GSM-Based Power Administration of Intelligent Buildings

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Abstract

This article describes the design and creation of a smart, controlling and realtime monitoring system for intelligent building. The system primarily tracks electrical variables like current and voltage and then determines the amount of power used. The application of the controlling technique to appliances in many ways makes this system innovative. The system created is versatile and affordable, allowing users to reduce their power costs, when a message is sent through GSM. The prototype has undergone thorough testing in actual settings, and the results of the experiments are quite positive. This technique can shut off the power supply when electricity is misused and send information to intelligent buildings through GSM.

Keywords: GSM, LDR, LCD, WSN, iHEM, RELAY

1. Introduction

Wireless mouse-tonic systems for home services and personal care are anticipated to become more commonplace and extremely helpful soon. Wireless Mechatronic systems monitor the environment by using many geographically dispersed sensors with limited data collection and processing capabilities. The capacity of WSNs to track and handle situational data for different intelligent services has made them more and more significant. WSNs have been used in various industries, including the military, business, environmental monitoring, and healthcare, because of these benefits [5]. The use of WSNs within the home to provide energy control services is growing. WSNs placed in the home monitor and manage common household equipment. Innovative developments in technology for information, sensors, meters, transmission, distribution, and electricity storage are examples of new technologies. The customers and electricity suppliers are supported with greater information and flexibility. To monitor and operate various home appliances, there are multiple ways to link them via wireless

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networks. But test bed scenarios are used to validate the prototypes. Additionally, smart meter systems are confined to certain locations and have been built for certain purposes, notably those that are geographical in nature [4]. For the best possible power consumption, many technologies for communication and information integration into smart meter devices are being developed and tested at various flats within a residential area, although individual management of the equipment is only possible in some homes [6].

Smart meters have been designed and developed to predict how much electricity will be used. The creation of an adaptable and low-costsystem to continually monitor and regulate depending upon customer demand is still in its infancy. In this study, a GSM-based smart home energy monitoring and control service was developed and put into use. GSM technology is used to facilitate networking and communication because of its low cost and low power requirements, which make it suitable for widespread use in residential and commercial settings. The study seeks technologically advanced yet user-friendly methods for keeping an eye on and conveniently operating home appliances. The comfort of the resident will rise, and better help may be given. This research has a strong emphasis on implementing monitoring and control of electrical equipment.

The created system includes the following distinguishing characteristics: 1) Using a TRAIC with an opto isolated driver to control electrical devices Utilizing a TRIAC -BT138 based smart sensing device, household appliances may be operated remotely or automatically. 2) No microprocessor or microcontroller: A processing unit within the sensing end is not necessarily due to the architecture of smart sensing units. 3) Controlling the appliances with flexibility: Depending on the needs of the user, multiple methods may be used to monitor and manage appliances [3].

2. Literature Survey

2.1 Using WSN to Manage Power Efficiently at Home

It is suggested to design and create a smart, real-time control and monitoring system for home electrical equipment. Power consumption usage is becoming a major issue. With a fixed power usage for each residence set by the EB office, a smart energy distribution system is suggested in this system [1]. Due to a lack of power generation from both renewable and non-renewable resources, electricity distribution from EB is the main problem. The developed design helps to reduce frequent power outages [10]. Additionally, monitoring and regulating

household appliances is done automatically, remotely, and with the aid of the internet. The key goal is to offer flexible operations at minimal cost. The objective is to create a freshly outfitted, well-designed prototype for customers to use at home to reduce power use. Users and the power distribution centre can control the electricity more effectively thanks to this. Microcontrollers as well as zig-bee transceivers are used to put the theory into practice in the house and in the EB unit. The internet efficiently offers the data necessary to regulate electricity by operating household appliances.

2.2 Service Robot: Intelligent Space-Based Wireless Sensor and Actuator Network

The actuator network and wireless sensor is an important element of the smart space for service robots. This research focuses on creating and implementing a ZWSAN, or a network of wireless sensors and actuators based on Zig-Bee, that can be successfully employed in the service enabling robot intelligent space. After a brief explanation of Zig-Bee protocols, a simple Zig-Bee stack used with ZWSAN is first suggested, and then the basic elements of the stack are demonstrated. To show exactly how each device in ZWSAN may work together to offer service, an application sample is provided [9].

