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A Nobel Approach for Campus Monitoring

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***Abstract*—**This paper presents one of the best applications of wireless sensor network for campus Monitoring. With the help of PIR sensor, temperature sensor and humidity sensor, effective utilization of energy resources has been implemented in one of rooms of Sharda University, Greater Noida, India. The RISC microcontroller is used here for analysis of output of sensors and providing proper control using ZigBee protocol. This wireless sensor module presents a tremendous power saving method for any campus**.**

***Keywords*—**PIC microcontroller; wireless sensor network; ZigBee.

I. INTRODUCTION

WIRELESS Sensor Networks (WSNs) have many advantages over wired network for monitoring the situation where the area might be poisonous or may not be possible to survive there. The small size, self healing, easy deployment and cost effectiveness are the potential of wireless sensor network. Campus monitoring is one of the applications of wireless sensor network. Monitoring of environmental conditions for e.g. Temperature and Humidity, security and short circuit monitoring, correlation based control and energy control are the main challenges in deployment of WSN for campus monitoring. Various researchers have considered WSN for environmental condition monitoring and thus providing energy controller. Rajesh Singh [1] proposed one sensor network for temperature monitoring using LM35Dz and communication module was ZigBee transceiver module. Microcontroller used was ATMega 16 low power CMOS bit microcontroller. Peng Liu [2] proposed the search a network energy harvesting for AC. In this work the use of TELOS B for performing computationally intense activities was investigated CC2420 (2.4 GHz) was used for detecting the speed of AC. Jer Hayes [3] proposed a sensor network for temperature and pH monitoring in FISH industries. The microcontroller used was PIC16F877 and GSM module was used for connectivity between nodes and base station. Guang-Li Long [4] proposed circuit for alarm intruder using 89C51 and Pyro sensors. Fredrick Osterlind [5] proposed a sensor network for building automation using TELOS B node. Dhawan [6] has proposed a sensor network for indoor surveillance for loud acoustic events such as gunshots. Mica nodes have been used for this approach. Roland Cheng et. al. [7] has proposed sensor network to track the motion for behaviour monitoring. This paper reports the development of a WSN for monitoring the temperature, humidity and motion and controlling the switching ON and OFF of electrical appliances such as lights, AC, Fans, and Exhaust etc. in one of rooms of Sharda University campus. PIC microcontroller based nodes has been development using ZigBee protocol for monitoring of parameters of campus and controlling electrical appliances to save energy and manpower. This approach is related to power savings and easy to implement.

A. Experimental Setup

The block diagram of the circuit is shown in Fig. 1.

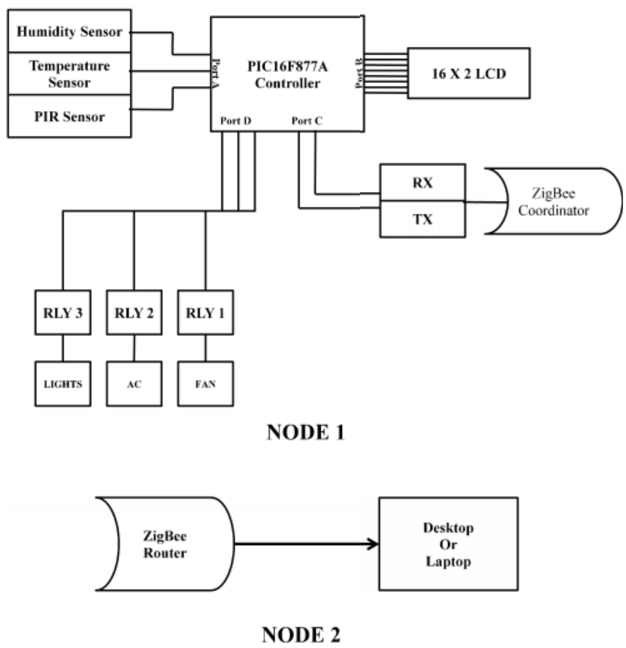

Fig. 1 Block Diagram of System for Campus Monitoring

This wireless sensor network provides real time data collection and analysis for temperature , humidity and motion and controlling of electrical appliance for e.g. lights, AC, Fans, Exhaust etc. of the campus. This system also provides security and can detect presence of a person using PIR sensor. It operates appliances only after detecting a motion in a particular area of the campus. This automatic control system provides remarkable power saving. This paper has four sections. Section II explains hardware development. Section III explains working of hardware. Section IV explains software development. Section V explains result and section VI explains conclusion and future work.

