A Low Cost Pollution Free System (PFS) for Smart Cities using Internet Of Things

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***Abstract*— Smart cites are one of the higher visions of our country to make it a pride. If we concentrate a particular city to become as a smart city, the major problems of the cities are needed to be sorted out and get solution through modern technology. The major factors that affect the cities are considered as pollution, earthquake and flood. In order to pre alert and make the city smarter the solution is proposed through an emerging technology "Internet of Things". In this technology, the sensors play a vital role for collecting the information and sensed data is processed through the controller then stored in cloud storage. The parameters being monitored are Temperature, rain, Vibration and smoke using the respective Sensors. These parameters can be monitored using pic Micro controller that will provide flexible data Transmission with low cost. The data gathered from respective sensors will be analyzed in the back-end and the results will be used to predict the pollution, earthquake and flood free environment for crating the smart cities across the countries.**

Keywords*— *smart cities, flood, pollution, IOT, PIC, sensors, earthquake.

I. INTRODUCTION

In recent decades, the science and engineering professions have been heavily influenced by their responsibilities to the society. This responsibility has been directed towards the protection of public health and welfare. In devising controls for emission of pollutants, scientists and engineers have developed strategies for monitoring the environmental pollution problems. Environmental monitoring is the processes of monitoring the circumstances of the city like to take counter measure on the hazards like pollution, flood and earth quake. These Activities must be closely monitored to develop a quality environment. Here environment is going to be monitored using temperature sensor to identify the temperature, and the Smoke sensor is used to find the pollution in the environment, Humidity sensor is used to monitor the humidity level. Vibration sensor is used to detect the earthquake. And Rain sensor is used to detect the rain information.

When IoT is amplified with sensors and actuators, the equipment turn out to be an illustration of the supplementary wide-ranging class of cyber-physical arrangement, which also encompass knowledge such as smart grids, effective influence power plants, elegant homes, intellectual transportation and also the smart cities. In smart cities, we need to track the high building and bridges periodically in order to realize life safety, maintenance and consequently economic benefits will definitely be gained. Therefore, many researchers and applications have been conducted and developed in the field IoT to monitor entire city based on environmental condition. Pollution free system (PFS) has drawn significant attention in the recent decades that supports environmental safety to make enhancement in developed cities and show them smarter. Thus, the potential advantage of PFS in the area such as smart cities has contributed to reduce the maintenance cost of the city and to increase the richness of the country.

II. REQUIREMENTS

Several technological trends have developed the opportunities for the implementation of innovative services.

i .PIC microcontroller

This System is fully based on the usage of a PIC microcontroller using IOT module for communication to monitor environmental parameter such as Temperature, pollution, rain and earthquake. The controller acts as central coordinator for data gathering and transmitting from sensors to cloud. The controller has more precedence over the enitre system.

ii. Wireless Sensor Networks

A Wireless Sensor arrangement is one kind of the wireless network comprise a great numeral of circulate intended for infinitesimal, low motorized devices that named sensor nodes called motes. These networks are certainly cover a very huge numeral of spatially disseminated, little, cordless, entrenched campaign that are networked to perceptively collect, procedure, and transport information to the operative, and it has controlled the competence of compute & dispensation. Nodes are the tiny computers, which work together to outline the arrangement.

iii. Internet Of Things

The **Internet of things** (**IoT**) is the association of substantial procedure, vehicle, residence appliances and items embedded with electronics, software, sensors, actuator s, and connectivity which enables these objects to connect and exchange data. the IoT permit substance to be intellect or prohibited distantly transversely obtainable set of connections communications, creating opportunity for more straight incorporation of the corporeal humanity into computer-based organization, and resultant in enhanced good organization, accurateness and financial advantage in adding to concentrated individual interference. When IoT is

amplified with sensors and actuators, the expertise becomes an occurrence of the additional common class of cyber-physical systems, which also include technology such as smart grids, virtual power plants, smart homes and equipments well organized and high efficient , intelligent transportation maintenance and smart cities.

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iv. Cloud Computing:

Cloud computing is an data management (IT) prototype that facilitate omnipresent admittance to communal collection of configurable organization resources and high-level services that can be quickly provisioned with negligible administration endeavor, frequently over the Internet. Cloud computing relies on distribution of resources that possess to accomplish consistency and economies of scale, comparable to a people utility.

