PERSONAL LUNG FUNCTION MONITORING DEVICE FOR ASTHAMA PATIENTS

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Abstract: Asthma is a life time lung disease causing irregular functions and shortness in breathing. Continuous monitoring is the essential action to monitor and control the chronic disease. On-time monitoring help asthmatics to get treated with proper medications and treatment Spirometry test is one of the currently standardized tests to find out the serious symptoms of the lung disease in hospitals. Along with the spirometer test, Peak Expiratory Flow meters are available to detect the PEF value of the exhaled breath air pressure. The proposed system helps to monitor the activity and environmental parameters of the asthmatics. Preliminary asthma symptoms can be found out by using this proposed system. The developed system includes a hardware module to monitor the air pressure, temperature, humidity, activity and corresponding volatile gases around the asthmatics. The sensed data from the hardware are sent to the patient's doctor. Doctor on examining the sensed values can take desired action on the asthmatics treatment and medications. The developed system is cost efficient, reliable, and easy to use device to find out the asthma symptoms in asthmatics.

Keyword– Arduino Uno, Gas Sensor (MQ2 Sensor), Flow Meter, Serial Cable.

I. INTRODUCTION

Asthma is a lingering lung disease, which is pigeonholed by recurrent occurrence of shortness in breathing, wheezing, irritation in airways, etc. The severity and frequency of the lung disease varies from individual to individual and also depends on the age group. The persistent attack of disease causes swells in the lining of the air passages intending the airway to narrow down thus plummeting air flow in and out of the lungs Hygiene Hypothesis, Atopy (a natural tendency to develop antipathies), childhood respiratory infections, aerial allergens or infant viral allergies are all the main aerial allergens or infant viral allergies are all the main causes of bronchial asthma [1, 2].

According to WHO (World Health Organization) around 230 million people suffer with the lung disease called asthma. Around 80% of death occurs in middle and low income countries. In developing countries such as India, it is estimated that10%-15% asthmatics are 5 to 11years old children. Under the developing countries category about20% people in Kenya are affected by this lung disease. In countries like Brazil, Peru and Panama, it estimates up to 20%-30% children [3]. While considering developed countries the situation greatly differs in the fact about 3 million asthma patients are in Japan of which 7% has severe and 30% has mild and moderate asthma. In Germany it is estimated to about 4 million asthma patients. In United States, 60% leapt in asthmatics every year since 1980's [4]. The Global Asthma Network suggests diagnosing and monitoring bronchial asthma symptoms at earlier stages is the best way to control the lung disease. Earlier stage control is necessary because asthma is a life time disease and it cannot be cured. Now-a-days most health care professionals diagnose and monitor severity of symptoms and responsiveness to treatment through spirometry and measuring PEF (Peak Expiratory Flow) rate. Both these test measurements require supervision from experts. Expert supervision is absolutely important in this scenario, but daily visit to health care centers is extremely impossible. This inability can be greatly tackled by considering advance technology portable devices. Recent advancements in wireless sensor systems, software application developments and smart phones paved the gateway for real time monitoring of patient's health condition. The wireless data transmission to medical experts helps to diagnose and monitor disease symptoms at earlier stage. Physiological monitoring of asthmatics using various sensors and smart mobile devices is prominently increasing. These monitoring devices act as an opportune method to measure parameters thus improving healthcare.

The main aim of this project is to design a low cost monitoring device for asthmatics. The device developed includes a pressure sensor to monitor the expiratory flow of the patient. The device also includes gas sensor to monitor the corresponding volatile gases around the asthma patients. Apart from that asthmatics also experience symptoms like wheezing sound so a sound model is also used which will detect the wheezing sound. Corresponding sensors are integrated to sense the real time values. The sensed data is sent to a Doctor through a message. Depending upon the sensed data, the patient's current situation is determined by the doctor. This system effectively monitors the symptoms of the asthmatics and it is very cost efficient.

II. LITERATURE REVIEW

The following research articles are selected for review:

Alice M. Kwan [1] proposed a study on wearable and bendable cardiorespiratory monitoring device by merging two noncontact sensor standards. The study proposes a wearable device which can be held in the patient's shirt pocket. In order to get the optimum performance, the device has to combine the standards of two sensors in noncontact way by invoking into several layers of textiles used by the patient. One sensor focuses on respiratory monitoring and the other sensor focuses on pulse detection. The main drawback of this study is that only two parameters are into consideration and real time monitoring is not taken into study.

