AIR QUALITY MONITORING SYSTEM USING ATMEGA328/P

[1]Medha Mukherjee, [2]Sagar Kumar Paul, [3]Dipali Ashok Shinde, [4]Jyoti Morbale
[1]Student, [2]Student, [3]Student, [4]Assistant Professor
[1,2,3] Department of Electronics/Biomedical
[1,2,3] Bharati Vidhyapeeth University College of Engineering, Pune, India

Abstract: Air quality monitoring is performed using specialized equipment and analytical methods used to establish air pollutant concentrations. These monitors can be easily operated by citizens, regulatory agencies, and researchers to investigate air quality and the effects of air pollution. It can be also used in form of portable devices in order to check the ambiance of the environment in which we are staying. Interpretation of ambient air monitoring data often involves a consideration of the spatial and temporal representation of the data gathered, and the health effects associated with exposure to the monitored levels. Since in our project we are considering the air pollution carried by the wind. Anemometric data in the area between sources and the monitor often provides the insights on the source of the air contaminants recorded by an air pollution monitor. In our monitoring system, we will determine the sufficient amount of harmful gases that are present in the air like CO2 (carbon dioxide), CO (carbon mono-oxide), smoke, NH3(ammonium) and many other. It will show the air quality in terms of ppm (parts per million) on the LCD.As the air quality goes down beyond certain level, the monitoring system will determine the changes and will trigger the alarm. In this project we will measure temperature and humidity in air will display the same on the display.[1][2]

Index Terms- Air Quality Monitoring; Gas Sensor; Humidity Temperature sensor; IOT Internet of things; Air Quality Index (AQI)

INTRODUCTION

In the developing country like India, Pollution is the big problem. The Environment in which we are living is very important factor affecting health. Environmental monitoring describes the processes and activities that need to take place to characterize and monitor the quality of the environment. All monitoring strategies and programs have reasons and justifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In this project of ours we are going to make Air Pollution Monitoring System in which we will monitor the Air Quality of the environment using specialized equipment. We can use its analytic method to determine the air pollutant concentrations. Design of this module is compact and easy to operate. It can be installed in any room and can be moved anywhere by just removing the power cord if necessary.

Any activity involving burning things/fuels and mixing substances that cause chemical reactions may release toxic gases in the process and some activities like construction, mining, transportation, etc. produce large amounts of dust which has the potential to cause air pollution. Air Pollution renders air unfit for respiration by humans and animals. Air pollution problem has been aggravated by the tremendous increase in the number of mobile sources (motor vehicles) in urban areas. The latest available 23 data on air quality have prompted WHO to call for greater awareness of health risks caused by air pollution, implementation of effective air pollution mitigation policies and close monitoring of the situation in cities worldwide. In April 2014, WHO issued new information after estimating that outdoor air pollution was responsible for the deaths of about 3.7 million people under the age of 60 in 2012 (TNI 2014).[5]

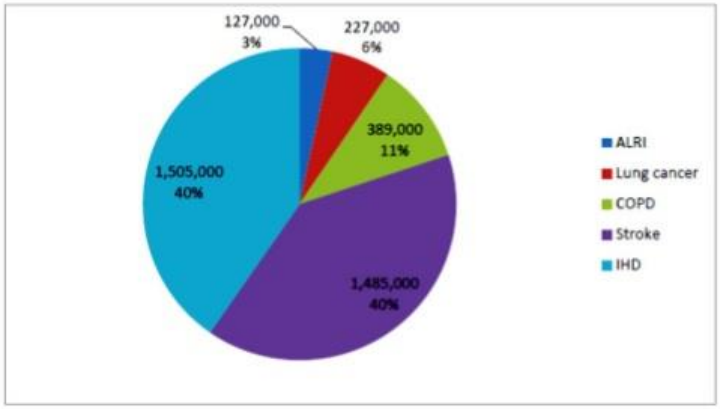

Fig:1 Picture depicting the deaths attributable to ambient air pollution in 2012, by disease. (ALRI: Acute lower respiratory disease; COPD: Chronic obstructive pulmonary disease; IHD: Ischemic heart disease).

United States Environmental Protection Agency designated a standardized air pollution level indicator known as the Air Quality Index (AQI), which mainly consists of six common air pollutants (also called as criteria air pollutants that can injure health, harm the environment and cause property damage) carbon monoxide (CO), Lead (Pb), nitrogen dioxide (NO2), Ozone (O3), particulate matter (PM), and sulfur dioxide (SO2) (USEPA-APM).

