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Personalised Asthma Prediction by Early Detection

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Abstract: This study proposes a prototype for an asthma monitoring system that consists of a band and a smart inhaler that may be utilised by asthma sufferers via the Internet of Things. The band is a little gadget that detects various irritants in the environment surrounding the patient in order to identify any indicators of asthma episodes or an unhealthy environment. As a result, asthma patients may determine whether or not the atmosphere around them is safe, allowing them to take necessary action. Additionally, the gadget has the capacity to send data to a physician for follow-up on the patient's situation, as well as a display that shows the ambient condition around the patient. Furthermore, using ThingSpeak, the band gadget shows data reordered in daily testing, allowing the patient and physician to assess improvement from prior days. According to the suggestions of physicians and telemedicine professionals, the band gadget is also linked with medical criteria. Finally, the smart bronchodilator is linked to the band to make it easier to locate.

Keywords: Asthma, IOT, Arduino, ESP32, Sensors, ThingSpeak, Machine Learning.

I.INTRODUCTION

Asthma is a chronic illness that causes inflammation and constriction of the bronchial tubes, which are the passages that enable air to enter and exit the lungs, making breathing difficult. Asthmatics' symptoms might increase if they are exposed to a chemical to which they are allergic, or if they are in a setting that disturbs their regular breathing patterns. Although asthma is not curable, there are effective treatments available. Avoiding triggers, using medications to prevent symptoms, and being prepared to treat asthma attacks if they occur are the best ways to manage asthma. A multitude of causes can induce asthma symptoms, which vary from person to person. When an asthma trigger comes into contact with the airways, they become inflamed, narrow, and fill with mucus. Shortness of breath, coughing, and wheezing are all symptoms of mucus build-up in the airways. The majority of asthmatic devices do not track different environmental factors like as dust, pollen, or other irritating particles. Patients will be able to assess whether or not they are in a healthy environment by utilising a monitor device to check the environment around them. It will also help them to take appropriate action, as well as aid the patient's physician in understanding what his or her patient goes through on a daily basis so that appropriate medicine may be provided if necessary. This may be achieved by giving the data obtained by the monitor device to the doctor.

II.PROPOSED METHODOLOGY

Asthma is characterized by intermittent exacerbations and episodic respiratory symptoms. The monitoring of these episodes is critical in the management of asthma patients, since it allows for the early diagnosis of exacerbations. Chronic disease monitoring is becoming increasingly necessary, yet it has an impact on patient's day-to-day activities. Even though the patients appear to be in good health, flare-ups might develop at any time. As a result, an external source is required to identify and diagnose flare-ups at any moment.
The main concern of this project is to predict asthmatic episodes. By detecting different environmental limitations that induce exacerbation and performing data analysis on them using machine learning and an IOT-based platform. So, the key concepts of this project are:

- To help Asthma patients to anticipate asthma attacks.
- To learn more about the factors that cause asthma attacks. These may range from person to person.
- To provide insights for the treating physician to assess control of asthma, and to investigate reasons for poor control.
- To provide useful data for Health care managers.
- To find the probability of further attack.

Currently, there are a large number of developments of portable systems that are capable of diagnosing or monitoring the condition of a patient suffering from bronchial asthma.

However, the vast majority of such developments do not find widespread introduction into clinical practice, either due to the presence of deficiencies inherent in the methods used, or due to the complexity of the procedure for licensing medical equipment. Diseases was carried out. The analysis of the results presented in the article allows us to conclude that people around the world are very interested in the implementation of integrated monitoring, information. There is the possibility of the patient's treatment by telephone or other means of communication in a specialized Call Center for advice on symptoms and necessary actions. The most complex systems involve the use of home systems, including portable systems, tele monitoring, and telemedicine.

Analysis of the effects obtained after the introduction of such programs of care about the health of the population, leads to the conclusion about their effectiveness. Asthma triggers are usually and distinctively categorized with allergens such as pollen, dust, cockroaches, and mound, food and food additives, exercise, irritants in the air such as smoke, air pollution, chemical fumes and strong odours, infections, medications, and many other factors.

