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IOT ENABLED REAL TIME ASTHMA MONITORING SYSTEM FOR SOUTH ANDAMAN DISTRICT(TROPICAL REGION) USING ESP32 AND ARDUINO CLOUD

[1] K PRAKASH RAJ
Department of Computer Science
Jawaharlal Nehru Rajkeeya Mahavidyalaya
Sri Vijaya Puram

[2] Dr. C PARTHIBAN
Assistant Professor
Department of Computer Science
Jawaharlal Nehru Rajkeeya Mahavidyalaya
Sri Vijaya Puram

[3] DR. N C VINOD
Head of Department
Department of computer science
Jawaharlal Nehru Rajkeeya Mahavidyalaya
Sri Vijaya Puram

Abstract- Asthma is chronic respiratory condition this makes the patient hard to breathe or causes you to cough or wheeze. Without treatment, these flare-ups can be fatal.To address this issue,this paper presents the design and development of an IOT based real time asthma monitoring system aimed
at improving medication adherence,
monitoring the environmental conditions and real time alerts during critical situations when condtion is not suitable for the patient.

Keywords: DHT11,ESP32,ARDUINO CLOUD,ASTHMA,IOT,ENVIRONMENTAL MONITORING,TROPICAL REGION,SOUTH ANDAMAN

1. INTRODUCTION

Asthma continues to be one of the most common and dangerous respiratory disease,which leads to hospitaliztion and it can be fatal if it left untreated.In many cases inhalers serves as the first aid in asthma treatment,studies have shown that many patients forget or ignore prescribed inhalers.Apart from that sometimes environmetal factors such as humidity,temperature or air quality slightly increases the risk of asthma attacks.

The Andaman and Nicobar Islands are one of the tropical regions in India, with an average daily maximum temperature of 31 degrees. High humidity and hot temperatures make the weather pleasant at times but also tropical humid.

The average annual temperature in the greater region of Andaman and Nicobar Islands is 28 degrees Celcius. It is highest in April at 29 °C and lowest in September.

Warm air can absorb more moisture than cold air. The relative humidity indicates how much moisture can be physically contained in the air. At high humidity, a person feels uncomfortable and perceives this as oppressive. In general, a relative humidity of 40-60% feels pleasant.

So, South Andaman Has high humdity

in environment which can be a fatal factor for Asthma patients.

To address these limitations, IOT based Asthma Monitoring System introduces an IOT cloud enabled approcah to Asthma Management.

This system is degigned to monitor the real-time environment condition which is suitable for Asthma Patients.It collects the air quality data and sends it to the cloud. This system system continuously monitor the temperature and humidity thorough DHT11 sensor and Air Quality(CO_2) through MQ-135 Sesor,with the help of these sensors feature we can reduce the severe asthma epsiodes.

2.HARDWARE REQUIREMENTS:

- ESP32 NodeMCU
- DHT11 Temperature & Humidity Sensor Module
- MQ135 sensor module
- 5v Power Supply

3.SOFTWARE REQUIREMENTS :

- Arduino IDE
- Embedded C
- Arduino Cloud

4.LITERATURE REVIEW:

i. Environmental Triggers and Asthma Management

Asthma is a chronic respiratory condition significantly influenced by external environmental factors. Research indicates that high relative humidity and extreme temperatures can trigger bronchoconstriction. According to studies on tropical climates, humidity levels exceeding 60% create a breeding ground for dust mites and mold, which are primary allergens for asthma patients. The geographic focus on the Andaman and Nicobar Islands is particularly relevant, as tropical maritime climates often maintain these high-risk humidity levels year-round.

ii. The Role of Air Quality Monitoring (MQ135)

Recent literature emphasizes the correlation between Poor Air Quality Index (AQI) and increased hospital admissions for asthma. The use of sensors like the MQ135 allows for the detection of Ammonia, Nitrogen oxide, Alcohol, Benzene, and CO2. Traditional monitoring relies on large, static government stations; however, current research trends favor localized, personal monitoring systems that provide real-time data specific to the user's immediate micro-environment, allowing for more precise medication adherence and preventative action.

iii. IoT Architecture in Healthcare (ESP32 & Cloud Integration)

The shift from Bluetooth-based monitoring to Wi-Fi enabled microcontrollers like the ESP32 has revolutionized patient care. The literature highlights the ESP32's dual-core processing and integrated Wi-Fi as superior for handling simultaneous sensor data processing and cloud transmission. By integrating with platforms such as Arduino Cloud, data is no longer siloed on a local device but can be accessed by healthcare providers or family members remotely, facilitating a "Tele-health" approach to chronic disease management.

iv. Edge Computing vs. Cloud Analytics

Current research explores the balance between processing data at the "edge" (on the ESP32) versus the cloud. Studies suggest that for real-time alerts (critical for asthma attacks), low-latency processing is required. Using Embedded C for local threshold logic ensures that an alert can be triggered even if cloud connectivity is momentarily lost—a vital consideration for regions with fluctuating internet stability.

