An intelligence technique to maximize power generation using solar panel and its maintenance

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ABSTRACT

The Earth receives the maximum amount (174 Peta Watts) of radiation from the upper atmosphere. Approximately 30% is reflected to space while the remainder is absorbed. Solar energy is an alternate for fossil fuels because it is non-polluting, clean, reliable, and renewable source of energy. It does not pollute the air by releasing harmful gases to the environment like carbon dioxide, nitrogen oxide or Sulphur oxide. So, the risk of damage is reduced. Thus, the utilization of solar devices was more suggested and therefore the traffic light and streetlights in villages was installed using solar array, but the solar PV modules are generally employed within the dusty environments and therefore the dust gets accumulated on the front surface of the module and blocks the incident light form the sun and it reduces the facility generation capacity of the module, the power output reduces if the module is not cleaned for a frequently.

In order to regularly clean the dust, this research presents a control application of a sun tracker that can follow the sun with high accuracy and clean the dust on the panel without requiring a precise process of installation or recalculation. The designed tracking system include sensors, microcontroller, drivers for dc motors and gear-bearing arrangements with supports and mountings. DC motor is used to move the system panel in order that sun's beam is in a position to stay aligned with the solar array and also clean the dust on the panel by wiping the panel using wipers which improves the efficiency of the solar array. Simulation and experimental results are obtained from a low-cost single axis solar tracker and exposed. Energy saving factors are taken under consideration, which means that, among other factors, the sun is not constantly tracked with an equivalent accuracy, to stop energy over consumption by the motors.

Keywords: Arduino IDE,Light Dependent Resistor (LDR),Servomotor,Arduino/Genuino Uno, Dust sensor,AI based cloud.

Introduction

Fixed solar panels are not directly directed at the sun due to the constant movement of the earth. As the result the facility produce by this device is not the utmost it should produce. The best solution for this system to get the maximum output power is to use solar tracking system. This is the primary reason for the solar tracker project. Is made. The solar tracker will follow the sun's light for greater output power. To overcome this problem, we are using a dust sensor to detect the dust on the solar panel. So, dust sensor will detect the dust on the solar panel and the wipers will be automatically activated.

A solar energy system converts Sunlight into electricity utilizing, e.g., multiple mounted arrays spaced in a grid on the ground. The solar cell network has a special optical size and is assembled for unitary motion on a traverse of a vertical support which follows the Sun.The chart can include sub-layouts, sections, modules and/or panels.

The amount of power generated by the array is directly associated with the quantity of Sunlight impinging upon the con stituent Solar cells. It is highly advantageous, it is therefore very advantageous to direct the array in such a way that the plane of the array (of lenses and solar cells) is orthogonal to the incoming sun, and therefore the

power generation is maximized. To that end, a Solar tracking mechanism is used that ensures that the plane of concentrator lens leads to a beam projected on the middle of the respective Solar cells in an ongoing manner because the Sun traverses the sky during the day, thereby optimizing the quantity of Sunlight impinging upon the cells.

Literature Review

- Tracking of Sun for Solar Panels and Real Time Monitoring Using LabVIEW-Bipin Krishna, Manipal Institute of Technology, Department of Instrumentation & Control. Sun is a very abundant source of power. Even so, only a fraction of the entire energy is harnessed and that too not efficiently. The main cause of this is the high cost of installation of solar cells. Also, solar cells are mostly kept fixed, so they do not obtain the optimum amount of sunlight throughout the day. The development of a simple process to track the sun and attain maximum efficiency using Microcontroller and LabVIEW for real time monitoring.
- Microcontroller based Automatic cleaning of Solar Panel -S. B. Halbhavi-Department of Electrical & Electronics Engineering, Gogte Institute of Technology, Belgaum Karnataka, India. The solar PV modules are generally employed in dusty environments which is the case in tropical countries like India. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun.
- A Performance Analysis of Brushless DC Motor by using PID Controller-Kautik R. Patil-PG Student, Department of Electrical Engineering, Matsyodari Shikshan Sanstha's, College of Engineering and Technology Nagewadi, Jalna. Increase in need of industry for high productivity is placing new demands on mechanisms connected with electrical motors. This leads different problems in operation due to fast dynamics and instability. The stability of the system is essential to work at desired set targets.
- Self-Cleaning and Tracking Solar Photovoltaic Panel for Improving Efficiency- Bandam Abhilash, Department of Electrical Engineering Indian Institute of Technology, Bombay Powai, Mumbai-400076- Electricity is one of the basic necessities of mankind. As the demand of electricity is increasing, there is need to exploit renewable sources of energy. power shortage in India, the use of solar energy could be beneficial to great extent.

