Internet of Things Implementation of Air Pollution Monitoring

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Abstract : Air pollution has reached to a level where it cannot be ignored and is increasing with every passing day. Air pollution is the direct effect of industrialization , vehicular transport and urbanization. This has led to increased occurrence of respiration related diseases and has severely affected the quality of life people are living.In the recent times lots of technological advances have taken place which have helped in the development of wireless sensor nodes at a very nominal price and has allowed researchers to experiment with the wireless sensor nodes. With the advent of Internet of Things it has been possible to arm the wireless sensor node with the capability to forward the data recorded by it to the web server or android application or a cloud. In this work we are utilizing IoT to forward the data on a web server.We have developed a prototype which is capable of monitoring P.M.10, SO2 , NO2 along with temperature and humidity and is able to forwarded the recorded values on to a web server .Thus we are able to monitor the the status of sensors as well as the AQI from the web server from anywhere using a mobile or a computer.

IndexTerms **- Internet of things, air pollution, sensors, monitoring system, arduino**

I. INTRODUCTION

Air is one of the most essential ingredient and of late it has caught the eye of everybody due to pollution . A few years back it was a non existing topic but has gained prominence. Air pollution has resulted in detrimental effect on the health and productivity of we humans . With every passing day the level is rising like any thing and with rise in the use of air conditioners, refregirators and excessive and unplanned industrialization things have moved to a worst. With progress in technology the air pollution monitoring system which were very costly have now turned out to be cheap and easily available. Of late the wireless sensor nodes have become quite popular for remote monitoring but a lot is still to be done. Recently, Wireless Sensor Networks (WSNs) have attained an excessive popularity for applicability in the arenas of monitoring, observation, information gathering, and medical telemetry. This potential can be attributed to their attractive characteristics like perform self configuration, remote monitoring and its adaptability to mobility.WSNs have not been exploited to hilt. IoT adds wings to the WSNs by allowing the WSNs to forward the data effectively and effortlessly on to the cloud ,a web server or an android application. Once the data is available on the web server or cloud it is very easy for the stake holders to view the data and and take corrective actions as and when required. .

II. EXISTING SYSTEMS

The researchers in this field have proposed various air quality monitoring systems based on Wireless Sensor Network , GSM and GIS. Each domain as its on advantages and disadvantages. Zigbee allows wireless transmission but with a limited range. GIS based system pinpoint the air pollution of specific areas but the latitude and longitude does not change for around 111 kilometers so does not pinpoints the exact location.GSM based systems have been able to provide the information to the users on the SMS which though very useful still appears very plain to the users in the age of the smart phone. So a wireless sensor network incombination with a cloud or a webserver or an android application give just what the present day user hopes for and is comfortable with.

III. NEED OF THE CONCEPT

Air pollution is here to stay. Though much cannot be done to prevent but a lot can be done to exempt oneself for its harmful effect .With people loving to have everything at their smart phone this concept serves them just the same . In this work we have develop an air pollution monitoring system which is capable to sense the level of NO2 , SO2, P.M. 10 ,temperature and humidity. The system is able to forward the values on to the cloud . Once the values are available on the cloud the user is in a position to view the data and is able to get an idea of the air quality prevailing and can take necessary actions to prevent himself from getting exposed to the dangerous gases. The sensors interact with arduino uno which processes this data and transmits it over the application. This allows authorities to monitor air pollution in different areas and act against it.

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines,objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human- to-computer interaction.

IV. AIR QUALITY PARAMETERS

The important parameters that are considered in the proposed framework include:

- Sulphur Dioxide (SO2) - Sulphur Dioxide is a colorless gas, having a distinct odour and taste. Major source of SO2 is the burning of conventional fuels and various industrial processes. Its high concentration leads to respiratory problem and becomes very critical for people suffering from asthma .
- Nitrogen Dioxide (NO2) – Nitrogen Dioxide is a brownish gas, having a very peculiar odour and is very corrosive and highly oxidant. It is produced as the result of fossil fuels burning. Nitrogen Oxide converts to NO2 and leads to respiratory problems and also contributes to acid rains.

- P.M. 10 Components of particulate matter (PM) include finely divided solids or liquids such as dust, fly ash, soot, smoke, aerosols, fumes, mists and condensing vapors that can be suspended in the air for extended periods of time. Particles originate from a variety of stationary and mobile sources and may be directly emitted (primary emissions) or formed in the atmosphere (secondary emissions) by transformation of gaseous emissions.

