IOT BASED INDUSTRIAL POLLUTION MONITORING

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Abstract - *Pollutions in the environment is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water and to ensure the freshness of clean air to breath, the quality of water and air needs to be monitored in real time. In this paper we present a design and development of a low cost system for real time monitoring of the water quality in IOT (internet of things) and Air pollution and dangerous Gas content like Ethane and Methane. The system consists of several sensors used for measuring the physical and chemical parameters of the water and air. The parameters such as PH temperature, turbidity, flow sensor of the water can be measured. The measured values from the sensors can be processed by the micro-controller. The Renesas model can be used as a core controller. Finally, the sensor data's are stored and viewed over the cloud (AWS) by both the government and the public. The developed system is cost effective and compatible for further enhancement.*

Key Words: **Renesas controller, PH sensor, Turbidity sensor, Temperature sensor, CO2 gas sensor, AWS cloud, etc.**

1. INTRODUCTION

Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. In this paper we present a design and development of a low cost system for real time monitoring of the water quality in IOT (internet of things) and Air pollution and dangerous Gas content like Ethane Methane. The system consist of several sensors is used to measuring physical and chemical parameters of the water & air. The parameters such as PH, temperature, turbidity of the water can be measured. The measured values from the sensors can be processed by the micro-controller. The Renesas model can be used as the core controller. Finally, the sensor data can be viewed on internet using WI-FI connection.

The aim of this project is to monitor the water pollution and dangerous gas content relies from the chemical industries to avoid Air and Water pollution and providing safety feature for human and animal's health security has been an important issue. The system detects the harmful gas content and pH level of water using gas and ph sensor and alerts the consumer about the water quality and dangerous gas content sending information through the cloud. The industrial monitoring system is designed especially to solve the cost effective, accuracy and transparency problems in a highly secured approach.

1.1 MOTIVATION

In the name of progress and growth, they say, we have plundered our planet and spoiled our atmospheric environment. Many people are pessimistic about the future and believe that our rush toward materialistic prosperity has unbalanced powerful biological forces that we do not fully understand and that we are not paying sufficient attention to the serious problems created by our advanced technology. Others view such statements as prophecies of gloom, fail to see air pollution as a serious problem in the World, or do not expect any widespread devastation in the foreseeable future, Since we can expect a continuing increase in the number of people, automobiles, and industries, we may expect there will be more dirt, more carbon monoxide, more sulphur dioxide, more bad smells, more bad air unless we do something about it. There are ways of controlling most forms of air pollution and people can insist that these means be used. The control measures pay off in more enjoyable life and better health. We have the techniques to control most sources of air pollution.

2. LITERATURE SURVEY

[1] Nikhil Kedia entitled "The Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project." Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India.

This paper highlights the entire water quality and pollutants monitoring methods, sensors used the embedded design, and information dissipation procedures, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain, while it automatically improves the water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people. [1]

[2] Jayti Bhatt,Jignesh Patoliya entitled "Real Time Water Quality Monitoring System". This paper describes to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, the design of IOT based water quality monitoring system that monitors the quality of water in real time. This system consists of some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature. The measured values from the sensors are processed by the micro-controller and these processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing. [2]

[3] Michal Lom, Ondrej Pribyl, Miroslav Svitek entitled "Industry 4.0 as a Part of Smart Cities".

This paper describes the conjunction of the Smart City Initiative and the concept of Industry 4.0. The term smart city has been a phenomenon of the last years, which is very inflected especially since 2008 when the world was hit by the financial crisis. The main reasons for the emergence of the Smart city initiative are to create a sustainable model for cities and to preserve the quality of life of their citizens. The term smart city is not only seen as a technical discipline, but different economic, humanitarian or legal aspects must be involved as well. In the Industry 4.0, the Internet of Things (IoT) shall be used for the development of so–called smart products. Subcomponents of the product are equipped with their own intelligence.

The added intelligence is used both during the manufacturing of a product as well as during subsequent handling, up to continuous monitoring of the product lifecycle (smart processes). The other main aspects of the Industry 4.0 for enhancing the services are Internet of Services (IoS), that includes especially intelligent transport and logistics (smart mobility, smart logistics), as well as Internet of Energy (IoE), which determines how the natural resources are made used in proper way (electricity, water, oil, etc.). IoT, IoS, IoP and IoE can be considered as an element that can create a connection of the Smart city initiative and Industry 4.0 – Industry 4.0 can be seen as a part of smart cities. [3]

