Automatic Pollution Monitoring in Industries

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Abstract: The project would be concerted effort to reduce air and water pollution in the Greater Sao Paulo area. It would provide finance for existing industries to carry out air pollution control subprojects to reduce particular matter emissions and water pollution control sub projects to preterit or fully treat their liquid effluents. The project would primarily improve air quality in the particular area and reduce the discharge of toxic substances and organic materials into water bodies. It is also includes technical assistance to strengthen the technical and operational capability of the environmental protection agency of the state, which would be responsible for technical appraisal and supervision of sub projects. The project would contribute to improving the health and living conditions of the population, particularly of the urban poor. Opposition by industrialists to such investments could slow down project execution. The financial incentives included would reduce this risk to an acceptable level.

Keywords - Pollution Monitoring, Industries, Automation.

I.INTRODUCTION

In global environment is polluted in more industrial wastes mixed in the air and water so the air and water is polluted. In our project to measure the water PH level and amount of moisture present in the air or amount of Carbon di oxide present in the air is measured using PH sensor and Air pollution sensor or CO2 sensor. Also we monitor the gas flow of industries and working temperature of the industries. If any over pollution or PH level increased in water or moisture or CO2 level is increased in air the controller will sent the message in any pollution control room. And to use display devices in industries to measuring monitoring the pollution level of the industries.

II. EXISTING METHOD

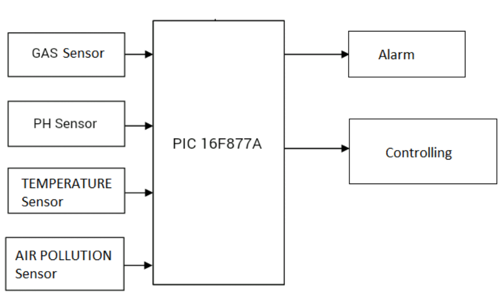

Fig 1: Existing Block Diagram

In Existing method Gas sensor, PH sensor, Temperature sensor and Air pollution sensor will connect to the PIC Microcontroller. The gas sensor will monitor gas flow and the PH sensor will detect the acidity level of the waste water in industries and the Temperature sensor will detect the working temperature of the industries, the Air pollution sensor will detect the amount of moisture present in the air. The sensors will monitor the pollution level of the industries if the level of pollution is increased the sensor will give alarm signal in the industries. And automatic pollution control methods are installed in some industries example to using air filters and reduce the air pollution.

III. GAS AND AIR POLLUTION SENSOR

In gas sensor MQ-7, MQ-5, MQ-3 sensors are used. They are suitable for alcohol checker, Breathalyser. They are used in gas leakage detecting equipments in industries, are suitable for detecting of LPG, natural gas, town gas, avoid the noise of alcohol and cooking fumes. They are used in gas detecting equipment for carbon monoxide (CO) in family and industry or car. Structure and configuration of MQ-7 gas sensor is shown as Fig. 2 (Configuration A or B), sensor composed by micro Aluminum oxide (AL2O3)ceramic tube and Tin Di oxide (SnO2) sensitive layer, measuring electrode and heater are fixed into crust made by plastic and stainless steel net, [7]. The heater provides necessary work conditions for work of sensitive components. The envelope MQ-7 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current, [1], [9].

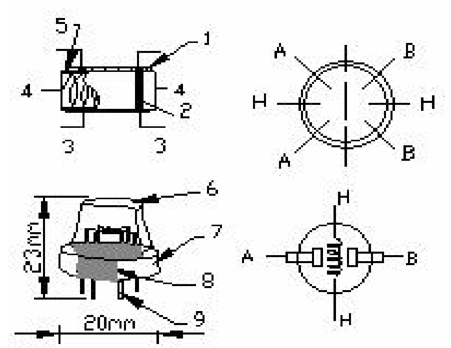

Fig 2: MQ-7 Sensor

The surface resistance of the sensor Rs is obtained through effected output of the load resistance RL which series-wound.

The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

signal when the sensor is shifted from clean air to carbon monoxide (CO), output signal measurement is made within one or two heating period (2.5 minute from high voltage to low voltage). Sensitive layer of MQ-7 gas sensitive components are made with SnO2 with stability, So, it has excellent long term stability. Its service life can reach 5 years under using condition, [4].

