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Hybrid Sensing System for Monitoring Air Quality

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Abstract: Diverse biological agents that cause human disease represent in indoor air. They produce illness primarily through infection of the respiratory tract and through immune response. Because of the diversity of these agents and their associated illness, this project proposes an air quality monitoring system with sensors Gas(H_2, CO, LPG, CH_4, alcohol, smoke or propane) and Dust sensors interfaced with arduino to share data over internet and the monitored data can be seen in an android app. Experiments are conducted to validate and support the development of the system for real-time monitoring.

Key words: Arduino and roid app · Indoor · Gas and dust sensors · Real time monitoring

INTRODUCTION

With growing transportation and population density and sudden climate change, air quality is one of the important measures to be closely monitored in real-time for today's lifecycle, because air quality has major in?uence on the health, safety, productivity and comfort of people. Levels of Carbon Dioxide CO_2 are always a useful and reliable indicator of poor indoor air quality. Typically, levels of CO_2 will indicate 500-600ppm to confirm a well ventilated and low occupancy workspace. During periods of cold weather and in areas where air conditioning does not exist, levels of CO_2 are frequently high. This situation is often due to high occupancy levels with CO_2 levels exceeding 1000ppm. However, if the office density is very high, during meetings for example, CO_2 levels can climb to 2,000ppm+. Reducing levels usually demands increasing ventilation by opening windows. Reducing CO_2 this way is likely to result in further complaints because of the cold. This work developed system, is organised with a prototype of sensor node, built upon arduino for monitoring GAS and DUST sensor. The monitored data can be seen in an android app.

Proposed Hardware System: In this work, two types of sensor; gas sensor that senses the H_2, CO, LPG, CH_4, alcohol, smoke particles and dust sensor that senses the minute dust particles. The sensor signals are analog in nature, embedded system accepts only digital signal. The sensed data is transferred to the app by connecting RS-232 cable. Power supply is used to give power to all units in the component.

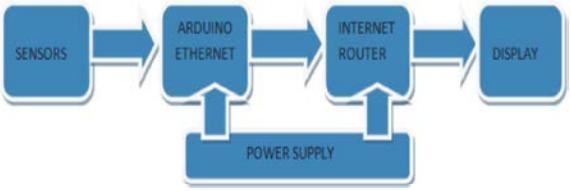

Fig. 1: Block diagram of proposed system

Figure 1 shows the block diagram of the hardware setup. The system consists of

- Sensors(Gas and Dust)
- Arduino
- Internet router

Arduino: Arduino is an open-source prototyping platform based on easy-to-use hardware and software. It is platform independent, has inbuilt library files and reduces the complexity of the program. The Uno is a microcontroller board based on the ATmega328p. The arduino requires input voltage 6-20V. Its operating frequency is 5V. It consists of 32KB Flash memory and 2KB SRAM.

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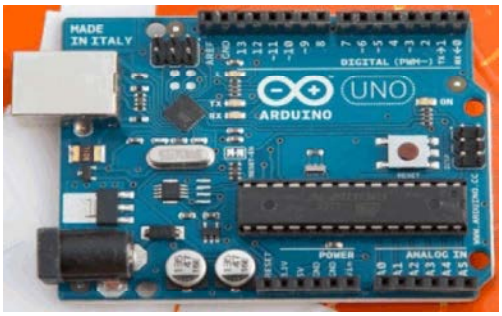

Fig. 2: Arduino UNO

Fig. 3: Gas Sensor

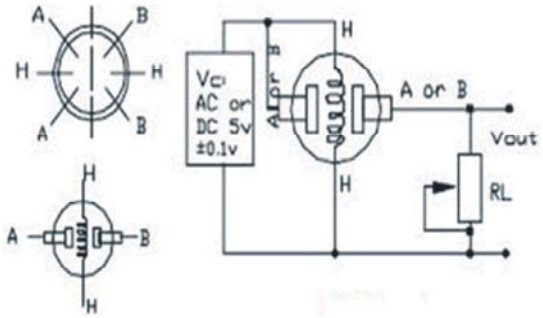

Fig. 4: Schematic diagram of gas sensor

GAS Sensor: Gas Sensor (MQ2) module is useful for gas leakage detection (in home and industry). It is suitable for detecting H2, CO, LPG, CH4, ALCOHOL, SMOKE or PROPANE. Due to its high sensitivity, low cost and fast response time, measurements can be taken as soon as possible. Its circuit and heating voltage is 5V.

- In the Figure 4 the heater is for +5V and is connected to both 'A' pins. This is only possible if the heater needs a fixed +5V voltage.
- The variable resistor in the picture is the load-resistor and it can be used to determine a good value. A fixed resistor for the load-resistor is used in most cases.
- The Vout is connected to an analog input of the Arduino.

Dust Sensor: Dust sensor is an optical sensing system. It gives a good indication of air quality in the environment by measuring the dust concentration. An infrared emitting diode (IRED) and a phototransistor are diagonally arranged into this device. It detects the reflected light of dust in air. Especially, it is effective to detect very fine particles. Compact size and Low consumption. Its Functionality is analog, Response Time is 0.28ms and supply voltage is 5V. This dust sensor can be used in air conditioner, air purifier, ventilator.

Table 1: Standard Work Condition of Dust Sensor

Parameter	Symbol	Rating	Unit Supply
Voltage	VCC	-0.3 to +7	V
Input Terminal Voltage	V_{led}	-0.3 to VCC	V
Operating Temperature	T_{opt}	-10 to +65	°C

Fig. 5: Dust sensor

The Figure 6 shows the working connection of the dust sensor, the pin connection of a sensor pin to the Arduino pin. The Table 1 gives the standard work condition of dust sensor.

