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Research Article

Using microcontroller based solar power system for reliable power supply

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ABSTRACT

This paper has been demonstrated by implementing renewable energy-based solar power for a reliable power supply controlled by the Node MCU microcontroller. The microcontroller is controlled the system by programming. Here also use an inverter, Node MCU, Battery, Solar Charge Controller. The main task of this Scheme is that when the sun reflects on this solar panel, it will charge and save its battery. Two AC loads will run from the battery to the inverter, which can control via the Internet. DC will be converted to AC through the inverter and load. The main objective of this research is to use solar sources for load control and monitoring through the Internet.

Key words: Renewable Energy, Solar Power, Microcontroller, Power system

INTRODUCTION

The solar system can produce a lot of energy, which makes the work of the solar panel very efficient. The vertical aspect ratio of the solar panel with the sun's rays is behind its performance. In case its installation fee is higher and cheaper options are also available. This Scheme discusses the prototype design and construction methodology for the solar panel energy storage system (Alawaji, 2001). The main control circuit node is based on the MCU microcontroller. Thus, the solar panel is set to receive maximum sunlight. In 1985, silicon solar cells were first produced with 20% efficiency. Although the solar panel's performance was a beautiful increase, getting more complete was still a distant goal. Below 40%, most panels are still running (Bahadori & Nwaoha, 2013). As a result, people are forced to buy multiple panels to meet their energy needs or buy single systems with larger outcomes. The availability of high-performance solar cells can be very expensive to purchase. There are several accessible ways to increase solar panel performance; however, monitoring is one of the ways to accomplish a specific purpose while minimizing costs. The monitor allows for a wider panel Scheme with higher power output to the sun (Fahrenbruch & Bube, 1983). It can be a double or single-axis tracker. Duality is best matched when it comes to tracking sunlight from both axes. It is cheaper to use a single tracker commercially, so a substantial price increase with increased power is worthwhile and acceptable, as the maintenance cost will be average.

Here, use a solar panel to produce electricity from solar radiation, which controls the charge controller and stores it in the battery, which is the main energy of this battery. The battery mainly produces energy, which is used mainly at this load after converting into the alternating current in this Scheme. The MCU is the main control unit in this Scheme that can also use a solar charge controller, inverter, relay for specific work. First, the sun is reflected in the solar panel, absorbing sunlight in the battery. Battery power is used to charge after AC conversion. This load will be managed via the mobile application.

RESEARCH METHOD

Methodology for the scheme

- Creating an idea for the design and construction of Renewable Energy Developed with Solar Power.
- Collect everything and configure the microcontroller to manage the system.
- Assemble everything on PCB & soldering board. Then assemble all the blocks on the board and finally perform the procedure to check whether it works or not.

Supporting data

To calculate the solar panel efficiency where maximum power is 6watt and the panel length: 254mm, Width: 203.2mm.

Here, know,

$\therefore$ Efficiency (%) = (P_max ÷Area)/(1000)×100%

Given Data,

P_max =6Watt

Length = 254mm = 254×0.001

= 0.254m

Width = 203.2mm = 203.2 ×0.001

= 0.2032m

∴Area =length ×width of the solar panel

= (0.254 ×0.2032) m^2

= 0.0516128 m^2

∴Efficiency (%) = (P_max ÷Area)/1000 ×100

= (6 ÷0.0517)/1000 ×100

∴Efficiency=11.625 % (Ans)

The Solar Panel Voltage 12V, Where the Solar Panel Quantity 1 and Panel Power 6 Watt. Calculate the total power and System Current?

Given Data,

Panel Quantity = 1 Pcs

Panel Power = 6Watt

Panel Voltage = 12V

∴Total Power = Panel Quantity ×Panel Power

= 01 ×6

= 6 watts (Ans)

Here,

System Current = (Total Power)/(Panel Voltage)

= 6/12

= 0.5 Ampere (Ans)

Hardware and software

This Scheme has worked on two things, Hardware and Software. The main controller is Node MCU, which mainly controls this Scheme. This Node MCU is a program by Arduino IDE Software. That is why Node MCU controls this Scheme smoothly.

