IOT Based Solar Energy Monitoring System

***Abstract*—Now the world depends on the internet and uses of the internet of things is increasing day by day. By using internet of things we can make our life easier and we can do some impossible things we can imagine. The world is getting warmer day by day and people are trying to use renewable energy to do their work. One of the most common renewable energy is the solar power. Gradually the world is getting improved and advanced by technology. There are many sectors where we can use the Solar energy to do our work properly and minimize the uses of different resources. So solar energy is a great source of resource we can use for our work and if we can monitor it properly with proper maintenance we can reduce the use of other resources like electricity. Sometimes the solar systems are install in different location where we cannot access all the time so we cannot monitor it physically properly. This project is based on IoT where we can monitor the solar power system remotely from anywhere in the world so we can supervise how the solar energy system is working now. The main goal of this project is to monitor how the Solar Panel or solar energy system works and how much solar energy is converted to electricity. The IoT system actually give us access to real time monitoring how the solar energy system is working. The main benefit this system is the real time monitoring from anywhere in the world.**

Keywords—Internet of things, wireless transmission, solar monitoring, Thingspeak, IoT.

I. INTRODUCTION

When we set up a solar power system we need to monitor it if the system gives us optimum power output this actually helps us to see if the system works efficiently or not. The monitoring system we are introducing here it actually helps us to monitor the real-time data of the Solar Panel be installed power home or working place. There are many e benefits of this system but in this introduction Part I am just explaining a few reasons why we need the system. The IoT based monitoring system actually helps us to see if the Solar Panel is working properly and efficiently. Suppose if there is enough on lying there are too many dust on the Solar Panel or if it cannot Store the Solar Energy properly are if there is any fault the system will give us different reading than usual. This automated system can run and can be monitor from anywhere in the world by using internet. The proposed system and the components which are used to complete this project will be described gradually. the system we are proposing here will constantly monitor the Solar Panel and by using the IoT it will constantly upload the real time reading through internet.

II. INTERNET OF THINGS

The concept of internet of things is we can change anything like which are not connected with internet can we transform and make it smarter. The Solar Panel which is known by a hardware-based system can be transformed in a smart form by which we can make it connected with internet by using IoT. The main thing is by using internet of things we can connect any objects internet by wireless medium. Some examples like some devices we use in our daily life home appliances, cars and other things. These things can be e integrated with some sensors and other stuffs we can connected with the internet. Gradually the IoT have achieved different wireless sensor network sensors GSM and GPRS Wi-Fi and microcontrollers and other microprocessors etc. By using the internet of things we have to ensure that the system is enough secure. We have to ensure the security of IoT system otherwise it can be controlled by others and can be do to harmful things tour system. One of the huge benefit of using internet of things that we can monitor our system from anywhere in the world and it will provide us the real time reading or the real time scenario what is happening to our system.

If we can maintain the security system and the system we want to integrate with the internet of things life will be easier so as the world is getting depended more on technology so we should also update our systems and connected with the internet of things so that you can be a more smart system for ourselves.

III. LITERATURE SURVEY

[1] An online monitoring and control system for distributed renewable energy sources can be done by Android platform and other platforms also. The method which actually used the Bluetooth platform on the Bluetooth interface of different devices like mobile phones laptops and desktop Bluetooth module which actually creates a communication link for data exchange between the hardware and the power conditioning unit.

[2] There are different methods to monitor renewable energy generation system. Different communication module are used like Bluetooth communication module and Wi-Fi module which actually helps to share the real time data which are read from the hardware system.

[3] Development of an instant monitoring system of renewable energy generation that is constituted with a solar panel on current and voltage measurement of each reliable source the related values are measured by the voltage and I am sensor and processed by the Arduino or other microprocessor which it is transmitted via Wi-Fi module to an online platform. It also can be monitored via personal computer and can be stored in a database or can be e monitor the real time data.

[4] There are many more system like the solar panel some people also try to create a monitoring system for the windmills which is also up renewable energy resources. These windmills are also controlled by the internet of things. This monitoring system actually helps us to monitor the real-time transmission of data and also verify if there is any kind of problem or issues with the system. We can actually in the system by synchronizing the hardware and the software.