Asthma can be managed by taking an active role in its management via ongoing treatment and building a strong partnership with doctors and other health care providers. Asthma action plans are said to be one of the most effective asthma interventions available. A Written asthma action plan is key to effective asthma management, because it is written by the patient, in conjunction with their doctor. Such that they can both easily recognize changes in the patient's asthma severity and provide clear instructions on how to respond.

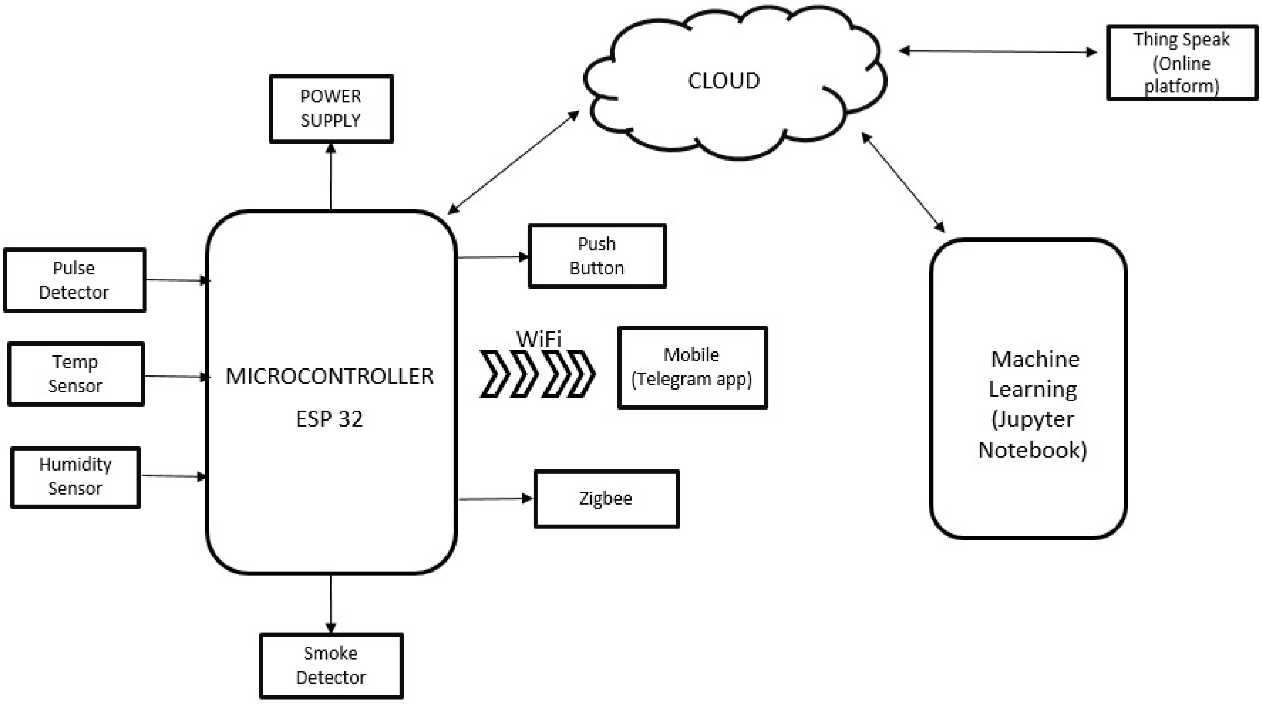

Fig 2.1 Block Diagram

Fig 2.1 shows the Block Diagram of the proposed work. The model begins detecting the environment and the person's condition which is been sensed by various sensors as shown in the fig. The health care monitoring using IoT which play a vital role in modern-day patient care for wide range of adapted interconnected sensors and devices. The technology of cloud and big data which are employed to gather, trace and monitor the patients data. The technologies through which integration can be formed into an elegant healthcare patient statistics monitoring system the projected system which can transfer the patients data among the different partaker in a manner of safe and sound, which can be retrieved from only the authorized healthcare examined team. On the cloud side, it can be supported to analyse, store, monitor and transmitting the data in a secure manner on the concern of medical recommendations. An additional evaluation has been engaged to minimize the errors in the hospitals to provide a healthcare in a good quality. Hence, it becomes inevitable to monitor through an external source. This project aims at doing so by monitoring external and internal variations with the help of various sensors and suitable micro controllers.