Software

Proteus 8.9, Arduino IDE and 3 Blynk App

Arduino software

The Arduino Nano digital microphone control unit can be configured using the Arduino IDE software shown in Figure 1. There is no need to install any software other than Arduino. First, select "Arduino Nano" from the Devices, Board menu (according to the microcontroller on the board) (Irfan *et al.,* 2019). ATmega16U2/8U2 can be unlocked Full of DFU loaders: Rev1 boards: Connect the welding adhesive to the back of the board (next to the Italian map) and restore the 8U2.

Rev2 or later boards: 8U2/16U2 HWB line pulling ground support, which simplifies tuning in DFU mode. The onboard RX and TX traffic lights will be illuminated when supplied with a USB serial chip and a computer via USB connection (but not for serial communication on nails 0 and 1). The

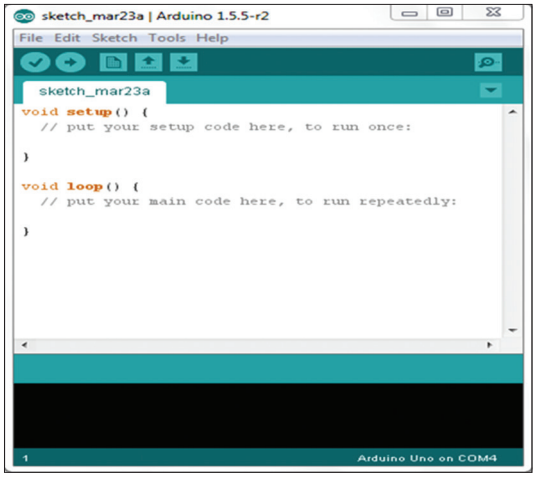

Figure 1: Arduino Software Interface IDE.

program library allows for continuous communication in each Nano digital anchor. ATmega328 also supports I2C (TWI) and SPI connections. The Arduino software includes a mobile library to facilitate I2C buses. Arduino programs are written in C or C ++, and the written code of the Arduino program is called schema. The Arduino IDE uses the GNU toolkit and the AVR lab to design and download applications (Kannan & Vakeesan, 2016). Because the Arduino platform uses Atmel microcontrollers, Atmel, AVR Studio, or the new Atmel Studio development platform can develop the Armelino program.

Proteus software

Proteus Design Suite shown in Figure 2 is a suite of software tools used for electronic design automation. Electronics design engineers and technicians primarily use the program to print schematics and electronic publications (Liu *et al.,* 2010). The first version of the Proteus Design Suite is now called PC-B and was written in 1988 by DOS Chairman John Jameson for DOS.

Remote XY

Remote XY is a normal preset to create and use mobile user graphical interface for controller programs via smartphone or tablet. The system includes:

- Mobile Graphics Interface Editor for controller boards located at remotexy.com
- XY remote mobile app connects to the controller and controls it using a visual interface with an image.

Hardware

Solar Panel, Solar Charge Controller, Battery, Transformer, Node MCU, Relay Module, Voltage Regulator Capacitor, Resistor and Transistor

Solar cell

Pole is a solar cell's photovoltaic module connected to an electric motor and integrated into a support system. A photovoltaic module is an integrated solar cell package.

