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Environmental Monitoring Using IoT Application for WSN Platform

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ABSTRACT: The Internet of Things provides a virtual view, using Internet Protocol, to a varirty of real life applications ranging from a teacup, to a building, to trees in a forest or agriculture. IoT is a networked interconnection to the everyday objects which are embedded with hardware, software, sensors and usually connected with ubiquitous intelligent. By accessing remote sensor data any place can control from a distance using IoT . WSN is most beneficial for long term data acquisition for IoT applications. Basically the proposed system that is environmental monitoring for IoT is to control the sensed data through ARM processor and transmission of data safely using RF. The system also uses GSM module for secured and global communication. The proposed system can be applied to many applications like green house, agriculture; industrial waste monitoring or location can be anything we may be interested in. The system is designed considering quality output, easy deployment, low cost, low power, long life and safe communication. This paper presents design and implementation of WSN platform which can be used for a range of long term environmental monitoring Interenet of Things applications.

KEYWORDS: IoT, GSM, RFID, Wireless Sensor Network, Sensor Nodes, WAMP Server.

I. INTRODUCTION

The Future internet, called as “Interenet of things” is seen to be a worldwide network of interconnected objects with unique address having standard communication protocols[12]. A system like sensors, RFID tags, computers, or mobile phones will be able to dynamically connect to the network, collaborate, and work efficiently to achieve different tasks. Including WSN platform in such a environment will open new directions or perspectives. Any physical system can be controlled and operated easily by using wireless technology if it is compared to manual operation[4]. If this automation is considered for environmental monitoring, it responds very fast. Also it increases chances of secure communication, speed of the system operation. Human entered data was seen as a limiting factor for acquisition systems, cost and pervasiveness.

Two main technologies are called as a key enablers for IoT are RFID i. e. Radio Frequency Identification Tag and WSN i.e. Wireless Sensor Network. While considering application field, WSNs plays very important role by collecting surrounding information and context. WSN helps to reduce physical efforts in the automated systems. WSN bring richer capabilities to IoT application for both sensing and actuation. The proposed system can be called as a smart system as it can measure parameters automatically. Sudden and gradual changes in environment undergoes in recent years because of human careless behaviour about environment. This results in disasters which can cause harms to human lives. The system can intimate in advance to user about such causalities.

This system also uses GSM module for the wireless control of environmental parameters.In this system, GSM network is used to give the status of each sensor connected to the controller on mobile. Applications and limitations of this monitoring system are discussed briefly.

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II. STRUCTURE OF WSN PLATFORM

The proposed system is divided into three parts : 1) Sensor node 2) WAMP server and 3) Monitoring devices .The tiered structure of WSN platform is shown in figure.

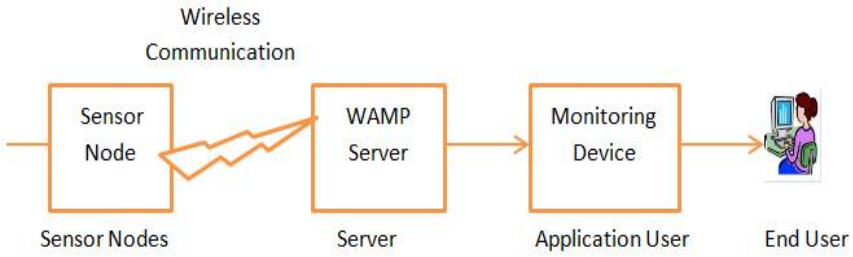

Fig. 1 Structure of WSN Platform

A sensor network is composed of number of sensor nodes,[8] User can spread wide variety of sensors within the interested area to monitor all collected data by extending period of time which can enable researcher to study if there is any complex interactions within the environment.[11]For good application performance sensor node's specifications is important. Sensor node parameters like weight, physical size, cost reduction and maitenance free service are also important requirements.[1] WAMP server known as a software stack for windows operating system .WAMP is also called as database which collects, process and forward the information received from RF receiver to the server which is connected to the internet . PHP is the part of WAMP server and is used to access the data from database. Backend alerts means end users processes this stored data using internet.