III RELATED WORK

The advance over wireless sensor networks was tremendous in these days, here are such systems which are comparably developed by some authors. More number of varieties have been included while developing the environmental monitoring system for the betterment of the countries. Reducing energy constrained through smart cameras has major challenges. Choosing cameras is very difficult for this kind of system because of its low communication range and power. These flaws may be overcome due to sensorcam [1], a long range smart wireless camera which runs on open platform that consists of better power management. This is a simple method for environmental monitoring but deals with some cost factor. A low-cost monitoring system had been developed using Arduino Open source platform to capture the environmental data in the forest [5]. It leads to prevent the forest fire and toxic gases emitted in it. There is a system built exclusively for temperature monitoring which mostly suits for industrial applications. The data accuracy is concentrated on sensing and data transmitting over various environments. It is not much considered and it is only focusing on temperature leads to unsuccess of the system [6]. Systematic, automatic and reliable monitoring system is proposed to assist threat and counter measures to prevent threat from the environmental flows [3]. Hence there were many drawbacks in the existing works which can be considered as a problem statement for the proposed work.

IV SYSTEM DESIGN

This system is designed using various sensors for fetching the data and imposed with microcontroller to control the sensors and transmit the data to the cloud storage. We use the following sensors like smoke sensor, rain sensor, seismic sensor and temperature sensor for monitoring various parameters like pollution, flood and earthquake. These sensors are integrated with PIC micro controller for the data collection and transmission to outside world from the sensors. The Fig 1. block diagram will explains the clear picture of the system.

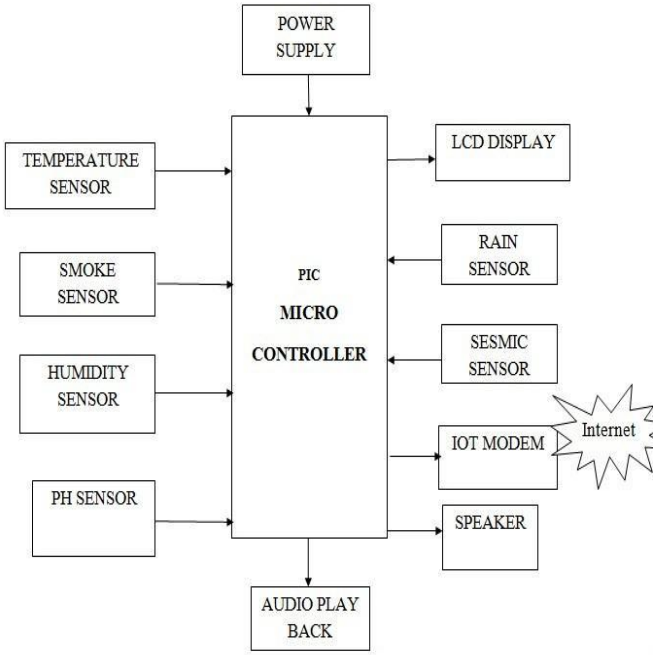

Fig 1. System Design

The block diagram of the system is explained as follows, As you can see that PIC act as a central controller that will be setup on the cities and it will be connected to a wireless network using IOT modem through which the data at Backend will be uploaded in cloud which will be hosted in public cloud domain. The data from the sensors plays vital role for developing the PFS system from which the goal is achieved. All the sensors assigned for the purpose will be connected to the controller as shown above.

V IMPLEMENTATION

A. ***i . MicroController***

PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC 16F877 features all the components which modern microcontrollers normally have. The figure of a PIC16F877 chip is shown below

Fig 2. PIC Controller

100000 times erase/write cycle enhanced memory, 1000000 times erase/write cycle data EEPROM

memory, WDT with its own RC oscillator for reliable operation and Programmable code protection are the special features of PIC micro controller.

i i *LCD Display to check the output and display*

Fig 3. LCD Display

LCD is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter. When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back. As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through. That particular rectangular area appears blank.

SENSORS USED

i Vibration Sensor:

Based on piezoelectric effect equipment a variety of corporeal quantity can be calculated; the preponderance frequent is heaviness and quickening. For heaviness sensors, For accelerometers, a seismic mass is emotionally implicated to the gemstone fundamentals. When the accelerometer understands a movement, the invariant seismic accumulation loads the fundamentals according to Newton's second law of motion.

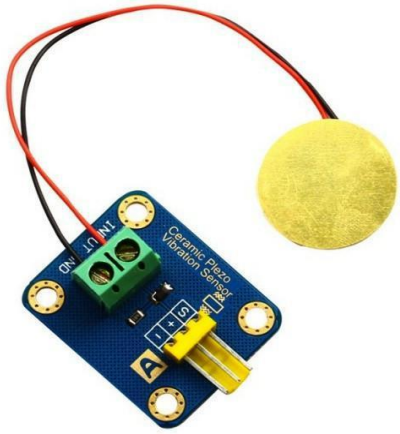

Fig 4.Vibration Sensor

The major dissimilarity in operational opinion connecting these two cases is the method they concern services to the intellect of the elements.

ii. Rain Sensor

Water sensor brick is designed for water detection, which can be widely used in sensing the rainfall, water level, even the liquate leakage. The brick is mainly comprised of three parts: An electronic brick connector, a 1 MΩ resistor, and several lines of bare conducting wires.

