International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

SMART TEMPERATURE DEPENDENT COOLING OF SOLARPANEL USING ARDUINO

Mrs. G. Suseelamma Mtech[1],**Mr. S.NagendraReddy**[2],**Ms.M.Vyshnavi**[3], **Mr.E.Krishna Reddy**[4],**CH..Ramudu**[5]
[1] Associate professor, Department of ECE, Tirumala Engineering College

***Abstract*—**The proposed project presents a solar panel cooling system utilizing Peltier cooling modules safeguard solar panels from overheating. With the increasing utilization of solar energy, ensuring the optimal performance and longevity of solar panels becomes imperative. Overheating can significantly degrade solar panel efficiency and lifespan. To address this issue, the project integrates an Arduino Uno micro controller, LCD display, DS18B20 temperature sensor, and relay module to regulate the temperature of solar panels within predefined lower and upper limit The system operates by continuously monitoring the temperature of the solar panel surface using the DS18B20 temperature sensor. When the temperature exceeds the upper limit, indicating a risk of overheating, the Arduino Uno activates the Peltier cooling module through the relay module. The Peltier cooling module absorbs heat from the solar panel surface, effectively cooling it down. Conversely, if the temperature drops below the lower limit, the cooling system is deactivated to prevent excessive cooling and ensure optimal operating conditions for the **solar panel**. Real-time temperature readings are displayed on the LCD display, providing users with insights into the system's operation.

Keywords*—Solar Panel ,Temperature Sensor,Micro Controller, Relay,Peltier System.*

1. INTRODUCTION

solar cell is an electrical device that uses photo voltaic effect to convert the light energy directly into electrical energy. The photo voltaic effect is the creation of voltage or current in a material due to exposure of material to sunlight. The solar cells are capable of producing electric current without being connected to any external voltage source

The most common semiconductor material used in the development of solar cells is silicon. One of the main obstacles that face the operation of photo voltaic panels (PV) is overheating due to excessive solar radiation and high ambient temperatures. Overheating reduces the efficiency of the panels dramatically . The maximum power output from the solar cells decreases as the cell temperature increases. Keeping insolation level as constant, if the temperature is increased, there is a marginal increase in the cell current but a marked reduction in cell voltage

An increase in temperature causes reduction in the band gap. This in turn causes some increase in photo-generation rate and thus, a marginal increase in current. However, the reverse saturation current increases rapidly with temperature. Due to this, the cell voltage decreases by approximately 2.2 mV per 1 0C rise in its operating temperature, depending on the resistivity of the silicon used: higher the silicon resistivity more marked is the temperature effect. So in order to get maximum output from the solar panel, the solar cells need to be cooled to maintain low temperature. Different types of cooling method have been proposed for this purpose. One among them is using water as cooling fluid to cool down the surface. The cooling design presented in this paper involved flow of water over the front side of the PV module. The heat extracted by water from the panel surface can be used for small scale heat requirements. This scheme is very suitable for gulf countries having higher solar insolation

2.RELATED WORK

In this project we are using a 22 V ,100 W solar panel . A temperature sensor and relay circuit is made using an NTC thermistor (10K) and Arduino micro controller. The **temperature sensor** is fixed at the back of the solar panel . A 12V mini DC water pump is used to circulate the cooling water. The relay in the temperature sensing circuit is connected to the water pump. This relay acts as a swith that connects the pump to the power supply (adapter). At the top elevated end of solar panel (solar panel placed in a slanting position) water sprinklers are provided to spray water on the panel surface. At the sides of the panel channels made of PVC pipes are installed to collect the sprayed water and re-circulate it. The water pump is connected to a zig-zag copper tube placed inside the heat exchanging chamber containing water that has to be heated. The tube that comes out of this chamber is connected to water sprinkler system[1].

Various researches have been done to protect vehicles from , some of these researches is design system to protect cars from with low cost, if some person attempts to s the micro controller send warning message to the owner of car. When motor of car work the vibration sensors measure the velocity and send this measurement to micro controller then it send intimation message to the owner of the car and with the help of we can detect the location of the vehicle over the time [2].

In other paper it designs system that the PIC16F877A micro controller stored valid smart card unique RFID numbers. When scanned the right the micro controller send signal to electromagnetic relay to close and will allow the user to start the vehicle. If scanned invalid smart card the system allows the user to try three times and if failed the **micro controller** commands the implement in micro controller [3].

In this proposed system it used ARM 7 processor based LPC2148 controller. The system consist of smart card

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

capable of store fingerprint of certain people that is used to authentication of vehicles, those vehicle it will be include card reader to read the card data. When person try to drive the car it will be in the first insert the card in the card reader and place the finger in the For more security and safety the system consist of IR sensor to detect the position of seat belts also include alcoholic sensor to detect the level of alcohol, if person drunk more than allowed level the vehicle stop and the reason and percentage of alcohol display in LCD [4].

