REPORT

E HEALTH DEVISED SMART INHALER – PHOENIX CLIQUE

By

BHAVYA S
GURU PRASAD V
SRI VAISHNAVI A
THILAKAVARSHINI T
BHUVANESHWARI M

ABSTRACT

As the prevalence of asthma is increasing, and with no known cure, there needs to be further research into how the disease can be managed and controlled more effectively. The current world faces a new pandemic condition by wearing the mask continuously we have the difficulty of getting affected with asthma. In addition, about 50% of the asthmatics use their inhaler incorrectly, which affects the result of the medicine negative. Our objective is to develop a *smart inhaler with inhaler app* which helps the doctor to continuously monitor the patient's condition. IoT-based health monitoring is an emerging technology that can revolutionize the health industry. The developed app use the user interface on the patient's side is implemented as an Android based application. The *Wi-Fi module* ensures communication with the smartphone which represents the interface where data are recorded and results are displayed. It even collects information about how the patient is using the device, such as shaking the inhaler before pressing the button to receive a dose of their medicine. This can then be fed back to the patient on their mobile phone to help them understand and better manage their own symptoms, but it can also connect doctors to real-time information on their patients. This app also helps alerts by giving a signal when patient *overuses* their preventer medicine. The proposed system "*Smart Asthma Inhaler*" monitors the patient's health conditions, tracks the location and the time the inhalers are used so as to provide suitable medication to the patients once the reports are analyzed by the physicians involved. The designed prototype can help *lower costs* by facilitating the delivery of care, and connecting people to their health care providers. Applications will allow both patients and health care providers to have access to reference materials, lab tests and medical records using mobile devices.

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INTRODUCTION

Asthma is a chronic disease involving the airways in the lungs cause the breathing problem of wheezing, Shortness of breath, Chest tightness or pain. It is a prolonged lung disease breathlessness that occurs several times a day or in a week in individuals. Asthma was diagnosed by the spirometer it's a device measure the pressure of exhale air from the lungs. The patients who had the asthma problem mostly they affected by the dust and pollution in the air which makes the inner walls of lungs becomes swollen, so that the patient takes less air to his/her lungs which feels the shortness in breath and leads to the wheezing, also leads the patient to die if he/she not taken any treatment. This disease is common among children, and the number of deaths in children is greater than those in the elders. According to WHO, more than 235 million people are suffering from asthma. This disease occurs in both low-income and high-income countries, while more than 80% of deaths occur in low-income countries. According to estimates released in 2016 by WHO, over 383,000 deaths occur because of asthma in 2015. Air pollution and smoking are the core causes for the problem. Due to the absence of instant help, elder people suffer most and may experience stress. Still, no widespread work has been done about cloud-assisted Healthcare IoT-driven framework for asthma patients.

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing internet infrastructure. It seems like every day a new company announces some IoT enabled product. Connected health remains the sleeping giant of IoT applications. The concept of a connected health-care system and smart medical devices bears enormous potential, not just for companies also for the well-being of people in general. Yet, connected health has not reached the masses. Health care access, affordability, and quality are problems all around the world. There are well-established disparities based on income and geography, and the high costs of health care present affordability challenges for millions of different people. Large numbers of individuals do not receive the quality care that they need. Mobile technology offers ways to help with these challenges. Through mobile health applications, sensors, medical devices and remote patient monitoring products, there are avenues through which health care delivery can be improved. These technologies can help lower costs by

facilitating the delivery of care, and connecting people to their health care providers. These applications empower patients and health providers proactively to address medical conditions, through near real-time monitoring and treatment, no matter the location of the patient or health providers. The sensors are embedded within electronic devices to detect the air quality, humidity and weather, thereby alerting the users whether to stay indoors or outdoors. There are also sensors that detect the number of times inhalers are used by the patients, therefore keeping track of their inhaler usage.

The designed prototype "E Devised Inhaler" monitors the patient's health conditions, tracks the location and uploads to the cloud server, where it is stored in the cloud database, so healthcare advisors can access and analyze that signal for possible action and medication.

