Air Quality Monitoring System using Raspberry Pi and Web Socket

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ABSTRACT
Air quality nowadays has been degraded to a large extent that it has become a necessary criteria for us to monitor its quality. The quality of air has been affected by various factors like industrial emission, vehicular transmission etc. The evolution of various technology like the Internet of Things, Raspberry Pi, it has become easier for us to deploy sensors and allow to detect the quality of air in real time. The Internet Of things is a term for various devices communicating with each other which was not possible before since the different devices use different kind of data which has been overcome by the use of single board computer (Raspberry Pi). Integration of IOT with Sensor nodes with the help of Raspberry Pi for Air Quality Monitoring provides an effective way than the approaches that were previously used. Sensor web node is proposed with commercial gas sensors for detecting the gases like CO, CO2 etc to monitor both indoor and outdoor air quality. The results obtained through these sensors are then evaluated by Ruby on Rails Server through web socket.

Keywords
Raspberry Pi, Arduino Mega, Web Socket, Sensors, IOT

1. INTRODUCTION
The air we inhale straightforwardly impacts our wellbeing, thus keeping up an ideal nature of air is significant to sustenance. Air contamination is a genuine worry, with a plenty of sources. From indoor air contamination to mechanical and vehicular discharges, all of which are adverse to our wellbeing. Confirmations indicate how drawn out introduction of kids to indoor contaminations corrupt youngster development [1]. Indoor air contamination is likewise a noteworthy supporter of the national weight of ailment in India [2]. The different wellsprings of indoor air contamination incorporate consuming of stoves, incense sticks and so on. Additionally, the fundamental contributing sources to open air contamination may incorporate vehicle fumes exhaust, flames, and gas controlled motors. The significant air toxins constitute ozone, particulate matter, nitrogen dioxide (NO2), and also sulfur dioxide (SO2), and carbon monoxide (CO). Out of these toxins, carbon monoxide harming is an intense and deadly harming in numerous nations. From the previously mentioned sources deficient burning of powers is the fundamental wellspring of carbon monoxide, certain sort of paints additionally creates CO. The principle focuses of CO are iron or copper containing destinations, for us human the red blood cells.[3] Carbon monoxide responds with hemoglobin show in cells to frame a particle which can't convey oxygen to different parts of the body, consequently prompting cerebral pain, wooziness and so forth. A legitimate comprehension of the sources and extent of air poisons is important in creating techniques to control air contamination. This can be accomplished by creating exact observing techniques. Such exact checking concentrates the convergences of toxins in different parts of a land territory. It likewise gives us the reliance of these toxins on different ecological components, for example, temperature, moistness and different contaminations. Another critical normal for such a framework would be movability. There is an expansion in modernity of measuring gadgets utilized today, despite the fact that this acquires a larger amount of detail these gadgets have a tendency to be massive in size. These confines the scope zone as few of these futures introduced in a specific city and furthermore growing the range would require more stations, talented laborers and higher upkeep. Contamination checking ought not be the sole obligation of the administration and frameworks ought to be accessible to make subjects mindful of the contamination content in the territory and find a way to lessen the contamination. This is the point of our venture. This paper shows a model to accomplish precise checking, which would be possible, versatile and give remote access to detected information and continuous information.

2. RELATED WORK
In [7], the author explains the pervasive monitoring of the air quality in the atmosphere. The system comprises of various components such as sensors Raspberry Pi and python programming to send read the data and display the data on to a terminal.

In [6], the author uses the analog to digital converter and sends the data from the sensor to the Raspberry Pi from the Raspberry Pi the data is sent to the Plotly website where the data is captured and appropriate graphs are drawn accordingly.

3. DESIGN
The major goal of our system is to read the data of polluting gases in the atmosphere real time. The system consists of various hardware as well as software infrastructure. The MQ sensors [1] that are attached to the system are responsible in reading the data. The MQ-7, MQ-2, MQ-135 are sensors that are responsible for reading the data. The data which is read by these sensors needs an interface so that they can be stored and displayed.

The Arduino Mega [2] is a device that can be used to interface these devices. The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (equipment serial ports), a 16 MHz gem oscillator, a USB association, a power jack, an ICSP header, and a reset catch. 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 Mega 2560 board is perfect with most shields intended for the Uno and the previous sheets Duemilanove or Diecimila. The Mega 2560 is an update to the Arduino Mega,

which it replaces. You can find here your board warranty informations. Once the devices are connected to the Arduino Mega, we can be able to read data from the devices.

The Raspberry Pi [3] is the next component in our system. The Raspberry Pi is a mini computer that was developed in the Raspberry Pi foundation in the United Kingdom that was introduced to teach basic computer science to students. Raspberry Pi has a quad core Cortex processor. Raspberry Pi 3 used in this paper features a Broadcom Videocore IV with 1 GB Ram and Ethernet and 802.11 wireless connectivity as well. Raspberry Pi includes various ports such as HDMI, 3.5mm audio-video jack 4 usb 2.0, Ethernet and Camera Serial Interface. The sensors are connected to the Arduino Mega and the Arduino Mega Plays an interface between the Sensors and Raspberry Pi. All these are on the hardware side of the system. Let's move on to the software side.