We have set a temperature limit of 350C on the Arduino micro controller. When the panel surface temperature exceeds 350C,the relay turns the pump ON and water will be sprayed on the panel surface. This water collects the panel surface heat and gives it to the water inside the heat exchanging chamber by using the copper tube. Thus water inside the heat exchanging chamber can be heated to obtain hot water. The cooling water after passing through the copper tubes of heat exchanging chamber losses its heat and can again be used for cooling the panel.

2. Methodology

As shown in Fig.l.The whole structure of the proposed system.

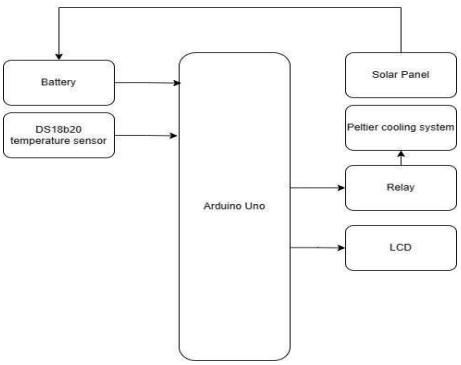

Fig.1. Proposed System Block Diagram

3.1. Solar Panel

Fig.2: Solar panel

3.2 DS18B20 Temperature sensor

Fig.3: Temperature sensor

The DS18B20 is a 1-wire programmable **Temperature sensor** from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from **- 55°Cto +125°** with a decent accuracy of **±5°C**. Each sensor has a unique address and requires only onepin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of your digital pins on the **micro controller**.

The pull-up resistor is used to keep the line in high state when the bus is not in use. The temperature value measured by the sensor will be stored in a 2-byte register inside the sensor. This data can be read by the using the 1-wire method by sending in a sequence of data. There are two types of commands that are to be sent to read the values, one is a ROM command and the other isfunction command. The address value of each ROM memory along with the sequence is given in the data sheet below. You have to read through it to understand how to communicate with the sensor.

3.3 Arduino Uno Micro Controller

A solar panel is a device that converts light from the sun into electrical energy. It consists of a number of photovoltaic cells made of semiconductor materials such as silicon, which generate electricity when exposed to sunlight. Solar panels are used in a variety of applications, including residential and commercial solar power systems, satellites, and portable devices. They are a clean and renewable source of energy, helping to reduce dependence on fossil fuels and lower greenhouse gas emissions.

A solar panel works by converting sunlight into electricity. It is made up of photo voltaic (PV) cells, which are made of a semiconductor material such as silicon. When sunlight hits the PV cells, it creates a flow of electrons, which

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

generate an electrical current. This electrical current is then directed into a circuit and transformed into usable electricity. The electricity can be stored in a battery or fed directly into a power grid. The efficiency of a solar panel depends on the quality of the PV cells and the amount of sunlight it receives transmitter, each reader must have either a **micro controller** or a microcomputer.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable.

Micro controllers frameworks which run only on Windows. Arduino programming is easy to learn and apply to beginners and amateurs. Arduino is an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer It's an open-source physical processing stage focused around a straightforward micro controller board, and an environment for composing programs for the board. Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physical outputs. Arduino activities can be remaining solitary, or they can be associated with programs running on your machine (e.g. Flash, Processing and Max msp.)

the open-source IDE can be downloaded free of charge. Focused around the Processing media programming environment, the Arduino programming language is an execution of Wiring, a comparative physical computing platform.

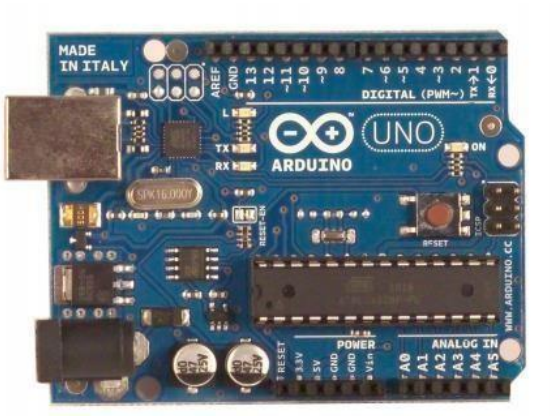

Fig 4 Ardunio Uno

3.3. Relay

.

Fig 5 Relay

Relay is an electro mechanical device that uses an electric current to open or close the contacts of a switch. The single- channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not safety of the vehicle and its occupants.

The relay itself, which, in this case, is a blue plastic case. Lots of information can be gleaned from the markings on the relay itself. The part number of the relay on the bottom says “05VDC”, which means that the relay coil is activated at 5V minimum – any voltage lower than this will not be able to reliably close the contacts of the relay. There are also voltage and current markings, which represent the maximum voltage and current, the relay can switch. For example, the top left marking says “10A 250VAC”, which means the relay can switch a maximum load of 10A when connected to a 250V mains circuit. The bottom left rating says “10A 30VDC”, meaning the relay can switch a maximum current of 10A DC before the contacts get damaged.