OBJECTIVES

Smart inhaler is developed with extra digital features, they link to an app on our phone or tablet to help us and our doctor manage the asthma better. They have also been designed that wirelessly send data on inhaler usage directly to a mobile health platform or website. The main objective of the inhaler includes:

- ✓ The developed system allow for immediate application of medicine to airways, ideal for asthma and COPD medicines.
- ✓ Smart inhalers have sensors which can an alert on our smartphone when the user hit high pollen or high pollution area, helps the user to decide whether to avoid it.
- ✓ Aids the patient to prove the doctor or asthma nurse that they have been under the inhaler medication regularly, so they can better understand if care needs changing.
- ✓ Generates the reminders, which signal a missed dose, have been shown to improve adherence in a number of trials.
- ✓ Smart inhaler use Wi-Fi technology to detect inhaler use, remind patients when to take their medication and gather data to help guide care. It might help by monitoring and correcting a patient's inhalation technique.
- ✓ Antibiotic medications have even been developed for inhalers to allow for direct delivery to areas of infection within the lungs.
- ✓ Updates when the user *overuses* their preventer medicine, helping to make sure that the patient undertakes the medication into lungs, and reducing possible side effects.

SYSTEM DESIGN

HARDWARE REQUIREMENTS

- Sensors selection criteria: It depends on the sensitivity: input parameter change required to produce a standardized output change, range: maximum and minimum values of parameters, precision and resolution. The other parameter to be considered during the selection of a sensor includes cost, size and power supply.

- Interfacing of the sensors: The ports of the sensors were soldered to the ports of the Wi-Fi module used. The concept of interfacing sensors is giving input from sensors to module in which they can understand and act accordingly.

- Sensors used:

   Dose Count Sensor: To keep count of the number of times the medicine is inhaled. When attached to regular anti-inflammatory medication, inhaler sensors provide reminders that alert the patient when to take the next dose. These reminders, which signal a missed dose, have been shown to improve adherence in a number of trials. These types of reminders join other electronic notifications, such as emails and text messages, in helping to encourage more regular and appropriate use of anti-inflammatory medication over time.

   Air vent: The Air vent used is *MQ-135*, which detects asthma triggering pollutants like NH_3, NO_x, alcohol, Benzene, smoke, CO_2, etc. Air quality can change daily. So it's important for people with asthma to check the air quality index (AQI) in their area often. To determine the quality of air in the patient's environment. These can help people with asthma track air quality closer to home and at certain times a day. For people who like to track air quality on a street level, wearable air quality detectors are being developed.

   Wi-Fi module: ESP8211 is used as a Wi-Fi module which is integrated with protocol. Smart inhaler use Wi-Fi technology to detect inhaler use, remind patients when to take their medication and gather data to help guide care. It might help by monitoring and correcting a patient's inhalation technique. Doctors can also notify the patient regarding the fluctuations in the asthma pattern since the medication was prescribed. A database is created to keep track, the complete history of the medications given to the asthma patients. Reduces the hospital expenses. Analyze the air quality in the environment we reside in.

SOFTWARE REQUIREMENTS

Android studio: It is the official integrated development environment (IDE) for Google's Android operating system, built on IDEA software and designed specifically for Android development. It is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. The *app is created* by coding with java in this platform. It is available for download on Windows, mac OS and Linux based operating systems or as a subscription-based service in 2020. It is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams. Allows the user to connect and save sensor data in the cloud and develop IoT applications.

SYSTEM IMPLEMENTATIONS

IOT based approach has been implemented to design a device to help monitor asthma patients. The proposed system is one such device which uses various low cost sensors, developed app for notifying the patients and the patients data is made available on the cloud platform. This helps the doctors to further draw conclusions from the data available and personalize the treatment of an asthma patient.

BLOCK DIAGRAM

Dose Counter		Wi-Fi Module	→	Cloud Computing	→	Smart Phone	→	Clinical IT System
Air vent								
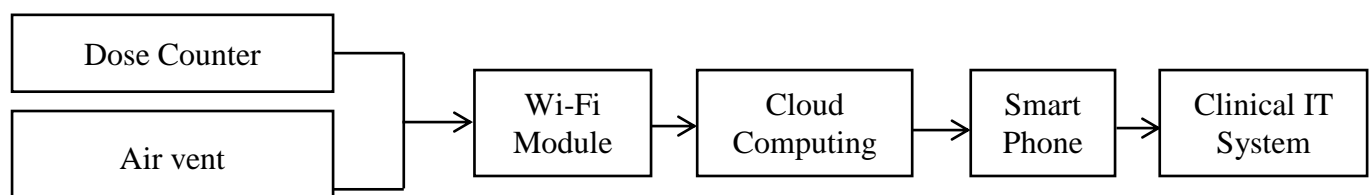
Smart Asthma Inhaler consists of two user interfaces. The user interface on the patient's side is implemented as an Android based application. The Wi-Fi module ensures communication with the smartphone which represents the interface where data are recorded and results are displayed. It is to be noted that for children, the device will personify funny characters, images and animations in order to allow them to forget their fears whilst taking the test. The aim of this project is to assess whether the Smart-inhaler was able to accurately record actuations using a range of pressurized metered dose inhalers.

