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WSN-BASED SMART SENSORS AND ACTUATOR FOR POWER MANAGEMENT IN INTELLIGENT BUILDINGS

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Abstract: **Wireless sensing network (WSNs) have the ability to monitor as well as control the situational information for various intelligent service so day by day the demand for wireless sensor networks(WSNs) goes on increasing. The consumption of energy in residential buildings is increasing day by day due to increase in urban population and increase in usage of AC appliances. Energy generated is not sufficient to meet energy demand. Therefore there is a need to save energy. The use of smart energy management system can assist in reducing the energy usage in an efficient way. Intelligent Power Management is the combination of smart sensors and actuators. The design and development of an intelligent monitoring and controlling system for home appliances in a real time system is presented in this project. This system principally monitors the electrical parameters such as voltage and 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 in Iot based by server. The user can control the home appliances by mobile app using server data. The developed system is a low-cost and flexible in operation and thus can save electricity expense of the consumers. Also the proposed system is an economical and easily operable. Due to these intelligent characteristics it becomes an electricity expense reducer and people friendly. Adopting WSNs for power management provides great advantages over traditional wired system. By using WSN technology data can be collected through sensing unit and transferred wirelessly to a control system for operation and management**

Index Terms **– WSN, IOT, Sensors.**

I. INTRODUCTION

It is foreseen that service and personal care wireless mechatronic systems will become more and more ubiquitous at home in the near future and will be very useful in assistive healthcare particularly for the elderly and disabled people [1]. Wireless mechatronic systems consist of numerous spatially distributed sensors with limited data collection and processing capability to monitor the environmental situation. 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 military, industry, environmental monitoring, and healthcare [2]–[4]. 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]. 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 ZigBee Alliance, wireless communication platform is presently examining Japan's new smart home wireless system implication by having an initiative with Japan's Government that will evaluate use of the forth coming ZigBee, Internet Protocol (IP) specification, and the IEEE 802.15.4g standard to help Japan to create smart homes that improve energy management and efficiency [6]. It is expected that 65 million households will equip with smart meters by 2015 in the United States, and it is a realistic estimate of the size of the home energy management market [7].There

are several proposals to interconnect various domestic appliances by wireless networks to monitor and control such as provided in [8], [9]. But the prototypes are verified using test bed scenarios. Also, smart meter systems like [9]–[11] have been designed to specific usages particularly related to geographical usages and are limited to specific places. Different information and communication technologies integrating with smart meter devices have been proposed and tested at different flats in a residential area for optimal power utilization[12],[13], but individual controlling of the devices are limited to specific houses. There has been design and developments of smart meters predicting the usage of power consumption [9]–[13]. However, a low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements is at the early stages of development. In this study, we have designed and implemented a Wi-Fi based intelligent home energy management and control service. We used ESP8266 WiFi technology for networking and communication, because it has low-power and low-cost characteristics, which enable it to be widely used in home and building environments [10]. The project 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. This system emphasizes the realization of monitoring and controlling of electrical appliances in many ways.