Jun Luan et al [6] gives an overview of sternocleidomastoid muscle contraction for asthma assessment and control. This study proposes the low power detection of muscle contraction near the neck area during inhalation of air. In this study a wearable monitoring device has been developed using LED and photo detector. The experimental result of this study explains the simplification of hardware design thus showing reduction in power consumption in monitoring parameters. This paper focuses on development of wearable device to monitor abnormal sternocleidomastoid muscle contraction during the lung disease asthma which is a sign of further respiratory problems.

Chinazunwa Uwaoma et al [3] proposed a work on monitoring and detection of asthma symptoms on resource constraint mobile device. The work comprises of a resource oriented mobile device to monitor various physical and environmental factors of the asthma patients. The work concentrates on available sensors and modules in a mobile device to monitor asthmatics medical parameters, physical activities and environmental factors. The medical records are stored in the same mobile device for patient's assistance. An algorithm is also developed to analyze the physical activity and breathe pressure. The study carried out in this paper can only be worked out in a smartphones readily available in the market.

Doukas et al [4] have developed a cloud platform to efficiently process, manage and visualize sensor data. The work delivers a preliminary demonstration of the way cloud computing is used in the IOT real time, consisting of Arduino board equipped with Wi-Fi adapter, accelerometer, and a couple of air quality sensors, textile sensors recording electrocardiography, body temperature and oxygen saturation and location, activity and ambient temperature using a motion sensor. Although a variety of modalities are used, no form of significant evaluation is performed or findings reported to support the claim.

III. PROPOSED SYSTEM

The below fig.1 shows the block diagram of personal lung function monitoring system for asthma patients. At the patient side there is a flow meter which will measure the expiratory flow of the patient, a gas sensor which will measure the concentration of gases around the patient, a sound meter which will detect the wheezing sound.All these parameters are integrated within the Arduino board. All the sensed data is sent to Doctor through a message. Whenever patient will take the readings, the doctor will receive a message. Depending on the sensed data, Doctor can monitor the patient.

In our project we are using Arduino uno instead of microcontroller 8051. Arduino is the development board based on the AT mega series of microcontroller of the AVR family. The AT mega series is much more advanced compared to the 8051. It has many more peripherals that can be programmed easily. Arduino is mostly used only in the prototyping stage of a project or hobby/college projects. If we will use the 8051, we will have to interface the power circuit with it. The Arduino comes integrated with all the circuits. The Arduino also provides all the pinouts and large community supports. The programming is a bit on the higher level compared to embedded C. Hence we are using Arduino in our project.

Python programs are generally expected to run slower than Java programs, but they also take much less time to develop. Python programs are typically 3-5 times shorter than equivalent Java programs. This difference can be attributed to Python's built-in high-level data types and its dynamic typing. For example, a Python programmer wastes no time declaring the types of arguments or variables, and Python's powerful polymorphic list and dictionary types, for which rich syntactic support is built straight into the language, find a use in almost every Python program. Because of the run-time typing, Python's run time must work harder than Java's. For these reasons, Python is much better suited as a "glue" language, while Java is better characterized as a low-level implementation language. In fact, the two together make an excellent combination. Components can be developed in Java and combined to form applications in Python; Python can also be used to prototype components until their design can be "hardened" in a Java implementation. To support this type of development, a Python implementation written in Java is under development, which allows calling Python code from Java and vice versa. In this implementation, Python source code is translated to Java byte code, Hence python language is used in our project.

