A Customizable Cartographic Air Pollution Monitoring System

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Abstract— Air pollution poses a serious challenge to the society and especially cities bear the burnt of excessive pollution. The entire ecosystem gets degraded due to the adverse effects of a polluted atmosphere. Many cities face air quality issues that do not meet environmental requirements for good health. Air pollution measurement and predictive technology for smart cities should be built. This paper presents a real-time air pollution monitoring using wireless sensors. An Arduino based approach has been employed in this design. The presented system was designed to monitor and analyze the air quality in real time using sensors, collecting data from the sensors and with the help of data, pollution level can be detected in Parts per Million (PPM) metrics and uploading it in cloud.The pollutants like Carbon dioxide, Carbon monoxide, dust particles are monitored and measured. This project also includes creating an application which is similar to Google map and uploading the collected data in that application and it can be accessed from anywhere and at any time to know the pollution level in an area.

Index Terms— Air Pollution, IoT, Arduino, Air Quality.

I. INTRODUCTION

Pollution refers to any substance which has a negative impact on the environment in which we live or organisms which live. In other words, pollution can be defined as undesirable substances or contaminant into environment which cause disturbance or adverse effect to ecosystem and living organisms. Pollution can be in the form of any chemical substances, energy such as noise, heat or light. Pollutant is a substance that pollutes something such as air, water, etc. It can be foreign substances or naturally occurring substances. Pollution can be broadly categorized into air pollution, water pollution, noise pollution, soil pollution, light pollution. This project deals with air pollution and monitoring the pollution level in the atmosphere. Air pollution means the presence of undesirable substances or chemicals compounds in the air, which lower the quality of the air or cause detrimental changes to the quality of life. Air is the most useful thing for each and every living thing. Not a single living thing can survive without air.Research on this serious issue is to estimate the quality of air for people and any other living thing which exist on earth. Very important to know for our living is that how much safe we are now and how the weather and climate has changed for air pollution and it will sustain sound. This project will ease to know the answers for air quality. Previously some researchers have done some experiments on air pollution monitoring system. As we are moving forward to smart system day by day so according to the fact the objective for making this project is to take the environmental pollution and analyze it using smart technologies

2 LITRERATURE SURVEY

Sami Kaivonen, et.al.,[1] proposed an experimental study based on Green IoT for monitoring of air pollution in real time by employing wireless sensor nodes atop public transportation buses. Libelium Waspmate plug sensor model called Smart Environment Pro is used on the city buses. The data from sensors is reported to Green IoT cloud via mobile network through HTTP interface. Smart Environment Pro supports the 4G data connection with GPS location tracking. The obtained sensor data is visualized by implementing via web programming on google maps to show the location and measured values. The CO sensor probe performed as expected, but the nitrogen dioxide sensor had low success rate in measuring non-zero concentration, which is due to its low sensitivity.

Simon Brienza, Andrea Galli, Giuseppe Anastasi, Paolo Bruschi, [11] designed a system suitable for monitoring air quality in urban areas. The proposed system is of low cost and makes use of cooperative sensing. A uSense low cost monitoring tool is used to know in real-time, the concentrations of polluting gases in city. uSense consists of O3, CO and NO2 sensors that can be privately installed by citizens. The obtained data are sent to uSense database via internet and it is made available to all the uSense users. It has been tested in three cities and the results obtained are not exact but a way closer to the original standard values.

Snehal V et.al.,[12] proposed on GSM based Remote Industrial Pollution Monitoring and Control System. It is designed with two sensors LM35 and MQ135 interfaced at port A on PIC and LCD panel connected on port B and GSM module on port C. The sensors at port A keep providing information of gases and display the results in three ways. In first process the message is displayed on LCD and it show the sensor readings. In second, if the user is requested then message is sent to that number and the LCD shows “sending message”. In third process, when the parameters cross danger levels message are trigged and user is noted.

