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Smart Asthma Health Monitor with Temperature and Dust Sensing using Arduino

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***Abstract*- Asthma Health Monitor is a Dust and Temperature Alert System for Asthma Patients referring to detection of certain conditions of dust mites and humidity in the air to prevent them from asthma Attack. a persistent lung condition that can strike anyone at any age. In 2019, 455 000 individuals died from asthma and an estimated 262 million people were affected by it. And in 2023, there will be about 339 million people. Small particle inhalation poses a larger risk to those who have asthma. The Environmental Protection Agency (EPA) suggests keeping humidity levels between 30 and 50%. Lower humidity inhibits the growth of mold, dust mites, and cockroaches, all of which can aggravate asthma symptoms. Therefore, in this study, a questionnaire survey is designed to understand the need of the patient when coming to design dust and temperature alert systems that will protect them from asthma attacks. This device needs to correctly identify safe and unsafe conditions or levels of temperature, humidity and dust particles in the air. By capturing this data, the device empowers patients with a comprehensive understanding of their surroundings. This system empowers asthma patients to lead healthier lives with reduced symptom burden and improved overall well-being.**

Keywords- Dust and Temperature Alert System, Asthma Patient, Dust mites and Humidity Alerts, Prevention of Asthma Attack Temperature Detection, Dust particles detection

I. INTRODUCTION

A considerable fraction of the world's population suffers from asthma, a chronic respiratory disorder marked by inflammation and airway constriction that places a heavy cost on public health. The World Health Organization estimates that 262 million people world-wide have asthma in 2019; by 2023, this figure is expected to reach 339 million. 455,000 people died from asthma-related causes in 2019, underscoring the vital necessity of proper asthma management and asthma attack prevention.

The onset of asthma attacks and the deterioration of an asthmatic patient's health are both greatly influenced by environmental factors. Dust mites, mold, pollen, and other airborne allergens can have a major negative impact on people who have asthma, increasing their need for hospitalization and degrading their quality of life. Dust particles, which are common in both indoor and outdoor environments and represent serious health hazards to those with asthma, are of special concern.

The Environmental Protection Agency (EPA) advises keeping indoor humidity levels between 30 and 50% to prevent the development of mold, dust mites, and other allergies. Making a space that is asthma-friendly also requires managing the temperature inside and keeping an eye on airborne dust particles. As a result of sensory nerve fibers in the airways being activated by high humidity and a high temperature, bronchoconstriction may result.

Asthma Health Monitor uses contemporary sensors for real-time dust particle, temperature, and humidity monitoring in an asthma monitoring system that takes these environmental aspects into consideration. Having rapid access to correct information about their environmental circumstances empowers asthma sufferers and enables proactive measures to lessen asthma triggers and prevent asthma attacks.

The major objective of this project is to design and build a complete health monitoring system that can recognize harmful temperatures, humidity levels, and dust particle concentrations as well as offer tailored advice to asthmatics on how to make their homes safer. By leveraging accurate sensors and Arduino technology, Asthma Health Monitor intends to bridge the gap between asthmatics and their surroundings, improving asthma control and quality of life.

II. LITERATURE REVIEW

There are considerable difficulties in managing and controlling asthma, a common chronic respiratory disorder that affects millions of people worldwide. Asthma episodes and symptom exacerbation are greatly influenced by environmental conditions, including dust particles, humidity, and temperature.

This examination of the literature looks at current studies on asthma triggers, IoT-based health monitoring systems, Arduino technology, and pertinent sensors in order to create a thorough knowledge and context for the creation of Asthma Health Monitor.

A. Asthma Triggers and Environmental Factors

Asthma triggers encompass a variety of environmental factors such as dust mites, mold, pollen, pet dander, smoke, and air pollution. According to a study by S. Arshad et al, published in the Journal of Allergy and Clinical Immunology, reducing exposure to indoor allergens like dust mites is vital in managing asthma. Effective monitoring of indoor air quality is crucial to mitigate these triggers.[1]

Figure 1: - Asthma Attack Triggers

B. IoT-based Health Monitoring Systems

The integration of the Internet of Things (IoT) into health monitoring has revolutionized healthcare. A study by Abdulmalek, Suliman, et al, discusses the potential of IoT-enabled health monitoring systems in providing real-time data for various medical conditions[2].