IV. TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy (Reference 2). It can be used with single power supplies. As it draws only 60 µA, and very low self-heating, less than 0.1°C in air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy), [2].

V. PH SENSOR

PH Sensor is also called as PH electrode. A pH electrode measures hydrogen ion (H+) activity and produces an electrical potential or voltage. The operation of the pH electrode is based on the principle that an electric potential develops when two liquids of different pH come into contact at opposite sides of a thin glass membrane.

The modern pH electrode is a combination electrode composed of two main parts: a glass electrode and a reference electrode as shown in Fig 3. pH is determined essentially by measuring the voltage difference between these two electrodes. At the tip of the electrode is the thin membrane that is a specific type of glass that is capable of ion exchange. It is senses the hydrogen ion concentration of test solution. Its reference electrode potential is constant and is produced by the reference electrode internal element in contact with the reference-fill solution that is pH of seven.

The sensor characteristics described need to be accounted for in order to design a circuit that will condition the sensor signal so it can be faithfully utilized by other components (such as an ADC, microcontroller, and so forth) along the signal path. First, because the pH electrode produces a bipolar signal and most applications operate on a single supply, the signal will have to be level shifted. Second, due to the high impedance of the electrode, a high-input impedance buffer will be required. Finally, the temperature of the measured solution must be known in order to compensate for the electrode's sensitivity variation over temperature, [4].

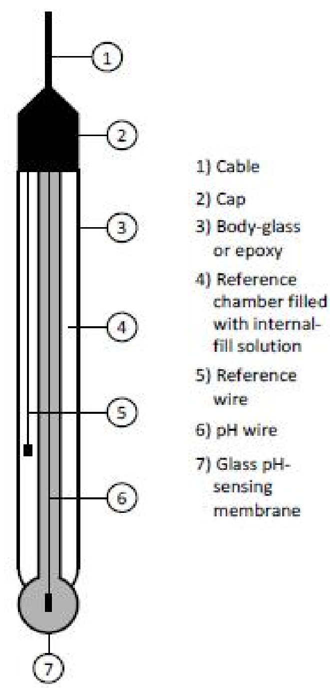

Fig 3. pH Electrode

The circuit in Fig 4 solves all three design challenges. Amplifier U1 off sets the pH electrode by 512 mV. This is achieved by using TI's LM4140A-1.0 precision micro-power low-dropout voltage reference that produces an accurate 1.024 V. That voltage is divided in half to equal 512 mV by the 10 kΩ resistor divider. The output of amplifier U1, that is set up in a unity-gain configuration, biases the reference electrode of the pH electrode with the same voltage, 512 mV, at low impedance. The pH measuring electrode produces a voltage that rides on top of this 512 mV bias voltage. In effect, the circuit shifts the bipolar pH-electrode signal to a unipolar signal for use in a single-supply system.

The second amplifier U2 is set up in a unity-gain configuration and buffers the output of the pH electrode. Again, a high-input impedance buffer between the pH electrode and the measurement instrument allows the circuit to interface with a greater variety of measurement instruments including those with lower input impedance. In most applications, the output voltage of the pH electrode is high enough to use without additional amplification. If amplification is required, this circuit can easily be modified by adding gain resistors to U2.

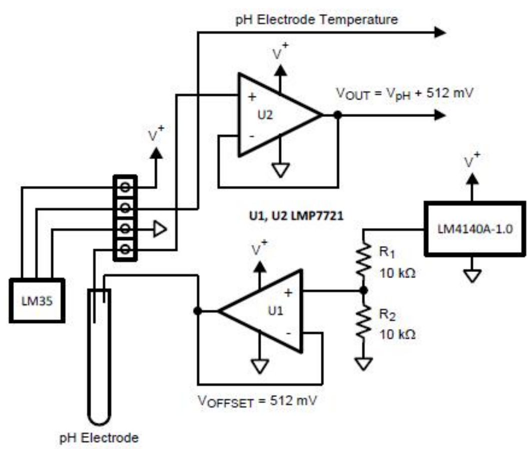

Fig 4. pH Electrode circuit

VI. MICROCONTROLLER

PIC 16F877A

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller". PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

X. PROPOSED SYSTEM

In our work the pH sensor, air pollution sensor, gas sensor and temperature sensor are connected to one Microcontroller(PIC16F877A) unit. The pH sensor measures acidity of the water or wastage of the industries. Air pollution sensor will measure the CO_2 level of air in industries. Temperature sensor will measure environmental temperature of the industries and gas sensor is used to detect whether there is any leakage of gases in industry.

