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Designed and Development IOT Based Solar Power Monitoring System and Control

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ABSTRACT

Nowadays power demand has increased due to this power failure happens many time. This project is designed to provide the solution for this power loss. This project is designed with LDR, amplifier, ADC, microcontroller, driver circuit along with motor and limit switches. Solar panel consists of number of silicon cells, when sun light falls on this panel it generates the voltage signals then these voltage signals are given to changing circuit. Depending on the panel board size the generated voltage amount is increased. Naturally suns direction varies per hour. In order to get the efficient voltage amount the solar panel position has to vary as per the suns direction. Solar power plants need to be monitored for optimum power output. This helps retrieve efficient power output from power plants while monitoring for faulty solar panels, connections, and dust accumulated on panels lowering output and other such issues affecting solar performance. The project is also an automated IOT based solar power monitoring system that allows for automated solar power monitoring from anywhere over the internet. We use arduino based system to monitor a 5Watt solar panel parameters. The system constantly monitors the solar panel and transmits the power output to IOT system over the internet.

The use of solar system is increased in the last two years. The objective of this system is to Power of the system can be monitor using the current and voltage value sensed by the arduino. This system helps to implement in solar system for efficient usage. The electricity generated by capturing the sun light is called as solar energy which is used for business and home purpose. The atoms lose the electrons when the photons hit the solar cells. A solar panel is made of multiple panels that wired together, more electricity is generated by the more panels we deploy. Silicon like semiconductors are used to make the PV photovoltaic solar panels as shown in figure. Direct Current is generated by the solar panels. Most of the electrical appliance works on AC supply can AC can be less expensive for transmit to long distances. Many energy companies are expanding to offer solar, which is among the most energy-efficient and lucrative sources of renewable electricity on the market.

LITERATURE SURVEY

Abhishek Parikh et al. (2015) presented continuous monitoring the condition and detecting the faults to ensure the stable power delivery of Solar panel in remote area is our contribution in this paper, this work is part of project. I am working on this project at Optimized Solutions Pvt. Ltd. as a part of curriculum activity in my final year project at Maharaja Sayajirao University. This paper describes the hardware and software implementation for fault detection and continuous monitoring system for solar panel in remote area. This research problem has been stated by engineers working in Solar panel maintenance system. As proposed solution to this wireless sensor node is provided with Voltage sensor, Current sensor, Light sensor, Temperature sensor and Dust sensor and XBeeS2 to implement WSN. Data are being continuously stored and monitored at central station called HUB and through that data are being sent to server via Ethernet. A friendly GUI using Python is implemented to visualize monitoring process and save data on Excel file. The designed system is built and satisfactory results has been obtained.

K.G.Srinivasan et al. (2016) proposed the Internet of Things has a vision in which the internet extends into the real world, which incorporates everyday objects. The IoT allows objects to be sensed or controlled remotely over existing network infrastructure, creating opportunities for pure integration of the physical world into computer based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. This technology has many applications like solar cities, Smart villages, Micro grids and Solar Street lights and so on. As Renewable energy grew at a rate faster than any other time in history during this period. The proposed system refers to the online display of the power usage of solar energy as a renewable energy. This monitoring is done through raspberry

pi using flask framework. Smart Monitoring displays daily usage of renewable energy. This helps the user to analysis of energy usage. Analysis impacts on the renewable energy usage and electricity issues.

R.Vignesh et al. (2016) presented that in advanced growing technologies IoT leads the work faster and smarter to implement. Each and every solar photovoltaic cell of a solar panel needs to monitor to know its current status as for this is concern monitoring as well as detecting in case of defect in solar cells of a panel and implement corrective measures .

Mayuri Ejgar et al. (2017) proposed that in the recent years, we have seen a rapid increase in installation of solar plants worldwide. The overall energy generation and performance of solar plants depends upon effective and timely maintenance of different devices such as strings of solar panels, inverters and transformers. These devices can degrade over time or due to specific malfunctioning in the equipment. Energy production at the plant is not only affected by internal factors but also due to external factors such as dust, irradiation, module temperature etc. In this paper, we present a system to identify various malfunctioning and possible breakdowns of such devices based on real-time monitoring and various real-time anomaly detection techniques. Once the anomaly is detected, it is immediately informed to the appropriate service engineers for timely action. It helps in providing.

