Portable Air Quality Detector for Personal Health Monitoring

Shivang Agarwal, Abhinav Banerjee, Abirami G

Abstract: *Low standards of air quality are amongst the greatest in ranks of risks to public health as well as the risks to climatic conditions. A substantial amount of costs and efficiency misfortunes are identified with poor indoor air quality. Air quality is extraordinarily troublesome for plenty to gauge or sense; therefore, the general population can't say whether air quality is undesirable. In the interim, the vast majority of the predominant air quality action gadgets are intended for experts; It is expensive and on the far side the compass of normal clients. Throughout this paper, associate degree robot application based mostly real-time air quality watching system is created, which could be handily used for private body space micro-climate watching and conjointly useful for individuals suffering from metabolism bother by unceasingly watching the parameters that are harmful. The detector node is enforced with a most well-liked Arduino prototyping board, a Bluetooth module, and a form of low-priced small gas-sensors.*

Keywords: *Arduino, Bluetooth, Sensors, Android, Air Quality, Real-time AQI.*

I. INTRODUCTION

Air contamination is the nearness of undesirable organic particles, particulates or option unsafe things into the worldwide climate. It is a serious reason behind infections, metabolism problems, and eventually reasons for death. It additionally harms the other living species just like the animals and additionally the crops attributable to acid rain. It is also responsible for varied kinds of metabolism infections (like asthma), causes of assorted forms of lung/throat cancer in people if they don't seem to be protected against these toxins or chemicals for long periods of some time. Methane arrangement of CH4 and (CO) are harmful to people because of it ought to happen genuine suffocation, cerebral pains on account of the creation of carboxy-hemoglobin. The World Health Organization (WHO) in 2014 approximated that seven million people died overall as a result of contamination. A similar guess generally rose to by the International Energy Agency (IEA) also.

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These synthetic substances or contaminations are liable for corrosive downpour and consumption of the layer. As a result of the spread of anthropogenic activities, contamination is on the development and predominant it is and away the first imperative move to be made. Inside the past, the air quality estimation sensors were huge in size, non-versatile and exorbitant. Presently, most pollution sensors developed on 5 commonest air pollutants viz. inhalation anesthetic, CO, dioxide, and particulate. Air quality observance is critical as a result of it incorporates an excellent result on human health. The developed air-quality measuring sensing element will establish and observe the incidence of pollution at intervals in the adjacent areas. It should be used for each indoor and out of doors. With the assistance of future innovative upgrades, these sensors can become less expensive and extra normal, modest, transportable air quality sensors that might be wearable by people to appear at the local air quality. In the future, additional sensors are also accessible to look at such gases which are not attainable these days and maybe this method may additionally be embedded in a very smart-watch.

II. RELATED WORK

In this paper, [1] the authors have tried to gift a cheap sensing element system to induce the readings from this atmosphere in a period wherever the device is placed. This is done by associating an Arduino board that is connected to the gas sensing element that provides the air quality readings and so the info is processed within the Arduino and so the result's created if the air is contaminated or not. The readings of the results square measure shown on the LCD connected to the Arduino. During this paper [2], the authors address the security necessities of health observance accomplishing medical sensing element networks and additionally proposes a secure framework referred to as "SHM" deploying wireless sensing element networks. The safety services like confidentiality, believability, and integrity of the patient's knowledge at affordable square measures achieved are exhibited by SHM. To produce confidentiality, we've got used PingPong-128 stream cipher. Believability and knowledge integrity of the patient's knowledge is achieved by Ping-Pong-MAC (message authentication code). During this paper, [3] a period of time sensing-based air quality observance system is made utilizing terribly low price likewise as low force gadgets with gas sensors to catch the air quality list from the atmosphere. Raw sensing element knowledge gathered from the gas sensors square measure transmitted to the cloud associating it with an android application. At intervals the cloud, the information is held and processed.