Methodology

In this project an Arduino Uno is employed, which works as a controlling unit. Two LDR's (Light Dependent Resistor) are connected to the analogue pins on the Arduino. One dummy solar plate is attached parallel to the servo axis and both sensors are attached to the dummy solar plate.

The Arduino IDE supports C and C++ languages by means of specific code structuring rules.

The Arduino IDE provides a software library of the cabling project, which provides numerous common entry and exit procedures. The user-written code only needs two basic functions, to launch the drawing and also the main loop of the program, which are compiled and linked with a stub main()program in a cyclical monitoring executable program with the GNU toolchain, also included in the IDE distribution. The Arduino IDE uses the avrdude program to convert the executable code into a file into hexadecimal encoding that's loaded into the Arduino board by a charger program within the board's firmware.

The Concept of Using Two LDRs is to stable position is when the 2 LDRs having the identical intensity level. When the sunshine source moves, i.e. the sun moves from west to east, the amount of intensity falling on both the LDRs changes and this alteration is calibrated into voltage using voltage dividers. The changes in voltage are compared using built-in comparator of microcontroller and motor is used to rotate the device during how so on target the sunshine source.Servo motors are used for various applications. they're normally small in size and have good energy efficiency. The servo circuit is constructed inside the motor and is delivered with a position shaft equipped with a gear. The motor is controlled with an electrical signal that determines the number of shaft movement.

Data Analysis

The student team originally developed six plans. Using the feasibility criteria listed above, a feasibility analysis was carried out to determine whether each of the proposed alternatives was feasible. Only three designs were considered feasible and are presented here. Each of the three design alternatives requires a fair amount of work to assemble. They each have tracking mechanisms to track the sun as well as the ability to harness energy from the sun, and we are using a dust sensor to detect the dust on the solar panel. So that when dust sensordetects the dust on the solar panel and the wipers will be automatically activated.

