ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Energy Efficient Sensor Mapping and Monitoring with Cloud Offloading Using IoT

Deepa Das
Department of Electronics and Instrumentation Engineering,
VNR Vignana Jyothi Institute of Engineering and Technology,
Hyderabad, Telangana-500090, India.

K.Ranga Sai
Department of Electronics and Instrumentation Engineering,
VNR Vignana Jyothi Institute of Engineering and Technology,
Hyderabad, Telangana-500090, India.

Abstract

Remotely monitoring of environmental parameters is important in various applicationsand industrial processes. In earlier period, monitoring systems are generally based onmechanical, electromechanical instruments which suffer from the drawbacks like poor rigidity, need of human intervention, associated parallax errors and durability. With the inclusion of electronics, the instruments were made compact and cheaper. However, these systems lack flexibilities of remote monitoring.

In this work, we have designed an Energy Efficient GPS Sensing with Cloud Offloading using IoT. The proposed system is an ARM based sensor node and it has the features of continuous monitoring of specified parameters.A traditional communication based security systems provides enhanced security as whenever a signal from sensor occurs, a SMS which uses GSM-GPS Module and LPC2148 microcontroller is sent to a desired number to take necessary action.

The system is deployed to monitor any deviations in the parameters such as temperature, light, humidity, rainfall, IR rays and smoke/gas. A general interface is developed forsensing the different parameters such as temperature, light, humidity, rainfall, IR rays and smoke/gas and the data is to be uploaded to a serverwith the IoT module. The task is to design a sensing system which detects the temperature, pressure, humidity, rainfall, IR rays, smoke and light. The presence of the parameters content will be displayed on the LCD display and through the IoT module we can notice that changes in the cloud server and it is notified by using the SMS alert with the help of GSM-GPS Module. Each parameter is uniquely identifiable through its embedded computing system.

Deflection in any parameter is directly uploaded in the server and it is notified through SMS. The work is aiming to develop a sensing device which can detect all day-to-day life physical parameters and monitor on it. The task entails to design an Energy Efficient GPS Sensing.

*Keywords-****Temperature Sensor LM35, Light Detecting resistor, LM358 IC 2 IR transmitter and receiver pair, Smoke Sensor –MQ2, Humidity Sensor, Rainfall Sensor, ARM7 (LPC2148) microcontroller, IOT Module – ESP8266, GSM (Global System for Mobile) Module – SIM800LIM Controller, GPS (Global Positioning System) Module – G65.***

INTRODUCTION

This paper outlines an approach to use sensor technology as a service, the integration of sensor technology and internet services, and methods of communication between them [1].

By accessing all the sensor networks, environmental behaviours are collected as a streaming data base to identify the environmental conditions. This methodology

Cite this article as: Deepa Das & K.Ranga Sai, "Energy Efficient Sensor Mapping and Monitoring with Cloud Offloading Using IoT", International Journal & Magazine of Engineering, Technology, Management and Research, Volume 4 Issue 11, 2017, Page 218-225.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

gives the monitoring data from stationary nodes deployed in city to the mobile nodes and the internet server which can be accessed from any location of our choice. This research work adopts the concept of "Internet of Things" [2] and implements an idea of energy-saving by proper management of sensors. This work mainly aims to design and develop reliable, efficient, flexible, economical, real-time and realistic wellness sensor networks for smart home systems [5].

PROPOSED MODEL

The Primary Objectives of this work are

- Detecting the parameters temperature, light, IR rays, smoke/gas, humidity and rainfall using the sensors Temperature Sensor LM35, Light Detecting resistor, LM358 IC 2 IR transmitter and receiver pair, Smoke Sensor –MQ2, Humidity Sensor, Rainfall Sensor respectively which are connected to the ARM7 (LPC2148) microcontroller
- The GPS(Global Positioning System) module - G65, shall continuously transmit data about the current position
- The GSM module communicates to the microcontroller with mobile phones through UART and alerts by SMS.
- Internet of Things – ESP8266 is used to send the data to the cloud server.

