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Design and Implementation of Wireless Sensor Network for Laboratory Monitoring System

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Abstract: The physical parameters such as temperature, humidity, moisture, pressure etc., can be monitored by spatially distributing the sensors and to transfer the collected data through the network is termed as Wireless Sensor Networks. In case of laboratories, due to variations in the physical parameters accidents may occur. Hence to avoid these accidents this system is proposed. This system provides measurement of physical parameters regularly and the data are collected from various sensor nodes and the collected data were transferred through the network. This transferred data is viewed in Android mobile application which facilitates laboratory monitoring without direct human intervention.

Keywords: Wireless Sensor Network, Lab Monitoring Embedded, Zigbee.

I. INTRODUCTION

The Wireless Sensor Networks (WSNs) for Laboratory Monitoring System will become more ubiquitous with wide range of application in environment monitoring. This system provides more flexibility and it is adaptable for all kind of laboratory monitoring. This system consists of number of Sensor Nodes that are wirelessly interfaced with the Network. The data which acquired from various Sensor Nodes are transmitted in different distributed network topologies with the Base Station [1]. This system can also provide an enhancement to the live streaming of collected data from the source node to the destination output through the cloud server [3]. There will be an effective data transmission in the network and the efficiency of the Laboratory Monitoring System is also improved. The effective live streaming on the Android Application is the novelty of the proposed system

The developed system consists of three important modules that include level converter, data logger and USB to UART converter.

Level converter is also termed as level translator (or) level shifter. The process that involves in conversion of input signal to some other signal level is called as level conversion. Usually the level converter takes current or voltage signals as input. The advantage of level converter is, both the inputs and output levels can be obtained as the user desired specifications.

Data logger that is used here is software which collects data from the sensor nodes (or) from the microcontroller and displays the data on the personal computer where the data assortment is continuous process which takes place around the clock. Thus the monitoring of the laboratory parameters is carried out continuously.

II. LITERATURE SURVEY

Literature survey has been listed to have an analysis about various issues related to the wireless sensor networks. And it also provides various views on the different projects worked on the basis of wireless sensor networks. It gives us the pros and cons of the developed systems and its real time applications. More over each system is developed for the advancement in the technology [6].

In case of power management systems the proposed systems are efficient in power management but it suits well for elderly people applications. Where as in case of environmental monitoring systems they reduces the inter processing of data sharing and it is effective in specific customization for applications.

While in the case of networking applications of WSN they are suited for military surveillance monitoring, when it comes to the real time application specific monitoring it is not much effective. In case of environment monitoring for embedded applications the system provides much efficiency, but it fails to meet the requirements of other embedded applications.

And in case of elderly home monitoring they are suitable for it but still psychological acquisitions of various home conditions are not proved to be effective on other home based monitoring systems [1].

All these system do have certain advantages and disadvantages but on having an analogy on various problem statement of different applications they provide a future enhancement and development of the proposing system. This proposed system may be unique and provides the user with multiple enhanced options.

Overall view on the individual survey of different systems will be useful with the future research purposes and also for

further effective system development with respect to wireless sensor networks.

These systems provide the key idea for the other enhanced developmental systems and it also gives an interest to researchers for exploring the technology. And many inventions for providing ease of service in wireless sensor networks can be resulted.

Table1. Analysis of Different Systems Proposed

Sl. No.	Title of the paper	Author name & Year of publishing	Methods	Merits and Demerits
1.	WSN-Based smart sensors and actuators for power management in intelligent buildings	Nagender Kumar et al. 2015	WSN, Zig-bee	This system efficient in power management. But it is suitable for elderly home management.
2.	WSN system design using raspberry pi and arduino for environ-mental monitoring applications	Sheikh Ferdough et al. 2014	Raspberry Pi, Arduino, Zig-bee, Cross bow	This system simplifies the internal processing data sharing. Effective for application specific customization.
3.	Networking and application interface technology for wireless sensor network surveillance and monitoring	D. S. Ghataoura et al. 2014	UGS, NCC, MAC	Effective monitoring for battlefield surveillance and mission monitoring. Not suitable for surveillance mission.
4.	Develop-ment and implementation of smart home monitoring system in embedded environment	Jie Zhang 2015	ARM, DSP, FPGA, AVR RISK	Suitable for embedded environment. Not effective for intelligent management.
5.	WSN based home monitoring system for wireless determination of elderly	Nagender Kumar et al. 2012	Zig-bee, ALD, IALD	Effective on daily activities at home. Psychological parameter measurement is not possible.

