Analysis of Air Pollution by Using Sensor at KCT Campus

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Abstract

Air pollution due to various emissions are the fatal threat to the world. Poor air quality poses a significant risk to vulnerable section of the society such as children, asthmatic, pregnant women, and the elderly persons. It requires a rapid monitoring system to take effective Swift action. To monitor air pollution the easiest and fastest way is equipments based on sensors. In India the sensor based equipments are in growing stage and there are very few sensors available and are expensive. In this project, the sensors are used for the air pollution monitoring which will be a handy equipment. The sensor for PM 10 and temperature, humidity, wind speed, wind direction are assembled, calibrated and monitored. A SD card is attached to that sensors so that the data is fetched by SD card reader through laptops or computers. The air pollution at KCT campus is been monitored by the Respirable dust sampler equipment (for PM 10) and the sensor based equipment simultaneously. The data from both the equipments are taken and compared. From the data obtained it is concluded that the sensors gives the accurate values. Hence the sensors can be used for the air pollution monitoring which can be taken to any place easily.

Key words: sensor, Respirable dust sampler, air pollution

I. INTRODUCTION:

The globe is in grave danger from air pollution brought on by numerous sources. Those who are more susceptible to risks from poor air quality include children, people with asthma, pregnant women, and the elderly. When people breathe in air pollutants, they can enter our bloodstream and cause or aggravate a variety of respiratory and lung disorders that can result in hospitalisation, cancer, or even premature death. They can also cause or worsen itchy eyes and coughing.

The World Health Organization (WHO) estimates that air pollution causes 7 million fatalities annually, of which 4.2 million are directly related to outdoor air pollution. Quick action needs to be taken quickly, which calls for a air pollution monitoring system.

To monitor air pollution, the equipments which are available so far are expensive, heavy to handle and transport. The availability of air pollution monitoring systems are very few in India. Equipment based on sensors is the quickest and easiest way of approach to detect air pollution.

II. LITERATURE REVIEW:

The air pollution monitoring systems are insufficient in India. The available equipments for air pollution monitoring are heavy to carry and difficult to transport from one place to another. The sensor based equipments are easy to carry and travel.

From the literatures, there are many sensors like MQ135, MQ6, MQ7, DHT22, DHT11, DSM501A, SHT, SDS021, Raspberry Pi, etc. which can be used to monitor air pollution very easily. Most of the research works are based on low cost sensors. The development of internet of things is combined with the idea of using sensor for monitoring air pollution.

III. METHODOLOGY:

The primary aim of this work is to make the air pollution monitoring to the easiest and fastest way. So to make it easy I have choosen the sensor to monitor the air pollution. For this I have selected the best sensors with more sensitivity and modified to assemble it. After that the manual equipment ie., respirable dust sampler is used to measure the parameter PM 10 and the assembled sensors are taken. Both the equipments are placed in the selected 10 locations at KCT campus and monitored for 24 hours simultaneously. The data obtained are

calibrated and both the data are compared to check the sensor's workability.

IV. SYSTEM SETUP:

A.REQUIREMENTS:

- Arduino uno
- Bread board
- Jumper wires
- LCD display
- SD card
- MQ 135 sensor (for PM 10)
- DHT11 sensor (for humidity and temperature)
- USB data cable

B.LCD DISPLAY CONNECTION:

- LCD GNO pin to Arduino GND pin
- LCD VCC pin to Arduino 5V pin
- LCD SCL pin to Arduino L2C cloud pin
- LCD SQA pin to Arduino L2C data pin