Power Supply: Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.Rectifier converts AC to DC. Filter is used to remove the unwanted signals. Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. The regulated DC output is very smooth with no ripple.

Software Description

Arduino IDE: The Arduino project provides the Arduino Integrated Development Environment (IDE), which is a cross-platform application written in Java. A program written with the IDE for Arduino is called a "sketch". A typical Arduino sketch consist of two functions that are compiled and linked with a program stub *main()* into an executable cyclic executive program:

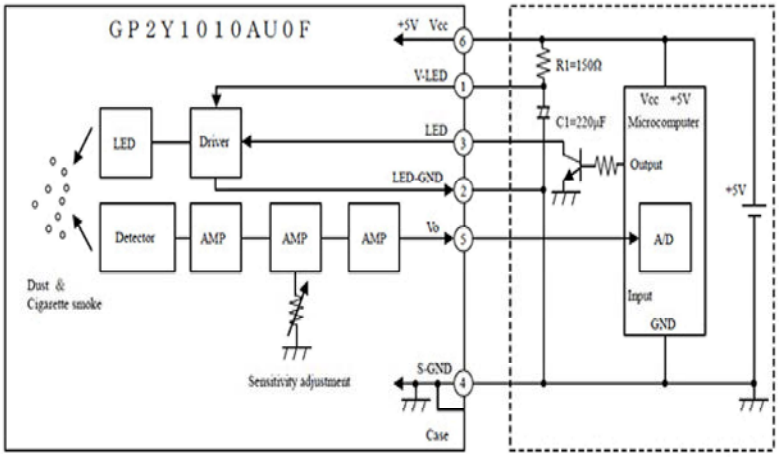

Fig. 6: Schematic diagram of system connections

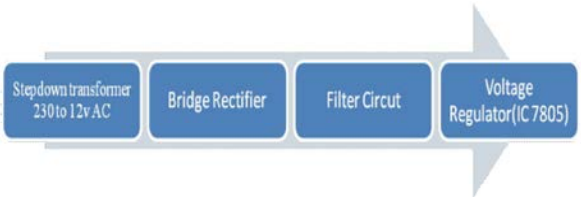

Fig. 7: Power Supply

- setup(): a function that runs once at the start of a program and that can initialize settings.
- loop(): a function called repeatedly until the board powers off.

Once the program is coded it has to be compiled and uploaded. The output of this can be seen in a serial monitor.

Android APP

Android Application Package: APK is the package file format used by the Android operating system for distribution and installation of mobile apps. To make an APK file, a program for Android is first compiled and then all of its parts are packaged into one file. APK files are a type of archive file, specifically in zip format packages based on the JAR file format, with .apk as the filename.

APK files can be installed on Android powered devices just like installing software on PC. To secure the device, there is an "Unknown sources" setting in Settings menu which is disabled by default. It must be enabled before installing any application with APK file. Enabling this setting is not required when you are installing a package via an official source (such as Google Play).

Software: Eclipse IDE Language : Java
Filename extension : .apk Ex
tended from : JAR and ZIP

Fig. 8: Android app

Blynk APP: Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.

Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet of your things.

Scenarios

Construction or Maintenance Sites: When workers are fully focusing on their given tasks, their general senses become blurred. In this situation, if there is a gas leakage, the workers who are exposed to bad air for a long time may lose their spirit. The indoor air quality monitoring will prevent this kind of critical emergency from happening. The monitoring system needs to be able to detect the gas leakage in real time, trigger for quick ventilation and alarm for immediate rescue.

Schools or Gathering Places: Students spend most of their time in the indoor classroom of school buildings. The indoor air quality is very important for students' health. Generally, each person also becomes a source of pollutant in a closed place for a long term stay. The air quality monitoring system needs to be able to detect indoor air quality change.

Air Conditioned Room: People spend most of their time in air conditioned room, as the number of people in the room increases, suffocation increases rapidly. This sensor module when placed in that room it monitor the quality of air, if any discomfort it send alert so that people can be aware and take necessary precaution.

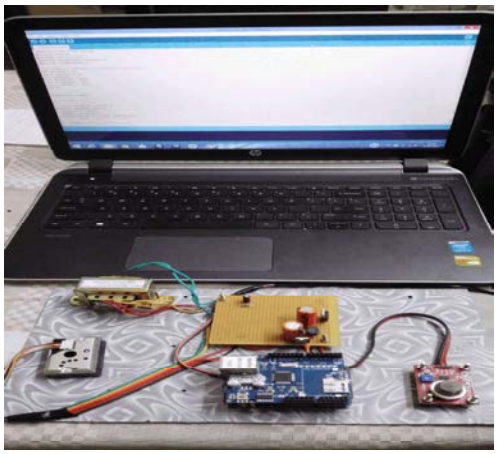

Fig. 9: Hardware setup

Fig. 10: Monitored front view in Android app

RESULTS

The hardware setup shows the sensors connected to the arduino which is connected with the Ethernet cable to the system.

The Figure 10 shows the values and graph of the monitored data in the android app.

CONCLUSION

A hybrid sensing system to monitor the quality of air in indoor environment is proposed. A sensing node connected to arduino is used through which the data can be automatically predicted and the levels exceed it will be noticed in an android app from mobile phone. This project identifies the existence of materials that may reduce quality of air. Manual work is reduced to predict the dust and Co2 levels in the environment or industries.

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