Vishal S. Patil et al. (2019) proposed the solar power monitoring system is used the Internet of Things for the purpose, to overcome the drawbacks of previous solar systems. An IoT is a joint network of the connected devices together and shares the data about how they are used in the environment in which they are operated. The solar power monitoring system is used for generating the electricity by using the energy of sunlight. This system is uses the Arduino Uno for enhancement of the solar systems. This solar power monitoring system uses the Arduino Uno. The Arduino Uno is microcontroller board, this microcontroller used the ATmega328p. ATmega328p is also a microcontroller chip which is developed by Atmel. By using Arduino Uno the solar panel is capable of moving in the direction where sunlight is moves, this is the additional feature of this solar system.

V.Kavitha et al. (2019) proposed renewable energy sources are proven to be reliable and accepted as the best alternative for fulfilling our increasing energy needs. Solar photovoltaic energy is the emerging and enticing clean technologies with zero carbon emission in today's world. To harness the solar power generation, it is indeed necessary to pay serious attention to its maintenance as well as application. The IoT based solar energy monitoring system is proposed to collect and analyzes the solar energy parameters to predict the performance for ensuring stable power generation. The main advantage of the system is to determine optimal performance for better maintenance of solar PV (photovoltaic). The prime target of PV monitoring system is to offer a cost-effective solution, which incessantly displays remote energy yields and its performance either on the computer or through smart phones. The proposed system is tested with a solar module of 125-watts to monitor string voltage, string current, temperature, and irradiance. This PV monitoring system is developed by a smart Wi-Fi enabled CC3200 microcontroller with latest embedded ARM processor that communicates and uploads the data in cloud platform with the Blynk application. Also the Wireless monitoring system maximizes the operational reliability of a PV system with minimum system cost.

INTRODUCTION

1.1 PROBLEM STATEMENT:

The method focuses on the problem that arises when there is a fault in the solar energy system which affects the output of the system and also it decreases the efficiency of the system. And it is difficult check often for the area of errors. It creates a need to monitor and proper maintenance of the solar power system. The project also deals with the varying of the angle of the sunlight rays in the period of harnessing which avoids the possibility of attaining maximum solar energy. It creates need to control the solar panel and turn it in the direction of maximum sunlight rays in order to attain a maximum output.

FIELD OF THE PROJECT:

Internet of things (IoT) is playing a major and crucial role in the daily life of humans by enabling the connectivity of many and most of the physical devices through internet to exchange the data for monitoring and controlling the devices from a remote location, where the devices are becomes intelligent.

IoT data collection is the process of using sensors to track the conditions of physical things. Devices and technology connected over the Internet of Things (IoT) can monitor and measure data in real time. The data are transmitted, stored, and can be retrieved at any time.

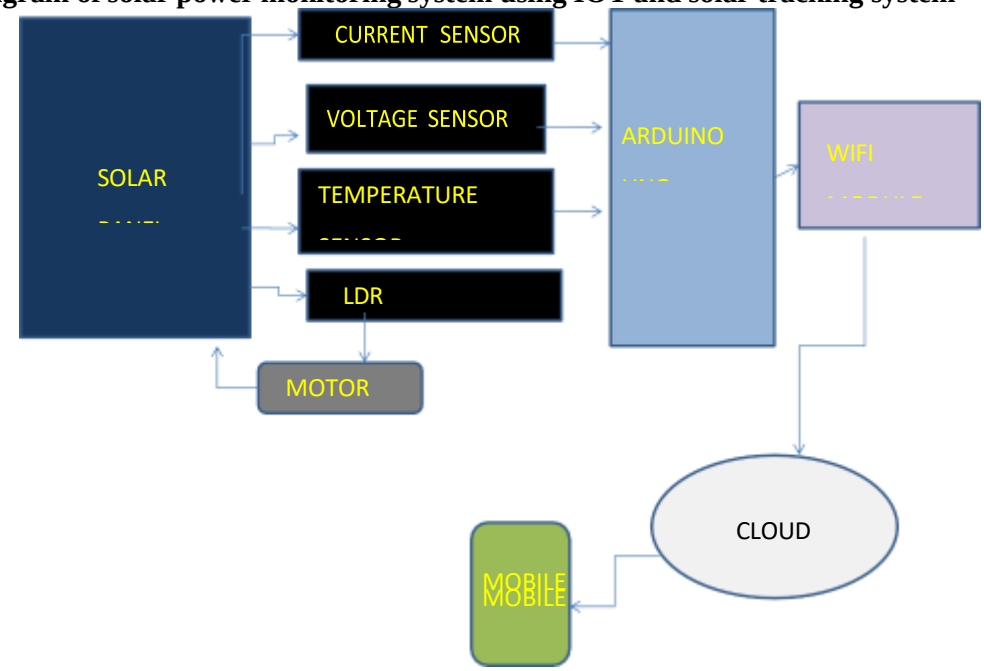
Sunlight is always be in two components, one is direct beam that carries about 90% of the solar energy, and the other is diffuse sunlight that carries the remainder which is the diffuse portion is the blue sky on a clear day, and is a larger proportion of the total on cloudy days. As the majority of the energy is in the direct beam, maximizing collection requires the Sun to be visible to the panels for as long as possible. The energy contributed by the direct beam drops off with the cosine of the angle between the incoming light and the panel.

