is available on digital pins 0(RX) and 1(TX). After processing the signal according to the algorithm, the signal and battery voltage is displayed on oled display. OLED is organic light emitting diode that emits light in response to an electric current. SSD1306 is a CMOS OLED driver dot-matrix system having resolution of 128*64 pixels.

At the same time, signals get transmitted to ubidots server through ESP8266-12E wifi module. This ESP8266 wi-fi module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to wi-fi network. It is capable of either hosting an application or offloading all wi-fi networking functions from an other application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. From any device we can give data connection. But the network id and

password of wifi-hotspot should be same as in the program. i.e, patient should be Known about the wifi id and pw that is predefined. The user id and pw of ubidots is also programmed and doctor should also know this. Then only patient and doctor can use same platform. IoT dashboard works as a front end of ubidots server, it represents the signal graphically to doctors or clinical experts. Ubidots is a IoT platform to send data to the cloud from internet enabled device. Self construct IoT applications and connected services with Ubidots data collection, analysis, and visualization tools.

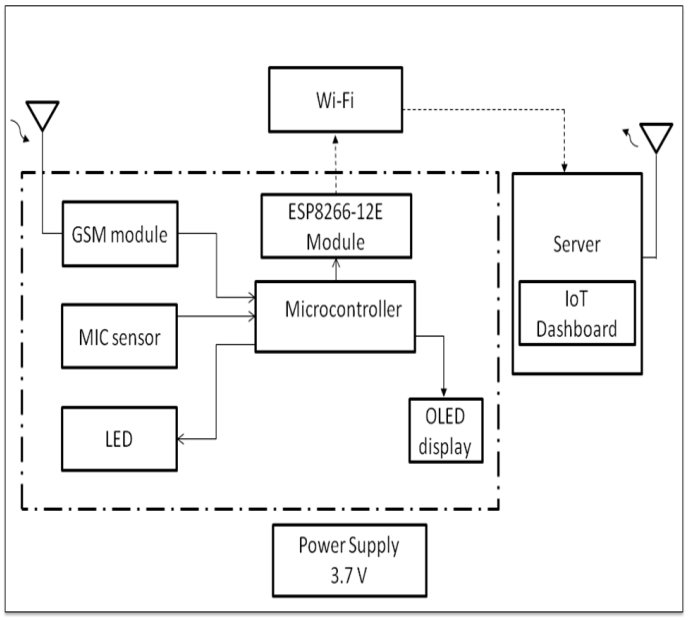

Fig. 1 Block Diagram of IBTS

After analyzing the line graph, the doctor can give very short message as feedback from his mobile phone to GSM module in our device. There is a green led which gives alert when message received. SIM800L GPRS GSM module with the antenna is used here. It is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls but we use receiving SMS transmission. Then message received is passing through microcontroller and process it, then displayed on oled display. When the message is displayed on device, our gsm sends message to doctor to let him know patient received the message.

3.2 Components Used

3.2.1 LIPO battery

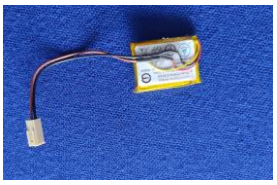

Fig. 2 lipo battery

Supply Voltage: 3.7V, Battery capacity: 500mAh, Weight: 30g. A lithium polymer battery or more correctly lithium-ion polymer battery is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. This batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature.

3.2.2 MIC sensor

Fig. 3 MAX4466

MIC sensor name: MAX4466, Operating Voltage (Range) : 3.3V(min 2.4V to max 5.5V), Frequency range: 20hz -20Khz Weight : 40mg, MAX4466 captures minute sound signals. MAX4466 Electric Microphone Amplifier with Adjustable Gain Module is fully assembled; tested board comes with a 20-20KHz.

3.2.3 Voltage regulator

Fig. 4 AMS1117

Voltage Regulator Name: AMS1117, Supply Voltage :3.7V, Weight: 0.1Kg, AMS1117 is a popular SMD package 3- pin voltage regulator that is available in many models for fixed and adjustable voltage requirements. The IC can deliver a maximum current of 1A and the output voltage can vary

from 1.5V to 5V. It also has a low drop out voltage of 1.3V when operating at maximum current.

3.2.4 ATMEGA328

Fig. 5 ATMEGA328

Operating voltage: 1.8V to5.5V, Flash memory: 32KB, SRAM size: 2KB, UARTs: 1, Maximum operating frequency: 20MHz, Device core: AVR, CPU type: 8-bit AVR.

3.2.5 ESP8266-12E

Fig.6 ESP8266-12E

ESP8266-12E is a microcontroller with wifi capability. The ESP8266-12E WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266-12E is capable of either hosting an application or offloading all WiFi networking functions from another application processor.

