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Smart Power Management System using Wireless Sensor Network

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Abstract: Intelligent Power Management is the combination of smart sensors and actuators. Proposed system is to design and develop a real time system which will intelligently monitor and control for home appliances. Proposed system monitors the electrical parameters such as voltage, current and subsequently calculates the power consumption of the home appliances that are need to be monitored. The innovation of this system is controlling mechanism implementation. Also the proposed system is a user authentication, economical and easily operable. Due to these intelligent characteristics it become an electricity expense reducer and people friendly. Smart power conservation is a method of controlling home appliances automatically for the convenience of users. Controlling of electrical devices in the home that can be programmed using a main controller or even via cell phone from anywhere in the world.

Keywords: Energy management, home automation, intelligent control system, wireless sensor network, android App.

I. INTRODUCTION

New technologies include cutting-edge advancements in information technology, sensors, metering, transmission, distribution and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity.
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. A smart home is a residence in which computing and information technology apply to expect and respond to the occupants' 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.

There is a need to design and develop a real-time system which will monitor and control household appliances. Wireless sensor networks (WSNs) have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. Due to those advantages, WSNs has been applied in many fields, such as the home automation, military, industry, environmental monitoring, and healthcare. The WSNs are increasingly being used in the home for energy controlling services. Regular household appliances are monitored and controlled by WSNs installed in the home [5]. The WSNs are increasingly being used in the home for energy controlling services. Regular household appliances are monitored and controlled by WSNs installed in the home. New technologies include cutting-edge advancements in information technology, sensors, metering, transmission, distribution and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity

New technologies include cutting-edge advancements in information technology, sensors, metering, transmission, distribution, and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity. The system monitors electrical parameters of household appliances such as voltage, current and subsequently calculates the power consumed. The novelty of this system is the implementation of the controlling mechanism of appliances. The developed system will prove to be low-cost, flexible in operation and thus can save electricity expense of the consumers. The WSNs are increasingly being used in the home for energy controlling services. Regular household appliances are monitored and controlled by WSNs installed in the home. The measurement of electrical parameters of home appliances is done by interfacing with fabricated sensing modules. The paper focuses on human-friendly technical solutions for monitoring and easy control of household appliances. The inhabitant's comfort will be increased and better assistance can be provided.

II. LITERATURE REVIEW

Han et al. [2] proposed a Home Energy Management System (HEMS) using the ZigBee technology to reduce the standby power. The suggested system consists of an automatic standby power cutoff outlet, a ZigBee hub and a server.

The power outlet with a ZigBee module cuts off the ac power when the energy consumption of the device connected to the power outlet is below a fixed value. The central hub collects information from the power channels and controls these power channels through the ZigBee

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module. The central hub sends the present state information to a server and then a user can monitor or control the present energy usage using the HEMS user interface. This facility may create some uneasiness for the users. For example, if the users may want low intensity of light, for some situation but the system will cut the power off leading to darkness.

Gill et al. [3] projected a ZigBee-based home automation system. This system consists of a home network unit and a gateway. The core part of the development is the interoperability of different networks in the home environment. Less importance is given to the home automation.

Song et al. [4] suggested a home monitoring system using hybrid sensor networks. The basic concept of this paper is a roaming sensor that moves the appropriate location and participates in the network when the network is disconnected.

Suh and Ko [5] proposed an intelligent home control system based on a wireless sensor/actuator network with a link quality indicator based routing protocol to enhance network reliability.

Nguyen et al. [6] have proposed a sensing system for home-based rehabilitation based on optical linear encoder (OLE); however, it is limited to motion capture and arm-function evaluation for home based monitoring.

S. Akbar Badusha, A. Mohamed Sarjun, Z. Ihsanullah [8], Zigbee which send the unit consumed by the load to the admin section and it also displays the cost of the unit and previous month unit. If any load which consumes more energy it can be controlled through zigbee and tampering can be detected by interfacing vibration sensor to the home section.