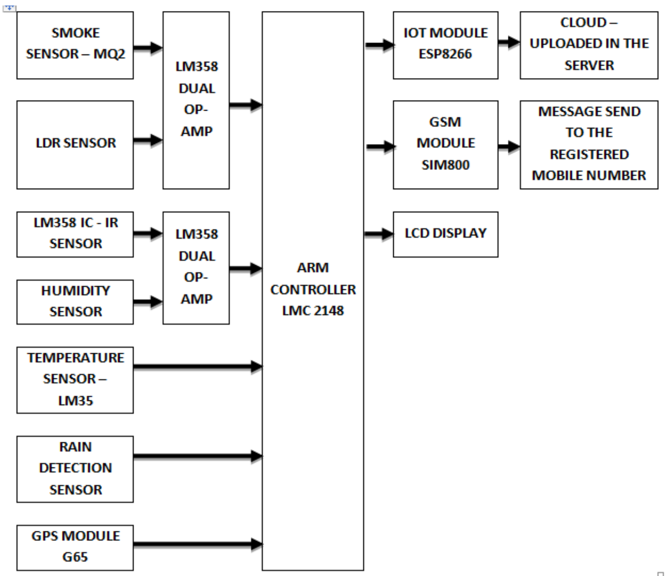


Fig.1: Block Diagram of Proposed System

ARM7-LPC2148 Microcontroller:

LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high-speed flash memory ranging from 32kB to 512kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM [3] of 8kB up to 40kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low-end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

Power supply unit:

This section needs two voltages viz., +12 V & +5 V, as working voltages. Hence specially designed power supply is constructed to get regulated power supplies.

Temperature Sensor - LM35:

The LM35 series are precision temperature sensors. Its output voltage is directly proportional to the Celsius temperature. Therefore, LM35 has an advantage over linear temperature sensors calibrated in °Kelvin, as the user does not need to subtract a large constant voltage from its output to obtain suitable centigrade scaling. It can be used with single power supply or with plus and minus power supplies. It sinks only 60μA from its supply, it has less self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55 to +150 °C temperature range.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Humidity Sensor:

Humidity measurement instruments usually rely on measurements of some otherquantity such as temperature, pressure, mass or a mechanical or electrical change in asubstance as moisture is absorbed. By calibration and calculation, these measuredquantities can lead to a measurement of humidity.

Gas/ Smoke Sensor – MQ2:

A Smoke detector is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of equipment is used to detect a gas leak. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

The Gas Sensor (MQ2) [4] module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.The sensor value only reflects the approximated trend of gas concentration in a permissible error range, it does not represent the exact gas concentration. The detection of certain components in the air usually requires a more precise and costly instrument, which cannot be done with a single gas sensor.

LDR Sensor:

An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. A light-dependent resistor (LDR) is a light-controlled variable resistor. The resistance of this decreases with increasing incident light intensity; in other words, it exhibits photo-conductivity. An LDR can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits. An LDR is made of a high resistance semiconductor. In the dark, an LDR can have a resistance as high as a few mega ohms (MΩ), while in the light, an LDR can have a resistance as low as a few hundred ohms. If incident light on an LDR exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band.

LM358 IC - IR Sensor:

IR sensor detects IR radiation falling on it. Depending on the application there are many types of IR sensors which can be built. IR Sensors uses a specific light sensor to detect a particular light wavelength in the Infra-Red (IR) spectrum. Here we can install a LED which produces light of same wavelength as per sensor's specifications to observe the intensity of the received light. The light from the LED reflects back from the object and into the Light sensor when that object is close to the sensor. Because of this the intensity of the received light suddenly increases and this can be detected by using threshold.

Rain Drop Detection Sensor:

A rain sensor or rain switchis a switching device activated by rainfall.

ESP8266 IOT Module:

ESP8266 Wi-Fi module gives accessto Wi-Fi or internet. It is a very cheap device and makes very powerful. It can communicate with any microcontroller and it is the most leading devices in the IOT platform [6].

Here we used ESP8266 Wi-Fi module which is having TCP/IP protocol stack integrated on chip. So that it can provide any microcontroller to get connected with Wi-Fi network. ESP8266 is a preprogramed SOC(Security Operation Centre) and any microcontroller has to communicate with it through UART interface. It works with a supply voltage of 3.3V. The module is configured with AT commands and the microcontroller should be programmed to send the AT commands in a required sequence to configure the module in client mode. The module can be used in both client and server modes.

It is the leading IOT devices in the world in which it is very cheap and effective to use. The hardware connections required to connect to the ESP8266 module

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

are fairly straight-forward but there are a couple of important items to note related to power:

- The ESP8266 requires 3.3V power–do not power it with 5 volts.
- The ESP8266 needs to communicate via serial at 3.3V and does not have 5V tolerant inputs.so you need level conversion to communicate with a 5V microcontroller.

