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Health Monitoring System with Air Purifier

Abstract: - In today's growing world, one of the greatest risks in the environment is the air pollution. In this work an innovative IoT based system that provides purified air for an individual person is implemented, when carbon-dioxide level is not in a normal range. A portable unit is designed which can be used to measure various body parameters like temperature and heartbeat rate of a particular person using various sensors. Also, an ML algorithm is used to predict whether a particular person is in normal condition or abnormal using the measured body parameters. A tool called air purifier is designed, which ionizes the impurities in the air and provides fresh air to breathe. This automation of air purifier will highly be useful in the upcoming days.

Keywords: improving air quality, protecting public health, Pollution, indoor air, purifier and air quality

I. INTRODUCTION

In a global landscape where the pursuit of air pollution is the major existing and increasing risk factor nowadays. The air contamination causes breathing problems and diseases in the respiratory track. This will affect the normal function of heart and lungs. To overcome these problems, air purifier is used. The air purifier is made to turn on, when it is required, thus providing fresh and clean air. This automation will use the purifier efficiently and helps to improve the life of the purifier. Temperature and heartbeat rate are the two very essential parameters of a person. These two parameters can help to identify the condition of the person. The Machine learning algorithm analyse the measured sensor values and identify whether a person is in normal or abnormal condition.

II. RELATED WORKS

The authors N.S Tallapaneni et. al [2021], developed an IoT based system [1] for health monitoring using machine learning. The system includes sensors that are used to measure the temperature, pulse rate, blood pressure and oxygen levels. The monitored values from the sensors are uploaded and the result is predicted using Random Forest algorithm.

J. Riyazulla Rahman et. al, [2021] This paper [2] describes the monitoring and prediction of using internet of things. It also describes the entire process of data collection from the sensors, processing through the microcontroller using ESP8266 Wi-Fi module and transmitting the data to the Thingspeak cloud.

Sneha N et. al [2017] In this paper [4], the basic parameters like body temperature, heart beats and pulse oximetry are monitored and analysed. The required data is transferred to the webpage to make it locally available for the users. The primary goal is to develop a reliable patient monitoring system so that the healthcare professionals can monitor their patients easily.

In general, the literature papers [5]-[9] describes the work related to healthcare monitoring system and air pollution monitoring system that is based on IoT.

A. A. Neloy et. al, [10] In this paper, the author proposes a general model built for observing the patients health condition using machine learning and IBM cloud computing as Platform as a service (PaaS). The key concept of this research is Machine Learning (ML) based health prediction of the patients.

The authors Ajitesh Kumar et.al (2020), proposes the development of an Internet of Things (IoT) [11] that enables air quality monitoring system that is mobile in nature. It analyses the real-time data by measuring carbon

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monoxide and smoke level existing in the environment. This system can measure local area air contamination and generate the data which is analysed and alerts the people through a buzzer device that is integrated into the system.

III. PROPOSED SYSTEM

The proposed system makes use of temperature sensor (LM35), Heartbeat sensor and CO_2 sensor (MQ135). The three sensors are connected to Arduino board. The Arduino IDE software is used to program the Arduino board. The CO_2 value measured is checked whether it is above or below the threshold value. Depending on the measured value, the relay gets turned on or off. The air purifier is connected to the relay, thus enabling the automation of air purifier. Automation of purifier is the advantage in this system from the existing system. The temperature and heartbeat rate values are entered in excel and analysed in MATLAB. The Support Vector Machine shows better accuracy when compared to other algorithms et.al.[3].
The block diagram for the hardware part is shown in Fig.1.

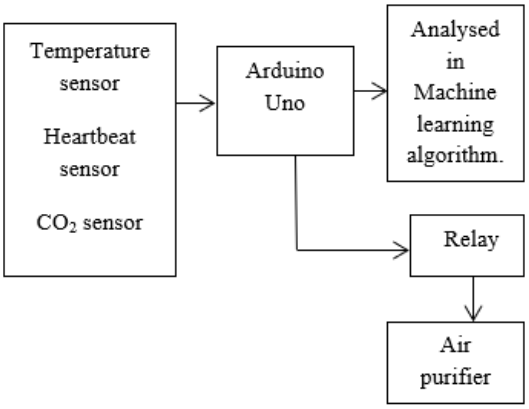

Fig. 1. Block diagram for hardware part.

