Responsive Smart Power Grid

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Abstract— *As we see, there is advancement in technology, there is an increase in the demand of electrical energy. It has become a great challenge for the production and distribution of the electrical energy. Due to this, we need power grids that are more sustainable, reliable and more efficient. This can be done by introducing "Smart grids" into the power system. This is a technique in which all the important features are enforced into the power grids so that they work in a smart way fulfilling our demands. Power systems are intricate and have significant importance in present day. They have great impacts on the economy, politics, social and some other aspects of modern life. These modern power systems are armed with a lot of different protection strategies to avoid outages and unexpected incidents, but still systems are facing faulty operations and urgent situations. Because of which the system may face cascading failures and natural circumstances. These can lead to blackouts. In this paper, evaluation on blackout and its solution is introduced. Different analysis methods of blackouts and the outcomes or effects of blackouts is examined.*

Keywords— Blackout, cascading events, smart grid, renewable energy

I. INTRODUCTION

The potential of power system to sustain the endurance and to secure constant flow of electrical energy from the system to the customers in any episodes of interference is important. As the power system is escalated over wide topographical area, the chances of occurrence of faults and failures is more.

If some events and failures which cannot be predicted occur, it leads to power failure and blackouts which have a great impact on modern life. Therefore, today's power systems must be armed with appropriate protection measures and control so as to reduce the disturbances.

Power system protection strategies are the ultimate combative to prevent the cascading episodes. This can be achieved by introducing important features into the existing power grids to make it work in a smart way. This technique of advancement of power grids is called as "Smart grid" technology.

Whenever there is a fault or a blackout large amount of time and energy is wasted in finding the fault and the location of the fault and then to operate it. This project mainly aims to reduce some time and effort of finding the location of blackout. The main purpose of this project is to reduce the time duration of outages and blackouts and faults to optimise the time and reliability of supply. The design of this project is to build an efficient system that will detect a locate faults in overhead lines such as line to line, line to ground faults. It will automatically indicate to the control room about the location of the fault occurred at the transmission line.

II. EXISTING SYSTEM

Our present grids are facing multiple challenges that are listed below:

1. First is about infrastructural problem, that is current grids are not interconnected with each other and current system is outdated as it is not fulfilling increasing demand of customers which ultimately leads to the blackout problem which are expensive for utilities especially since it is spreading rapidly due to lack of communication among the grade and the control room.

2. Next challenge is about location and detection of the fault as grids are not connected smartly to each other it is difficult task to find out exact location of fault and what type of fault has occurred.

3. Third challenge is about the flexibility of current grid, which is unable to support the development of renewable energy or other new technologies which will make the system more sustainable.

III. PROPOSED SYSTEM

Modern life is not possible without continuous supply of electricity so for continuous supply, monitoring and controlling of supply in smarter way is essential in today's life. The main purpose of the system is to detect and fix the problem of black out as soon as possible. Hence, we have introduced a responsive smart grid which is able to send SMS with the help of thingspeak cloud, ESP8266 and Twilio application. The main objective of the project is to remove the blackout as soon as possible. For that, we are using renewable energy and rerouting and restoring protocol of neighboring grid i.e sharing supply of neighboring girds to the grid where fault has occurred.

IV. COMPONENTS

A. *Arduino UNO*

Fig.1 Arduino UNO

In this project, we have used Arduino UNO to connect Twilio application and thingspeak cloud to our system. It is micro-controller board which can read input like Twilio messages and able to convert input into output i.e., turning On and OFF of LED light.

B. *ESP8266*

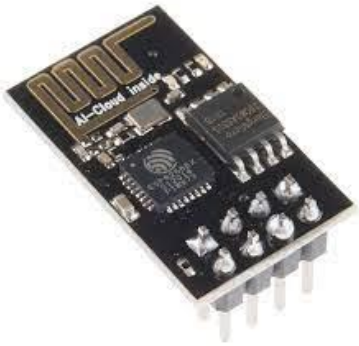


Fig.2 ESP8266

It is a cheaper Wi-Fi microchip. We have made the use of ESP8266 to give access of our Wi-Fi network to our microcontroller, so that our system can send SMS regarding fault or repair of grid in our mobile phone.

C. *Jumper wires*

Fig. 3 Jumper Wires

We have made use of jumper wires to connect components with each other.
Three types of jumper wires are: -

- Male-to-male
- Male-to-female
- Female-to-female.

In our project we have made use of male to male and male to female jumper wires for connection.

D. *Sliding Button*

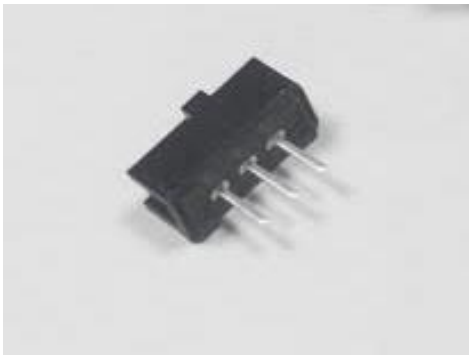


Fig.4 Sliding Button

Main function of button is to ON and OFF the system. As cutting and repairing of wire is not feasible to show digitally, we have made use of sliding button to show cutting of line by making it 'OFF' and repairing of grid by making it 'ON'.