  Primary PM sources are derived from both human and natural activities. A significant portion of PM sources is generated from a variety of human (anthropogenic) activity. These types of activities include agricultural operations, industrial processes, combustion of wood and fossil fuels, construction and demolition activities, and entrainment of road dust into the air. Natural (nonanthropogenic or biogenic) sources also contribute to the overall PM problem. These include windblown dust and wildfires.

  Secondary PM sources directly emit air contaminants into the atmosphere that form or help form PM. Hence, these pollutants are considered precursors to PM formation. These secondary pollutants include SOx, NOx, VOCs, and ammonia. Control measures that reduce PM precursor emissions tend to have a beneficial impact on ambient PM levels.Pm10 along with any two sensor values are necessary to calculate the Air Quality Index.

  Temperature and humidity- Temperature and humidity gives an idea of general climatic condition . Information about the temperature and humidity gives helps in setting up of a complete air pollution monitoring system.

V. DESIGN OF SYSTEM

The different components of the equipment along with their intended purpose are discussed below:

The system design consists of two parts: part (1) is the hardware design and part (2) is the software design.

▪Part (1): The hardware Design

The hardware design of this study is as mentioned in the three blocks

(Input, Central process, Output):

▪**Input**

- Mq5 gas sensor (SO2)

- Mq5 gas sensor (NO2)

- DHT11 temperature and humidity sensor.

- Dust Sensor(P.M. 10)

▪**Process**

- Arduino Uno board: The Arduino is an open source electronics platform based on easy to-use hardware and software. It serves as the brain of the system which accepts the data from the sensors and forwards it to the cloud.

▪**Output**

- Values of sensor forwarded to the cloud
- Display of AQI

Part 2 The Software design

The software design part consists of using the Arduino IDE (integrated development environment) to program the Arduino board. It contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them. Programs written using Arduino Software(IDE).

The other software here is the Cloud dashboard, which serves as the IoT platform that allows you to upload your IoT projects data and create your cloud monitor.

IV. RESULTS AND DISCUSSION

We have developed a prototype which is capable of monitoring P.M.10, SO2 , NO2 along with temperature and humidity and is able to forwarded the recorded values on to a web server .Thus we are able to monitor the status of sensors as well as the AQI from the web server from anywhere using a mobile or a computer.

