IoT based smart grid using node MCU

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Abstract. In recent decades energy crisis and global warming has raised, so we have motivated development and use of sustainable, alternative, clean sources. We have added the renewable energy sources, that is solar generation for the energy production. Smart grid enables integration between conventional power and renewable energy sources. This paper describes about the usage of grid power and renewable sources in an ideal manner. This aims at designing and developing a smart grid system with the use of renewable energy and IoT technology. The ultimate goal is to provide No-interrupted sources daily needs and for the future.

1. Introduction
Electricity plays a vital role in human life without electricity life on earth is impossible. So absolutely we need to measure and calculate the consumed electricity. Nowadays by using normal wattmeter, every month a person from a TNEB has to visit each customer’s house for calculating the bill amount. So, it takes much manual work and consumes more time.

Due to growth in technological, the population raised in industries, the facility demand exceeds in rapid manner than the level of power generation. So as to enhance the era of existence of the installation of a grid connection and to fulfill out the facility of the supply demand then, there’s a requirement to modify the surplus loads, when significant demand will exceed the level of the edge. The proposed model may be categorized into high priority and low priority loads. The load consumption of the consumed energy depends upon the voltage and current sensed by the voltage and current sensor at regular time span.

The solar installation and their voltage is mainly integrated to grid. The Node MCU controller is employed to either attach or detach the excess loads (i.e., non-prioritized loads) whenever demand go off above the generation level from grid [1]. So, the power generated by solar PV is unwastefully consumed [2]. If solar PV panel stops to assist grid, then the traditional 230v ac supply helps out in sparking the load side demand and helps the connection of the grid system [3]. So, proposed model discovered to be more robust functionality for the load demand testing and hence the utilization of annual energy is decreased [4]. Simultaneously, MATLAB simulation result is stored and the conclusions are given in section 6 and 7.

2. Block Diagram
Node MCU is an open-source hardware. A program for Node MCU hardware can be written in Embedded C language. IoT plays a very important role in Smart Grid. Voltage and current sensors are capable of providing information for both energy production and consumption. Here, solar panel and grid are used.

The first priority is given to solar panel. The energy obtained from the solar panel is stored in the battery. The grid is chosen as second priority. The output of solar panel is DC and the output of the grid is AC. Here, only DC loads are used. So, rectifier is used in grid for converting it from AC to DC. Voltage sensor at the input side is used to measure the generated voltage. The generated voltage value is then passed to the Node MCU. It is a microcontroller which checks the level of voltage and makes the relay to operate either using solar panel or grid. Here, three loads are used. If the generated power is higher than consumer targeting power, then remaining power from solar panel is fed into grid and if the generated power is less than consumer targeted power, grid is used. Node MCU passes this information to relay. If the solar panel itself satisfy the user, there is no need of grid power. The voltage and current sensor are to measure the level of voltage and the current used by loads [6]. The output load is fed into cloud through IoT. Simulation model is developed using MATLAB software. Figure 1 shows the Proposed model block diagram.

Figure 1. Proposed model block diagram.

3. PV system

In photovoltaic system, there are one or more solar panels are used for converting solar energy into electricity. The components include the PV modules, electrical connections, mechanical, mountings and means of regulating and/or modifying the electrical output. The energy consumption of the domestic and commercial was high so the power source is increased daily [7]. It’s hardly difficult to hold on the demand power, alternately there will be an answer where the non-prioritized loads are switched off for entire intermission of time in high consuming hours [8].
Figure 2. Circuit Diagram

Rp => parallel resistance.
Rs => series resistance.

Applying Kirchhoff’s law,
\[ I = I_{ph} - IR_p-ID \]

Where,
I => I stands for Cell current,
Iph =>Iph stand for Insolation current

4. Voltage Sensor
Voltage sensor is a device which can measure the voltage supply and can determine the voltage level either AC or DC. The input of this sensor gives voltage value and the output of this sensor is switch and signal current, audible and analog. The input voltage is reduced by a factor of 5 using potential divider in this sensor module. The voltage higher than the capable of sensing is measured at analog input pin of a microcontroller. If the input analog range is (0 to 5) V then the voltage can be measured up to 25V. The input voltage, \( V_{in} = V_{out} \times (R2/(R1+R2)) \). There are two pins namely positive and negative pins at the input side [9].

5. Current Sensor
Rogowski coil is an air cored encircling conductor toroidal winding where the value is measured. The conductor surrounded by the alternating magnetic field is picked by winding and the output is proportional to rate of the changing current [10]. Current sensor is a device which is also known as current transformer. It measures the current flowing through a wire by using the magnetic field to detect the current and generate a proportional current. When the current flows through the conductor, the proportional magnetic field will be created around the conductor. Current transformer measures current flow using this magnetic field. Inductive technologies are used if the CT is designed to measure AC current. Similarly, for DC current we use Hall effect device to measure hall effect sensor.
6. Simulation Results
Here the selected solar for 60v and grid for 90 v. The simulation time is for 3 sec. First 1 sec it connects the solar and then it automatically switches to grid connection. Use an extra load, so after 2sec it switches to the extra load… So, in that time current will rise (over load). Figures 3-9 shows the simulation results.

**Figure 3. Simulation.**

**Figure 4. Sub system.**
7. Conclusion
It develops a smart grid system with the help of IOT and renewable energy sources, so here we successfully developed Uninterruptible power supply for the electrical load sand also it can Monitor & Analysis the system from anywhere. Through this study they can get more ideas about renewable energy and its important and how it strengthen the conventional grid system also get the information about IOT technology and its application areas.
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