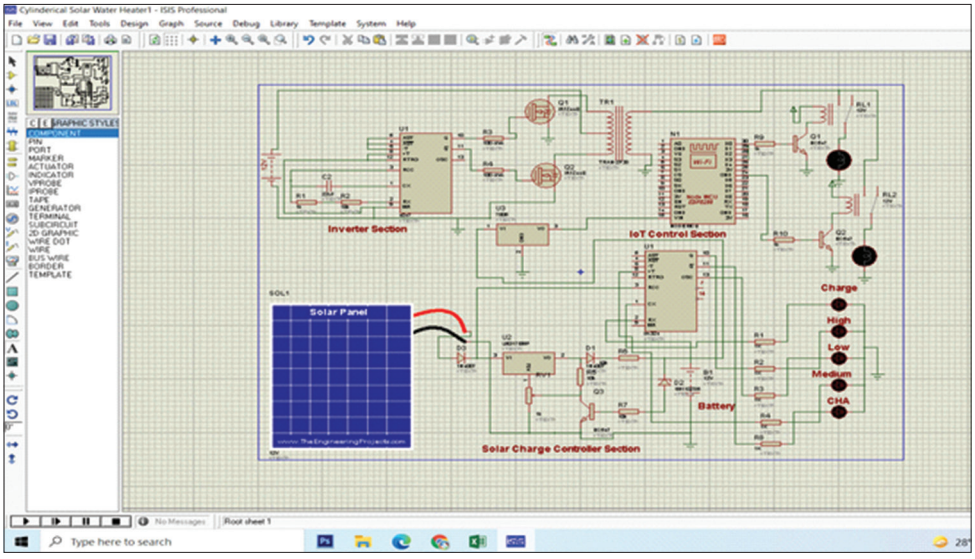

Figure 2: Proteus Software Interface.

Figure 3: Solar Panel.

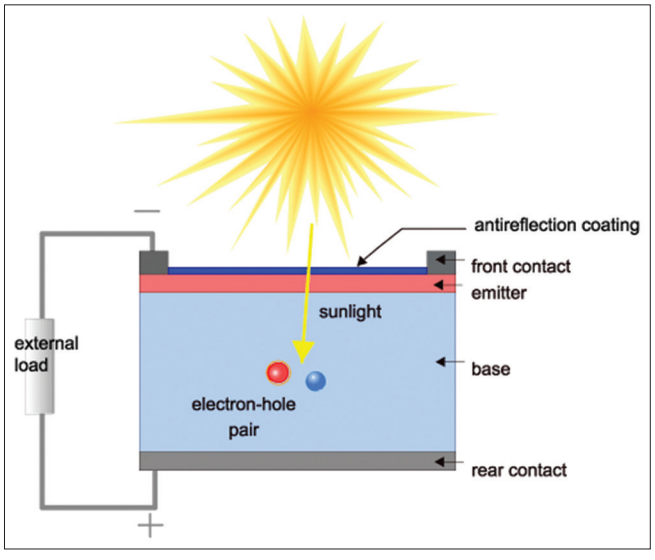

Figure 4: Solar Panel Schema Diagram.

Solar panels shown in Figure 3 can be used commercially and as part of a larger photovoltaic system to generate and

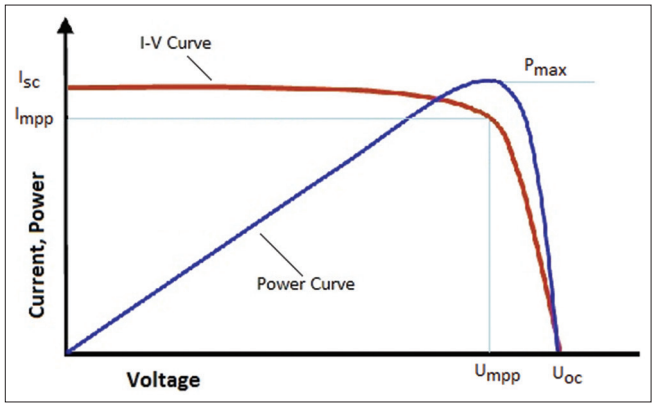

Figure 5: Solar Cell Curve.

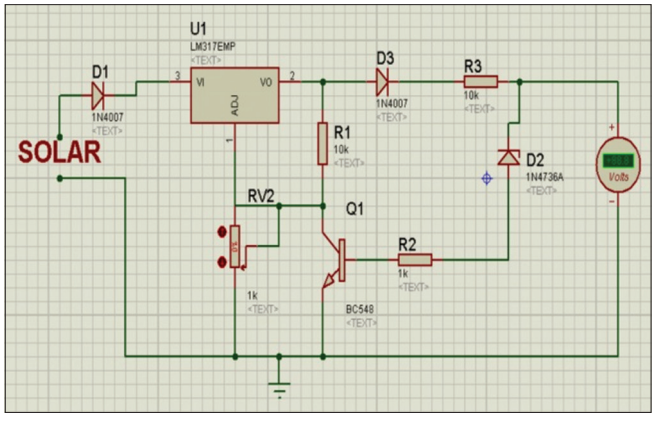

Figure 6: Solar Charger Controller Circuit.

transmit electricity. Each module is tested by DC test power under standard test conditions, typically from 100 to 320 watts (Ohunakin *et al.*, 2014). The module's performance determines the area of a single approved module - 8% well 230-watt module will be double the 16% effective 230-watt module. One solar module can generate maximum power; most components have multiple modules. Photovoltaic

systems usually include panels or solar modules, converters, and sometimes batteries and solar panels and wiring harnesses.

