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Secured Wireless Communication for Industrial Automation and Control Using LabVIEW

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ABSTRACT: Wireless based industrial automation is a prime concern in our day-to-day life. The approach to ZigBee Based Wireless Network for Industrial Applications standardized nowadays. In this paper, we have tried to increase these standards by combining new design techniques to wireless industrial automation. The personal computer based wireless network for industrial application using ZigBee can be adopted at micro and macro Industries, it has various types of Processors and Microcontrollers. Here Microcontrollers, Temperature Sensors, Zero crossing detector, Voltage regulators are used. The system is fully controlled by the Personal Computer through LabVIEW. All the processor and controllers are interconnected to personal computer through ZigBee. The Personal Computer will continuously monitor all the Data from remote processing unit and compare with value preloaded process structure. If any error is found, the personal computer takes necessary action. The ZigBee is connected to the personal computer it acts as full function devices and is used to send and receive data from other nodes. The ZigBee are reduced function devices and they are used to control the operation of DC motor, temperature control and lamp illumination control respectively.

KEYWORDS: Wireless Communication, ZigBee Network, Secured Data transmission, Dual Bridge DC Motor Control, Temperature Control, Illumination Control Using Relay.

I. INTRODUCTION

The need to improve performance and safety of industrial process plant equipments and other complex industrial processes has led to increased use of automation. In addition, the ongoing revolution in computing and Information system technology is leading plant designers, through economic and performance incentives, to continually increase the extent of automation. Automation is simply the delegation of human control function to process equipments for increasing Productivity, Quality, Cost reduction and plant safety. A Control system, which takes care of the various operations involved in a process, in an automated way with minimal human intervention, is generally known as Automation.

The main objective of the project is to simulate the industrial process parameter monitoring and control using LabVIEW. Study the ZigBee wireless communication for remote monitoring and control. Acquire the various parameters of the industrial process plant using various sensors. Transmit acquired parameters to the remote control unit by Encrypted wireless communication, analyse parameter and control the parameter by sending appropriate commands to plant unit through ZigBee communication.

II. SYSTEM REQUIREMENTS AND DESIGN

This project consists of three units.

1. Sensor Unit.
2. Microcontroller Unit.
3. LabVIEW Computer.

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Sensor unit which basically sends the sensed load parameter data to the ADC unit for analog into digital data conversion.

Microcontroller unit processes the acquired sensor data from the ADC unit and sends the command signal to the LabVIEW computer by wireless communication using **Encryption** and **Decryption** for Data security.

LabVIEW computer is responsible for controlling and monitoring the loads using wireless ZigBee communication. Monitored parameters are visualised on the LCD display interfaced to the microcontroller as well as on the LabVIEW monitor display. Encryption and Decryption is provided for the security of the system.
The main parameters we considered are,

1. Temperature
2. Light
3. Voltage

A LabVIEW computer gathers various electrical parameter data from the sensors using ZigBee where the data is being processed by ATmega32 micro controller then displayed on the LCD display.

The Personal Computer will continuously monitor all the Data from the remote sensing unit and compare with the value preloaded process structure. If any error is found the Personal Computer takes necessary action.

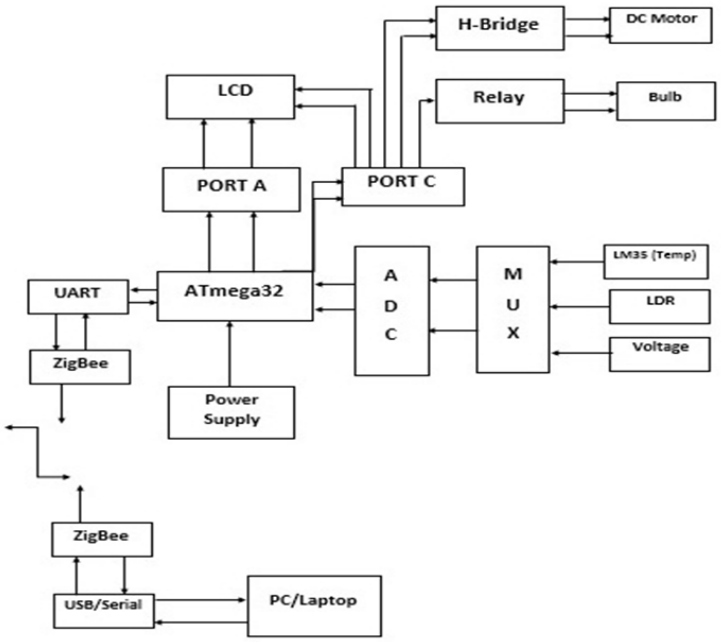

Fig 1. Project Block Diagram

Sensor unit senses the various load parameters like Temperature, Brightness, and voltage. These values transmitted to control unit via ZigBee communication for controlling action.
The sensed parameter values are processed and displayed on the LCD display interfaced to the microcontroller as well as on the LabVIEW Computer monitor display for monitoring purpose.