C. Arduino Technology in Healthcare

Arduino, an open-source electronics platform, has gained traction in healthcare applications. A study by Thapa, Pradeep, et al., published in the International Advanced Research Journal in Science, Engineering and Technology, discusses the integration of Arduino-based systems in healthcare, emphasizing its cost-effectiveness and ease of customization[3].

D. Sensor Technologies for Environmental Monitoring

The choice of sensors is critical for accurate environmental monitoring. An article by Ho, Clifford, and M. Schöning et al., published in the Sensors journal, provides insights into various sensor technologies applicable for environmental monitoring.

This includes optical and capacitive sensors, which are essential for detecting dust particles, temperature, and humidity[4].

E. IoT-based Air Quality Monitoring Systems

Air quality monitoring systems have witnessed a surge in IoT integration. A study by Saini, Jagriti, et al., published in the International Journal of Environmental Research and Public Health, presents an IoT-based air quality monitoring system. This study emphasizes the importance of real-time monitoring and data analytics[5].

In conclusion, this literature review emphasizes the pressing need for “Asthma Health Monitor” to effectively address asthma triggers by leveraging IoT and Arduino technologies. By integrating precise sensor technologies, the device aims to empower individuals with asthma to proactively manage their environment

and, ultimately, improve their overall well-being. These referenced studies underscore the significance of environmental monitoring and IoT technologies in advancing asthma.

III. METHODOLOGY

A. *Device Components*

i) 20x4 LCD Display

The heart of the device is its 20x4 LCD display. This interface provides real-time visual feedback to the user by displaying Temperature in Celsius, percentage of Humidity in air and Air Quality obtained from the DHT11 and PMS7003 Dust sensor respectively. The display not only offers air quality but also serves as a conduit for user interaction and alerts.

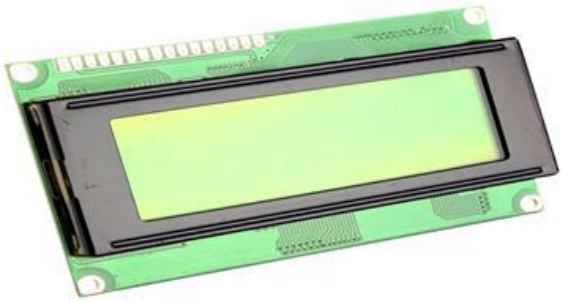

Figure 2: - 16x4 LCD Display

ii) Dust Particle Sensor

PMS7003 is a kind of digital and universal particle concentration sensor, which can be used to obtain the number of suspended particles in the air, the device can detect dust particles present in the air and figure it out in real-time.

Figure 3: - PMS7003 Dust Sensor

iii) Temperature and Humidity Sensor

The **DHT11** is a commonly used Temperature and humidity sensor For more accuracy in air quality monitoring systems. It collects serial data of temperature and humidity from the environment.

Figure 4: - DHT11 Temperature and Humidity Sensor

iv) Buzzer

The buzzer, directly connected to the accelerometer, plays a vital role in alerting the user and those in proximity to potential hazards. When the accelerometer detects unusual motion, the buzzer emits a distinct, attention-grabbing sound that serves as an audible warning.

Figure 5: - Buzzer

v) Arduino Nano

Acting as the device's computational brain, the Arduino Nano oversees data processing, logic execution, and sensor coordination. This advanced microcontroller is well-suited for IOT applications, providing the necessary power and capabilities to ensure the device responds promptly and accurately to detected events.

