SSRG International Journal of Electronics and Communication Engineering
ISSN: 2348 – 8549 /doi:10.14445/23488549/IJECE-V7I5P102
Volume 7 Issue 5, 5-9, May 2020

Smart Monitoring System for Asthma Patients

Niranjana.S[1], Hareshaa.S.K[2], Irene Zibiah Basker[3], and Dr.Jose Anand[4]
[1,2,3,4]*Department of ECE, KCG College of Technology, Chennai, Tamil Nadu, India*

Received Date: 09 April 2020
Revised Date: 09 May 2020
Accepted Date: 13 May 2020

Abstract—*Asthma endures a condition in which the airways narrow, swell and produce extra mucus. The causes are prejudiced by genetic and environmental factors, in which environmental factors have a great impact. The symptoms of asthma are breathing difficulty and trigger coughing, wheezing, and shortness of breath. But still, a direct cause of asthma is unknown; therefore, it cannot be relieved but can be managed by proper guidance and treatment. Self-management remains an essential factor for the proper treatment of asthma. By considering these factors, we proposed a solution. This paper provides a portable device integrated with an android app that monitors the environmental factors faced by asthma patients and their health parameters and transmits this data to the cloud. These parameters are typically measured using different sensors such as temperature and humidity sensors, gas sensors, and pulse rate sensors. The measured parameters are polluted gas, temperature, humidity, specific location, and pulse rate of the user. An android app consists of AST (Asthma Symptom Test) to predict the probability of asthma, and it gives necessary precautions to the patients by gathering details from the cloud, thereby preventing them from getting a severe attack. This paper aims to provide a compact device and user-friendly app integrated into the device. The future scope is to increase the system's feasibility by including the key concepts of machine learning for user's accurate tracking.*

Index Terms—*Asthma, Self-management, Cloud, Android-app*

I. INITIATION OF WORK

Asthma is a chronic inflammatory illness that affects the lungs and weakens airways through the acquisition of excessive mucus, which results in a limited amount of oxygen delivered to vital organs. Asthmatic people often experience various symptoms that lead to a diagnosis of asthma. The exact cause of asthma is not known yet. However, various studies have shown that a combination of genetic and environmental factors leads to an increase in asthmatics worldwide. This terrible disease is a public health problem for the rich and poor. The main causes of asthma symptoms vary greatly from person to person. Even now, one thing remains with asthma: when the airways experience asthma, then they become thinner, weakened, and filled with smoke, and large amounts of mucus contribute to the air's tendency. Even this area leads to an asthma attack that resembles a person who is allergic to food and other factors that affect their body. An allergist can determine if you have asthma through a series of tests. If you are diagnosed with asthma, your allergist will work with you to define the right course of treatment so that you can manage your chronic condition. There are different asthma types present, such as primary, intermediate, and critical levels; this varies from person to person.

According to doctors in a large Indian community, there has been an increase in air sickness in children due to increased pollution. This project proposes a framework for detecting air pollution by constantly monitoring the air using various sensors and helping the patient reduce the risk of asthma by providing a sophisticated device. If the collection of air particles exceeds a certain amount, it is shown to the patient by the android app by giving appropriate suggestions to them. The user's health status is regularly monitored and updated in the database, which supports them in taking precautionary measures on their own and can contact the physician in a crisis.

The main objectives of the paper:

- To improve and monitor the health conditions of asthma patients.
- To provide precautions to the patients.
- To monitor the environment of the patient continuously.
- To detect the quality of air.
- To provide a user-friendly device.

II. EXISTING METHODS

In this segment, we present an overview of some important contributions made by several researchers in the field of embedded and IoT:

The authors in [1] proposed an m-health system to help control asthma control by providing a tool for patients to assess airway control quality. The system is based on the Asthma Control Questionnaire (ACQ), Asthma Control Test (ACT), the most widely used clinical practice. This contributes to self-management by determining the quality of patient management.

The authors in [2] designed a device that monitors the patients' surroundings and sends this data to the cloud. This concept focuses on measuring various gases such as CO, smoke and compares them with a standard air quality index (AQI) as a

reference. Patients are intimated by messages when there is a rapid change in the data.

The authors in [3] analyze the air quality index (AQI) and provide personalized and localized feedback to patients to improve their health conditions. This paper focuses on both indoor and outdoor air quality. AQI for outdoor air quality is considered a reference for our paper.