Encryption and Decryption is provided for the security of the system.

Mainly three sensors are used in this project namely LM35, LDR and Voltage sensor (multi-turn potentiometer). According to the mount and remove its readings change and corresponding electrical signal is received by the microcontroller. The inbuilt 10-bit ADC of microcontroller provides suitable digital input to microcontroller. ATmega32 is the standard microcontroller widely used. As the sensors do not come with its own display, the LCD

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interfaced with ATmega32 performs the same. At this stage all sensor values readings are processed and converted to suitable text forms and sent to computer through serial communication port (USB-UART).

Microcontroller again processes the values. As per the AVR Studio coding, mode of operation is selected i.e. auto mode or manual mode. In auto mode all sensors will work simultaneously while in manual mode only one selected sensor will work. If the measured component i.e. LM35, LDR and Voltage sensor lies within the range specified then DC Motor starts rotating and Lights turned OFF, that the component manufactured is as per the standards.

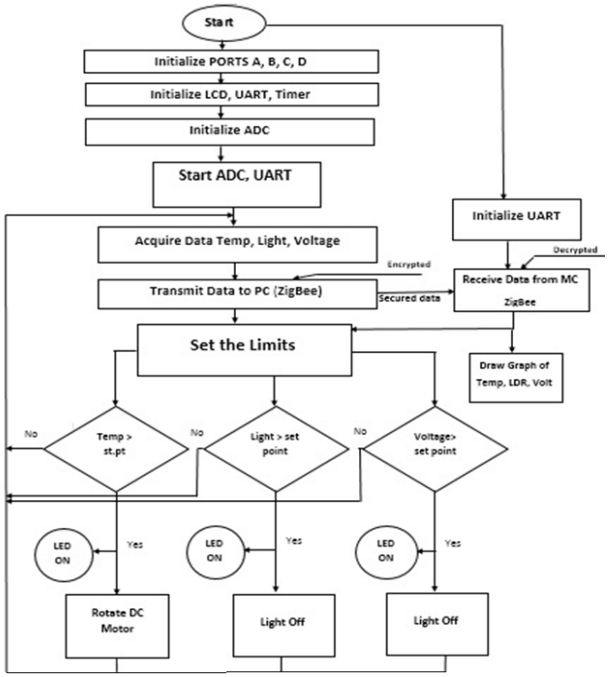

Fig 2.The General Flowchart of the Project

III. SYSTEM IMPLEMENTATION USING LabVIEW

Implementation:

The implementation of the project was through a phase by phase manner. All the steps are mentioned below

Step 1:Feasibility Study: At the beginning the feasibility of the project was evaluated. IEEE reference papers were collected and examined thoroughly before selection. After research, the circuit diagrams were designed and project layout was prepared. Economic aspect of the project was evaluated through listing the price of all major components before the start of project work. As this project work is carried out in college, all laboratories were checked and suitable Lab was selected.

Step 2:Software Implementation: The first phase was learning both microcontroller and LabVIEW programming. All software components were collected and installed. After learning and completing practice exercises, working on actual code started. Logic for each operation was defined, and coding was done accordingly. All codes are individually tested before incorporating with the hardware.

Step 3: As per the circuit diagram, automated measurement sensors were built and tested.

Step 4: In the final stage all individual modules were assembled and all software were loaded and final testing was done. The limitations and future improvements were noted down.

