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WSN Based Power Management with Automation and Security

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Abstract - *The design and development of wireless sensor network based power management for automated and secure home is proposed in this paper. The system is used to control household electrical appliances. Electrical appliances can operated by automation system, electrical parameters of household appliances like voltage and current can be monitored for further calculation of power consumption of an appliance. The system also focus on home automation to identify, alert and prevent an intrusion attempt in a home. The system is easy to operate, cost effective also can help electricity expense of consumer.*

***Key Words*: wireless sensor network, Rf link, home automation and security, power management, sensor**

1.INTRODUCTION

Automation is a modern technology which helps to make many tasks automatically. Automation is nothing but smartening the home. The home automation involves the controlling and automation of light system, ventilation and security, also different home appliances which are often used in day to day life. The devices used for home automation can be wired or wireless, it depends on which technology we choose, most precisely the protocols. Another essential part of automation system is power management . Power management is to control the total amount of power consumed by an electrical device at home, with minimal impact on performance.

This system focuses on three major aspects home automation, security and power management of electrical appliances with help of wireless sensor network.

1.1 Automation

The main idea is to automatically control and monitor electrical and electronic home appliances. Which helps to operate it from remote place too.

1.2 Security

A modern home automation system must identify, alert and prevent an intrusion attempt in a home. As a result to get an secure n safe premise.

1.3 Power management

To monitor electrical parameters of household appliances such as voltage and current and subsequently calculates the power consumed by it.

This system enables the switching of devices in various power modes, each with different power usage characteristics related to device performance. To have a smart and affordable energy saving, power management is focused by controlling lighting, based on the programmed scheduling and such automation systems reduce the energy bills considerably. For light management, sensors like light sensor, LDR sensors can be used. For home security smoke sensor, fire sensor, LPG sensor plays an important role. With the help of all these a system including power management, home security a complete automation can take place forming different nodes for various places.

2. RELATED WORK

This section explains the existing systems and proposed systems. The overall literature review of other systems has been considered in this section. Nagender Kumar Suryadevara, Subhas Chandra Mukhopadhyay[1] discussed the a real time ,smart and controlling system for electrical appliances. It monitors current and voltage i.e. the electrical parameters of an appliance to calculate the power consumed. The collective data is further transmitted to the host computer and stored. It is a low-cost and flexible in operation which helps to save electricity expense of the consumer. Michal Varchola, Miloš Drutarovský[2] discussed power management using measurement of electrical parameters by interfacing appliances with fabricated sensor module. Rasberry-pi is a heart of module to operate the system and data is transmitted wirelessly with help of Xbee, an USB camera is also embedded to achieve the video streaming of load functionality. German Osmaa, Laura Amadoa, Rodolfo Villamizara, Gabriel Ordoñeza[3] discussed Building Automation System(BAS) provide significant advantage to the building. it helps to reduce the energy consumption and the environmental impact during building lifespan. Also it can reduce the fuel consumption and CO2 emissions for power outage to help define the most profitable slots of work-time. Jianfeng Wu Huibin Qin[4]discussed ZigBee wireless sensor networks of star

which can help remote monitoring and control by GSM module. System consist of intelligent sensors like temperature sensor, humidity sensor, vibration sensor and kinds of security sensors. Output demonstration done on mobile phone. An system is easy and effective way to control the intelligent home devices outside or in other place through GSM module for remote user. R.P. Shaikh,Dr. R.R. Dube[5] The system monitor and control power consumed by appliances. System monitors the electrical parameters like current and voltage to calculate power consumption of appliances. it is an electricity expense reducer and people friendly. Data transmitted using Bluetooth Device. *R. Raju, M. Vishwanath, A. Rajkiran[7]* discussed *ARM11 processor is used to control process unit with Zigbee for WSNs ,USB camera to monitor room from remote places.*
Mr. S. N. Suryatale, Mr. S. R. Hirekhan[12] discussed the system focusing on automation and security.the proposed system also concentrate on domestic automation of temperature, humidity, LPG, light by implementing reliable sensor nodes.

3. SYSTEM MODEL

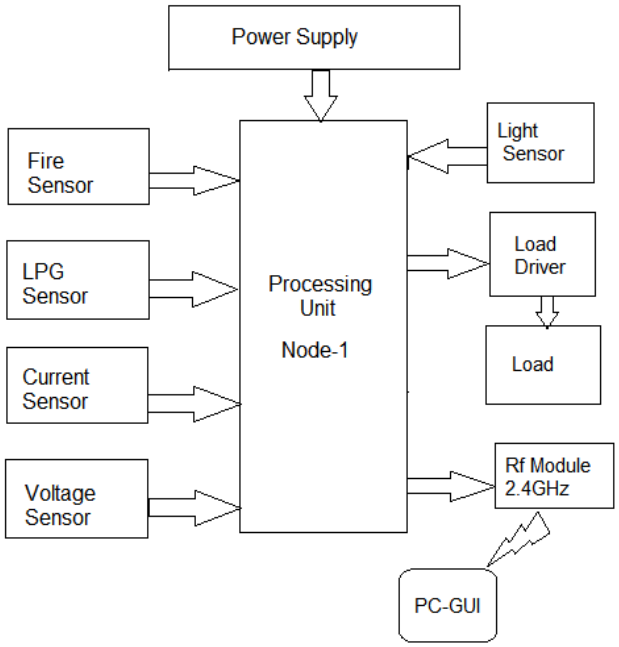

Fig-1: WSN Based Power Management System

3.1 SYSTEM COMPONENTS

As shown in Figure-1 System is composed of different components voltage and current sensor for power calculation, Fire and LPG sensor to give alert on any intrusion attempt and light sensor to make load on-off automatically depending upon amount of light present around. The components are discussed briefly as further.