Only sunlight produces solar energy that does not store charge, so some of the energy generated must be stored to ensure electricity flows when the sun is not shining. Rocks are parts of electrical energy cells (connected sequentially to convert chemical energy into electrical energy).

Stone cells are made up of two electrons immersed in an electrical solution that generates electricity when it travels between them.This current is due to the synthetic reactions between the electrodes and the electrolyte in the cell (Pirasteh *et al.,* 2014). Reusable stones are called pit stones or pile stones. As the stone is formed, electrical energy is stored as chemical energy in the cells. When removed, the energy stored in the battery is removed and converted into electricity. In East Africa, the second most common type of rock is Lead-acid rock.

Specifications of solar panel

Size: 8"/10", Weight: 3.2 ounces/100 grams. Cell type: Monocrystalline

Solar charger controller

The Solar Panel Schema and Solar Cell curve are shown in Figures 4-6 respectively (Zhiqiang, 2005). This uses various batteries to absorb sunray—the department stores solar energy to power recyclable batteries for various purposes. There is an existing order with several power outages.

Node MCU

The Node MCU shown in figure 7(a), 7(b) and 8 is an open-source firmware for the prototyping board design available. The term "Node MCU" combines "node" with "MCU" (small control unit). "Node MCU" actually means firmware and not integrated upgrade tools. Both the firmware and the typewriter create an open sauce. The firmware uses Lua typing language. The firmware is based on the Lua Scheme and the Espressif Non-OS SDK for ESP8266 (Timilsina *et al.,* 2012). It uses many open Schemes, such as lua-cjson and SIFFS. Due to hardware problems, users have to select the appropriate modules for their Scheme and build firmware that suits their needs. 32-bit ESP32 support was also made (Tiwari & Tiwari, 2016).

