

Internet of Things based Health Monitoring System for Asthma Patients

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Abstract— Most people in the country reside in rural locations, where it might be difficult to have access to high-quality healthcare. This demonstrates the usefulness of telemedicine by implementing the Internet of Things (IoT) concept, which is now under development in Bangladesh. This study shows how the current problems in the healthcare system can be resolved by developing a remote health and environment monitoring system, especially for asthma patients who are more susceptible to COVID-19. In our project, the temperature, humidity, pulse rate, and gas quality of the surrounding environment are tracked using an AT Mega 328U microcontroller, a gas sensor, and a pulse sensor (MAX 30100).

Index Terms— Digital humidity and temperature sensor DHT11, gas sensor, and AT Mega 328U microcontroller unit.

I. INTRODUCTION

All ages are prone to the chronic long-term respiratory disease known as asthma. It is one of the most common medical conditions. Asthma symptoms include wheezing, dyspnea, chest tightness, and coughing. The main causes of asthma are allergens such as dust or pollen and illnesses such as the flu and cold. Asthmatics are particularly concerned about COVID-19 because of the compromised immune system and lung function that asthmatics have. Individuals who suffer from asthma may have an episode due to many factors, such as elevated ambient temperatures, dust particles, and humidity. Asthma sufferers must therefore take unforeseen climate changes into consideration. Nowadays, everyone uses everything, even for everyday tasks, which greatly simplifies life. The "Internet of Medical Things" (IoMT) is the term used to describe the application of IoT technology in healthcare through a network of connected sensors that rapidly identify critical data. Approximately 4 million devices are presently used by the healthcare industry to gather and analyse patient data in real time. Our emergency health monitoring system can be strengthened with the use of the Internet of Things (IoT), a dependable e-healthcare technology. IoT principles are used to connect easily accessible medical resources and provide intelligent, dependable, and efficient healthcare to patients.

II. LITERATURE SURVEY

The study by Wudan et al.[1] examines ways to improve aerosol medicine administration into the lungs, linked and smart inhalers, the biologics underlying inhaler drug delivery, and wearable technologies to monitor the patient's condition.

According to Utkarshani Jaimini et al., one of the most common reasons for paediatric hospital admissions is asthma. Additionally, she examines correlations in the data that may be useful in the management of asthma, such as the possibility that a patient's prescription (Albuterol) reduced the quantity of nitric oxide they exhaled or the possibility that a patient's activity restriction was linked to a day with high pollen activity.

The significance of patients adhering to their asthma medication regimen was explored in a study conducted by Martin S. Holmes et al. Listening to audio recordings of inhaler usage manually is a time-consuming and labor-intensive process. Therefore, the development of a reliable and automated algorithm to perform this task would be highly beneficial. In their research, the researchers recorded the acoustic signals of patients using a commonly used dry powder inhaler by attaching a recording device.

Another study by Rawinan Praditsangthong et al. proposed the use of a Machine Learning (M-Learning) system to deliver inhaler usage instructions in the form of instructional videos based on the correct inhaler technique. This approach aims to enhance patients' proficiency in using inhaler devices, which could lead to a modest reduction in the risk to patients' lives.

Scott W. Burgess et al. conducted an in vitro evaluation of an asthma dosage device, wherein they examined the accuracy of various smart inhalers in different clinical and research settings. Their study included a comprehensive comparison of different smart inhalers with dosing capabilities.

Additionally, James Dieffenderfer et al. assessed the effectiveness of low-power wearable systems for continuous monitoring of environmental and health parameters in individuals with chronic respiratory diseases.

The underlying issue identified is that asthma patients are at risk of experiencing severe episodes triggered by sudden and extreme weather changes, which could potentially have life-threatening consequences.¹ The suggested fix

A. SYSTEM DIAGRAM

Integrated sensors can be utilized to monitor humidity, temperature, heart rate, and air quality, as these factors are primary triggers for asthma attacks. Regularly updating these sensor readings enables us to provide patients, doctors, and medical personnel with information about the risk and probability of an asthma attack. This proactive approach helps reduce the likelihood of asthma attacks occurring.