GSM Modem – SIM800:

A GSM module is a second-generation digital mobile cellular technology, which covers a fairly broad geographic area. This offers customized travel, financial, reference and commercial information to the users. It can operate in 400MHz, 900MHz and 1800MHz frequency bands.

The GSM modem can accept a SIM card just like a mobile phone and operate on a subscription to a network of mobile data transfer. The GSM Modem supports three types of services namely bearer or data services, supplementary services, and telecommunication services [7].

GPS Modem – G65:

Each GPS (satellite) transmits data that indicates the current time and its location. It transmits signals to a GPS receiver. This receiver requires an unobstructed view of the sky, so they can only be used effectively outdoors.

Liquid Crystal Display (LCD):

Dot Matrix LCD 16*2 (16 char & 2 rows) is used. It can display the location of a vehicle in terms of coordinates and the SMS sent or received by the GSM modem. The two rows of the LCD are used to show the north and east coordinate. The Pin 2 is connected to VCC and pin1 with Ground. Pin no 3 is connected with resistor value of 10K Variable Resistor that is used for the contrast colour of the LCD. Pin no 4 (RS), 5(R/W), 6(EN) are attached with P2.5, P2.6, P2.7 of the MCU respectively. Rests of the 8 pins are attached to port 0 of the MCU [8].

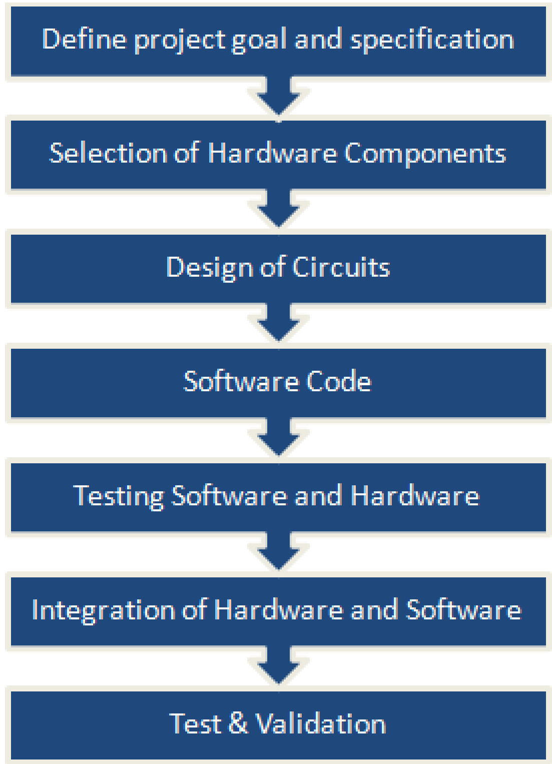


Fig.2: Flow chart of the system

Software to simulate the design:

- Keil µ Vision Compiler – for compilation.
- Flash Magic Programmer – for dumping code in Microcontroller.
- Proteus 7 (Embedded C) – for hardware simulation.
- Express PCB – for designing circuit board.

Although there are varieties of software packages, which can be used to simulate the circuit; the most commonly used are the circuit wizard and the PCB wizard. In order to test the circuit, Proteus design suite (software) is used. It is very powerful tool for the electronic circuit simulation, the schematic capture and the printed circuit board (PCB) design. By combining ISIS schematic capture and ARES PCB layout the Proteus design suite (software) provides an integrated and easy to use suite of tools for professional PCB design. The Proteus can be used to design a complex circuit for the simulation and the printed circuit board (PCB) layout.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

METHODOLOGY

System consists of the sensors used for acquiring required data from the atmosphere.The implemented system consists of a microcontroller (LPC2148) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. The sensors can be operated by the microcontroller to retrieve the data from them and it processes the analysis with the sensor data and updates it to the internet through Wi-Fi module connected to it.

Data from these sensors are basically analog signals. These analog signals are converted to its equivalent digital form. The data can be displayed on the 16x2 LCD connected to the microcontroller. To send data to a remote location the data from system is sent to the Wi-Fi module (ESP8266). Wi-Fi module is connected to the microcontroller using MAX 232 [5]-[9].The Wi-Fi module interacts with microcontroller using two ports i.e. transmitter and receiver provided on it. The measured data is sent from the module to any location within its range from the data can be fetched using a laptop/mobile. For that we have to give module the Wi-Fi details to connect to internet, and then provide the IP address of the website.

This project is developed to reduce the work load of human beings and to sense the parameters like Gas/Smoke, Temperature, Humidity, Rain, Light and Infra-Red Radiation. After sensing those parameters depending on the scenario the ARM controller will take appropriate action. This whole model can be placed anywhere. This model has Sensors as an input device to sense the environment conditions and depending on the parameter measured the controller will take appropriate action.

