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A Robust Approach for Power Monitoring and Device Management

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ABSTRACT: Wireless sensor networks (WSNs) have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. Due to these advantages, WSNs has been applied in many fields, such as the military, industry, environmental monitoring, and healthcare. As the power consumption varies as per the uses it is necessary to reduce the power usage and manage the total power consumption. To do so we propose a design for wireless sensor based embedded system for monitoring and controlling of remotely electrical appliances at any time. Smart monitoring and controlling system will calculate the total power consumption of electrical appliances. Thus the GUI is developed to show the status and consumption of electrical appliances which in turn help the user to manage the appliances wirelessly. A log sheet is maintained which records the power consumed by each device.

KEYWORDS: WSN, intelligent services, power consumption, smart monitoring, control system, GUI, wireless sensor, embedded system.

I.INTRODUCTION

Wireless Sensor Networks (WSNs) have become an attractive technology for the research community, particularly with the rapid increase in Micro-Electro-Mechanical Systems technology which has facilitated the development of smart sensors [3]. Typically, a WSN is a distributed system that is composed of autonomous units with sensing capabilities (sensor nodes), interconnected by wireless communication system. This network offers a optimized and potentially low-cost solution to several problems [4-8] including military target tracking, health care services monitoring, environment control systems, animal monitoring, and smart Homes. In recent years, the introduction of network enabled devices into the home environment has proceeded at a remarkable rate. Moreover, with the rapid growth of the Internet, there is the requirement for the control and monitoring of such network enabled devices remotely. However, the new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation remain largely undeveloped.

Nowadays home and building automation systems are used more and more. On the one hand, they provide increased comfort especially when employed in a private home. A smart environment is a physical world that is interconnected through a continuous network abundantly and invisibly with sensors, actuators and computational units, embedded seamlessly in the everyday objects of our lives [1]. A smart home is a residence in which computing and information technology apply to expect and respond to the occupiers' needs and can be used to enhance the everyday life at home. Potential applications for smart homes can be found in these categories: welfare, entertainment, environment, safety, communication, and appliances[2]. Some of the important communication technologies employed by today's home automation system cover Wi-MAX, Bluetooth, Wireless LAN (Wi-Fi), Zig-bee, and Global System for Mobile Communication (GSM). Nagender Kumar Suryadevara [1] proposed the idea of design and development of smart monitoring and controlling system for electrical appliances in real time using Zigbee module connected in a mesh topology such that the adjacent Zigbee node is less than 10m away to have a reliable data reception at centralized Zigbee coordinator. Ahmed ElShafee, Karim Alaa Hamed [2] in his paper presents a design and prototype implementation of new home automation system that uses Wi-Fi technology as a network infrastructure connecting its parts. Xiangyang Li ,Weiqiang Zhang ,Hujing [4] introduces the intelligent home appliance control system, the system

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is developed through ARM microprocessor, embedded Linux operating system, ZigBee (CC2430) wireless communication technology and network technology. Manivannam M, Kumaresan N [9] in this paper approaches the design and development of online Interactive Data Acquisition and control System (IDACS) using ARM based embedded web server.

This paper 'A Robust Approach for Power Management and Device Control' discusses the base idea of WSN which uses the RF module for communication between the systems. I have developed a embedded system which is used for connecting various load and a GUI is built on MATLAB which helps the user to monitor the power consumption by each load. User can also control connected electrical loads through buttons on GUI. Thus power is monitored and logged in a file for records.

II.WSN BASED AUTOMATION

This paper explains the two major parts in the application.

- Hardware implementation
- Algorithm development for statistical analysis

In the developed application, the basic idea of wireless communication is used. Wireless communication is basically a transmission of data wirelessly to any location. Systems using wireless communication can be made by linking up stand alone appliances that are present at home or in office and integrating to form a cooperating network.
Another concept used is algorithm for statistical analysis of received data. The received data is analyzed and displayed graphically on GUI. GUIs (also known as graphical user interfaces or UIs) are created in MATLAB and provide point-and-click control of software applications, eliminating the need to learn a language or type commands in order to run the application. A GUI typically contains controls such as menus, toolbars, buttons, and sliders. Many MATLAB products, such as Curve Fitting Toolbox™, Signal Processing Toolbox™, and Control System Toolbox™ include apps with custom user interfaces. You can also create your own custom apps, including their corresponding UIs, for others to use.

