IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

Volume 13, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.317

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304035 |

Automatic Solar PV Module Cleaner

K.Kranthi, B.Pavan Kumar Reddy, CH.Ajay Babu , B.Sai Pavan , M.Gopi Chand

Assistant Professor, Department of Electrical & Electronics Engineering, Usha Rama College of Engineering & Technology, Krishna, Andhra Pradesh, India.

U.G. Students, Department of Electrical & Electronics Engineering, Usha Rama College of Engineering & Technology, Krishna, Andhra Pradesh, India.

ABSTRACT: The efficiency of solar panels is crucial for maximizing energy production, and one significant factor affecting their performance is the accumulation of dirt and dust on their surfaces. This abstract presents an overview of automatic solar module cleaners, focusing on their design, functionality, and impact on solar panel efficiency. These systems utilize various mechanisms such as robotic arms, brushes, or water jets to remove debris from solar panels without the need for manual intervention. By implementing these automated cleaning solutions, solar panel owners can significantly improve energy output, reduce maintenance costs, and prolong the lifespan of their photovoltaic systems. This paper discusses the technological advancements, economic feasibility, and environmental benefits associated with automatic solar module cleaners, highlighting their role in advancing the adoption of solar energy as a sustainable power source.

KEYWORDS: Arduino Uno (At Mega 328), Motor Drive L293D, RTC(DS1307), Limit Switch ,12v Battery, DC Gear Motors.

I.INTRODUCTION

In the quest for sustainable and efficient energy solutions, solar power stands out as a promising option. However, the effectiveness of solar panels can be compromised by the accumulation of dust and dirt. To address this challenge without relying on water-based systems, innovative solutions have emerged in the form of **automatic solar module cleaners.**

Automatic solar module cleaners represent a technological breakthrough designed to maintain solar panel efficiency without the need for water-based cleaning methods. These systems employ a variety of mechanisms, such as brushes, air blowers. By avoiding water usage, these cleaners offer several advantages, including reduced environmental impact, lower operating costs, and increased compatibility with arid or water-scarce regions. Moreover, they eliminate the need for water infrastructure and minimize the risk of water-related damage to solar panels and surrounding equipment.

Through advancements in robotics, sensors, and materials science, automatic solar module cleaners can intelligently adapt to varying environmental conditions, optimizing cleaning schedules and methods for maximum effectiveness. This autonomous approach not only enhances solar panel performance but also reduces maintenance requirements and enhances the overall reliability of solar energy systems.

As the demand for sustainable energy solutions continues to grow, the development of waterless automatic solar module cleaners represents a significant step forward in the advancement of clean energy technologies, offering a greener, more efficient alternative for maintaining solar panel efficiency.

II.BLOCK DIAGRAM

The below block diagram is Advanced Solar Module Cleaner. When the supply is given Arudino board the components will get energized . the all components are get works the wiper starts cleaning the module.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304035 |

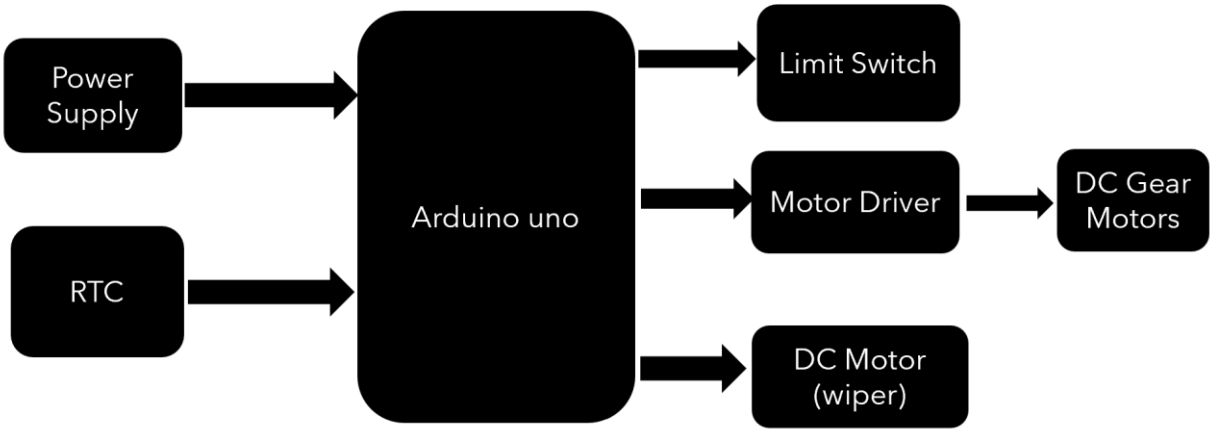


Figure 1: Block Diagram of Automatic Solar Module Cleaners.

