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POWER GRID CONTROL USING ARDUINO

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Abstract: In the traditional system, the power transactions were done via one-way communication. SCADA (Supervisory Control And Data Acquisition) systems are currently employed in many applications, such as home automation, greenhouse automation, and hybrid power systems. Sometimes, problems arise due to the failure of the electricity grid leading to an entire area getting supply from that particular grid. This project demonstrates applying Arduino using an ESP8266 board to solve this problem using IoT as the means of communication and also tackling other issues which a smart system can deal with.

INTRODUCTION

Electric energy generated is transmitted and distributed through overhead lines and underground cables at different voltage levels. In the traditional system, the power transactions were done via one-way communication due to which generation of power at the user side is not possible. This was overcome by the concepts of microgrid and smart grid. Smart grid uses the latest communicating technologies like smart metering systems and the Internet of Things (IoT) which makes the tracking and controlling of power transactions more effective, flexible, and transparent.

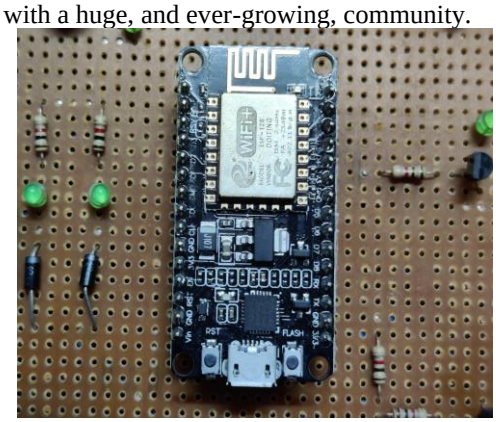
Energy generation companies supply electricity to all the households via intermediate controlled power transmission hubs known as Electricity Grid. Sometimes problems arise due to the failure of the electricity grid leading to the blackout of an entire area that was getting supply from that particular grid. The project aims to solve this problem using IoT as the means of communication and also tackling various other issues which a smart system can deal with to avoid unnecessary losses to the energy procedures.

POWER GRID

An electrical grid is an interconnected network for electricity delivery from producers to consumers. Electrical grids vary in size and can cover whole countries or continents. It consists of electrical substations to step voltage up or down. electric power transmission to carry power long distances. The power grid is **a network for delivering electricity to consumers**. The power grid includes generator stations, transmission lines and towers, and individual consumer distribution lines. The generator produces energy. Convert energy into a high voltage for distribution.

ESP8266 MODULE

The ESP8266 Serial Wi-Fi Wireless Transceiver Module is a self-contained SoC with an integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box) The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community.



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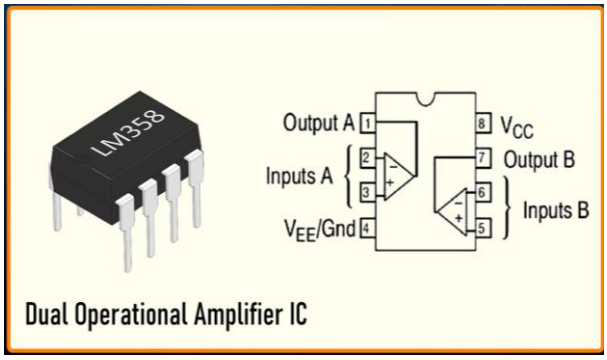
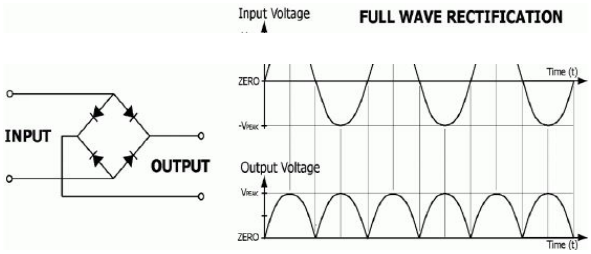
LM358 IC

The LM358 IC is a great, low-power, and easy-to-use dual-channel op-amp IC. It is designed and introduced by the national semiconductors. It consists of two internally frequency compensated, high gain, independent op-amps. This IC is designed specially to operate from a single power supply over a wide range of voltages. The LM358 IC is available in a chip-sized package and applications of this op-amp include conventional op-amp circuits, DC gain blocks, and transducer amplifiers. LM358 IC is a good, standard operational amplifier and it is suitable for your needs. It can handle 3-32V DC supply & source up to 20mA per channel. This op-amp is apt if you want to operate two separate op-amps for a single power supply.