This sensor works by having a series of exposed traces connected to ground and interlaced between the grounded traces are the sens traces. The sensor traces have a weak pull-up resistor of 1 MΩ. The resistor will pull the sensor trace value high until a drop of water shorts the sensor trace to the grounded trace. It detect the amount of water induced contact between the grounded and sensor traces.

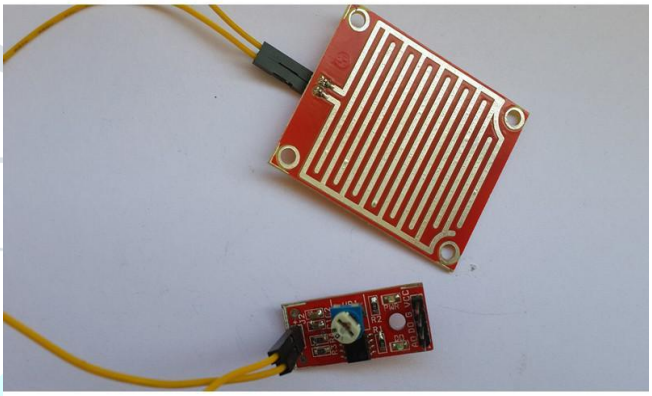

Fig 5.Rain Sensor

This item can judge the water level through with a series of exposed parallel wires stitch to measure the water droplet/water size. This item can easily change the water size to analog signal, and output analog value can directly be used in the program function, then to achieve the function of water level alarm. This item has low power consumption, and high sensitivity, which are the biggest characteristics of this module.

iii. Seismic Sensor

An instrument used in seismic exploration and designed to p ick up mechanical oscillations ofthe ground and convert the m into electrical oscillations. Inertial sensors are used for wo rk onland. A common type is an electrodynamic sensor with natural frequencies of 0.50 Hz andwith aperiodic critical da mping. There are vertical and horizontal seismic sensors. Ve rticalsensors, which primarily record compressional waves (P waves) arriving from below, are usedmost often. Horizont al types are used to record shear waves (S waves). A three-componentsensor consisting of a vertical sensor and two hor izontal sensors in a single housing is used tostudy the total v ector of ground displacement.

iv.Temperature Sensor

There're many types of devices that can be employed as temperature sensors. They include integrated circuits (ICs),

pyrometers, resistance temperature detectors (RTDs), thermistors, thermocouples, electromechanical & volume (EMV). LM35 is a precision IC temperature sensor with its output proportional to the temperature (in oC). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possess low self heating and does not cause more than 0.1 oC temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every oC rise/fall in ambient temperature, i.e., its scale factor is 0.01V/ oC.

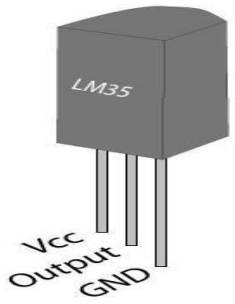

Fig 6.Temperature Sensor

We use LM-35 as a temperature sensor for our system which affords in a low cost.

v. IOT Modem

SIM800 is a complete Quad-band GSM/GPRS solution in a SMT type which can be embedded in the customer applications.SIM800 support Quad - band 850/900/1800/1900MHz, it can transmit Voice, SMS and

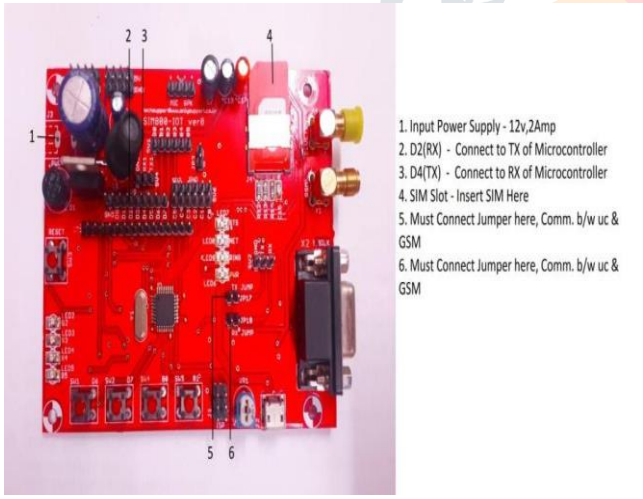

Fig 7. IOT Modem

data information with low power consumption. With tiny size of 24*24*3mm, it can fit into slim and compact demands of customer design. Featuring Bluetooth and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

vi. Connection Details

A hardware kit is developed with the integration of sensors and controller for which we mention the important connection details in the below table.

