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IOT Enabled System for better Environmental Monitoring

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Abstract: A variety of air pollutant gases have known or proved harmful effects on human health and the environment. There is a need to monitor such polluted areas and hence alert the people living in that area. This research paper presents a hardware implementation of Air quality monitoring system which includes Air quality sensor, methane ,butane, carbon monoxide and dust particles which can be present in an urban ambient place where industrial activities and major human activities takes place. The system will work real time by using web-based technology using Arduino Mega,ESP8266 and various sensors. The real time data will be stored in the webpage and hence can be used whenever required for the research work
Keywords: Air quality, Arduino mega, ESP8266, Server.

I. INTRODUCTION

Air pollution is one in all the largest threats for the environment and affects everyone: humans, animals, crops, cities, forests, aquatic ecosystems. Air pollution is outlined as an alteration of air quality that may be characterized by measurements of chemical, biological or physical pollutants within the air.

Therefore, air pollution means that the undesirable presence of impurities or the abnormal rise within the proportion of some constituents of the atmosphere. Air pollution is caused by the presence in the atmosphere of harmful substances, chiefly created by human activities, despite the fact that generally it may end up from natural phenomena like volcanic eruptions, mud storms and wildfires, conjointly depleting the air quality.

Human impact on the environmental pollution sources are:
1) Combustion of fossil fuels, like coal and oil for electricity and road transport, manufacturing air pollutants like nitrogen and sulfur dioxide
2) Emissions from industries and factories, releasing great amount of carbon monoxide gas, hydrocarbon, chemicals and organic compounds into the air
3) Agricultural activities, because of the employment of pesticides, insecticides, and fertilizers that emit harmful chemical
4) Waste production, principally due to methane generation in landfills.

The causes of air pollution is not possible to explain the complete extent of potential and actual harm caused by all types of air pollution. however here are the main consequences:

A. On The Environment

Air pollution incorporates a major impact on the method of plant evolution by preventing chemical change in several cases, with serious consequences for the purification of the air we tend to breathe. It additionally contributes to the formation of air pollution, atmospheric precipitations in the type of rain, frost, snow or fog, that are discharged throughout the combustion of fossil fuels and remodeled by contact with water steam in the atmosphere.

B. Global Warming

On high of that, pollution could be a major contributor to heating and global climate change. In fact, the abundance of carbon dioxide within the air is one among the causes of the greenhouse effect. Normally, the presence of greenhouse gases ought to be useful for the earth as a result of they absorb the infra-red radiation created by the surface of the planet. But the excessive concentration of those gases in the atmosphere is the reason for the recent global climate change.

C. On Human Health

Our continual exposure to air pollutants is answerable for the deterioration of human health. Air pollution is so a big risk issue for human health conditions, inflicting allergies, metabolic process and cardiovascular diseases further as respiratory organ harm.

So there was a need to implement a system which can monitor the poisonous gases and put a track on it. The implementation of the system hence includes some gaseous sensors which are mainly responsible for the degradation of the air. The system is having a main module as Arduino mega which is the processor of the system which will control all the activities within the project. The system is having five type of sensors via; carbon monoxide, butane ,methane, Air quality sensor and pm 2.5 dust sensor which all gives a analog readings and hence connected to the analog pins of the arduino mega (Atmega 2560).

All the readings are then sensed by the sensors and then sent to the http server through internet using ESP8266 WiFi Module. ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability .All the sensors and the controller is powered by power supply .