AQI	Personalised feedback
0 - 33	Very Safe to travel Outdoor
34 - 64	Safe to travel Outdoor
65 – 99	Sensitive people advised staying indoors
100 - 149	Poor air quality. Sensitive people highly advised to stay indoors
150-199	Warning levels of air quality. Sensitive people must stay indoor
200	Hazardous levels of air quality. Sensitive people must avoid outdoor activities

Fig. 1 Outdoor air quality table [3]

III. SYSTEM OUTLINE

In our proposed system, we have both hardware and software. The hardware includes a micro-controller, gas sensor, temperature sensor, humidity sensor, GPS module, and heartbeat sensor. The sensors are used to detect pollutants such as carbon monoxide and carbon dioxide in the atmosphere, differences in temperature and humidity, and monitor the health parameters. The values obtained from the different sensors are sent to the cloud periodically. Data obtained in the cloud is used to analyze and provide patients with security measures through the mobile app.

A. MICRO-CONTROLLER

NodeMCU is an open-source development board based on the ESP8266 Wi-Fi module. It has FCC-certified Wi-Fi modules and a PCB antenna. The board integrates general-purpose input-output (GPIO), inter-integrated circuit (IIC), ADC (analog to digital converter). Its firmware runs on the Express ESP8266 Wi-Fi Soc system. NodeMCU typically has 128 KB of memory. Its scripting language easy and visual. The board uses a micro-USB port for power and communication with the PC. It can be easily operated from a USB to a micro USB port via a power bank. Due to the comparative ease of use and the built-in Wi-Fi modules, NodeMCU is generally preferred over other micro-controllers.

Fig. 2 Example of Node MCU

B. SENSOR

a) Gas sensor:

The MQ-2 gas sensor is usually a sensitive sensor for detecting SnO2 and CO. It is suitable for increasing carbon monoxide concentrations (ppm) in polluted air. It is fast, reliable, and long-lasting. SnO2 is the material in this sensor that detects gas concentrations smoothly and accurately. SnO2 has low concentrations in the air. It can usually measure CO concentrations from 20 to 2000 ppm. The output of the sensor indicates analog resistance. The conductor circuit is simple and consists of a voltage divider that operates from the heater coil with 5V AC or DC, which is connected to load resistance and output ADC or linear [5].

Fig. 3 Example of Gas Sensor

b) Humidity and Temperature sensor:

Here we are using the DHT11 sensor, which is an economical digital temperature and humidity sensor. It features a humidity sensor and a thermistor that measures the surrounding atmosphere and provides a digital signal on the data pin. It is easy to use but requires more time to locate the data. The output is obtained within 2 seconds [6].

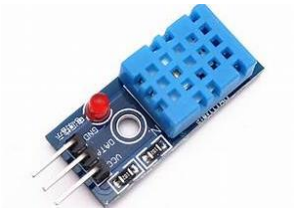

Fig. 4 Example of DHT11

c) Heart rate sensor:

The heart rate sensor, which is used, detects the pulse rate of the user. The analog output is obtained by placing the finger on the LED. It gives output in the form of BPM, and it can also be used to find the oxygen level in the blood. It can be easily integrated with any micro-controller. It also includes a monitoring app that regularly monitors e data and updates in the app. It is a painless method to measure the heart rate in an inexpensive manner [7].

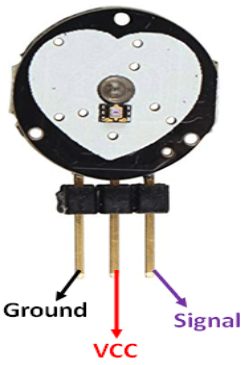

Fig. 5 Example of Pulse Sensor

d) OLED

OLED (Organic Light-Emitting Diodes) is a horizontal light-emitting technology that is made by keeping the organic thin films between two conductors in a series manner. A bright light is emitted when the current is applied to it. OLEDs are more efficient than LEDs as they are thinner in a structure that does not require a backlight. It is thin and efficient and provides good image quality, which can be made more flexible and transparent.

Fig. 6 Example of OLED

C. ARDUINO SOFTWARE

The Arduino IDE, which is abbreviated as Arduino Integrated Development Environment, is a software tool used to write and upload code to different Arduino boards. This software consists of various in-built libraries that contain necessary functions that make programming easy. It also has a great feature that makes it convenient to debug errors and troubleshoot problems.

The NodeMCU can also be programmed using Arduino IDE by installing the libraries required and choosing ESP8266 NodeMCU in the Board Manager Option. The NodeMCU microcontroller is programmed using embedded C language [8].