A Doctor access the data sent by the inhaler and can prescribe medication and they tracks and analyzes the data for clinical research. Then the database is accessed for medical history of previous occurrences. User/Patient has to use the inhaler to send information and mobile application to send location details and should make effective use of inhaler preventing overdose. They receive immediate medical attention from a doctor, in case of an emergency. The Bluetooth module ensures communication with the smartphone which represents the interface where data are recorded and results are displayed. It is to be noted that for children, the *device will personify funny characters, images* and animations in order to allow them to forget their fears whilst taking the test he technology is believed to increase medication adherence which in turn decreases severe flare-ups and emergency hospitalizations.

APPLICATIONS

The data from the inhaler is sent to the cloud to monitor the asthma patients. The temperature, Air quality level and the frequency of dosage intake when the asthma patient inhales the medicine is sent to the cloud.

➢ Smart Inhalers are designed to deliver medication directly to the lungs through a person's own breathing.

➢ Antibiotic medications have even been developed for inhalers to allow for direct delivery to areas of infection within the lungs.

➢ Education on the correct use of inhalers for delivery of medications is a commonly cited topic in medical studies and a great deal of thought has been put into how best to help people learn to use their inhalers effectively.

➢ A smart metered dose inhaler works to give the user a metered dose. This means that it gives you that dose every single time you use it.

- As a method of delivering an asthma treatment, smart inhaler have another distinct advantage. Most of the medicines that are currently available to asthma sufferers can utilize an inhaler as the delivery system.
- The prototype helps asthma patients to keep asthma under control.
- The developed app is used by asthma patients to inhale the drug during asthma attacks as well as during prescribed time. A Switch is implemented to this, which transforms the low availability of the drug to a notification on telegram reminding the patient to refill the device.

FUTURE SCOPE:

- The proposed prototype is more reliable and dependable.
- The smart device can be made much simpler in design i.e., less bulky.
- An in-built power supply can be provided in the circuit itself for better life.
- The data can be transferred to wearable smart watches to create many more opportunities for everyone at any given period of time. These devices are light weight and so compact than the mobile phones and laptops and people tend to use these devices much more in the years to come.

CONCLUSION:

IoT-based health monitoring is an emerging technology that can revolutionize the health industry. In the hospital-centric healthcare service, patient health status is recorded through different processes and devices. In this chapter, we developed a smart, inexpensive, scalable, and efficient IoT-based cloud-assisted healthcare monitoring framework for asthma patients. The proposed scheme provides remote monitoring of patient health status anytime, anywhere, and enables healthcare advisors to access, analyze, track, and monitor patient health status in a real-time manner. To ensure security, the recorded signal was watermarked before sending to the cloud server. The performance measurements and classification accuracy were evaluated through experiments. A system similar to the proposed system has been implemented but it is launched abroad. The proposed system targets the Indian market where pollution is a major factor which triggers asthma attacks. By providing objective and accurate data on a patient's medication usage, the treatment plans tailored to each patient can

be developed, and in doing so dramatically improve their quality of life. "The use of smart technology solutions to improve outcomes for patients is an important aspect of future care, particularly as it relates to respiratory medicines. For successful implementation IOT related platforms, the integrated frameworks need to be designed, developed and collaborated with various tools and devices in Big Data scale, so that IOT products and services can reach geographically.

We have demonstrated that our smart electronic dose counter is used to record the times number of doses and taken times by actuating pressurized metered dose inhaler. We also provide an inhaler APP to help patients track their medications history, and it also reminds the patients when the patients forget to use their inhalers on their medication time. We believe that our low-cost smart inhaler counter with the inhaler APP can help manage adherence in asthma patients, it could be lowered healthcare cost and saved lives.

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