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IoT based Wireless Framework for monitoring and controlling of Industrial Parameters using Raspberry Pi

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***Abstract*- Internet of Things (IoT) is rapidly increasing technology. Iot is a combination of physical objects embedded together with network , software, hardware electronics to communicate over internet. In this paper, we have tried to design a system which will automatically monitor the industrial parameters and generate Alerts and take decisions for controlling of the parameters using concept of IoT. IoT has given us a promising way to build powerful industrial systems by using wireless devices and sensors. The main contribution of the paper is to develop a secure wireless framework to monitor and control the industrial parameters.**

Keywords: IoT, Sensors, monitoring, server, wireless, network, interface.

I. INTRODUCTION

All industrial applications require collection of data in development, production, quality control management, process control, etc. The data collected is used to make decisions and control the operation by the computer without any human interface as per requirements i.e. automation helps to reduce human errors involved in process applications. Because of automation decision is achieved resulting into perfection of received data[8].

IoT is simply the network of interconnected things/devices which are embedded with sensors, software, network connectivity and necessary electronics that enables them to collect and exchange data making them responsive. More than a concept Internet of Things is essentially an architectural framework which allows integration and data ex-change between the physical world and computer systems over existing network infrastructure. Basically the Internet of Things is a combination of various independent technologies that form the fundamental component of IoT. The fundamental components that make internet of things a reality are: 1) Hardware:-Making Physical Objects responsive and giving them capability to retrieve data and instructions.
2) Software:-Enabling the data collection, Storage, manipulation, processing. 3)Communication infrastructure:-Topologies, protocols and technologies which enable two physical objects to exchange data.[5]

IoT is made in the service-oriented architecture (SOA) .The main motive of IOT is to connect different things over the network SOA can be applied to support IOT. From the perspective of their functionalities, a four layered service-oriented architecture of IoT is shown where the four layers interact to each other.[9]

Layers	Description
Sensing layer	This layer is integrated with existing hardware(RFID, sensors, actuators, etc) to sense/control the physical world and acquire data.
Networking layer	This layer provides basic networking support and data transfer over wireless or wired network.
Service layer	This layers creates and manages services to satisfy user needs.
Interface layer	This layer provides interaction methods to users and other applications.

Table. 1: Service Oriented Architecture of IoT

II. INDUSTRIAL IoT AND RECENT TRENDS

In recent years a wide range of industrial IoT applications have been developed and deployed. This has started from RFID ,these are microchips that can be detected wirelessly using radio waves. By using RFID readers, people can identify, track, and monitor any objects attached with RFID tags automatically. Wireless sensor networks (WSN) is another wireless technology that allows intergration sensors for monitoring . Its applications include environmental monitoring, industrial monitoring, traffic monitoring. Both RFID and WSN are used to develop IoT. Then upcoming technology is IoT with Artificial Intelligence. In previous year, Industry was monitored manually, but this paper introduces Artificial Intelligence to monitor as well as control the Industry autonomously.[3]

III. SYSTEM DESIGN AND IMPLEMENTATION

A. System Overview

In this modern era of automation and advanced computing using IoT with Artificial Intelligence offer promising solutions towards the automation of Industry. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure. The Block diagram of the proposed system is as shown in Fig.1.

The complete system is divided into three parts – Hardware , Software & Communication media.The Hardware unit is consisting of microcontroller/development boards, analog to digital converter (ADC), relays, wifi transmitters /wifi dongles, Power Supply, etc. The IoT device will acquire values of physical parameters and will perform digital conversion of them for further processing. This digital data is then transmitted using any of the wireless technologies. The job