1.3 OBJECTIVES:

- To monitor the power generated by a solar panel using the current and voltage value acquired from the sensors.
- To monitor the factors that affects the energy production such as temperature.
- To track the direction of solar radiation
- To vary the angle of the solar panel with the variation of the direction of the solar radiation using LDR and motor.
- To monitor all the acquired data through a mobile application using IOT.
- Thus to increase the efficiency of the solar energy system.

METHODOLOGY

FIG 2.1 Block diagram of solar power monitoring system using IOT and solar tracking system



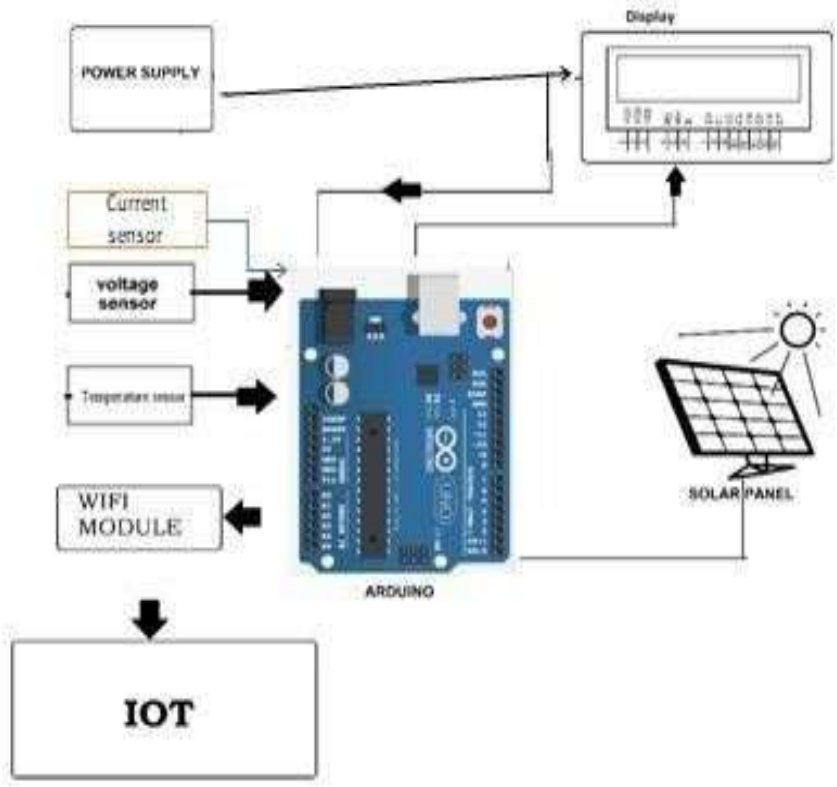


FIG 2.2 Block diagram of solar power monitoring system using IOT

Description of the components:

SOLAR PANEL:

The electricity generated by capturing the sun light is called as solar energy which is used for business and home purpose. The natural nuclear reactor is sun which releases the energy with tiny packets called photons. The atoms lose the electrons when the photons hit the solar cells. A solar panel is made of multiple panels that wired together, more electricity is generated by the more panels. Direct Current is generated by the solar panels.

