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Wireless Tariff Based Power Supply Control from Four Different Sources using Node MCU

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Abstract: ***In Earlier, the electrical appliances had electrical supply to be controlled using switches. The Home Automation is now the leading technology and has become the recent research area as this is the technology that automatically controls and devices, and monitors their activities in a home. The project implements IoT which connects devices with Internet thereby they can be controlled and their performance can be monitored. Node MCU being an inbuilt Wi-Fi module kit acts as the server system that allows home automated network to interact with user. The user can virtually interact with home IoT network via webbased interface by seeing which of the four electrical sources (Solar PV Array, Inverter, Diesel Generator and Mains) is supplying the load instantaneously. The selection among the four considered sources is done by relay switches and the selection is based on payment mode by calculating the Tariff which remains lowest in the moment.***

Keywords: IoT based Home automation, Supply from four different sources, Tariff calculation

1. Introduction

The power interrupts are now the major issues which are faced by industrial, residential sectors, hospitals. In accordance with this issue, the project now aims to automatically control the power supply to load from one to another power source [1]. The change of power source from one to the other based on the tariff calculation during any power outrages or interruptions or faults is merely to ensure the continuity of supply to load and also for the reliability of the constructed automation system. Electrical power supply is now the basic essential for each and every running sector. Most of the firms are now depending on electricity, it also contributes the overall growth of each country. The practical need is to provide uninterrupted supply to any loads of residentials to higher industries as the power interruption is unavoidable for the consumers.

2. System Components

2.1 Transformer

Transformer is a static electrical apparatus which transfers the electric supply from one to another circuit with change in voltage and current whereas the frequency remains unchanged. It works on the principle of electromagnetic induction where alternating current in primary winding creates an alternative magnetic flux at core. This flux in turn produces alternating magnetic flux at the secondary winding which induces voltage at secondary winding. A step-down transformer with no centre tap winding reducing 230V to 12V is used to provide power supply to the system from the mains.

2.2 Bridge Rectifier

A four-diode arrangement which rectifies the AC input to DC output. It is mainly used to provide DC supply to power electronic components and it can be constructed without a transformer i.e. no centre tap is required.

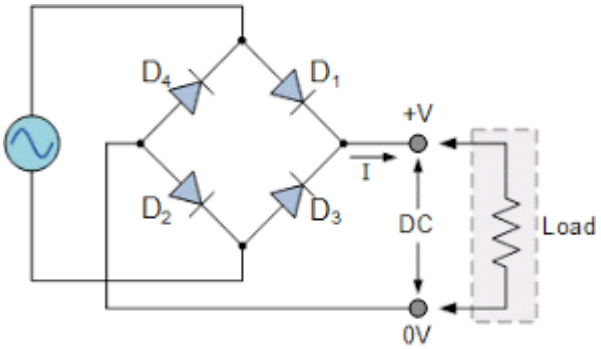


Figure 1: Bridge Rectifier

2.3 Relay

Relay is an electromechanical device, which performs switching operation in a circuit by responding to a signal of voltage, current or temperature. Here a solid-state relay is used as it made of power electronic components. It requires low voltage DC input for switching thus it is ideal for using with a microcontroller. It has LED and a optocoupler isolation. The LED is connected with input and optocoupler isolates the input from output. To turn ON this relay into conduction, a voltage greater than the minimum value must be applied at input terminals. Here the input is from Node MCU (ESP8266). It has 5V of operating voltage and fly back diode to protect the microcontroller.

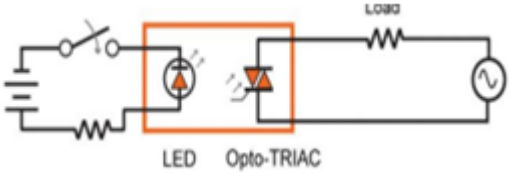


Figure 2: Solid State Relay

2.4 Motor Driver IC

The motor driver IC is used to control motor with the signals from microcontroller or a microprocessor. The

microcontroller operates in a lower voltage and it has to control the motors of higher voltage. Here Dc Motor Driver (LM293D) is used to control two DC motors of 12V. It can change the direction of rotation and also performs braking (Stall) depending upon the instruction from the microcontroller by H-Type configuration i.e. switches are arranged with H-Bridge topology.

