

# Innovative Air Pollution Monitoring with Sensors and Controlled By Wireless Communication

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**ABSTRACT:** Wireless sensor network (WSNs) consist of sensor node with sensing and communication capabilities This system proposed a brief introduction to vehicular pollution, effect of increase in vehicular pollution on environment as well on human health. To monitor this pollution wireless sensor network (WSN) system is proposed. The proposed system consists of a Mobile Data-Acquisition Unit(Mobile-DAQ) and a fixed Internet-Enabled Pollution Monitoring Server (Pollution-Server). The Mobile-DAQ unit integrates a single-chip microcontroller, air pollution sensors array, a General Packet Radio Service Modem (GPRS-Modem), and a Global Positioning System Module (GPS-Module). The Pollution-Server is a high-end personal computer application server with Internet connectivity. The Mobile-DAQ unit gathers air pollutants levels (CO, NO<sub>2</sub>, and SO<sub>2</sub>), and packs them in a frame with the GPS physical location, time, and date. The frame is subsequently uploaded to the GPRS-Modem and transmitted to the Pollution-Server via the public mobile network. A database server is attached to the Pollution-Server for storing the pollutants level for further usage by various clients such as environment protection agencies, vehicles registration authorities, and tourist and insurance companies.

**KEYWORDS:** WSNs, Mobile Data-Acquisition Unit(Mobile-DAQ), General Packet Radio Service Modem (GPRS-Modem), Global Positioning System Module (GPS-Module).

## I.INTRODUCTION

A wireless sensor network(WSN) distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The

Development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

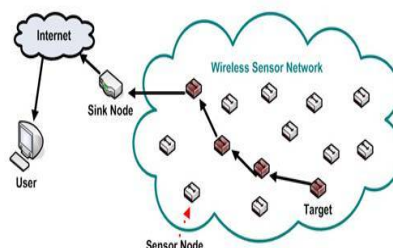


Fig:1 Wireless sensor network

In the field of soil environmental monitoring, real-time monitoring the temperature and humidity of soil can correctly guide horticulture. Traditional wired communications exist many problems it has broad application prospects in soil environmental monitoring field. The age of the Internet of things comes wireless sensor networks become the core of networking. In order to achieve greater things on the technical requirements of the Internet of things, we adopt the technology of wireless sensor network based on Zigbee, GPRS and Web Services technology designing a set of low cost, low power consumption, flexible automatic networking temperature humidity monitoring system of soil. The system consists of wireless sensor network nodes and network management platform.. The automatic networking realizes through the many jump routing consumption, flexible automatic networking temperature humidity monitoring system of soil. And the system is a complete set of wireless sensor network induction, acquisition, storage, application, reporting, solution, has a good man computer exchange interface

### 1.1 Mobile Cloud Computing

The term Mobile Cloud Computing (MCC) is basically a combination of two technologies: mobile computing (MC) and cloud computing (CC), in which a mobile client can use CC without any limitations of any type of fixed equipment's. That is MCC is the availability of cloud services in a mobile ecosystem. There are several challenges in implementing cloud services with mobile environment and deploying it on the mobile devices[6]. The main problem is that, MCC technology depends on the continuous network connection, failing which fails the system completely, the client is blank. Other challenges include network latency, the limited bandwidth of a mobile network, access schemes in mobile environment, elastic applications, and security and privacy schemes. In MCC the mobile screen is limited and there by the cloud requirement is varied by context.