Ch.V Sai Kumar proposed on IOT based Air quality monitoring system. The conceptual model consists of CO and NO2 sensors mounted on masses and an IOT (Internet of Things) system. There is a dominant server to support incident management in the short-range real-time and ongoing deliberate planning. Here the Arduino platform is used for fast and easy communication of the sensor values. WSN (Wireless Network of Sensors) acts as the Trans receiver and provides a low rate monitoring system in real time over the use of low rate, low information rate and low control of wireless communication technology. Different applications can transfer or share the projected surveillance system and through IOT we can visualize the global values. Shilpa R.Khodve, A.N. Kulkarni, [16] proposed a web based air pollution monitoring system with ARM7 LPC2138, as the heart of the system. The designed system monitors CO, NO, temperature and dust. All the

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parameters of these sensors are displayed on the LCD. Bluetooth based transfer of data to a mobile unit is made possible and a web page creates an interface for accessing contents from anywhere. Then values are displayed on mobile window as well as worldwide mobile so that PC Data will be viewed by everyone throughout the world. This system will have one more facility as all the values are sent by microcontroller to the Mobile. Mobile application will note down the coordinates of the area with sensor values stored in the form of database and person will be able to view the air pollution area wise due to the GPS facility. Another feature is that it will show all values of the sensor on the monitor window and compare it with threshold value of the air pollution; if any value is above the threshold value then system will send the message to the administrative part or the engineer.

3 PROPOSED SYSTEM

The block of the proposed design is presented in Fig. 1. The device will be set in the environment and data will be collected from sensors based on the concentration of air pollutants like carbon-dioxide, carbon-monoxide, and dust particles. Depending on the values collected, it will show the output.

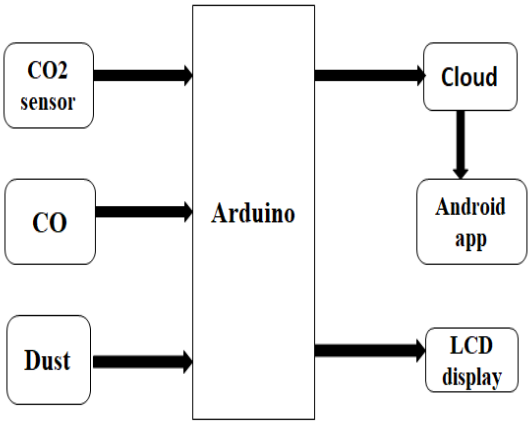

Fig. 1. Block Diagram

3.1 Arduino UNO:

It is a controller board. It is an open source available freely on the internet. This is based on ATmega328P microcontroller. It has both input and output digital and analog pin. It has 6 analog I/O pin and 14 digital I/O pins and is also programmable with Arduino IDE. It has 16 MHz quartz crystal, a power jack, a reset button and an ICSP header. Its power supply is given by USB cable and 9 volt battery, as it can accept 7 to 20 V. The word 'UNO' is nothing but the 'first' in Italian language. This board can read inputs like a finger on a button, a twitter message or light on a sensor and it give the output to publishing something on online, turning an LED and for activating a motor. The languages used in Arduino are C/C++ functions that can be called from your code.

3.2 Carbon Monoxide Sensor

MQ-7 is a carbon monoxide (CO) sensor, used to detect concentrations of carbon monoxide (PPM) in the air. The MQ-7 sensor can measure the CO concentration between 20 and 2000ppm.

3.3 Dust Sensor

The Sharp GP2Y1010AU0F is used to detect fine particle larger than 0.8µm in diameter, even like the cigarette smoke. It has very low power consumption, analog voltage output, the output level is linear with dust density and has an embedded voltage boost circuit to support wide range of power supply.

3.4 Carbon Dioxide Sensor

This sensor is suitable for detecting ammonia (NH3), nitrogen oxides (NOx) benzene, smoke, CO2 and other harmful or poisonous gases that impact air quality. This sensor unit has a sensor layer made of tin dioxide (SnO2), an inorganic compound which has lower conductivity in clean air than when polluting gases are present. To calibrate Air quality, use the on-board potentiometer to adjust the load resistance on the sensor circuit.