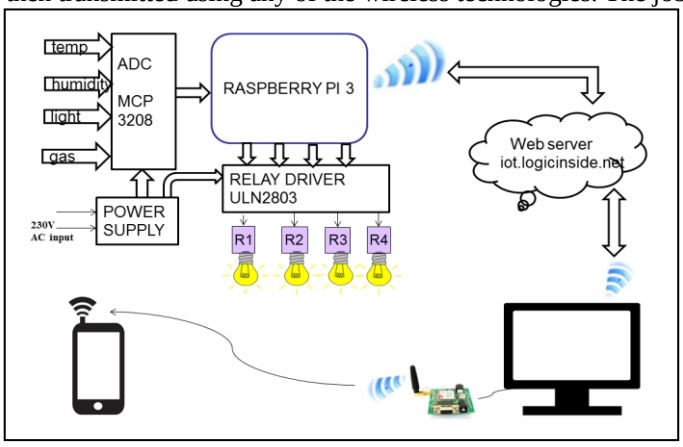


Fig.1: Functional block diagram

of Server is to receive those incoming values and transfer into PC. With the help of visual basics software necessary reading are plotted and information is displayed. The job of the controlling unit is to control the received parameters for optimum working of the device. It helps the device to operate within the specified range. The software will display the data (Voltage values) of all channels in real time.

B. Design and development

1) Sensor network: The prototype unit is well equipped with an open source Raspberry pi-3 having inbuilt Wi-Fi capability. The measured data from the sensors is transmitted by Raspberry Pi-3.The sensors used are LDR(Light dependent Resistor), temperature sensor LM35, humidity sensor HS220 and gas detector MQ6.These sensors interfaced with Raspberry Pi collect the data relentlessly.

2) Embedded board- Raspberry Pi-3: The Raspberry Pi is credit card-sized single-board computers .It has a 64-bit quad-core ARMv8 processor .The Raspberry Pi 3 computer is a wireless Internet capable system-on-a-chip (SoC) with 1 GB RAM, connection ports, a Micro SD card slot, camera and display interfaces and an audio/video jack[10]. We have used the GPIO pins for the interfacing of the ADC and the relay boards.

3) Network Connectivity: The system utilizes the wifi facility available on the raspberry pi -3 to communicate with the server. Also Ethernet connection can be provided using RJ45 cable. It supports IEEE 802.11 standard.

At its most basic level, the Internet of Things is all about connecting various devices and sensors to the Internet, here we have used the device to gateway model of connectivity as shown in Fig. 2. In the Device-to-Gateway model, IoT devices are connected to an intermediate device to access a cloud service. In this model application software operating on a local gateway device (for example a smartphone or a "hub") acts intermediate between an IoT device and a cloud service. This gateway could provide security..[11]

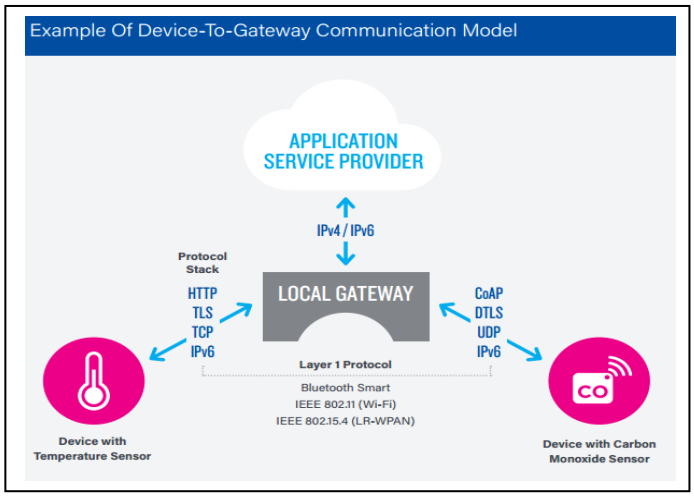


Fig. 2: Communication Model of the System

4) Real time sensor integration with cloud: The raspberry Pi uses either wired or wireless connectivity to feed the sensor data to online cloud. The cloud platform utilized for communication is iot.logicinside.net . It generates an API key for individual user and a channel or feed ID as well. The API key is used in the Raspberry pi code Written in C#.net to update and retrieve data to the cloud server. Once an API is assigned to a user then server allows user to create his own channel consisting of eight fields of data, three location fields and one status field.

5) Visual Studio User interface on PC:

A typical GUI is created using visual basics software and coding using C# serial client application that integrates raspberry pi with the server. Values received from all the sensors is sent in text file on cloud that can be easily accessed from any computer and make decision about the alerts generated. The Fig. 3 shows the C# interface for parameter monitoring.