III. COMPONENTS

(i) ARDUINO UNO

Arduino is an open-source hardware and software platform that simplifies the process of creating interactive electronic projects. It provides a range of microcontroller boards and a development environment for writing, compiling, and uploading code to these boards**.** Its simple programming language, extensive community support, and vast ecosystem of add-on modules (shields) make it accessible for beginners while also offering enough flexibility for advanced projects.

(ii) MOTOR DRIVE

A motor drive is a device or circuitry that controls the speed, direction, and torque of an electric motor. The controller interprets signals from a microcontroller, sensors, or other inputs, and adjusts the power stage to regulate the motor's operation.

(iii) REAL-TIME CLOCK (RTC) MODULE (DS1307)

The DS1307 Real-Time Clock (RTC) module provides accurate timekeeping functionality, allowing the project to keep track of time with precision. Featuring a low-power, clock/calendar chip, the DS1307 module offers seconds, minutes, hours, day, date, month, and year information.

(iv) LIMIT SWITCH

A limit switch is an essential device used in machinery and automation to detect the presence or position of an object. It ensures precise control over motion and prevents overtravel. A limit switch consists of a housing, an actuator, and electrical contacts.

(v) GEAR MOTORS

Gear motor is a type of electric motor that incorporates a gear train to provide mechanical advantage. It actually combines an electric motor with a gearbox to produce high torque or low speed, making it suitable for various applications where high torque and low speeds are required.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304035 |

IV.PROJECT MODEL

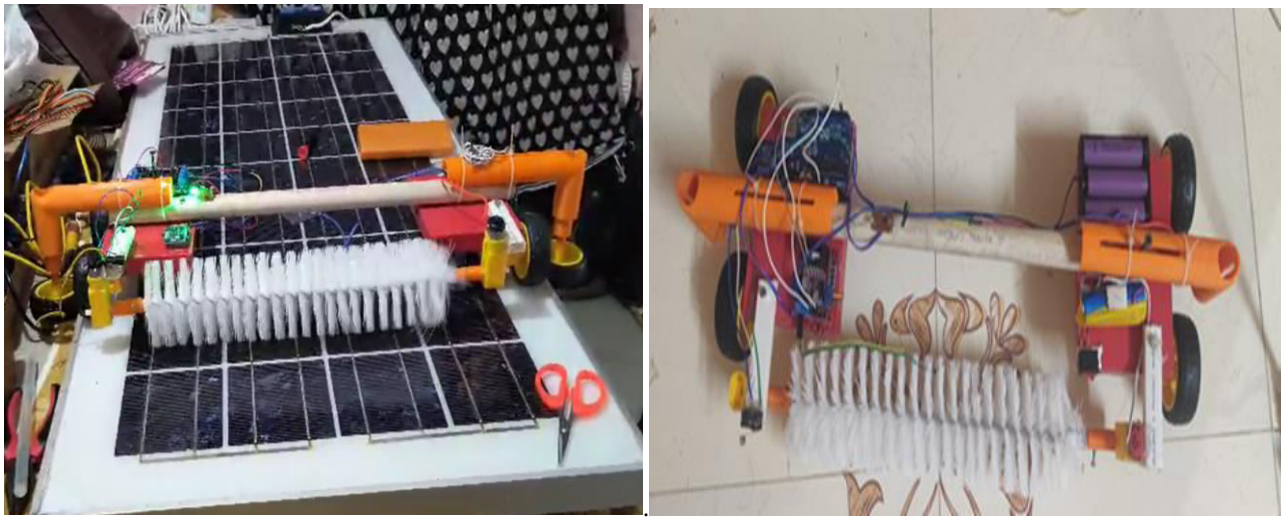


Figure 2: Hardware Kit of Automatic Solar PV Module Cleaner

This is the Automatic Solar PV Module Cleaner by using this we can clean solar module efficiently. By using of wipers and DC motors. These components will playing key role in this project..