BLOCK DIAGRAM

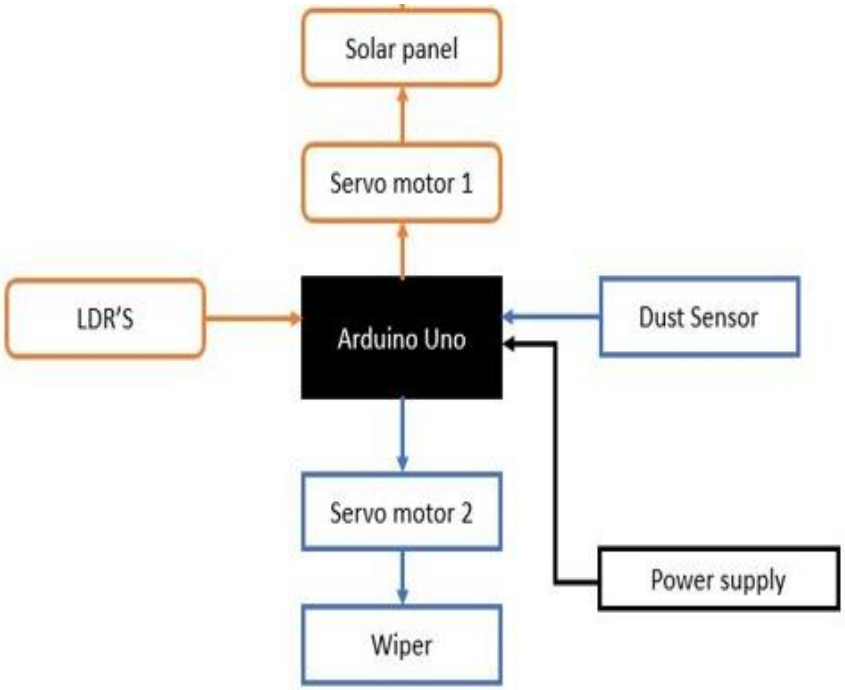

Fig 1. Block diagram of the system

Maintenance

A few of the simplest places to gather solar power also are a few the dustiest on Earth. Dust from pollution and traffic that fall on the solar array surface prevents the daylight from reaching the solar cells. The efficiency of solar array gets affected due to the presence of dust particles. While many factors affect what proportion of electricity your solar panels will produce, dusty solar panels are often one among the most important, and easiest to repair. Experts have agreed that dusty solar panels do not produce the maximum amount power as clean panels. The power output of the solar panel decreases up to 50% because of the dust accumulation. A solar array cleaning system is proposed to form a solar array operate at the simplest power generation state, while the solar array is employed in dusty environment.

This system consists of a Dust sensor and wiper unit. The Dust sensor can detect dust and smoke particles in the environment, when the dust is detected above or equal to the threshold value the wiper will be activated. A windshield wiper is attached to the actuator for linear movement to effectively remove the dust layer from the solar module surface. It is a lightweight and compact cleaning technique.