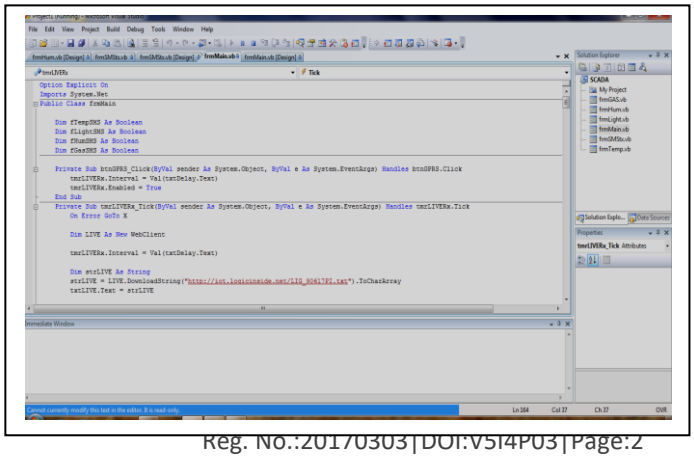


Fig. 3: The visual Studio interface

6) Message Alert using GSM: The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. It is a Dual-Band 900/ 1800 MHz wireless device.A GSM module is attached to the system so as to generate alert messages whenever the limis whether higher or lower the predefined values are crossed. The settings and the display of the GSM Setup is shown in Fig.8.And the alert generated message received on mobile is as in Fig. 9 [13].

IV. TESTING AND RESULTS

The complete hardware and experimental setup of the prototype are shown in Fig. 4.

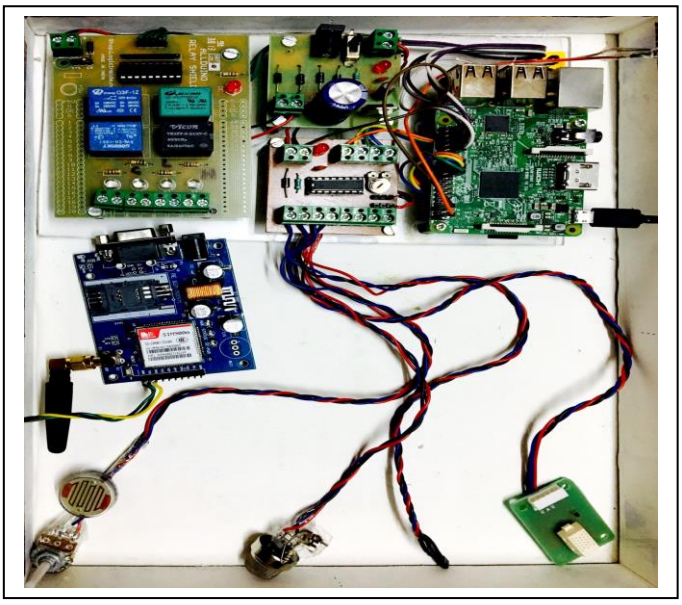


Fig. 4: Complete Hardware and Experimental Setup

The inbuilt Wi-Fi of the Raspberry Pi is used to provide network environment after allocating the IP address to the system as shown in Fig. 5.

Fig. 5: IP address configuring of the Raspberry Pi.

From Fig. 6 it is clearly visible that all the sensor values are getting updated to server in real time. Visual basic allows user to display the acquired values in numerical normalised form as well as in graphical form as in Fig. 7. These values will be updated and displayed relentlessly as long as Raspberry Pi is connected to Wi-Fi connectivity.