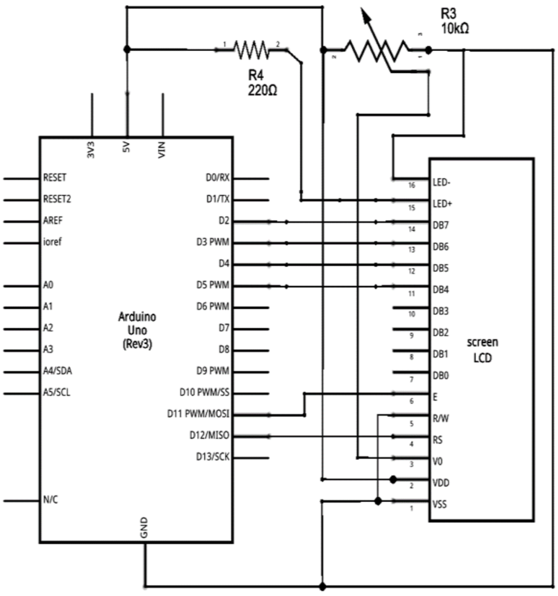

Fig. 1. Connection of LCD display

C.MQ135 SENSOR CONNECTION:

- MQ135 VCC pin to Arduino 5V pin
- MQ135 GND pin to Arduino GND pin
- MQ135 AO pin to Arduino AO pin
- MQ135 DO pin to Arduino DO pin

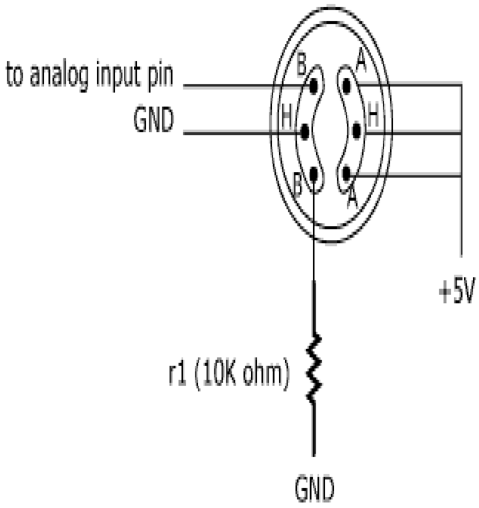

Fig. 2. Connection of MQ 135 sensor

D.DTH11 SENSOR CONNECTION:

- DTH G pin to Arduino GND pin
- DTH V pin to Arduino 5V pin
- DTH D pin to Arduino D8 pin

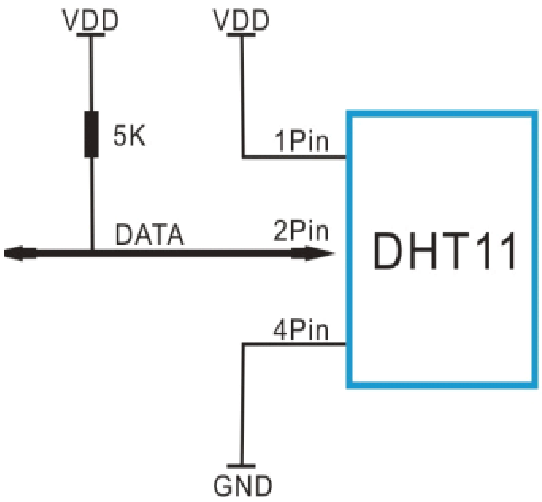

Fig. 3. Connection of DHT11 sensor

E.DATA LOGGEN:

- DL GND pin to Arduino GND pin
- DL VCC pin to Arduino 5V pin
- DL MISO pin to Arduino 12 pin
- DL MOSI pin to Arduino 11 pin
- DL SCK pin to Arduino 13 pin
- DL SS pin to Arduino 10 pin

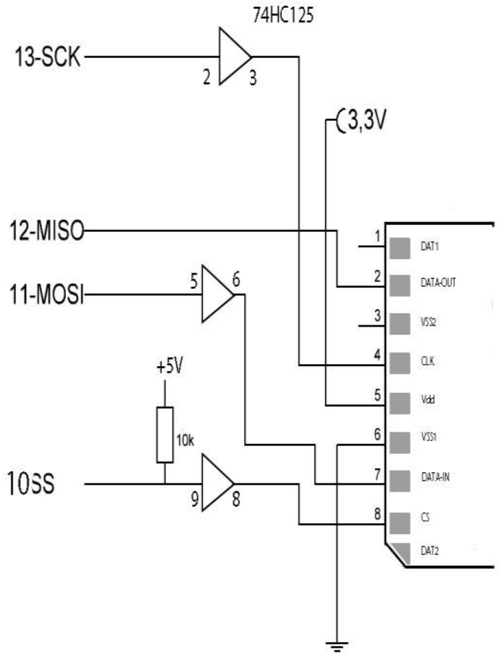

Fig. 4. Connection of data loggen

F.ASSEMBLED SENSOR:

The sensors which are choosen for this project are MQ 135 and DHT11 sensors. MQ 135 is a gas sensor which can detect Ammonia, benzene, sulphur, carbon dioxide and other harmful gases and smoke. To modify this MQ 135 sensor to measure PM 10 parameter a coding is used and modified. All the components which are required to make a hand held equipment is been kept ready and they are connected and assembled as shown in the fig. 5.

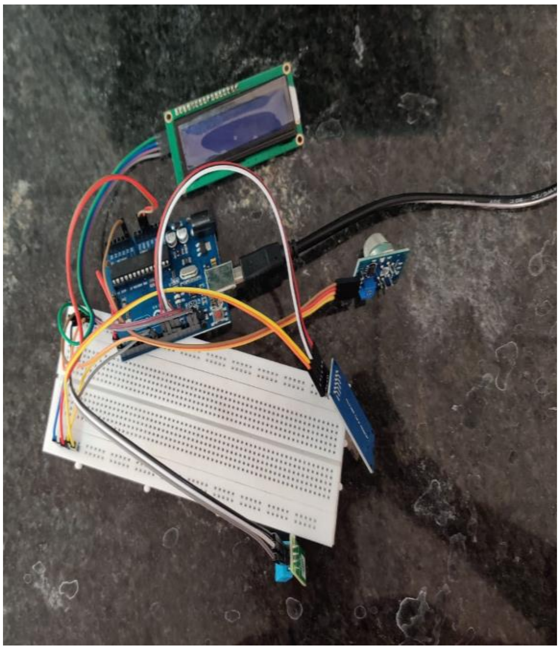

Fig. 5. Assembled sensors

G.WORKING OF SENSOR DEVICE

The sensors MQ 135 and DHT11, SD card and LCD display are connected to Arduino uno using jumper wires via bread board. A coding is used to merge all the components value to display in LCD screen. After the start of the device it takes delay time of 2 seconds and displays Temperature, humidity, PM 10 in LCD screen. The device which detects the air pollution data is stored in the SD card while monitoring. The SD card is detached after the monitoring and it is pluged into the card reader which can be used in computers and laptops. The data from the sensor is taken and calibrated. This gives the accurate PM 10 data and temperature, humidity.

V. DATA COLLECTION:

A 10 point location is identified at KCT campus where the equipments can be placed easily with a current supply. The locations are front gate parking, Bus parking, Girls hostel, back gate parking, civil department, transportation office, ahimsa vanam, resource recovery park, KVB bank and admin block. Air pollution at KCT campus is been monitored in 10 selected places using respirable dust sampler and the assembled sensors simultaneously for 24 hrs to measure PM 10 pollutant. The humidity and temperature data is taken from the sensor which is assembled. The wind speed and wind direction are the secondary data as shown in the Table 1. PM 10 pollutant is the only parameter which is compared between the respirable dust sampler's data and the sensor's data as shown in the Table 2.

VI. RESULTS:

The data obtained from the monitoring at 10 locations at KCT campus is been compared between the two equipments ie., respirable dust sampler and the assembled sensors. The error is been found out by comparing the data. The data is also compared to National Ambient Air Quality Standards (NAAQS) to check the air quality of the monitored data. The error of the equipment is shown in the fig. 6.