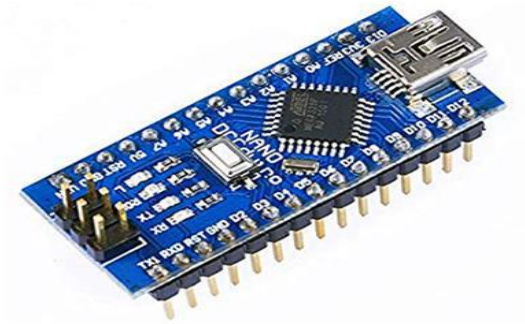

Figure 6: - Arduino Nano

vi) 3D Printed Structure

The 3D printed outer casing encapsulates the components in a durable and ergonomic design. It not only provides physical protection but also helps to move devices from one place to another place. If the patient is shifting his room or place so easily they can carry. With a 3D printed case it is to install and carry.

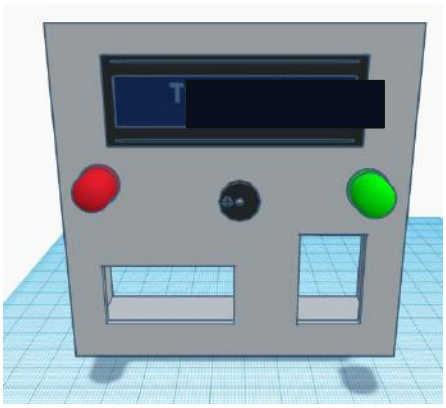

Figure 7: - 3D Printed Model

B. Functionality and Integration

i) Sensors, LEDs and Buzzer Interaction

The temperature and dust sensor continuously monitor temperature, humidity level and count of dust particle in surrounding air. In this process if air quality goes down, it sends a signal to the buzzer, which promptly emits an audible alarm and Red LED glows else Green LED glows.

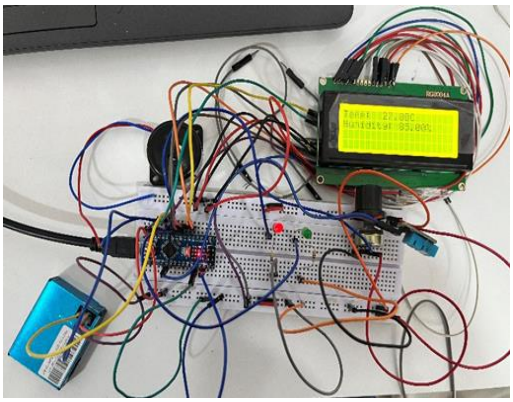

Figure 8: Hardware Functionality & Integration

The suggested technique collects data from the environment using sensors that measure temperature, humidity, and dust. The microcontroller processes the data that was received from the sensors and shares it with the Arduino nano controller. The controller performs processing continually and instructs the appropriate components, such as the buzzer and LEDs.

ii) Circuit

DHT11 is connected to the microcontroller on pin number A1 to communicate with microcontroller and Rx and Tx pin of PMS7003 is connected to D8 and D9 respectively.and LCD is connected on D2, D3, D4, D5, D11 and D12 along with Potentiometer. Pin D6,D7 and D10 is used to connect Red LED, Green LED and Buzzer Respectively as shown in figure 9

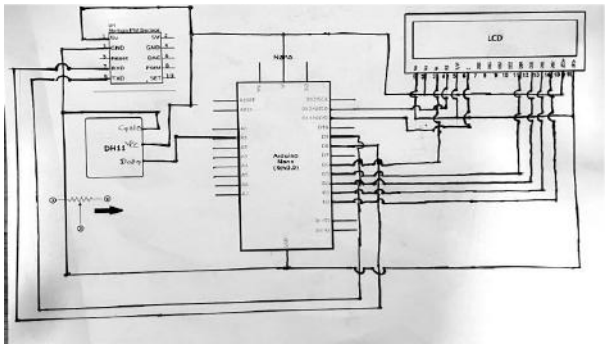

Figure 9:- Circuit Diagram

iii) Output & Result

The system continuously monitors Temperature, Humidity and Dust Particles from the surroundings. Sensors are collecting the data and wedding it to the microcontroller for the further process.