E. *LCD*

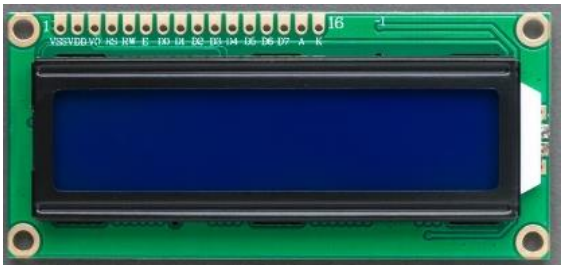


Fig. 5 LCD

In our project we have used Liquid Crystal Display to show output in the form of message. For example, 'what type of fault has occurred', 'system is stable or not', etc.

F. RELAY MODULE

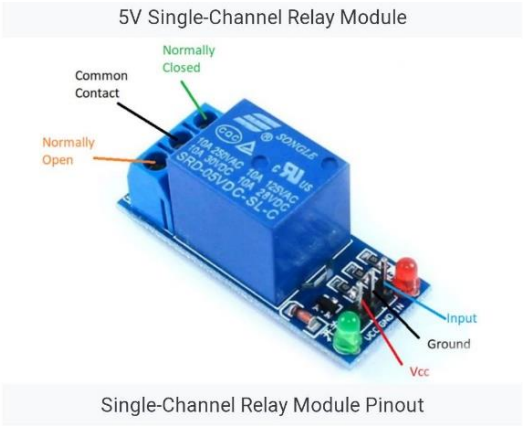


Fig.6 Relay Module

A relay is an electromechanical device that operates as a switch by opening and closing contacts with an electric current. The single-channel relay module is made up of components that facilitate switching and connection, as well as indicators that show whether the module is powered and the relay is operating. The LED light on the relay turns on when it is active, indicating that current is flowing through the relay coil. Through the input jumper, power is sent to the relay coil and LEDs. When the jumper's input pin is pulled high, it activates the relay.

G. LED

Fig.7 LED

When an electric current travel through it, a light-emitting diode emits light. It's a semiconductor-powered light source. When current flows through the LED, electrons recombine with holes, producing light. It's a form of diode that's similar to the p-n junction diode in terms of properties. This indicates that an LED permits current to flow forward but not backward. A thin layer of strongly doped semiconductor material is used to build light-emitting diodes. When forward biassed, an LED emits a coloured light at a specific spectral wavelength depending on the semiconductor material used and the amount of doping.

V. DESIGN AND WORKING

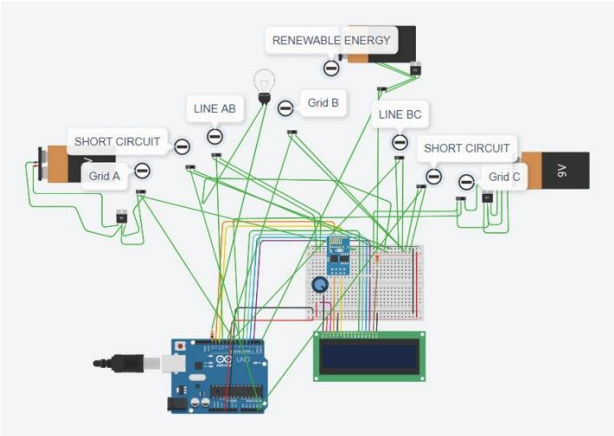


Fig.8 Circuit Diagram

We have considered three-point grid as point grid A, point grid B and point grid C and we have made grid B as a smart grid. If any grid failure happens and if the fault is point fault, then the system is going to send an SMS to the registered electrician using thingspeak cloud and Twilio application and if it is a line fault then the system will send a request to the nearest power station to repair it. Suppose the fault is point fault and an SMS is sent to the registered electrician for repairing the grid & if the grid is repaired then the system will be stable. And if it is not repaired then the system is going to check whether the nearest grid point has electricity or not. If the nearest grid point has electricity, then the system will start power sharing protocol of neighboring grid and it is going take the shared supply of the neighboring grids as a temporary solution to the blackout. If the nearest grid point does not have the electricity, then the system is going to send a temporary power supply from the nearest power station. It may be a renewable energy supply. If the problem is solved, then the service of power supply is going to stop and system will be stable. Every time we are going to receive a SMS of whether the system is stable and whatever the fault is occurred on our mobile.