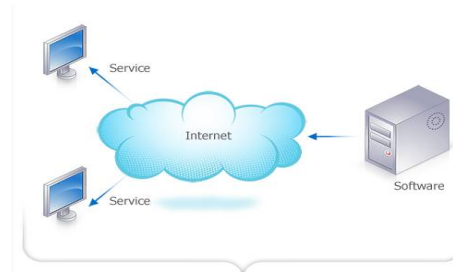


Fig:2 Mobile cloud computing

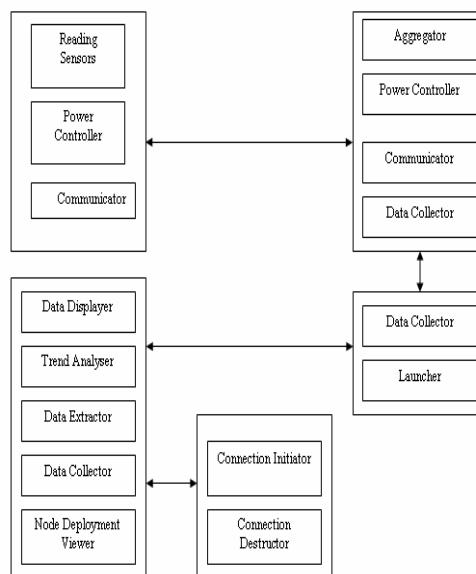
The concept of mobile cloud is used in this project to solve various issues which simple mobile devices are unable to achieve. MCC allows the users device to maintain very small thin layer architecture only for few applications and to pushes all the computational processing workload(s) to the virtual machines on the cloud side. MCC overcomes the limitations of mobile processing power and data storage, helps extending the battery life by moving the computations on cloud server. Using cloud service MCC increases the security level of every mobile devices and increases mobility. Many air pollution systems in urban and rural areas that utilize smart sensor networks and wireless systems were reported in recent literature. An environmental air pollution monitoring system that measures CO<sub>2</sub>, NO<sub>2</sub>, and SO<sub>2</sub> was reported. The system is based on a smart sensor micro converter equipped with a network capable application processor that downloads the pollutants level to a personal computer for further processing. A wearable and wireless sensor system for real-time monitoring of toxic environmental volatile organic compounds was developed in. An air pollution geo-sensor network consisting of 24 sensors and 10 routers was installed to monitor several air pollutants in. The system provides alarm message depending on the detected pollution types in the field. A high-resolution surveillance Web-camera was used to monitor air quality via the Internet. A wireless mesh network based on embedded microprocessors consisting of multiple sensors and multihop wireless communication is designed to cover a geographic area in. The system monitors and transmits parameters atmospheric environment to a command center. Another wireless sensor network system was developed to monitor indoor air quality in. The indoor environmental parameters were monitored and transferred to a client personal computer or personal digital assistant (PDA) using an RF transmitter. An outdoor air pollution monitoring system using ZigBee networks for ubiquitous-cities was reported in. The system integrates a wireless sensor board which employs dust, CO<sub>2</sub>, temperature, and humidity sensors. The

system's monitoring range is 270 m. An abstract model of a system based on long-range wireless communication was proposed in most of the above air pollution and quality monitoring systems are based on sensors that report the pollutants levels to a server via wired modem, router, or short-range wireless access points. In this paper, we propose a system that integrates a single-chip microcontroller, several air pollution sensors (CO<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub>), GPRS-Modem, and a general positioning systems (GPS) module. The integrated unit is a mobile and a wireless data acquisition unit that utilizes the wireless mobile public networks. The unit can be placed on the top of any moving device such as a public transportation vehicle. While the vehicle is on the move, the microcontroller generates a frame consisting of the acquired air pollutant level from the sensors array and the physical location that is reported from the attached GPS module. The pollutants frame is then uploaded to the General Packet Radio Service Modem (GPRS-Modem) and transmitted to the Pollution-Server via the public mobile network. A database server is attached to the Pollution-Server for storing the pollutants level for further usage by interested clients such as environment production agencies, vehicles regeneration authorities, tourist and insurance companies. The Pollution-Server is interfaced to Google maps to display real-time pollutants levels and their locations in large metropolitan area such as Sharjah City, UAE.

**II. WIRELESS AIR POLLUTION MONITORING SYSTEM (WAPMS)**

In this system we proposed a wireless sensor network air pollution monitoring system (WAPMS). Indeed, with the increasing number of vehicles on our roads and rapid urbanization air pollution has considerably increased in the last decades in Mauritius. For the Past thirty years the economic development of Mauritius has been based on industrial activities and the tourism industry. Hence, there has been the growth of industries and infrastructure Works over the island. Industrial combustion processes and stone crushing plants had contributed to the deterioration of the quality of the air. The proposed wireless sensor network air pollution monitoring system (WAPMS) comprises of an array of sensor nodes and a communications system which allows the data to reach a server. The sensor nodes gather data autonomously and the data network is used to pass data to one or more base stations, which forward it to a sensor network server. The system sends commands to the nodes in order to fetch the data, and also allows the nodes to send data out autonomously.

**2.1 ARCHITECTURE DIAGRAM OF WAPMS:**



**1) READINGS SENSOR:**

Generates a random value whose range is set based on the value of a seriousness variable.

