Smart Wearable System for Asthma Patients

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***Abstract*—Internet of Things (IoT) which is a network based on the physical systems in which it can be exhibited in the form of a typical embedded system including electronic devices such as sensors. The connectivity of the network which can be enabled by these objects for exchanging and collecting data. Asthma could be a lifetime chronic disease initiating to abnormal respiratory organ functions and problem in breathing. Regarding 350 million individuals, that is comparable to one in every twelve adults, suffer from bronchial Asthma worldwide. Self-monitoring is that the preliminary course of action to watch, treat and manage the chronic unwellness. Self-monitoring together helps physicians and patients to possess management over real-time observance and to supply on-time treatment. Classical spirometer take a look at is presently the greatest thanks to diagnosing the severity of respiratory organ functions and their response to treatment, however, it needs superintendence. To assist the people who are affected we had designed a device to perform their regular activities. With the help of the sensors like dust, temperature, humidity and barometer, the data has been collected and then it is uploaded to the cloud for further analysis. The data uploaded in the cloud will be received by a concerned doctor or the caretaker of the patient.**

Keywords - Asthma patients, Data analysis, Internet of things, Wearable sensors, Wheezing.

I. INTRODUCTION

Due to the population growth, present healthcare systems and resources are not adequate to satisfy the needs. Increasing the development of application software, communication protocols and devices for monitoring the health have a large influence on the healthcare industry. The Internet of Things has a great scope on patient health monitoring and assisting professionals of the healthcare industry. For patient assisting, the IoT is on its early stage on design and development to minimize the manual error and increasing the efficiency in a smart way. The Internet of Things is that the network of physical objects or "things" embedded with natural philosophy, software, sensors, and network property that permits these objects to collect and exchange info. The IoT permits objects to be perceived and controlled remotely across existing network infrastructure creating opportunities for tons of direct integration between the physical world and computer-based systems and resulting in improved efficiency, accuracy and economic profit. Needless to mention that this packaging around the IoT is large. It looks like each day a replacement company announces some IoT enabled product. Connected health remains the sleeping bag of IoT applications. The construct of a connected health-care system and good medical devices bears monumental potential, not only for firms conjointly for the well-being of individuals generally. Yet, connected health has not reached plenty. Healthcare and patient monitoring requires mobile technology to the efficient monitoring. The sensors are connected with the embedded system to collect the information from the patients. Applications can permit each patient and health care suppliers to possess access to reference materials, research laboratory tests and medical records victimization mobile devices. These applications empower patients and health suppliers proactively to deal with medical conditions, through close to period observation and treatment, regardless of the placement of the patient or health supplier. For assisting asthma patients we proposed a smart healthcare system which senses the environmental conditions. Change in the environment may have a great impact on asthma patients. Analysing the conditions includes temperature, humidity, heartbeat and pollution level giving the patient insight into how long the patient can stay in that environment. This is a cloud-based system through which the doctors and caretakers can ensure the health condition of the patient. If any critical condition emerges, the alert is given to the doctors and caretakers immediately. The symptoms for the patients affected with asthma disease can be varied from person to person. The symptoms which have infrequent asthma attacks will be occurred in certain times such as when going with exercises. The major symptom which include the shortness of breath i.e. it causes problem during breathing which can cause heart attack. The tightness is caused in chest when work in dine in high extent by the patients. It also a reason for the disturbances in sleeping. A trouble is caused during sleeping such as whistling type of sound is produced. Sometimes due to the low oxygen content environment where

the patients can't breathe properly. In case of this predicament, whishing is caused which leads to breathing problem while exhaling. This symptom is common sign for asthma. The coughing and wheezing which attacks the concern are worsened on the basis of the environmental conditions. The later stage will include the increased difficulty of breathing. It can be measured through a peak flow meter in which we can measure the working of lungs. The asthma patients are provided with an inhaler in which it is loaded with medicine for the concern stage of disease. The medicine in the inhaler which is of powder type. When it is pressed, the inhaler will release a medicine which can be inhaled easily. The asthma which may reach a worse condition, when the air is cold and dry, hence the exercise is induced as asthma. Some factors which can include the working place irritations which are triggered by chemical forms of fumes, gases or dust. They are also caused by airborne gist such as pollen, mold spores.