DATA		PRIMARY DATA				SECONDARY DATA	
DATE	**LOCATION**	**PM 10 Sensor (µg/m³)**	**PM 10 Manual equipment (µg/m³)**	**HUMIDITY (%)**	**TEMPERATURE (degree celcius)**	**WIND SPEED (km/h)**	**WIND DIRECTION**
14.02.2023	Front gate parking	275.22	273.61	31	30	11	NE to SW
15.02.2023	Bus parking	85.62	87	32	30	11	SE to NW
16.02.2023	Girls hostel	36.28	35.35	36	29	17	NE to SW
17.02.2023	Back gate parking	75	74.75	49	28	15	NE to SW
18.02.2023	Civil Department	31.51	32.68	47	29	15	NE to SW
20.02.2023	Transportation office	55.63	55.32	52	28	15	NE to SW
21.02.2023	Ahimsa vanam	34	35	49	29	9	E to W
22.02.2023	Resource recovery park	246	245.25	41	30	15	E to W
23.02.2023	KVB bank	47.56	48.23	27	31	11	E to W
24.02.2023	Admin block	191	190.53	33	29	17	NE to SW

Table 1. air pollution monitoring data

LOCATION	PM 10 sensor (µg/m³)	PM 10 manual equipment (µg/m³)	Error	PM 10 standard (µg/m³)	Air quality
Front gate parking	275.22	273.61	1.61	60	Higher
Bus parking	85.62	87	1.38	60	Higher
Girls hostel	36.28	35.35	0.93	60	Good
Back gate parking	75	74.75	0.25	60	Higher
Civil department	31.51	32.68	1.17	60	Good
Transportation office	55.63	55.32	0.31	60	Good
Ahimsa vanam	34	35	1	60	Good
Resource recovery park	246	245.25	0.75	60	Higher
KVB bank	47.56	48.23	0.67	60	Good
Admin block	191	190.53	0.47	60	Higher

Table 2. compared data

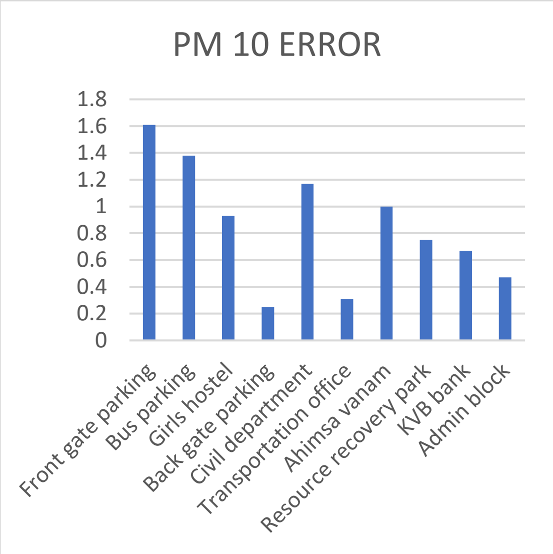

Fig. 6. PM 10 error graph

VII. CONCLUSION:

The sensors are choosen according to the availability in Coimbatore city. MQ 135 sensor and DHT11 sensor are used to measure PM 10 and temperature, humidity respectively. MQ 135 sensor is a gas sensor which is modified to measure PM 10. The sensors are connected to Arduino uno. SD card is also connected to Arduino uno to fetch the data through SD card via computers and laptops. LCD display is connected to Arduino uno to show the readings lively in the LCD screen. To merge all the components a coding is used and assembled.

Air pollution monitoring has been done at KCT campus in 10 locations with duration of 24 hours. Monitoring is done by respirable dust sampler to measure PM 10 and the sensor equipment which measures PM 10, temperature and humidity simultaneously which are taken as primary data. Wind speed, wind direction is taken as secondary data. The obtained data is slightly higher in some places according to National Ambient Air Quality Standards (NAAQS). Comparing PM 10 concentration from respirable dust sampler and the sensor equipment has an error of + or - 2 $\mu g/m^3$. Hence the sensor based equipment works accurately and it can be used to measure the air pollution very easily and fastly. This equipment is handy so it can be carried out to any place at any time without any hurdles.

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