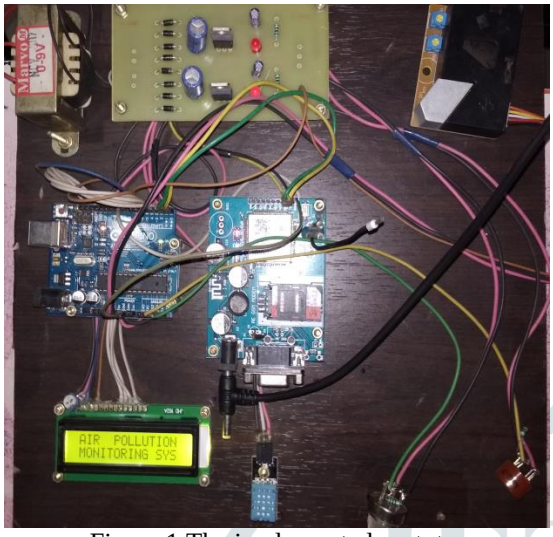

Figure 1 The implemented prototype

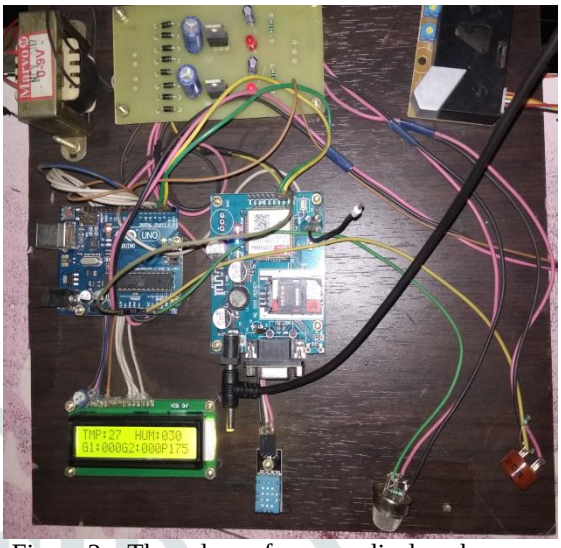

Figure 2 The values of sensors displayed on the LCD screen

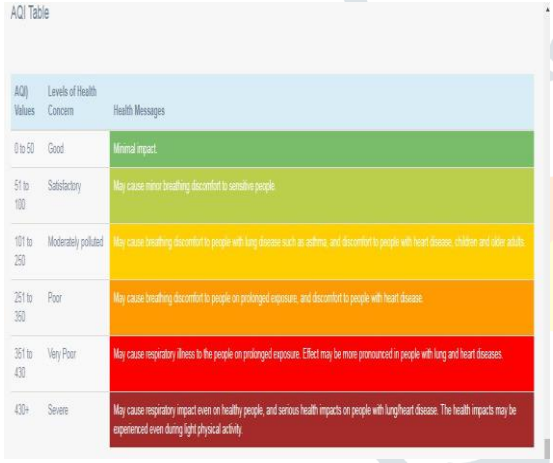

Figure 2 The AQI Table

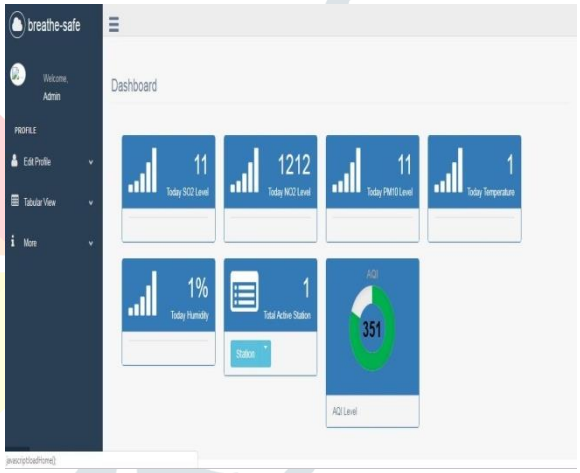

Figure 3 The Dashboard of Cloud

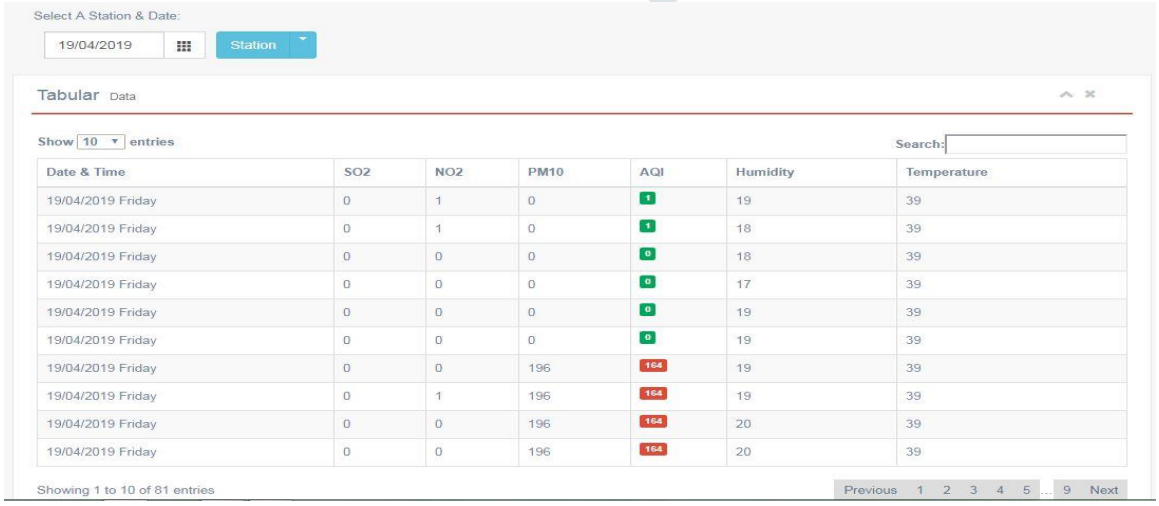

Figure 4 The data of sensors displayed on the cloud in Tabular format

VI. CONCLUSION

We conclude that we have been able to implement a prototype Wireless Sensor Network (WSN)-based air quality monitoring system using IoT.The cloud acts as a central server and the sensors interfaced to arduino together works as a wireless sensors. This system is very simple as compared to the existing air quality monitoring systems. The data on cloud gives the convenience to the user to view the data on his pc or smart phone any time . As the data is always available to the user he is in a better position to limit his exposure to the pollution. In future, this prototype can be extended in real time implementations of urban cities. We can also try to add the capability of prediction to the implemented prototype .

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