[4] Zhanwei Sun,Chi Harold Li,Chatschik Bisdikian,Joel W.Branch and Bo Yang entitled "QOI-Aware Energy Management in Internet-of-Things Sensory Environments".
In this paper an efficienergy management frame work to provide satisfactory QOI experience in IOT sensory environments is studied. Contrary to efforts of the past, it is expected to be transparent and compatible to lower protocols in use, and preserving energy-efficiency in the long run without sacrificing any attained QOI levels. Specifically, the new concept of QOI-aware "sensor-to-task relevancy" to explicitly consider the sensing capabilities offered by an sensor to the IOT sensory environments, and QOI requirements required by a task. A concept of the "critical covering set" of any given task in selecting the sensors is to service a task over time. The energy management decision is made dynamically at runtime, as the optimum for long-term traffic statistics under the constraint of the service delay. At last, an extensive case study based on the utilization of the sensor networks for performing water level monitoring is given to demonstrate the ideas and algorithms proposed in this paper, and a simulation is made to show the performance of the proposed algorithms. [4]

[5] Sokratis Kartakis, Weiren Yu, Reza Akhavan, and Julie A. McCann entitled "Adaptive Edge Analytics for Distributed Networked Control of Water Systems".

This paper presents the burst detection and localization scheme that combines lightweight compression and anomaly detection with graph topology analytics for water distribution networks. This approach developed not only significantly reduces the amount of communications between sensor devices and the back end servers, but also can effectively localize water burst events by making use of the difference in the arrival times of the vibration variations detected at the sensor locations. Our results can save up to 90% communications compared with traditional periodical reporting situations. [5]

4. PROBLEM DEFINITION

The system to be developed is a wireless sensor network for monitoring water and air pollution by industries. To achieve this, the sensors are set at different locations where the pollution levels are to be monitored. The sensor values are read and noted in different conditions and timings of the day. This is done in order to collect data sets for the pollutants values at different environmental locations. These datasets are used to select the threshold value for different gases and real time data collected is compared against these threshold values to say if there is any violation or threat to the water and air quality.

The gas sensors are connected to a microcontroller which is connected to a WIFI module. The output of the sensors is given to the Renasas board which contains the microcontroller and all the sensor outputs that is the real time data is sent to the cloud for storage. Thus, the model consists of the following Renesas board consisting of the microcontroller, different sensors; sensors used are specific to the particular chemical.

The WIFI module used is ESP 8266 which is used to connect the hardware that is the Renesas to the internet so that the real time data collected is sent to the cloud for storage in the cloud database. There is a global positioning system used so that the location also is sent as real time data and stored in the cloud. A purification device for purifying both water and air is also set up which can be controlled remotely using IoT.

5. PROPOSED DESIGN

In this Project, we present the real time monitoring of water quality and Air pollution gas content in IoT environment. The overall block diagram of the proposed method is described. Each and every block of the system is explained in detail. In this proposed block diagram consist of several sensors (temperature, pH, turbidity, Gas) is connected to the microcontroller.

The micro-controller are accessing the sensor values and processing them to transfer the data through internet. Renesas is used as a core controller. The sensor data can be viewed and stored over the cloud system. The system detects the Harmful gas content and pH level of water using gas and ph sensor and alerts the consumer about the water quality and dangerous gas content sending information through Wi-Fi.

A. BLOCK DIAGRAM

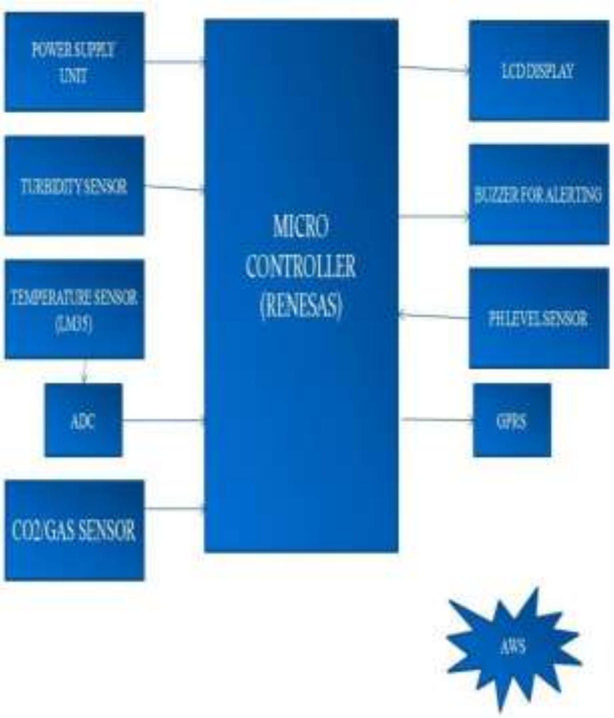

Fig-1: BLOCK DIAGRAM

The figure shows the overall system architecture of the environmental monitoring wireless sensor network system. Sensors are a major part in this system it is responsible for information or real time data.

i) Renesas Microcontroller.

