Community-Friendly and Cost-Effective Monitoring Device for Environmental Pollution Using IoT

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Abstract. Air contamination is today the world's toughest problem for the environment and public health. Air contamination has a detrimental effect on the wellbeing of humans, the atmosphere and the biodiversity. Factory air pollution continues caused by leaked toxic gases, vehicle waste and increasing accumulation of unhealthy gases and particulate matter. Particular materials are among the principal parameters of elevated air emissions, including real-time air quality monitoring to be monitored and analysed to determine correctly in a prompt manner. A standalone air quality control system with many parameters in operation in real-time is introduced in this article: CO₂, temperature, humidity, air quality PM 2.5 and carbon monoxide. In reality, in every sector, the Internet of Things is commonly used and is also a key factor in air quality management. The Internet of Things Cloud Computing is a new way of improving the data processing of multiple sensors obtained and transmitted by the low-cost Raspberry pi ARM minicomputer.

Keywords: IoT, Raspberry pi, Air quality, Cloud computing, Environment safety.

1. Introduction

Accumulation of particulates, toxic chemicals and biochemical molecules in the earth's atmosphere causes air pollution. It affects the lives of individuals, animals and food. It can also influence the atmosphere and its building [1-2], which will lead to asthma, unhealthy conditions as respiratory disorders, respiratory diseases and death. The Greenpeace environment group reported on almost 1.2 million Indians die of airborne toxins every year in January. The particulate matter is a microscopical and suspended liquid or solid matter in the atmosphere of the earth. We are exposed to this particulate matter that impacts our heart and our lungs constantly. Until now, multiple surveys in the field of environmental monitoring using the IoT[3] have been carried out. However, particulate matter analysis has gained the least attention, as has researchers surveyed Ecological requirements such as temperature, plumbing, barometric air pressure, monoxides and dioxide of sulphur[4]. Monitoring of air quality is insufficient without understanding the particulate matter content in the environment. The
PM sensor is then used to track carbon monoxides, sugars, temperatures, humidity and barometric air pressure, and low strength, cheaper and very lightweight rubber pi sensors. The DSM501 A-System will therefore overcome this issue. It is a good interface framework for multiple devices simultaneously[5]. The Internet and cloud computing is the most up-to-date infrastructure. The Internet of Things is a philosophy or model where computers detect, recognise, perform, and interact without interference. The practice of cloud computing is to access distributed server services, including storage, virtual machinery, software and tools stored on the Internet, rather than to develop and manage in-house computing infrastructure[6]. As cloud computing converges on the Internet of Things becomes very strong. IoT’s cloud framework offers a view to connect, customise and run IoT services and functionality in the specified API. Data stored in the cloud will still be restored, and examples can be better analysed to any degree to monitor atmospheric emissions[7].

2. Literature Review
The air quality management system [8] is proposed by Kgoputjo et al. as per the IEEE/ISO/IEC standard 21451. The electrical sensors and infrared sensors were measured to concentrate CO, CO₂, SO₂ and NO₂. Reports on data servers are held. Intelligent sensors, objects, instruments and papers were studied on the Internet of Things. [9]. In different ways, the developers clarified the value and principles of IoT. The table illustrates the variations and similarities in IoT between clever objects and clever things.

In [10] uses a PIC18F87K2, Infrared with amperometric gas sensors to track parameters of the atmosphere. Sensor nodes are designed to map the earth in multiple positions. The findings can be seen on the city map. Baralis, Baralis. The commercial intelligence engine (APA) is given by Elena et al. [11]. The device has a structured structure to warn the public of several factors such as toxins, toxic gases, etc. Air emission analyses are performed using APA from various viewpoints such as meteorological data, emissions and traffic data. The device allows people to achieve an effect on air quality depletion.

[12] introduced a framework for tracking, predicting, and modifying urban environments' environmental parameters. After studying the local microclimate, the framework is applied to adapt an effective urban infrastructure.

[13] points out the town atmosphere surveillance system for device implantation, low-cost Raspberry pi. Measures for carbon monoxide, carbon dioxide, temperature and pressure control are carried out but do not focus on particulate matter.

