An Internet of Things based 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 un-wellness. Self-monitoring together helps physicians and patients to possess management over real-time observance and to supply on-time treatment. Classical spirometry 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 (Dinesh et al. 2015b). Approximately twenty billion devices would be connected to the internet by 2020 as per the analysis of Forbes and Gartner. 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 (Dinesh et al. 2015a). 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. each issue is unambiguously distinctive through its embedded ADPS but is prepared to interoperate within the prevailing internet infrastructure (Virone et al. 2006).

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 big 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 (Raji et al. 2016). 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 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 (Mohanapriya et al. 2013).

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 whisling type of sound is produced. Sometimes due to the low oxygen content environment where the patients can't breath properly. In case of this predicament, whishing is caused which leads to

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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, waste of cockroach, mold spores and dried dribble shack by pets (Fasidi et al. 2019).

Many researchers are had an interest to analyse the air born disease. Aravind et al describes the custom designed sensors to monitors the respiratory alignments of the patients (Rajan et al. 2015). In this the sensor data is uploaded in the cloud through the android mobile phone and done the data analysis. Halvorsen et al introduced the awareness of asthma patient monitoring system. They used gas sensors to analyse the environmental gas details through which they alerted the asthma patients with mobile devices. Nikita et al developed a mobile based software platform to collect the asthma patient's details. They collected the air pollution, temperature and humidity details of the environment and based on the details they help the person to understand the asthma details.

Gizem et al proposed the characteristics of split ring resonator based sensor to monitoring glaucoma. They used a silver conductive paint to fabricate a sensor with flexible substrate material. They mainly focused to develop a system which is used to measure the scattering parameters of antennas, identifying the different curvature profile of devices and developed a sensor structure with finite element analysis. But the main drawback of this work was that SRR sensor based technique is not an emerging method for monitoring of glaucoma (Rajan 2014).

Fuchao suggested during a publication of the Department of Health and Human Services that so as to stay aldohexose at a healthy level, people with polygenic disorder ought to keep a balance between three vital aspects: diet, exercise and polygenic disorder drugs in daily routine. He then developed a mobile personal health care system for patients with the polygenic disorder. His objectives were to develop a mobile health care application and integrate the application with a wearable sensing element. He created the use of golem SDK for developing the mobile app (Rajan et al. 2015). Nikita et al developed a mobile based application for Australian asthma patients that includes the air quality details and travel plans.

Jongyoon et al. prompt that a wearable system appropriate for ambulatory stress observance should strike a balance between data content and luxury (Rajan et al. 2012). They worked on mobile stress observance with minimally-invasive wearable sensors. Their objectives were to create a platform that employs minimally invasive sensors, hardware shrinking, and wireless technologies, and can record uninterruptedly for periods of up to 13 hours a variety of physiological variables best-known to be influenced by stress (8). Siddiqui et al describes the Severity Exploratory Model Analysis to classify the patient's asthma level. The model is suitable to measure the patient's health conditions in home itself. They measured the patient heart rate and done the time series alalysis, and used machine learning algorithms to classify the severity of asthma level (Nikita et al. 2018).

Nur Ilham and Malarvili worked on the look of a wheezing severity observance tool. They targeted on planning a graphical user interface to observe the severity of respiratory disease by mistreatment MATLAB software (Rajan et al. 2015). Their analysis methodology started with gathering relevant and detailed literature review on the capnography, then, the graphical user interface layout was designed 1st before implementation method by mistreatment MATLAB software. The last step was graphical user interface improvement by adding up patient information and patient medical background components. They were able to develop a graphical user interface to observe and monitor the severity of respiratory disease (Sukanesh et al. 2010a). While their tool was an easy one, its limitation was that the entire monitoring tool wasn't made to watch the severity of asthma; the GUI will solely analyze CO2 (Rajan et al. 2013).

Virone et al projected system design for good aid based mostly on a complicated Wireless sensing element Network. It specifically targets assisted-living residents (Sukanesh et al. 2013). WHO could get pleasure from continuous, remote health observance. Mansingh et al worked on period observance and detection of respiratory disease symptoms on the resource-constraint mobile device. They stated that advanced technologies in transportable devices like phones and wireless body sensing element systems gift open doors for consistent monitoring of patient's health condition and transmission of determined data to doctors. By utilizing the capabilities of internal sensors, smartphones will function veritable helpful tools for observance and alerting respiratory disease patients and their care suppliers on early symptoms of asthma exacerbation (Sukanesh et al. 2010b).

Narendra et al. projected a far off aid observance system mistreatment wearable sensors. They declared in their work that thanks to advancement in technology low-power networked systems and medical sensing elements area unit incorporated as wireless sensor networks in healthcare(Vijayprasath et al. 2012). WSN represent a replacement means that to handle the problems of managing and observance chronic diseases, older individuals, surgical rehabilitation patients, and persons with special disabilities. David et al introduced Wearable sensors area unit hooked up to the patient body forming wireless body area network (WBAN) to watch changes in patient's very important signs closely and provide real-time feedback to assist maintain the best health status (Davood et al. 2015). The sensors sense physiological knowledge from the patient's body and wirelessly send them to the microcontroller mistreatment radio transceiver. The microcontroller controls the practicality of alternative parts within the sensor node and

processes the sent knowledge domestically (Palanivel Rajan 2014).