III. BLOCK DIAGRAM

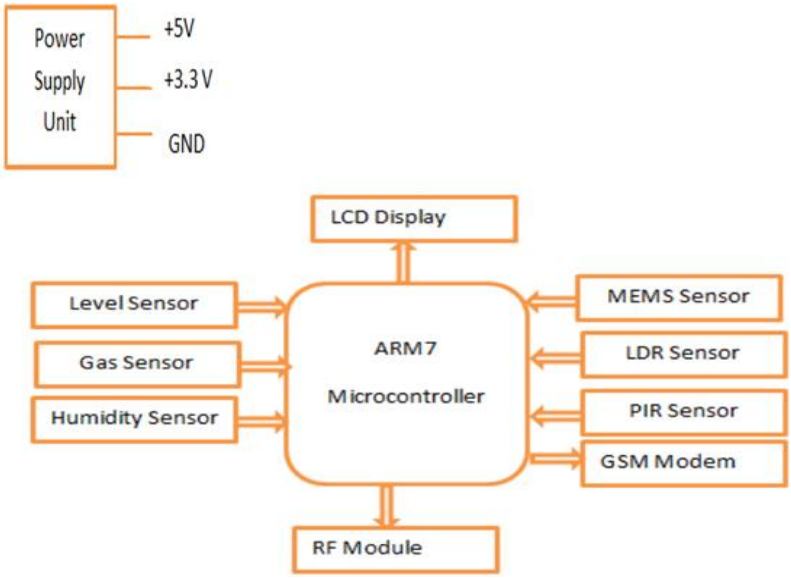

Fig. 2 Block diagram of Transmitter with GSM Modem and Power Unit

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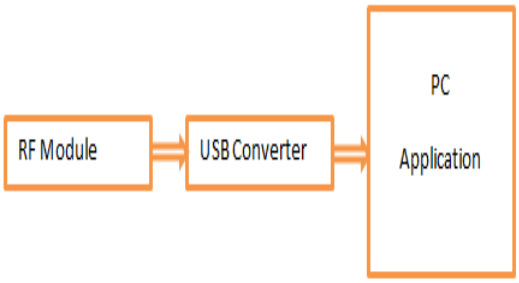

Fig. 3 Block diagram of receiver

IV. BLOCK DIAGRAM DESCRIPTION

The block diagram is divided into following modules:

1. Power supply : When working with electronics, always need one basic thing i.e. Power. Power supply is required in every electronic circuit. Each and every component should work properly, the exact amount of voltage and current to be supplied to it. If the power exceeds its limit, it can be fatal. Power supply which gives output of 5V , 3.3V is used in the system , as only that much is required for microcontroller.

2. LPC 2138 Microcontroller: The NXP (Philips) LPC 2138 is an ARM7TDMI-S based 32 bit RISC microcontroller. [2] LPC 2138 processor is used in proposed system to monitor process and control the process. LPC 2138 saves up to 33% less power than other microcontrollers. It is having 512 kB high speed flash memory. All the sensors are interfaced to LPC 2138 which is heart of the system. On chip ADC [6] improves the performance of LPC 2138. PIR & LDR sensors are digital sensors & other four sensors are analog sensors.

3. Sensor module: Sensors module consists of six types of sensors. These sensors collect information about status of environmental parameters and feed it to controller. Function of sensors is given here.

a) Level sensor:
Float Sensor is an electrical ON/OFF Switch, when liquid level goes up or down with respect to specified level it operates automatically. The signal from float sensor can be utilized for control of motor or relays . Float Sensors contain hermetical sealed Reed Switch in the stem and a permanent type magnet in the Float. As the float rises or falls with the level of liquid the Reed switch is activated by magnet.
working: Available either Normally Open, Normally Close, Change Over Contact Form
If water crosses to the danger level in dam, tank or reservoirs, level sensor will check water level & it will processes signal accordingly. Level sensor is Float sensor type. It operates automatically when liquid or water level goes up or down w.r.t. its specified level. Thus the Signal available from the float Sensor can be used for controlling of a Motor Pump or allied electrical elements.

b) Gas sensor:
The enveloped MQ-7 have 6 pin 4 of them are used to fetch signals, and other 2 are used for providing heating current. MQ 7 is highly sensitivity to carbon monoxide.

