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Smart Wearable Device for Asthma Patients

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Abstract: ***A sensor network is a network comprising a group of tiny, typical battery powered devices that are capable of monitoring and recording the conditions in any environment. This recorded readings can be shared to a device where it can be stored thorough internet with the help of physical system known as internet of things (IoT). The connectivity of the network can enable the exchanging and collecting of the data. Asthma could be a lifetime chronic disease initiating to abnormal respiratory organ functions and problem in breathing. It causes your airways to get inflamed and narrow and makes breathing difficult. Coughing, wheezing, shortness of breath, and chest tightness are classic asthma symptoms. The medical experts are trying their best to treat the asthma condition. Self-monitoring is the best preliminary course of action to watch, treat and manage this chronic disease. With the help exchanging and collecting of the data through sensor network and self-monitoring together helps the physician, caretaker and the asthma patients to possess management in real time, and thus supply on-time treatment. In this paper, to assist the people with asthma condition we have designed a device to perform at their regular activities. With the help of the gas, temperature and heart beat sensors the data will be collected and uploaded to the cloud for the further analysis. The concerned medical expert and the caretaker of the patient will be receiving the data which is uploaded in the cloud.***
Keywords*: Asthma patients, sensor network, internet of things, cloud, Asthma attack.*

I. INTRODUCTION

Asthma is a chronic condition or disease that causes inflammation and narrowing of the bronchial tubes, the passageways that allow air to enter and leave the lungs, making it harder to breathe, If people with asthma are exposed to a substance to which they are sensitive or a situation that changes their regular breathing patterns, the symptoms can become more severe. According to the latest World Health Organization (WHO) estimates, approximately 250 million people suffer from asthma worldwide, and almost 25 million Americans are affected by this disease according to AAFA, this disease is a public health problem in both rich and poor countries. Although there is no cure for asthma, effective treatments are available. The best way to manage asthma is to avoid triggers, take medications to prevent symptoms and prepare to treat asthma episodes if they occur. Bronchial asthma is one of the most severe Broncho pulmonary diseases affecting people of all age groups, including young children. Currently, more than 300 million cases of bronchial asthma of varying severity have been detected worldwide. In addition, there is a tendency to an increase in the number of patients with bronchial asthma, including young children. Therefore, the development of new methods and devices for the diagnosis of bronchial asthma, including inexpensive portable devices, is a very urgent task. Modern technologies are able to provide important tools for diagnosing a wide range of various diseases, including bronchial asthma. At present, one can find a tendency to actively introduce modern technologies, in particular, in the development of modern low-cost portable devices for diagnosing or monitoring human condition. Asthma is one of the most common chronic diseases and the third leading cause of hospitalization among adolescents. It is a medical condition that causes coughing, wheezing, and difficulty in breathing. During the period from 2008–2010, the prevalence of Asthma was higher among children than adults. According to the Centre for Disease Control, it affects 7.1 million (1:11) children and its rampancy has increased by 15% in the last decade [1]. Records obtained from the Centre for Disease Control and Prevention also indicate that in 2013, about 21% of high school students (grades 9-12) had asthma. Asthma demands a great deal of health care utilization and entails a lot of missed days of school and work.

Asthma is characterized by episodic respiratory symptoms and intermittent exacerbations [1]. The symptoms, airflow obstruction, and exacerbations in asthma vary greatly in both frequency of occurrence and severity. Monitoring these events is crucial to the care of patients with asthma and is directed at the early detection of exacerbations and monitoring of the day- to-day control of asthma. Monitoring can also be extended to investigate reasons for poor control and reasons for exacerbations, such as noncompliance and exposure to triggers. It is important to identify who will perform the monitoring because this has implications for the type of data that are collected, their validity, and their accuracy. Asthma can be monitored by the following people:

A. The patient with asthma because self-monitoring allows the early detection of exacerbations;
B. The treating physician to assess control of asthma and investigate reasons for poor control; and
C. Health care managers to assess the quality and cost of care for patients with asthma.

This article reviews asthma monitoring from each of these perspectives. Asthma is a chronic disease affecting one in nine Australians. As of 2014, 1.5 out of every 100, 000 deaths in Australia were due to asthma. People with asthma have sensitive airways which react to environmental triggers, causing 'flare ups'. This is when muscles in the wall of airways tighten and swell, narrowing the airway itself. This, in combination with the production of mucus can block the airway to varying degrees. Resulting in symptoms such as coughing, wheezing, tightness in the chest and shortness of breath, making it extremely difficult to breathe. There is no cure for asthma, even when patients feel fine, they still have asthma and flare ups can occur at any time. Asthma varies in severity from mild to severe. In severe asthma, breathing difficulties can be life threatening. Asthma Australia's 2015-16 annual report, stated the individual cost of having asthma as $11 741 per asthmatic, and the direct and indirect costs of asthma to the Australian economy was an estimated $28 billion per annum. With $1.2 billion being costs to the health system by means of prescriptions and hospitalizations. In the Australian Institute of Health and Welfares 2014-15 report, there were 39 500 hospitalizations and a totalled 419 deaths from due to asthma.