This module continuously monitors the environmental parameters of the place where it is placed. If the temperature varies, Gas detected, Rain fall detected, Humidity varies, light is detected and Infra-red light is traced when the environmental conditions varies, then the ARM controller [3] to convey the information will activate by displaying the changes in LCD display, intimates by SMS alert to registered mobile number and the data is displayed in the internet server to monitor in the remote location.

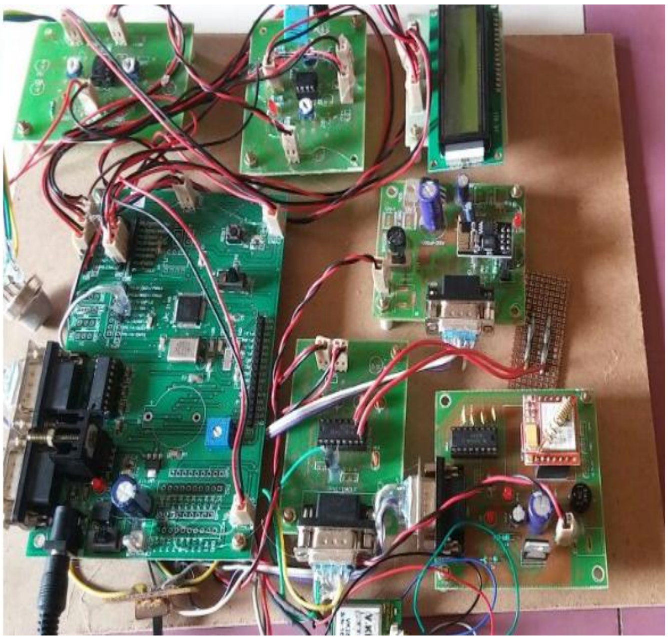


Fig.3: Experimental hardware setup

To transmit the measured value or monitored from remote location to another location a network of internet is required. To enable this a Wi-Fi module is used in the system. There are different modules available but here we are using the module ESP8266.It is basically a SOC which helps to meet user's continuous demands for efficient power usage, compact design and reliable performance in the industry of internet of things. It has 802.11 protocol support and Wi-Fi direct support. It operates on 3 to 3.6V input. As it is a SOC [7] it can be programmed accordingly to the user requirements and used. The main advantage provided by it is small in size.

It is used to connect processor to internet. In the system for the transmission of the monitored data from the area to be monitored and to another location Wi-Fi module is used. It basically connects the system to internet. The IP address of the particular website is provided to the module and then it sends the stored data to the website which can be fetched by using laptop or mobile.

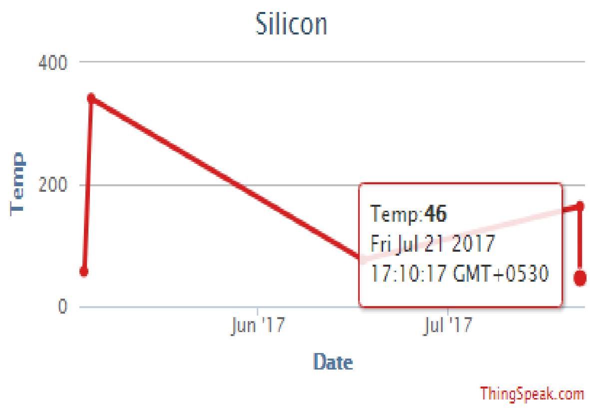
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

RESULTS AND DISCUSSIONS

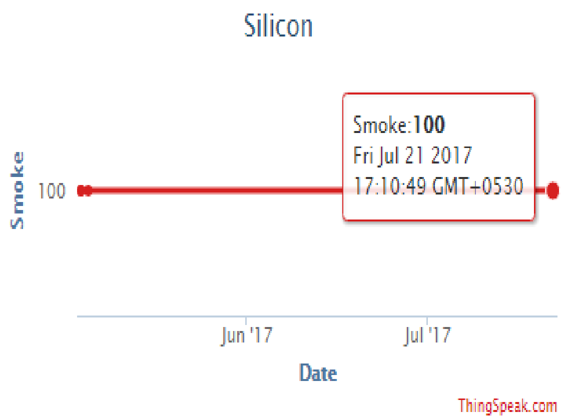
Output of the Sensors displayed in the Cloud Server with the help of IOT Module:

The below output data was collected on 21-07-2017 – in field visit and the data is uploaded in the Cloud Server.