V. CODE

```
#include <Wire.h>
#include <RTClib.h>
#include <L298N.h>

RTC_DS1307 rtc;

// Pin definition for motor control
const unsigned int IN1 = 7;
const unsigned int IN2 = 8;
const unsigned int EN = 9;
const unsigned int MANUAL_SWITCH_PIN = 2; // Pin connected to the manual switch
const int ledPin = 13;   //the number of the LED pin
const int ldrPin = A0;  //the number of the LDR pin

// Create one motor instance
L298N motor(EN, IN1, IN2);

void setup() {
  Serial.begin(9600);
```

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304035 |

```
  Wire.begin();

  pinMode(MANUAL_SWITCH_PIN, INPUT_PULLUP); // Configure the manual switch pin as input with internal pull-up resistor
  pinMode(ledPin, OUTPUT);  // Initialize the LED pin as an output
  pinMode(ldrPin, INPUT);   // Initialize the LDR pin as an input

  if (!rtc.begin()) {
    Serial.println("Couldn't find RTC");
    while (1);
  }

  // Check if RTC is running before adjusting the time
  if (!rtc.isrunning()) {
    Serial.println("RTC is NOT running!");

    // Adjust the date and time
    rtc.adjust(DateTime(2024, 4, 11, 20, 11, 0));
  } else {
    Serial.println("RTC is running!");
  }

  // Set initial speed for the motor
  motor.setSpeed(100);
}

void loop() {
  DateTime now = rtc.now();

  // Print current date and time from RTC
  Serial.print("Current time: ");
  printDateTime(now);

  // Check if the current time is 10 AM or manual switch is pressed
  if ((now.hour() == 10 && now.minute() == 0) || digitalRead(MANUAL_SWITCH_PIN) == LOW) {
    // Tell the motor to go forward
    motor.forward();
```

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304035 |

```
  // Print the motor status in the serial monitor
  printMotorInfo();
 } else {
  // Stop the motor
  motor.stop();
 }

 // Read the LDR value
 int ldrStatus = analogRead(ldrPin);

 // Print LDR value
 Serial.print("LDR value: ");
 Serial.println(ldrStatus);

 // Check LDR status and control LED accordingly
 if (ldrStatus <= 300) {
  digitalWrite(ledPin, HIGH); // Turn LED on
  Serial.println("LDR is DARK, LED is ON");
 } else {
  digitalWrite(ledPin, LOW); // Turn LED off
  Serial.println("LDR is BRIGHT, LED is OFF");
 }

 // Wait for a brief moment before proceeding to the next iteration
 delay(1000);
}

/*
Prints the date and time to the serial monitor.
*/
void printDateTime(DateTime dt) {
 Serial.print(dt.year(), DEC);
 Serial.print('/');
 Serial.print(dt.month(), DEC);
 Serial.print('/');
 Serial.print(dt.day(), DEC);
 Serial.print(' ');
 Serial.print(dt.hour(), DEC);
```