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Software Flowchart:

Implementation of software is the important aspect for the success of the project. The flows of these programs were mentioned in Figure 3.1

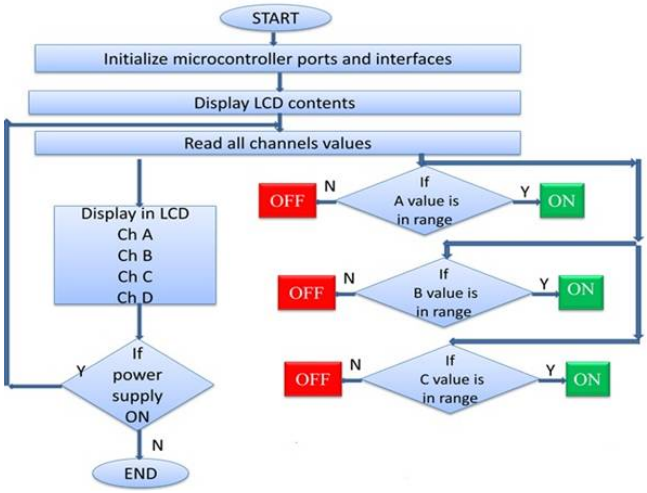

Fig 3.1 Flowchart of Microcontroller Program

Figure 3.1 represents the flow of program inside the microcontroller of Secured Wireless Communication for Industrial Automation and Control System. The main objective of this program is to collect real- time measurement sensors readings, display them in LCD and interpret the readings according to the program or requirement. As shown in Figure 3.1,various conditions are examined, after which interpreted message is sent to LabVIEW coding through ZigBee.

LabVIEW Processing:

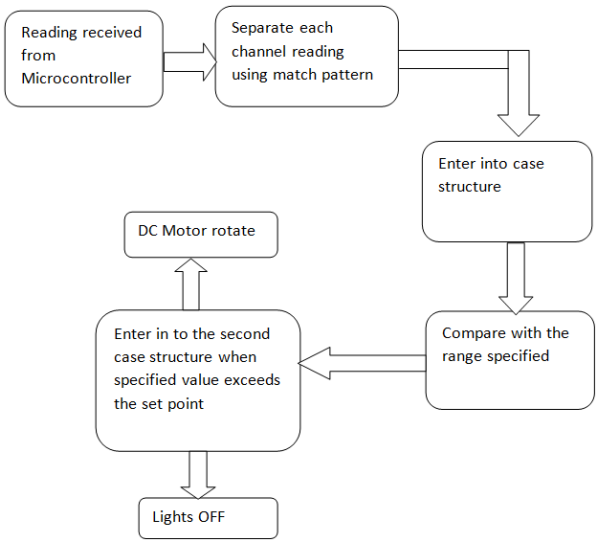

Fig 3.2 Functional Block Diagram of LabVIEW Processing Code

Sensors data is received from microcontroller using UART. Received reading is in the form of string format. All the 3 channel readings are separated using “match pattern” algorithm of LabVIEW.

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Since processing has to be done by decimal values, each channel reading is converted into decimal format using "string to decimal/fraction conversion". The converted decimal values are in terms of mV. Once these values are converted into decimal format, processing the data as per requirement becomes easy.

Once the temperature is measured by the sensors, if the measured value is in the range specified then the value enters in the "true" condition of first Case Structure else it will enter in "false" condition of first Case Structure, i.e. reading will be discarded.so we are using two Boolean case structures.

When the "true" value enters in first Case structure, it is connected to the particular sensor defined same value is displayed on the front panel.

IV. RESULTS

During the course of operation of 'Secured Wireless Communication for Industrial Automation and Control' following results were obtained**.**

Fig 4.1 Testing results in auto mode

Figure 4.1 shows the front panel result when the measurement system is in auto mode, where all channels are active simultaneously. The cat1 box shows the concatenated string of the data received from microcontroller. Here we can see both the**Encrypted** and **Decrypted** values. From the histogram charts, analysis part is done. The various arrays are used to store the successful readings of each sensor/channel. After Decryption all the three Graphs are drawn.

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Figure 4.2 Testing results when Temperature exceeds

When the temperature exceeds the set point value, the virtual LED becomes red and DC Motor starts rotating, simultaneously the waveforms are obtained.

Figure 4.3 Testing results when LDR exceeds

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When the Brightness exceeds the set point value, the virtual LED becomes red and Bulb becomes OFF automatically, simultaneously the waveforms are obtained.