2.3 Zig-Bee-Based Smart Home Energy Control Systems

With wireless personal area networks & wireless sensor networks becoming more and more popular, the IEEE 802.15 Wireless Personal Area Network Work Group has produced no fewer than a few standards to satisfy the requirements of diverse applications. The ubiquitous home network has attracted a lot of interest because of how seamlessly it integrates into daily life [8]. This ground-breaking solution transparently integrates energy technology, smart sensors, and numerous home appliances. This research develops descriptions of smart home devices and best practices for Smart Energy applications such as load control and demand response that are required in smart energy-based residential or light business contexts.

2.4 Wireless Sensor Networks to Support the Smart Grid's Cost-Effective Residential Energy Management

As the smart grid is expanded to include residential properties, WSNs will be crucial in enabling a variety of demand as well as energy management applications. These applications will immediately reduce power costs and carbon emissions while improving the demand-supply balance. In this research, the efficacy of an application for iHEM is assessed. The effectiveness of iHEM is contrasted with that of an optimization-based household energy

management system, whose goal is to reduce consumers' energy costs. The iHEM lowers energy costs, lowers consumers' peak load contributions, lowers household carbon emissions, and achieves savings that are comparable to OREM.
A home automation system based on GSM [7].

3. Proposed Method

In the suggested system, sensors and human wireless control are used to automate the power supply management of the building. It may be manually controlled. To send the device's state to the controlling part, use a GSM. In manual wireless mode, the control component of the system uses GSM to operate the entire device. This approach primarily addresses the energy use within a structure. The proposed method is shown in figure 1.

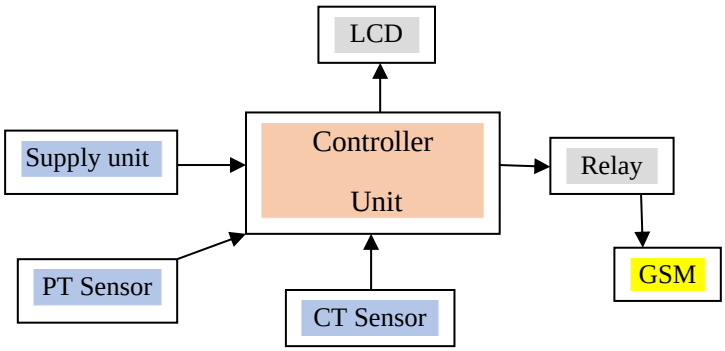

Figure 1. Block Diagram of the Proposed Method

3.1 Liquid Crystal Display (LCD)

A collection of colour or monochrome pixels are positioned in the centre of a light source with reflector to create the compact, flat liquid crystal display, which is used as a display technology. It is commonly used in electrical devices that run on batteries since it uses relatively little electric power. Without a liquid crystal in the spaces between the polarizing filters, the second polarizer would stop light from flowing through the first filter. Liquid crystal molecules are aligned in a certain direction by treating the electrode surfaces that come into proximity to the liquid crystal material.

3.2 Light-Dependent Resistor (LDR)

A device whose resistance changes depending on the amount of light that hits its surface is called an LDR. Any electric circuit, especially garden lights integrated with night security

lighting, that must switch on and off based on the amount of ambient light must include light-dependent resistors. LDR have highly useful in circuits with light and dark sensors. Either an intrinsic or an extrinsic photoelectric device is possible. Since intrinsic semiconductors, like silicon, has its own charge carriers, The semiconductors are not much efficient.

3.3 Current Sensors

The Allegro ACS75x family of current sensors provides precise and cost-effective current sensing for systems used in many applications. It is easy for customers to adopt thanks to the device package. Examples of usual usage include power supply, over current fault prevention, management, & load management. The copper conduction line's integrated Hall IC measures and converts the magnetic field created by the supplied current into a proportionate voltage. Precision of the device is enhanced by magnetic signals present close to the Hall transducer.