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Gas sensors are designed to detect and measure CO2 level and give intimation of dangerous level mixed in the environment to end user. MQ7 gas sensor is used to sense the gas. As CO2 is detected it will give intimation of gas detected. Output is given to ADC pin of ARM 7.

c) Humidity sensor: SY-HS-220 sensor is used to check the water vapour contained in the air or environment. Like other analog sensors it also gives output in the form of humidity if humidity is there in environment. Output is connected to the analog pin of processor.

d) MEMs sensor: Micro-electro-mechanical systems sensor is used to measure shocks, dynamic acceleration, vibration and static acceleration (tilt or gravity). ADXL 335 with 3 axis sensing, low power is preferred. It can survive at 10000 g shocks.

e) LDR sensor: Light Dependent Resistor (LDR) is used to detect light intensity. It helps in maintaining light intensity required to maintain environment. Example: Green houses.

f) PIR sensor: Pyro electric infrared module sensor allows users to sense motion, mostly used to detect whether human or animal body has moved in the sensor range. Module provides an optimizedcircuit that will detect moving animal up to 6 meters away.

It is inexpensive, small in size, easy to use. [3] When human body is detected output of PIR sensor goes high.

4. GSM Modem: SIM 900 [7]GSM Modem is used to communicate over longer distances & to alert authorities via SMS on mobile. GSM (Global system monitoring) system & RF Module uses serial communication UART devices i.e. UART0 & UART1. The system uses a wireless communication through GSM network.

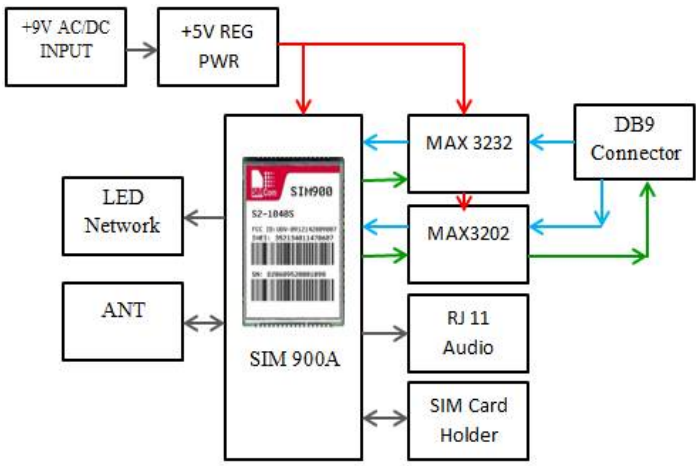

Fig. 4 General block diagram of GSM module

Now a day, every person has a mobile phone with him and GSM network makes it possible for people to communicate with each other. So in this projecta device based on the GSM network to control environmental parameters through cellular phones is designed. [4] The system includes cell phone which is connected to the designed system via SIM card holder. If there is any message regarding parameter change,the system sends a message to cell phone of user from the SIM Card inserted in GSM module.

GSM module SIM 900 is used in this project. It works like a cell phone and offers a facility of sending message to user phone. This communication of sending messages is programmed by using AT commands. The basic AT commands which are necessary are used in programming of microcontroller. Figure shows GSM modem having signal pins connected to the communication port includes: RJ 11 audio, SIM card holder, antenna, LED network, transmitter and receiver pins, external power pins, flash programming signal pins.Tx and Rx pins are used for the serial communication with controller. Various AT commands are there to check SIM card connection and signal range. Some basic commands for GSM are used in the program of controller to connect with the GSM module.