In India, the Central Pollution Control Board (CPCB) has specified CO, NO2, SO2 and PM as criteria pollutants for monitoring through its National Air Quality Monitoring Programme (NAMP).
In order to know more about the Air Quality Index, we surveyed the nearby Air Quality Monitoring Board. It specifies all the necessary details in order to the check the air quality of the surrounding. Apart from determining the pollutants, it also indicates the parameters such as:

- Temperature
- Humidity
- Wind Direction and Speed
- Rate of Rainfall
- It also shows the maximum and minimum temperature of particular location (Katraj-Pune) on daily basis.
- If the range of the Air Quality Unit is high it can also determine the temperature of the surrounding location/area/city.

Fig:2(a)

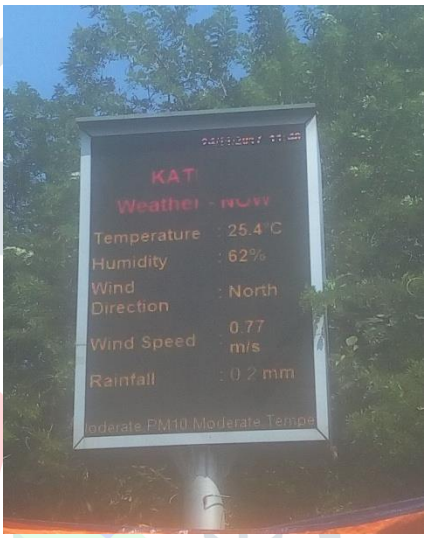

Fig:2(b)

RESEARCH METHODOLOGY

We took an example of the survey, which we showed in fig:2(a),(b) and designed a small scale prototype which can determine the basic environmental conditions. The main advantage of this unit is that it is portable and can be carried wherever required. This unit is an **IOT Based Air Monitoring System** which **monitors and controls the Air Quality of the surrounding.**
Basic block diagram of this technique is as shown in Fig:3.

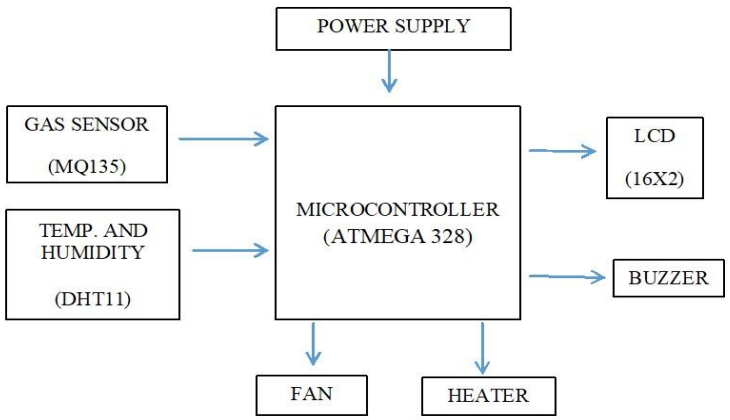

Fig:3 Basic Block Diagram of the AQM System.

Detailed Explanation of the blocks are given below:

A. MICROCONTROLLER ATMEGA328/P:

The Atmel® Pico Power® ATmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture**.** The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial-port,10-bit A/D-converter (8-channelsin TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz's.[3]

B. TEMPERATURE/HUMIDITY SENSOR DHT 11:

It's the most basic type of temperature and humidity sensor. A humidity sensor senses, measures and regularly reports the relative humidity in the air. It measures both moisture and air temperature.DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability**.**[4]

C. GAS SENSOR MQ 135:

These sensors are used in air quality control equipment for buildings/offices and are suitable for detection of NH3,NOx, alcohol, Benzene, smoke, CO2 , etc**.**Sensitive material of MQ135 gas sensor is SnO2, which has low conductivity in clean air. When the target combustible gas exist, the sensors conductivity is higher along with the gas concentration rising. A simple electro-circuit is used to convert change of conductivity to corresponding output signal of gas concentration. MQ135 gas sensor has high sensitivity to Ammonia, Sulphide and Benzene steam. It is also sensitive to smoke and other harmful gases. In this project we are using this sensor which cant determine the overall pollutants present in the environment.It can either be presented as parts per million or can be written in percentage.

D. LCD 16X2:

Liquid Crystal Display is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix.