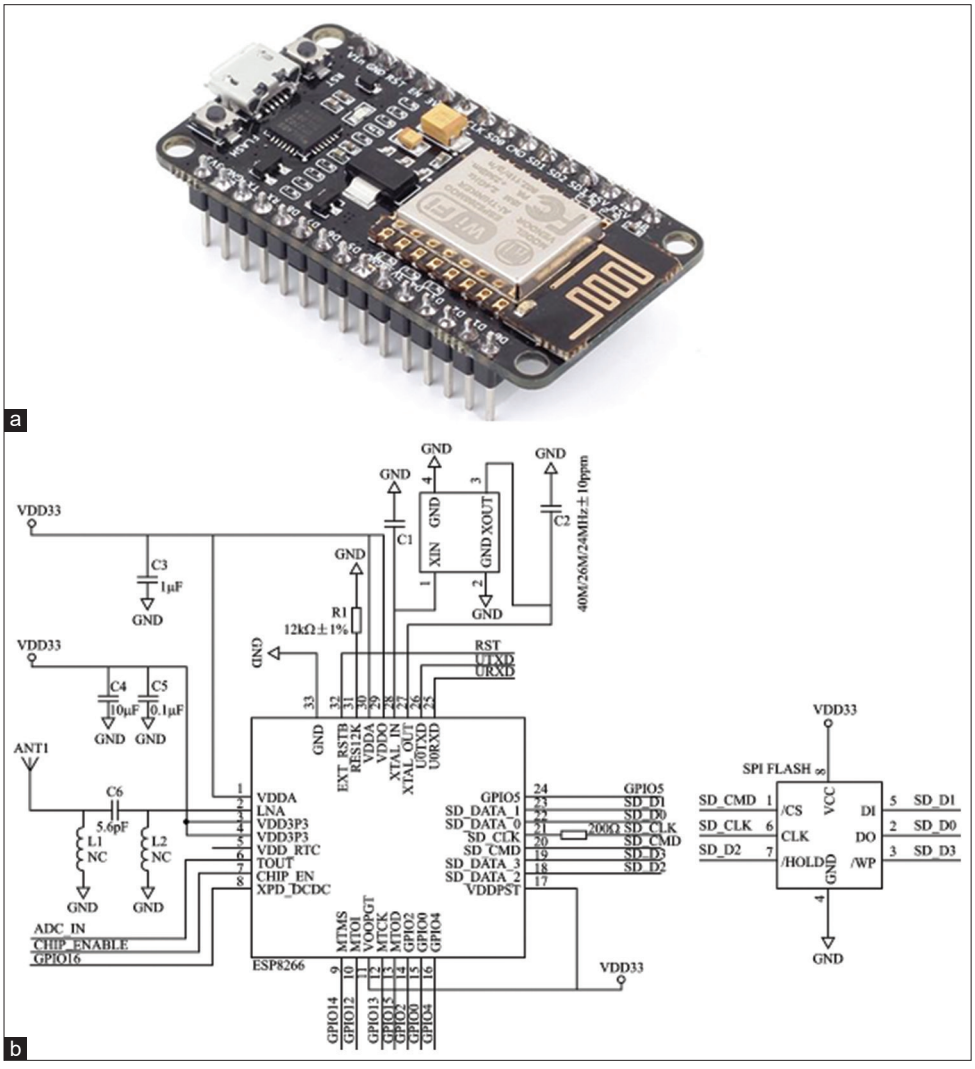

Figure 7: (a) Node MCU (b) Node MCU Schematic.

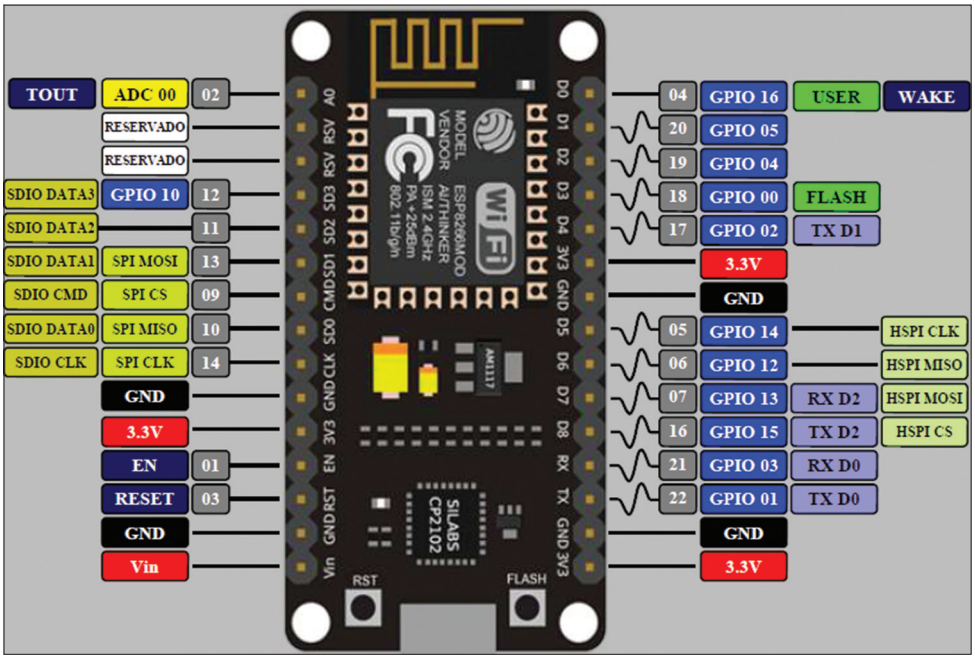

Figure 8: Node MCU Pin Out.

The prototyping Hardware is a commonly used circuit board that acts as a dual-in-line package (DIP) that includes a USB controller with a small over-installed board with MCU and antenna.

This open-source IoT platform includes firmware that runs on ESP8266 Wi-Fi SoC from Express or Systems and hardware based on the ESP-12 module (Tsur & Zemel, 2000). By default, "Node MCU" refers to firmware and not upgrade kits. The firmware uses the Lua scripting language.

PROPOSED MODEL

The block diagram shown in Figure 9 has set up a Renewable Energy-based Solar Power development and the corresponding circuit diagram is shown in Figure 10. Here the solar panel absorbs the sunlight and stores charge in a battery. Here, use a Node MCU microcontroller for controlling this system.

Printed circuit board design

PCB design shown in Figure 11 provides information on the connection from the schematic pull module to the pure list form. These details include the user's design rules and various design automation. The 16 copper layers of the PCB can be manufactured with a design size limited to the product configuration.