III. SYSTEM DESCRIPTION

The system has been designed for measurement of electrical parameters of household appliances. Important functions to the system are the ease of modeling, setup, and use. From the consumer point of view, electrical power consumption of various appliances in a house along with supply voltage and current is the key parameter. Fig. 1 shows the functional description of the developed system to monitor electrical parameters and control appliances based on the consumer requirements. The Proposed system aims to design a system that can monitor electrical parameters of household appliances such as voltage, current and subsequently calculates the power consumed. This system checks the status of appliances in the absence of person at home and gives a feedback to the particular user. This system will also give an option to operate the appliance in economic mode. In economic mode bill amount will be set first and accordingly the system based on the amount sets threshold which eventually controls the appliance to get the desired power consumption.

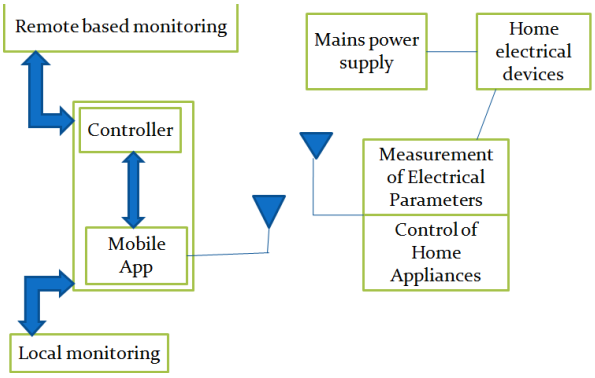

Fig.1. Functional block diagram of the system.

IV. HARDWARE DESCRIPTION

- **Arduino**

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world.

- **Circuit diagram of Arduino barebone**

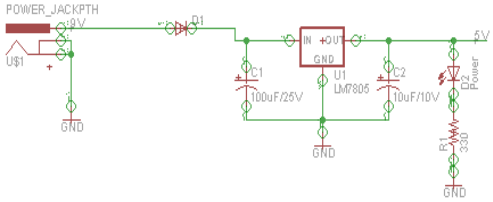

Fig.2. Circuit diagram of power supply

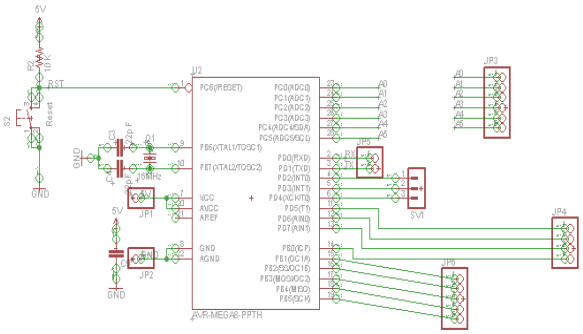

Fig.3. Circuit diagram of Arduino Barebone

- **HC-05 Embedded Bluetooth Serial Communication Module**

HC-05 embedded Bluetooth serial communication module (can be short for module) has two work modes: order-response work mode and automatic connection work mode. And there are three work roles (Master, Slave and Loopback) at the automatic connection work mode. When the module is at the automatic connection work mode, it will follow the default way set lastly to transmit the data automatically. When the module is at the order-response work mode, user can send the AT command to the module to set the control parameters and sent control order. The work mode of module can be switched by controlling the module PIN (PIO11) input level.

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Serial module PINs:
1. PIO8 connects with LED. When the module is power on, LED will flicker. And the flicker style will indicate which work mode is in using since different mode has different flicker time interval.
2. PIO9 connects with LED. It indicates whether the connection is built or not. When the Bluetooth serial is paired, the LED will be turned on. It means the connection is built successfully.
3. PIO11 is the work mode switch. When this PIN port is input high level, the work mode will become order-response work mode. While this PIN port is input low level or suspended in air, the work mode will become automatic connection work mode.
4. The module can be reset if it is re-powered since there is a reset circuit at the module

• Estimating Energy Consumption
Use this formula to estimate an appliance's energy:
(Wattage × Hours Used per Day ÷ 1000 = Daily Kilowatt-hour (kWh) consumption
(1 kilowatt (kW) = 1,000 Watts)
Multiply this by the number of days the appliance is used during the year for the annual consumption. Calculate the annual cost to run an appliance by multiplying the kWh per year by the local utility's rate per kWh consumed.