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II. Hardware Development

This section consists of hardware development of the system for campus monitoring. Hardware development is divided into two parts;

a) Node 1
b) Node 2

A. Node 1

This node consists of power supply unit, sensors, microcontroller and Zigbee Module.

- Power Supply Unit
  System is basically driven with précised power supply given to both nodes. This provides 5 and 12 volt to function the system properly.
- Sensors
  Three sensors has been implemented in Node 1.
- Temperature Sensor (LM35 DZ)
  LM35-DZ is a precision centigrade temperature sensor from national semiconductors. This produces the output voltage proportional to the Celsius temperature. LM35 does not require any external calibration or trimming circuits it draws only 60µa from its supply. It is operated over -55 C to 150C with the linear scale factor of 10mv/°C [8].
- PIR Sensor (Passive infrared Sensor)
  PIR sensor is a pyroelectric device that detects motion by measuring changes in infrared level emitted by surrounding objects or by any change in environment. It has a range of approx 20 feet. This can vary with environmental conditions. The sensor is designed to response by toggling its output when sudden changes occur, such as when there is motion [9].
- Humidity Sensor (HR 202)
  HR202 is a humidity-sensitive resistor that detects the humidity level of environment. It is made up of organic macromolecule materials. This sensor can be implemented in places like hospitals, storage, workshop, industries, pharmaceutical field etc. This sensor can be operated over humidity (20-95%RH) temperature (0-60 °C).It requires a power supply 1.5 volt AC (maximum sine). Accuracy level of this sensor is +_5%RH [10].
- Microcontroller
  PIC16F877A is a low power CMOS 8 bit microcontroller based on RISC CPU architecture. PIC16F877A achieves 20 MHz clock input and 200ns instruction cycle. It helps the system to optimize power consumption with respect to processing speed [11].
- LCD Module
  LCD module receives character codes (8bit per character) from microcontroller. It is easy to interface with a microcontroller due to presence of an embedded controller with operating temperature -20°C to 70°C .It latches the codes to its display RAM (80 character code) into a 5*7dot matrix character patterns and displays the characters on its LCD screen[12].
- ZigBee Module
  It is a radio frequency transceiver module which allows the OEM designer to develop the remote control application in quickest way. The module size is small enough to be compatible with any radio frequency transmitter application. It allows reliable communication between sensor node and base station. It operates at 3.3v at 40 mA and has 250kbp maximum data rate. Its range is about 400ft (120m) and is operable at 2.4GHz with working condition of -40°C to 85°C [13]. ZigBee Module in node1 is configured as end device.

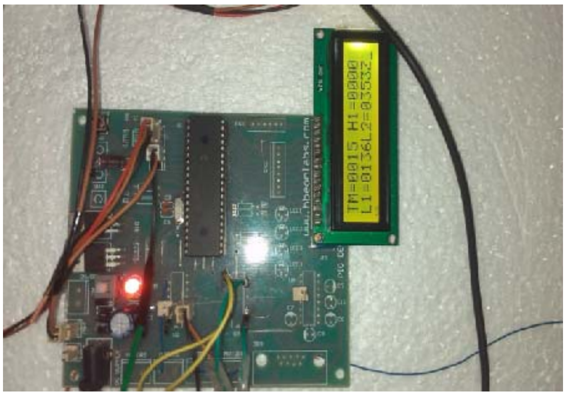

Fig. 2 Snapshot of Node1

B. Node 2

Node 2 consists of power supply, ZigBee Module connected with Laptop.

- Power supply unit
  Input voltage of 12v supply to router which is connected with laptop.
- ZigBee module
  In this node, ZigBee transceiver performs the function of receiving data of node 1 in form of radio frequency signal and provides the necessary control to node 1.This node is configured as co-ordinator node.
- USB to serial port connector
  DB9 connector cables provide interfacing of ZigBee router module and Laptop.

