

Wireless Sensor Network Based Bank Monitoring System Using LabVIEW™

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Abstract — LabVIEW™ and WSN techniques are introduced for Bank Monitoring System. The proposed system is based on a Regional Office of a Bank and its branches. Three different sensors are deployed in Branch and some major information is passing to its Regional office for ensuring the security. In branch office the IR sensors detect the number of persons entering and leaving the bank, and from the count, system controls the light and air conditioning accordingly. The Piezoelectric sensor is employed for locker security. And finally CO₂ Gas sensor is introduced inside the bank for monitoring CO₂ quantity and if it exceeds the limit, an air exhaust will happen. NI DAQ cards acquire data from each Sensors separately and wirelessly through ZigBee protocol at the Branch office. TCP/IP is used for establishing the communication between Branch and its Regional office, where a LabVIEW™ based System which collects the security related information from branch and pass to authenticated personals (bank manager, nearby police station, etc) via GSM protocol as a SMS or CALL

Keywords – LabVIEW™, IR Sensors, Piezoelectric Sensor, CO₂ Gas Sensor, NI DAQ cards, ZigBee, TCP/IP, GSM

I. INTRODUCTION

Bank monitoring refers to the controlling of light and ac depending upon the number of persons inside the bank, ensuring the locker security continuously, monitoring and providing pure ventilation by detecting air quality. By controlling the room automatically depend on the number of people inside the bank leads saving electricity. This monitoring and controlling is established with the help of IR sensors and the program is developed in LabVIEW [5] platform. LabVIEW is a system design software and development environment for a visual programming language from National Instruments. The introduction of LabVIEW increases the flexibility of a powerful programming language and does not have complexity of traditional development environments.

Another important factor concerned with a bank is its security. Piezoelectric sensor is used for locker security. It detects vibration existed at the non-working hours of the bank. In case of any theft, sensor detects and gives the information to the system and drive an alarm, as the same time the information is passed through its regional office by TCP/IP. The system at Regional office is designed based on the LabVIEW and where used a GSM module to send the related

information to authenticated personals as a SMS or CALL to ensuring the security of each of its branches.

CO₂ Gas Sensor is used to detect the amount of CO₂ contained in the air inside the room. If the amount is increases at limit system notices and provides proper ventilation through an exhaust fan. Thus providing quality air inside the bank.

The Xbee [2] is used for ZigBee establishment. Each Sensors are directly connected with LabVIEW DAQ unit through wirelessly by this communication. Here Single hop WSN [1] technique is used, where sensors are communicated with sink. Here sink is LabVIEW and DAQ unit.

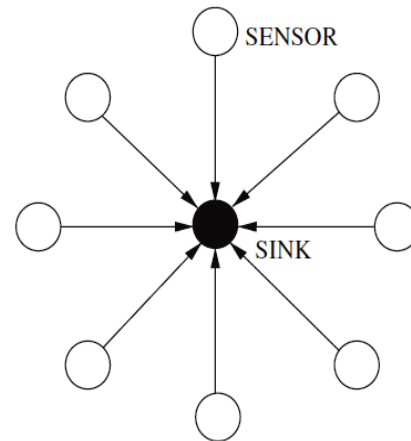


Fig. 1 Single Hop WSN

II. LITERATURE REVIEW

The most modern technology for bank monitoring is done by episensors in Ireland using WSN, introduced into market in 2013. The existing systems include smart gateways and multiple wireless sensors monitoring the energy consumption including electricity, water, gas samples etc. This project ensuring low power, portable, reliable, and efficient system for monitoring a bank in all the way by introducing powerful language LabVIEW and ZigBee wireless protocol. Thus system offers us the freedom of extensive acquisition, analysis and presentation capabilities in a single environment.

III. SYSTEM DESCRIPTION

The detail description of the proposed system is given below and the block diagram is shown in fig.2.

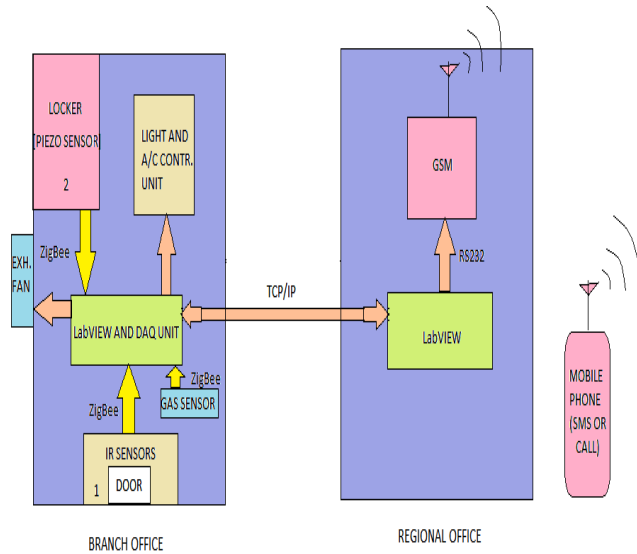


Fig. 2 Block Diagram of the proposed system

A. LabVIEW

LabVIEW is a G programming language used for instrumentation, automation and control, communication, data acquisition and analysis. It is a program development application and used to interface computer with an external device. The program written in LabVIEW is called “virtual instruments”, simply VI.