D. FIREBASE

Firebase is one of the cloud platforms that is used to collect data in real-time. Firebase works with the most popular platforms like Arduino, ESP8266, and Raspberry Pi. It has a powerful API. It allows the user to send and view data in the cloud. If the threshold from the data is found correctly, there are options to set triggers. Data can be instantly updated to the cloud every 1 second, allowing real-time data monitoring. It is built on rails and nodes on Ruby. The dashboard in IO allows the user to allow different feeds in different formats of his choice. Data received from the gas sensor is transmitted to this cloud platform.

IV. WORKING

This paper aims to reduce asthma risk by providing a compact and portable device along with an android app that provides continuous precautions to the patients whenever required. The hardware consists of different sensors like the gas sensor to detect the hazardous gases in the atmosphere, a temperature sensor to sense the temperature, a humidity sensor to sense the changes in the climate, a pulse sensor to detect the heart rate as well as the oxygen level in the blood, a GPS module to track the location of the user and also to identify the polluted area this information is updated to the government as well as to the cloud, and a Wi-Fi module is used to upload the values of the sensor to the cloud. All the values from these sensors are uploaded to the cloud, and rapid changes in these values are altered to the patients via an android app. The premium step in the android app is to register the user's details properly, and then it is continued with asthma and trigger symptom test, which consists of some questions to test the symptom of asthma before consulting a doctor. If the test comes out to true, then two options are provided, consult the doctor or take the test again. The regular precautions are instantly given to the specific user by accurately comparing the specific health conditions and environmental conditions. The user's health condition is regularly monitored and updated in the database for subsequent reference. In a critical situation, the app has an enhanced feature to call the doctor or a family member. The device is compact and portable, which can be used by asthma patients and ordinary users. The personal app is user-friendly and encourages the user to take care of their health and take precautions in severe conditions, which naturally make them self-dependent, and asthmatics will be able to remedy before getting an asthma attack.