II. PROPOSED SYSTEM

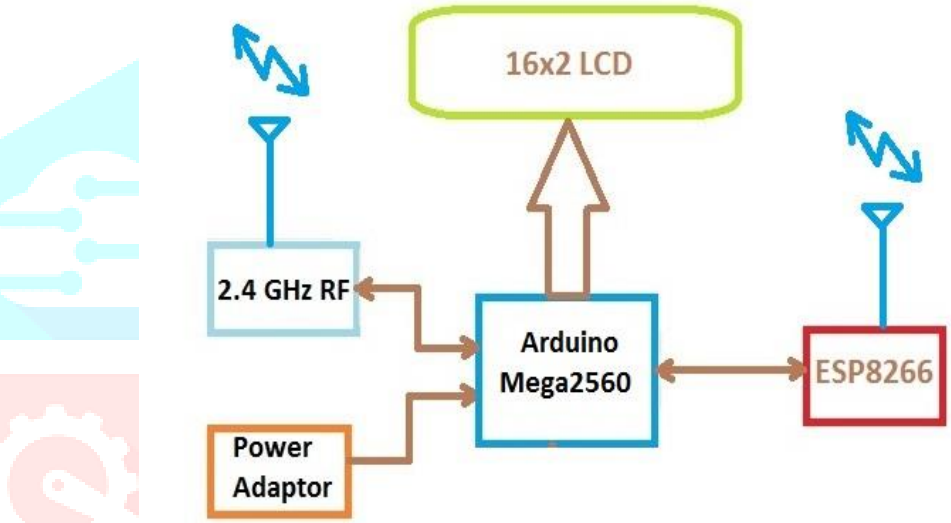

Figure 1. Functional block diagram of server transmitter and monitor unit

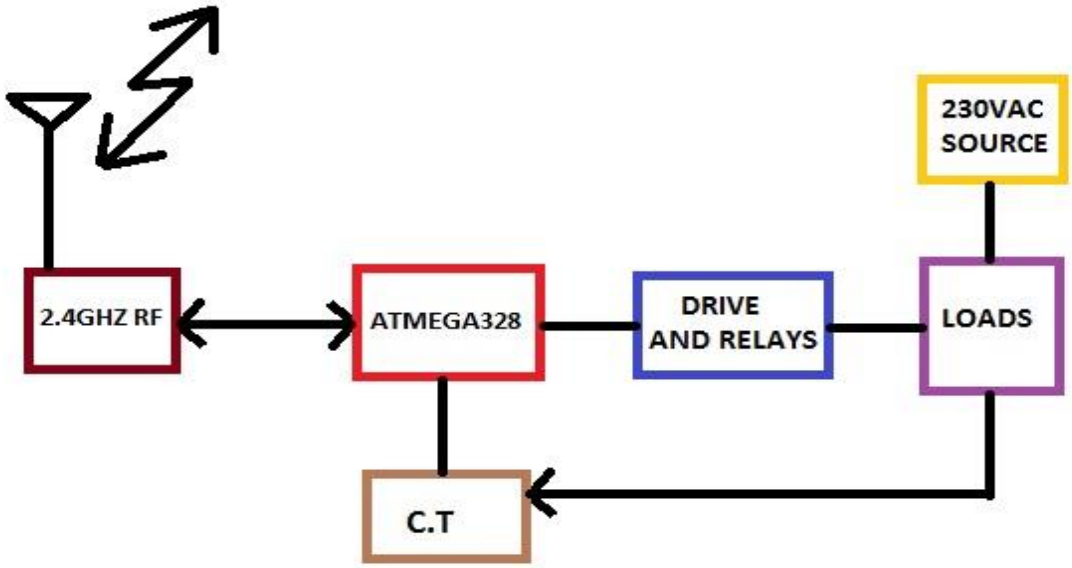

Figure 2. Functional block diagram of power measurement and controlled unit

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.3.1.1 shows the functional description of the developed system to monitor electrical parameters and control appliances based on the consumer requirements. The measurement of electrical parameters of home appliances is done by interfacing with fabricated sensing modules. The proposed system consists of a potential transformer, current transformer and Relay. Android application is developed to monitor and control how much current each load consumed. The smart power metering circuit is connected to mains 240 V/50 Hz supply. The current and voltage rating is obtained by current and potential transformer. The turn ON and OFF of loads can be done by relay via relay driver circuits. These electrical parameters can be monitored by the user via handheld device such as mobiles by creating an android application. The design and development of a smart sensing for home appliances has been reported in this project. The developed system is a low cost and flexible in operation. Thus one can save electricity expenses. This concept can be built in real-time situations because experimental results will be encouraging. By analyzing the power from the system, energy consumption can be controlled.

III. HARDWARE

A. ESP01(ESP8266)

Espresso's ESP8266EX delivers highly integrated Wi-Fi SoC solution to meet users' continuous demands for efficient power usage, compact design and reliable performance in the Internet of Things industry. With the complete and self-contained Wi-Fi networking capabilities, ESP8266EX can perform either as a standalone application or as the slave to a host MCU. When ESP8266EX hosts the application, it promptly boots up from the flash. The integrated high speed cache helps to increase the system performance and optimize the system memory. Also, ESP8266EX can be applied to any microcontroller design as a Wi-Fi adaptor through SPI / SDIO or I2C / UART interfaces. ESP8266EX integrates antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules. The compact design minimizes the PCB size and requires minimal external circuitries.

B. Arduino MEGA 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega 2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Decimal.

C. 3 nRF24L01

The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced Shock Burst™), suitable for ultra-low power wireless applications. The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400 - 2.4835GHz

D. ATMEGA328

The Atmega328 is a microcontroller chip produced by Atmel. It is 28 pin 8-bit microcontrollers that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and 6 analog input pins. These I/O pins account for 20 of the pins.

IV.SOFTWARE

Embedded C language

In every embedded system based projects, Embedded C programming plays a key role to make the microcontroller run & perform the preferred actions. At present, we normally utilize several electronic devices like mobile phones, washing machines, security systems, refrigerators, digital cameras, etc. The controlling of these embedded devices can be done with the help of an embedded C program. An Embedded system program allows the hardware to check the inputs & control outputs accordingly.

V. RESULT

The project is having the facility of getting the voltage, current and power units reading at any time on the server.

VI. CONCLUSION

Thus, the real-time monitoring of the electrical appliances can be viewed through a mobile app. The system can be extended for monitoring the whole intelligent building. A smart power monitoring and control system has been designed and developed toward the implementation of an intelligent building. Thus, the constant checking of the electrical appliances can be seen through a site. The system can be stretched out for observing the entire intelligent building.

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