CURRENT SENSOR:

Current sensor ACS712 is a sensing device that used to sense the amount of current flowing through a wire. It is Hall Effect based linear sensor device. It can detect both AC and DC.

LIGHT DEPENDENT RESISTOR:

LDR or light dependent resistor is a component that works based on the principle of Photo conductivity. All the electrons in the semiconductor of the valance band excites when the light or photos fall on the resistor. When the light falls on the LDR resistance gets decreased and increase in the dark or called as dark resistance.

LDR SENSOR MODULE:

LDR sensor module is a low-cost digital sensor also a analog sensor module, which is capable to measure and detect light intensity. This sensor also is known as the Photoresistor sensor. This sensor has an onboard LDR(Light

Dependent Resistor), that helps it to detect light. This sensor module comes with 4 terminals. Where the “DO” pin is a digital output pin and the “AO” pin is an analog output pin. The output of the module goes high in the absence of light and it becomes low in the presence of light. The sensitivity of the sensor can be adjusted using the onboard potentiometer.

ARDUINO UNO:

Arduino Uno is a microcontroller board that is based on the ATmega328P. It is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs and turn it into an output. It has 14 digital input/output pins of which 6 can be used as PWM output, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

LCD DISPLAY:

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizer. It is used to display the information or data. It receives the data from the arduino to be displayed.

MOTOR:

A Simple DC motor consists of a stator, an armature, a rotor and a commutator with brushes. Opposite polarity between the two magnetic fields inside the motor cause it to turn. Here the motor is used to turn the solar panel.

LIMIT SWITCH

A mechanical limit switch interlocks a mechanical motion or position with an electrical circuit. A good starting point for limit-switch selection is contact arrangement. The most common limit switch is the single-pole contact block with one NO and one NC set of contacts. However, limit switches are available with up to four poles.Limit switches also are available with time-delayed contact transfer. This type is useful in detecting jams that cause the limit switch to remain actuated beyond a predetermined time interval.

THERMISTOR:

A thermistor is a resistance thermometer whose resistance is dependent on temperature. When temperature increases, the resistance increases, and when temperature decreases, resistance decreases NTC 103 thermistor is a 5mm epoxy coated disc. Its Operating temperature: -20°~+125°C.

ARDUINO PROGRAM

#define BLYNK_PRINT Serial #include <ESP8266WiFi.h> #include <BlynkSimpleEsp8266.h> #include<LiquidCrystal.h>

char auth[] = "oH0INF2LIfpVtj0CCb0P0dlV5Y2lBG8R"; char ssid[] = "IOT";

char pass[] = "123456789"; unsigned int m=0,act=0; String inputString = ""; unsigned char a[200];

LiquidCrystal lcd(13,12,11,10,9,8); const int ls1=4;

const int ls2=5; const int temp=A0; const int volt=A4;

const int current=A3; const int ldr1=A1; const int ldr2=A2; const int m1=2; const int m2=3;

int v=0,l1,l2,i=0,p=0,t; void setup()

