Smart Asthma Attack Prediction System Using Internet of Things

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***Abstract*— Right now about 334 million people across the globe are suffering from asthma. People with asthma are sensitive to things which may not bother normal people at all. For example they may feel uncomfortable with increased levels of smoke, pollen or fog in air. The number of people suffering from asthma has been rising sharply over the years, pollution being one of the biggest reasons. Though controlling pollution is a broad topic, but preventing oneself from asthma is an easier way out. It is important to keep track of what triggers asthma attack in a patient, because symptoms do not occur right after the exposure to the triggering parameters. The delay in attack occurs depending on how much the person is sensitive to the factor. Thus we try to propose a model of a smart asthma prediction system using Internet of Things.**

Keywords—GPS; Watson; VOCs; Pollen Detector; Nima; Sinusities

I. INTRODUCTION

According to Global Burden of Disease Study (GBD) undertaken in 2008-2010, the number of people suffering from asthma in the world may be as high as 334 million[1]. The worst affected are the aged people between 75-79 years and adolescence (ages 10-14) in terms of disability and premature death. Asthma is a chronic disease which causes uneasy breath along with coughing and wheezing. There may various factors which may trigger an asthma attack, which varies from person to person. Some of the common factors which trigger asthma are:

- Infections
- Food and food additives
- It can happen after an exercise.
- Smoking and chemical fumes
- Sinusities
- Outdoor allergens, such as pollens from grass, trees and weeds
- Indoor allergens, such as pet dander, dust mites and mold

Here we try to measure and predict when a person is about to have an asthma attack using Internet of things (IoT). Whenever he or she is about to have an asthma attack, a warning is sent to their smart phone as a notification. Thus the person moves away to some safe zone free from factors which can trigger the attack.

II. PROPOSED METHOD

We propose a system and method which will help an asthma patient to avoid some situations which cause breathing trouble. The following work has already been done:

When the user takes the inhaler, automatically a signal is sent to the mobile app via BLE Bluetooth, at the same time by getting the signal the app starts gathering some real time parameter values like the location by GPS, the body temperature, heart beat etc. using fitbit wearable. When the patient goes to the Doctor for consultation the app shows some analytics to help the doctor to diagnose the asthma problem. Now we are going to extend this work.

We have different sensors which sense smoke, fog etc. We can incorporate these sensors into the device.

We can take pictures using street cam and fed to Watson[2] to analyze whether there are any specific object which affects the persons' health. Humidity affects a person health by increasing asthma attack chance. We can use weather report for Humidity. For some people physical activities like exercising also trigger asthma attack. Thus when the person is running or walking hard and crossing the normal threshold value of regular walk, we can send a warning notification. We can also alert that person to use mask whenever there is any kind of abnormality in environmental situation such as a lot of dust is being generated at a construction site which may cause an asthma attack.

Often during a journey, a person may travel to a zone which is harmful to an asthma patient. In such a case, he or she can input the location of source and destination in smart phone. Using location and internet we can notify the user if a given route is a safe one. We will have sensors to collect the traffic data, more the traffic more the pollution. So in such situations the user will receive a warning not to take a route where there is too much smoke produced due to prolonged traffic jam.

Source and Destination path of patients or end user:

We can assume that a person travel from point A to point H (see fig-1). We can define this path as an input in our application:

- By analyzing regular activities of that person via mobile GPS tracker.

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- Put manually source and destination path in application.

We are assuming that a person takes a specific path to reach office. Now we place some sensors at some specific terminal points or some specific places on his way to office. These sensors collect the PM (Particulate matter) levels of specific places where sensors have been deployed. We can use soot sensors[3] for this purpose. Now we have a data base where we have kept the PM level value which is normal for the user. If we see the PM level has crossed the normal threshold value we will alert him not to take the path.

VOCs[4] are categorized as either methane (CH4) or non-methane (NMVOCs). NMVOCs depend on the local region. Aromatic NMVOCS like benzene, toluene and xylene have been suspected to be carcinogenic. They are also asthma triggering substance. Aeroqual makes VOC sensors which will help us to determine VOC content in air and thus make suitable recommendation to the user.