3.4 Power Supply Unit

All digital circuits require a very low DC voltage to operate. To deliver the proper voltage, a power supply device is needed. A transformer, rectifier, filter, and regulator make up this device. There are usually in the final DC voltage there will some oscillations or waves.

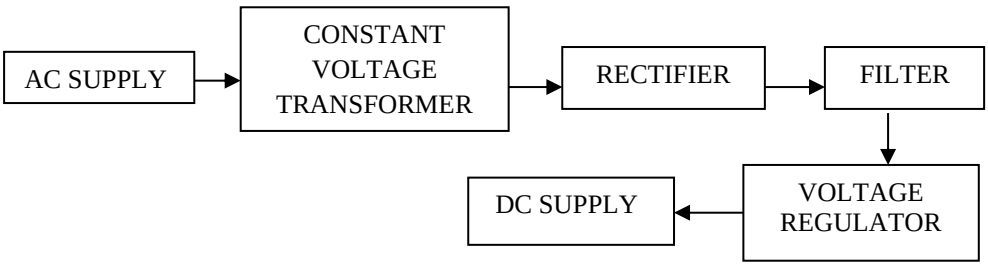

Figure 2. Power Supply Block Diagram [2].

After rectification, filtering, and regulation, the accessible AC supply is used to create the necessary DC supply. It displays a block schematic of the power supply unit. The frequency of the transformer's output matches that of the AC power input. Through diodes, this alternating current power is transformed into DC power. Here, a bridge diode transforms an AC power supply into a DC power source. This transformed DC power supply contains a ripple component, and for the circuit to operate normally, the DC power supply's ripple component must be as low as feasible. Because the circuit's lifespan will be shortened by the power supply's ripple content. Power supply block diagram is shown in figure 2.

3.5 Transformer

With the use of inductively linked wires, a transformer may move electrical energy from one circuit to another. A changing magnetic field is produced by a changing current in the first circuit, and this magnetic field then generates a changing voltage in the second circuit.Because of their thickness, most wires lose electrical energy with a rate proportional with the square of the current that passes through them. By converting electrical power into a low-current to a high-voltage state for transmission, transformers enable the cost-effective transmission of electricity across large distances.Transformers constitute some of the most efficient electrical devices, with some large units being able to pass on 99.75% on their input power to their output.

3.6 GSM

In the proposed method, GPS data recorded on the Butterfly AVR board is transmitted through a mobile phone to a distant receiver module. The GSM standards are used by this mobile phone. The ETSI committee has overseen developing GSM technology. Text messages are sent through SMS from the nearby transmitter to the distant receiver. SMS is a function that came from the GSM standard's transition to GPRS over a period of years. To raise the information rate from the initial 9600 bits per second to 40 kilobits per second, this was designed. The primary elements of a GSM network are briefly outlined here.

3.7 Relay

Relays are electronic devices that enable low-power circuits to regulate signals that must be electrically disconnected from the circuit used in controlling or switching a relatively strong current.A relay must have an appropriate pull-in that maintains the current DC sent via the energizing coil to function. Additionally, most tiny relays used in electronics work are intended to function off a specific supply voltage, which is frequently 12 volts or 5 volts in these cases. Each coil has a resistance that, when linked to that supply voltage, will cause it to draw the proper pull-in and holding currents.

3.8 Graphic User Interface

Users may communicate with electronic devices using graphical icons and voice through the GUI. An interface by which a user engages with electronic equipment is known as

a GUI. The suggested approach uses a GUI to show all the gathered data on the computer, allowing for action to be taken directly from the GUI.

3.9 MP Lab

Software called MPLAB X IDE is used to create applications for Microchip digital signal controllers and microcontrollers. It briefly demonstrates how MPLAB X IDE Microchip can be used in the development of the suggested embedded system.

3.10 Proteus

In the Proposed method Version 8.16 of the Proteus Editor is being used to extract the proposed output. Several fundamental actions are involved in setting up and altering a new session.