III. PARAMETER DESCRIPTION

PIC16F877A: PIC controllers are a family of small RISC controllers used in embedded applications. Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. PIC controller is a 40 pin IC.

PIC Microcontroller consists of 5 ports. PORT A is a 6-bit wide, bidirectional port. The corresponding data direction register is TRIS A. PORT B is an 8-bit wide, bidirectional port. The corresponding data direction register is TRIS B. PORT C is an 8-bit wide, bidirectional port. The corresponding data direction register is TRIS C. PORT D is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORT E has three pins which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers.

Table2. Description of Sensor Parameters

Sensor	Operating range	Accuracy	Operating Voltage	Response time
Humidity	0 – 60° C	± 5 RH	1.5 V AC	< 10 s
Temperature	-55° C to -150° C	0.5° C accuracy guaranteeable at +25° C	4 to 30 V DC	< 5 s
Smoke	-45° C to +85° C	10% at 20° C	4 V	< 10 s
IR	< 15 cm	0.78 – 3 µm	2 V	< 1 s
Gas	-35° C to +75° C	± 5%	4 V	< 10 s
Moisture	3.3 V to 5 V	± 4%	1.5 V	< 4 s

Temperature Sensor: The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in degree Celsius) [1]. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. 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.

Humidity Sensor: Humidity indicates the likelihood of precipitation, dew, or fog. A humidity sensor also called a hygrometer, measures and regularly reports the relative humidity in the air [1]. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold.

Moisture Sensor: A simple water sensor can be used to detect soil moisture when the soil moisture deficit module outputs a high level, and vice versa output low. Module dual output mode, digital output and analog output more accurate. Soil moisture module is most sensitive to the ambient humidity is generally used to detect the moisture content of the soil [9].

Smoke Sensor: Smoke detectors function to sense smoke either by sensing atomic particles using an ionization process, or by seeing smoke particles using a photoelectric process. A smoke detector can warn of a smouldering fire before any significant property damage occurs, and before the occupants of the structure find themselves in grave danger.

IR Sensor: IR sensor consists of emitter and detector. The emitter is nothing but an IR LED and the detector is nothing *but* an IR photodiode which is sensitive to IR light. When IR light falls on the photodiode its resistance and its output

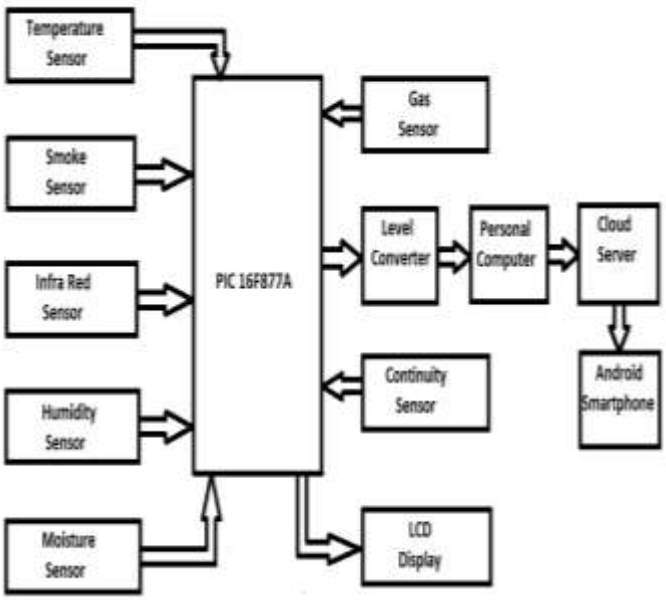

Figure1. Block Diagram of the System

voltage change in proportion to the magnitude of IR light received.

Cloud Server: A cloud server is a logical server that is built, hosted and delivered through a cloud computing platform over the Internet. Cloud servers possess and exhibit similar capabilities and functionality to a typical server but are accessed remotely from a cloud service provider. A cloud server may also be called a virtual server or virtual private sever [10].

IV. SYSTEM DESCRIPTION

The developed system consists of input power supply of 230v (50Hz) A.C. This power supply is given to a transformer which consists of number of primary and secondary turns.