3.2.6 GSM module

Fig. 7 GSM Module

GSM Module Model: SIM800L, Operating Voltage : 3.7 V (min 3.4V to max 4.5V), Interface : UART, Weight : 28g. It gives more suitable network and it has world wide connectivity and extension coverage. SIM800L support Quad-band 850/900/1800/1900 MHZ, it can transmit voice, SMS, and data information with low power consumption

3.2.7 OLED display

Fig. 8 OLED display

OLED Display Weight :2.18g, Driver IC : SSD1306, Resolution: 128*64, Length: 27mm. Its power requirement is low. It gives better performance than LCD and LED display. OLED displays driven by SSD1306 driver IC. SSD1306 is a CMOS OLED driver with controller for OLED dot-matrix graphic display system. OLED display has 256 steps for brightness control. OLED display in above image has resolution of 128*64 pixels.

3.3 Algorithm

Step1: Power up and initializes the micro-controller section.

Step 2: Initialize the LED display section.

Step3: Initialize the GSM module provided in the stethoscope unit.

Step 4: The MIC sensor senses heartbeat and lung sound value and the data is collected by the controller and displayed on OLED display.

Step 5: The uploaded data is accessed by the physician from any remote location from the IoT dashboard.

Step 6: Required prescription is given by the physician in the form of text message.

Step 7: Prescription send by the text format is received in the GSM module and is displayed on the OLED display simultaneously.

4. Result

The below picture shows the final product:

Fig. 9 IBTS with and without casing.

Part 1:

Fig. 10 IBTS is initially displayed when the device is powered ON.

Part 2:

Fig. 11 The output voltage of MIC sensor and Battery is the displayed correspondingly. The voltage of mic sensor changes according to the input analog value of audio signal. For the normal case of battery voltage, it keeps approximately 3.6 V. It decreases according to energy discharge and when it reaches 3.4 V means battery low. i.e, it needs immediate charging. Then when it reach at 4.2 V considered to be full charge battery level.

Part 3:

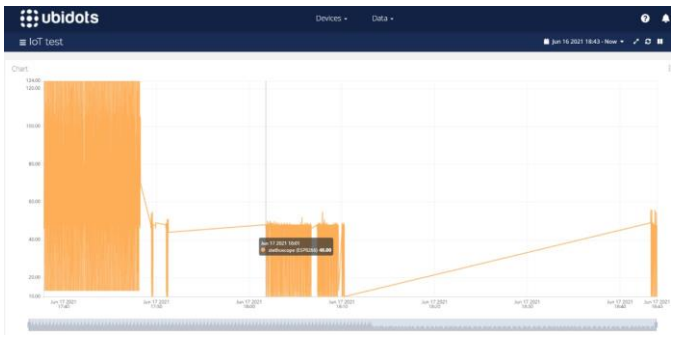

Fig. 12 The line graph representation of MIC sensor output in IoT dashboard of ubidots server.

Part 4:

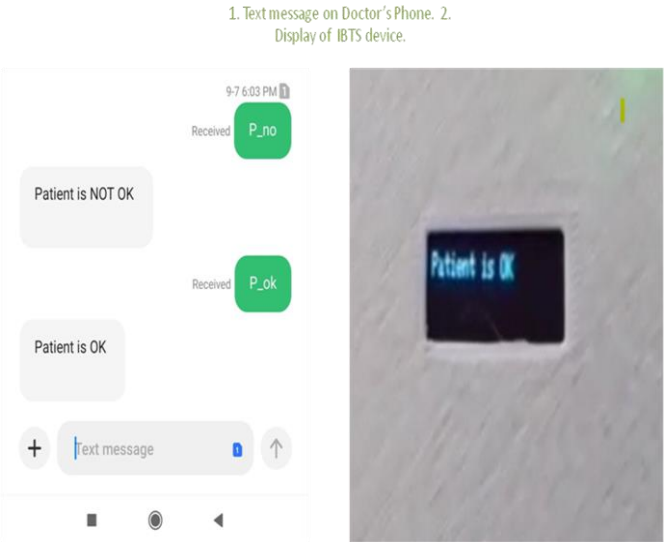

Fig. 13 After analyzing the graph, the doctor can give very short message as feedback to the GSM module provided in the device through his own phone. The doctor can use P_ok for displaying "Patient is OK". Similarly P_no for displaying "Patient is NOT OK". To give doctor an assurance that this message is displayed in the device, there is another feedback system where the displayed message will send back to doctor.

CONCLUSIONS

In this work, IoT based Telemetry system has been developed and implemented. Heart and lung sound were wirelessly transmitted to IoT dashboard to analyze cardiac

and respiration health. It also has GSM facility to receive messages from doctor and it can be displayed in the display. A led is also provided for message alert.

Internet of Things (IoT) simply refers to a network of objects that are connected to the internet. It provides devices with the ability to transfer sensor data on the Internet without requiring intervention. The function of IoT is control, real time monitoring, and perform autonomy or autonomous function and optimization. Perhaps one of the main reasons why the IoT is extremely large is that it aims to make life more convenient, and people are more likely to invest in things that make their lives easier. Therefore to tackle the problems faced during the use of convectional stethoscope and visiting hospital for regular checkup in this COVID-19 pandemic we must integrate IoT into this.

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