Smart hybrid power supply system for home appliances

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Abstract: India, power generation for daily usage is being tedious. Increase in population, creating a high demand for alternative source for power generation. Though India is abundant with solar energy, implementation of solar energy is being very tedious due to its higher initial installation cost. This can be overcome, using a hybrid technology, where alternative power sources and the main power source is being switched based on the requirement or usage of the household. The proposed work uses a micro controller based system to do the switching by calculating the power utilized by the house hold using a current sensor. Most commonly used switched sources are solar energy and the main supply from electricity board.

Keywords: current sensor, voltage sensor, TFT Screen and Node MCU.

1. Introduction

Smart Grid is a caption that is used for referring tools and technologies which makes electrical appliances reliable and affordable to consumer’s needs. Smart grids are used in real time to effectively monitor the usage of power demand and the condition of the system. Smart grids are used to find the flow of electricity with great accuracy, by combining digital devices and software applications and according to the situation of inputs they apply appropriate logic [1]. These smart grids also record the usage of electricity by the consumer at different time intervals and supply the energy usage data to the consumer. By analyzing the problems that occur in the generation of AC supply, this paper aims to design a system that uses the solar power. If solar power is used in home appliances then the requirement of grid’s power can be very much reduced. Thus the renewable energy can be used efficiently. The system designed to use solar panels will always reduce the problem of load shedding and thereby electricity bills will be reduced [2]. The output which is synchronized will be applied to the ARM and automatically the source of supply will be selected based on the requirements of load and the source. Due to advancement in technology, the users can simply use a phone to control various devices [3]. The users will be informed about the daily usage of power through a text message. Information regarding the system’s status in terms of different parameters like voltage, current & power consumption will be displayed.
This paper is organized as follows. Section 2 briefs the literature review. Section 3 explains the design of the proposed system. In section 4 the hardware resources used in this design are elaborated. Section 5 gives the picture of the experimental setup. Section 6 discusses the results obtained. Finally Section 7 concludes the findings.

1.2 Existing System

In the existing system, power is measured with the help of measurement devices using man power. There is no separate energy generate source monitoring system using internet. The data is transmitted wirelessly to control energy sources in which the distance covered is less.

2. Literature Review

R. Vidhya [7] et.al put forward a novel IoT based hybrid energy system using NodeMCU. In this paper a technique is proposed that controls the hybrid power system using IoT. This is done by using a NodeMCU Wi-Fi unit to switch between solar and wind energy. An arduino controller is used for switching. Monitoring of the energy sources is done by the user by using smart phone or PC.

Vignesh [8] et.al proposed a smart device for monitoring hybrid energy supply using IoT. In this paper ESP 32 module is used to control energy sources, in which wireless data transmission is done. Here the data is controlled using an android app.

D. Nagalaxmi [9] et.al came up with a Smart Grid architecture which is constructed with Web of Things. Information about each of the energy meters on-site will be given in real time using web interfaces. MoDBUS is used as communication protocol for communicating embedded internet devices.

Prakhar Srivastava [10] et.al uses ESP8266 module to control the hybrid energy system using IoT. Here again the data transmission is done wirelessly and the operation of the device is very simple. The range of energy sources focused are solar, wind bio fuel, etc., It is also controlled using smart phone.

3. Design of the proposed system

The system designed here works as follows. This system uses two sensors that are interfaced to the Node MCU. All the components of this designed system are placed in a box.

Figure 1. Blok diagram of the proposed system

The sensors involved are current and voltage sensor using which the current and voltage that the solar panel generates and the user consumes can be measured. The function of NodeMCU is to
compare the actual values and the pre defined threshold values. Once the deviation over the safety value is detected then the NodeMCU actuates the switching unit. For the purpose of report generation and monitoring, these values are stored.

4. Hardware resource features sensing module

The current Sensor and the voltage Sensor collects the data and send the values to the controller, Node MCU, which controls the switching unit (Relay).

4.1 ACS 712 Current sensor

In many applications like over current protection circuits, switching mode power supplies and programmable current sources the most basic requirement is sensing and controlling the flow of current. The sensor that is commonly used to detect AC or DC current is ACS721 [4]. Using this sensor the highest value of AC or DC that can be detected is around 5A.

![Current Sensor](image)

**Figure 2. Current Sensor**

**Features**
- Supply Voltage: 4.5V~5.5V DC
- Measure Current Range: -5A~ 5A
- Sensitivity: 180mV/A ~190mV/A
- Typical: 185mV/A

**Application examples**
- Pump/motor control
- Robotics
- Level detectors
- Medical diagnostics
- Pressure switching
- Blood pressure measurement

4.2 Node MCU ESP8266 Controller

A commonly used open source IoT platform is NodeMCU [5]. The firmware and hardware that is used in the NodeMCU are ESP8266 Wi-Fi SoC & ESP – 12 module respectively.
4.3 Switching Unit

The Controller actuates the Relay and controls the power utilized.

Relay:

A relay is basically a switch that is operated electrically. Usually electromagnets will be used to operate the switch mechanically but at times solid state relays are also used. Relays mainly find its applications in places where there is a necessity to control a single circuit by a separate low power signal. They were also used for performing logical operations in computers and also in telephone exchanges [6].

A contactor is another type of relay that is used in applications to control high power. On the other hand, circuits with no moving parts are controlled using solid state relays. In modern electric power systems, in order to protect circuits from faults relays with multiple operating coils and calibrated operating characteristics are used. There are other types of relay which works based on magnetic latching, that needs pulses to move their contacts in to and fro direction. If the pulses get repeated from same input, they will not have any effect.

Figure 3. Node MCU Controller

Specifications:
- Type: Single board microcontroller
- Operating system: XTOS
- CPU: ESP8266
- Memory: 128kbytes
- Storage: 4Mbytes

Figure 4. Relay unit
4.4 Display Unit

TFT screen:

A type of liquid crystal display (LCD) that employs a thin film transistor liquid – crystal display (TFT LCD) is used for improving the image qualities like contrast and others. It is simply a direct driven active matrix LCD with a less number of segments.

They are employed in applications like, hand held mobile phones, video games PDAs, TVs etc.,

Figure 5. Display unit

5. Experimental Setup

Figure 6. Experimental Setup

6. Results and Discussions

Though there are temporary solutions to generate power domestically, this system provides a improved efficiency by switching between the normal Power supply and the solar power. This switching has huge impact over the power consumption in our day to day life and thus being economical. The future scope is complete solution for home appliances using the Grid that can provide power to domestic purposes and can be supplied to various other reason, which is left unused. Comparison of power consumption details in various location provides detailed analysis of the power consumption in cities for better understanding of the consumption details.
Figure 7. Switching graph

The figure below shows the consumption graph:

Figure 8. Consumption graph

7. Conclusion

This work considered in the paper helps to monitor the current consumption in all homes enabling the reduction in power consumption and theft or loss. The work induces the usage of Renewable resources (Solar Power), as main supply to home, thus enabling energy conservation methods. This switching of renewable energy and the main power supply is achieved through complete hardware and software supports.

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