FLOWCHART

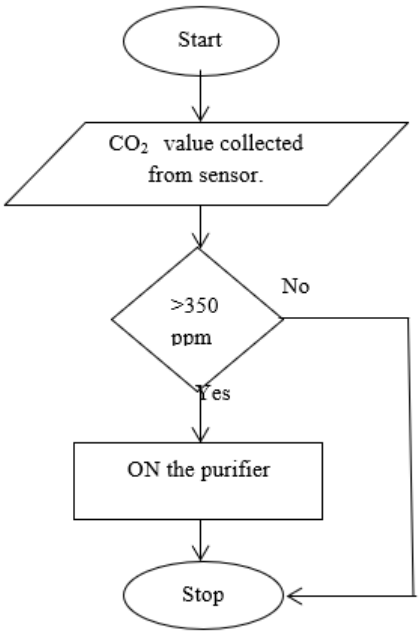

Fig. 2. Flow chart representation.

The flow of working of purifier is shown in fig.2. When the CO_2 value exceeds the limit of 350 ppm, the condition passes, and the energized relay turns the purifier ON.

IV. HARDWARE CONNECTION

The temperature sensor, heartbeat sensor and CO_2 sensors are connected to the Arduino Uno board. Arduino IDE software is used to write the program and the program is uploaded by using USB port connection and the measured sensors values are noted down in serial monitor. The hardware connection of 3 sensors is shown in fig.3.

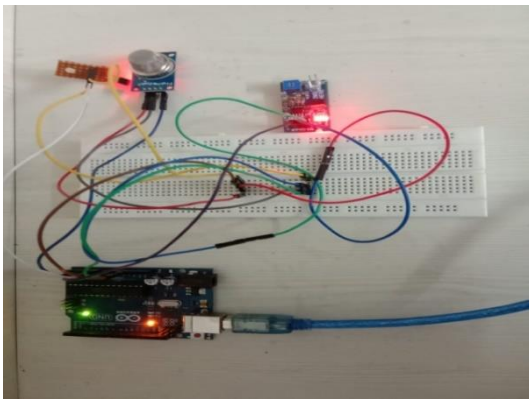

Fig. 3. Hardware connection of sensor.

The power for the operation of air purifier is obtained from the power supply of 220V. Transformer is used to step down the power to 12V. It is connected to the relay and the relay is connected to air purifier. The programmed Arduino is connected to the CO_2 sensor. The hardware connection for operation of air purifier along with CO_2 sensor is shown in fig.4.

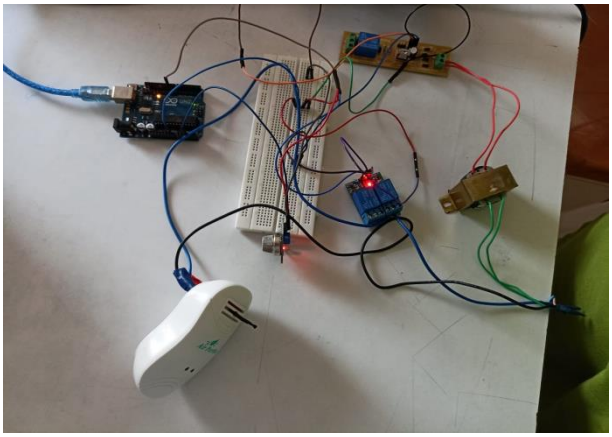

Fig. 4. Hardware connection for air purifier operation.

V. RESULTS

The measured value from the serial monitor is noted and analysed in the MATLAB code for SVM algorithm. The measured values at different time intervals in a particular day for a particular person is shown in the table 1.

Table I: Sensed values of temperature and heartbeat rate

Timings	Temperature(^{0}C)	Heartbeat(bpm)
6.00 am	35.16	68
7.30 am	41.5	68
9.00 am	35.64	64
10.00 am	36.13	72
11.30 am	25.39	76
1.00 pm	52.25	92
3.00 pm	36.13	88
5.00 pm	37	99
7.00 pm	40.12	80
9.00 pm	38.12	70

The temperature measured at different time is plotted in fig 5.