IV. PROPOSED MODEL

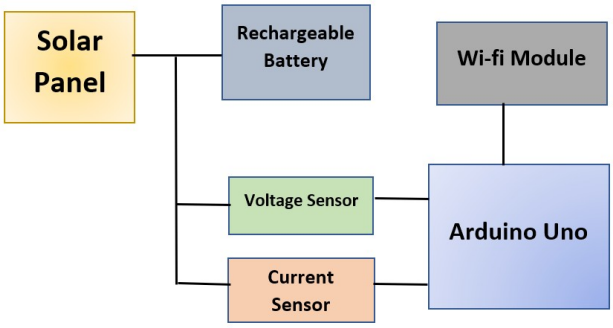


Fig: Block Diagram of Solar power monitoring system using IoT

A. Proposed system concept:

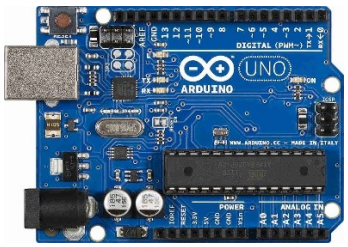
In the given proposed system we can see that there is a Solar panel which will absorb the solar energy and will transfer the Solar energy to Electricity and the produced electricity will be stored in a rechargeable battery. And there will be a connection between the Solar Panel and the rechargeable battery we will connect two sensors between the Solar Panel and rechargeable battery. The census which are used is a voltage sensor and a current sensor. The reason of using a voltage sensor and a current sensor is the solar panel converts the Solar energy to electricity and we want to know how much voltage it is producing and how much current it is producing and storing in the rechargeable battery. Then the voltage sensor and the current sensor will be attached or connected with Arduino UNO and there will be also a Wi-Fi module which is connected with the UNO. The reading of the voltage sensor and currencies all will be e processed by the Arduino board and then through the Wi-Fi module we will transmit the real time data which is the voltage and the current. We will use thingspeak to get the data from the Wi-Fi module and show the graph on the reading which is transmitted from the proposed system. The thingspeak is a platform which is used for transmit the real-time data and we can access the data from anywhere by using the internet and we can use any type of device like Android desktop laptop.

This is our Concept for our proposed model what we wanted to do.

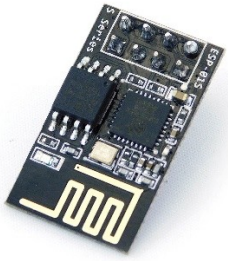
B. Components for the model

- *Solar panel (cell small)*

- Arduino UNO



- ESP8266 (wi-fi module)



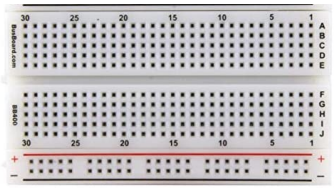
- Voltage Sensor

- Current Sensor

- Battery

- Wires

- Bread board



V. SIMULATED CIRCUIT

A. Simulated circuit design

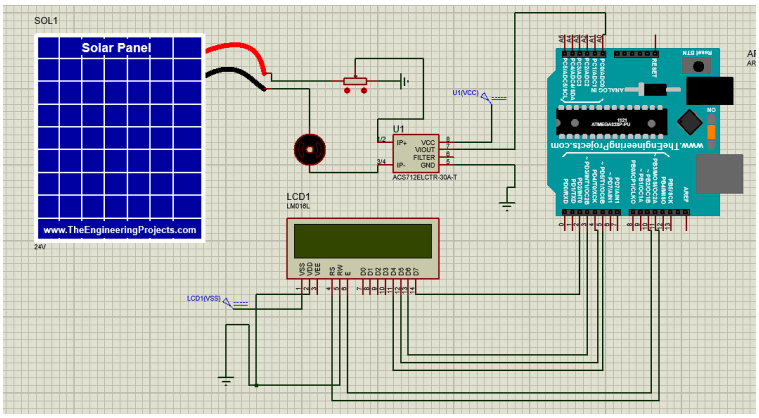


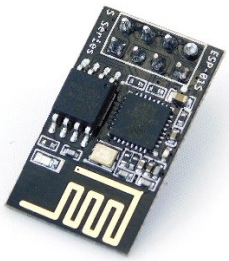
Fig: Simulated Circuit

B. Components for the simulation

- *Solar panel*

- Arduino UNO

- ESP8266 (wi-fi module)



- Current Sensor

- Battery

- Wires

- Motor

- Potentiometer

- LCD

C. *Different phases in simulation:*

In this section we will see the photos of different phases of simulation to show the circuit is really working.