Problem statement:
Asthma could be a lifetime chronic disease initiating to abnormal respiratory organ functions and problem in breathing. Regarding 350 million individuals, that is comparable to one in every twelve adults, suffer from bronchial asthma worldwide. Self-monitoring is that the preliminary course of action to watch, treat and manage the chronic un-wellness.

Previous works:
As the air quality index in various metropolitan cities tends to get poor year by year, Among India's 1.31 billion people, about 6% of children and 2% of adults have asthma. Previous works didn't leverage the current trends in technology which resulted in system being huge and not affordable and relied on continuous monitoring by a medical practitioner. The old systems were not able to predict in advance of exacerbations, which is too careless to avoid. The proposed system leverages IoT which makes continuous self-monitoring ease and will predict exacerbation in advance.

II.REQUIREMENT SPECIFICATIONS:

HARDWARE AND SOFTWARE REQUIRMENTS

The proposed model is implemented with the below specified hardware and software environment.

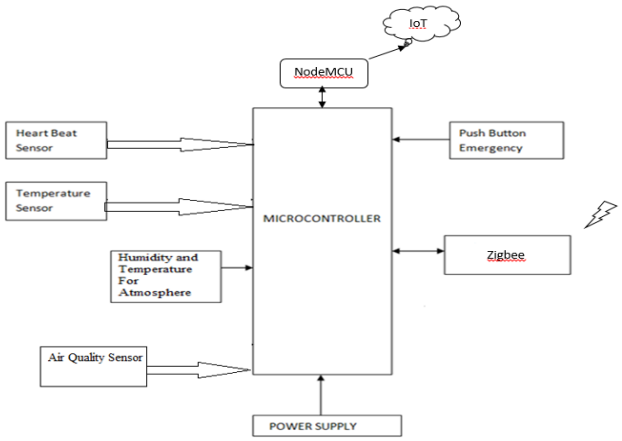
HARDWARE REQUIRMENTS

- Arduino NANO
- Humidity Sensor
- Temperature Sensor
- Pulse Sensor
- WIFI ESP 8266
- Load cell
- Power Supply

SOFTWARE REQUIRMENTS

- Embedded C
- Arduino Suite

III. ARCHITECTURE DIAGRAM



In this project, the architecture is nothing but whatever component we are using in the project and also the interfacing components we are interfacing to the main microcontroller. Here, we are using the main microcontroller as mode MCU. Arduino nano is the main microcontroller because every component is connected to this. In Arduino, there will be many controllers like Arduino uno, Arduino nano, Arduino mega.in our project, we will be using a band for that purpose we should be using Arduino nano. We are connecting the heartbeat sensor, temperature sensor, humidity sensor, and air quality sensor to the Arduino nano. Also, an emergency switch is connected. These parameters will be getting the readings from the Arduino nan. From the Arduino nano, it is connecting to the mode MCU. From the mode MCU, we are updating the linked application. If the value goes beyond the threshold value, an SMS will be generated in the telegram application We will be using Arduino IDE or Arduino suite as the software where we will be writing the programming part. The Arduino nano is supporting the programming language which is the embedded C (embedded C is the coding language) In Arduino nano, the operating voltage is +5 volts. Arduino microcontroller is open source. open source is nothing, but they will be having one form, in that form all the library files are available. We will be using these library files and will be filling our main program. For example, in the C program also, there will be functions like printf() and scanf(). We use the function to read the value from the user and print it. Likewise, in Arduino also, there will be predefined library functions. we use these library functions to write our main program. Arduino nano whose voltage is +5v will have both analog and digital PINs because in our project we are using both analog and digital sensors. We will be having 14 digital pins and analog pins. There is no restriction in connecting the pins. But, there will be some conditions, for example, the heartbeat sensors and temperature sensor should be connected to analog pins only. While reading the value of the pulse rate sensor or heart rate sensor, it works when we place the finger, it reads our blood movement value. Within a fraction of a second, it will read the blood pressure value and we can calculate the heart rate of a person. In Arduino nano, we are writing the programming for the heart rate sensor, for example, if there

is a certain count, there will be a specified heart rate. If the heart rate is more than some threshold or less than the threshold value, an SMS will be sent to the registered number. In the Arduino nano, analog pins will be inbuilt. That's the reason we are using both heartbeat and temperature sensor as an analog sensor. Analog means that the value changes according to the condition.