{

lcd.begin(16,2);
Serial.begin(9600);
pinMode(m1,OUTPUT);

```
pinMode(m2,OUTPUT);
pinMode(volt,INPUT);
pin Mode(current,INPUT);
pinMode(temp,INPUT_PULLUP);
pinMode(ldr1,INPUT);
pinMode(ldr2,INPUT);
pinMode(ls1,INPUT_PULLUP);
pinMode(ls2,INPUT_PULLUP);
digitalWrite(m1,HIGH);
digitalWrite(m2,HIGH);
lcd.setCursor(0,0);
lcd.print("SOLAR "); lcd.setCursor(0,1);
lcd.print("TRACKING"); delay(2000);
 lcd.clear(); Serial.begin(9600); Blynk.begin(auth, ssid, pass);
}
void loop()
{
t = analogRead(temp);
t = map(t,0,1023,150,0)/4;
lcd.setCursor(6,1);lcd.print("T:");
if(t<= 9){lcd.print("00");lcd.print(t);}
else if(t <= 99){lcd.print("0");lcd.print(t);} else if(t <= 999)
{
lcd.print(t);
}
v = analogRead(volt);
v = map(v,0,1023,0,12);
lcd.setCursor(0,0);lcd.print("V:");
if(v<= 9){lcd.print("00");lcd.print(v);}
else if(v <= 99){lcd.print("0");lcd.print(v);} else if(v <= 999){lcd.print(v);}
i = analogRead(current)/100; i = map(i,0,1023,0,12);
lcd.setCursor(0,1);lcd.print("I:");
if(i <= 9){lcd.print("00");lcd.print(i);}
else if(i <= 99){lcd.print("0");lcd.print(i);} else if(i <= 999){lcd.print(i);}
p = v*i;
p = map(p,0,1023,0,100);
lcd.setCursor(6,0);lcd.print("P:");
if(p <= 9){lcd.print("00");lcd.print(p);}
else if(p <= 99){lcd.print("0");lcd.print(p);} else if(p <= 999){lcd.print(p);}
l1 = analogRead(ldr1); l2 = analogRead(ldr2); if(l2 < 100)
{
digitalWrite(m1,HIGH); digitalWrite(m2,LOW); delay(500); while(digitalRead(ls2) == HIGH);
digitalWrite(m1,HIGH); digitalWrite(m2,HIGH);
}
if(l1 < 100)
{
digitalWrite(m1,LOW); digitalWrite(m2,HIGH); delay(500); while(digitalRead(ls1) == HIGH); digitalWrite(m1,HIGH);
digitalWrite(m2,HIGH);
}
else
```

```
{
digitalWrite(m1,HIGH); digitalWrite(m2,HIGH); delay(500);
}
senddata(); delay(1000);
}
void senddata()
{
Serial.print('*'); Serial.print("VOLTAGE :");
If (v <= 9){Serial.print("00");Serial.print(v);}
else if(v <= 99){Serial.print("0");Serial.print(v);} else if(v <= 999){Serial.print(v);} Serial.println();
Serial.print("CURRENT :");
If (i <= 9){Serial.print("00");Serial.print(i);}
else if(i <= 99){Serial.print("0");Serial.print(i);} else if(i <= 999){Serial.print(i);} Serial.println();
Serial.print("POWER :");
If (p <= 9){Serial.print("00");Serial.print(p);}
else if(p <= 99){Serial.print("/0");Serial.print(p);} else if(p <= 999){Serial.print(p);}
Serial.println(); Serial.print("TEMPERATURE :");
if(t <= 9){Serial.print("00");Serial.print(t);}
else if(t <= 99){Serial.print("0");Serial.print(t);}
 else if(t <= 999){Serial.print(t);} Serial.println();
Serial.print('@');
}
void loop()
{
while (Serial.available())
{
char inChar;
inChar = (char)Serial.read(); Serial.print(inChar);
a[m] = inChar;
if(a[0] == '*'){if(a[m] == '@'){act = 1;}else{if(m<=200){m++;inputString
   += inChar;}}}
}
if(act)
{
Blynk.virtualWrite(V0, inputString); Serial.print(inputString); m=0;inputString = " ";
act = 0
}
Blynk.run();
}
```

Circuit Diagram of the project

CONCLUSION:

Thus the system has been designed and successfully tested. The values of current, voltage, power and temperature were monitored through the LCD display and the Blynk mobile application. The solar panel turns on the side of higher solar radiation using motor. The system keeps continues track of solar panel, the daily weekly and monthly analysis becomes easy and efficient also with the help of this analysis it is possible to detect any fault occurred within power plant as the generated power may show some inconsistency in data of Solar power plant. The system helps the power plant to achieve better efficiency using solar tracking.

FUTURE SCOPE:

The web application can be developed for interaction with the end user, the user can also predict values of the future events. In future, the controlling feature of Solar panel voltage, current and power can be added to this experiment. Based on the consumption by the customer, when the maximum power consumption is reached the control unit generates a signal and the necessary action can be taken. Furthermore, this can be improved by using time-based control for disconnecting the load.

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