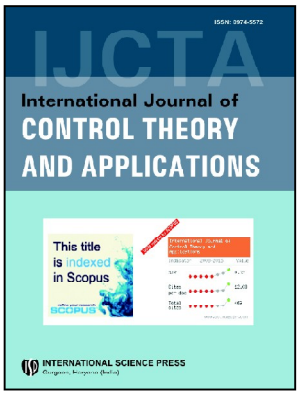

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Smart Power Saver for Home Appliances Through Embedded Control Unit

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Abstract: The goal of this paper is to develop an android application which will be capable of tracking each and every appliance in the home and the user will be able to receive the status of the energy consumption parameters of each appliance. Along with this, the energy consumption parameters of each individual appliance will be sent to android based smart device where a power management algorithm will be running to manage all the appliances as per user requirements. The user can monitor the energy parameters of each individual load using the android device which will also work as a data setter to set the user programmable parameter threshold. The user will receive a notification when the consumption exceeds certain limit. By automatically turning off loads when not in use, the system can provide energy savings in homes, hospitals, universities etc.

Keywords: smart device; household appliances; mobile application; sensor; Bluetooth

1. INTRODUCTION

In today's world energy has been utilizing in an abundant manner and it is very difficult for the government to construct so many power plants for the generation of electricity. In order to fulfill the energy needs of each residence, an efficient power saving mechanism is needed. By monitoring the individual consumption of each appliance, the user will have a mindset to save the power. In the previous work, Power meters in home will display total real time usage and auto shutdown of appliance is not installed [15, 16].

We proposed an approach for creating a new smart home energy management system based on Bluetooth to make home appliances more intelligent and automatic and to overcome the disadvantages of existing system. By empowering consumers with real-time information of their energy usage will make the user to use energy more efficiently [1-3]. Open Source microcontroller Arduino is used for power calculation, transmission, recording

and control over relays. The power is calculated from the output of current sensor and voltage sensor. The home appliances readings are transmitted to Android device by using Bluetooth transceiver which is a wireless technology standard for exchanging data over short distances (in the ISM band from 2.4 to 2.485 GHz using short-wavelength UHF radio waves) for mobile devices and building personal area networks.

Threshold is set at the user side for appliances which consume more power. The appliance will turn off automatically when the threshold is reached. The user will receive a notification when certain Power limit is exceeded (for e.g. 500 units). By using the user profile tools, the user can modify the threshold value based upon their convenient for avoiding the unnecessary power consumption. A user profile tool is a visual display of particular appliance associated with a user interface. It refers therefore to the explicit digital representation of a specific threshold identity. APK files can be installed on Android powered devices just like installing software on PC [14]. By using the Bluetooth serial commands the readings will be transmit one node at a time. The micro controller coordinates all household appliances by controlling their working condition and inquiry their current status to the user through the serial commands.

2. ARCHITECTURE OF THE SYSTEM

The electrical appliances will be connected with relay drivers for converting the high volts into low volts. The input supply for arduino is 5V but AC provides 220V. In order to convert the 220V to 5V, relay drivers are used. The sensing unit consists of current sensor and voltage sensor. The current sensor is used for detecting the electric current and generating a signal proportional to current. It may be analog voltage or even digital output. The voltage sensor is used for detecting the voltage for each appliance. For every 5ms, the readings are stored in the external storage of the Arduino UNO board. Then the stored readings are transmitted to Android Application device through the Bluetooth transceiver by using the Bluetooth serial commands.

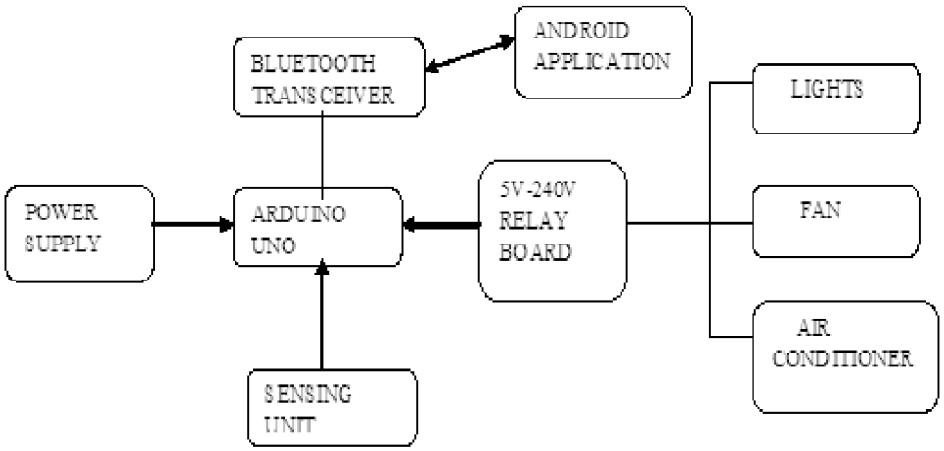

Figure 1: Smart Power Management System

3. SYSTEM DESCRIPTION

In general, the Arduino is not equipped with a display to visualize calculating data. If you want to get the data you need a personal computer for printing the data to the console. or a display is mounted directly to the Arduino. Hence there is no simple way to wirelessly visualize the calculating data.