II. BACKGROUND

Asthma is a leading chronic disorder among children and adolescents. Although some children outgrow asthma while transitioning into adulthood, there are others who continue to suffer from life-threatening asthmatic exacerbations. Teenagers tend to have certain misconceptions about their asthmatic condition and treatment which are rarely recognized or addressed in regular clinical consultations. In the year 2017, Aiswaria S. Nair & Karen DeMuth developed a website that resides in the public cloud and uses a novel animation video– based curriculum to deliver essential healthcare education to asthmatic adolescents in an interactive manner. What distinguishes it from similar initiatives is the use of a cost- effective technique to simulate caregiver-patient interactions and the ability to cater to a wide range of socio-economic statuses and educational levels [4]. In the year 2018, E-J. Maalouf, A. Aoun, N. Marina developed a prototype asthma irritant monitoring system (AIM) that can be used by asthma patients. The AIM is a compact device that senses the environment around the patient for different irritants in order to detect any signs of asthma attacks or potentially unhealthy environments. In addition, the device offers the capability of sending the data to the physician to follow the patient case [1]. In the year 2018, Anna Glazova, Zafar Yuldashev, Anna Bashkova developed a method and algorithm for remote monitoring of patients in asthma. The method includes a comprehensive evaluation of the results of standardized questionnaire about disease symptoms, changes in the bronchodilator intake regimen and data of functional test of respiratory systems state [2]. In the year 2019, Ivan V. Semernik, Alexander V. Dem'yanenko discussed about the prospects and possibilities for creating an individual wearable system for monitoring the condition of a patient suffering from bronchial asthma and preventing attacks of the disease [3].

III. METHODOLOGY

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. How-ever, the vast majority of such developments do not find wide-spread 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 Centre for advice on symptoms and necessary actions. The most complex systems involve the use of home systems, including portable systems, telemonitoring, and tele-medicine. 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.

One trigger for asthma is the allergies and it is a common problem. Approximately 80% of people with asthma have allergies to airborne substances such as tree, grass, and weed pollens, mild, animal dander, dust mites, and cockroach particles. 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 [1]. 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 con-junction 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 1. Shows the block diagram of the proposed model.

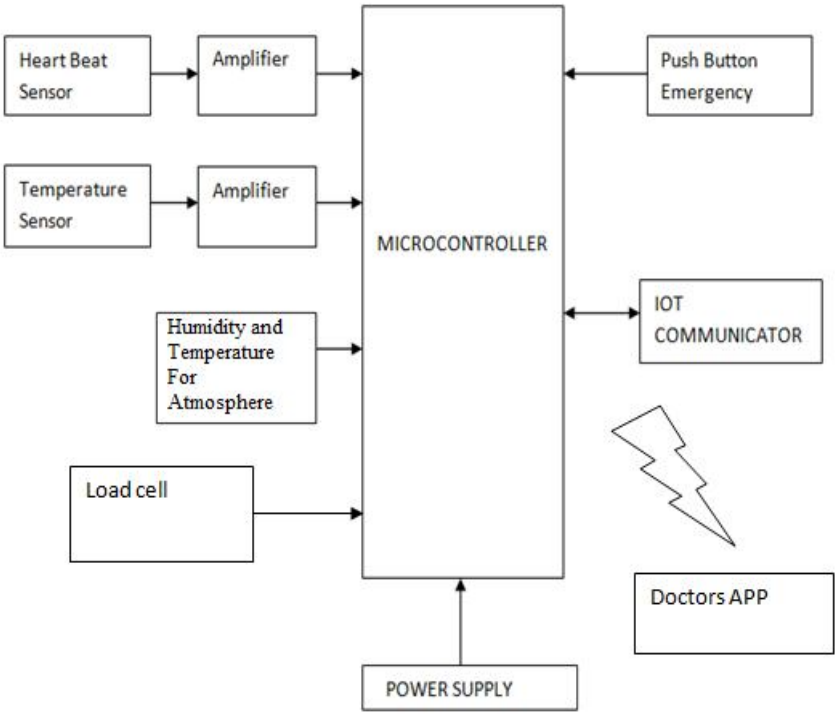

Figure. 3 Block diagram of the proposed model.

The Asthma patient can monitor his own condition at any time, though this he can save the life. Sensor technology is to be use for monitoring the Asthma patient condition easily. This System even helps in monitoring the weight of medicine in in-haler and intimates the patient. It monitors the count of patients using inhaler and update to doctor.

1) *Temperature*: For the temperature we have 2 domains, the cold air and the hot air. The patients are mostly ex-posed 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.
2) *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 trouble-some, with 60% becoming dangerous for the asthmatic patients. Humidity is an essential contributor, so the patient should be very cautious from these conditions.
3) *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 combi-nation of the symptoms at different times [7]. 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.