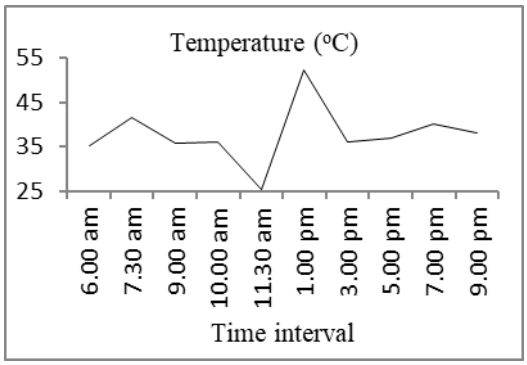

Fig. 5. Time interval Vs Temperature

From fig 5, it can be inferred that at 4 time slots the temperature value exceeds the normal range of 37 ºC. and the abnormality in temperature is observed. From fig 6, it can be inferred that the heartbeat is normal throughout the day. The normal range is 60-100 beats per minute.

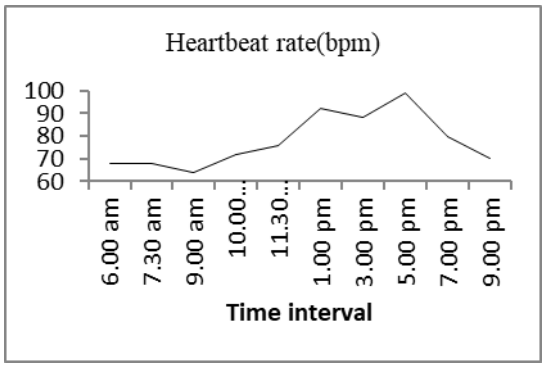

Fig. 6. Time interval Vs heartbeat rate

The result from MATLAB window is shown in Fig. 7.

Fig. 7. Result from MATLAB window.

From the fig.7, it is observed that the person has proper heartbeat rate and abnormal temperature. Then, depending on the CO_2 value, the air purifier is automated. The threshold value of CO_2 is 350 ppm. The fig.8 below shows the air purifier is ON, when the CO_2 value is 380 ppm. The relay is energized, which turns the purifier ON. The fig.9 below shows the air purifier is OFF, when the CO_2 value is 270 ppm (which is below the threshold value).

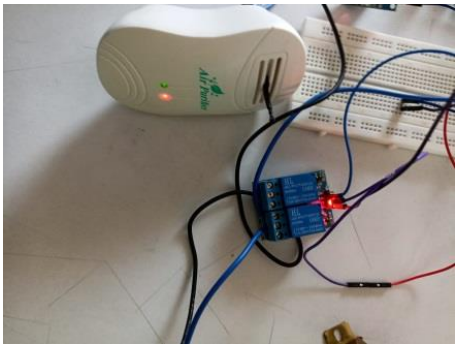

Fig. 8. Air purifier with relay (ON state)

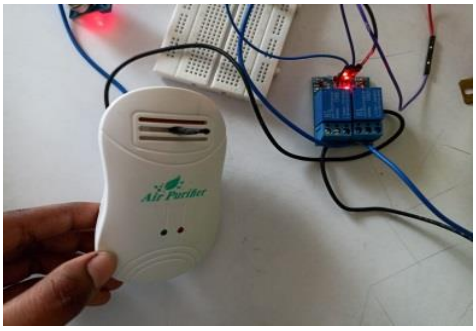

Fig. 9. Air purifier with relay (OFF state)

VI. CONCLUSION

This work helps in analysing the health condition of an individual and can conclude on the state of an individual. Air contamination is a serious issue. This automation of air purifier will help in producing the fresh air in an efficient way thereby making an individual to lead a healthy life.

VII. FUTURE WORK

Using this system as a prototype, the upcoming system can be designed in the miniature size. The components and purifier can be integrated together in a chip, thus reducing the size, and making the system easy to use.

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