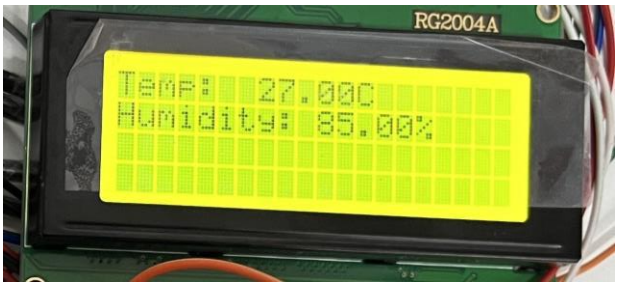

Figure 10:- LCD with Temperature and Humidity Data

Microcontroller does the process on received data, showing the result on LCD Display depending on which the Buzzer and LED is also controlled accordingly. System is able to detect the safe and unsafe environment for Patients. Buzzers create alarming sounds when the surrounding air is unsafe.

IV. CONCLUSION

By tracking environmental triggers, the Asthma Health Monitor with Dust and Temperature Sensing offers a comprehensive and cutting-edge answer to the urgent demand for efficient asthma care. Worldwide, asthma continues to be a common respiratory disorder that affects millions of people, and environmental variables play a crucial role in asthma flare-ups. The goal of this research-driven project was to develop a dependable monitoring system that would enable people to take control of their condition. It did this by utilizing emerging technologies, particularly Arduino-based hardware and sophisticated sensors.The main goals of this work were to examine three important environmental factors—temperature, humidity, and dust particles—that are known to affect asthma symptoms. Dust particle, temperature, and humidity sensors were integrated to provide real-time data collection and analysis, giving users access to vital information. The system's user-friendly interface made it straightforward to retrieve environmental data and receive real-time feedback. To make sure that the device's design and performance matched user demands and medical standards, we used a user-centric approach and conducted needs assessments, spoke with medical specialists, and reviewed relevant literature. The accuracy and clinical relevance were validated through collaboration with medical specialists and the incorporation of their insights. The monitoring device's accuracy and precision in various environmental situations, including controlled and real-world settings, were proven throughout the validation and testing phase. The findings supported the device's potential to help people control asthma triggers by demonstrating its capacity to precisely detect dust particles, temperature, and humidity.

In conclusion, Asthma Health Monitor represents a significant step towards empowering individuals with asthma to take informed measures to mitigate environmental triggers and enhance their overall quality of life. The integration of technology and healthcare through such innovative devices holds promise for a future where individuals can effectively manage their health conditions in real time, promoting proactive and personalized healthcare solutions. Future iterations of "Airsafe" will further refine the design, incorporate additional features, and broaden its accessibility, aiming to make a meaningful impact on asthma management and respiratory health globally.

REFERENCES

[1] Arshad, Syed Hasan. “Primary Prevention of Asthma and Allergies.” Journal of Allergy and Clinical Immunology, vol. 116, no. 1, July 2005, pp. 3–14,

[2] Abdulmalek, Suliman, et al. “IoT-Based Healthcare-Monitoring System towards Improving Quality of Life: A Review.” Healthcare, vol. 10, no. 10, 1 Oct. 2022, p. 1993. Mdpi,

[3] Thapa, Pradeep, et al. “IOT BASED HEALTH MONITORING SYSTEM USING ARDUINO UNO.” International Advanced Research Journal in Science, Engineering and Technology, vol. 10, no. 6, 30 May 2023,.

[4] Ho, Clifford, and M. Schöning. “Sensors for Environ-mental Monitoring.” Sensors, vol. 5, no. 1, 28 Jan. 2005, pp. 1–3,

[5] Saini, Jagriti, et al. “Indoor Air Quality Monitoring Systems Based on Internet of Things: A Systematic Review.” International Journal of Environmental Research and Public Health, vol. 17, no. 14, 9 July 2020, p. 4942

[6] Paganelli, Antonio Iyda, et al. “Real-Time Data Analysis in Health Monitoring Systems: A Comprehensive Systematic Literature Review.” Journal of Biomedical Informatics, vol. 127, Mar. 2022, p. 104009,