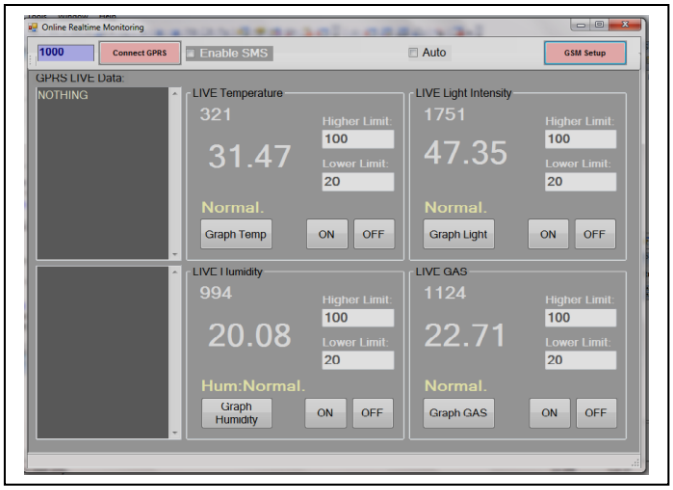


Fig. 6: Sensor values received in real time displayed on the visual basics interface

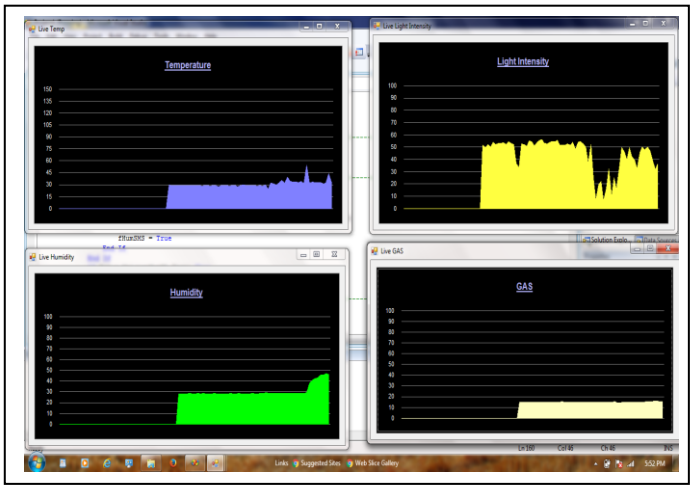
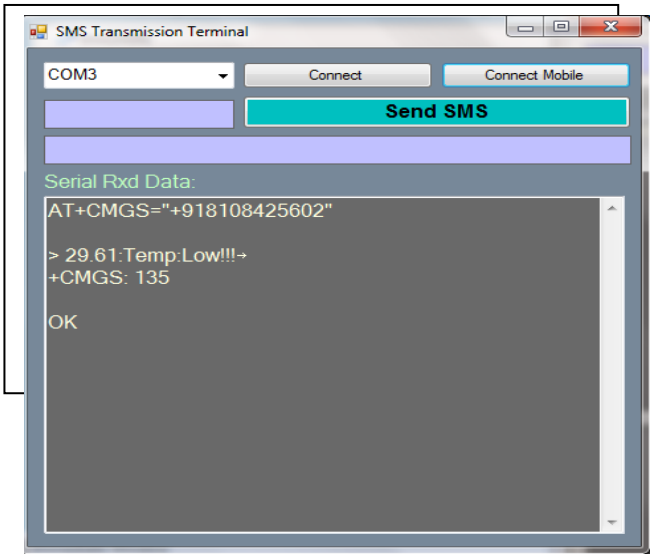
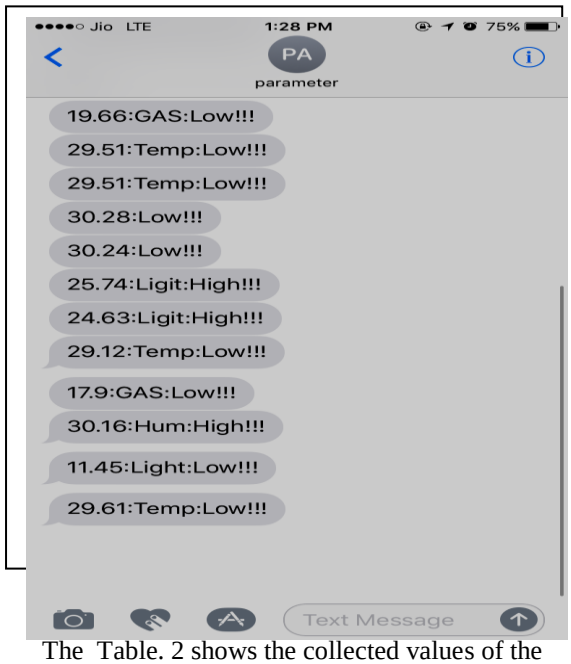


Fig. 7: Graphical plotting of sensor values

The Fig. 8 and Fig. 9 shows how the alert and status messages are generated from the system. GSM setup to notify the concerned user when something is amiss. This facility is active only when enable SMS is selected in the interface.