Dimension view

The 3-dimensional framework allows one to view the board set on a 3D board and a semi-transparent plane that shows the area around the board (Figure 12) (Wang & Zhai, 2010). For hard work or plant deployment, STEP output can be transferred to active CAD programs, such as Autodesk.

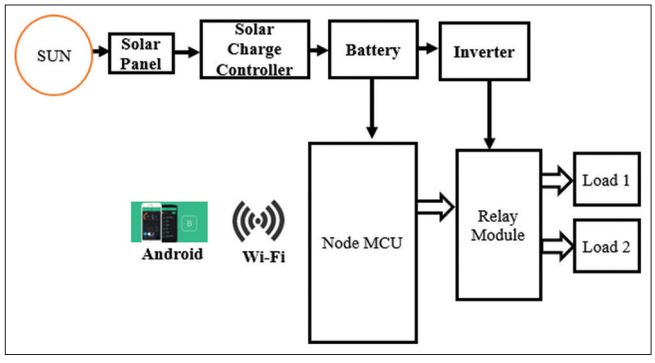

Figure 9: Block Diagram of Renewable Energy Developed with Solar Power.

RESULT

Real implementation

Automation or automatic control uses various control systems for operating equipment such as machinery, processes in factories, boilers, heat-treating ovens, and other applications and vehicles with minimal or reduced human. An automatic system shown in Figure 13 is so useful in everyone's daily life. A solar panel is the best used for creating electricity and nowadays it makes huge support of some electrical appliances. Many sensors are automated technique that is used for automation systems. This paper has used a solar panel as a primary power source. Here also use an inverter, Node MCU, Charge controller, battery, relay, capacitor, resistor and voltage regulator. The main work of this Scheme is that when the sun reflects in this solar panel, it will charge and store it in a battery with the help of a controller circuit. Here input 12V direct current, inverter convert 12 voltage AC. Then step-up transformers step up 12-volt ac to 220-volt ac, and load will be on. A mobile app will control the load.

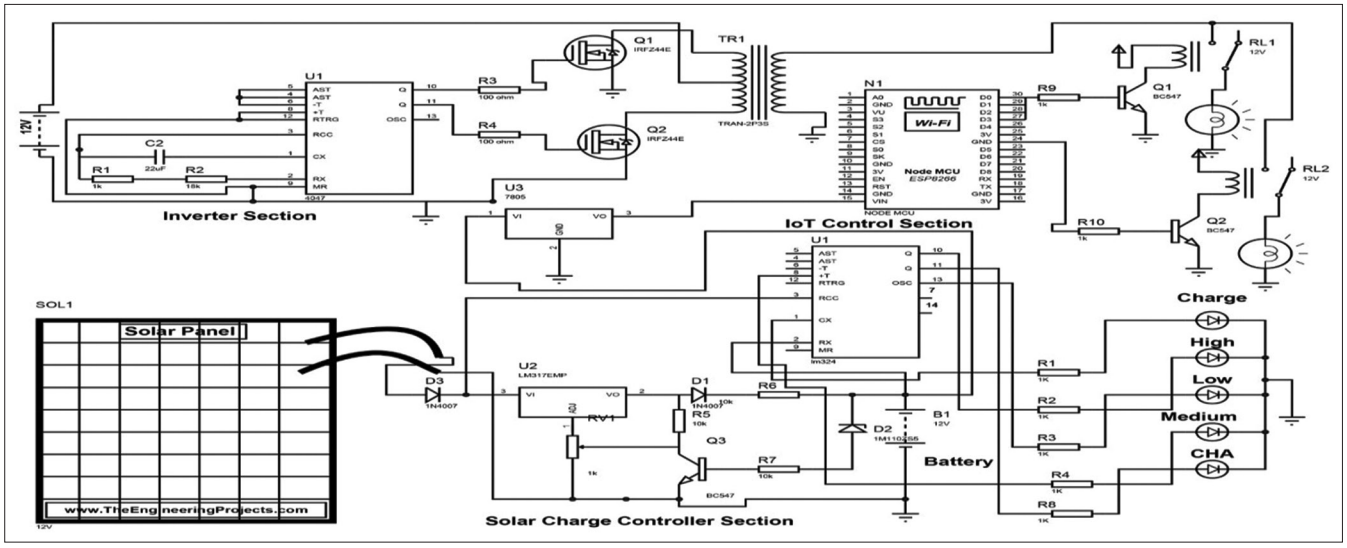

Figure 10: Circuit Diagram of Renewable Energy Developed with Solar Power.