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#### 2)READING TRANSMITTER:

Gets the generated value from the reading sensor and transmits it through the communicator.

#### 3)POWER CONTROLLER:

Each node will have a method called “turn on” that will start the node and we just call it. As for power-saving modes, this will depend on what the simulator will provide to us.

#### 4)COMMUNICATOR:

This is implemented by the simulator. Inter-process communication is usually done using sockets; so, we expect the simulator to provide us with sockets as well as methods such as “send” and “receive”.

#### 5)LAUNCHER:

Informs the data collector to start collection based on the delivery mode set by the user.

#### 6)DATA COLLECTOR:

Gets a list of nodes from which it has to collect readings, then sends Messages to inform them and finally receives the required values.

#### 7)AGGREGATOR:

Implements the RCQ algorithm for data aggregation that we will discuss in the Next section.

#### 8)CONNECTION INITIATOR:

The java Driver Manager allows for a method to open a database, providing it the name of the database, user name and password as parameters. So, this component just has to make a call to this method and store the return reference to the connection.

#### 9)CONNECTION DESTRUCTOR:

Connection object, in java.sql package, usually provides for a close method that closes the latter safely and frees associated memory as well as save the state of the latter.

### III.FEASIBILITY STUDY

A feasibility study aims to objectively and rationally uncover the strengths and weaknesses of an existing business or proposed venture, opportunities and threats present in the environment the resources required to carry through, and ultimately the prospects for success. In its simplest terms, the two criteria to judge feasibility are cost required and value to be attained. A well-designed feasibility study should provide a historical background of the business or project, a description of the product or service, accounting statements, details of the operations and management, marketing research and policies, financial data, legal requirements and tax obligations. Generally, feasibility studies precede technical development and project implementation. A feasibility study evaluates the project's potential for success; therefore, perceived objectivity is an important factor in the credibility of the study for potential investors and lending institutions. It must therefore be conducted with an objective, unbiased approach to provide information upon which decisions can be based.

#### 3.1 TECHNICAL FEASIBILITY

This assessment is based on an outline design of system requirements, to determine whether the company has the technical expertise to handle completion of the project. When writing a feasibility report, the following should be taken to consideration:

- A brief description of the business to assess more possible factors which could affect the study
- The part of the business being examined
- The human and economic factor
- The possible solutions to the problem

The technical feasibility assessment is focused on gaining an understanding of the present technical resources of the organization and their applicability to the expected needs of the proposed system. It is an evaluation of the hardware and software and how it meets the need of the proposed system.

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#### 3.2 ECONOMIC FEASIBILITY:

The purpose of the economic feasibility assessment is to determine the positive economic benefits to the organization that the proposed system will provide. It includes quantification and identification of all the benefits expected. This assessment typically involves a cost/ benefits analysis.

#### 3.3 LEGAL FEASIBILITY:

Determines whether the proposed system conflicts with legal requirements, e.g. data processing system must comply with the local data protection regulations.

#### 3.4 OPERATIONAL FEASIBILITY:

Operational feasibility is a measure of how well a proposed system solves the problems, and takes advantage of the opportunities identified during scope definition and how it satisfies the requirements identified in the requirements analysis phase of system development. The operational feasibility assessment focuses on the degree to which the proposed development projects fits in with the existing business environment and objectives with regard to development schedule, delivery date, corporate culture, and existing business processes.

To ensure success, desired operational outcomes must be imparted during design and development. These include such design-dependent parameters such as reliability, maintainability, supportability, usability, reducibility, disposability, sustainability, affordability and others. These parameters are required to be considered at the early stages of design if desired operational behaviors are to be realized[13]. A system design and development requires appropriate and timely application of engineering and management efforts to meet the previously mentioned parameters. A system may serve its intended purpose most effectively when its technical and operating characteristics are engineered into the design. Therefore, operational feasibility is a critical aspect of systems engineering that needs to be an integral part of the early design phases

#### 3.5 SCHEDULE FEASIBILITY:

A project will fail if it takes too long to be completed before it is useful. Typically this means estimating how long the system will take to develop, and if it can be completed in a given time period using some methods like payback period. Schedule feasibility is a measure of how reasonable the project timetable is. Given our technical expertise, are the project deadlines reasonable? Some projects are initiated with specific deadlines. It is necessary to determine whether the deadlines are mandatory or desirable.