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

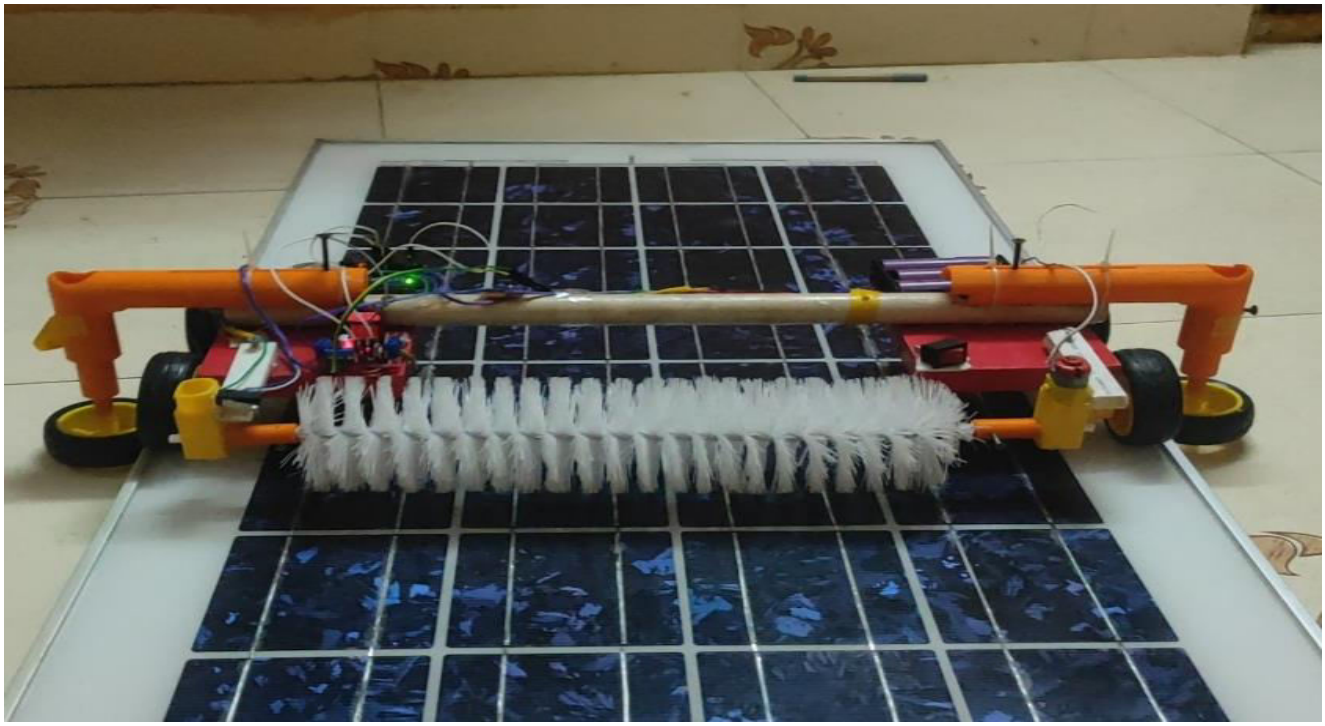
||Volume 13, Issue 4, April 2024||

| DOI:10.15662/IJAREEIE.2024.1304035 |

```
  Serial.print(':');
  Serial.print(dt.minute(), DEC);
  Serial.print(':');
  Serial.print(dt.second(), DEC);
  Serial.println();
}

/*
Prints the motor status to the serial monitor.
*/
void printMotorInfo() {
  Serial.print("Motor is moving = ");
  Serial.print(motor.isMoving());
  Serial.print(" at speed = ");
  Serial.println(motor.getSpeed());
}
```