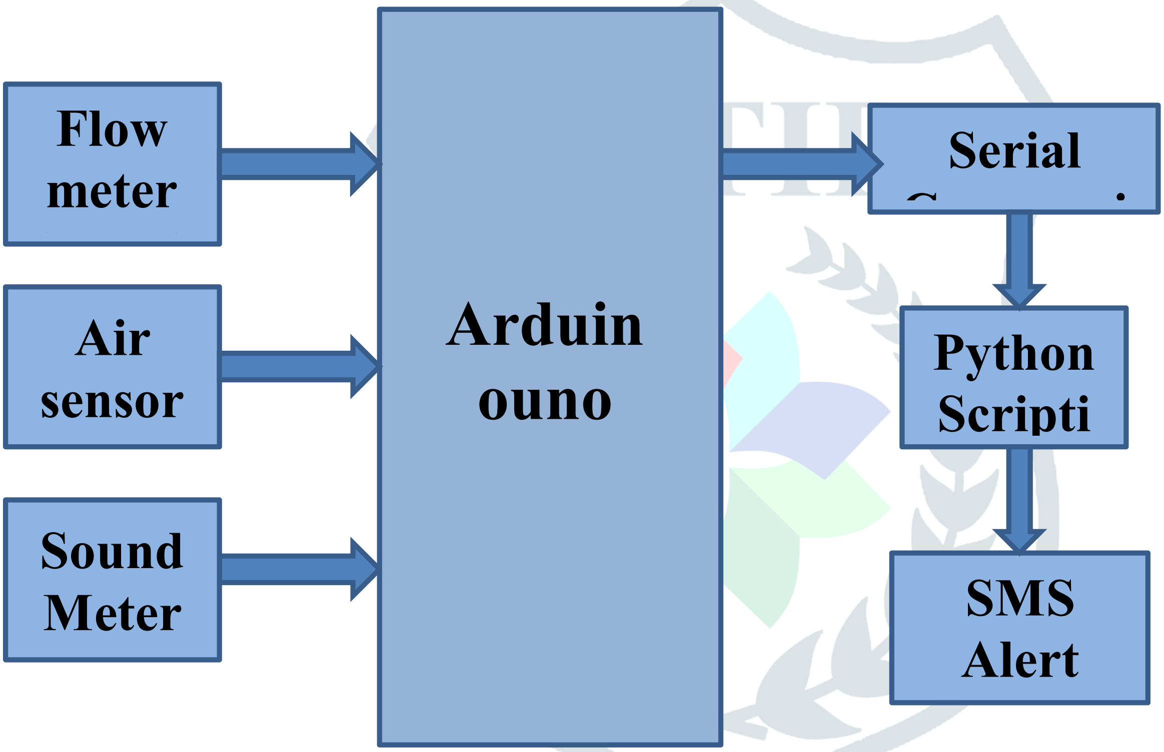

Fig.1.Block diagram of personal function monitoring system for asthma patients

IV. METHODOLOGY Circuit Diagram

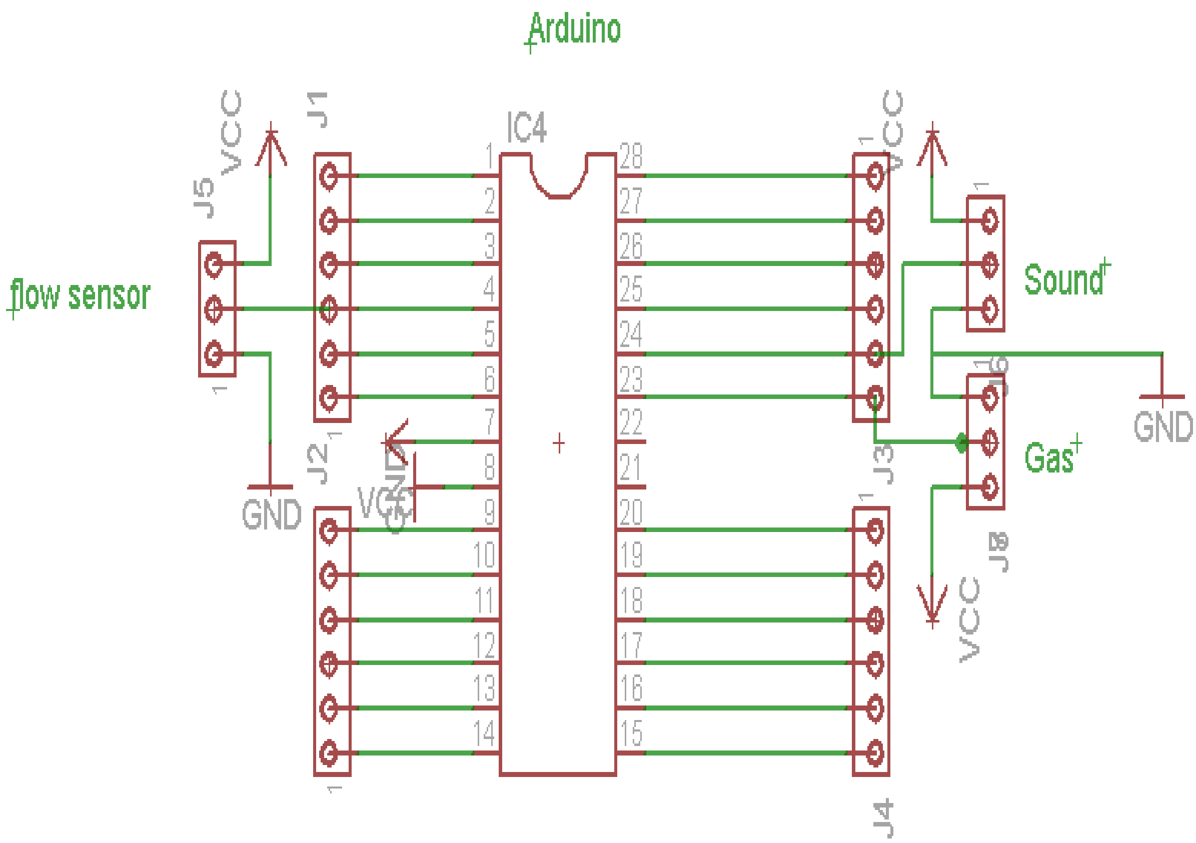

Fig.2.Circuit Diagram

The monitoring system involves an Arduino development board as a processing unit. At mega microcontroller is integrated within the development to carry out the data processing. The development board works at 5V power supply, so a power supply module is designed to power up the board and other sensors interfaced with it. An asthmatic end to wheeze when he/she involves in doing exercise. In this situation an activity sensor is required to determine the activity of the asthmatic. Monitoring activity of the asthma patient is very important, so that unnecessary fall situations can be avoided.

The Arduino flow meter works on the principle of the Hall Effect. According to the Hall Effect, a voltage difference is induced in a conductor transverse to the electric current and the magnetic field perpendicular to it. Here, the Hall Effect is utilized in the flowmeter using a small fan/propeller-shaped rotor, which is placed in the path of the air flowing. The air pushes against the fins of the rotor, causing it to rotate. The shaft of the rotor is connected to a Hall Effect sensor. It is an arrangement of a current flowing coil and a magnet connected to the shaft of the rotor, thus a voltage/pulse is induced as this rotor rotates. In this flow meter, for every liter of liquid passing through it per minute, it outputs about 4.5 pulses. This is due to the changing magnetic field caused by the magnet attached to the rotor shaft as seen in the picture below. We measure the number of pulses using an Arduino and then calculate the flow rate using a simple conversion formula.

The connections required for this flow rate sensor with respect to the Arduino are very minimal. There are only three wires coming from the flow rate sensor. The 5V VCC (red wire), the GND (black wire) and the signal/pulse (usually yellow) line. Connect the VCC and GND of the flow meter to the Arduino's VCC and GND. The pulse line of the flowrate sensor is connected to the Arduino's digital pin 2. The Arduino's digital pin 2 serves as an external interrupt pin (interrupt pin 0).