3.1.1 Current Sensor

Heart of system is ACS712 IC. It is fully encapsulated PCB and it is compact sized .ACS712 fully integrated Hall-effect Current sensor IC. This module can be designed for 5A,20A,30A requirements. It requires 5V single supply operation. Current is measured in proportion to voltage across analog pin of sensor. Further Figure-2 shows current sensor connection to load.

Voltage = Current sensor value
Vrms= (Voltage/2) * 0.707 .....(1)
Amprms = (Vrms * 1000) / mVperAmp. .....(2)
I req. = Amprms * sf [mA] .....(3)

Voltage output from the sensor converted to its rms value(Vrms). Further converted to rms current(Amprms) . desired current(I req.)obtained using scaling factor.

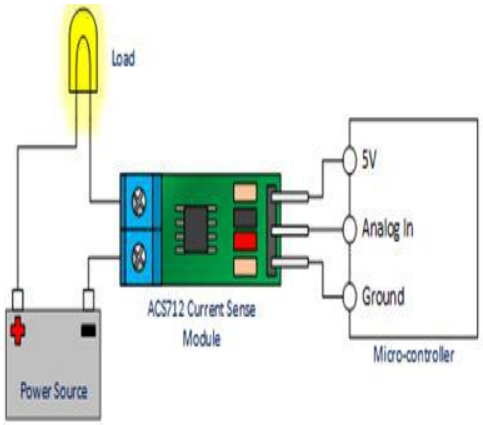

Fig - 2: Current Sensor connection

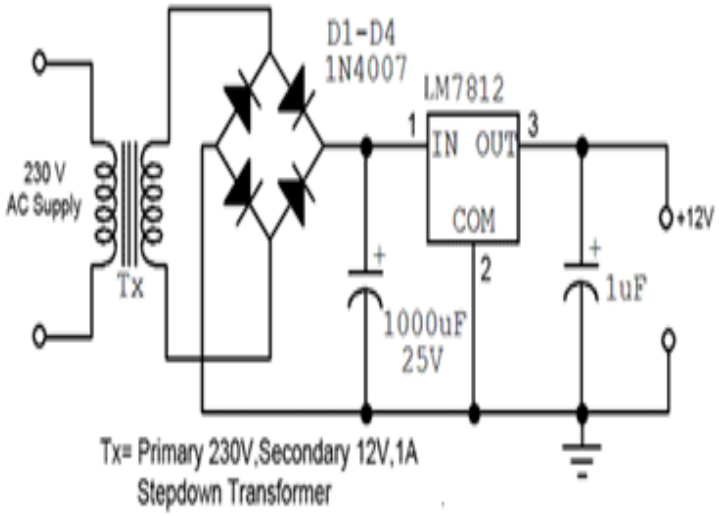

Fig - 3: Step down transformer for voltage calculation

3.1.2 Voltage Calculation

The step-down voltage transformer is used to convert input supply of 230–240 V to 10 VRMS AC signal. As the desired voltage is directly proportional to input voltage, it can calculated by rectifying secondary voltage and passed through the filter capacitor to get a dc voltage. Figure-3 shows the detailed circuitry for voltage calculation.

Volt = analogRead(A3) .....(4)

Volt = Volt * 4.88 .....(5)

volt req. = Volt * sf [V] .....(6)

Analog voltage derived from circuit is converted to measured value then the final voltage(Volt req.) is obtained by scaling factor(sf) and measured voltage(Volt).
fire sensor- It Detects fire outputs signal. The required operating voltage for fire sensor is 3.3V-5V and detection distance is up to 100cm. We can obtain Digital and Analog output as per the choice. The digital output pin DO- switch outputs(0 -1) and the analog output pin AO-analog voltage.

3.1.3 LPG Sensor

Heart of sensor module is MQ6. When the target flammable gas exist around, the sensor's conductivity gets higher along with the gas concentration rising. The sensor convert change of conductivity to correspond output signal of gas concentration to get level of gas present in the air. It is low cost ,simple driver circuit sensor for many applications. Power by External +5V DC supply. Sensitive material present in the sensor is SnO2.

3.1.4 RF Module

It is a Serial Data Link. Easily transfer serial data over 2.4 Ghz. RF Enables transparent bi-directional communication for wireless data logging and sensor reading. Working at 2.4 Ghz frequency in half duplex mode. High data rate and longer transmission distance. Working voltage is 5V and Frequency 2.4 Ghz.