Fig-2: Renesas microcontroller

- Renesas micro controller is of RL78 Family which is of 16bit microcontrollers with 64pins.
- The basis of RL78 Family is accumulator-based register-bank CISC architecture with 3-stage instruction pipelining.
- It has 3 modules: power supply section, controller section and communication section. It has 20-bit 1M Byte address space.
- It has 11 ports with 58 Input/Output Pins.
- It is an advanced micro controller through which many devices could be connected and made use of.

ii) LCD DISPLAY

Fig-3: LCD Display

- LCD: A liquid crystal display is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals.
- Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome.

- A 16x2 LCD display is the very basic module and is very commonly used in various devices and circuits.
- A 16x2 LCD means it can display only 16 characters per line and there are 2 such lines (i.e. 2 rows, 16 columns).

iii) Co2 Sensor

Fig-4: Co2 Sensor

- CO2 sensor measures the carbon dioxide from the air using the NDIR principle.
- The measured values are displayed in the LCD screen.

iv) Temperature Sensor

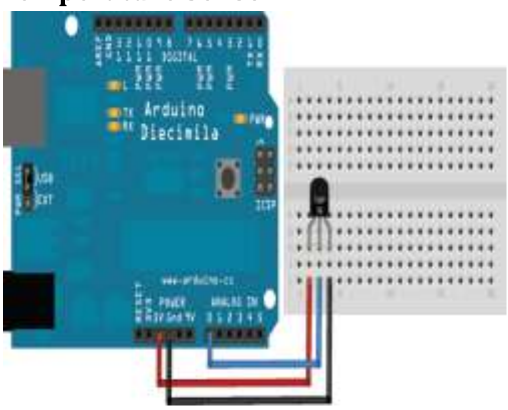

Fig-5: Temperature Sensor

- Infrared sensors are used to measure the surface temperatures ranging from -70 to 1,000°C.
- They convert the thermal energy sent from an object in a wavelength range of 0.7 to 20 um into an electrical signal that converts the signal for display.

v) pH Sensor

Fig-6: pH Sensor

- It is designed to get pH measurements at ± 0.1pH (25 °C).
- It has an LED which works as the Power Indicator to let know the pH of water.

vi) Turbidity Sensor

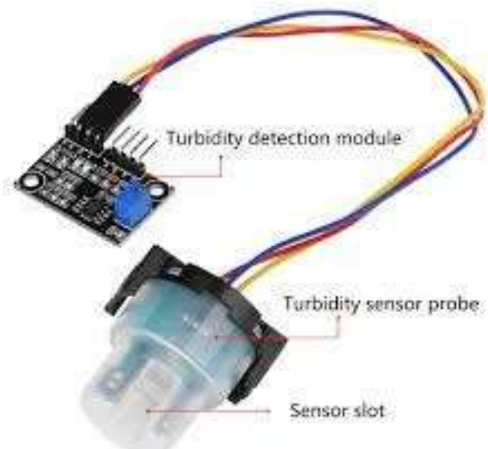

Fig-7: Turbidity Sensor

- The Turbidity Sensor measures the turbidity of fresh-water samples in NTU (Nephelometric Turbidity Units)
- It also monitors precipitate formation or algae and yeast populations in water.