Jumpers	JP17 - TX - Connect the J17 Jumper, to make communication between on board microcontroller and GSM modem
	JP18 - RX - Connect the J18 Jumper, to make communication between on board microcontroller and GSM modem
	JP3 - Connect the JP3 Jumper, to make On Board LCD Backlight ON
.LED's	LED's to indicate POWER, STS, NET
IC	On Board ATMEGA-8 Microcontroller
TTL	TTL Serial Communication for GSM Modem to PC
GSM	SIM800A GSM Module

Table-1 hardware connection details

VI. RESULTS

We develop a new prototype with sensors and controllers fixed as a whole unit. In this proposed model, we monitor four calamities such as temperature, pollution, flood and earthquake. We try to monitor these calamities and those monitored data were stored in cloud. The monitored data is then retrieved and from the obtained results we determine whether the obtained values are within the normal range or exceed the threshold such that we create the PFS.

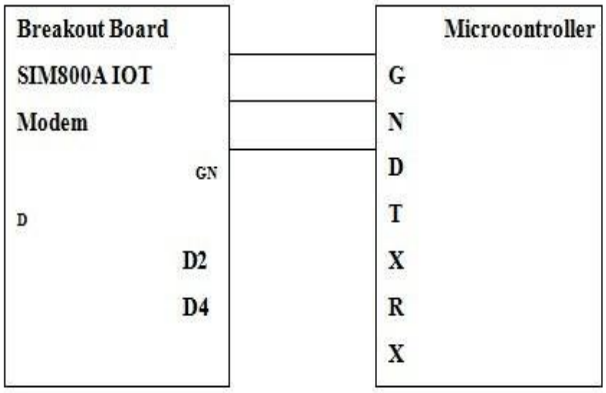

Table-2 Reference Circuit

The output console is developed using the proteus simulation tool which is shown below.

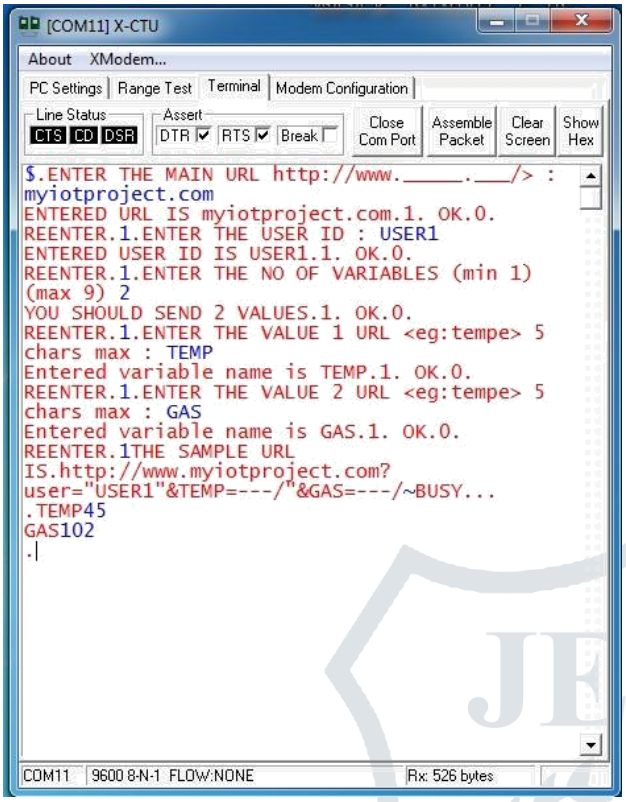

Fig-8 Output Console

The web interface is shown below

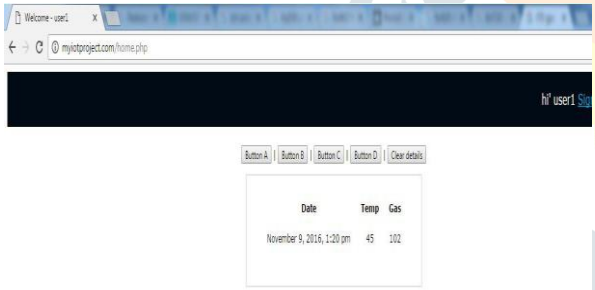

Fig-9 Web Console

Thus the output can be seen in three ways viz, LCD display, Console developed in simulation tool and web console for easy user interface. Thus the advancement of the system completely depends on the technology and the sensors used with cost effective.

VII. CONCLUSION

Hence the small prototype had been developed for pollution free system to make smart cities supported by the above experimentation and results. In this a low cost pollution free system, that also keeps an eye on environments is proposed and a model for monitoring the different calamities of the nature using the concepts of IoT is developed. This monitoring is done with help of sensors to achieve more accuracy in real time with low cost.

VIII FUTURE ENCHANEMENT

This idea can be extended for complete monitoring of smart cities with various scenarios & conditions with the real time data to be live updated in cloud. This data can be taken for various data analytics purpose with machine learning concepts to move into automation arena in near future.

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