III. PROPOSED SYSTEM

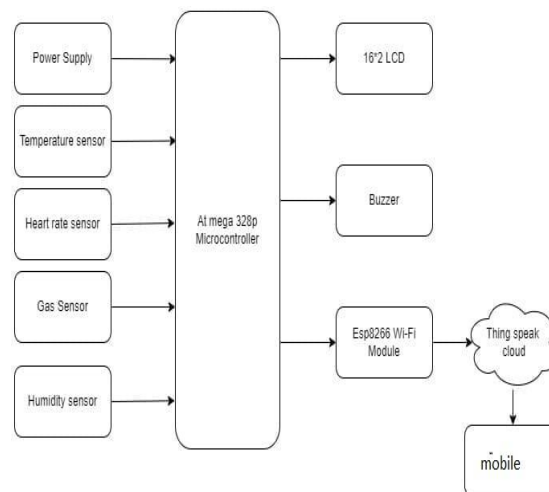


Fig. 1. System Diagram

A. HARDWARE REQUIREMENTS

- At Mega 328 u microcontroller
- Gas sensor
- Pulse Sensor
- Humidity Sensor
- Wifi module
- LCD display

1) ATmega 328 u Microcontroller

The ATmega 328 u microcontroller is equipped with an electrically erasable programmable read-only memory (EEPROM) capable of storing up to 1KB of data. This attribute highlights the microcontroller's ability to retain data and deliver results even after being powered off. electric supply is disconnected. Furthermore, the ATmega-328 features 2KB of static random access memory (SRAM), and we will delve into more details about its additional capabilities in subsequent explanations. Thanks to its various attributes, the ATmega-328 is currently the most favored product in the market. Some of these distinguishing features encompass a configurable Serial USART, among others.

The ATmega-328 is distinguished by its advanced RISC architecture, delivering excellent performance while maintaining low power consumption. It features a dedicated real-time clock with a separate oscillator, six PWM pins, and a programming lock for software security. With a throughput capacity of up to 20 MIPS and various other attributes, it stands out as a versatile microcontroller.



Fig.2 . ATmega 328 u Microcontroller

1) Gas Sensor

To assess an asthma patient's environment, a gas sensor MQ-135 is employed, which is a significant contributor to asthma attacks. This sensor utilizes tin (IV) oxide, known for its higher resistance compared to air. The analog output from the sensor is relayed to an Arduino, enabling us to derive air quality measurements in parts per million (ppm).



Fig. 3. Gas Sensor

2) Pulse Sensor

The main purpose of this sensor is to continuously monitor an individual's heart rate over a one-minute period. A typical heart rate for a healthy adult falls within the range of 60 to 100 beats per minute. By observing and recording a person's heart rate, we can assess their overall health condition.



Fig.4.Pulse sensor

3) DHT11 Sensor

The abbreviation DHT stands for Digital Humidity and Temperature, which is a sensor capable of measuring both temperature and humidity. To gauge temperature, it employs a thermistor with a negative temperature coefficient, resulting in decreased resistance as the temperature rises. The DHT11 sensor operates within a voltage range of three to five volts, providing temperature measurements between 0 to 50 degrees Celsius with an accuracy of 2 degrees Celsius. Additionally, it can measure humidity in the range of 20% to 50% with an accuracy of 5%.



Fig. 5. DHT11 Sensor

4) Wifi module

In our setup, we employ the ESP8266 WiFi Module, which functions as a self-contained System-on-Chip (SoC) with a built-in TCP/IP protocol stack. This module allows any microcontroller to connect to your WiFi network, facilitating data transmission from the microcontroller to external devices when connected.

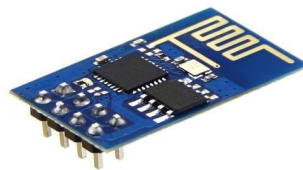


Fig.6.Wifi module

5) LCD display

The acronym LCD stands for Liquid Crystal Display, which is a specialized electronic display module found in a wide range of circuits and devices, including mobile phones, calculators, computers, and more. Our configuration utilizes a 16x2 LCD, enabling it to present information on two lines, with each line capable of displaying up to 16 characters.