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The respective data is stored on the cloud and graphical representations of the different variations can be accessed using an IOT platform. It helps us to monitor asthma patients by using smart devices such as band and the inhaler where the band and inhaler is connected through ZigBee module. Band is a portable device which consists of sensors such as temperature sensor LM35 to detect the body temperature, smoke sensor MQ2 to detect smoke between the ranges 1cm to 8cm. It also uses pulse and humidity sensor to detect the heartbeat and to measure the surrounding air and temperature respectively.
Temperature: For the temperature we have 2 domains, the cold air and the hot air. The patients are mostly exposed to cold air after exercising. It is advised to avoid temperatures below 18°C. The temperature of 15°C and below is considered risky. The hot air is by itself dangerous. It also helps contain pollen and air pollution. It is advised to avoid temperatures above 27°C. The temperature of 30°C and above is considered also risky for the asthmatic patients.
b) Humidity: Dry and humid air can cause bad flare-ups (coughing, vomiting, etc.). It is necessary to avoid air below 40% humidity. Air as humid as 55% is troublesome, with 60% becoming dangerous for the asthmatic patients. Humidity is an essential contributor, so the patient should be very cautious from these conditions.
c) Smoke/Gas: Breathing CO, methane and hydrogen are dangerous for the asthmatic patients. Alcohol is also on the list. While the symptoms described in the above are typical indicators of asthma, not all people suffer in the same way or the same combination of these symptoms. Research shows that some people may have the coughing, wheezing, chest tightness and shortness of breath, while others may have a different combination of the symptoms at different times [10]. Sometimes during an attack, some of the symptoms will be worse than others, and even vary from one episode to another. Some are mild and generally more common, while some are more serious. The life-threatening attacks may be less common, but they also may last longer in length and require emergency medical care.

The measurement results are transmitted via a wireless interface to a PC, tablet or smartphone and are recorded in an electronic diary or, for example, can be used to train a neural network. This will allow for the accumulation of data to adapt the program of processing results for a specific patient and more accurately monitor the change in its health. When the measurement results exceed the set limits, an alarm is generated, which is displayed as a message on the screen of the mobile device and can be sent to the email address of the medical centre.
The described individual system can be useful for continuous express monitoring of the condition of a person suffering from bronchial asthma during the day and warning him about the need to take medicine. In addition, it can be useful in medical institutions for monitoring the condition of a patient in hospital, and monitoring the effects of drugs.
If the connection between the inhaler and the mobile is lost then we get a connection lost message. The distance between the inhaler and the mobile should be 3meter. In case of emergency the push button can be used and the caretaker or the doctor will get to know the patient's location through GPS module. All these information is stored in cloud which can be seen in an IOT platform known as ThingSpeak. Fig 2.2 shows the overall look of the Wearable Band