Apart from these environment parameters we introduce some biometric parameters. It may happen that the user may unknowingly enter an environment which can trigger asthma attack. In such a situation, the user will initially have irregular breathing pattern. For such a situation Spire can be used to monitor his breathing pattern and warn him accordingly to leave the place.

III. Pollen Detector (PS2 pollen sensor)

This pollen detector[5] detects pollens by the principle of scattering of light. Conventional Pollen counting has been time-consuming work so far. However, a person can now on spot analyze the presence of pollen particles using pollen sensors by taking advantage of real time analysis that is available anywhere. It uses one light emitter and two light receptors to distinguish pollen from other particles on the basis of two factors, "scattered light intensity" and "degree of polarization". Thus the asthma detection system successfully detects presence of pollen to warn the user.

IV. Humidity sensor

Hot humid air is heavier and difficult to breathe. Hot air can irritate the airway and lead to inflammation. Again at the same time, moisture in the air can absorb oxygen. Thus for some asthma patient it is not a problem. However insufficient moisture can lead to inflammation of airways too. Thus, some people experience asthma symptoms when air is too dry (during winters).

So there is a need for a humidity sensor. CL-M53R[6] - a small structure humidity sensor / SHINYEI HUMENT serves this purpose. CL-M53R sensor is lead free sensor and environmentally safe. Thus the system also detects humidity percentage.

V. Food allergen detector

There are 8 types of food that can cause 90% of the food allergy: milk, eggs, peanuts, tree nuts, fish, shellfish, soy and wheat. Food allergen detector[7] allows us to detect presence of these components in food by glowing red as an alert. If the food is safe, then it grows green. This concept is used to feed a warning or safety signal as a notification in smart phone. For example Nima[8] is such a detector as mentioned above. Results are displayed in front of Nima as well as in sync with an application in the smart phone of the user.

VI. Conclusion

We have tried to propose a model of a system which will take into consideration, the most important parameters before arriving at a conclusion whether to alert the user or not. However a challenge yet remains to integrate the entire system into one model to make it usable. We have food, pollen and also humidity detector available, but all these sensors need to be integrated into a single device which will also incorporate other parameters as we have described in our model. Histamine[9] is a chemical which is involved in our immune system, Central Nervous System and also required for proper digestion. Histamine's role in our body is to cause an immediate inflammatory response. It acts as an alert in our immune system, notifying our body of any potential attackers. As a result, asthma attacks are more probable whenever histamines come into play. Histamine stabilizers can control histamine production in our body, but till date we haven't found a histamine tracking system which can keep a watch on the histamine levels in the patient.

These are some of the parameters which have not been addressed yet. Asthma can be prevented if proper monitoring of the patient is done on a regular basis, as we all know, prevention is better than cure.

Model

Figure-1(Between A to H there are various paths where wireless sensors have been placed)