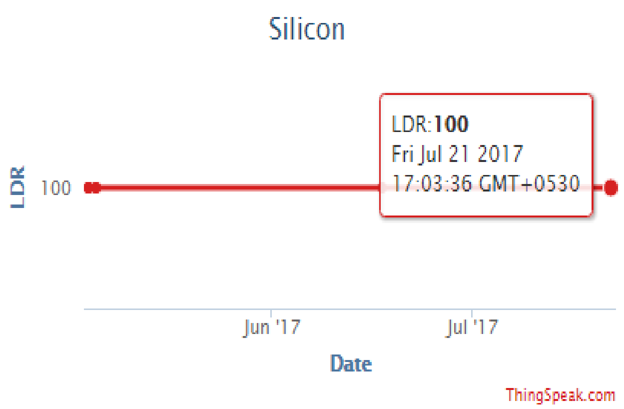
Temperature Sensor Output:



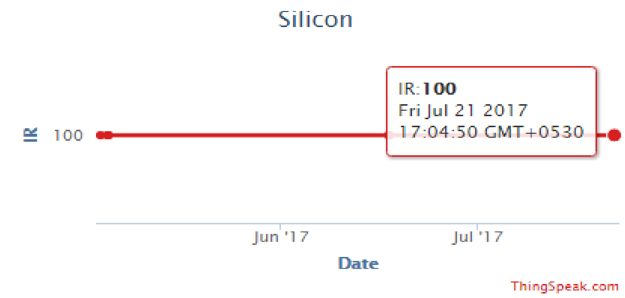
Smoke/ Gas Sensor Output:



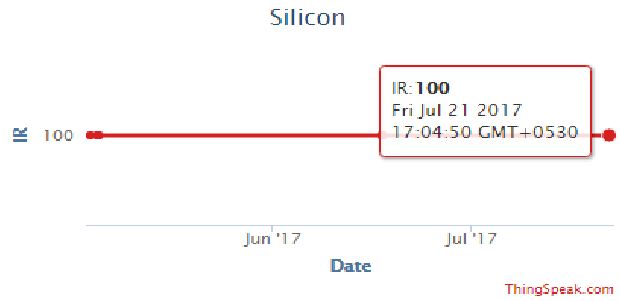
LDR Sensor Output:



IR Sensor Output:



Humidity Sensor Output:



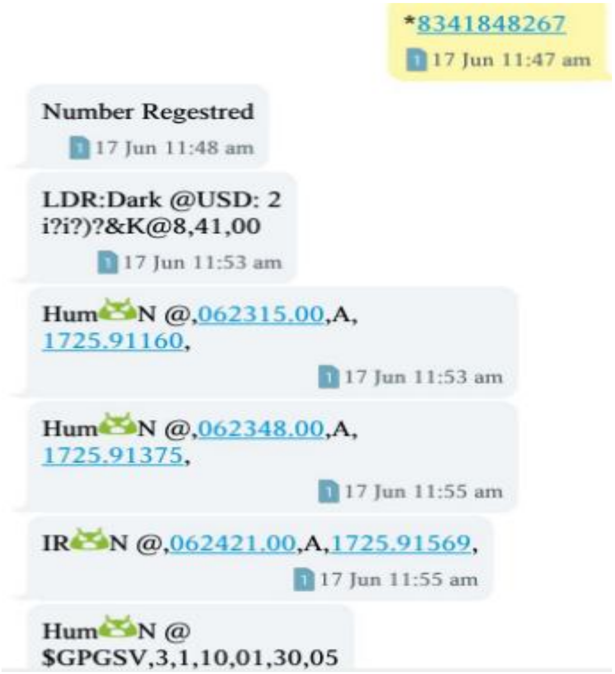
Rainfall Detection Sensor Output:

After sensing the data from different sensor devices, which are placed in particular area of interest. The sensed data will be automatically sent to the web server, when a proper connection is established with sever device. The web server page which will allow us to monitor and control the system. By entering IP address of server which is placed for monitoring we will get the corresponding web page.