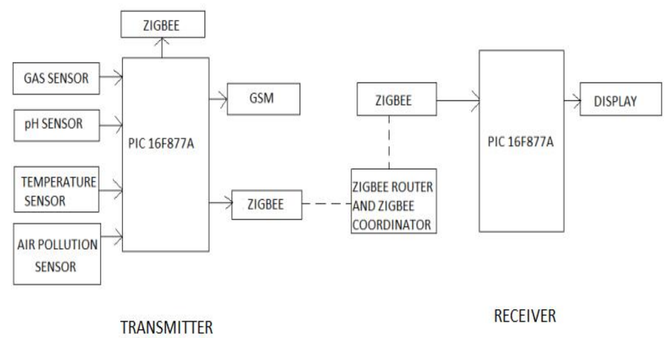

Fig 5: Proposed Block diagram

All sensors will monitor and measure their respective pollution level. If the temperature sensor detects high temperature and the gas sensor senses any leakage in the industries it produces alarm automatically. ZIGBEE is used to transmit all sensors outputs to display devices using ZIGBEE Router and ZIGBEE Coordinator. The display devices are present in each and every place of industry for monitoring purpose and pass emergency signals to the control room. The signals from controller is passed to the Pollution Control and Health Board Department through GSM and Zigbee devices. Remedial measures will be taken by the department authorities to prevent violation of toxic outputs from industries .

VI. ZIG-BEE

The explosion in wireless technology has seen the emergence of many standards, especially in the industrial, scientific and medical (ISM) radio band. There have been a multitude of proprietary protocols for control applications, which bottlenecked interfacing. Need for a widely accepted standard for communication between sensors in low data rate wireless networks was felt. As an answer to this dilemma, many companies forged an alliance to create a standard which would be accepted worldwide. It was this ZIGBEE Alliance that created ZIGBEE. Bluetooth and Wi-Fi should not be confused with ZIBGEE. Both Bluetooth and Wi-Fi have been developed for communication of large amount of data with complex structure like the media files, software etc. ZIGBEE on the other hand has been developed looking into the needs of communication of data with simple structure like the data from the sensors.

Fig 6: ZIGBEE

ZIGBEE devices can form networks with Mesh, Star and Generic Mesh topologies among themselves. The network can be expanded as a cluster of smaller networks. A ZIGBEE network can have three types of nodes: ZIGBEE Coordinator (ZBC), ZIGBEE router (ZBR) and ZIGBEE End Device (ZBE) each having some unique property.

Let us understand ZIGBEE through a typical usage scenario in a home automation system. There can be only one ZBC in a network, the one that initiates the network in the first place and stores the information about the network. This would be the main control panel or remote control in the living room of each storey. All the devices in the network communicate with this ZBC. It has routing capabilities and acts as a bridge to other networks on other floors. A ZBR is an optional component used to extend the coverage, say, providing access to the ZIGBEE receivers controlling the garage lighting and shutter which is in the nearby shed. The router itself may host an application like a CC Camera which is continuously in active monitoring state. It can also handle local address allocation or de-allocation. A ZBE is optimized for low power consumption and is the cheapest among the three node types. It communicates only with the coordinator and is the point where sensors are deployed. Any end device like lighting units, air conditioning elements etc. can be ZIGBEE End Devices. Unicast Device Discovery is done if Network ID is available; else Broadcast Device Discovery is done, [6], [8].

A ZBR or ZBC's response to Device Discovery query is a payload containing IEEE address, the Network Address and all known network addresses. Device bindings which are logical links between end devices can be created like binding of a Lamp Application Object with a Switch Application Object. The Radio unit and the Processing unit are often built into a single chip to reduce costs. When a car enters the premises, the radio transmitter inside the car broadcasts its presence to the ZIGBEE Coordinator through routers. The coordinator then binds the garage shutter's receiver with the Car's transmitter and all packets from the Car transmitter are routed to the Shutter, which can then open and close without stepping out of the car. The whole transaction can be automated such that by the time the car reaches the garage door, it automatically opens.