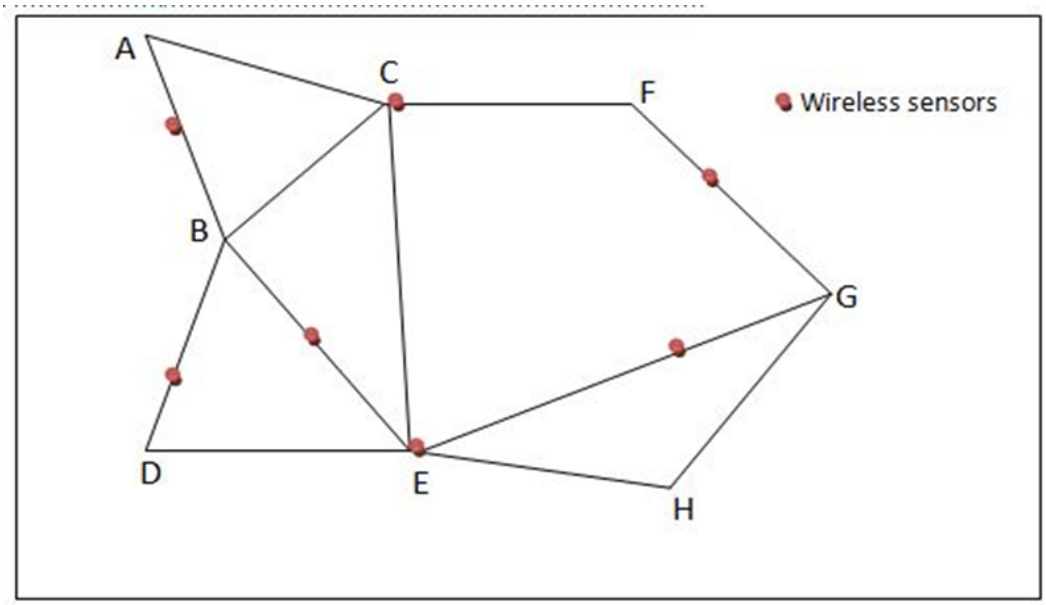
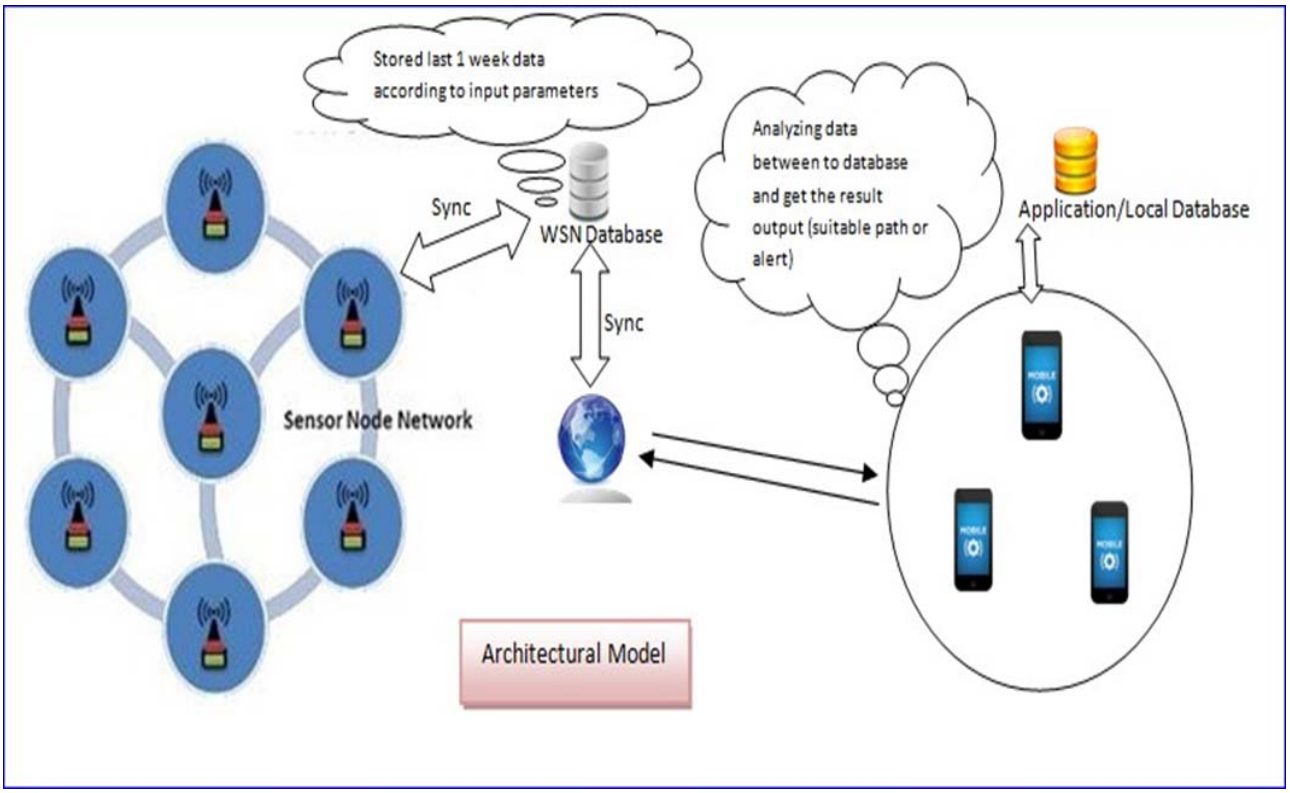


Figure-2(Architectural Model)



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