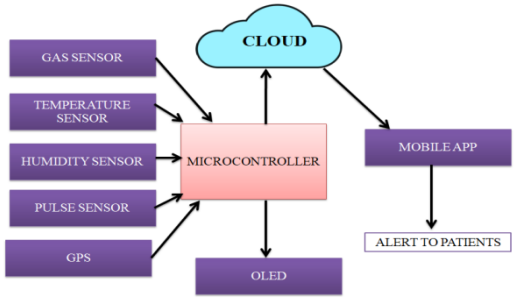

Fig. 7 Basic Block Diagram of Prototype

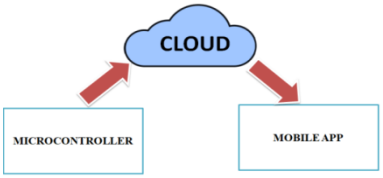

Fig.8 Basic Overview

V. RESULTS

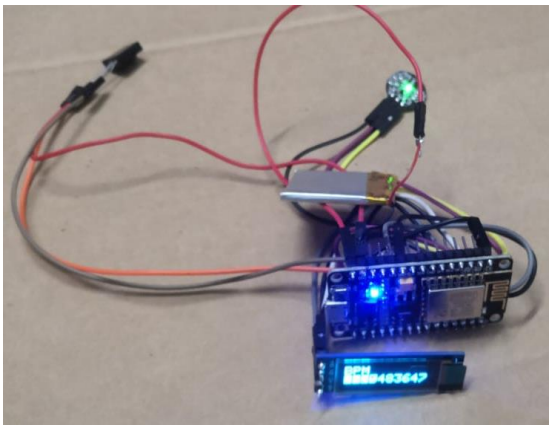

Fig. 9 Basic Prototype

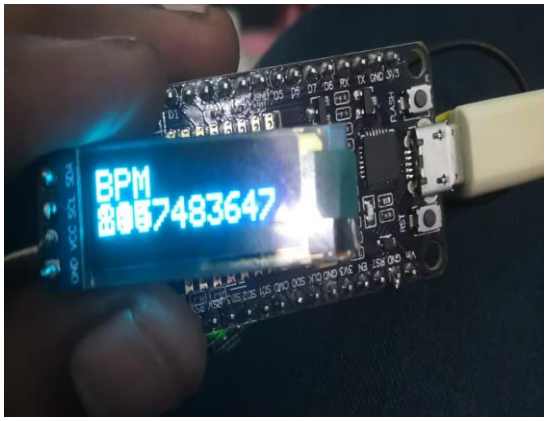

Fig. 10 OLED

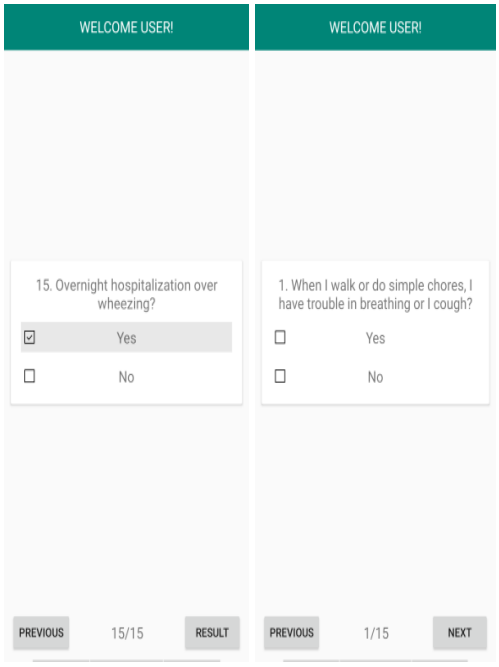

Fig. 11 Sample AST (Asthma Symptom Test)

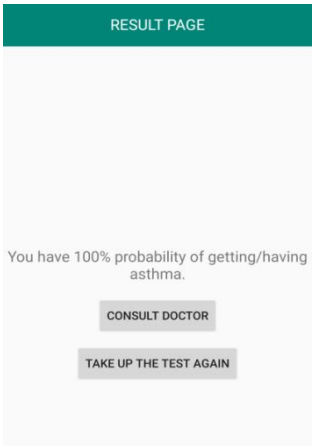

Fig. 12 Sample result of AST (Asthma Symptom Test)

VI. CONCLUSION

The proposed system consists of both hardware and software components. The hardware components are clubbed to develop a compact and portable device made up of different sensors such as temperature and humidity sensor, gas sensor, pulse rate sensor, and an OLED to display these values instantly. The portable device is seamlessly integrated with an android app. The sensor's value is regularly updated to the cloud, and also it is utilized to provide precautions to the user for the rapid changes in the sensor values with the help of online features of the firebase cloud. These appropriate precautions are provided in the innovative app and the real-time data of the sensor values from the cloud. The system's future scope is to implement machine learning in the system for user tracking and add a spirometer test that will be integrated with the app and device.

REFERENCES

[1] Thales A. Silva, Marly G. F. Costa, Rafael Stelmach, Peter K. Bley, Marco A. Gutierrez, Cicero F. F. Costa Filho. "*Development of a system mobile-based to assist asthma self-management,*" 2018 3rd Biennial South African Biomedical Engineering Conference (SAIBMEC), 2018.

[2] S. Indulakshmi, M. Adithya, A. R. Anirudh, A. Jawahar. "*Design and Development of Prototype Model for Asthma Trigger Detection,*" 2018 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), 2018

[3] Nikita Isaac, NaveenaaSampath, Valerie Gay. "*SAM Smart Asthma Monitoring: Focus on Air Quality Data and Internet of Things (IoT),*" 2018 12th International Symposium on Medical Information and Communication Technology (ISMICT), 2018

[4] MdNazmulHoq, *"Prediction of a possible asthma attack from air pollutants: Towards a high-density air pollution map for smart cities to improve living,*" Added to IEEE Xplore: 04 April 2019.

[5] MQ 2Grove, "MQ2 Gas sensor," MQ 2 datasheet,

[6] DHT11," https://www.adafruit.com/product/386"

[7] PULSE RATE SENSOR, https://wiki.eprolabs.com/

[8] "Arduino." [Online]. Available: http://www.arduino.cc/download/

[9] Rohit Kumar Dubey, Sakshi Mishra, Shreya Agarwal, Ravi Sharma, Nandita Pradhan, Vineet Saran"Patient's Health Monitoring System using Internet of Things (Iot)", International Journal of Engineering Trends and Technology (IJETT), V59(3),155-161 May 2018.

[10] Chukwunazo. J. Ezeofor, Remigius. O. Okeke, Ogbuokebe S.K"Design and Simulation of Microcontroller Based Wireless Patient Intelligent Health Monitoring System with GSM Alert Technology", International Journal of Engineering Trends and Technology (IJETT), V24(2),87-95 June 2015.

[11] P.Amaranadha reddy , J.Damodhar. "A REAL TIME MONITORING SYSTEM FOR PHYSIOLOGICAL SIGNALS USING WIRELESS SENSOR NETWORK". International Journal of Engineering Trends and Technology (IJETT). V3(4):502-506 Jul-Aug 2012.

[12] Narendra Kumar , Alok Aggrawal , Nidhi Gupta. "Wearable Sensors for Remote Healthcare Monitoring System". International Journal of Engineering Trends and Technology (IJETT). V3(1):37-42 Jan-Feb 2012. ISSN:2231-5381.