The IoT may be a developing innovation of interconnected gadgets and sensors. These gadgets and device will catch, store, transmit, and share that info for arrangement and investigation. varied originative IoT applications develop within the decade. In any case, the foremost encouraging application between them is welfare checking. aid IoT includes gathering quiet info through numerous gadgets and sensors, dissecting, and sending them by utilizing a system to welfare counsels for fast thought . the vital sign is one amongst the imperative physiological angles to be checked to amass persistent wellbeing knowledge in basic condition. it's a significant sign to foresee sickness, a quick reject inpatient eudaemonia. Fasidi et al(4) projected on-line portals for IoT e-Healthcare observant with each remote and wired primarily based administrations. The wired portals square measure used in a very little building or area to form the framework lowest effort and power proficient; development within the building or area is restricted. In radio-recurrence distinctive proof - primarily based healthful services observant arrangements were projected. In associate IoT-based system was projected to screen quiet info by utilizing UHF-RFID innovation. In creator projected a wellbeing checking framework utilizing RFID to catch persistent viscousness and temperature knowledge and send them to the cloud for any investigation and comprehension. In respiratory disease observant set up was created utilizing crucial signs and IoT. In creators examined totally different difficulties and prospects exist in IoT for the executives and wellbeing checking. In utilizing distributed computing, versatile process, and net edges, the creators engineered up a far off patient observant framework (Arvind et al. 2018).

II. MATERIALS AND METHODS

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 analyze, 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. The concern asthma patients respiration data can be collected using a sensor and after that the process of re-establishment, improvement and other sorts of encryption (Kavitha et al. 2017).

A.Dust Sensor

The environmental dust cause immediate breathing problems in asthma patients. This device offers an honest indication of the air quality in Associate in Nursing setting by measurement the dust concentration. The material level within the air is measured by numeration the Low Pulse Occupancy time in given amount. LPO time is proportional to PM concentration. It is a tiny sensor module which can be used in wearable devices.

B.Humidity and Temperature sensor

Decrease in the temperature or increase in humidity directly impacts the patient which excite wheezing. The Humidity and Temperature sensors are used to sense the change in atmospheric conditions.

C.Barometer sensor

It is accustomed live atmospheric pressure and forecast short term changes within the weather. as a result of atmospheric pressure conjointly varies with elevation. Thus change in geographical conditions analysed.

D.Controller unit

The controller unit is the main hardware of the system in which all the sensor units are directly connected and enable cloud access. The threshold values are set for each sensors individually by measuring the physical parameters of the patients. If any abnormalities are detected in the patient, immediately the doctors and patients are alerted.

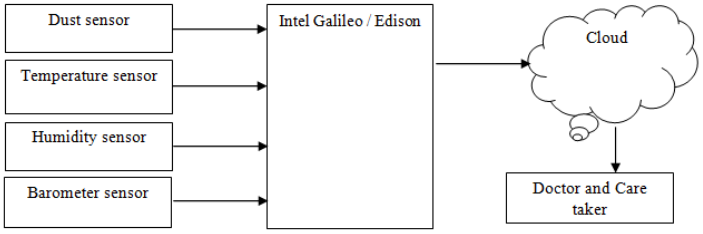

Fig No 1 block diagram of proposed system

III. RESULTS AND DISCUSSION

So as to recover the sensors' information, a portable application was created. The application will keep running on an advanced mobile phone and recovers the information remotely utilizing cloud storage. This information is being handled by contrasting it and some pre-characterized values in the application's guidance and gives a yield that would be controlled by those qualities. Should any deviation from the typical components edge of the natural parameters i.e sensor data. which can eventually trigger an asthma assault, the versatile application will promptly inform the patient of his/her wellbeing status and ecological dangers or potentially send an alarm message including the patients area facilitates and address to some predefined numbers on the framework dependent on the application rationale rules.

Usage period of a framework is the following stage to be considered after an effective plan of the framework. It includes the way toward characterizing how the framework ought to be fabricated, guaranteeing that the framework is operational and utilized, and guaranteeing that the framework satisfies quality guideline. The primary motivation behind usage is to build framework components that meet the prerequisite created at the beginning time of the framework

life cycle. These components are then coordinated to shape the middle of the road totals and eventually the framework wanted framework. Testing of the framework trails the execution, testing is done to quantify the framework adjustment to determination and to guarantee convenience by clients of the framework.

IV. CONCLUSION

As we proposed a smart asthma personal care system to assist the patients in regards of the change in environmental conditions they exists. In this system we measured atmospheric pressure, temperature, humidity and dust concentration. The measured sensor values are continuously uploaded in the cloud server, through which the patients' health condition can be monitored at any time anywhere by the doctor and caretaker. The performance measurements and classification accuracy were evaluated through experiments. Future work involves implementing the planned system with real patients and care advisors as a check trial.

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