The Table. 2 shows the collected values of the parameters measured at different conditions. .It gives the idea of the status of the system and helps to perform the analysis of the same.

Sr. no	Parameters	Given Limits		Collected values	Status
		higher	lower		
1	Temperature	100	20	31.47	Normal
				18	Low
				110	High
2	Humidity	100	20	32.97	Normal
				44.05	Normal
				90.00	Normal
3	Light	80	20	44.63	Normal
				6.73	Low
				85.23	High
4	Gas	50	20	39.02	Normal
				21	Normal
				55.63	High

Table. 2: Collected values of the measured parameters

V. ENHANCEMENTS

A. *Limitations*

Some limitations of the system are listed below

- Range is less,
- Less no of parameter,

B. *Drawbacks*

This system has certain drawbacks also as listed-

- System u`ses IoT i.e the internet, hence the data is not safe completely , many IoT devices are vulnerable to hacker attacks.

C. *Future Scope*

. The following improvements can be done to enhance the working of the system:

- Range can be increased by using high power Zigbee transmitters,
- More Parameters can be integrated,
- The system can be enclosed in waterproof body.
- It can have more accurate digital sensors so that the even the slightest error can be detected which can generate an alarm at the user end
- Database can be created in order to store data and carry on processing in future.
- Android app can be developed so as to remotely operate using mobile phones.

VI. CONCLUSION

Nowadays we need everything computerized. Earlier we can only monitor the situations with the help of cameras. Due to this old system there occur industrial accidents causing massive destruction. In order to enhance the present industrial security we have developed a system to monitor as well as to inform the responsible person to take appropriate measures. By using Internet of things (IoT) as the key concept it is easy to monitor the parameters from remote area and also control it wirelessly. This system can also be installed in a closed down industry so as to keep a security check on it. Hence this IoT based wireless framework for monitoring and controlling of industrial parameters is a better alternative for the present manual monitoring and controlling systems.

REFERENCES

[1] "Li Da Zu- Internet of Things in Industries: A Survey" *IEEE Transactions on Industrial Informatics*, vol. 10, no. 4, November 2014

[2] Sadeque Reza Khan Professor Dr. M. S. Bhat "GUI Based Industrial Monitoring and Control System", *IEEE paper*, 2014

[3] "Industrial Automation using Internet of Things (IOT),"*International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)* Volume 5 Issue 2, February 2016

[4] "K. Ashton, "Internet of Things," *RFID Journal*, June 22 2009."

[5] http://internetofthingswiki.com/internet-of-things-definition/

[5] https://en.wikipedia.org/wiki/Internet_of_things
[6] http://www.rfidjournal.com/articles/view?4986
[7] "Supervisory Control and Data Acquisition SCADA"IEEE Ref: http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=4078866
http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=191395
http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=191397
[8] "Design and implementation of industrial automation system by using Internet of things (IoT)", *International Research Journal of Engineering and Technology (IRJET)"* Volume: 03 Issue: 05 | May-2016
[9]"Internet of Things: Current Research, Trends and Applications", *International Journal of Innovative Research in Computer and Communication Engineering*. Vol. 3, Issue 12, December 2015
[10] https://www.raspberrypi.org/help/faqs
[11]"The Four internet of things connectivity models explained",by David Hamilton,Friday April 29,2016
[12]https://en.wikipedia.org/wiki/Microsoft_Visual_Studio
[13]https://wiki.eprolabs.com/index.php?title=SIM_900A_GSM_GPRS_Module