TABLE.1.Wattage of Devices

Microwave	750-1100 watts
Toaster	800-1400 watts
Television 19"-36"	65-133 watts
Washer	350-500 watts
Iron	100-1800 watts
Ceiling fan	65-175 watts
Coffee maker	900-1200 watts
Hair dryer	1200-1875 watts
Laptop	50 watts
Computer monitor	150 watts

• MIT App Inventor
App Inventor for Android is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT).It allows newcomers to computer programming to create software applications for the Android operating system (OS). It uses a graphical interface, very similar to Scratch and the Star Logo TNG user interface, which allows users to drag-and-drop visual objects to create an application that can run on Android devices. In creating App Inventor, Google drew upon significant prior research in educational computing, as well as work done within Google on online development environments.

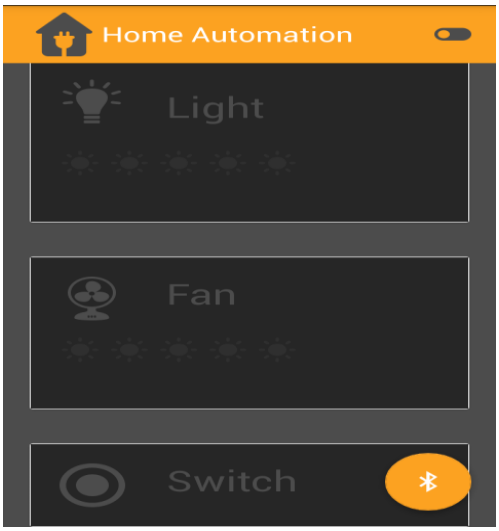


Fig.4. Home page of Android App

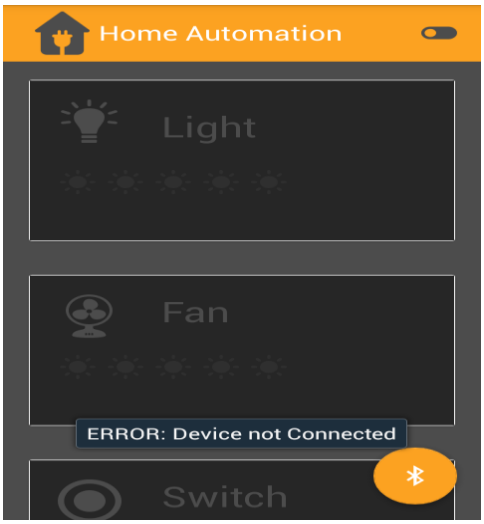
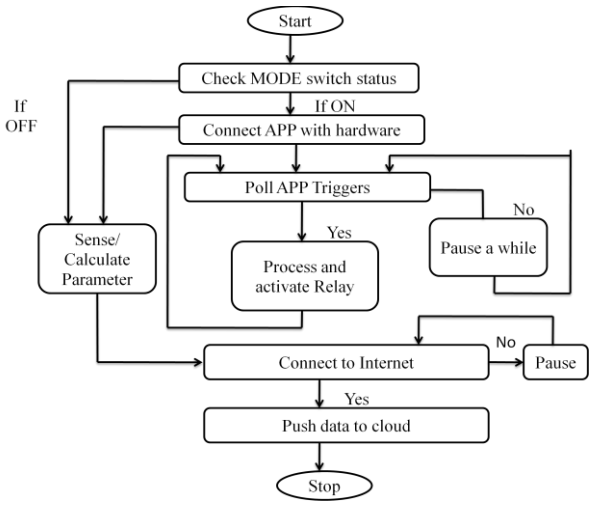


Fig.5. Device connection window

V. SYSTEM FLOWCHART



V. CONCLUSION

An intelligent power monitoring and control system will be design and develop towards the implementation of smart building. The proposed system will monitor and control the electrical appliance usages at home. The real-time monitoring of the electrical appliances can be viewed through website. The sensor networks will be programmed with various user interfaces suitable for users of varying ability and for expert users such that the system can be maintained and interacted easily.

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BIOGRAPHIES

Rubana P. Shaikh has received B.E. degree from the Electronics and Telecommunication Engineering Department, Solapur University. She is currently pursuing M. E. from the Electronics Engineering Department, Solapur University. Her main area of interest is Embedded system.

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