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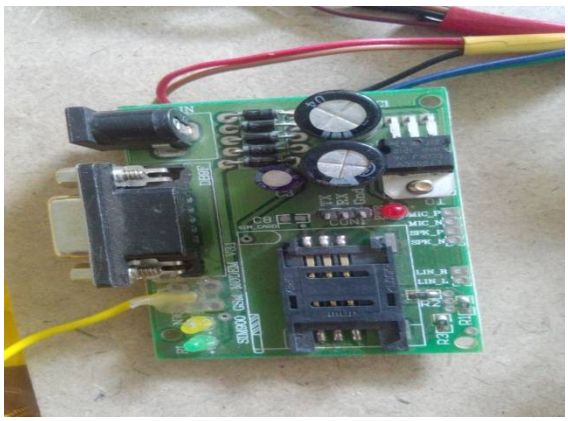
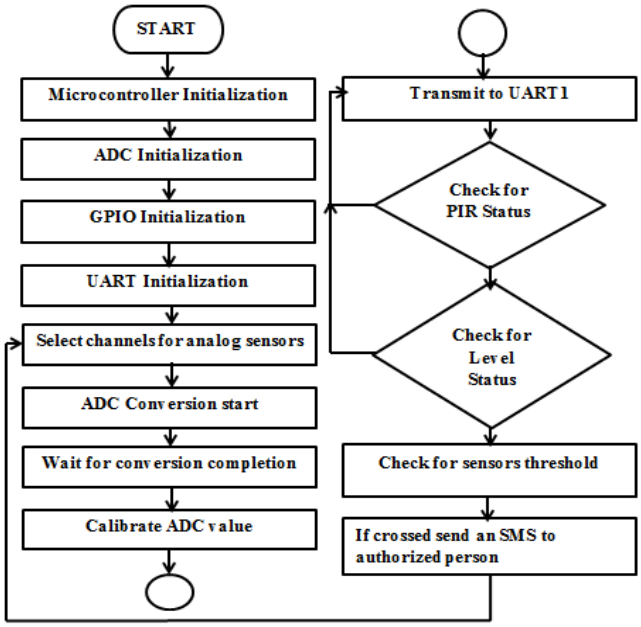


Fig. 5 SIM 900 GSM Modem

5.RF Module: Wireless Serial Communication RF Module, 2.4 Ghz, 30 m range (Wireless UART @9600) is used. RF tx module receives data collected by microcontroller. It transmits received data to RF rx module and RF module transmits this received data to end user through USB converter.It has 30 meters range with onboard antenna. [5] Typically, thistrans-receiver is used with a microcontroller.

6. PC Application: Java is used as PC application. WAMP server tool is used to store received data in its database from RF receiver. The system contains typical client-server architecture where, the client accesses the server through the LAN router and the Internet. Whenever the client wants to access server, it sends request to the server, this request is taken by router - connected to the Internet. The web processes the request made and finally connects to the desired web server, access the requested data and sends the data to the client.