III.BLOCK DIAGRAM

In figure (1), the block diagram is shown in which the embedded system consisting the major elements are:

1. Electric load: For processing the electric watts which is the real time input.
2. Micro-controller: For sending commands to the software system.
3. RF module: To establish the wireless communication.

MATLAB based GUI: It is a software system to control the electric devices connected to the hardware system.

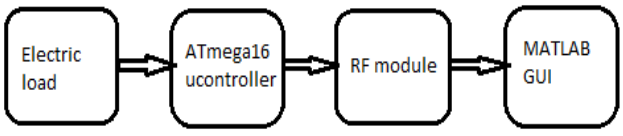

Figure (1)

Methodology:

The algorithm for the above proposed system is as explained below.

1. Connect the load through relay module.
2. Connection with the microcontroller to any one the ports is done.
3. Establish the wireless communication using RF module with the software system.
4. Updates the GUI with connections.
5. Notify the user with the system status.
6. Display of the current status of the power consumption by the loads connected.
7. Sending commands to the controller wirelessly for desired action to be taken.
8. Controller controls the load by sending commands to the relay module.

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IV. RESULT AND DISCUSSION

This project is developed for the purpose of automation of home. With the increase in consumption of energy and population, there is a great need to conserve energy in every possible way. The inability to access and control the appliances from remote locations is one of the major reasons for energy loss. For ATmega16 to interact with the electric loads with varying watts, the load/s is connected to the relay module. With the help of this data is passed between the load/s connected and micro-controller.

As soon as the connection is established the intent is registered and application starts. The user can connect load or loads of varying watts to the input terminals of relay module. LEDs are connected to the relay module which shows the status of the relay. The load connected to the relay module is ultimately gets connected to the port of ATmega16 microcontroller. As the load is connected to the micro-controller, the controller sends this information to the processor of the system. CC2500 is the communication module used for wireless communication between the systems.

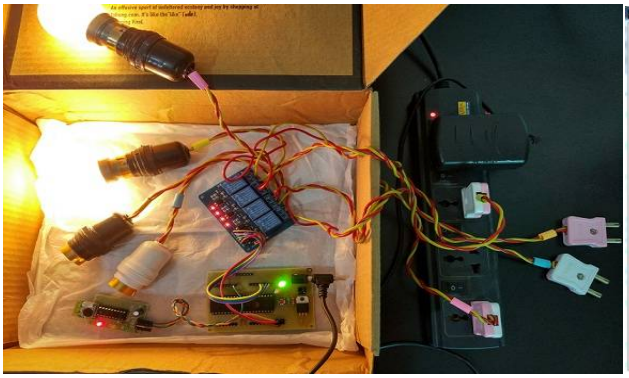
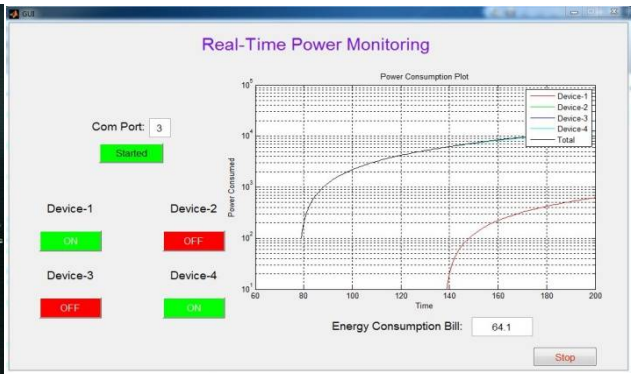