5. METHODOLOGY:

The methodology of this project follows a four-tier architecture: Sensing Layer, Processing Layer, Communication Layer, and Application Layer.

i. System Architecture

The system is designed as a real-time Embedded IoT node. The sensors (DHT11 and MQ135) act as the input interface, collecting raw environmental data. This data is processed by the ESP32 microcontroller and transmitted via Wi-Fi to the Arduino Cloud for storage and analysis.

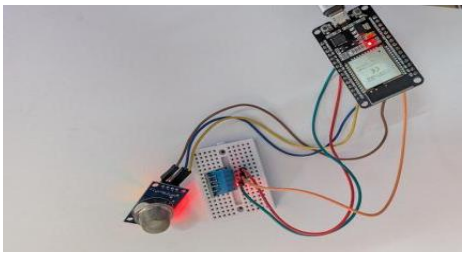
ii. Hardware Implementation

The hardware setup involves interfacing the sensors with the ESP32 NodeMCU.

DHT11 Sensor: Connected to a digital pin to measure temperature and humidity using a single-bus protocol.

MQ135 Sensor: Connected to an Analog-to-Digital Converter (ADC) pin of the ESP32 to measure gas concentration in parts per million (PPM).

Power Management: The system is powered by a stable 5V DC supply, regulated down to 3.3V by the ESP32's onboard voltage regulator to power the sensors.



iii. Software Development (Embedded C)

The firmware is developed using the Arduino IDE using Embedded C. The logic follows these steps:

Initialization: Setting up Wi-Fi credentials and initializing the Arduino IoT Cloud library.

Data Acquisition: Periodically sampling the DHT11 and MQ135 sensors.

Threshold Logic: If the humidity exceeds 60% or AQI levels surpass a safety limit (specific to asthma triggers), a "Critical" flag is generated.

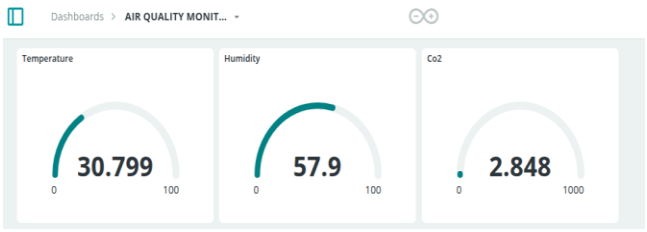
Synchronization: Using the ArduinoCloud.update() function to sync local variables with the cloud dashboard.

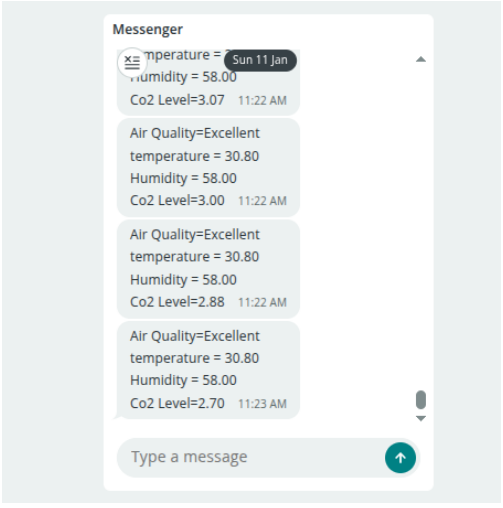
iv. Cloud Integration and Monitoring

The Arduino Cloud serves as the central monitoring hub.

Dashboarding: Visual widgets (gauges and charts) display real-time trends of temperature and air quality.

Alerting System: Webhooks or push notifications are configured to alert the patient or caregiver when environmental conditions in the room become "high risk" for an asthma flare-up.





6. CONCLUSION

This research successfully demonstrates the design and implementation of an IoT-based Asthma Monitoring System tailored for tropical environments. By integrating the ESP32 microcontroller with DHT11 and MQ135 sensors, the system provides a low-cost, real-time solution for monitoring the two most critical environmental triggers: high humidity and poor air quality.

The project highlights that in regions like the Andaman and Nicobar Islands, where average humidity often exceeds the safety threshold of 60%, continuous monitoring is not just a luxury but a clinical necessity for asthma management. The transition from manual tracking to Arduino Cloud-based automation ensures that patients receive timely alerts, potentially reducing the frequency of emergency hospitalizations and improving overall medication adherence.

Future iterations of this project could incorporate Machine Learning (ML) algorithms to predict asthma attacks before they occur based on historical sensor patterns.

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