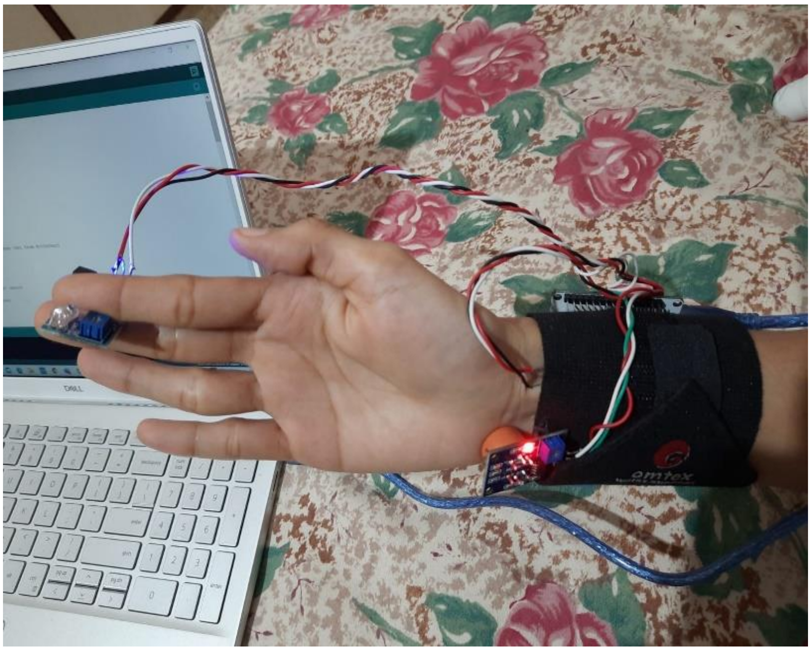

Fig 2.2. The Wearable Band

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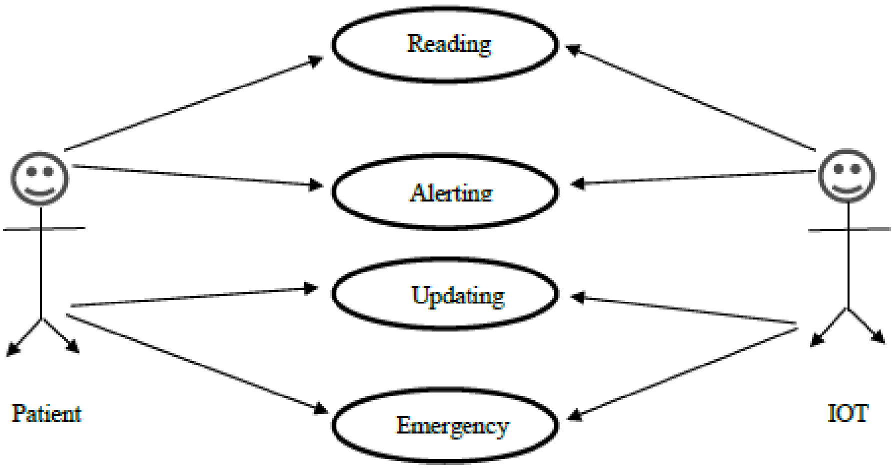

Fig.2.3. Use Case Diagram

Fig 2.4. Shows the diagram of the different applications of the project which are Reading the data from the cloud, alerting the patient or the user or the Doctor, Updating the data and storing it in the Dataset and an emergency alert message or a notification.

The model of the components that make up the Personalized Asthmatic Management System is shown in this class diagram. The sensors readings are detected and the threshold level is checked, after which the data is uploaded to the Arduino IDE compiler and the conditions are compared, as shown in the picture. After connecting to the Wi Fi module, the data is continually updated on the open web portal, ThingSpeak, an IOT platform that provides a graphical depiction of the current data. These records are updated on a regular basis.

III.RESULT

A wearable band containing a Node MCU ESP 32, Arduino, sensors, a ZigBee module, and additional internet apps and platforms such as ThingSpeak and Telegram make up the personalised asthma management project. The model in Fig. 2.2 collects data parameters from the surroundings as well as the patient's body parameters, stores the data, and uploads it to cloud. After that, the data is sent to the ThingSpeak online platform, which generates graphical representations of the patient's health based on the data provided, and these data are saved and uploaded, as well as alert pop up notifications on the Mobile Telegram Application for monitoring the asthma patient's health, which aids in the early prediction and detection of an attack. Other applications and uses include, for example, notifying my emergency pushbutton. Machine Learning Technology is also used to permutated and combine the output dataset in order to tailor the project to a certain patient. If the connection between the devices is lost, the programme will send us a connection loss notification.