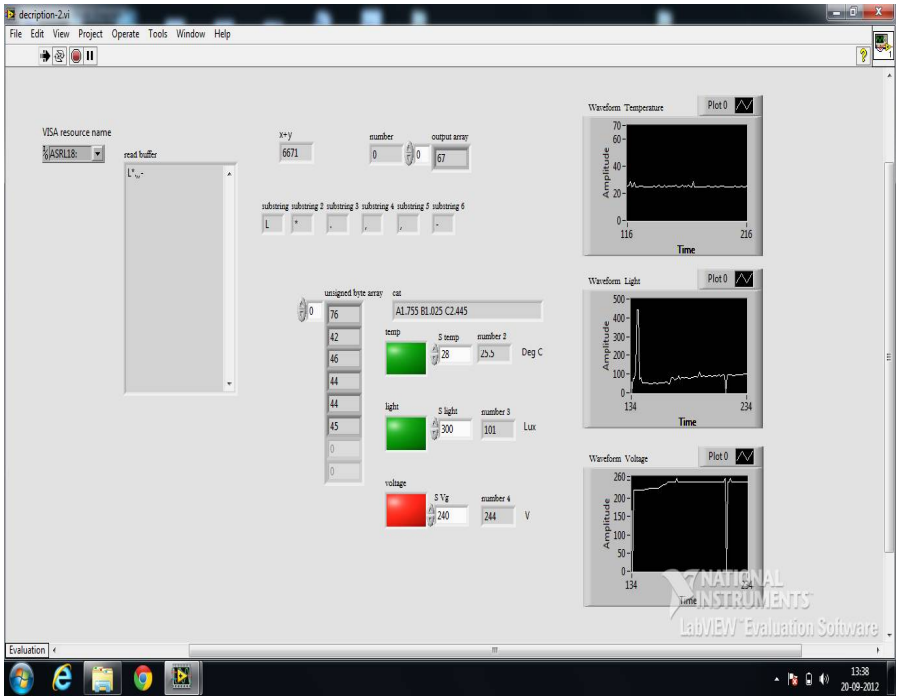

Figure 4.4 Testing results when Voltage exceeds

When the Voltage exceeds the set point value, the virtual LED becomes red and Bulb/Load is cut off, simultaneously the waveforms are obtained.

V. CONCLUSION

Industrial users should consider the type of monitoring and control applications that are suitable for LR-WPAN technology such as ZigBee with secured data transmission. Reliability, security and performance are potential challenges when designing and deploying wireless technologies and factors such as EMI/RFI and multi-path fading in industrial environments can be specific issues to consider. Zigbee provides proper network topology, and it overcomes all problems in industries caused due to environmental issues. We tested Zigbee networks in various environmental conditions by using four node star network for industrial applications like speed and direction control of D.C motor, Illumination control of incandescent lamp and closed loop water path temperature control. It was seen that error free proper communication was established between the processing unit and monitoring unit. In future we can also test other ZigBee networks for proper wireless data communication.

REFERENCES

1. Alliance. Cheng B., Kumar K., Reddy M., Welsh M., 2006, Ad-Hoc Multicast routing on RessourceLimited.Sensor Nodes, In Proc. Of the International Symp. On Mobile and Ad-Hoc Networking and Computing, pp.87-94. Lorincz K., Malan D., Fulford-Jones T.R.F., Nawoj A., Clavel A., Schnayder V., Mainland G., Moulton S. and Welsh M., 2004, Sensor Networks for Emergency Response: Challenges and Opportunities, In IEEE Pervasive Computing.
2. A.Dell Aquila, M. Liserre, V.G. Monopoli, P. Rotondo, "An energybased control for an n-H-bridges multilevel active rectifier," IEEE Trans. on Industrial Electronics, vol. 52, no. 3, pp. 670- 678, June 2005.
3. El Din, A.S.Z. Dept. of Electr. Eng., Minoufiya Univ.; PLC-Based Speed Control of DC Motor, Power Electronics and Motion Control Conference, 2006. IPEMC 2006. CES/IEEE 5th International Publication Date: 14-16 Aug. 2006 Volume: 2, on page(s): 1-6 Location: Shanghai, ISBN: 1-4244-0448-7.

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4. Maxim Osipov ”Home Automation with Zigbee” Next Generation Telegraphic and Wired/Wireless Advanced Networking 8 th International Conference, NEW2AN and 1st Russian Conference on Smart Spaces, SMART 2008 St. Petersburg, Russia, September 3-5, 2008
5. Nang KaythiHlaing and LwinLwinOo,” Microcontroller-based single-phase automatic voltage regulator” International Conference on Computer Science and Information Technology (ICCSIT), Chengdu.P.P 222 - 226 September 2010.
6. S. Kaliyugavaradan.“A microcontroller-based program-mable temperature controller” 23rd International Conference on Industrial Electronics, Control and Instrumentation, vol.1 P.P 155 – 158, August 2002.