Pollution Control Using Internet of Things (IoT)

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Abstract: The Internet of Things (IoT) can play a major role in controlling pollution by providing real-time monitoring and analysis of environmental conditions. IoT devices can be used to measure various pollutants in the air, water, and soil and send this data to a central database for analysis. This data can then be used to identify sources of pollution and implement control measures to reduce emissions. By leveraging IoT technology, it is possible to reduce the impact of pollution on the environment and improve overall sustainability. The IoT has the potential to revolutionize the way we monitor and control pollution. IoT devices such as sensors, cameras, and smart devices can collect and transmit real-time data on various environmental parameters such as air quality, water quality, and soil quality. This data can be analyzed and processed to identify the sources of pollution and help authorities take appropriate measures to mitigate it. One example of an IoT-based solution for pollution control is the deployment of sensors to monitor air quality in cities. The sensors can measure parameters such as particulate matter, nitrogen oxides, and ozone, and transmit the data to a central server. The server can then analyze the data and identify areas with high pollution levels, which can be addressed by implementing appropriate measures such as traffic management and the use of cleaner technologies. In addition, IoT can be used to monitor industrial processes and provide early warning to systems to prevent pollution incidents. In conclusion, IoT has the potential to play a significant role in the fight against pollution. With its ability to collect and transmit realtime data, IoT can help authorities identify sources of pollution and take appropriate measures to mitigate it.

Keywords: Air Pollution; Pollution Control; sensors; Noise Pollution Monitoring System

I. INTRODUCTION

Pollution is one of the biggest issues in our natural world. It occurs when air, water, and soil are mixed with impurities. W e must monitor the pollution level of the air, water, and other resources in order to protect our natural environment. We must purify the air, water, soil, etc., when pollution levels exceed safe limits. We all know that "prevention is better than cure," so we need to be on the lookout for signs of pollution before it reaches unsafe levels. We will demonstrate how to keep an eye on the pollution level in this paper. How to track noise pollution, water pollution, and air pollution will be the topic of our paper. This project will make use of a Raspberry Pi and a few sensors. We need to measure air pressure, temperature, ultra violet radiation, air quality, smoke, and airborne nitrogen dioxide and carbon monoxide for pollution control. To determine the degree of air pollution, we require the BMP085 pressure and temperature sensor, the UVI-01 ultra violet radiation sensor, the LDR light-dependent resistor, the TGS 2600 general air quality sensor, the MICS-2710 NO2 concentration sensor, and the MICS-5525 CO concentration sensor. We need to measure the pH, temperature, dissolved oxygen, hardness, ammonia, nitrite, and nitrate levels of the water in order to control water pollution. As a result, we require a pH sensor, a temperature sensor, a nitrate sensor, and a dissolved oxyg en sensor. We need to measure the decibel in order to reduce noise pollution. The normal human ear can hear sounds with a decibel level of 0 to about 140. We will measure the sound levels with a breakout microphone amplifier. A monitor will be connected to the raspberry pi. The instant results will be displayed on the monitor. An alarm will go off in the pollution control room if any of the results go above the safe limit. All of the data will be uploaded to the cloud every five minutes. The data will be analyzed by the pollution control room to change and remodel in order to come to a specific conclusion about a situation.

II. RELATED WORKS

An integrated Internet of Things (IoT) design that combines the capabilities of cloud computing and Service-Controlled Networking (SCN) is used in this cyber-physical area, where various kinds of sensors operate over wireless networks to gather information and provide services for monitoring pollution. The resulting community-driven huge knowledge platform makes it easier for environmental scientists to find, organize, and share data from a variety of sensors about the effects of pollution. The standard air automated observation system has a high exactitude according to empirical study, but its size and cost prevent it from being installed on a large scale. This method will reduce the hardware value to the same level as before by utilizing IoT. To establish a network of observation devices, the system is deployed across a wide range of observational spaces. By analyzing the data obtained by the front-end perception system, in addition to demonstrating the functions of an automatic pollution observation system, it also demonstrates the operation of predicting the development trend of pollution over a precise time range.