The transformer used here is a step-down transformer, which converts 230v ac to 12 dc. This power is used for the complete utilization of the hardware components. Then the transformer is connected to a driver circuit which provides a uniform distribution of power supply to all the connected nodes.

The data are collected from various sensor nodes and it is given to the microcontroller [4].

The temperature sensor collects data by variations in the voltage levels and calibrations are made as per the manufacturing of National Semiconductor devices. The soil moisture sensor collects data from the soil by the measurement of dampness that makes variations in the sensor metal plates [8].

The humidity sensor also senses the data as similar to the moisture sensor. The smoke sensor collects input by ionization process of atomic gas molecules and produces gas levels.

The IR sensor detects obstacles by transmitting electric pulses from the transmitter to the receiver, when these pulses are broken down with the variation in the voltages the data are collected.

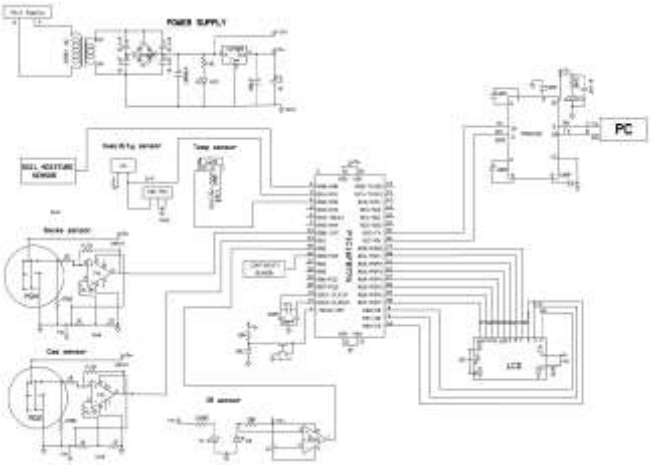

Figure2. Circuit Diagram of the System

Each sensor is calibrated and their values are transmitted to the microcontroller. Then the microcontroller provides data to the level converter where the required voltage levels are

obtained. And it is given to the USB to UART serial converter, where the data can be transferred to the personal computer [5].

Now the personal computer acts as an intermediate between hardware and software for transmitting the data from the microcontroller node to the server [2]. The data are read from the UART serial port with the help of the data logger software. This software collects data for particular period of time and puts the collected data on a Notepad. Then this data are transferred to the server with the help of the visual studio. On executing the program, it uploads the data to the server [7]. Finally a web page is created and the collected data is displayed.

V. EXPERIMENTAL RESULTS

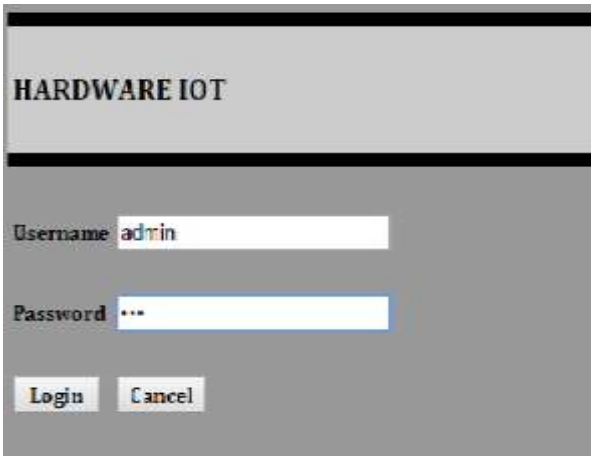

Figure3.a. Login page of the application

The login page of the developed android application is created. The collected data from the hardware is published in the android application.

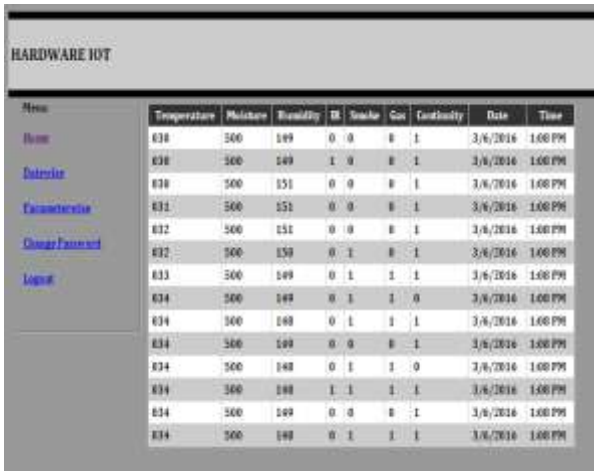

Figure3.b. Home page of application with result

The results can be viewed on the basis of the parameters. Even the date wise view of the results can be obtained. And the time at which the data are collected is also viewed on the output page. The obtained results are effective with the collected data and it is efficient. The obtained results are also accurate to their calibrations.