4. RESULT AND SYSTEM FLOW

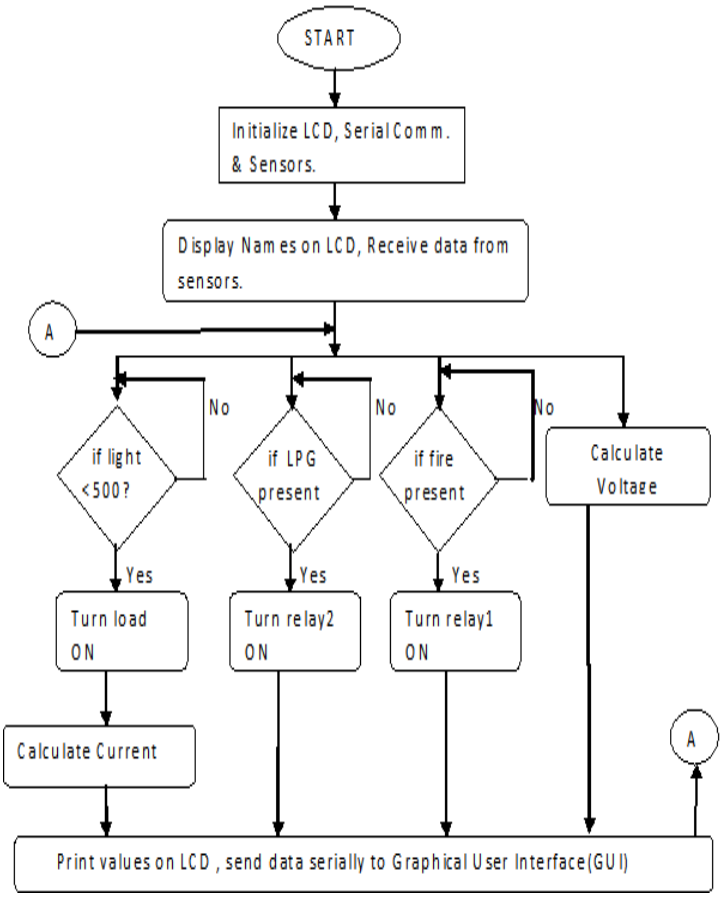

Fig-4: Flow Diagram of System.

As shown in the Figure-4 system flow can be explained. Once the initialization of all the sensors like voltage and current sensor, light sensor, LPG and fire sensor along with the serial communication takes place. All the sensors start monitoring the load connected. Voltage calculation takes place continuously. Whereas when the light sensor detect less amount of light present around than the predefined threshold value(500) which is an analog value calculated by sensor, the load connected gets driven as a result the current calculation of the load takes place. After getting the current and voltage value power calculation can be derived easily. By which we can calculate the total amount of power consumption during a day. At the same time the fire and LPG sensors also keep monitoring continuously to check any intrusion attempt. If any emergency takes place relay1 and relay2 respectively may get triggered. Also all these output from monitoring sensors are displayed on the LCD placed on the system. Serially values are sent to the serial port to display the values on Graphical User Interface(GUI) of host PC.

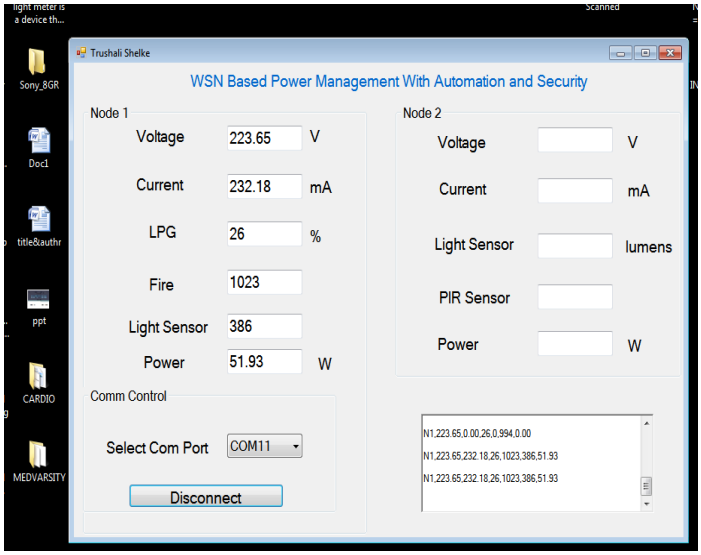

Fig -5: Graphical User Interface at the Host PC.

Figure-5 shows results displayed on the GUI of host PC for a single node. Which contains all the values voltage, current, LPG, fire and the analog value calculated by the light sensor. We can calculate the total amount of power consumed during a specific time span by plotting the values after some intervals.

5. CONCLUSION

WSN based power management with automation and security system is successfully constructed and tested to get an smart home. Simulation shows the automation of household appliances resulting the power management to reduce the electricity expenses by calculating the power consumption at peak hours for consideration. The smartening of home takes place as system makes it automated and secure from the intrusion attempts. System is flexible and easy to access controlling the house hold appliances.

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