International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

IoT Based Patient Monitoring System using Arduino

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Abstract - Health monitoring is an issue for healthcare professionals and patient safety. Bringing accessibility through technological advancement, we developed the IoT based patient monitoring system using Arduino. The sensor measures heart rate along with the SpO2 levels of blood. When monitoring, data is sent to the Arduino device and transmitted to a custom Android app via Bluetooth, syncing data with the IoT platform hosted on Google Firebase, an open-source application that stores and retrieves data over the internet. Information is displayed on an 0.96" OLED screen implemented by an Arduino Sketch which also allows transmission of data to the Bluetooth module.

Key Words: **IoT; Patient; Arduino; sensor; Android app; Monitoring; Google firebase.**

1. INTRODUCTION

Internet of Things-(IoT) is undoubtedly revolutionizing the healthcare industry, providing healthcare solutions with ease and contentment. Before the IoT, patient's interactions with doctors were limited to visits, and tele and text communications. There was no way doctors or hospitals could monitor a patient's health continuously and make recommendations accordingly. IoT has made remote monitoring in the healthcare sector possible, unleashing the potential to keep patients safe and healthy, and empowering physicians to deliver superlative care.

The IoT Based Patient Monitoring System using Arduino helps to detect the onset of critical events like Hypoxia, Bradycardia, and other heart and lung diseases by analysis of the data by clinicians, so that they can make informed care decisions. It also gives on-the-move caregivers virtually anywhere, anytime visibility to a patient's vital signs, so they can communicate and collaborate to decide on the best course of care and the right caregiver to provide it

2. OBJRCTIVES

- To impart remote health monitoring and telehealth.
- To enhance Patient satisfaction and engagement.
- To provide advancements in care management.
- To deliver preventive care, scotch and obviate chronic diseases.
- To supply swift healthcare to patients in dire situations.

3. MOTIVATION

Poor-quality health care is a leading, preventable killer of people around the globe. A recent report by The Lancet Global Health Commission on High-Quality Health Systems found that 5.7 million people die in low and middle-income countries every year from poor quality healthcare compared with the 2.9 million people who die from lack of access to care. In other words, in many countries, a person has a greater chance of dying from receiving poor quality care than from going without care entirely. Poor healthcare quality leads to more deaths than insufficient access to healthcare--1.6 million Indians died due to poor quality of care in 2016, nearly twice as many as due to non-utilization of healthcare services (838,000 persons). The Lancet HQSS Commission report says High-quality health systems could prevent 2-5 million deaths from cardiovascular disease.

The health of patients is deteriorating and going unnoticed because important signs, such as blood oxygen levels which can predict heart and lung problems, are either not being recorded at all or often enough. A lot of times it happens that patients don't get medical attention on time which can harm their health severely.

Remote health monitoring, which is very possible thanks to the Internet of Things, partially helps solve the rise of chronic diseases, and allows us to overcome such impediments.

4. SYSTEM AND OVERVIEW

A. Block diagram

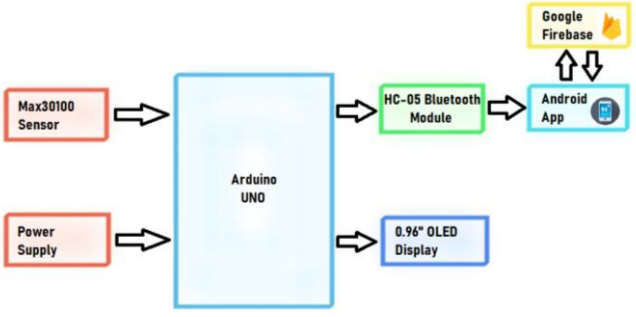

Fig.1-Project Block diagram

Figure 1. above illustrates the flow of the system. In this project patient's Heart rate and SpO2 levels of the blood are measured through the Max30100 sensor. This sensor then emanates the data to Arduino which further transfers it to the OLED screen and the Bluetooth module for transmission to an Android app specifically built for this project. This Android app syncs the data with google firebase, where the patient's vital parameters are stored. This data stored on the firebase can be retrieved on the app from anywhere in the world.

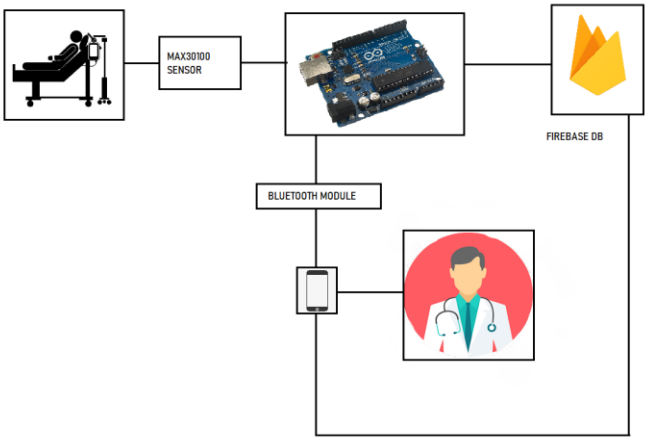

Fig. 2-Project Illustration

B. Components used

1. Max30100 sensor

The Max30100 senses the heart rate and the SpO2 levels of the blood. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. One of the two LEDs emits red light, and another emits infrared light. For pulse rate, only the infrared light is needed. Both the red light and infrared light is used to measure oxygen levels in the blood.