VI.RESULT



| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 4, April 2024||

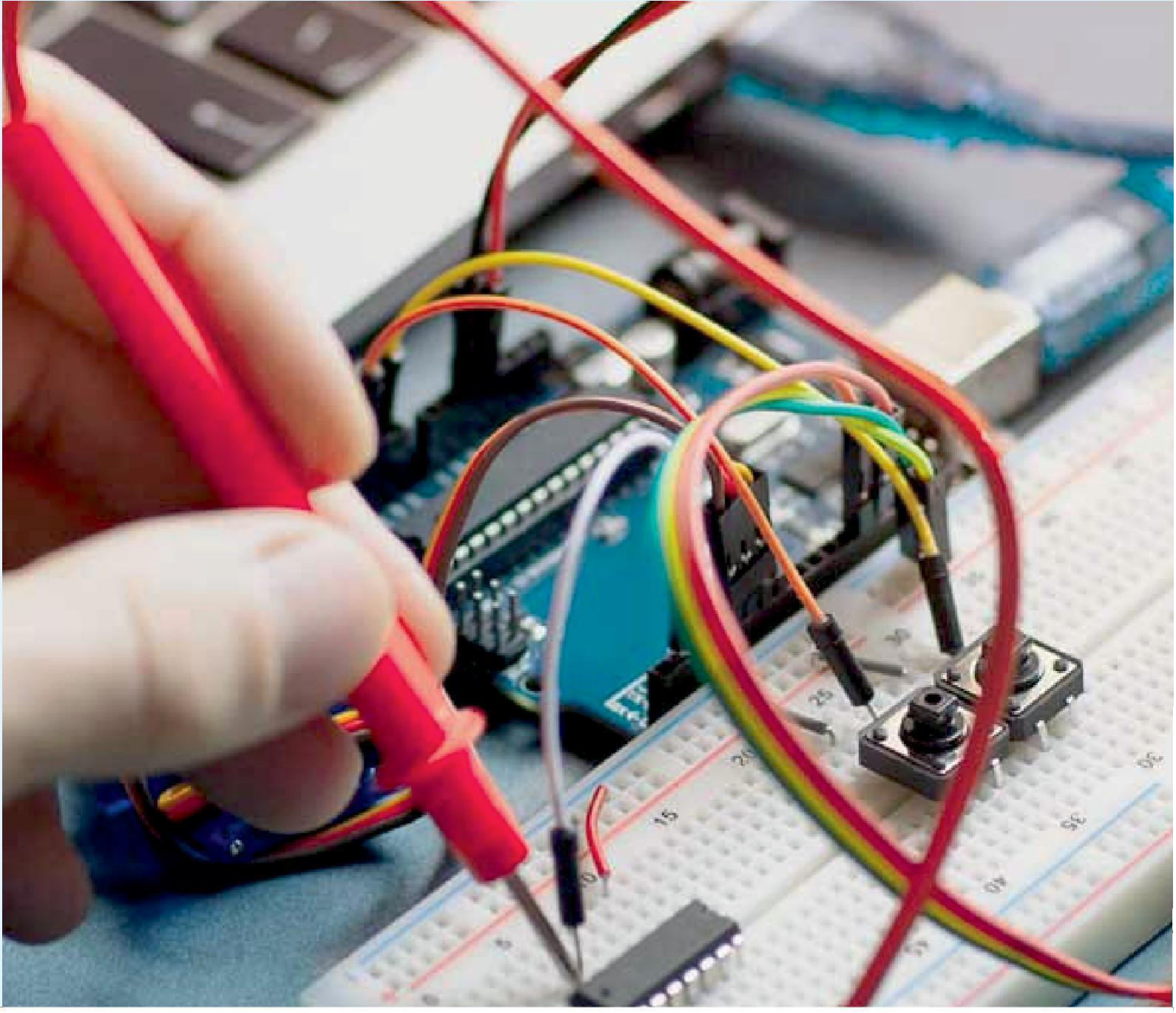
| DOI:10.15662/IJAREEIE.2024.1304035 |

VII. CONCLUSION

In this paper, an automatic solar panel cleaning system is proposed and built with easily available components. The proposed system is inexpensive and does not require any water to do the cleaning operation. Thus, wastage of water is avoided here. And this feauture makes this system applicable in the desert areas and where no water source is available. This proposed cleaning system is based on wiper . This feature ensure the safety of the panel because any type of scratch is not seen duting the experimental tests. Experimentally the cleaning system is capable of serving its purpose.

REFERENCES

[1] Website: https://www.venturesolar.com/blog/the-importance-of-solar energy/ [Accessed: 30- Oct.- 2020].
[2] A. Chandramouli and V. Sivachidambaranathan, “Extract Maximum Power from PV System Employing MPPT with FLC Controller,” J. Elect. Eng. Automation, vol. 1, pp. 58-71, 2019.
[3] X. Liu, S. Yue, L. Lu, and J. Li, “Investigation of the Dust Scaling Behaviour on Solar Photovoltaic Panels,” J. Cleaner Production, 2021, 126391.
[4] J. Zorrilla-Casanova et al., “Analysis of dust losses in photovoltaic modules,” World Renew. Energy Cong. 2011 – Sweden, Linköping, Sweden, May 8-11, 2011, pp. 2985-92.
[5] N. Sugiartha et al., “Preliminary design and test of a water spray solar panel cleaning system,” J. Physics: Conf. Series, vol. 1450, 012108, Feb. 2020.
[6] A. S. Alghamdi, A. S. Bahaj, L. S. Blunden, and Y. Wu, “Dust removal from solar PV modules by automated cleaning systems,” Energies, vol. 12, pp. 1-21, 2019.
[7] K. P. Amber et al., “A self-cleaning device for pole mounted solar photovoltaic installations,” Thermal Science, vol. 23, no. 2A, pp. 739 49, 2019.
[8] Syafaruddin, F. A. Samman, Muslimin, and S. Latief, “Design of automatic control for surface cleaning system of photovoltaic panel,” ICIC Express Letters, Part B: Appl., vol. 8, no. 11, pp. 1457-64, 2017.
[9] H. Kawamoto, “Electrostatic cleaning equipment for dust removal from soiled solar panels,” J. of Electrostatics, vol. 98, pp. 11-16, 2019.
[10] M. Mazumder et al., “Characterization of electrodynamic screen performance for dust removal from solar panels and solar hydrogen generators,” IEEE Trans. Ind. Appl., vol. 49, no. 4, pp. 1793-1800, 2013.



INNO SPACE
SJIF Scientific Journal Impact Factor

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

9940 572 462 6381 907 438 ijareeie@gmail.com

Scan to save the contact details