RESULTS AND DISCUSSION

As our prototype isan IOT based unit, so we got reasonably good results by monitoring it on April 27, 2018
from 02:00 a.m. till 23:00 p.m. in Katraj, Pune. We made a proper note on the changes that took place in temperature, humidity and AQI (i.e. Air Quality Index). In order to advance its usage, this unitworks in such a way thatwhen the air quality goes down beyond a certain level, i.e. when there is certain amount of harmful gases present in the air, like CO2, smoke, alcohol, benzene etc. the alarm will trigger so as to notify us the current condition of the surrounding. An exhaust fan is triggered ON whenever there is high humidity and heater is triggered ON when temperature drops.
Results are presented in graphs and tables as shown below:

1. Temperature-Time Representation:

TIME (HOURS)	02:00	05:00	08:00	11:00	14:00	17:00	20:00	23:00
TEMPERATURE (CELCIUS)	30	27	29	32	34	32	31	30

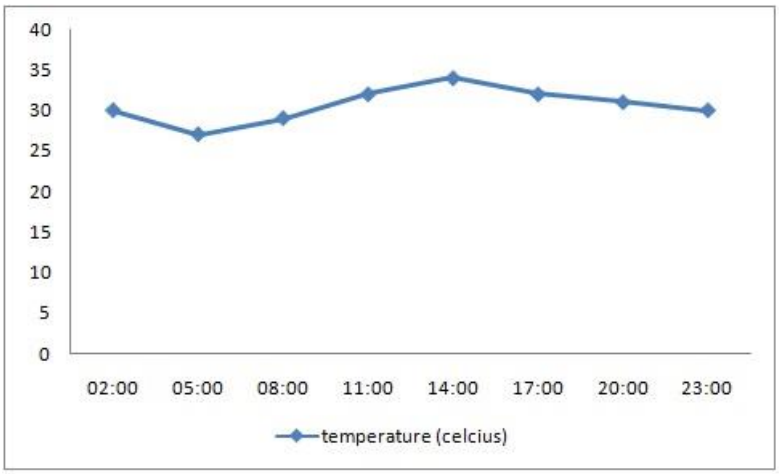

Fig: 4 Graphical Representation of Temperature and Time

2. Humidity-Time Representation:

TIME (HOURS)	02:00	05:00	08:00	11:00	14:00	17:00	20:00	23:00
HUMIDITY (%)	27	28	25	26	26	27	30	28

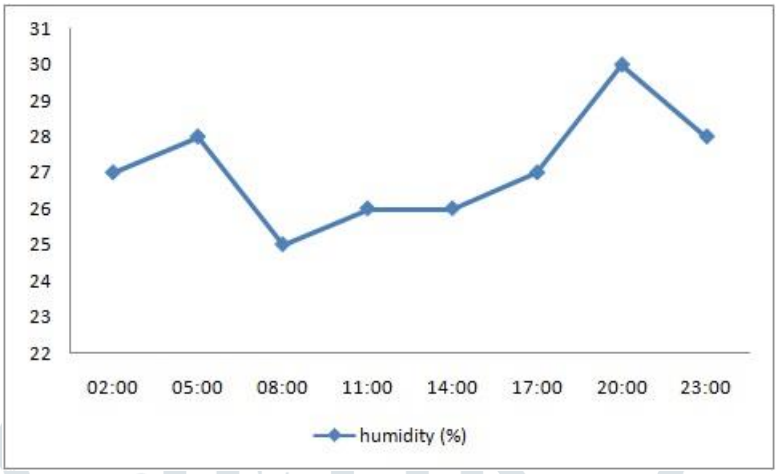

Fig: 5 Graphical Representation of Humidity and Time

3. Air Quality Index(AQI)-Time Representation:

TIME (HOURS)	02:00	05:00	08:00	11:00	14:00	17:00	20:00	23:00
AIR QUALITY INDEX (ppm)	14.5	14.5	14.2	14	13.2	13.5	15	15.5

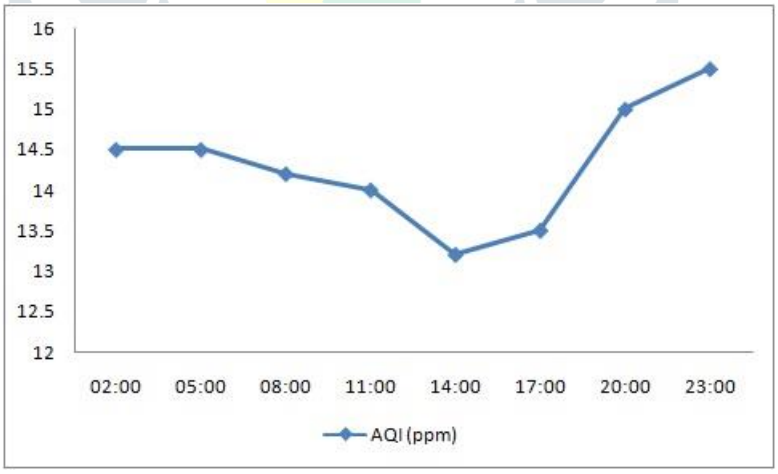

Fig: 6 Graphical Representations of AQI and Time

CONCLUSION

