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Smart Wearable for Respiratory Health Monitoring

Deva Sahaya Raja S, Lokeshk, Mohammed Asif A, Rithikg, Dr K G Parthiban

U.G. Student, Department of Biomedical Engineering, Dhaanish Ahmed Institute of Technology, Coimbatore, India

U.G. Student, Department of Biomedical Engineering, Dhaanish Ahmed Institute of Technology, Coimbatore, India

U.G. Student, Department of Biomedical Engineering, Dhaanish Ahmed Institute of Technology, Coimbatore, India

Principal/Professor, Department of Biomedical Engineering, Dhaanish Ahmed Institute of Technology,
Coimbatore, India

ABSTRACT: This project is a real-time Lung Disease Monitoring System based on IoT and Machine Learning methods. The system utilizes various sensors such as a respiratory rate flow sensor, MQ-135 for air, DHT11 for humidity and temperature, and MAX30100 for SpO₂ and heart rate, interfaced to NodeMCU through an MCP3008 ADC. All of the sensor data are shown on an I2C LCD as well as sent to a laptop for processing at the same time. A K-Nearest Neighbors (KNN) classifier is used to classify possible lung-related ailments according to the measured parameters. This intelligent monitoring system is designed to offer early diagnosis and ongoing health monitoring, facilitating proactive medical treatment in lung disease management.

KEYWORDS : Lung disease monitoring, Internet of Things (IoT), Machine Learning, K-Nearest Neighbors (KNN), real-time health monitoring, respiratory rate, air quality sensor (MQ-135), temperature and humidity sensor (DHT11), SpO₂ and heart rate sensor (MAX30100), NodeMCU, MCP3008 ADC, I2C LCD display, early detection, smart healthcare system, proactive medical intervention.

I. INTRODUCTION

This project proposes a smart Lung Disease Monitoring System using Internet of Things (IoT) and Machine Learning (ML) to facilitate real-time monitoring and early detection of respiratory diseases. As lung conditions like asthma, COPD, and bronchitis increase because of environmental pollution and lifestyle-related issues, there is an increasingly urgent need for affordable and permanent health monitoring systems.

The system is implemented with a NodeMCU ESP8266 microcontroller, which reads data from a number of sensors: an MQ-135 gas sensor for air quality, a flow sensor for respiratory patterns, a DHT11 sensor for temperature and humidity, and a MAX30100 sensor for blood oxygen saturation (SpO₂) and heart rate. Analog signals are converted with the MCP3008 ADC and are shown on an I2C LCD. At the same time, data is sent wirelessly to a laptop to be analyzed.

A K-Nearest Neighbors (KNN) algorithm interprets the sensor readings to diagnose respiratory disorders using trained datasets. This system enables early diagnosis and minimizes dependence on costly, hospital-based machinery.

Small, non-invasive, and affordable, the system is suited for remote medicine, home health monitoring, and mobile health clinics. It is a step toward intelligent, preventive care with the help of IoT and ML technologies.

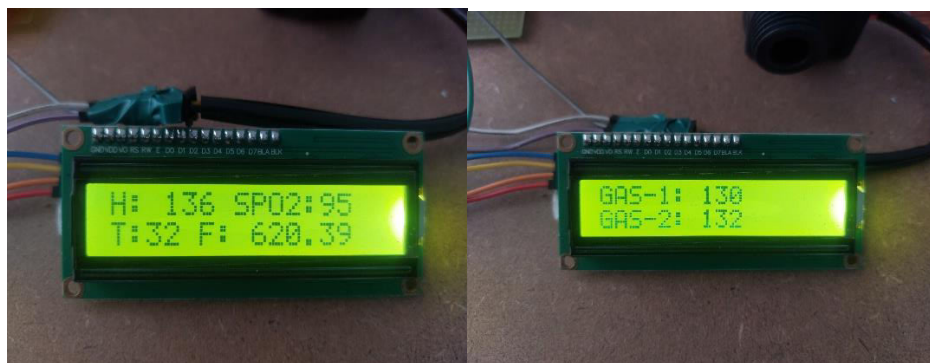
II. LITERATURE SURVEY

Recent research in lung disease monitoring focuses on remote, real-time healthcare solutions. Unnikrishna Menon et al. (2014) introduced a remote diagnosis system based on FFT-based analysis of lung sounds and GSM/3G transmission, with room for enhancement through machine learning. Keyi Yang et al. (2024) designed an energy-efficient dual-mode AI accelerator for wearable lung sound monitoring, providing substantial performance gains. Bunyuan Sun et al. (2019) pushed the development of Electrical Impedance Tomography (EIT) for lung cancer diagnosis, and Mariem Hafsa et al. (2022) developed a cloud-based EIT system for real-time, continuous monitoring. Clinical validation and integration are needed for wider application.

III. METHODOLOGY

The intended system is an IoT-enabled intelligent lung disease monitoring system using various biomedical and environmental sensors connected with a NodeMCU ESP8266 microcontroller. The system consists of a flow sensor for respiratory airflow measurement, an MQ-135 gas sensor to identify toxic air pollutants, a DHT11 sensor for recording ambient temperature and humidity, and a MAX30100 sensor to monitor heart rate and blood oxygen saturation (SpO₂). The sensors give both digital and analog outputs, with the analog being digitized through the MCP3008 ADC for compatibility with the NodeMCU. The real-time data of all the sensors are shown on an I2C LCD display and at the same time transmitted over Wi-Fi to a connected laptop for processing. On the laptop, a K-Nearest Neighbors (KNN) machine learning algorithm is employed to classify and analyze the data to predict possible lung-related conditions like asthma, bronchitis, or early onset of COPD. Labeled datasets are used to train the system to identify patterns associated with different respiratory conditions. This intelligent health-monitoring system facilitates real-time observation, early detection of disease, and anticipatory care, providing an affordable solution for both urban and rural healthcare use.

IV. EXPERIMENTAL RESULTS



Lung Monitoring Dashboard	
Real-Time Data	
Parameter	Value
BPM	136
SpO ₂	95
Temperature	32
Flow Rate	0.00
Gas 1	125
Gas 2	125
Result Prediction	[Healthy]

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V. CONCLUSION

In summary, the Lung Disease Monitoring System based on IoT sensors and machine learning provides a smart and efficient method of monitoring respiratory health in real time. By incorporating major sensors like the MQ-135 gas sensor, DHT11, MAX30100, and a flow sensor into the NodeMCU ESP8266, the system monitors critical health metrics like air quality, temperature, humidity, airflow, and blood oxygen levels around the clock. The information gathered is processed through the KNN algorithm to forecast possible lung diseases, generating early warnings and alerts for users. This system not only facilitates preventive care but also enables people with chronic respiratory disease by providing ongoing surveillance, minimizing hospitalization, and facilitating timely medical treatment. Its scalability, affordability, and portability make it an exciting weapon against lung diseases, enhancing quality of life and generating useful health information for individuals and healthcare providers alike.

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