#### 3.6 FINANCIAL FEASIBILITY:

In case of a new project, financial viability can be judged on the following parameters:

- Total estimated cost of the project
- Financing of the project in terms of its capital structure, debt to equity ratio and promoter's share of total cost
- Existing investment by the promoter in any other business
- Projected cash flow and profitability

The financial viability of a project should provide the following information:

- Full details of the assets to be financed and how liquid those assets are.
- Rate of conversion to cash-liquidity (i.e. how easily can the various assets be converted to cash).
- Project's funding potential and repayment terms.

Sensitivity in the repayments capability to the following factors:

- Time delays.
- Mild slowing of sales.
- Acute reduction/slowing of sales.
- Small increase in cost.
- Large increase in cost.

In 1983 the first generation of the Computer Model for Feasibility Analysis and Reporting (COMFAR), a computation tool for financial analysis of investments, was released. Since then, this UNIDO software has been developed further, to also support the economic appraisal of projects. The Computer Model for Feasibility Analysis and Reporting

(COMFAR III Expert) is intended as an aid in the analysis of investment projects. The main module of the program accepts financial and economic data, produces financial and economic statements and graphical displays and calculates measures of performance. Supplementary modules assist in the analytical process. Cost-benefit and value-added methods of economic analysis developed by UNIDO are included in the program and the methods of major international development institutions are accommodated. The program is applicable for the analysis of investment in new projects and expansion or rehabilitation of existing enterprises as, e.g., in the case of projects. For joint ventures, the financial perspective of each partner or class of shareholder can be developed. Analysis can be performed under a variety of assumptions concerning inflation, currency revaluation and price escalations.

#### **IV.ENERGY DEFINED AIR POLLUTION MONITORING SCHEME FOR SECURE WSN**

Manual methods Passive samplers the simplest approach to sampling of gaseous air pollutants involves passive collection onto a chemically treated surface or material. Results generated by these methods are useful in a relative sense, but because of the variability of the factors affecting collection and retention of the pollutant it is difficult to establish any simple relationships to the airborne concentrations. Paper tape samplers the usefulness of the above systems can be extended if air is forcibly drawn through or over the treated surface by means of a pump. An example of this is the paper tape sampler Numerous applications have been reported for gases such as H<sub>2</sub>S, HCN, NH<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, Cl<sub>2</sub>, COCl<sub>2</sub>, amines and isocyanides. In most commercial systems the tape is automatically advanced at selected time intervals to produce a series of discrete spots or samples. In others it is necessary to remove the tape for measurement or analysis of each spot. A paper tape system has also been developed into a continuous monitoring system for particulate matter, using the attenuation of low energy radiation. Bubbler Systems One of the most universal approaches for the collection of gaseous pollutants is to bubble the air through a solution designed to absorb or react with the contaminants. Most gases and vapors can be collected in this way, followed by an appropriate laboratory analysis of the resulting solutions.

#### **4.1 INSTRUMENTAL MONITORING METHODS**

A wide range of instrumental methods have been reported for the monitoring of air pollutants. Many of the systems are based on photometric techniques, and the most common examples of these are described below. Non-Dispersive Infra-Red (NDIR) NDIR analyzers have been developed to monitor SO<sub>2</sub>, NO<sub>x</sub>, CO, and other gases that absorb in the infra-red, including CO<sub>2</sub> and hydrocarbons. The technique is of relatively low sensitivity, and is more applicable to the concentrations found in source emissions than in ambient air. An NDIR analyzer is basically an instrument that does not disperse the light emitted from an infra-red source i.e. the light is not split up into its component wavelengths by means of a prism or grating. Instead a broad band of light is produced by means of a band pass filter, which is chosen to coincide with an absorption peak of the pollutant molecule.