B. FLOW CHART

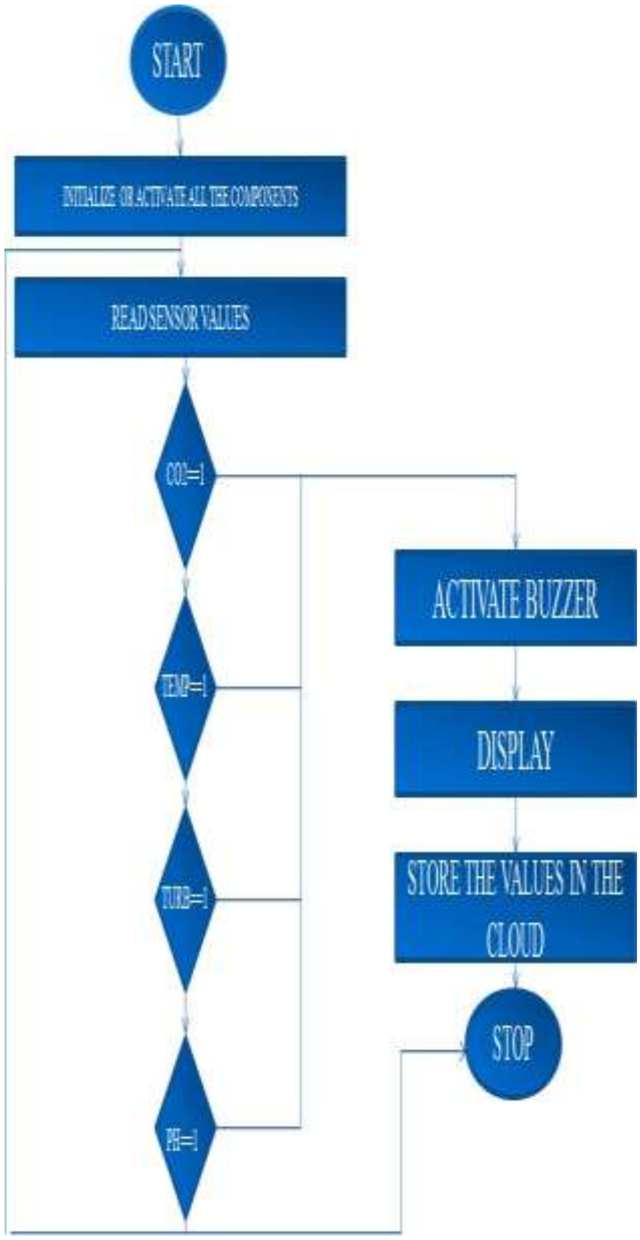

Fig-8: Flowchart

As shown in the flow chart each sensor's has its own threshold values which are the approved by the government. If the sensor value's exceeds the threshold, the buzzer will ring and alarm the system.

7. EXPERIMENT SETUP

A) Connection of controller to LCD

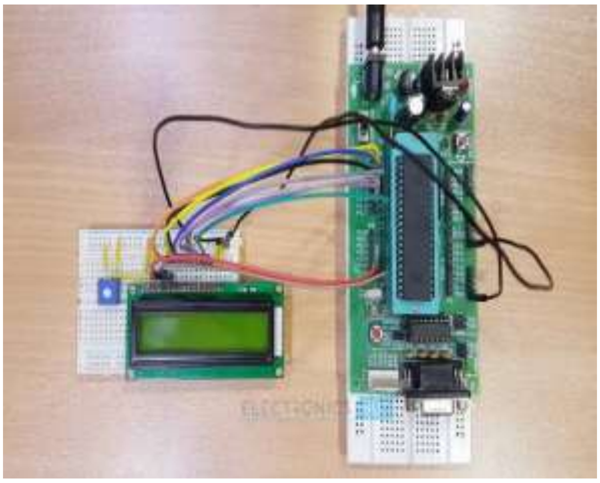

Fig-9: Connection of controller to LCD

Each port of the controller which is necessary for the system is connected to the ports of the LCD. Thereby the values read through the sensors are converted to digital format and is displayed in the LCD screen.

B) Connection of sensors to the controller

Fig-10: Connection of sensors to the controller

The sensors that monitors both air and water pollution are connected to the LCD and the Renesas microcontroller. The values of the sensors are read by the controller and are displayed in the LCD screen.

8. APPLICATIONS

1) Industrial perimeter monitoring

2) Indoor air quality monitoring.

3) Drinking water pureness monitoring.

3) Site selection for reference monitoring stations.

4) Making data available to users.

9. ADVANTAGES

1) Easy to Install

2) Updates On mobile phone directly

3) Accurate Pollution monitoring

4) Remote location monitoring

10. Experimental Observations And Results

The system implementation and hardware connections are shown in the figure. The analog signal from the sensors is converted to a digital signal where it is passed as an input to a microcontroller device, which compares the measured value with a threshold value. The result is then transmitted using the internet of things technology to a database on the cloud where the data is stored as required. The signal acquired from the sensors from different areas is compared with the predetermined values in the microcontroller. When the pollution detected is below the threshold, the sensors keep reading data continuously. When the pollution increases beyond the pre-determined threshold, then the gathered data can be sent to the higher authorities for which appropriate actions can be taken by them.

11. CONCLUSION

The industrial monitoring system is designed especially to solve the cost effective, accuracy and transparency problems in a highly secured approach. This system is more effective than the existing system, since it uses an advanced controller for monitoring the environmental conditions and controller collects the data from sensor and those updated sensor values are written by the Python coding in particular text file. Using PHP coding the value is read and updated in webpage. Based upon the collected value, the respective action will be carried out.

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