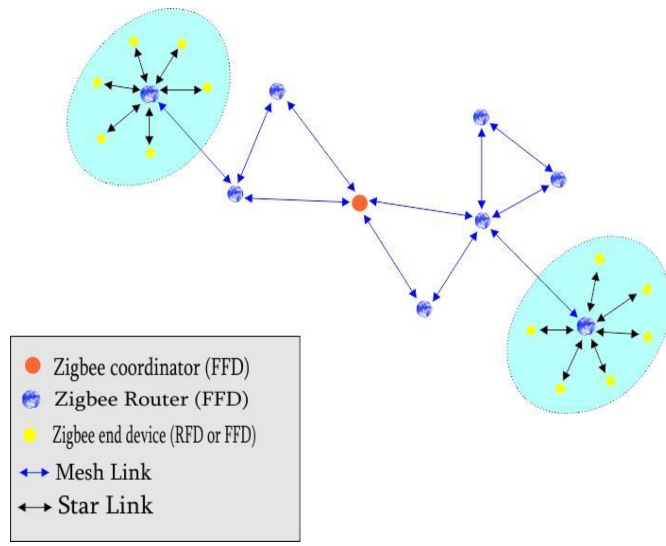

Fig 7: ZIGBEE Networks

In a network, data traffic can be periodic, intermittent or repetitive. When data is periodic, the application determines the rate of transfer. Intermittent data needs optimum power savings and hence the data rate is stimulus dependent. For repetitive type of data, guaranteed time slots are used, for example the air conditioning unit.

VII. GSM

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard set developed by the European Telecommunication Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular network using by mobile phones.

The GSM standard was developed for first generation (1G) analog cellular networks, and originally described a digital, circuit switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit switched transport, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

Further improvements were made when the 3GPP developed third generation (3G) UMTS standards followed by fourth generation (4G)LTE Advanced standards.

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such modules.

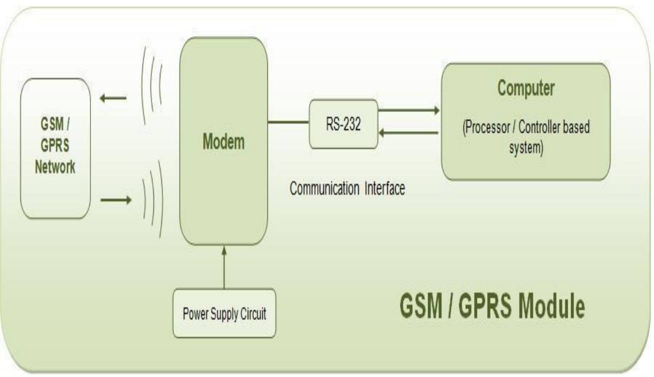

Fig 8: GSM Communication

XI. SOFTWARE RESULTS

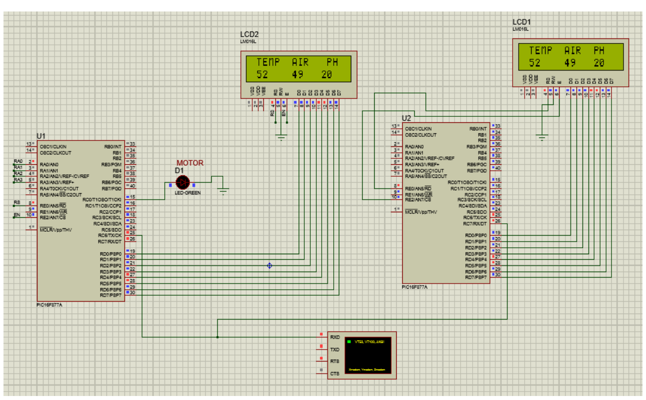

Fig 9: Simulation diagram

Fig 9 shows the transmitter and receiver side outputs. It will shows the how to four sensor output will changes

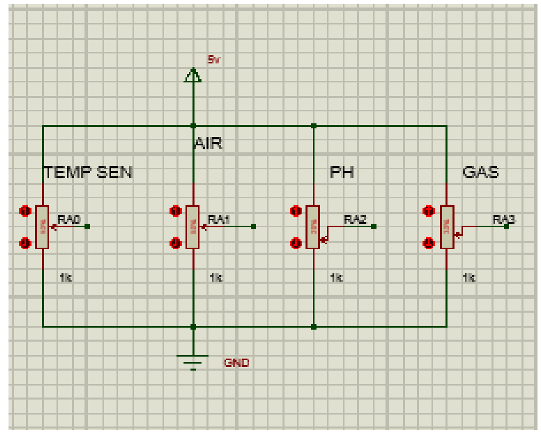

Fig 10: Sensor arrangement

Fig 10 shows the sensor arrangement of the proposed system and the signals sent to the transmitter terminals.