In Arduino, there will be a 10-bit ADC(2 =1024) which is the resolution of the ADC. In this condition, we are reading the value of heartbeat sensor, temperature and the air-quality sensor. LM-35 is the temperature sensor which we are using. The operating condition pf this is +5volts. The temperature sensor LM-35 will support upto 100 degree Celsius. If we touch LM-35 sensor, it will read the body temperature or else show the room temperature. This is the condition. Whatever value is read from the temperature sensor, this value should be converted into voltage. To convert into voltage, whatever value is displayed from the sensor is in the form of analog. this analog value is multiplied by 5V(which is nothing but resolution of the ADC). This voltage value,if we multiply by 100,then we will get the value of temperature. Coming to the humidity and the temperature sensor, which is also called as relative humidity. This relative humidity reads the environmental temperature and environmental humidity. The senor we will be using here is DHT-11. Temperature dependent humidity, this sensor(DHT-11) will be reading the environmental temperature. If the asthma patient, incase wants to go outdoor, this DHT-11 sensor will check the outside temperature like the condition of humidity, temperature to see if these conditions are suitable for the asthma patient or not. If the condition is not okay for the asthma patient. Then it will give a message like an alert saying its not safe for the person. Air quality sensor, we are using air sensors like MQ-3,MQ-5,MQ-6,MQ-7,MQ-135(in this any sensor can be used). There is also a threshold value we will be adding in the programming, if the air quality sensor crosses the threshold value, that moment it will recognise, read, compare the value with the given threshold value. This information will be sent to the caretaker. Zigbee-It is a wireless communication device. In the project we are using 2 different modules, one is for reading the health condition of patient and second is for measuring the asthma inhaler weight. If the inhaler medicine is getting over, it will send an intimation to the care taker or the person having the device. It will intimate to refill the inhaler. The inhaler part of the module and the health monitoring of the module, these two devices will communicate with the ZigBee. Range of the ZigBee is 50-100 meters which we are using. The values will be read using the node MCU, this node MCU is one kind of Arduino but it has in-built WIFI. If we give the internet connection to node MCU, it will give the information to the blynkapplication(which is an android application) If there is any emergency, then a SMS is sent to the telegram application which will connect to the doctor. Load cell is used to detect the inhaler weight.

a) MODULE SPLIT-UPS AND SENSORS

1. ARDUNIO NANO

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by boot loader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

2.HEARTBEAT SENSOR

This product is based on the principle of photoplethysmography (PPG) which is a non-invasive method of measuring the variation in blood volume in tissues using a light source and a detector. Since the change in blood volume is synchronous to the heart beat, this technique can be used to calculate the heart rate. Transmittance and reflectance are two basic types of photoplethysmography. For the transmittance PPG, a light source is emitted in to the tissue and a light detector is placed in the opposite side of the tissue to measure the resultant light

3. TEMPERATURE SENSOR

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming

4. NODE MCU

- Node MCU is an open-source LUA based firmware developed for ESP8266 Wi-Fi chip. By exploring functionality with ESP8266 chip, Node MCU firmware comes with ESP8266 Development board/kit i.e., Node MCU Development board.
- Node MCU Dev Kit/board consist of ESP8266 Wi-Fi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by ESPRESSIF Systems with TCP/IP protocol. For more information about ESP8266, you can refer ESP8266 Wi-Fi Module.

5.LOAD CELL

A load cell is a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally.

6. HUMIDITY SENSOR

Humidity is the presence of water in air. The amount of water vapor in air can affect human comfort as well as many manufacturing processes in industries. The presence of water vapor also influences various physical, chemical, and biological processes. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, humidity sensing is very important, especially in the control systems for industrial processes and human comfort.

IV. CONCLUSIONS AND DISCUSSION

In this paper, we have proposed a Smart Wearable system for asthma patients. The purpose of the project is that the device used by asthma patients perform multiple functions that enables self-monitoring and physician to monitor the patient's condition and to provide continuous care. In this system we have used different sensors like the temperature sensor, humidity sensor, heartbeat sensor. The sensors value is always updated in the telegram app through which the patient's condition can be monitored at anytime and anywhere by the patient, caretaker and the doctor. Through various experiments the performance was measured and accuracy was evaluated. In future the work will be implemented by planned system with care advisor and real patients and different check trial will be implemented.

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