- Create and name a New File.f
- Insert segment(s) into that file.
- Edit each segment.
- Test segments in real-time using PC mode.
- Save the finished session.
- Transfer it to Proteus, alone or as part of an Album.

4. Result and Discussion

The system was created for the purpose of measuring electrical characteristics. The system's simplicity in modelling, setup, and usage are key features. The most important factor from the perspective of the user is the amount of electricity used by the different equipment in a home, combined with the supply voltage and current. The following sections include specifics on the design and creation of the sensor modules.

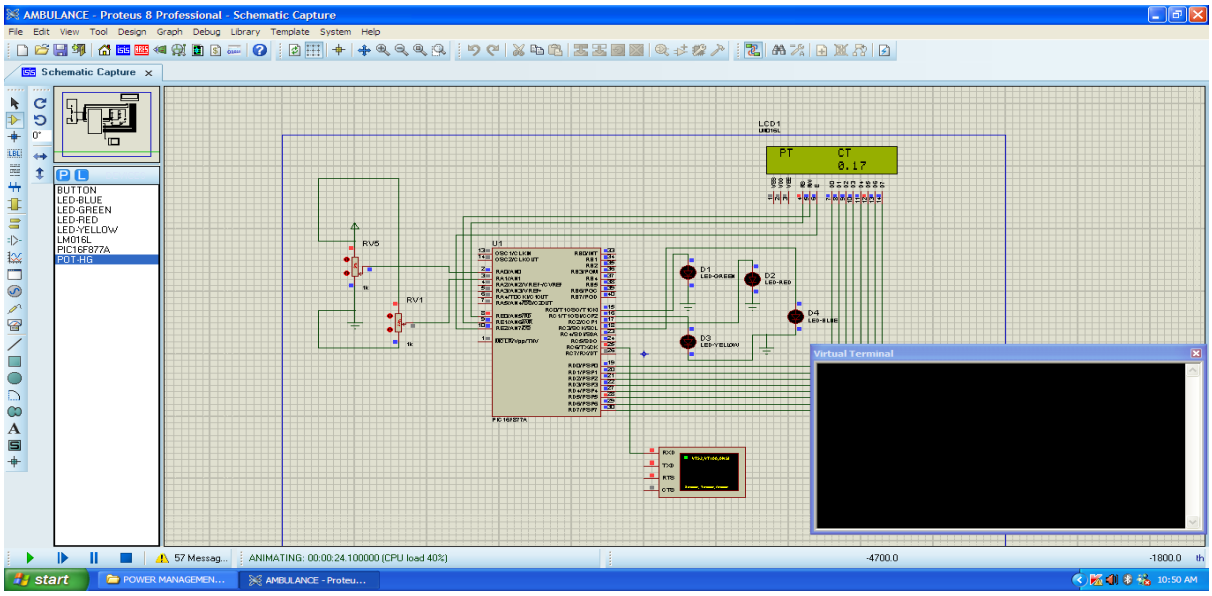

Figure 3. Simulation Result of Current Sensor Working and Power Calculation

The greatest distance between neighbouring GSM nodes is less than 10 meters, and valid sensor fusion data can be achieved using the mesh topology's hopping approach. The host computer's USB port has been used to connect the GSM coordinator, and the host computer is where the data is stored in a database. To remotely monitor and manage the home environment, the gathered sensor fusion data has been delivered to a domestic internet gateway. Figure 3 represent the simulation result of current sensor working and power calculation.