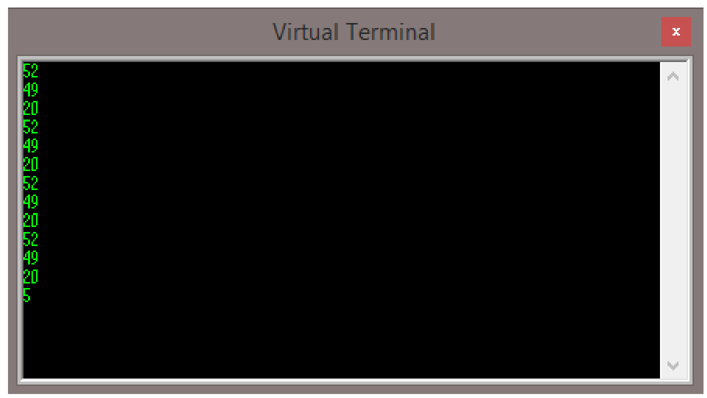

Fig 11: Output

XII. CONCLUSION

This is the one of the method to monitor the pollution level in industries. To monitor the pollution in industries using pH electrode, Air pollution sensor, temperature sensor, Gas sensor to control using Pick controller and transmit the message using GSM and ZIGBEE. And showing the simulation results to measuring the air pollution and transmit using ZIGBEE up to one kilometer and sent message using GSM.

XII. REFERENCES

[1]. Alessandro Depari, Alessandra Flammini, Emiliano Sisinni, Andrea De Marcellis, Giuseppe Ferri, and Paolo Mantenuto, “Fast, Versatile, and Low-Cost Interface Circuit for Electrochemical and Resistive Gas Sensor”, IEEE Sensors Journal, vol. 14, no. 2, FEBRUARY 2014.

[2]. Alessandro Depari, Alessandra Flammini, Daniele Marioli, Emiliano Sisinni, Elisabetta Comini, and Andrea Ponzoni,

"An Electronic System to Heat MOX Sensors with Synchronized and Programmable Thermal Profiles", IEEE Transactions on Instrumentation and Measurement, vol. 61, no. 9, SEPTEMBER 2012.

[3]. Godse A.P, Godse D.A, "Microprocessor & Microcontroller", book.

[4]. Jawad Sarfraz, Daniel Tobjörk, Ronald Österbacka, and Mika Lindén, "Low-Cost Hydrogen Sulfide Gas Sensor on Paper Substrates: Fabrication and Demonstration", IEEE Sensors Journal, vol. 12, no. 6, JUNE 2012.

[5]. Jun Li, Frank Albri, Robert R. J. Maier, Wenmiao Shu, Jining Sun, Duncan P. Hand, and William N. MacPherson, "A Micro-Machined Optical Fiber Cantilever as a Miniaturized pH Sensor", IEEE sensors journal, vol. 15, no. 12, DECEMBER 2015.

[6]. Mohd Adib Sarijari, Mohd Sharil Abdullah, Anthony Lo, Rozeha A.Rashid, "Experimental Studies of the ZigBee Frequency Agility Mechanism in Home Area Networks".

[7]. Sebastian Bicelli, Alessandro Depari, Guido Faglia, Alessandra Flammini, Ada Fort, Marco Mugnaini, Andrea Ponzoni, Valerio Vignoli, and Santina Rocchi, "Model and Experimental Characterization of the Dynamic Behavior of Low-Power Carbon Monoxide MOX Sensors Operated With Pulsed Temperature Profiles", IEEE Transactions on Instrumentation and Measurement, vol. 58, no. 5, MAY 2009.

[8]. Reza Filsoof, Alison Bodine, Bob Gill, Stephen Makonin, Robert Nicholson, "Transmitting Patient Vitals Over a Reliable ZigBee Mesh Network ".

[9]. V.Ramya, B. Palaniappan, "Embedded system for Hazardous Gas detection and Alerting", International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.3, May 2012.