IV. RESULTS AND DISCUSSION

The sensors will be collecting the data continuously around the environment. The collected data is being sent to an application running on a smartphone which stores the data in the cloud. The typical range of component parameters will be set at the beginning. If any deviation occurs in those values i.e., sensors data which could trigger the asthma attack, the application will immediately inform the patients about his/her wellbeing and the environment condition around them which helps the treating physician to treat the patient accordingly by monitoring patients activities. Whereas for an unfavourable condition the device is capable to send an alarm message with the location of the patient's to the predefined numbers by pressing the emergency button. Immediate response is given to the patient's activity and the concerned medical expert will take the further actions to manage the condition.

V. CONCLUSION

Here in the paper, we proposed a smart wearable device for the asthma patients which collects the environmental conditions by the use of sensors like gas, temperature, heart beat and body temperature. The values is being stored in the cloud and they are constantly monitored by the concerned doctors and caretakers in a safe way. In any unfavourable condition they will be alerted to vacate the surrounding area and get to a safer place to evade the asthma attack. Future work involves implementing the proposed system with real patients and care ad-visors as a check trial. The block diagram presented in the project is cost effective with a portable computing device like a smartphone or a tablet. The result which we get is efficient and accurate which will contribute to its wider usage.

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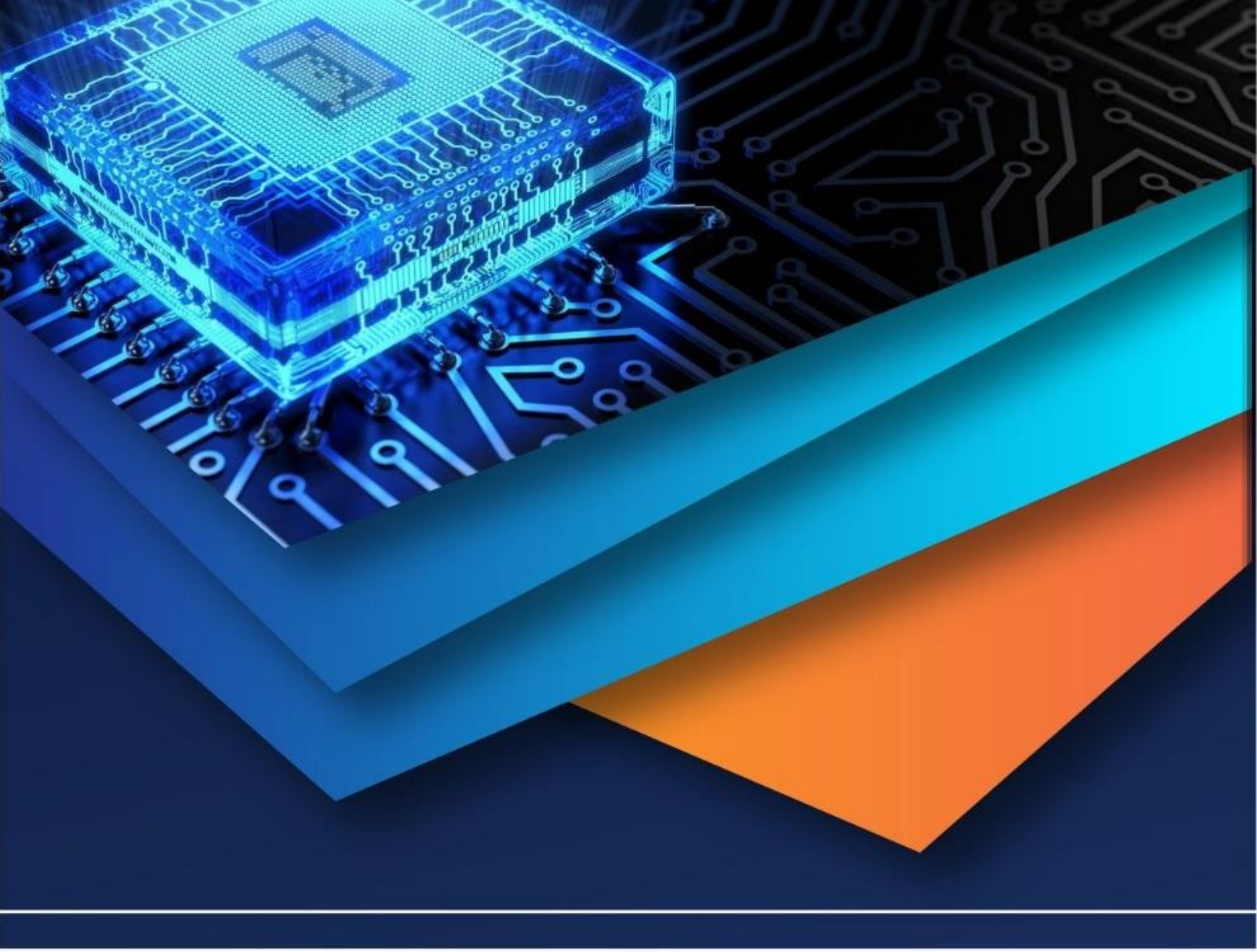

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