The World Health Organization recently stated that pollution-related health risks are increasing worldwide. According to July 2014 Public Facilities indoor air quality measurements, the majority of multi-use facilities were found to violate indoor pollution standards, by Seoul, 2011. The internet of things (IoT) has recently introduced challenges, despite the perceived benefits we tend to realize from these sensors. The measuring of indoor air quality by utilizing the atmosphere device, associating the measured knowledge to come up with a mechanism signal needed for ventilation, and improving indoor air quality by implementing an observation system with time measuring, autonomously managing the air quality in our lives so that it is. Finding a suitable infrastructure to capture and store a large amount of heterogeneous device knowledge, making sensible use of the collected device knowledge, and managing IoT communities in such a way that users can seamlessly search for, find, and utilize their device knowledge are some of these requirements.

III. AIR POLLUTION MONITORING SYSTEM

An air pollution monitoring system is a network of devices and equipment used to measure and monitor the levels of various pollutants in the air. The goal of such a system is to gather data on the presence and concentration of pollutants, such as particulate matter, nitrogen oxides, sulfur dioxide, ozone, and others, in order to understand the quality of the air we breathe and to identify sources of pollution. The data collected by air pollution monitoring systems can be used to inform public health policies, to evaluate the effectiveness of existing pollution control strategies, and to guide future efforts to reduce air pollution.

A. Wireless Sensor Model

The infrastructure of a wireless sensor network consists of components for computing, sensing, and communication. This gives the administrator control over the desired network parameters. Knowledge collection, monitoring, police work, and medical telemedicine are all common uses for WSN. It is also used to monitor and control parameters like water flow, temperature, humidity, and moisture in greenhouses and irrigation systems.

B. Sensors

Hardware devices known as sensors produce measurable responses to changes in the healthiness of pollution. An analog to digital device converts the analog signal sent by the sensors and sends it to the controller for any processing. There are many different kinds of detectors on which we can choose the appropriate and acceptable sensor.
On the applying.
Sensor 1 (CO detector): - The CO sensor senses the gas and communicates the info with the microcontroller.
Sensor 2 (N sensor): - The chemical element sensors sense the gas and communicate the info with the microcontroller.
Sensor 3 (smoke detector): - The smoke sensor senses the gas and communicates the info with the microcontroller.
Sensor 4 (temp detector): - The worker sensor senses the temperature and communicates the info with the microcontroller.

C. Bluetooth Module HC-06

In the planned system, we typically use a Bluetooth modem to transmit data to the lpc2138 mobile device. Serial communication (SPP - interface profile) is the purpose of these tiny Bluetooth TTL transceiver modules. It eliminates the need to connect a serial cable to your computer and enables the Target device to transmit or receive TTL information via Blueto oth technology. The modules that are factory-set to be Master or Slave Modules are those with the HC-06 computer code. The factory setting cannot be used to switch between master and slave modes. It's possible that HC-06 is a product designed for businesses.

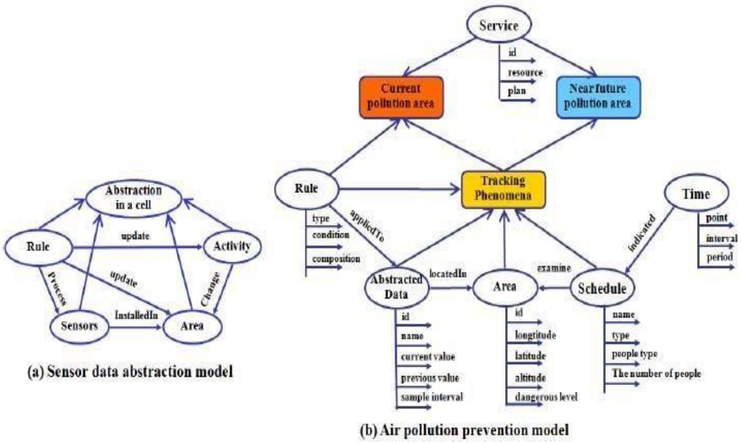

Fig 1- Context Model

D. Microcontroller unit

A microcontroller like the ARM (LPC2138) processes information, performs tasks, and manages practicality with various detector node components. Arm Processor: The microcontrollers based on ARM7 use a load-store, reduced instruction set architecture, have 32-bit registers, and the op-code length is stuck. There is a linear 4GB memory address area in the design. The ARM7 core is cost-effective, easy to use, and supports current object-oriented programming techniques.