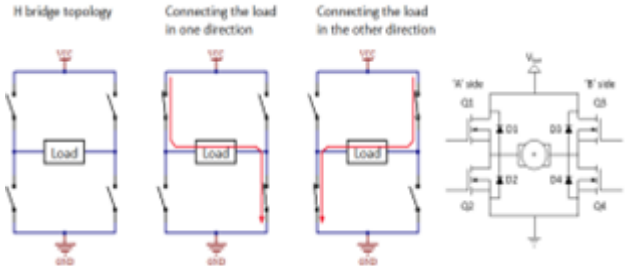


Figure 3: Motor Driver – H Topology

2.5 Voltage Regulator

Voltage regulator (L7805CV) is used to provide stable voltage throughout the system regardless of varying input or the load conditions. The DC supplied to components has negligible pulsations and these regulators act as buffers which protect the electrical equipments from damage. An output of constant 5V and 1.5A is delivered from it.

2.6 Node MCU

The Node MCU is a open source IoT Platform built of a SoC ESP8266 Wi-Fi SoC chip [2]. Hence the ESP8266 can be programmed with Arduino IDE. The Node MCU has CPU core, Wi-Fi system, supports Bluetooth 4.2 and an in-built temperature sensor. The ESP8266 has the following features:

1) It has 7pins of General Input Output Interface (GPIO) to assign various functions by programming the registers.
2) It has 1 I2C interface (both Master and Slave) to connect the microcontroller with other peripheral equipments (here relay is a sensor).
3) The clock frequency is of 100KHz at its maximum.
4) It is a SoC (System on Chip) with TCP/IP protocols (for Transport and Networking respectively) and the module has set of preprogrammed AT commands so that it can be interfaced with Arduino device.
5) It is a 32- bit microcontroller with operating voltage of 3.3V. The operating temperature is - 40oC-125oC.

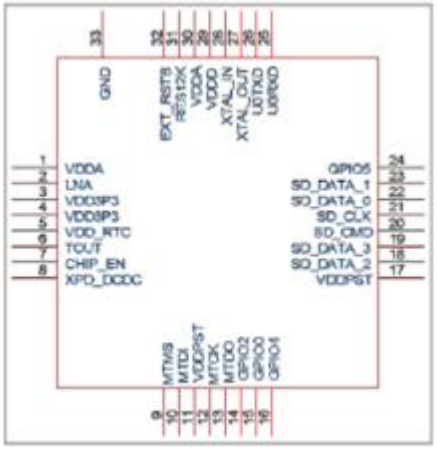
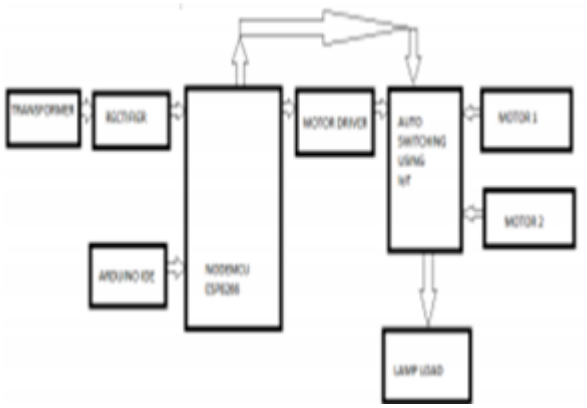


Figure 4: Pin Out-ESP8266

3. Block Diagram



4. Working Principle

The block diagram showed here has relay switches as it is practically impossible to get the four sources [1] such as Solar Array, Inverter, Diesel Generator and Mains. The Display unit is constructed using graphic interface using Blynk Platform which can be accessed as an Android application. The software components provide the IoT structure for the project. The first source is the Solar supply. It is currently supplying the load. All the sources are connected in parallel [3]. The push buttons are virtually connected using Blynk Platform and these are connected to all sources. When the button is pushed, itindicates the interruption at the corresponding source [4]. This function is interfaced with ESP8266. The relay and motor driver receives the output signal from ESP8266 and provides uninterrupted supply to load.

1) The tariff calculation is done by considering 3200imp/kwh as pulse rate of Energy metere.
2) The pulse of 100W bulb is to be calculated i.e. the number of times LED blinks for a 100W bulb.
3) Pulse= (Pulse rate* Watts*Time)/ (1000*3600), by substituting values we obtain the Pulse rate as 5.33 per minute.
4) The Power Factor of single pulse is to be calculated to find the power consumption in a minute PF=Watts/ (Hour*Pulse), by substituting we obtain 0.3125 Watt in single pulse.
5) Total pulse in an hour is Pulse rate*60, by substituting we obtain 320. Units=PF*Total pulse/1000, we get 0.1 per hour. A 100W bulb being illuminated for a day consumes Units*24 i.e. 2.4 Units and we assume unit rate in considered region is Rs.5 per unit. The payment for 2.4 units is 2.4*5= Rs.12.

The Display Unit in graphic interface shows the source which supplies the load momentarily.

5. Conclusion

This project now undergoes tariff calculation for a given load and switches among the various sources. The automatic power supply control is important along industrial applications. The given project can be further developed into a more complex level for higher loads.

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