A framework for water quality measuring and acquisition data acquisition and findings is presented on the IBM Watson IoT platform [14]. A solar charger unit installed on panels powers the device.

Data on air quality from South African cities [15]. The data were used for machine learning techniques, and models were developed for ozone prediction.

3. Proposed System
Fig.1 shows the simpler scheme of the current method. The key node of our system is the Raspberry pi. Sensors are regulated by different environmental parameters such as particulate matter, carbon monoxide, carbon dioxide, temperature, moisture and pressure. The sensors are linked with the Arduino board, and Raspberry Pi is connected with a USB cable to Arduino Uno. Due to its strong network connectivity, sensor data is continuously transmitted to the cloud via Raspberry pi via the Internet. For temperature, humidity and pressure measurements in sensors DSM501A, the digital output is used. In our environments DHT22 and BMP180 we have a PWM output for measuring particles, namely smoke and dust. Analogous measurement devices for carbon monoxide and carbon dioxide are used in the captures, MQ 9 (gas sensor) and MQ135 (air quality sensor). Arduino Uno is a low-cost ATMEGA-328P microprocessor board conveniently paired with a highly efficient ADC Raspberry Pi. Since Model B Raspberry pi 2 is not fitted with a Wi-Fi adaptor built into the unit. MQTT (Message Queuing Telemetry Transportation) lightweight protocol. In the production of
communication between sensor and user, MQTT plays an important role. The customer will access details with the user account from the dashboard, but the customer cannot alter it.

Figure 1. Design of the system

The device scheme was shown in fig. 1. It consists of sensing unit using some sensor modules then the processing unit which is a controller followed by ISP from where it is fed to cloud server and finally which can be accessed by the user.

4. Methodology
A very reliable, cost-effective and simple-to-use air quality sensor-based instrument - the DSM501A - is a PM sensor attached to the Arduino Digital Pin 5, DHT22, BMP1 80 the Arduino Pi3 Digital 4, and the Arduino Analog Pin 2 and Pin 3 analogue MQ135 and MQ9 interfaces. Applications: a USB cable connects Arduino to Raspberry Pi. The Raspberry Pi Adapter is fitted with Wi-Fi access and connects via USB port to the Raspberry pi. It must first upgrade its operating system by uploading the image from the official Raspberry pi webstore the.zip file must be uninstalled to import the.img file and enter the sd card's image. When Pi boots up, Node-RED starts to run with the "Sudosystemctl allow nodered.service." command automatically. A Blynk Account will be developed to use Blynk's cloud resources, and a computer should be registered at the same time. Only by providing the Auth token used to transfer data from the device into IoT is the Blynk IoT Platform able to identify a user when the device is registered. On the Arduino board are already the electrodes, and Raspberry Pi has the Arduino. The serial node is then connected to the IoT node via the serial node to gather data in a Raspberry pi. The data can only be accessed globally on the Blynk IOT dashboard while the device is linked to the Internet.

5. Results & Discussions
Figure 2. Setup of the system

Figure 2 shows the hardware setup of the pollution monitoring system developed using Arduino, Raspberry Pi, which is the full configuration of a sensor device, which is the module, which is used to extract the live information from an environment.

Figure 3. Parameter values in the dashboard

Figure 3 displays the shown criteria on the dashboard. The Dashboard presentation looks really attractive due to the various styles available on the Blynk platform. At the same time, we can view various parameters like CO, CO₂, temperature, Celsius, humidity, and atmosphere's pressure values.

6. Conclusion

The device proposed offers a low cost, low power, lightweight, and very exact monitoring system to monitor the atmosphere globally with dedicated sensors. A great balance is reached between accuracy and expense using the Raspberry Pi single-board minicomputer and suitable sensors that contribute to a well-backed setup. Blynk dashboard data sheets help define successful strategies to combat against growing emission levels to guarantee a safe climate. If emissions such as dioxide sulphur, nitrogen dioxide, ozone at ground level, etc., have also been tracked, the control method may be more useful. Moreover, it is possible to uncover long-term trends of emissions and find some connections between air contaminants.
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