The Bluetooth module connections can be a confusing one because the TXD is connected to Rx and RXD is connected to TX. Transmit and Receive operation refers to each device, therefore a transmission from TXD pin of the Bluetooth module must be received by the Rx Pin 0 in the Arduino. In the same manner, a transmission

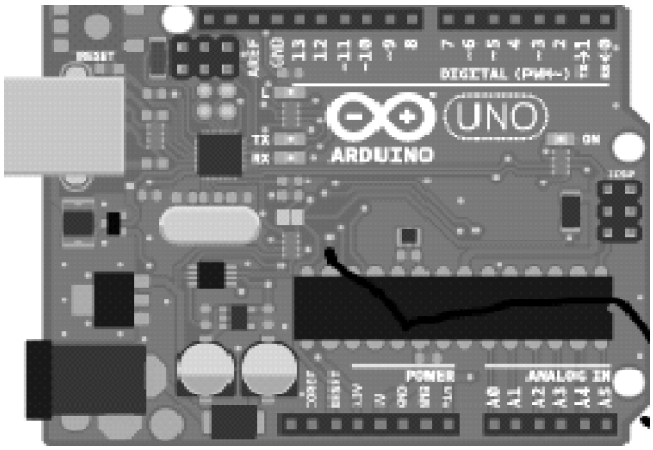

Figure 2: Arduino Uno

going out of Arduino TX Pin 1 should reach RXD pin of the module. The ground pin of Bluetooth is given to ground pin of Arduino. A power supply of 3.3V is given to the Arduino.

The Bluetooth-Module is communicating with the Arduino via the Universal Asynchronous Receiver/ Transmitter (UART)-Interface, which is a hardware device for asynchronous serial communication in which the data format and its transmission speeds are configurable. A driver circuit which is external to the UART handles the electric signaling levels and methods.

Arduino listens for commands to turn off the loads or show its status, if calculated power is greater than a threshold then the load will be turned off. For every n millisecond (where n is a parameter set through the Embedded C code) a status report is sent to the application. The user will receive a notification when the consumption exceeds a predefined limit. A simple command structure enables the app to send parameters and values to Arduino [10-12].

Every message the Arduino wants to send, is first given to the Bluetooth-Module, which sends the message wirelessly. Arduino and Bluetooth-Module have to use the same baud-rate to avoid problems with the UART.

Before starting this application, the Bluetooth-Module has to be coupled to the Smartphone. In the special case of the Bluetooth module the default Pin Code for initiating the Coupling-Process is “1234”

The slave module connection is used between the Arduino and the Android phone .For better understanding; we take two types of devices: Master and Slave. A Master can communicate with more than one Slave. On the other hand, a Slave can communicate with a single Master at a time. In this communication Master to Master or Slave to Slave communication is not allowed. Since, all smart phones is of Master type we need a Slave type for the Arduino.

4. INTERFACING WITH GSM

GSM module to Arduino interfacing is done by making 3 connections between them. A GSM Module is nothing but a GSM Modem (like SIM 900), which is connected to a PCB with different types of output taken from the TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a personal computer. The PCB will also have pins to attach speaker and mic, to take out power supply of +5V or any other values for both power and ground connections. These values will vary with different modules [4].

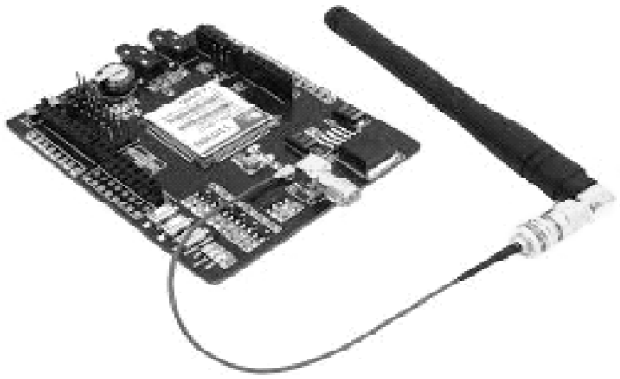

Figure 3: Gsm Module

5. CONNECTION WITH GSM MODULE

GSM module is connected to Arduino by two ways. The mode of communication between the GSM and the Arduino is serial. Hence serial pins of Arduino (Rx and TX) are used. The Transmitter (TX) pin of GSM module is connected with Receiver (Rx) pin of Arduino and vice versa. The ground pin of Arduino is connected with the ground pin of GSM module.

6. VISUALIZATION

The readings are represented in a graphical manner to the user for better representation.

Share 1	Share 2	Reconstructed block
0 0 1 1	0 0 1 1	0 0 1 1
0 1 0 1	0 1 0 1	0 1 0 1
0 1 1 0	0 1 1 0	0 1 1 0
1 0 0 1	1 0 0 1	1 0 0 1
1 0 1 0	1 0 1 0	1 0 1 0
1 1 0 0	1 1 0 0	1 1 0 0

By using this graph, the power consumed in KW for each month and power saved in KW for each month can be analyzed.