V. RESULT

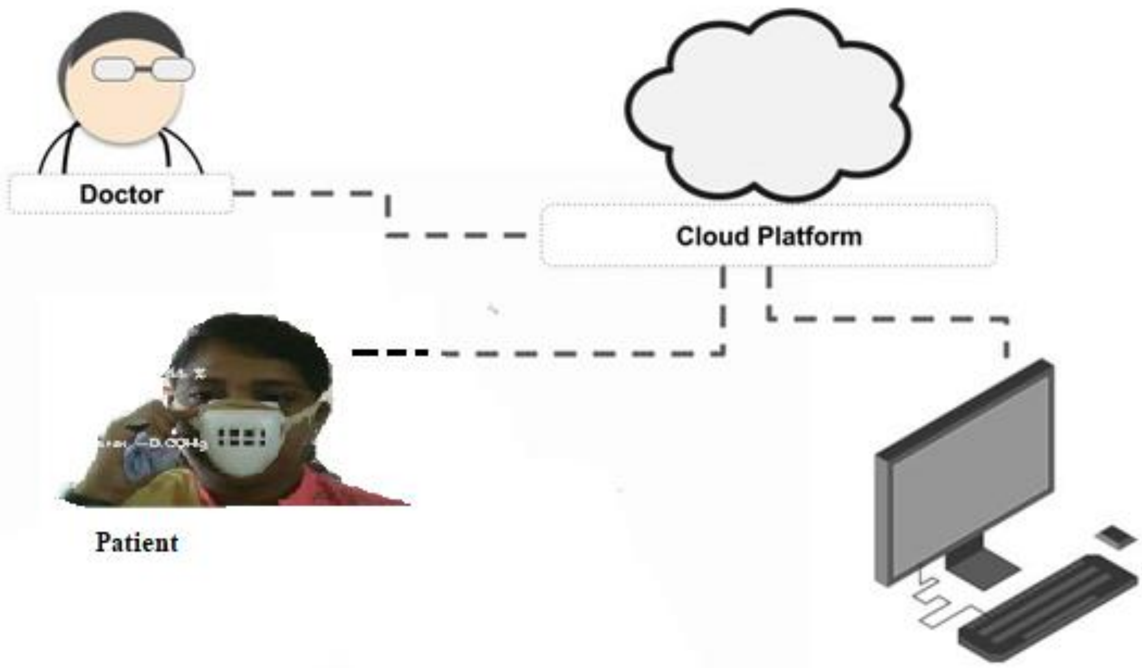

Fig.3.Concept of Project

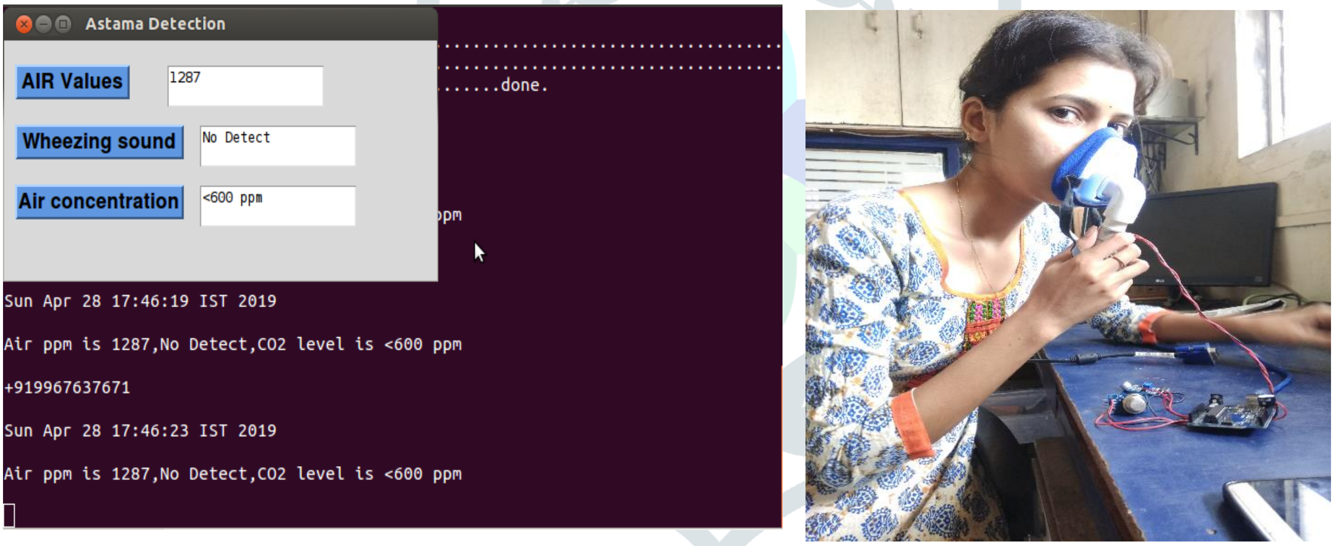

Fig.4.Result of the Project

Project Survey

Project survey is the most important part in project report. The purpose of this survey is to increase knowledge in fields such as social research demography. Survey research is often used access thoughts, opinions and feelings. Survey findings need to be presented in a way that is readable and technically acceptable.

For Normal Person

Name of the person	Air pressure values	Wheezing sound	Gas concentration
Akshada	1287	No detect	<600ppm
Karishma	1350	No detect	<600ppm
Vaishali	1098	No detect	<600ppm
Shruti	1124	No detect	<600ppm
Rahul	1425	No detect	<600ppm
Yadnya	1299	No detect	<600ppm
Ruchita	1750	No detect	<600ppm
Riddhi	1358	No detect	<600ppm
Vishnu	1102	No detect	<600ppm

Table 1

FOR ASTHMATIC PATIENTS

Name of the person	Air pressure values	Wheezing sound	Gas concentration
Purva	940	Detect	>250ppm
Dushyant	721	Detect	>250ppm
Aarvi	832	Detect	>250ppm
Akshay	688	Detect	>250ppm

Table 2

According to our Project survey the readings are "Air pressure reading for normal person is greater than 1000ppm" and "Air pressure reading for asthmatic patients is less than 1000ppm."

VI. CONCLUSION

The proposed system for asthma patients will monitor and determine the lung disease in asthmatics. This system will find the various parameters and will determine the level of seriousness in patient's health. The data will be sent to the specialist. The physician after examining the results can communicate the change in medications and severity of disease to the patient. Quick and effective way of asthma examination will be achieved by this device. This system will be user friendly and of low cost with quick access to data.

VII. ACKNOWLEDGMENT

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