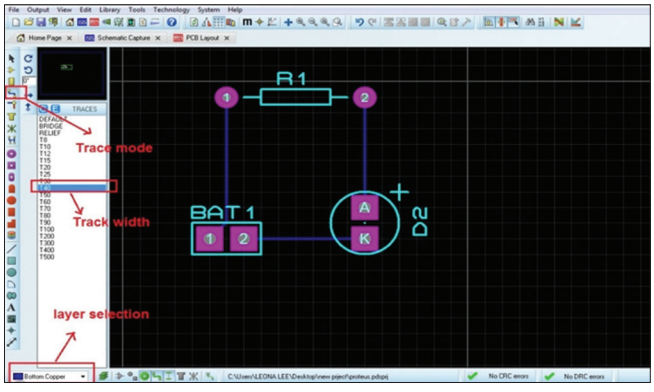

Figure 11: PCB Design.

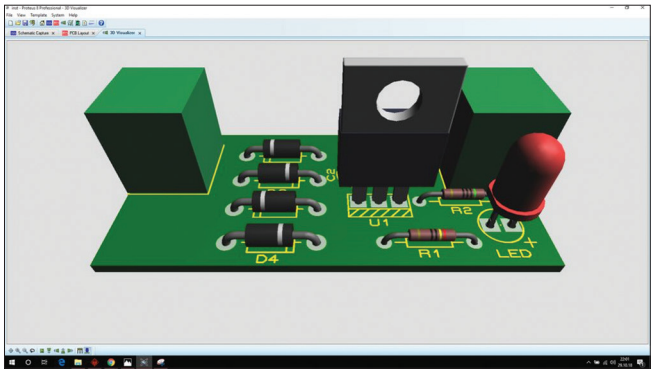

Figure 12: 3D Verification.

DISCUSSIONS

This paper contains the results obtained and a discussion about the full Scheme. This Scheme is renewable energy development with a solar power system. The Scheme assembly used PVC boards for total hardware making. After finally completing this Scheme that is running it & observed the output of this Scheme. It is working well as expected. After doing the Scheme, observes it very carefully. This Scheme gives output perfectly, and all equipment works perfectly. There are certainly many advantages of the Scheme, and some of the major ones have been given below:

- The system is natural and can store the charge in the battery.
- Reduce power consumption with optimal use.
- The Scheme can be used in existing programs.
- The whole system is automated and saves energy by detecting the presence of light.
- The system is easy to use.

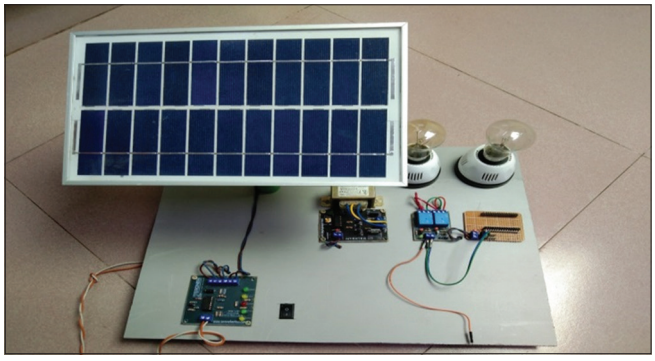

Figure 13: Real Scheme Prototype (Top View).

CONCLUSION

Solar power is an unlimited source of renewable energy. This article shows the development and implementation of the Node MCU microcontroller for renewable energy-based solar power. Arduino controls all of these applications. This Scheme fully contributes to developing a renewable energy system that can work without fossil fuels and is a useful system for sustainable development in the environment. Solar energy is a source of stimulants. It can be applied in places with a lot of power wastage. It can be applied in areas with a shortage of

electricity. Automated systems can be implemented in areas that require security. It can be applied in areas where traditional resources are not available. This system is environmentally friendly because it uses renewable energy.

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