Air pollution is an essential environmental issue due to the tremendous impacts on public health, global environment, and worldwide economy. Urban air pollution with non-uniform distribution trend arises the necessity for pollution monitoring with high spatio-temporal resolution, which the conventional air quality monitoring systems cannot provide because of the limited data availability and non-scalability of the systems.[6]

In future we can use this IOT project, to monitor the pollution level from anywhere using ones computer or mobile and can send alert via SMS/mail to the user. By utilizing the advance sensing technologies, Micro-Electro Mechanical Systems (MEMS) and Wireless Sensor Network (WSN), researchers are able to push the concept of The Next Generation Air Pollution Monitoring System (TNGAPMS) to the limit and are at an urge to achieve great progress. Many of state-of-the-art air pollution monitoring systems have been implemented and tested. All of these

system evidence that an air pollution monitoring system with high spatio-temporal resolution, cost and energy efficiency, deployment and maintenance feasibility, convenient accessing ability for the public or professional users are achievable. Also there are some abilities or characteristics of these existing systems that we want to carry forward or enhance while building the future systems.[6][7]

SYSTEM SETUP OF AIR QUALITY MONITORING UNIT

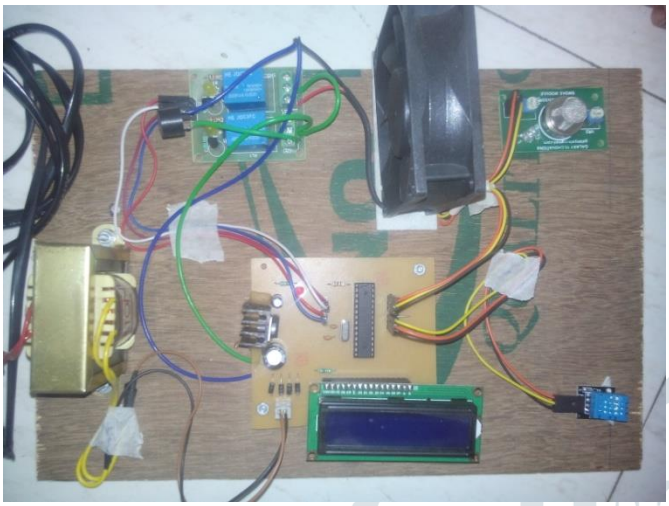

Fig: 7(a) Top View of the Air Quality Unit

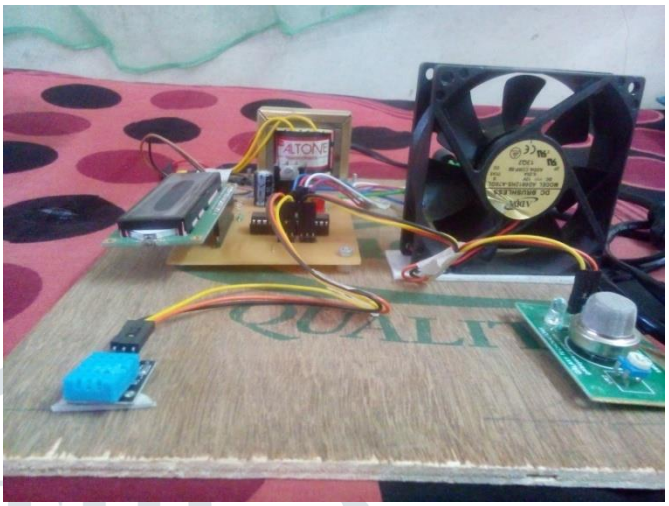

Fig: 7(b) Side view of the Air Quality Unit

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