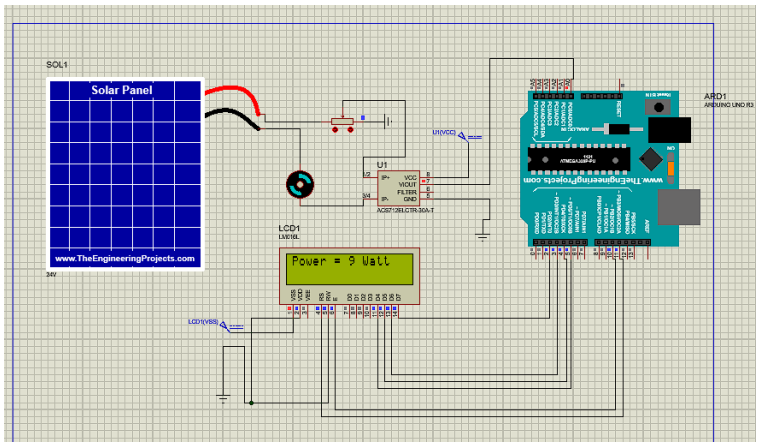


Fig1: Here the circuit is simulating and the motor is rotating also showing the different values in LCD

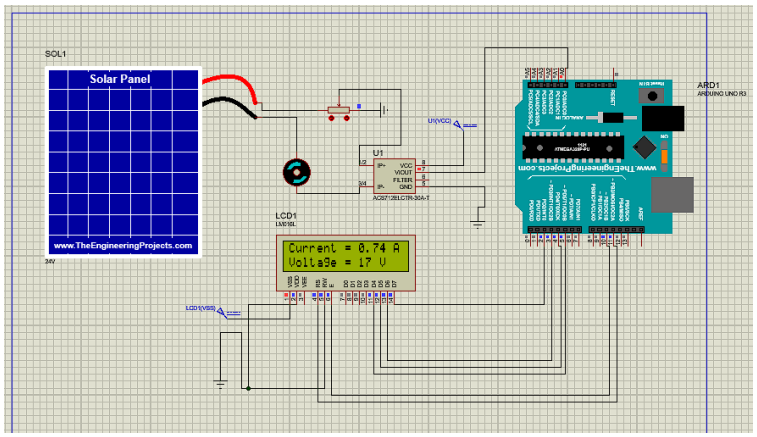


Fig 2: Here the current and voltage is shown in the LCD

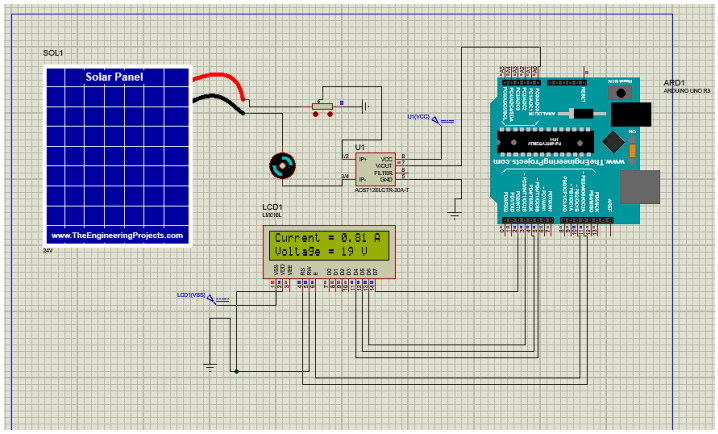


Fig 3: Here for using the potentiometer the value of Current and voltage is changed.

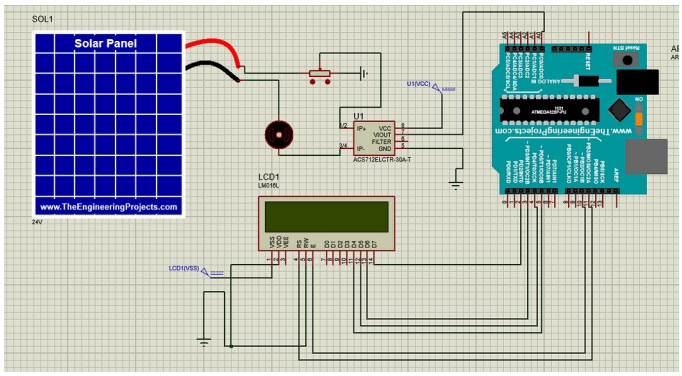


Fig 4: This figure is showing the initial state when the simulation is over.