The processed knowledge is pictured in a period of time and appropriate outputs square measure given in step with the patient's health conditions. Indoor pollution has received wide attention as a result of it affects people's health. The upsides of exiting indoor setting observance square measure detective work and up indoor air quality. In any case, several obstacles should be overcome before the period of time observance and furthermore, the self-governing portable framework will comprehend, a bit like the high price, that terrains up in low value much of the time. Thus, this paper [4] equates shrewd portable indoor recognition frameworks that support Arduino management for numerous sensors to notice air quality, that has been intended to reenact the client's indoor courses and notice air quality in a timeframe to help obtain indoor cool explicitly. Analyses the foremost necessary factors that have an effect on the precision and legitimacy of the estimation results by symmetrical trial style, whose results show that non-heritable by the framework gets high connection property with information of expertise instrumentality. The framework accomplishes self-ruling versatile gadgets with low cost and consequences of the tests delineate its fundamental usage cost. A sort of LAN remote observance and system controlled by LM3S8962 is bestowed during this paper [5]. This style has the advantages of stability and ultra-low power consumption. By transplant the LwIP protocol on the LM3S8962, to attain a home-cured lookout web association Associate in Nursing mechanically acquire an information science address, the user through a transportable device to access the system through an internet application to show the temperature, humidity, voltage, PM2.5, and alternative sensing element knowledge. Also, the network entry will management sub-node peripherals using the management instruction which might be uploaded to send to the sub-node, thus on accomplish wireless computer network to the net for remote observance and system by ZigBee, the native show LCD| digital display |alphanumeric display} would display the parameters and information science addresses. Meanwhile, the system will even be used as a shopper, wherever the collected knowledge is uploaded to a typical knowledge center networking platform-yeelink web site to be more processed for advancements within the medical field.

III. PROPOSED WORK

In this paper, Arduino UNO, LM35 Temperature sensor, MQ2 Gas sensor, MQ6 Gas sensor, and CO2 Sensor, LCD display, rechargeable 9V battery, breadboard, jumper wires have been used to build a portable air quality detector for personal health monitoring based on Arduino. The system combines a small-sized, low-cost gas sensor unit to the Arduino microcontroller unit (Fig. 1). The device is linked with an android application using a Bluetooth module and a GSM module (in case the user is not near the device) as well. The readings taken by the sensors are then passed on to the Arduino microcontroller and the user through the android application as well. According to the readings, the user is then notified by the android application if the circumstances are not suitable for the user. The parameters are set when the Arduino is programmed. This idea can be further embedded in smart-watches connected to iOS/Android devices.

IV. WORKING PRINCIPLE OF THE SYSTEM

The main components of this system are the low-cost gas sensors MQ 2, MQ 6, C02 and temperature sensors. The Arduino Uno is a microcontroller unit (MCU) board based on the principle design: ATmega328P. It is simply connected to a computer by a USB for programming the Arduino board. This module is connected to a battery source to make it a portable device. Using jumper wires the MQ2, MQ6, smoke and CO2 gas sensors and LM35 (Temperature sensor) is connected to the Arduino MCU. The sensor's manual pin is then linked to the manual pin 0 and digital pin 0 to digital 8 on the Arduino MCU, while +9V and the ground pins on the sensors are connected to the 9 Vcc and ground pin respectively on the microcontroller unit. The Arduino MCU is connected to the android application using the Bluetooth and GSM module for both cases i.e; user near the device and user far from the device respectively. According to the readings and the parameters set on the Arduino, the android application notifies the user about the circumstances (safe or unsafe).This device is highly scalable by adding more low-cost sensors, specific to read certain harmful gases which the users may be curious about and maybe allergic to.

V. HARDWARE MODULES

A. Arduino Uno

Arduino UNO is a microcontroller unit responsible to derive the readings from the gas sensors and then according to the parameters set, it notifies the user through the Bluetooth/GSM module. The arduino is basically an open-source hardware and software company. These designed products are then checked and licensed by the General Public License (GPL) [8]. Commercially these boards are available in the form of DIY (Do It Yourself) kits that are easy to program. Designs use a variety of microprocessors and microcontrollers. These boards can be made to work a certain way in digital devices by connecting to a computer and programming it. Languages like C/C++ are used to program the Arduino microcontroller. The Arduino itself possesses an IDE (Integrated Development Environment) for the languages used for programming the Arduino also helping in the faster compilation of the code.