E. World Positioning System

GPS receivers are utilized by both private individuals and businesses for navigation, positioning, surveying, locating, and time determination. Throughout the event of the GPS system: (a) it's to supply druggies with the eventuality of determinant time, speed and position whether or not in stir or at rest. (b) It ought to have continual, global, three-dimensional positioning capabilities with a high degree of delicacy, irrespective of the rainfall. The Global Positioning System (GPS) is an essential standard that is utilized for placement-aware knowledge work, pursuit, and navigation. Through UART, the board can be connected to a microcontroller. Knowledge such as the meridian and latitude of the planet where the vehicle is located is received. Connection options on the board that work with antennas Only 3.3V power supply will power it.

F. Digital display show

The simplest human-machine interface, Liquid Crystal Displays displays incredible visual data in the form of icons, symbols, numbers, alphabets, and characters. ODM's digital 16x2 display was used. The Mobile Data-Acquisition Unit (Mobile-DAQ) and the stuck web-enabled Pollution observation Server (Pollution server) make up this system. The Mobile-DAQ is a 32-bit singlechip microcontroller that uses analog ports to integrate a detector array. Using an RS-232 interface, the Mobile-DAQ is connected to a Bluetooth module and the device.

IV. NOISE POLLUTION MONITORING SYSTEM

A field of study that has received a lot of attention from scientists over the past ten years is the construction of sensible cities and as a result the observation of environmental parameters. It is common knowledge that these environmental parameters are essential to an individual's well-being. In cities, strict adherence to these kinds of parameters is a difficult and expensive task. The development of observance devices for deploying Wireless sensing element Networks is one area in which recent technologies of inexpensive computing and low-power devices have opened up research to a large and easily accessible field. Improved urban plans can be implemented with the information gathered from them, thereby assisting voters. The development of a low-cost acoustic sensing element supported by the Raspberry Pi platform for use in sound field analysis is represented during this work. In addition, the device is connected to the cloud for instantaneous results sharing. The Raspberry Pi's computational capabilities make it possible to analyze high-quality audio for precise acoustic parameters. The installation of two acoustic devices in the construction of a section served as the setting for a pilot test. During this preparation, extensive measurements were used to analyze tho se devices, obtaining numerous acoustic parameters in real-time for broadcasting and research. The pilot test has not only served as a tool for the residents of the neighborhood to become more aware of the noise in their own residences, but it has also demonstrated the Raspberry Pi as a robust and reasonable computing core for a low-cost device.

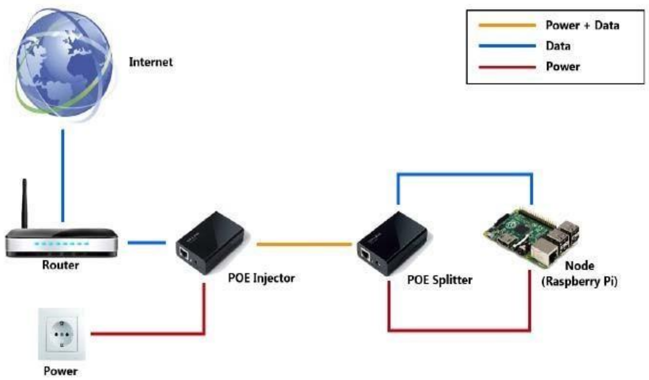

Fig 2- operation scheme

V. CHALLENGES IN IMPLEMENTATION

There are numerous obstacles for IoT-based systems to overcome to realize the aforementioned sustainable applications in a smart city. The difficulty lies in incorporating intelligence into everyday electrical objects by enabling these devices to learn and become smarter, becoming more autonomous through data and information sharing with other objects, and maintaining reliability in the face of the volatility that is frequently brought on by real-world dynamics. By coordinating these devices based on their relationship with one another, goals achieved, and location requirements, as well as their adaptation to the network of things, we plan to deal with the heterogeneous platforms of the multiple smart devices. Additionally, concerns regarding privacy and security throughout the entire process must be addressed. Therefore, the use of encryption and the prohibition of data theft from these devices is essential. Redundancies and firewalls must be incorporated into these devices to guard against hacking. In the implementation of such devices, system failure prevention is also fundamental, and the presence of backup system software to take over in the event of a failure is detrimental.