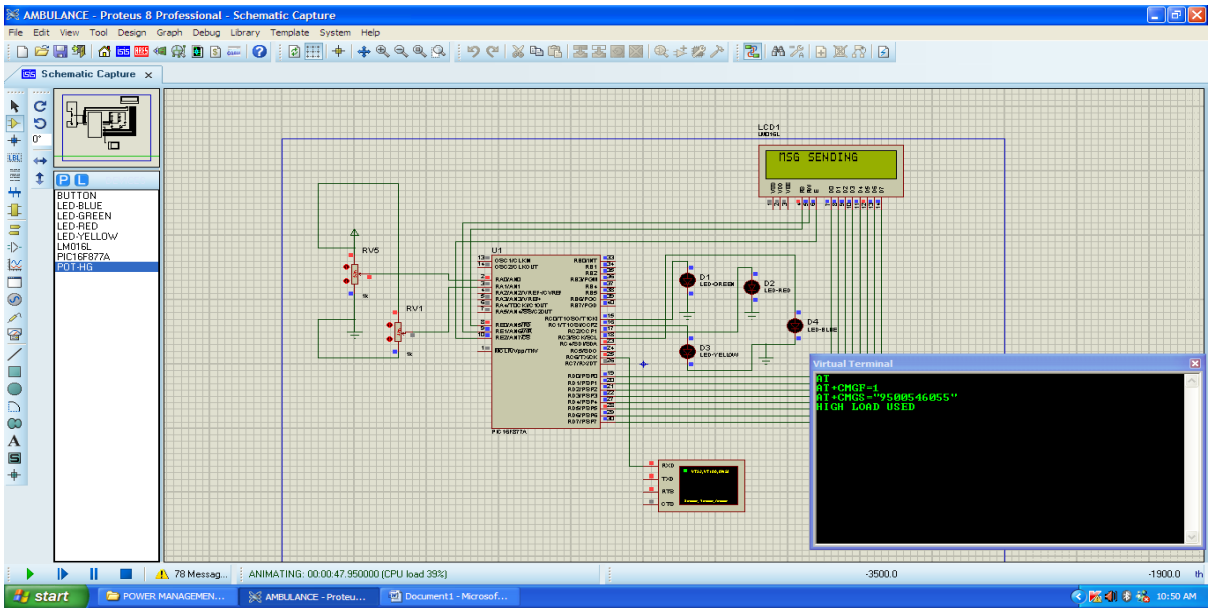

Figure 4. Simulation Result of Current Sensor Working

Above figure.4 shows the simulation result of current sensor working concept. The prototype is in use in a test house with a variety of electrical equipment that the resident routinely uses. Various electronic components like microwave, heater, oven, kettle, radio, a television, a refrigerator, and a battery charger were all put to the test. In the experimental setting, a total of 10 different electrical devices were employed; nevertheless, any electrical appliance with a power consumption of less than 2000 W will be applicable for the system. The sampling rate was sensor modules were constructed adjusted to 50 Hz to provide accurate recording of electrical appliance consumption over short time intervals. Data are gathered via a smart coordinator by tracking the power usage of the appliances, and all data are saved in the system for analysis and future use. The parameters that will be input into the data coordinating software from appliances are voltage, the value of current, and power. These variables will be examined and recorded in a database.

The computer's GUI window will show the collected data so that the GUI may be used to perform the necessary action. A home where the system is being tested has a control system and smart energy monitoring. The values of the processed power, voltage, and current are shown on the computer's graphical user interface. The results of the processing are precise and easy to utilize. The sensor node's sensing mechanism measures voltage and current. The coordinator receives the unprocessed information. The data is then processed by the computer after being collected from the coordinator. The required formulae are then used by the computer to determine the real power, voltage, and current usage of the electrical equipment. MP Lab is used to process the measurements for voltage and current for the user interface of the local home's smart software system.

5. Conclusion

By employing a GSM module, this endeavor could be used in any industry. The reduction of energy waste is a benefit of this initiative. The research helps in determining the exceeds in the voltage level than the permitted level of power consumption, the microcontroller at this point will use the GSM module to transmit a message to the appropriate authorities. The circuit will conduct current if a 40-watt power supply is used. The current will pass throughout the circuit without tripping when a 60-watt power supply is applied. When a circuit with a 100-watt power source is used, a voltage drop will take place in the circuit because of the power tripping. A message will be delivered to the GSM module's saved number once the power is interrupted.

In the future, the danger factor will be decreased by the research in several sectors and other household uses. As a result, the GSM Module will send the user a notice if the current ever rises above the typical level during a trip. The IOT will be able to adopt this technology in the future at a cheap cost with more secure features.

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