B. LCD Monitor

Liquid crystal display (Fig. 2) is a form of display that operates with the use of liquid crystals as the primary form for the transmission of images. Now in recent times, LEDs are being used more in smartphones, television, displays, etc. It is much more efficient and uses less power in the longer run. It's a flat panel display that uses light-ray modulating properties of the crystals in the display. The working principle is that it does not emit light directly, it rather uses a backlight/ reflector for producing images in color/ monochrome. It contains two polarized surfaces perpendicular to each other when the light is passed through the polarized surfaces, the light is reflected by the respective crystals that are responsible for the correct display.
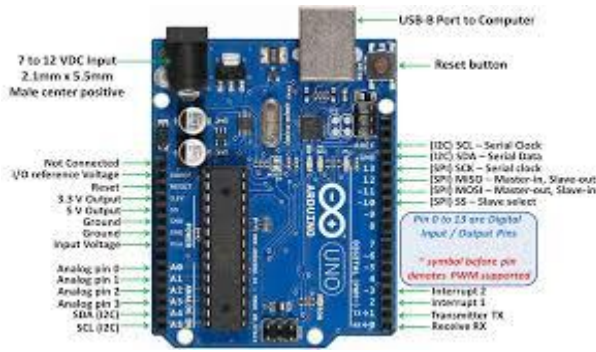
Fig. 1. A Detailed description of Arduino Uno

C. Gas Sensor Module

The gas sensor module (Fig. 3) is the unit that takes in a sample of air from the surroundings through the front inlet and then tests for the particulate matters between the polarized surfaces (anode and cathode). There is also a pH electrode that gives the idea of the acidic or basic nature of the sample. The sample is taken at regular intervals and analog signals are sent to the Arduino MCU through the analog pin 0 (the readings).
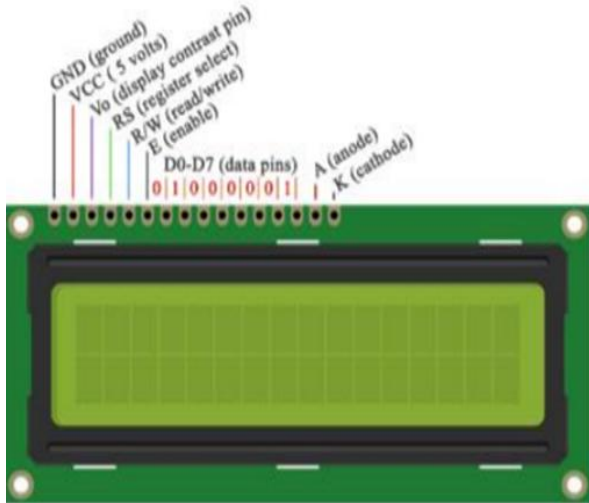

Fig. 2. LCD Panel detailed description

VI. SOFTWARE MODULE

A. Android Application

The android application is the medium or the interface between the user and the device. The device is connected to the android device in which the application is present through a Bluetooth module or a GSM module. The value that the device reads from the various sensors in the device is then processed by the Arduino and sent to the android device (in the application.)

The GUI of the application is such, when the user logs in, and enters the personal details and medical conditions (if any), the Arduino quickly allocates the parameters and sets the application accordingly. The home page of the application shows the current values of all the sensors that are presently working. It also synchronizes in regular intervals given the Bluetooth/GSM/location features of the android device is switched on. During the real-time monitoring, whenever the value goes beyond the limits. The android application gives a prompt to the user with a push notification.

The physical device as well as a beep alarm that can intimate the user given, the user is near the device or is using the device.

Fig. 3. MQ6 Gas Sensor Module

VII. RESULT DISCUSSION

Here in this paper, a Portable Air Quality Detector for Personal Health Monitoring has been developed. This device has huge scalability and also scope in the upcoming smart device market. This device successfully derives real-time data of the environment within the range of 2 meters.

Here a test had been conducted (Table 1) for the proper working of the device using cigarette smoke and how it responds [6]. The table below shows the approximate readings of the device that it has sent to the android device in real-time.

Table 1: Smoke detector readings with time and distance

Time(sec)	Value(ppm)	Distance(m)
02	70(fresh air)	0.7
04	95(polluted)	0.4
06	112(very polluted)	0.3
08	137(very polluted)	0.2
10	66(fresh air)	0.9
12	81(fresh air)	0.5
14	71(fresh air)	0.7

By studying the table we can very well figure out that cigarette smoke has an impact on the device even when the sligthest of changes have been made on the distance from the device. This shows the sharpness and accuracy of the device even when cost-effective sensors and euipments have been used.

VIII. CONCLUSION

The portable Air Quality Detector for Personal Health Monitoring has been developed and proposed in this paper. It is a very effective air quality and respiratory health monitoring system. According to the performance, it is easy to use and responds very accurately with minor changes in surroundings in real-time. The functionality of this low-cost device comparatively good to that of the large-scale expensive devices.

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