III. Working of Hardware

This section explains the working of the circuit. PIR sensors (Motion sensor) sense the movement inside its remote area. Output of sensor is analog signal which is converted into digital by inbuilt ADC in the PIC16F877A. As motion is detected, corresponding lights are ON and other sensors are initialized. Temperature as well as humidity are sensed and analyzed by microcontroller. According to the conditions, the relays are activated and thus corresponding appliances are controlled .Relays remain inactive until movement is sensed by PIR. Analysed data are transmitted through end device. At the receiving end, the real time data is received by ZigBee co-ordinator module which is connected with laptop through USB to serial port (DB9) connector .Data are displayed on the window of X-CTU or TeraTrum [13]. The window of TeraTrum is shown in Fig. 3 and Fig. 4.

Fig. 3 Data displayed on window of TeraTrum

Appliances can be controlled through base station (laptop) by pressing some input from keyboard of the base station.

A = AC "ON"
B = AC "OFF"
C = FAN "ON"
D = FAN "OFF"
E =ALL RELAYS "ON"
F = ALL RELAYS "OFF"

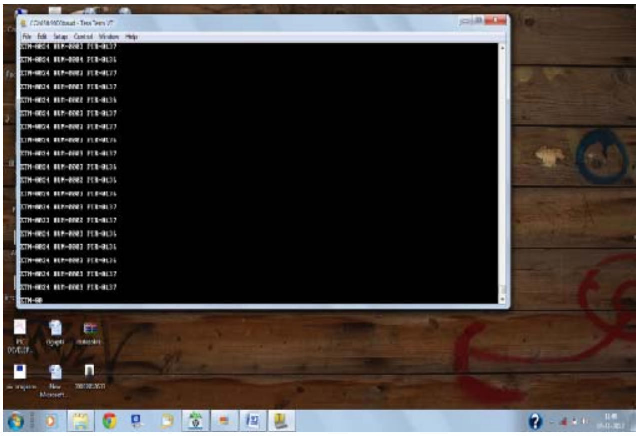

Fig. 4 Snapshot of monitor of Laptop during communication

IV. Software Development

This section explains software development for the circuit. Firmware for the system has been developed with the help of PIC compiler (MP LAB). Software part is written C language and compile using MPLAB.IDE regarding library function it is taken from

- <Pic.h>
- Central C.h

Software development is achieved step by step. The basic steps are coding/ debugging and compiling is done by MPLAB. Programming of target is done by PIC programmer and evaluation is analysed in MPLAB.

A. Algorithm

Basic algorithm of functioning of system is explained in flow chart.

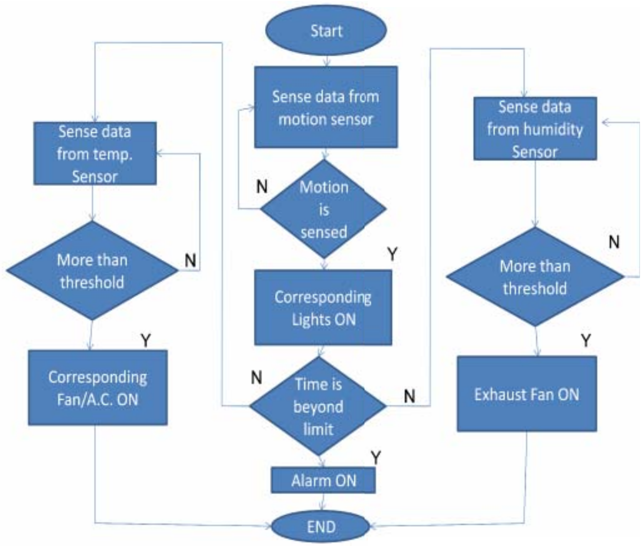

Fig. 5 Flow Chart for Algorithm

Even with this monitoring system, base station can provide command to control appliances in any condition using interrupt function with following coding:

```
d=get_char();
    put_char(d);
    lcdData(d);
    if(d=='A')
    flag1=1;
    if(d=='B')
    flag1=0;
    if(d=='C')
    flag2=1;
    if(d=='D')
    flag2=0;
    if(d=='E')
    flag3=1;
    if(d=='F')
  flag3=0;
```

V. Result

The data is measured in one of rooms of Sharda University campus. By application of the circuit, 8.40 KWH can be saved in one working day without application of manpower.