LabVIEW is used as the frontend and backend for both Regional Office and Branch Office. The sensors in Branch Office are interfaced with LabVIEW and also with TCP/IP. In Regional Office GSM module is connected with LabVIEW via serial RS485 cable.

B. IR Sensor

The IR sensor is used for human detection [6]. Two IR sensors are used one for detecting the persons entering the bank and the other for detecting those who leave the bank. It consists of a transmitter and receiver. The transmitter is an IR LED and photodiode act as a receiver. When the human presence is detected the comparator circuit to which the IR sensors are connected produces an analog output voltage. The output voltage is acquired by LabVIEW through ZigBee, NI CDAQ 9172 and analog input module NI 9201.

C. Piezoelectric Sensor

Piezoelectric sensor [6] which convert the mechanical energy into electrical energy. Here the sensor is used for locker security. The mechanical vibrations produced during theft operation in the locker are detected and converted into an output voltage using a charge amplifier circuit. The output voltage is acquired by LabVIEW through ZigBee module, NI CDAQ 9172 and analog input module NI 9201 DAQ Card.



Fig. 3 Piezoelectric Sensor

D. CO₂ gas sensor

It is a chemical sensor which is used for detecting CO₂ amount in the air. Depending upon the concentration of CO₂ gas, the sensor gives corresponding voltage output. This sensor is mainly used for monitoring air quality. The output voltage from sensor is given to analog DAQ card through Xbee module.



Fig. 4 CO₂ Gas Sensor

E. NI DAQ Cards

The NI DAQ cards used are 9201 and 9472, which are analog input and digital output cards respectively. The DAQ card 9201 is an eight channel analog input data acquisition device which acquires the real time signals from sensors, in the above system two IR sensors and a piezoelectric sensor are connected.

The DAQ card 9472 is an eight channel digital output module which is used for connecting actuators. Here the respective DAQ card is connected with relay switch for light and AC control.

F. ZigBee

ZigBee is a standard for wireless communication protocols used to create personal area networks. ZigBee is based on an IEEE 802.15.4 standard. It is a low power consumption wireless communication protocol.

XBee module is a commercial device from Digi Electronics which follows ZigBee standard. Hence it is used to establish the system. It transfers data quickly between nodes in monitoring and control systems for wireless sensor networks.

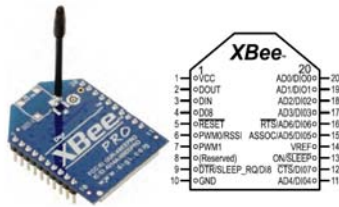


Fig. 5 XBee Module

G. TCP/IP

Transmission Control Protocol/ Internet Protocol are a set of protocols used to transmit the data independent of the physical medium. It is used to establish internet communication. LabVIEW has inbuilt TCP/IP module. In the above system the information from piezoelectric sensor is transferred from Branch Office to Regional Office via the mentioned inbuilt module.

H. GSM

Global System for Mobiles is the widely used second generation cellular technology. GSM technology supports variety of services like voice, video, SMS etc. In the above system, if any theft operation exists at Branch Office the SMS will be sending from the Regional Office to the authenticated personals using this module.



Fig. 6 GSM module

IV. DESIGN METHODOLOGY

The design methodology of the proposed project is as follows:

A. Sensor Calibration

IR Sensor:

Under Human Detection	3.52V
Normal Case	0V

Piezoelectric Sensor:

Under Vibration	2.3V
Normal Case	0V

CO₂ Sensor:

1000 ppm	4V
Normal Case	0-3.9V

B. Application Development in LabVIEW

The Program is developed in LabVIEW as shown in the fig.. The two IR sensors are used for human detection. First IR sensor detects the number of persons entering the bank and the second detects those leaving the bank. When the first person enters the bank the count set in the LabVIEW starts incrementing as per the program. When count is greater than or equal to 1 the light and ac turn ON. When the second IR detects the human the count starts decrementing and when the last person goes out of the bank the light and ac turns OFF.

Piezoelectric sensor output gives above 3V treated as a vibration and hence the system takes corresponding decision.CO₂ gas sensor value is changing with respect to the air CO₂ concentration. Normal level is below 1000ppm.That is maximum limit is set as 1000ppm.If it exceeds the limit, system gives a voltage to a DC motor to drive an exhaust fan to get ventilation for reducing the CO₂ amount.

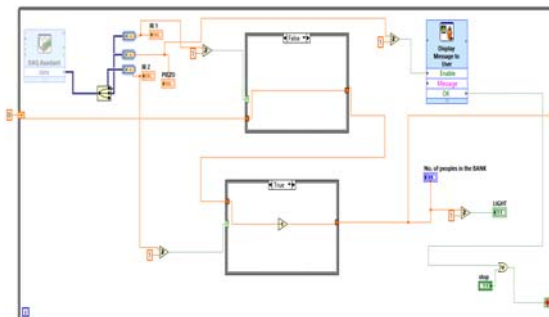


Fig. 7 LabVIEW Block Diagram

C. TCP/IP Interfacing

The server program is developed in Branch Office for sending information and client program developed at Regional Office for receiving. Both server and client programs for TCP/IP are shown in fig. 6 and fig.7 respectively.