V. FLOWCHART FOR THE SYSTEM



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VI. EXPERIMENTAL RESULTS

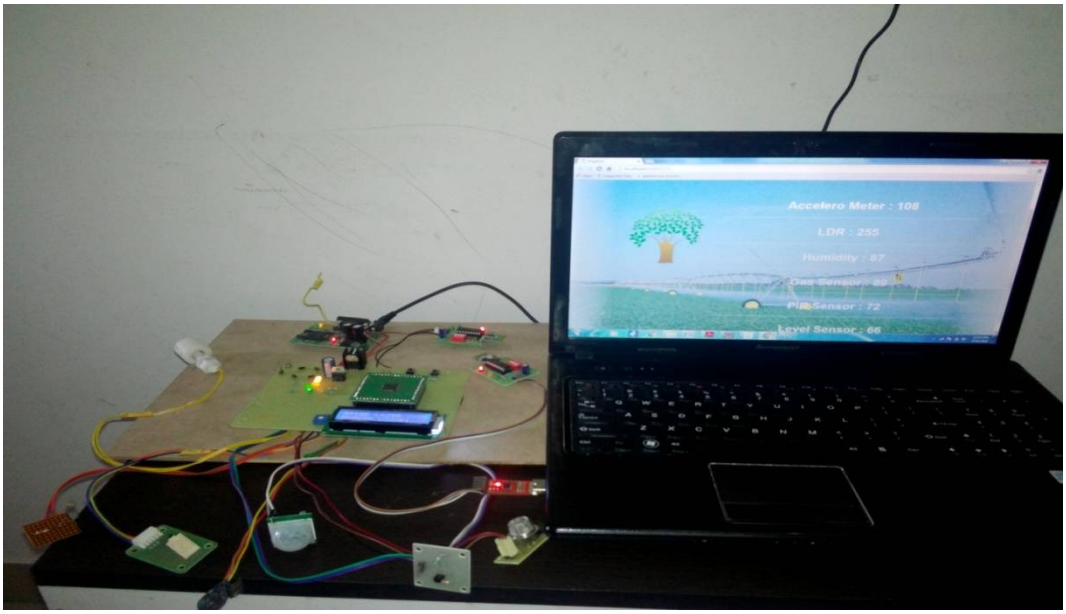

Fig. 6 Experimental setup for the system

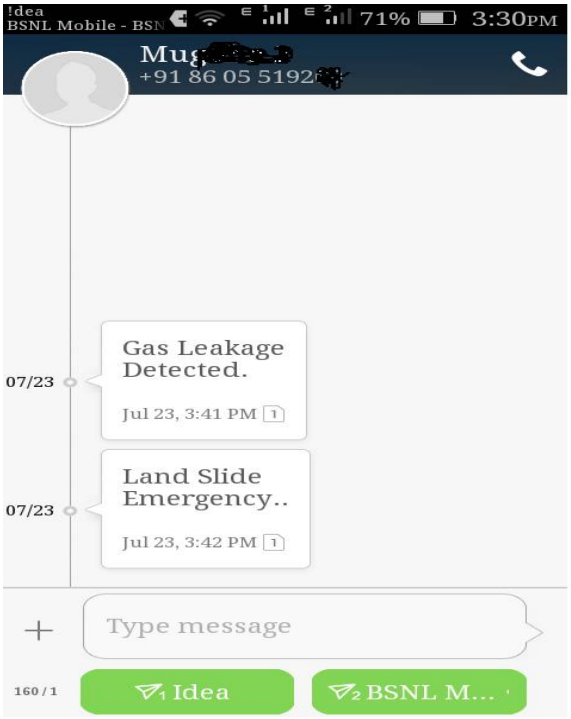

Fig. 7 Output of GSM on Mobile Phone

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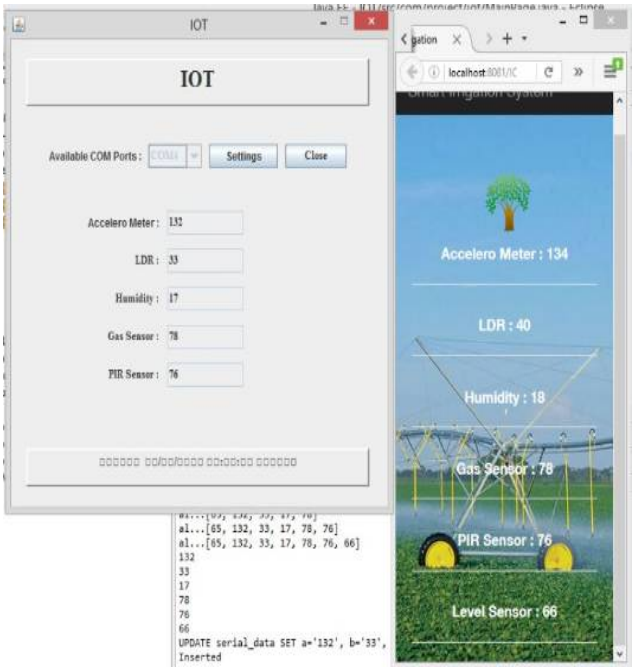

Fig 8 Result in tabular form using Java application on PC

VII. CONCLUSION

Wireless Sensor Network is designed successfully and implemented for the purpose for which it has been designed. On observation of the performance it is concluded that the present system is reliable and variety of applications can be applied. Application parameters calculation and monitoring is precise and automatic even over the larger area. System can be monitor globally using uploaded data over internet. GSM is an alternative secure way to the internet. Parameters threshold can be changed depending upon the environment

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BIOGRAPHY

Venkat Ghodke received the B.E. degree in Electronics Engineering from Dr.B.A.M.University, Aurangabad, Maharashtra, India, in 1997, and the M.E degree in Electronics Engineering specialization with Digital System from Savitribai Phule Pune University, Maharashtra, India, in 2010. Currently He is an Assistant Professor in AISSMS'S Institute of Information Technology of Savitribai Phule University of Pune, India.His research interests include digital image processing and embedded system area .He had worked in various Institutes as UG and PG guide for Image and embedded system design related area. He had published books and also published papers in various International Journal.

Sarika Shinde is persuing her M.E. degree from Savitribai Phule Pune University. She received the B.E. degree in Electronics and Communication Engineering from Dr.B.A.M.University, Aurangabad, Maharashtra, India, in 2009. She has 2.9 years industrial experiece as a Design engineer. Her area of interest is Embedded Systems and Digital Electronics.