Peltier system

The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice versa. A thermoelectric device creates voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. At the atomic scale, an applied temperature gradient causes charge carriers in the material to diffuse from the hot side to the cold side

3.Results & Discussion

The **Peltier** effect occurs whenever electrical current

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

flows through two dissimilar conductors; depending on the direction of current flow, the junction of the two conductors will either absorbor release heat.

In the world of thermo electric technology, semiconductors (usually Bismuth Telluride) are the material of choice for producing the Peltier effect because they can be more easily optimized for pumping heat. Using this type of material, a Peltier device (i.e., thermo electric module) can be constructed in its simplest form around a single semiconductor "pellet" which is soldered to electrically-conductive material on each end (usually plated copper). In this configuration, the second dissimilar material required for the Peltier effect, is actually the copper connection paths to the power supply.

Fig 6 Peltier system

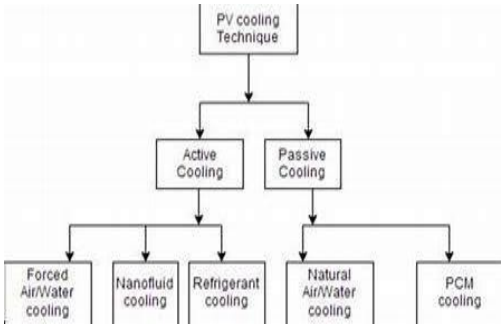

Fig 7 Flowchart Proposed System

Fig 8 System Hard ware

Fig 9 Solar Charge Controller

Fig 10 Temperature shown on LCD display

Conclusion & Future scope

In conclusion, the implementation of solar panel cooling systems utilizing Peltier cooling modules presents a significant advancement in the field of solar energy technology. By effectively regulating the temperature of solar panels within optimal limits, these systems offer a range of benefits including improved efficiency, extended lifespan, cost savings, and environmental sustainability.

Through the integration of advanced control algorithms and monitoring capabilities, solar panel cooling systems provide precise temperature control and efficient cooling, ensuring maximum energy output and reliability across various applications. From residential rooftop installations to large-scale solar farms, these systems offer versatile solutions to enhance the performance and viability of solar energy systems in diverse contexts.

Furthermore, the deployment of solar panel cooling systems contributes to the broader goals of transitioning towards renewable energy sources and reducing greenhouse gas emissions. By optimizing the efficiency of solar energy generation and minimizing reliance on fossil fuels, these systems play a crucial role in advancing environmental sustainability and combating climatechange.

In conclusion, solar panel cooling systems represent a promising technology with significant potential to

revolutionize the solar energy industry. Through ongoing research, development, and deployment efforts, these systems will continue to play a vital role in accelerating the adoption of solar energy.

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of theATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano farad capacitor. When this line is asserted taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB)

References

1. Rajatabh Agarwal, Boominathan P," Solar panel System Using IoT Application", IRJET, Volume 05, Issue 04, Apr- 2018.
2. A. Z. Loko, A. I. Bugaje, Usman Abdullahi," Microcontroller Based Solar Panel on Washing and Cleaning System", International Journal of Engineering Trends and Technology, Volume 29, NO 3 November 2015.
3. Priti K Powale, G. N, Zade," Real time Solar Panel Water Cleaning micro controller", international journal of advance research in computer science and management studies, Volume 2, Issue 1, January 2014.
4. Mr. Raj Rai, Prof. Dinesh Katole, Miss. Nayan Rai," Survey paper on Solar Panel Fan Control system", international journal of emerging trends & technology in computer science (IJETICS), Volume 3, Issue 1, January - February 2014.
5. C Saikrishna Prasad*, U. Sravan Kumar M.Tech, Dr.M.Narsing Yad av M.S., PhD (U.S.A), " Advanced Solar Panel Cooling System", IJESMR,January 2016.

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

Biography

Mrs.G.Suseelamma received Mtech (Electronics&Communication Engineering) from Acharaya Nagarjuna University, Andhra Pradesh, India in the year 2009, Btech (Electronics & Communications) Degree from RVR&JC Engneering College,Andra Pradesh, India in the year 2005. She is currently working as Associate Professor in ECE, Tirumala Engineering College, Narasaraopet. Andhra Pradesh. She research interests are Wireless Communications & Networks, She is having 10 years of Teaching Experience. She is a life member of technical association IETE.

S.Nagendra Reddy pursing B.Tech in Electronics & Communication Engineeri ng at Sai Tirumala NVR Engineering College Narasaraopet, Andhra Prade6sh .

M.Vyshnavi pursing B. Tech in Electronics & Communication Engineering at Sai TirumalaNVR Engineering College Narasaraopet, Andhra Prades.

E.KrishnaReddy pursing B. Tech in Electronics & Communication Engineering at Sai Tirumala NVR EngineeringCollege.Narasaraopet,And hra Pradesh.

CH.Ramudu pursing B. Tech inElectronics & CommunicationEngineering at Sai Tirumala NVR EngineeringCollege.Narasaraopet,An dhra Pradesh.