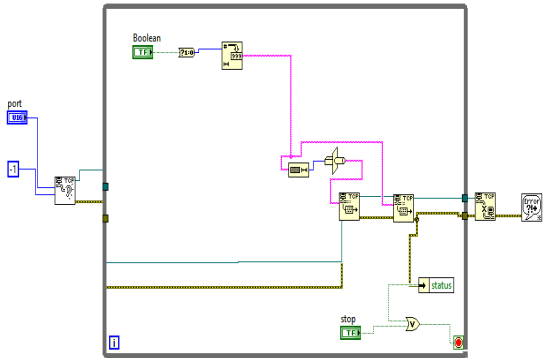


Fig. 8 TCP Server

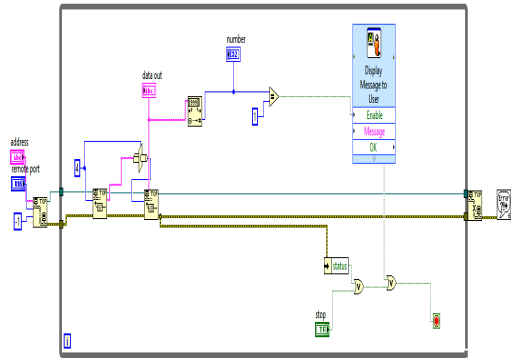


Fig. 9 TCP Client

V. RESULTS

The LabVIEW and wireless sensor networks are successfully implemented in bank monitoring system. The data collected by the IR sensors and piezoelectric sensor, and Gas sensor are transferred wirelessly to the LabVIEW as shown in fig.8. The information from IR sensor is used for light and AC control. During theft operation the piezoelectric sensor information is successfully transferred from Branch Office to Regional Office, at the same time the message “BANK UNDER THEFT” as shown in fig.10 is displayed at LabVIEW front panel. Also the message is send using GSM to authenticated personals from Regional Office. Gas sensor continuously monitored the CO2 amount in the air inside the bank and system provide proper ventilation if exceeds the limit of harmful gas and thus giving more fresh air.

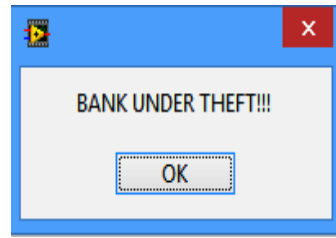


Fig. 10 Message when bank under theft

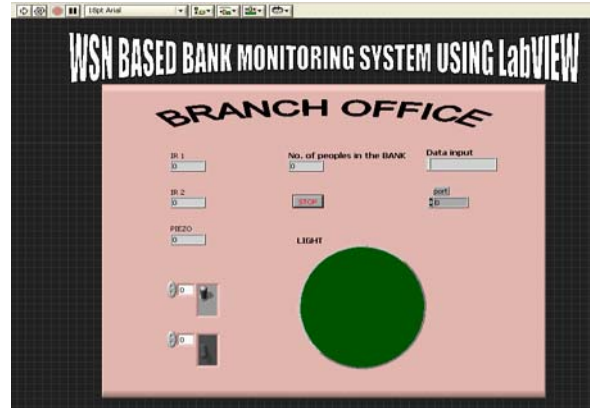


Fig. 11 LabVIEW Front panel 1

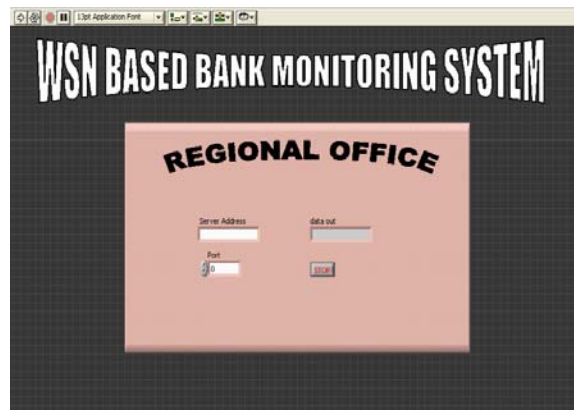


Fig. 12 LabVIEW Front panel 2

VI. CONCLUSION

The proposed project reduces the electricity since the light and AC is controlled automatically depending upon the number of persons entering and leaving the bank. As well as the bank locker security is ensured under theft operation by sending message to authenticated personals. Also ensured the quality of the air inside the bank continuously. Hence the power consumption is reduced and security and quality services are improvised in this project.

VII. FUTURE SCOPE

We can make this system as a stand-alone using NI's CRIO board or LabVIEW supported ARM board. And connect this system with cloud using Web Publishing tool of LabVIEW to more secure and sophisticated.

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