#### **V.PERFORMANCE AND SIMULATION STUDY**

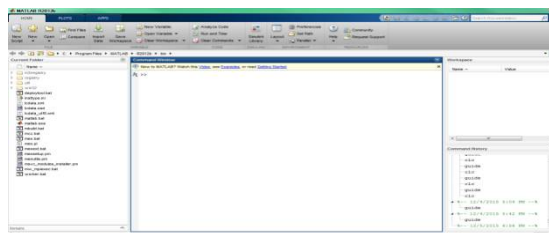


Figure1: Command Window

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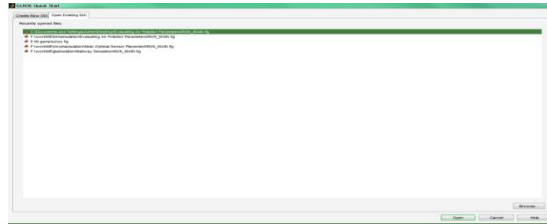


Figure2: File Holder Chooser

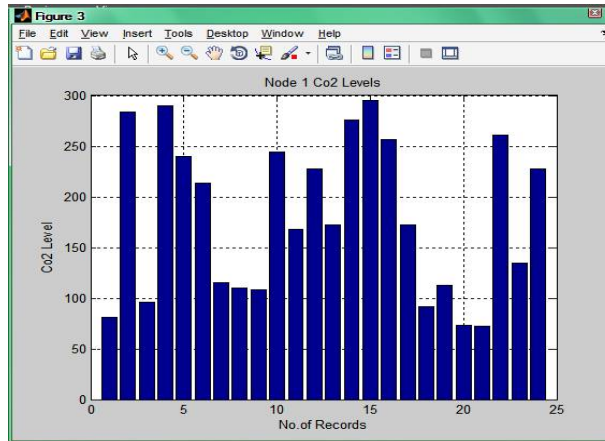


Figure3:Co2 Levels

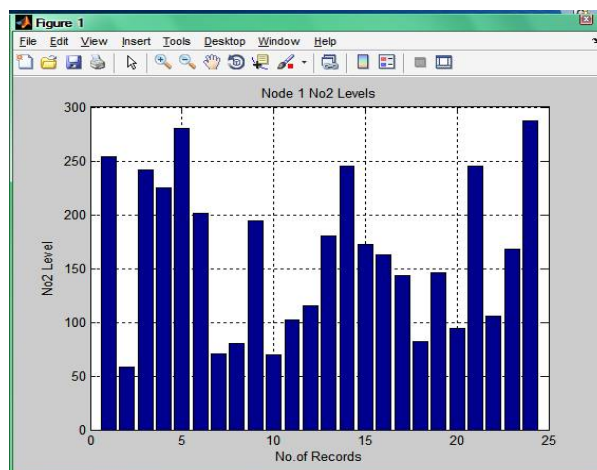


Figure3:No2 Levels

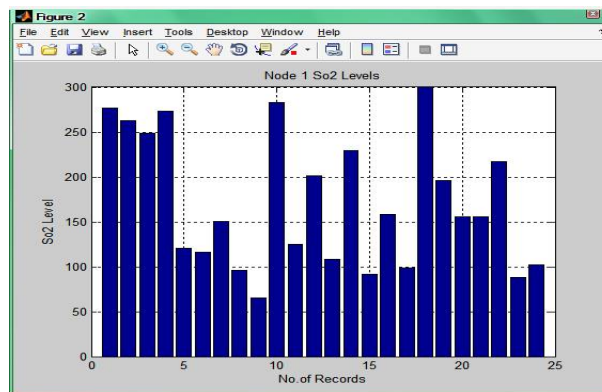


Figure4: Co2 Levels

## VI.CONCLUSION

In this system, recent technological developments in the miniaturization of electronics and wireless communication technology have led to the emergence of Environmental Sensor Networks (ESN). These will greatly enhance monitoring of the natural environment and in some cases open up new techniques for taking measurements or allow previously impossible deployments of sensors. WAPMS is an example of such ESN[9]. WAPMS will be very beneficial for monitoring different high risk regions of the country. It will provide real-time information about the level of air pollution in these regions, as well as provide alerts in cases of drastic change in quality of air. This information can then be used by the authorities to take prompt actions such as evacuating people or sending emergency response team. WAPMS uses an Air Quality Index to categories the various levels of air pollution. It also associates meaningful and very intuitive colors to the different categories, thus the state of air pollution can be communicated to the user very easily. The major motivation behind our study and the development of the system is to help the government to devise an indexing system to categories air pollution in Mauritius. The system also uses the AQI to evaluate the level of health concern for a specific area. WAPMS uses a novel technique to do data aggregation in order to tackle the challenge of power consumption minimization in WSN. This highly reduces the amount of data to be transmitted to the sink, thus reducing the transmission energy required and at the same time representing the original values accurately.. The collected readings are saved in a database and these can be accessed individually in a table or summarized area wise in a line graph.

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