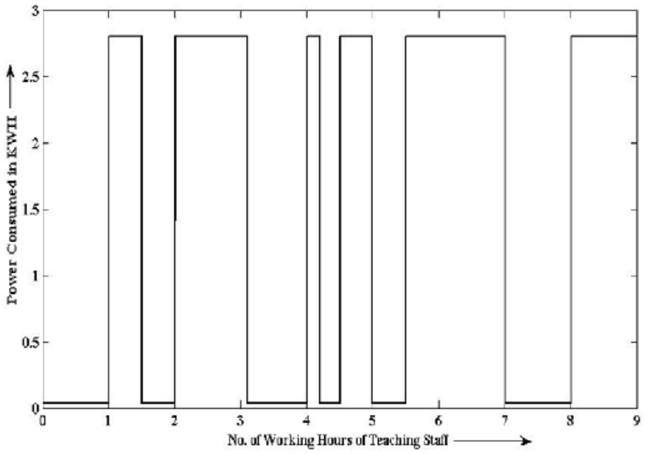

Fig. 6 Graph of power savings using the circuit

One working day means Eight to Nine hours. The data is shown in Fig. 6. In one cabin light consumes .030 KWH, fan consumes .075KWH, A.C. consumes 2KWH .Total consumed power is 2.105KWH per hour. Without application of this circuit, the total consumed power for Nine hours is 18.945KWH. After application of this circuit, the total consumed power for Nine hours is 10.525KWH. Electricity is saved for approximately 8.42KWH. By this approach around 45% electric power can be saved without applying manpower.

In winter season, room heater is required in each cabin. Room heaters also consumes 2KWH.The energy saving is again about 55% for one cabin. Fig. 7 shows the comparison graph of power consumed for 30days in summer and Fig. 8 shows comparison graph of power consumed for 30 days in winter.

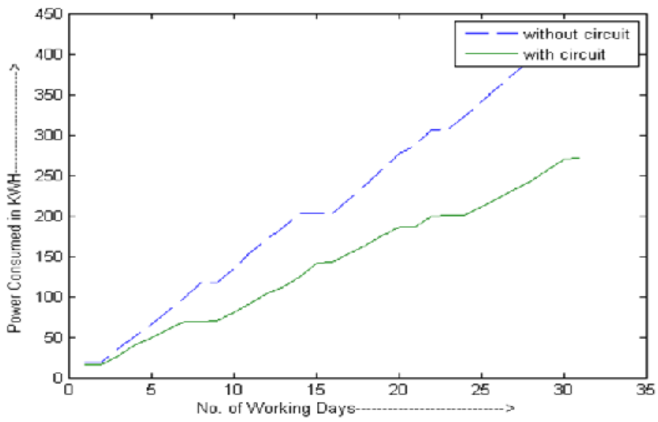

Fig. 7 Comparison Graph for with and without Circuit in summer

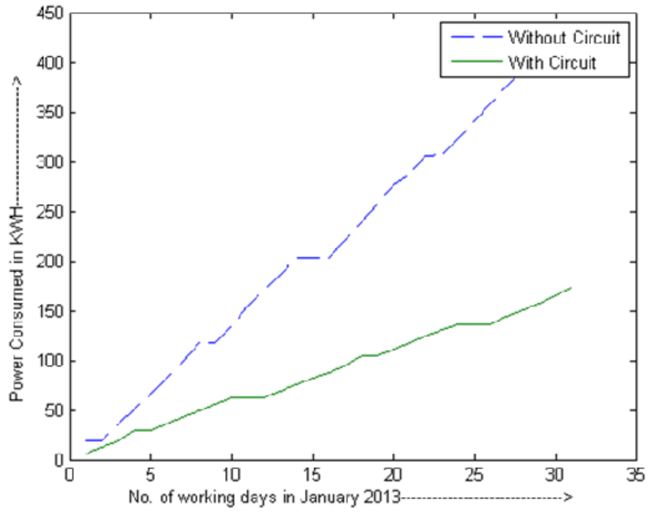

Fig. 8 Comparison Graph for with and without Circuit in Winter

VI. Conclusion

Wireless sensor network has been developed and implemented in one of rooms of Sharda University campus by monitoring system and integrating it with ZigBee to save energy. Due to irregular appearance of the staffs of university in their rooms, appliances remain working and consume power without any use, which result in wastage of power. Since this system is controlled by wireless sensor network, no man power is required to control the appliances and 45% power can be saved per day.

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