Figure (2) a. Initial system



b. GUI for initial system

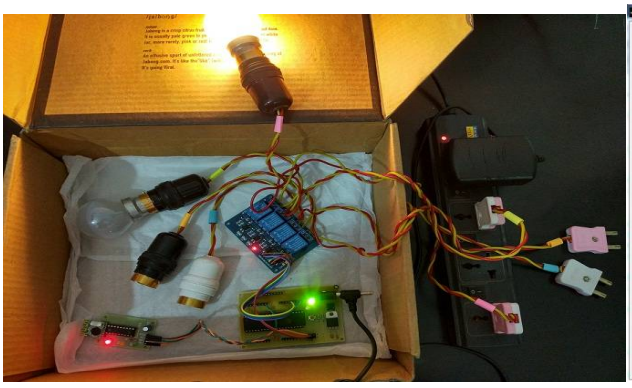
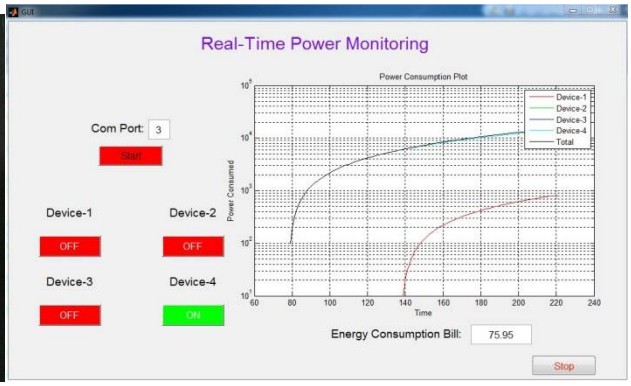


Figure (3) a. System status after command



b. GUI for system

A GUI is developed on MATLAB platform. This GUI shows the present running status of the loads connected. It also contains the system which shows the status of load/s, a graphical representation of the watts consumed by the load/s connected, buttons (ON/OFF) for controlling the load/s. Once the system gets start, we can switch ON the load status as per our requirement. When we start the button for particular load, a graph starts to show the consumption by that load. A graph showing the total power consumed by all the loads connected also starts building. When the user updates the

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status of any of the load connected by using buttons in the GUI, the graph for that load also gets updated ultimately updating the graph for total power consumed.

As soon as the user commands the system to Switch ON or OFF any load, this information is transferred to the RF module connected to the controlling system. As soon as the command is received by the RF module, it transfers to the micro-controller which directs the relay module to take action required.

A log file also gets created and maintained with the real time data of power consumption by each device and total watts consumed. This helps the user to keep the record and track in case of faults occurred in the system.

A	B	C	D	E
0	0	0	5600	5600
0	0	0	5700	5700
0	0	0	5800	5800
0	0	0	5900	5900
0	0	0	6000	6000
10	0	0	6100	6110
20	0	0	6200	6220
30	0	0	6300	6330
40	0	0	6400	6440
50	0	0	6500	6550
60	0	0	6600	6660
70	0	0	6700	6770
80	0	0	6800	6880
90	0	0	6900	6990
100	0	0	7000	7100
110	0	0	7100	7210
120	0	0	7200	7320
130	0	0	7300	7430
140	0	0	7400	7540
150	0	0	7500	7650
160	0	0	7600	7760
170	0	0	7700	7870
180	0	0	7800	7980
190	0	0	7900	8090
200	0	0	8000	8200

V.CONCLUSION

A smart power monitoring and control system has been designed and developed toward the implementation of an intelligent system which can be used in different fields such as home, hospitals and even industries. We aim to determine the areas of daily peak hours of electricity usage levels and come with a solution by which we can lower the consumption and enhance better utilization of already limited resources during peak hours. The sensor networks can be programmed with various user interfaces suitable for users of varying ability and for expert users such that the system can be maintained easily and interacted with very simply. The system developed provides a log sheet which helps the user monitor the amount of power consumed by particular load. This helps the user to track power consumed and get the faults cleared by using maintained logs.

VI.FUTURE WORK

- To develop algorithm for optimization of power and lowering the price points.
- To add voice controlled features.
- To implement the system using internet server with security features.

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