2. Arduino UNO

Arduino Uno is a microcontroller board based on an 8-bit ATmega328P microcontroller. The Arduino sketch runs on the microcontroller, and performs functionalities such as reading, conversion and transferring data to the screen, and Bluetooth module. It has 14 digital i/o pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. It operates on voltage ranging from 5-20 V.

3. Bluetooth Module

HC-05 Bluetooth Module is a Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication. It has a red LED which blinks in different frequencies indicating the status of connection. Its operational voltage range is 3.6-5V.

4. 0.96" OLED Screen

The organic light-emitting diode (OLED) display is a mono-color, 0.96-inch display with 128×64 pixels. Its pixels consume energy only when they are on, so the OLED display consumes less power when compared with other displays. It has four pins and communicates with the Arduino using I2C communication protocol. It operates on 5 Volts.

C. IoT Platform

The IoT platform used is Google Firebase for the synchronization of data. It is an open-source IoT application widely used by web developers. The patient's vital data is stored in the database of the firebase which can be retrieved on the Android App from anywhere in the world. The fig.3 below shows the data stored on the firebase.

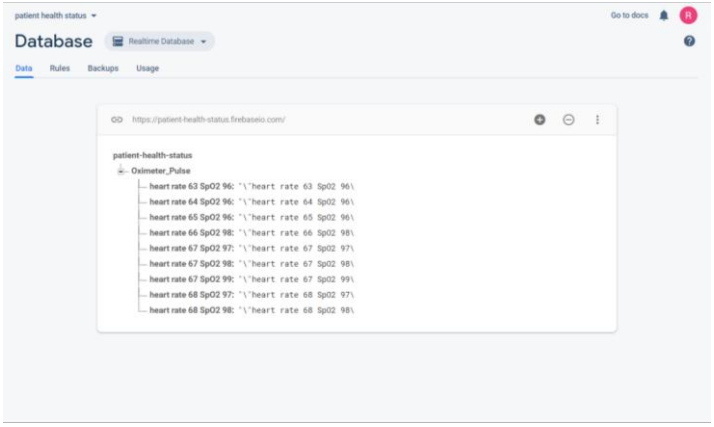

Fig.3-Google Firebase Database

A. The Android App

Health Cloud –

Health Cloud is an android app developed on MIT App Inventor. It is an open web application that lets users build android apps. Health Cloud connects to the Arduino via Bluetooth, and receives patient's parameters like heart rate and SpO2 level. It has two levels as shown in fig.4 one Doctor

and another Patient. The data is received via Bluetooth on the Patient screen as shown in fig. 5 and when pressed sync data it sends the parameters to the firebase for storage.

Fig.4-Login Screen

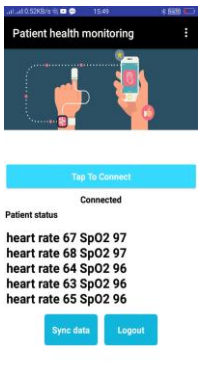

Fig.5-Patient Screen

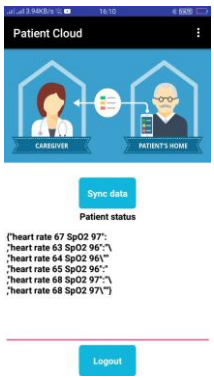

Fig.6-Doctor Screen

As shown in fig 6. The patient's health parameters can be retrieved on the doctor screen from anywhere in the world providing on-the-move caregivers accessibility to analyze data from anywhere and take care decisions and provide care through another caregiver present.

5. SCOPE AND APPLICATIONS

According to the availability of sensors or development in biomedical trends more parameters can be sensed and monitored which will drastically improve the efficiency of the wireless monitoring system in the biomedical field. The main objective of this project is to provide economically effective healthcare solutions.

With some alterations and advancements this project can be a part of the Internet of Medical Things (IoMT). The Internet of Medical Things is an amalgamation of medical devices and mobile applications connecting healthcare information technology systems via network technologies. The technology can reduce unnecessary hospital visits along with lessening the burden on health care systems by connecting patients to their physicians and doctors while allowing the transfer of medical data that too over a secure network.

Disabled patients who find difficulty to go to doctors on regular basis or for patients who need continuous monitoring from the doctor can make use of this project.

Patient health parameters are stored in the cloud. So, it is more beneficial than maintaining the records in a printed paper in separate files or in digital computers, laptops, pen drives, or specific memory locations. In such cases there may be a chance of losing the data. Whereas in the case of IoT, the data is stored in the cloud and has minimal chance of data loss.

6. CONCLUSION

With the wide use of the internet, this work is concentrated to execute the internet technology to establish a system that would communicate through the internet for better health. Internet of Things rules the whole world in various fields, mainly in health care sectors. Hence the present work is done to design an IoT based patient monitoring system using Arduino. In this, the Max30100 sensor is used to detect the heartbeat and the SpO2 levels of the blood and sending the data to an app via Bluetooth and then to the cloud using the internet. This information is also sent to the OLED screen, so the patient can easily know their health status

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