VI. How does it work

Circuit Description :

We have used **Proteus Professional** which is mainly used for virtual circuit design and simulation. In Proteus we can import additional library files for particular components. We have imported Solar Panel Library and Arduino Uno Library !

Connections:

1. **Arduino**'s pin 2,3,4,5 is connected accordingly with **LCD**'s pin 14,13,12,11 which are actually the Data pin 7,6,5,4.
2. **Arduino**'s pin 10,11 is connected accordingly with **LCD**'s pin 6,4 which are actually *Register Signal* (RS) and *Enable* (E) mode.
3. **Arduino**'s pin A0 (Analog Input) is connected with the **ACS712**'s pin 7 which is actually the Analog Output from *current sensor* **ACS712**.
4. **ACS712**'s pin 8 is connected with *DC 5V* and pin 5 in connected with *GROUND*.
5. **Solar Panel's** Positive Terminal is connected with Potentiometer's positive end and Solar panel's Negative Terminal is connected with DC Motor's one end.
6. **DC Motor's** another end is connected with pin ¾ (IP-) of ACS712 and ACS712's pin ½ (IP+) is connected with the Variable part of Potentiometer and the final end of potentiometer is connected with ground!
7. **LCD**'s pin 1 (VSS) is connected with DC 5V , pin 2 (VDD) and pin 5 RW (Read/Write) both is connected with *GROUND*.

Working Description :

24 V solar panel supplies current through Potentiometer to ACS712 current sensor, Current sensor capture the current value at a range of 0-1024 (analog value). Current Sensor ACS712 is connected with additional DC 5V. ACS712's IP- pin then pass that current to DC Motor and the DC motor another terminal is connected with Solar Panel's negative end.

In Our coding part we need to import the **LiquidCrystal.h** as we have used LCD display.

Then we need to create an instance of LiquidCrystal like `LiquidCrystal lcd(11,10,5,4,3,2);`)

And the most important part is the calculation part. We know the ACS712 current sensor is works with DC 5V so , when there is no current flow through the Ip+ and IP- terminal of the current sensor the output voltage at VIOUT of ACS712 is 2.5V. This means that we need to subtract 2.5 V from the voltage measured at the A0 analog pin of Arduino.

Equations :

$P = VI^2$

$V = IR$

```
const int currentPin = A0;
int sensitivity = 66;
int adcValue= 0;
int offsetVoltage = 2500;
double adcVoltage = 0;
double currentValue = 0;
```

```
adcValue = analogRead(currentPin); // 0-1024
adcVoltage = (adcValue / 1024.0) * 5000;
currentValue = ( (adcVoltage - offsetVoltage) / sensit
int loadvoltage = currentValue * 12;
int power = loadvoltage*currentValue*currentValue;
```

Here the sensitivity is actually the internal resistor of ACS712_30A current sensor.

IoT Connection :

We have tried out level best to use a Wifi device in out model but virtually it next to impossible without having a physical network device. Our plan was to use ESP8266 and upload the real time data to cloud. We wanted to use Thingspeak for our cloud side.

Future Work :

In future we want to make this project to a complete IoT project using ESP8266. We also have some plan for rotating the solar panel according to the sun light.
We are also planning to do this in future

REFERENCES

[1] Jiju K. et. al., 2014. "Development of Android based on-line monitoring and control system for Renewable Energy Sources." Computer, Communications, and Control Technology (I4CT), International Conference on. IEEE, 2014 Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first ...”

[2] Kabalci, Ersan, Gorgun A. and Kabalci Y., 2013. "Design and implementation of a renewable energy monitoring system." Power Engineering, Energy and Electrical Drives (POWERENG), Fourth International Conference on. IEEE, 2013. .

[3] Yoshihiro G. et. al., 2007. "Integrated management and remote monitoring system for telecommunications power plants with fully DC-powered center equipment." INTELEC 07-29th International Telecommunications Energy Conference. IEEE, 2007.

[4] Alexander S. and Galkin I., 2013. "Case study on using non-intrusive load monitoring system with renewable energy sources in intelligent grid applications." International Conference Workshop And Power Electronic

5] Mayamiko N., Zennaro M. and Bagula A., 2011. "SM 2: Solar monitoring system in Malawi." Kaleidoscope: The Fully Networked Human?-Innovations for Future Networks and Services (K-2011), Proceedings of ITU. IEEE, 2011.

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