7. EXPECTED OUTCOME

At the receiver end, the user will be provided with an interactive representation of power consumption data in the form of various graphs. The fig.6 represents the economy level of the current consumption by visualizing the graph with three colors (Red, Green and Yellow).

Table 1
Monthly Power Consumption Statistics

Month	*Consumed Power in KW*	*Saved power in KW*
August	250	100
September	200	80
October	150	60
November	160	64
December	180	72
January	130	52
February	120	48
March	125	50
April	170	68
May	173	69.2
June	184.5	73.8
July	193.5	77.4

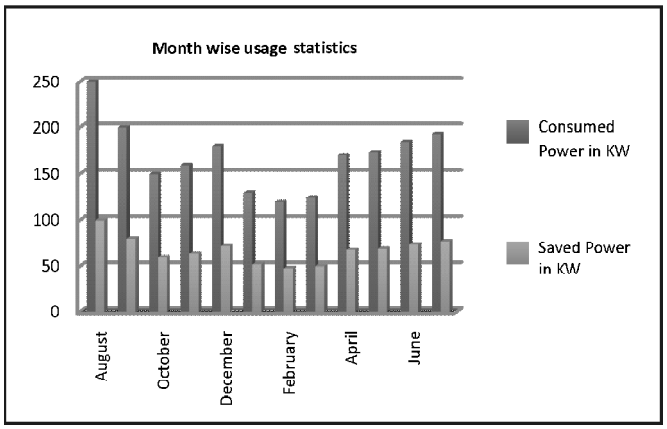

Figure 4: Monthly Consumed and Saved Power

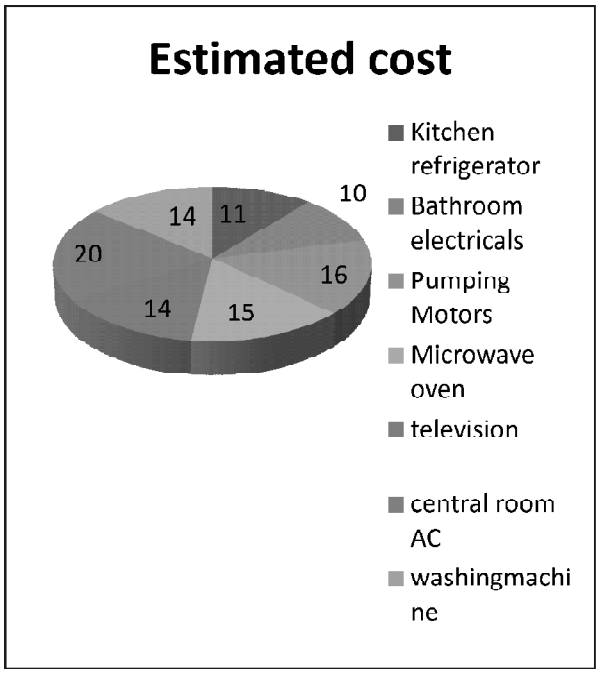

Figure 5: Power Consumed By Each Appliance In Percentage

Figure 6: Gauge Graph

The fig.7 represents the amount of saved power in percentage. By setting a predefined target power, the total power consumed for the day is analyzed. If the consumed power is lesser than the target power, then percentage of saved power is determined.

The fig.8 represents the maximum and minimum power consumption of the appliances in the home. It also determines the average power consumption of all appliances.

Figure 7: Representation of saved power

Figure 8: Minimum and Maximum Level Consumption

The fig. 9 represents the power consumed by the heater in every hour and also represents the average power consumed.

The fig.10 represents the power consumed by the HDTV and its cost for the power consumed.

Figure 9: Average Power of Heater

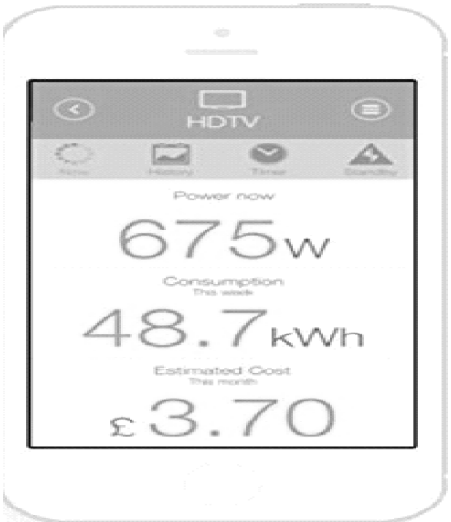

Figure 10: Estimated Cost for HDTV Power Consumption

8. CONCLUSION

This paper presents an efficient power saving mechanism in each residence. The proposed system can automatically turn off the load which exceeds the threshold limit. The future system focuses on monitor the appliances lifetime which is useful for the user to detect the efficiency of the appliance.

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