The concept of web socket [4] has been used in this paper. Web socket was introduced as a specification when HTML5 was developed. Its name was coined by two people Ian Hickson and Michael Carter in collaboration with IRC chat room. Later, Google Chrome 4 was the very first browser that included web socket enabled as default. It is a computer communication protocol which has a full duplex connection between the client and the host over a single TCP connection. HTTP is a protocol in which when a browser requests for a page, the server returns the page and connection is closed. The WebSocket protocol enables interaction between a browser and a web server with lower overheads, facilitating real-time data transfer from and to the server. This is made conceivable by giving an institutionalized path to the server to send substance to the program without being requested by the customer, and taking into consideration messages to be passed forward and backward while keeping the association open. Along these lines, a two-way (bi-directional) progressing discussion can occur between a program and the server. The communications are done over TCP port number 80 (or 443 in the case of TLS-encrypted connections), which is of benefit for those environments which block non-web Internet connections using a firewall. Comparable two-way program server correspondences have been accomplished in non-institutionalized ways utilizing stopgap advances, for example, Comet.

Ruby on Rails [5] is a server side web framework written in Ruby. Rails have a framework that includes a model, view and a controller. It provides a default access to a database, a web service and web pages. It uses JSON for data transfer and HTML, CSS, Javascript for display and user interfacing. It uses convention over configuration software engineering technique as well.

4. IMPLEMENTATION

The entire system is connected through various connectors. According to figure 1.1, the sensors are connected to the Arduino Mega which acts as the interface. The Arduino Mega needs a power source so that the sensors start working. The Raspberry Pi provides the power supply to the Arduino Mega as well as the sensors. The Raspberry Pi can be connected to the power supply either through a USB Cable or a charger. Once the power supply is given, the sensors start to detect data. The data detected by the sensors is sent to the Arduino Mega, when the sensor specific code is run on it. We can actually see the data coming through the serial monitor in the Arduino IDE. A UDP connection is created between the Arduino and Raspberry Pi through a Ruby Code which is run on the Raspberry Pi. Once the data reaches the Raspberry Pi, the only thing left out is to send the data to the web server hosted by Ruby on Rails. The Ruby on Rails framework implements Web Socket through Action Cable. Once this action cable is established, there will be full duplex communication channel between the web server and the Raspberry Pi. This channel exist until it is manually stopped, hence the real time data reading can be achieved.

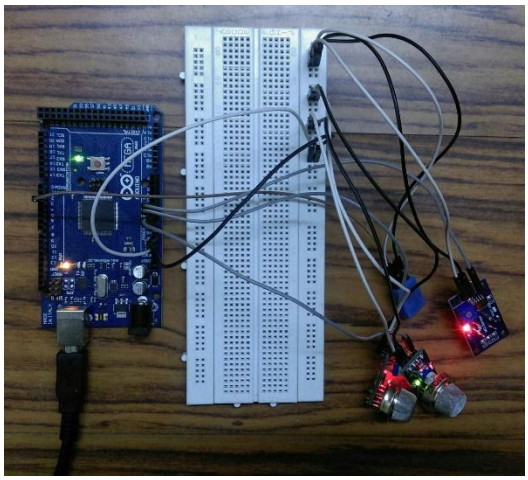

Figure 1.1

5. CHALLENGES FACED

1. Security

As millions of devices are connected together, security is one of the key features that need to be focused on. Since these sensors detect very sensitive information it is necessary for us protect that data that is in transit from the outside world. Major industries like defense, medical etc require security as the data can be extremely critical in nature.

2. Data

The effect of the IOT on capacity is two dimensional in sorts of information to be put away: individual information (buyer driven) and enormous information (undertaking driven). As of now being used in key verticals, for example, human services and monetary administrations, enormous information is changing how and why organizations gather and store information. IT administrators that are already tasked with keeping the storage centers running will also have to figure out how to store protect and make all the incoming data accessible. If, as Gartner, estimated, storage servers are only being used to between 30 and 50 percent of capacity, the physical capabilities are there. Managing them, however, is an entirely different problem.

3. Storage Management

However, even if the capacity is available now, there will be further demands made on storage and one that will have to be addressed as the need to access this information becomes more important. Businesses will have weighed up the economics of storage against the value of IoT information.

6. CONCLUSION

In this way our attempt of making a model for observing contamination, for the most part the measure of carbon monoxide, carbon dioxide, methane, smoke utilizing sensors MQ2, MQ7 and MQ135 individually alongside DHT sensor to gauge temperature and stickiness, progressively was executed. This model is stationary and can be deployed in different places. The sensor measurements of various gases, temperature and humidity are accurate.

The future enhancement to this model can be done by deploying the sensors to a movable object. As it is implemented in real time, these sensors can be deployed to a movable robot so that it

can move around detecting the various gases present in the surroundings. This model can be implemented near industrial areas so that it can detect the gases and if the gases exceed the standard limits of pollution, a website can be designed to inform the industrial agents to reduce the pollution. These sensors can also be implemented in drones which can move around and detect the polluting gases in the environment. Security measures can be enhanced to protect the data that is being sent through the components by introducing new protocols.

7. REFERENCES

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