3.5 LCD

A flat-panel or other electronically modulated optical monitor with fluid crystal light modulation capabilities is a flat-panel display (LCD). Liquid crystals don't emit light directly; instead they produce color or monochrome images by using backlight or reflector. Natural images (as in the computer display for general purposes) or low-info set picture contents are displayed with LCDs.

4 RESULTS AND DISCUSSIONS

Fig. 2. shows the experimental setup of detecting the air pollutant and monitoring it in Liquid Crystal Display. The components used in this setup are Breadboard, Arduino, Carbon dioxide sensor, Carbon monoxide sensor and dust sensor.

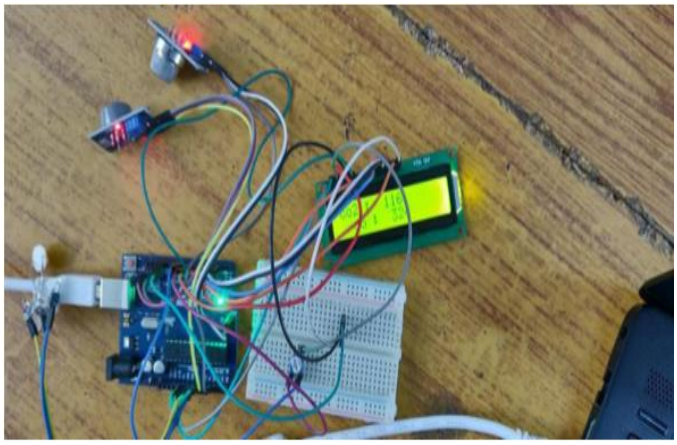

Fig. 2. Setup of the designed Pollution Monitor

Fig. 3. Pollutant level Indicator

Fig. 4. Dust Level Indicator

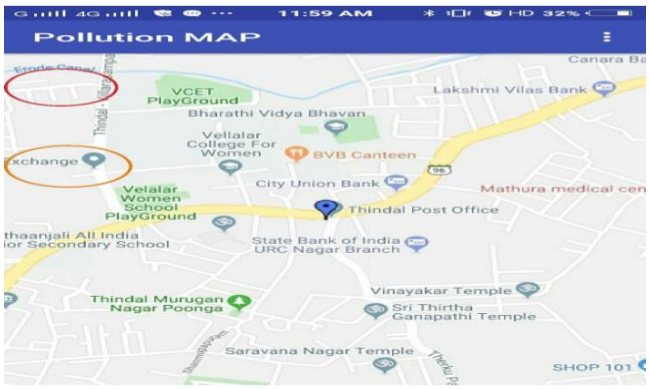

Fig. 5. Map representation of the polluted areas

Fig.5. indicates the pollution level in different colorings as red and orange colors. If there is no pollution or less amount of pollution it is not indicated in form of ring. Red color indicates very high pollution level and orange color indicates medium level pollution.

5 Conclusion

The smart way to monitor environment and air is done in low cost effectively presented in this paper. In proposed system the functions of every components and overall performance were discussed. The air pollution monitoring system was able to monitor the gas levels on different area. Our project device showed that it is effective and cheap and with some highly working sensors it can really be a reliable one to everybody and its data's will be a key to take some necessary steps for the betterment of the society as it will help to identify the affected area so that we can take early steps to reduce damages for the next generation. This system can be made more effective by upgrading its few features. The device can be updated with additional sensors that can sense data from the existence of other gases such as Nitrogen dioxide and Sulphur dioxide. These gases will provide the condition of the atmosphere and able to take further decisions accordingly. The sensors that we have been worked with can also be reset according to recent time update. In future output can be displayed in a webpage or in the form of pie chart, table, etc.

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