II. IMPLEMENTATION

Basically five sensors are connected to Arduino mega board. The sensors are Air quality sensor ,Methane sensor ,carbon monoxide sensor ,butane sensor,PM 2.5 dust sensor. These are the sensors which will collect analog data using arduino mega as controller from the environment. Then these data is then , sent to a http server through internet using ESP8266 Wi-Fi module using HTTP protocol. And hence the collected data is stored on that http server which we have made. Also whenever required the data can be retrieved and used by the authorities. These all system data can also seen on serial monitor of IDE software.
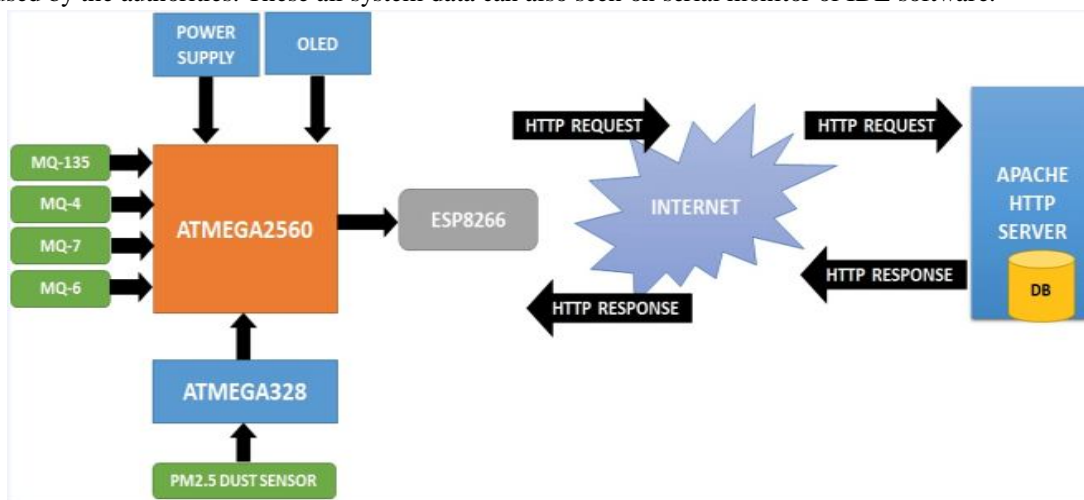

Fig. Block diagram of the system

A. Arduino Mega (Atmega 2560)

The Arduino Mega is a microcontroller board based on the ATmega1280 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The board can operate on an external supply of 6 to 20 volts. The ATmega1280 has 128 KB of flash memory for storing code (of which 4 KB is used for the boot loader), 8 KB of SRAM and 4 KB of EEPROM
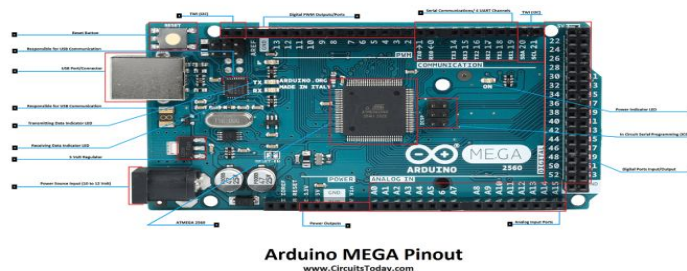

Arduino MEGA Pinout
www.CircuitsToday.com

Fig. Arduino mega board

B. Sensors

1) Air Quality (MQ 135): Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application.

2) *Methane (MQ 4):* They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of CH4,Natural gas.LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke.

3) *Carbon Monoxide (MQ 7):* This is a simple-to-use Carbon Monoxide (CO) sensor, suitable for sensing CO concentrations in the air. The MQ-7 can detect CO-gas concentrations anywhere from 20 to 2000ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The drive circuit is very simple; all you need to do is power the heater coil with 5V, add a load resistance, and connect the output to an ADC.

4) *BUTANE (MQ 6):* This is a simple-to-use Butane sensor, suitable for sensing LPG (composed of mostly propane and butane) concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm.This sensor has a high sensitivity and fast response time.

5) *PM 2.5 Dust Sensor:* PM2.5 laser dust sensor is a digital universal particle concentration sensor it can be used to obtain the number of suspended particulate matter in a unit volume of air within 0.3 to 10 microns, namely the concentration of particulate matter, and output with digital interface, also can output quality data of per particle.

C. Atmega 328

Atmega328 has 28 pins in total. It has 3 Ports in total which are named as Port B, Port C and Port D. Port C is an analogue Port and it has six pins in total. So, in simple words, ATmega328 has 6 analogue pins. Port B and Port D are digital ports and have 7 pins each. So, in total ATmega328 has 14 digital pins.

