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IOT BASED SOLAR MONITORING SYSTEM USING ARDUINO

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Abstract - *The Solar Monitoring System project is a forward-looking initiative designed to elevate the efficiency and reliability of solar energy systems. By integrating continuous monitoring of solar radiation levels with precise measurements of voltage and power output, this system provides users with a comprehensive understanding of solar panel performance. Utilizing advanced sensors and intelligent algorithms, the Solar Monitoring System delivers real-time data analysis through a user-friendly interface, facilitating seamless access, and response to critical performance metrics. The interface serves as a centralized hub for data visualization, supporting both real-time monitoring and historical analysis. To enhance user experience, the system incorporates an alert mechanism, notifying users of any deviations from expected performance parameters and the goal of this solar monitoring system is to measure the current generated by the solar panel, displays it on an alphanumeric LCD, and control a DC motor based on the solar power generation. In essence, the Solar Monitoring System project aims to simplify and enhance the monitoring of solar energy systems, contributing to the broader goals of sustainable energy solutions and the continual advancement of solar technology and through monitoring methods, users can analyze and optimize the use of renewable energy, leading to reduced concerns associated with electricity consumption. This project addresses this need by proposing a sophisticated yet user-friendly system that integrates continuous solar radiation monitoring with precise measurements of voltage and power output. The project's primary objective is to empower users with the tools and insights necessary to optimize the performance of their solar panels.*

Key Words: Arduino, Resistor, C Motor, ACS712, LM044(LCD Display), Solar Panel.

1.INTRODUCTION

The Solar Monitoring System project represents a significant stride towards enhancing the performance and reliability of solar energy systems, responding to the growing need for efficient and sustainable energy solutions. In the context of escalating environmental concerns and the increasing adoption of solar technologies, the need for real-time, comprehensive monitoring systems has become imperative. This project addresses this need by proposing a sophisticated yet user-friendly system that integrates continuous solar radiation monitoring with precise measurements of voltage and power output. The project's primary objective is to empower users with the tools and insights necessary to optimize the performance of their solar panels. By leveraging advanced sensors and intelligent algorithms, the Solar Monitoring System delivers not only real-time data but also a historical perspective on the system's performance. This enables users to make informed decisions regarding maintenance, troubleshooting, and overall system optimization. The Solar Monitoring System project is not just about data collection; it's about providing users with a proactive approach to solar panel management. The inclusion of a dynamic sun tracking mechanism ensures accurate solar radiation readings, while high-precision sensors monitor the electrical performance of the panels. Additionally, an alert system promptly notifies users of any deviations from expected performance, allowing for swift intervention to minimize downtime and maximize energy production. Ambuj Gupta Student et al [1] In this study proposed and explored the application of the use of Raspberry Pi as a microcontroller-based computer in solar monitoring systems they have explored the versatility and cost-effectiveness of Raspberry Pi in collecting and transmitting data from solar panels the integration of Analog to Digital Convertors (ADCs), such as MCP3008, has been investigated for precise data acquisition in solar metering systems. Solar Infrared et al [2] In this study proposed Infrared Thermography has emerged as a powerful tool for inspecting photovoltaic solar systems, enabling non-intrusive and comprehensive analysis. Literature underscores its potential to detect issues such as damage to cells, loss of efficiency, and fire hazards. The application of infrared cameras for large-scale solar system assessment is gaining prominence due to its efficiency in capturing detailed thermal information. Manish Katyarmal et al [3] In this study the researchers emphasize the use of web-based interfaces as a practical solution for remotely monitoring solar plants. The majority of solar installations being in hard-to-reach locations necessitates a dedicated approach for real-time monitoring and data access. Savitha Krishna et al[4] In this study the focus is on real-time data analysis and representation is crucial for understanding the dynamic performance of individual units and the entire solar microgrid system. Studies highlight the importance of actionable insights derived from continuous monitoring, contributing to efficient decision-making and system maintenance. The literature recognizes and addresses the challenges encountered during the transformation of solar microgrids. K.G.Srinivasan et al [5] In this study literature explores the impact analysis of smart monitoring on renewable energy usage. Researchers discuss how real-time data and analysis contribute to increased awareness, efficiency improvements, and the resolution of electricity-related issues. A. Gupta et al [6] In this study proposed applications of IoT in the renewable energy sector, offering insights into how IoT can be monitoring and enhancing the performance of solar energy systems focusing on the specific aspect of dust tracking on solar panels, this work explores techniques within IoT-based systems. It may shed light on innovative methods to keep solar panels clean and optimize power generation. H. M. Ahmed et al [7] In this study analyze the use of Arduino Uno in solar power monitoring systems. It may cover aspects such as system architecture, data acquisition, and the real-time monitoring capabilities provided by Arduino. The advantages, challenges, and potential innovations associated with this integration. Focusing on the manufacturing process of solar panels and the use of silicon wafers, this literature survey may provide a detailed understanding of the technology behind solar panel production and its impact on energy generation.