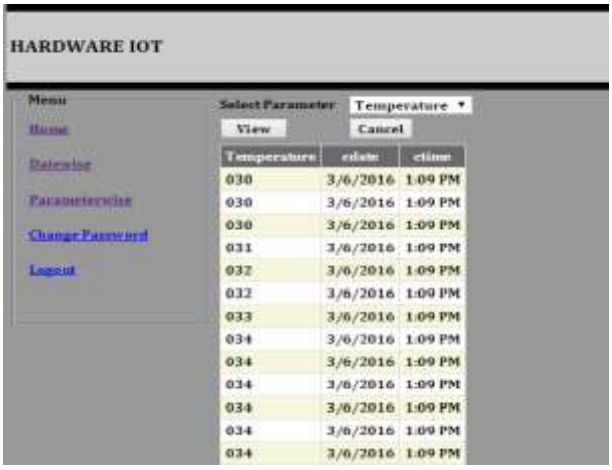

Figure3.c. Specific parameter wise view of resulted data

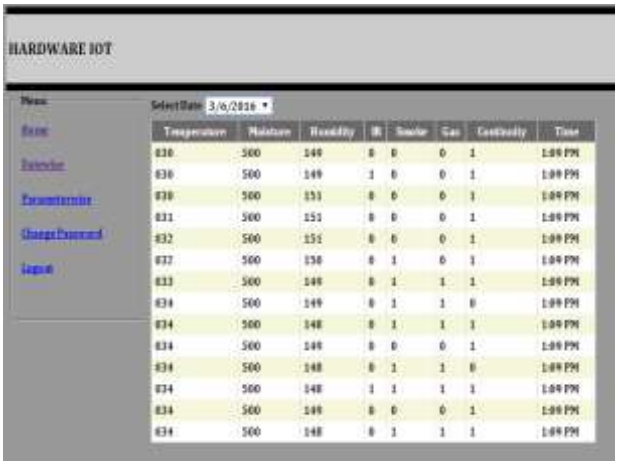

Figure3.d. Date wise view of resulted data

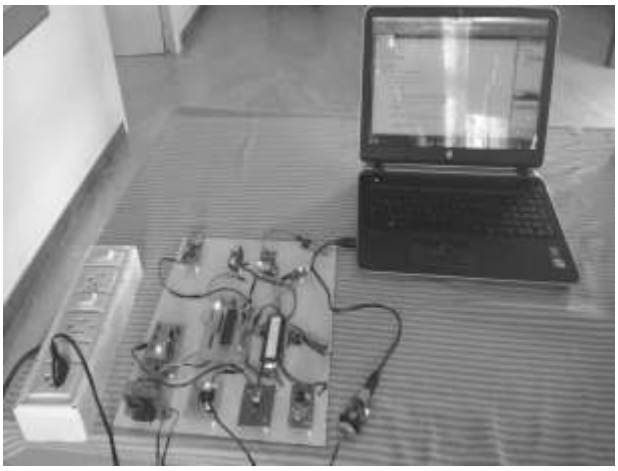

Figure3.e. Laboratory monitoring system view

Figure 3 provides the information about obtained results showing the login page with password, home page with complete results, results showing only temperature values collection, date wise of the collected data is shown and the complete system with hardware is shown.

VI. CONCLUSION AND FUTURE WORK

The data which is registered by the RS232 Data logger is written into a text file as per the user wish. Then the text file is uploaded to a hosting domain using coding in visual studio. When the visual studio code gets executed, upload process is initiated (started). The text file is uploaded to the website and the user is intimated. The user can access the data from any device with internet connectivity. The data can be accessed in the form of a website through PC. In the case of smart phones the data can be accessed through an android application. The android application and the website get data from the same FTP server. Thus the user has a flexible and mobile way of accessing the data and monitoring is achieved. On the future work of this paper only the real time monitoring operations had been obtained here. Controlling operations on the proposed system can developed and that suits the system even better with the future work.

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