D. ESP8266 Wi Fi Module

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability. It is mostly used for development of IoT (Internet of Things) embedded applications. To communicate with the ESP8266 module, microcontroller needs to use set of AT commands.

E. Web Application Development

Web Application is Designed & Developed in HTML, CSS, AJAX, JQUERY & MySQLi

1) *Front End:* HTML & CSS

2) *Back End:* PHP & MySQLi

3) *Server:* Apache HTTP Server

The front end of the project looks like the figure shown below. The home page where current data is going to be observed is also shown below.
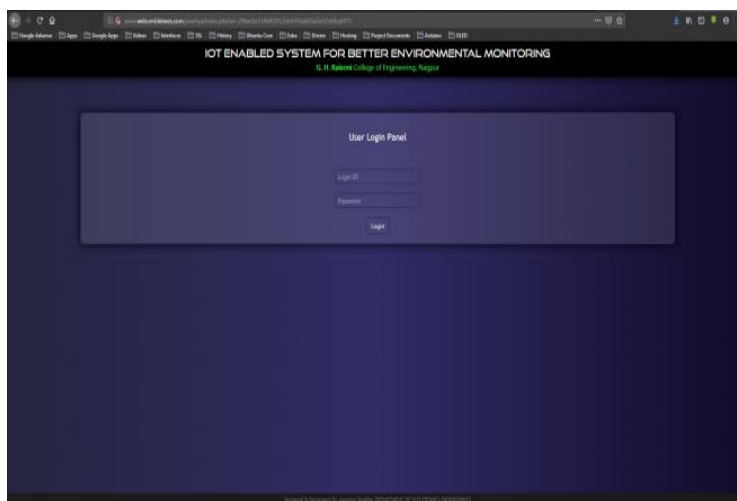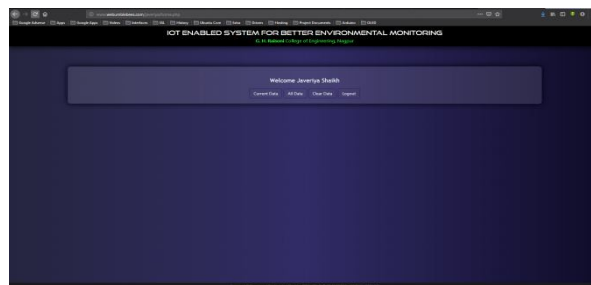

Fig. Login page of the web application.

Fig. Home page where all the data is going to be stored.

III. RESULT

The result of the system is shown in the photos below.

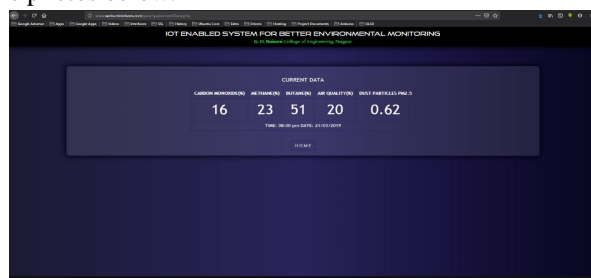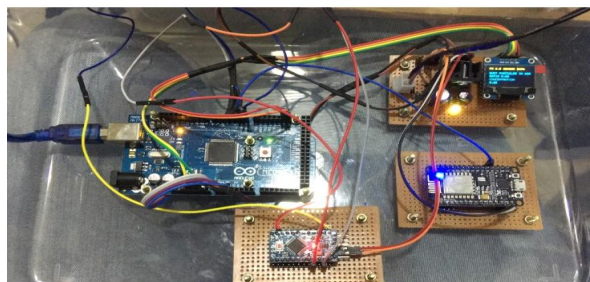Fig. Readings of the system

Fig. final project hardware

IV. CONCLUSION

We have setup a local server to demonstrate its working. To monitor the air quality from anywhere in the world, you need to know the login id and login passwords of the website. Since high security is given to it for the safety of the data recorded. After login all the incoming connections will be forwarded to this website and you can open below shown webpage by just entering the login id and passwords using your internet from anywhere. You can now access or use these data whenever necessary.

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