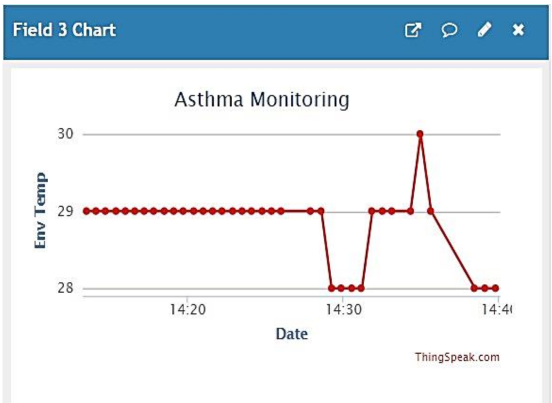

Fig 3.1. Graphical representation of environment temperature

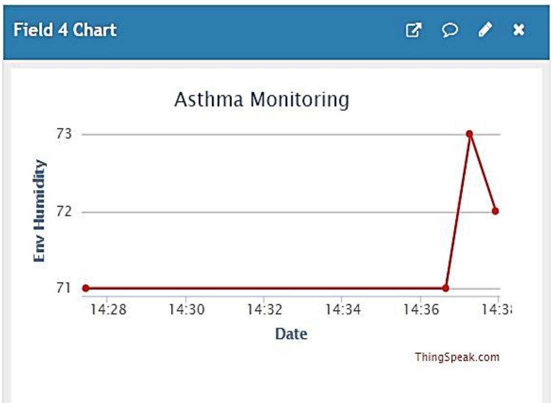

Fig.3.2. graphical representation of environment Humidity

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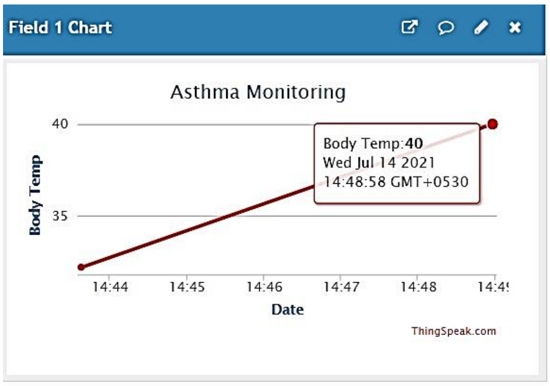

Fig.3.3. Graphical representation of body temperature

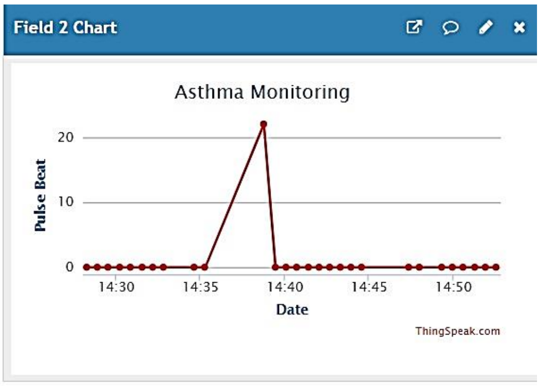

Fig.3.4. Graphical representation of pulse beat

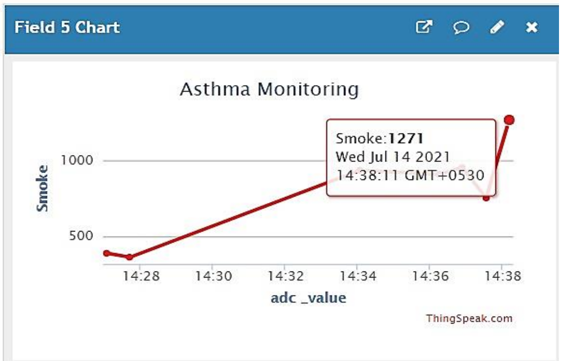

Fig 3.5. Graphical representation of smoke

The Massage DANGER on the Telegram application is shown in Fig. 3.6. When the computed data surpasses the threshold level, the application displays a pop up massage as shown in the figure.