Additionally, these kinds of systems need to have support for scalable data analysis systems. One of the greatest obstacles we must overcome is the requirement to process a large number of metadata in real-time.

VI. Design and Requirements

The various subsections in this section explain the prototype's design, creation, algorithm implementation, and cloud connection. To achieve the proposed final objectives, the device's design had to fulfill certain requirements. To use the final, lowcost, but reliable device, certain goals must be met. The requirements for this prototype were:

- The device has to use low-cost components to create affordable sensor networks of several devices with a relation costquality.
- The device has to have reliability for long-term measurements.
- The device should have capability to be connected to the cloud for remote updates of the software and for sharing results.
- The quality of the measurements has to be enough for advanced audio parameters’ calculation.
- The device has to have enough computing power to do on-board calculations.
- The device has to be able to connect to the peripherals needed for the purposes of the project (e.g., a microphone).
- The device has to be able to interpret MATLAB programming language.
- The final device has to be protected against outdoor conditions using protective housing.
- The device needs to have different connectivity options.
- The distance from the nodes to the power source should be a maximum of 100 m.

The Core: Raspberry Pi

Working with a free operating system is one advantage of using Raspberry Pi. A Raspbian distribution, a GNU/Linux OS distribution for the Raspberry Pi, has been utilized for this device. The algorithms were created in MATLAB and compiled in C. The device's Internet connection and SSH (Secure Shell) make it possible to work remotely. It is possible to remotely access the device and update the algorithms using a command terminal. Software maintenance tasks and system checks can also be accomplished remotely. The audio configurations are managed by the ALSA library in an efficient manner. The board allows a variety of connections, primarily Ethernet, Wi-Fi, ZigBee, or a 3G connection, depending on the bandwidth requirements for continuous information transmission. The Ethernet connection was selected for this device and its installation. The nodes would be outfitted with wireless communication systems for further locations without Ethernet connections, and the power could come from a variety of sources, including batteries, solar panels, or a lamppost connected to an electricity supply. Th e deployment of a LAN connection rather than a wireless system aims for two primary goals: First, Ethernet cables can be properly shielded to avoid these undesirable effects, whereas a wireless connection is more susceptible to hindrance than a wired connection. Despite the fact that signal degradation can occur in Ethernet cables as well, managing and avoiding this issue is simpler when considering the LAN cables' categories and qualities as well as the maximum distance required for effective communication, which is 100 meters. Second, taking advantage of the cable network, a Power Over Ethernet (POE) scheme based on IEEE 802.3af was chosen to power the devices.

VII. CONCLUSION

Pollution is one of the topmost headaches of humanity. Due to pollution, society is getting infected by conditions, contagions, bacteria, etc. To keep safe ourselves, we need to take some conduct. In this paper, we're dealing with how to help air pollution and noise pollution… We are using some sensors, which can detect air pressure, temperature, Ultra Violet radiation, Air quality, Smoke, Nitrogen Dioxide in the air and Carbon Monoxide in air, noise level etc.… The detectors will shoot the collected data to the pall. Assaying the data, a report will be generated. Grounded on that report, action will be taken against pollution. In conclusion, the Internet of Things has the potential to play a significant role in controlling pollution and improving the environment. By us ing IoT devices such as sensors and smart devices, data can be collected in real-time on various environmental parameters, such as air and water quality, temperature, and more. This data can then be analyzed to identify the sources of pollution and to monitor their levels. Additionally, smart devices can be used to control and regulate industrial processes to minimize their impact on the environment, implement smart waste management systems, and improve traffic management. Overall, the use of IoT in pollution control provides a powerful tool for managing environmental challenges and promoting sustainable development. By providing real-time data and enabling effective decision-making, IoT can help to improve the quality of life and to preserve our planet for future generations.

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