Temperature and Humidity Compensated Air Quality Monitoring System

S.V.V. Srinivas¹, Aditya Kumar Singh², Aman Raj³, Abhishek Shukla⁴, Aviral Malay⁵
Department of ECE
ABEST Ghaziabad, India

Abstract:
The objective of this work is to provide the concerned authorities with a tool to help them gather data by observations using the AQM device and help them to form the strategy for the resource planning.

Keywords: Peltier, Drv103U, Heat Sink, Particulate Matter (PM), Microcontroller.

I. INTRODUCTION
Air pollution is one of the most serious problems in the world. It refers to the contamination of the atmosphere by harmful chemicals or biological materials. Two of the worst pollution problems in the world are urban air quality[4] and indoor air pollution. To solve the problem of air pollution, it's necessary to understand the issues and look for ways to counter it.

A Cost effective AQM solution will be worked upon with pollutant identification and quantification, which is compatible with diverse Indian atmospheric conditions. A possible replacement of commercial AQM systems with real time high-density data collection for AQI calculation.

This will be achieved by introducing an Air Conditioning System that will regulate the Temperature, Humidity, rate of flow of air that sensors[2] meet. Gas Sensors experience drift when exposed to normal air. This results in difference in accuracy and precision of Sensor data as compared to those in laboratory conditions. By providing conditioned air, this difference can be eliminated to a larger scale. Air conditioning is achieved by implementing a Peltier based cooling system. This system will also control humidity[1] of the air.

II. IMPORTANCE AND IMPACT OF THE WORK

Saving human lives takes priority in any situation also prevention is better than cure therefore deploying AQM devices over different places and collecting data makes the job of resource planning easier and affordable to any organization.

The project is expected to have the following impact:

- Awareness regarding air pollution among the public.
- Availability of a low-cost monitoring equipment in the hands of the government.

Fig. 1- Flow diagram of work
III. WORKING

The whole system consists of a thermoelectric based air-cooling chamber with different filters and solenoid valves to control the quality and movement of fluid in the system. An air pump is used to pump the ambient air into the system. This air is passed through a HEPA filter. An UV lamp will also process upon this air. The filter outlet is connected to a Peltier chamber. Three valves control the airflow in this chamber. The air is moved in a loop through loop with the help of a pump. This done to ensure the air is uniformly cooled. When the desired temperature and humidity is obtained, the outlet valve is opened to another chamber where the Sensors are placed. This is where the actual reading takes place. This to be noted that the air provided to the PM sensor neither filtered nor conditioned. After the Sensors take the reading, the air is forced out with the help of an exhaust pump. After sometime, this process is repeated again.

IV. TECHNICAL SPECIFICATION

A. Circuitry

![Fig.-2 Electrical circuitry](image)

The figure shows the components embedded in the circuitry where the main controller relates to several peripheral devices such as sensors, motors, relay and display unit along with the IoT device. Here the Sensors takes the raw input from the surrounding environment with the help of air pumps attached to the microcontroller using DRV and passes through the air conditioning device which controls the temperature and humidity related parameters of the incoming air accordingly and before going to sensors a final touch is given to the airflow that is to control the flow rate by employing a mass flow controller in between the Sensors and conditioning system. The IOT device attached to the microcontroller is used to transport the data gathered by sensors to cloud or any such platforms to store information in an organizational manner for future reference.

B. Motor driver(L293D)

The Motor driver(L293D) is an electrically powered motor driver device which intended to provide bidirectional drive currents of up to 600-mA at voltage ranging from 4.5 V to 36 V. From this electrically powered motor driver device, two electric motor can be driven simultaneously, both in onward and backward course.

C. DRV103U

The DRV103U is a power switch engaging a pulse-width modulated (PWM) output. Its robust design is optimized for driving electro-mechanical devices such as valves, relays, actuators, solenoids, positioners and motors. The DRV103U is also ideal for driving thermal devices such as coolers, lampstand and heaters. PWM operation conserves power and reduces rise in heat, resulting in higher reliability. In addition, adjustable PWM allows sufficient control of the power provided to the load. DC-to-PWM output delay time and oscillator frequency are also externally tunable. The DRV103U can be customized to offer a strong initial closure, automatically switching to a “soft” hold mode for saving power. A resistor, Digital-to-Analog converter, analog voltage can control the duty cycle. An output OK flag specifies when thermal shutdown or over current occurs.

D. CC3100BOOST

The Wi-Fi CC3100BOOST make available the flexibility to add Wi-Fi to any microcontroller (MCU). This Internet-on-a-chip solution contains all you need to easily create IoT solutions such as security, quick connection, cloud support etc.

E. Microcontroller (MSPEXP-430F5529LP and MSPEXP-430F5994)

The MSP430 series is mixed-signal microcontroller kinfolk from TI with a built-in 16-bit CPU and is specifically for low cost and low power consumption in embedded system applications. These microcontrollers will act as brain for the controlling circuits such as speed motors, managing IOT devices, opening and closing of valves, switching on and off fan and all other component that are embedded to this integrated circuit.

F. Peltier

A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump, which transfers heat within device from one side to the other, with consumption of electrical energy, depending on the direction of the current. Such an instrument is also called a Peltier device. It can be used for both heating and cooling; although in practice, the main application is cooling, hence using Peltier to cool down the temperature of incoming air in the Peltier chamber as required by the sensors.

G. HEPA (High efficiency particulate air)

High efficiency particulate air (HEPA), also sometimes called high-efficiency particulate arresting or high-efficiency particulate arrest is a type of air filter, which are designed to arrest very fine particles effectively, but they do not filter out gasses and odor molecules. This device is employed in filtering out the waste particles which are not required as input to the sensors.
**H. Mass flow controllers (MFC)**

The mass flow controller is the device that is used to control the rate of flow of air or any other gases without changing their properties.

**V. FACTS AND FIGURES**

The above graph shows the relationship between carbon-di oxide and temperature. In this experiment the CO₂ sensor is kept in a temperature and humidity-controlled chamber and pure CO₂ made to flow at constant rate using a mass flow controller while keeping the relative humidity constant and after a certain interval of time temperature is varied and the changes are noted and plotted in graph.

The current competition offers low reliability and lifespan while high performance systems are very expensive. Market study shows that this system will occupy a unique place in the market. The system will provide moderate performance at an affordable cost, which will ensure that it can set up in multiple locations. The data that has been collected can be kept in a database, which upon using AI and Machine Learning can be used for Pollution Pattern and Future Predictions. This data can also be sold to concerned groups and authorities.

**VI. MARKET APPROACH AND CURRENT COMPETITION**

The field of electronics and robotics is filled with vast opportunities for further development of the current work. There is a diverse range of sensors and equipment available in the market such as thermal cameras, heat Sensors and pressure Sensors, which can be, mounted on the platform, helping in further enhancement the capabilities of the AQM device. There is continuous research and development in this field and the current technological innovation is yet to reach a limiting block.

The core innovation of the work is the Peltier chamber where the temperature and humidity of the incoming air is varied according to the requirement of the Sensor.

The main objective is track and monitor accurate pollution level of a specific area and make available on a mobile application through smart communication.

**REFERENCES**