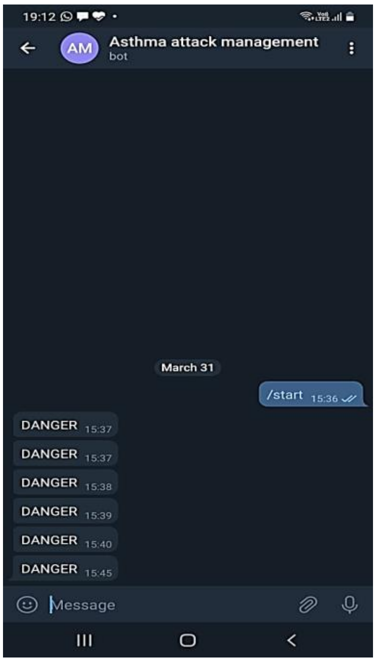

Fig.3.6. message shown if high smoke rate is detected.

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Outputs from Machine Learning

I.RFR outputs

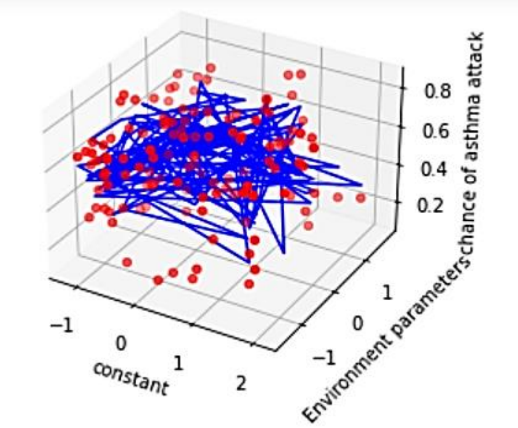

Fig 3.7: Plotting Significant Feature V/S Predicted Model

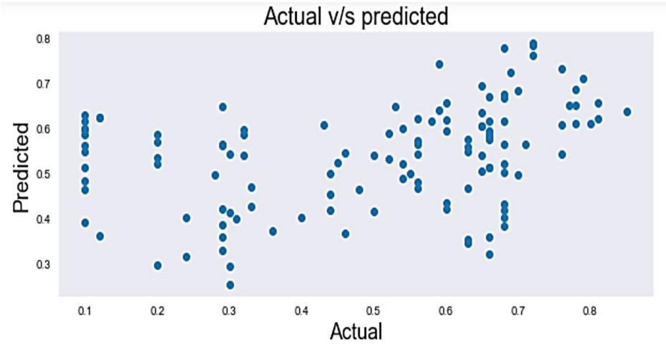

Fig 3.8: Actual V/S Predicted Values

II.RFR with PCA outputs

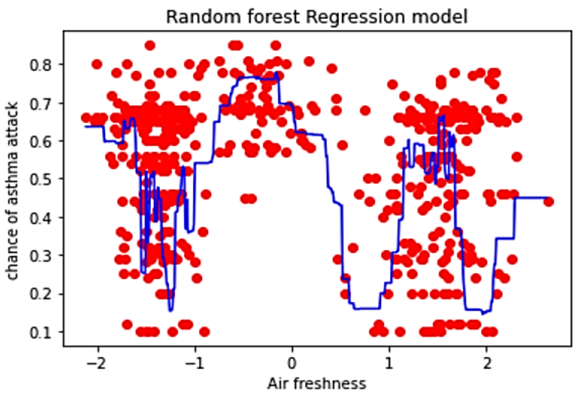

Fig 3.9: Plotting Significant Feature V/S Predicted Model

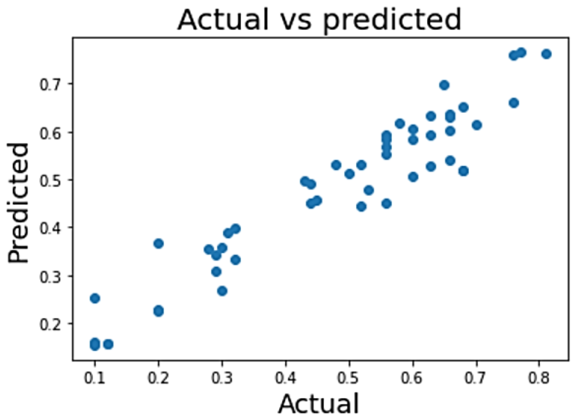

Fig 3.10: Actual V/S Predicted Values

III.MLR with PCA outputs

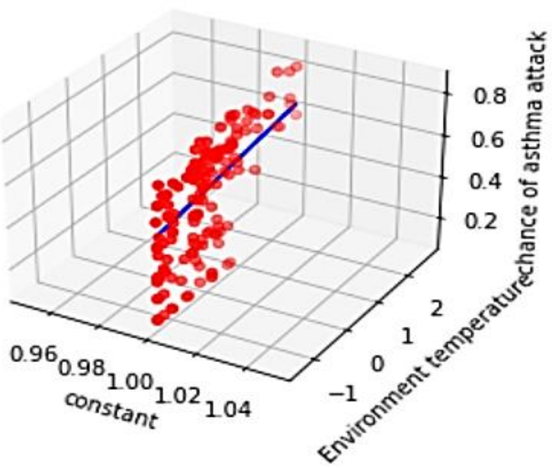

Fig 3.11: Plotting Significant Feature V/S Predicted Model

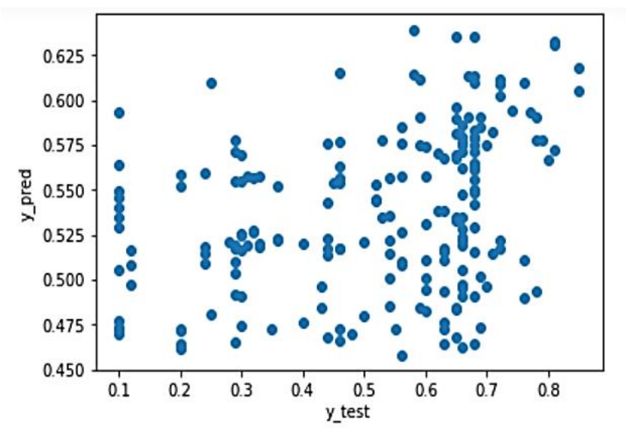

Fig 3.12: Actual V/S Predicted Values

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IV.CONCLUSION

Asthma is characterised by intermittent exacerbations and episodic respiratory symptoms. The monitoring of these episodes is critical in the management of asthma patients, since it allows for the early diagnosis of exacerbations. Chronic disease monitoring is becoming increasingly necessary, yet it has an impact on patients' day-to-day activities. Even though the patients appear to be in good health, flare-ups might develop at any time. As a result, monitoring from an external source becomes unavoidable. This project seeks to accomplish so by using various sensors and appropriate microcontrollers to detect exterior and internal fluctuations. The data is kept in the cloud, and an IoT platform may be used to view graphical representations of the many permutations. A block diagram of the system is presented on the basis of a cheap patient status sensor in combination with a portable computing device - a smartphone, tablet, etc. Such a structure will significantly reduce the cost of the device, which will contribute to its wider distribution. As the main method of state control, it is proposed to use the method of measuring the transmission coefficient of the microwave signal through the patient's chest. In this case, measurements are carried out at a single point, but for a long time, for example, when the device is continuously worn during the day. The advantages of using microwave technologies allow us to apply the proposed structure to monitor the condition of patients of all age groups, including young children. The integration of additional sensors for the patient’s vital activity and the state of the environment, together with the use of modern IT technologies, will enable the creation of a comprehensive system for monitoring the patient’s condition and informing him of the necessary actions in a timely manner.

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