1.1 Literature Review

S. M. Patil et al [8] In this study proposed applications of IoT in the renewable energy sector, offering insights into how IoT can be monitoring and enhancing the performance of solar energy systems focusing on the specific aspect of dust tracking on solar panels, this work explores techniques within IoT-based systems. B. Shrihariprasath et al [9] In this study an overview of various solar tracking systems, discussing different technologies, approach, and their impact on energy efficiency. Exploring the concept of hybrid power systems, the integration of Arduino-based solar monitoring with other renewable sources, providing a more comprehensive solution for sustainable energy. S. Singh et al

[10] In this study an overview of IoT applications in renewable energy, exploring various technologies and challenges associated with integrating IoT into energy monitoring systems and explore the role of Raspberry Pi in renewable energy projects, discussing recent advancements and potential applications and the integration of Raspberry Pi with IoT for monitoring purposes. Investigating the Flask framework, this review could discuss the features and applications of Flask in web development. R. Niranjana et al [11] In this study proposed discussed communication technologies used in real-time monitoring systems and the use of the Blynk application in IoT-based energy monitoring systems. Investigating smartphone-based microcontroller applications in solar energy monitoring, this paper could discuss design aspects and performance analyses of systems similar to your proposed solution. E. I. Archibong et al [12] In this study proposed an overview of the latest advancements in photovoltaic solar tracking systems, discussing various technologies, control systems, and their impact on energy gain. It also covers both theoretical and practical aspects of solar tracking. Focusing on Arduino-based solar tracking systems, this review is about recent developments in hardware, control direction, and practical applications. B. K. S. Vastav et al [13] In this study offer an overview of different solar tracking systems, discussing various technologies, including Arduino-based systems, and their impact on energy capture and conversion efficiency. Focusing specifically on solar tracking systems utilizing Arduino, this review may cover recent advancements, implementation challenges, and potential improvements.

2. Design and Simulation

The goal of this solar monitoring system is to measure the current generated by the solar panel, displays it on an alphanumeric LCD, and control a DC motor based on the solar power generation.

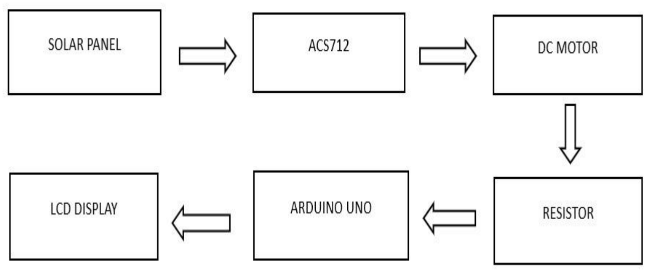

Table -1: Block diagram

To simulate this system, we have used software like Proteus. we have set up the components and connect them according to the circuit connections mentioned below. By using Arduino code, we run the simulation the simulation, and the LCD displaying the current and the motor turning on/off based on the simulated solar and simulation parameters are listed below:

SL NO.	COMPONENT	QUANTITY	VALUE
1.	ARDUINO UNO	1	
2.	SOLAR PANEL	1	
3.	ACS712	1	
4.	RESISTOR	2	4K,1K
5.	LM044(LCD)	1	
6.	DC MOTOR	1	