VI. FLOWCHART

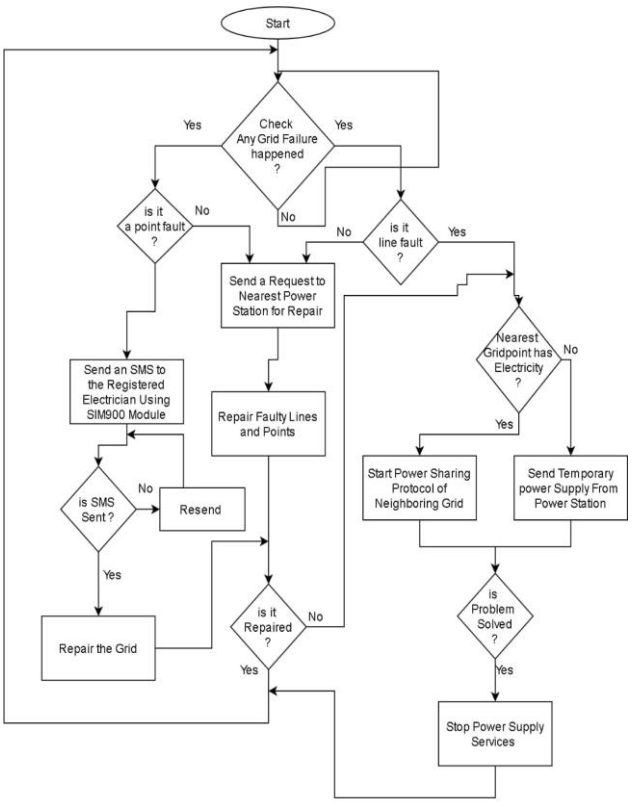


Fig.9 Flowchart

VII. SOFTWARE

A. Arduino IDE

Writing code and uploading it to the board is simple with the open-source Arduino Software (IDE). It's compatible with Windows, Mac OS X, and Linux. The coding is written in Java and based on Processing and other open-source software.

B. ThingSpeak Cloud

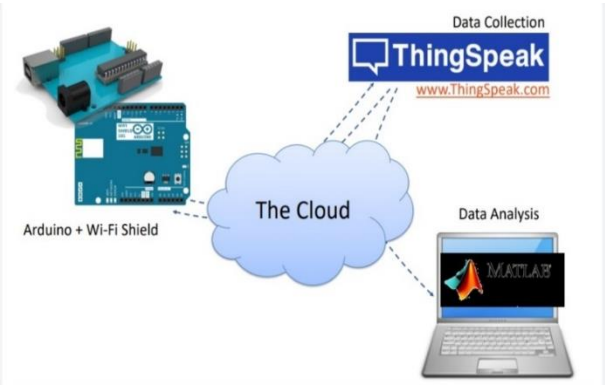
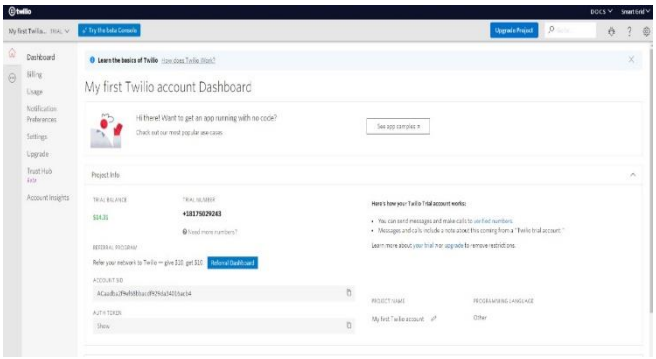


Fig. 10 ThingSpeak Cloud

We have used ThingSpeak Cloud which is an open-source Internet of Things (IoT) application to connect Twilio application to Arduino UNO. ThingSpeak Cloud permits the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

C. Twilio Application



Apps / ThingHTTP / short circuit

Edit ThingHTTP

Name:	short circuit
API Key:	DJC9VRY9WTWV6EB5 Regenerate API Key
URL:	https://api.twilio.com/2010-04-01/Accounts/ACaadba2f9ef68bbacdf929da34016acb4/Messages.json
HTTP Auth Username:	ACaadba2f9ef68bbacdf929da34016acb4
HTTP Auth Password:	32cbcdb0b7834bdb703870e979d3311f
Method:	POST
Content Type:	application/x-www-form-urlencoded
HTTP Version:	1.1
Host:	
Headers:	
Body:	To=+918898650659&From=+18175029243&Body=Short Circuit Occurs between Grid Point A and B
Parse String:	
Created:	2021-04-19 7:09 am

Fig. 11 Twilio Application

With the help of Twilio Application we have designed message alert for each fault. This application will send information related to fault to the numbers which are registered on it.

VIII. RESULT

Fig. 12 Result

Fig. 13 Result on LCD

We have analysed the types of faults on overhead transmission line and we are successfully able to remove the blackout using this technique when the fault is occurred on overhead transmission line. The message is sent to the control room or the local electrician on the mobile phone via ESP 8266 modem. We receive messages on mobile like 'Fault is occurred at point B', 'system is stable', 'shared supply of A and C is ON', 'renewable energy supply is on'.

IX. CONCLUSIONS

Here, in this project we have designed ESP 8266 modem based on overhead transmission lines, monitoring and fault clearing system that can send required information about fault to local electrician and control room via SMS.

2. Our system mainly focus on clearing the fault i.e., removal of blackout by renewable energy supply and shared supply from neighbouring grids. This project has continuous monitoring system integrating with ESP8266 and Arduino uno.

X. REFERENCES

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