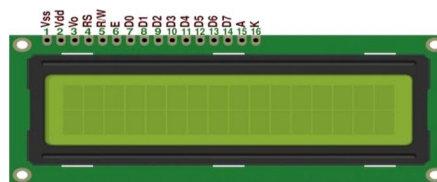


Fig.7.16*2 LCD display

7) Hardware Kit



Fig.8.Hardware kit

B. SOFTWARE REQUIREMENTS

- Arduino IDE
- Thingspeak

Arduino IDE

Code can be written and uploaded to Arduino boards through the open-source Arduino IDE, an integrated development environment (IDE). This IDE is compatible with operating systems such as Windows, Mac OS X,

and Linux. Programmers have the flexibility to work with C and C++ languages. When you create a program or code within the Arduino IDE, it's commonly known as "sketching."

To upload the sketch created in the Arduino IDE program, it's necessary to connect the Genuino or Arduino board to the IDE. The file extension for these sketches is ".ino".

ThingSpeak

ThingSpeak is a versatile open-source software tool that empowers us to transmit sensor data to the cloud. This platform provides the capability for both data analysis and data visualization, leveraging the capabilities of MATLAB. ThingSpeak accommodates both private and public channels; private channels allow data collection, while public channels support data sharing. A noteworthy feature is the ability to trigger actions and integrate various applications.

IV. METHODOLOGY

The microcontroller is linked to the pulse sensor, gas sensor, temperature, and humidity sensor. Additionally, a 16x2 LCD display module is interfaced with the microcontroller to showcase the readings acquired from these sensors. In the event that any of the sensor parameters, such as temperature, humidity, pulse rate, or gas levels in the air, surpass predefined threshold values, a buzzer alert is activated.

Furthermore, the recorded sensor data is regularly updated in the ThingView app, enabling patients to monitor environmental changes and take preventive measures to mitigate the risk of asthma attacks

V. RESULTS AND ANALYSIS

To facilitate the comprehension of data acquired from different sensors, we employ graphs that depict the relationships between various factors and time. This graphical representation simplifies the analysis process.



Fig. 9. Graph of temperature in Thingspeak

In the graph above, temperature values are depicted on the y-axis, while time is represented on the x-axis. Additionally, the graph illustrates the daily highest and lowest recorded values.

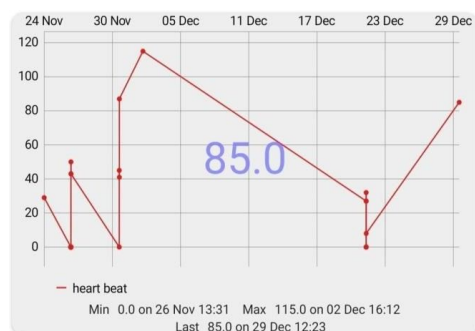


Fig. 10. Graph of heart beat in Thingspeak

In the above graph, the y-axis represents heart rate values, while the x-axis signifies time. Furthermore, the graph includes visual indicators for the daily minimum and maximum recorded heart rates.



Fig. 11. Graph of Humidity in Thingspeak

In the graph displayed above, you'll find the representation of humidity and time values. The y-axis corresponds to humidity, while the x-axis corresponds to time. Furthermore, the graph features markers indicating the lowest and highest values recorded each day.

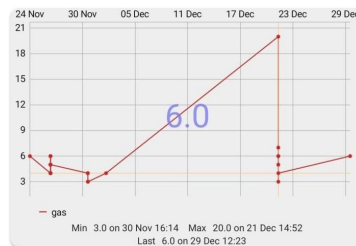


Fig. 12. Graph of gas level in Thingspeak

In the graph displayed above, you'll find the representation of humidity and time values. The y-axis corresponds to humidity, while the x-axis corresponds to time. Furthermore, the graph features markers indicating the lowest and highest values recorded each day.

IV. CONCLUSION

The primary objective in creating this prototype was to provide asthma patients with a tool to anticipate and prepare for potential asthma attacks. By doing so, patients can potentially mitigate the severity of the attack and reduce the associated risks. It's important to note that the system's main purpose is not disease detection, but rather ongoing monitoring of asthma patients.

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