Chart -1: Components Required

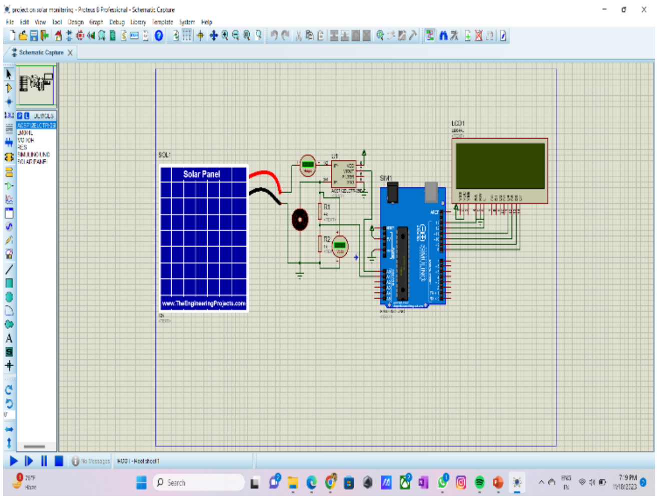

Fig -1: switch off condition

2.1 Code

```
//include the library code:
#include <LiquidCrystal.h>//library for LCD
//initialize the library with the numbers of the interface pins
LiquidCrystal lcd(13,12,11,10,9,8);


//Measuring Current Using ACS712
int senstivity=185;//use 100 for 20A Module and 66 for 30A Module
int adcvalue=0;
int offsetvoltage=25000;//sensor calibration
double voltage=0;//voltage measuring
double ecurrent=0;//current measuring


void setup()
{
lcd.begin(20,4);//set up the LCD's number of columns and rows:
lcd.setCusor(0,0);
lcd.print("THE BRIGHT LIGHT");
lcd.setCursor(0,1);
lcd.print("SOLAR MONITORING");
}


void loop()
//Measure The Voltage


//read in the input on analog pin A1:
int sensorValue=analog(A1);
//Convert the analog reading (which goes from 0-1023) to a voltage(0-5V):
float vol=(senorValue*5.0)/1023.0;
float voltage=vol*5;
lcd.printCursor(0,2);
lcd.print("Voltage=");
lcd.print("V");

//Measure The Current

adcvalue=analogRead(A0);//reading the value from the analog pin A0
Voltage=(adcvalue/1024.0)*5000;//Gets you mV
ecurrent=((Voltage-offsetvoltage)/senstivity);
lcd.setCursor(0.3);
lcd.print("current=")
lcd.print(ecurrent);
lcd.print("A");//unit for the current to be measured
delay(2000);
}
```

3. RESULT ANALYSIS

As we want to conclude here that our working model gives us the nearly accurate values of current and voltage when we run the program of Arduino as mentioned below. This program helps to give us the exact value of current that is gained by the solar panel.

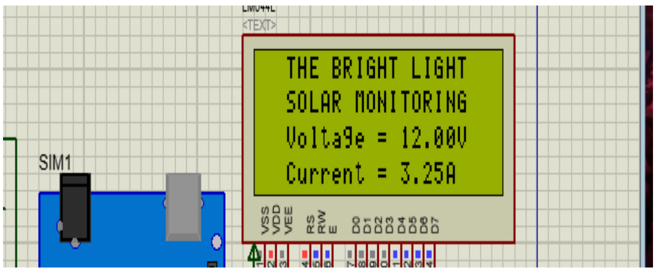

Fig -2: Current and voltage analysis

4. CONCLUSION

The adoption of Renewable Energy technologies serves as a strategy to diminish environmental impact. Through monitoring methods, users can analyze and optimize the use of renewable energy, leading to reduced concerns associated with electricity consumption. By making future forecasts based on current project monitoring values as benchmarks, there is room for development that could enhance this initiative even more. Additionally, an interactive web application may be created for end-users' convenience which will provide predictions about upcoming events readily available at their disposal. To ensure data accuracy during forecast analysis multiple models must be employed; enabling a single precise estimate per dataset established by each model individually or altogether when achievable.

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