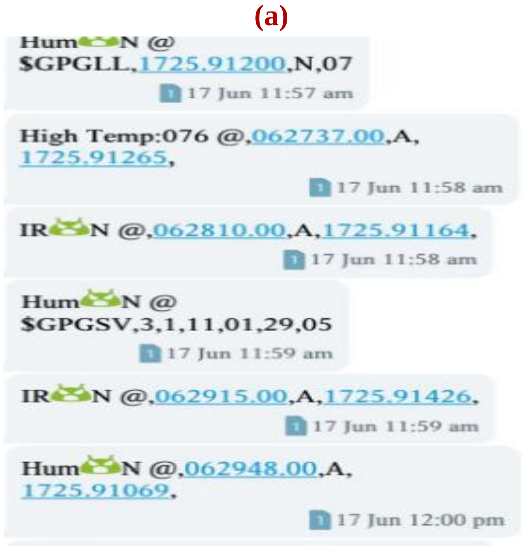
The sensed data will be stored in cloud. The data stored in cloud can be used for the analysis of the parameter and continuous monitoring purpose.

The positioning is done in the form of latitude and longitude along with the exact location of the place, by making use of Google maps. The system tracks the location of a particular vehicle on the users request and responds to the user via SMS. The received SMS contains longitude and latitude. The system is very simple and easy to use. There are various parameters which can be adjusted in this software.

The below output text message displayed in the field visit on 17-06-2017 and 24-07-2017.



(a)



(b)

Fig.4 (a) & (b): Output Message received to the Registered Mobile Number

The developed GSM based sensing system gives good response to the sensor and sends SMS when it detects the changes in the parameters once if it is increased above desired level. The time taken by the system to deliver the SMS is dependent on the coverage area or range of the specified mobile network. If the mobile is in the range of the system, then the SMS is delivered in 25-30 seconds.

CONCLUSION

By keeping the embedded devices in the environment for monitoring enables self-protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi. The smart way to monitor environment and an efficient, low cost embedded system is presented in this paper. In the proposed architecture functions of different modules were discussed. The monitoring system with Internet of Things (IoT) concept experimentally tested for monitoring six parameters. It also sent the sensor parameters to the cloud.

We have tested this system at various places. We have used it at the places where standard devices for the measurement of pollutants.

FUTURE SCOPE

This data will be helpful for future analysis and it can be easily shared to other end users. This model can be further expanded to monitor the developing cities and industrial zones for pollution monitoring. To protect the public health from pollution, this model provides an efficient and low-cost solution for continuous monitoring of environment

REFERENCES

[1].Nashwa El-Bendary, Mohamed Mostafa M. Fouad, Rabie A. Ramadan, Soumya Banerjee and Aboul Ella

Hassanien, "Smart Environmental Monitoring Using Wireless Sensor Networks", K15146_C025.indd, 2013.

[2].M. Brain, "How Microcontroller Works," HowStuffWorks, a division of InfoSpace LLC, [Online]. Available: http://www.howstuffworks.com/microprocessor.[Accessed 10 12 2014].

[3].H. D. Pham, M. Drieberg and C. C. Nguyen, "Development of vehicle tracking system using GPS and GSM modem," in IEEE Conference on Open Systems (ICOS), Kuching , 2013.

[4].M. Ahmad Fuad and M. Drieberg, "Remote vehicle tracking system using GSM Modem and Google map," in IEEE Conference on Sustainable Utilization and Development in Engineering and Technology (CSUDET), Selangor , 2013.

[5].Grzegorz Lehmann, Andreas Rieger, Marco Blumendorf, SahinAlbayrakDAI, "A 3-Layer Architecture for Smart Environment Models"/A model-based approach/LaborTechnische University Berlin, Germany978-1-4244-5328-3/10 © IEEE,2010

[6].Muhammad Saqib Jamil, Muhammad Atif Jamil, Ana Mazhar, Ahsan Ikram, Abdullah Ahmed, and Usman Munawar, "Smart Environment Monitoring System by employing Wireless Sensor Networks on Vehicles For Pollution Free Smart Cities" Humanitarian Technology: Science, Systems and Global Impact 2015, HumTech, 2015

[7].Hai Liu, Miodrag Bolic, Amiya Nayak, Ivan Stojmenović, "Integration of RFID and Wireless Sensor Networks", School of Information Technology & Engineering, University of Ottawa, Ottawa, Canada, K1N 6N5,

[8].Wazir Zada Khan, Yang Xiang, Mohammed Y Aalsalem, and Quratulain Arshad "Mobile Phone Sensing Systems: A Survey" IEEE COMMUNICATIONS SURVEYS & TUTORIALS, VOL. 15, NO. 1, 2013

[9].Anjaiah Guthi, Implementation of an Efficient Noise and Air Pollution Monitoring System Using Internet of Things (IoT), International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 7, July 2016.