FULL-WAVE RECTIFIER

A full-wave rectifier is a device that is used to rectify all the alternating current components in an alternating supply and make it purely direct current. The two alternating halves of an AC are rectified in a full-wave rectifier which is an advantage over a half-wave rectifier. Most electronic devices cannot withstand very high voltage or AC due to their intense high power. The use of batteries in all devices is not practical as their replacement and durability is a huge problem as the device has to be Dismantled each time for such a replacement So these rectifiers are used in most electronic devices like TV's radios, chargers, and lightings, etc.



WORKING

First, the source selected is a direct AC source from our households, then the power is passed through a full-wave rectifier which converts AC into DC 3.3V. Every component of this project is working on a 3.3V DC supply which is provided by this rectifier. The rectifier includes one step-down Transformer, two capacitors of different ratings, one regulator, resistances diodes, and LEDs. Through the rectifier, the power goes to the **Arduino ESP8266 module** which is responsible for controlling the loads over wi-fi. The software used for coding the Arduino Module was **ARDUINO IDE (Version 1.8.15)**. And the smartphone application used for controlling the load is the **BLYNK** Application. In the ESP8266 module, both of the loads are connected to different output pins. From the Arduino ESP module, the signal goes to the Relays and different relays are used for different loads. In between diodes, transistors and LEDs are used. Relay is a type of Electronic switch which turns on and off the system according to the requirement. And then at the end, from the relay, the signal and power go to the loads. It operates according to the needs.

Basically what is happening in this GRID is a person can control the grid from anywhere in the world, the only condition is that the ARDUINO ESP module and the user must be connected to wifi. It is not necessary that both have to be connected to the same network, it can be different networks. The **BLYNK** application on the mobile has two switches for the loads so the person can control the load through that application. This is the controlling of the grid part, now comes the protection part.

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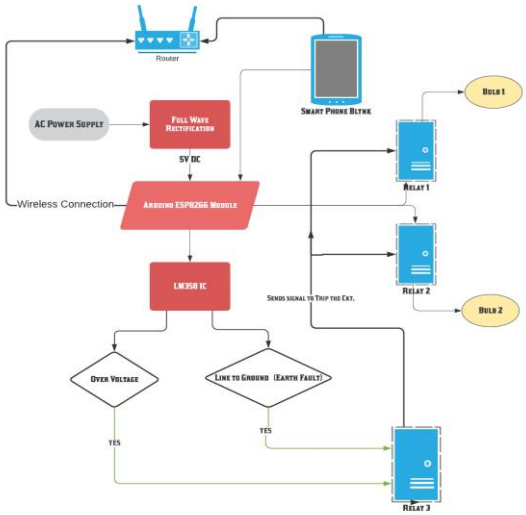
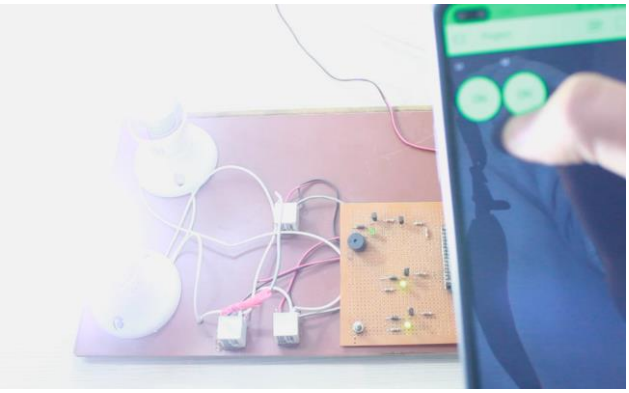
There is a fixed difference set in the IC so, whenever there is an over-voltage usage by a device, the IC sends the signal to the protection relay which then sends the signal to both the other relays and trip the circuit i.e. cut off the supply. Exactly like that whenever there is an earth-fault, i.e. the line somehow gets connected to the ground for any reason, the protection relay will send the signal to the other two relays and then trip the circuit. Hence, saves valuable resources and lives.



Actual Image of the Model

Working of the Model



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CONCLUSION

A revolution in the energy domain is underway, namely the Smart Grid. Users can check daily consumption from any location using the internet. The owner can control the customer meter from the control unit. The smart grid represents one of the most promising and prominent internet of things applications. Its basic building blocks are the existing efforts of the Internet of Things and Internet of Services, which come together with cooperation as the key goal. In Smart Grids, networked embedded devices are making the electricity grid itself, the homes, the factories, etc. smarter, enabling and increasing the collaboration among them. In the Smart Grid era, it is expected that all devices will offer their functionalities as services that other entities can (dynamically) discover and use.

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