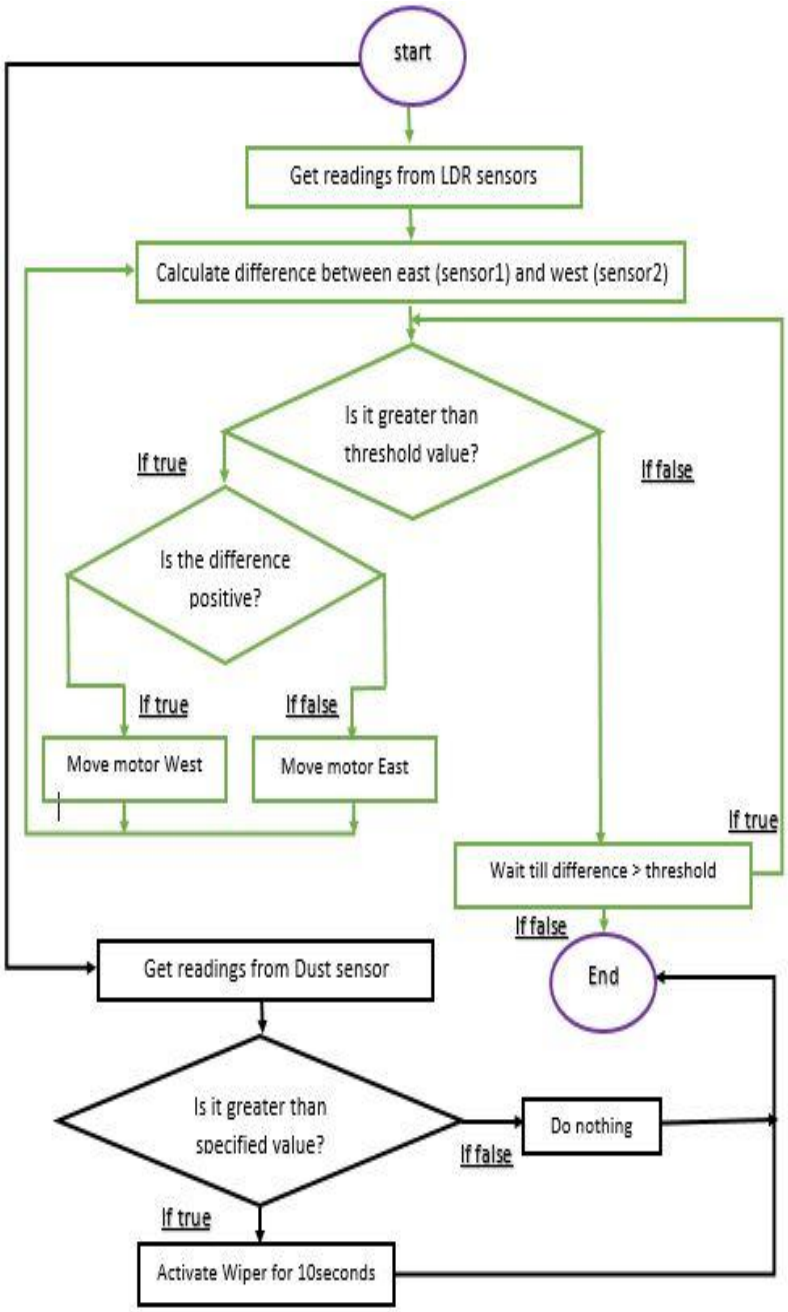

Fig2.Procedure Flow 1: Working of solar tracker and dust sensor.

- **Cloud Computing:** The next wave of intelligent cloud-based technologies is emerging, including the Internet of Things (IoT), machine learning and artificial intelligence. Combined with smart technologies and digital business services, cloud computing can propel businesses towards a new level of competitiveness.
- If LDR or Dust Sensor gets damaged, then it will affect on the tracker and the tracker will stop working. So, to resolve this problem we are using Artificial Intelligence system which will decide either tracker need to get Sensor values or need to obtain the data from the cloud.

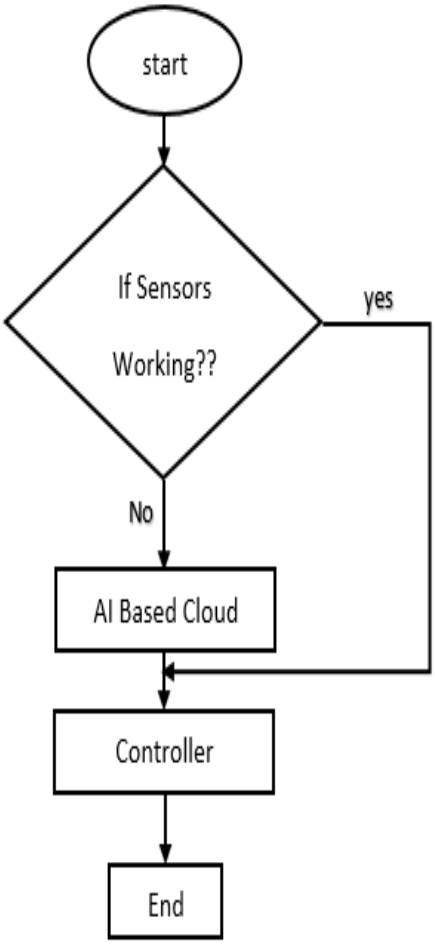

Fig3. Procedure Flow 2: Using cloud to get data if sensors are damaged.

Conclusion and Results

The use of the Arduino board reduced the cost of building the system without relying on complex, expensive and bulky proprietary infrastructure.The Arduino board, which belongs to a family of low-cost control systems, has also been shown to be extremely energy efficient. The one-axis solar tracking with the self-maintenance algorithm improved the power generated by the solar panel with a 34% efficiency improvement.The study concluded that it is very important to follow the sun at a high level of precision to improve the absorption of solar radiation.The algorithm developed has the advantage of space savings over the addition of solar panels to enhance the energy produced. The use of the Arduino board reduced the cost of building the system without relying on complex, expensive and bulky proprietary infrastructure.

A self-maintenance tracking system for solar panels has been designed and installed. The aim of the solar panel tracking system is to track the position of the sun for better efficiency of the solar panel has shown in the tables below. This system is adaptable to meet the needs of small-scale energy production and the needs of a large solar power plant.

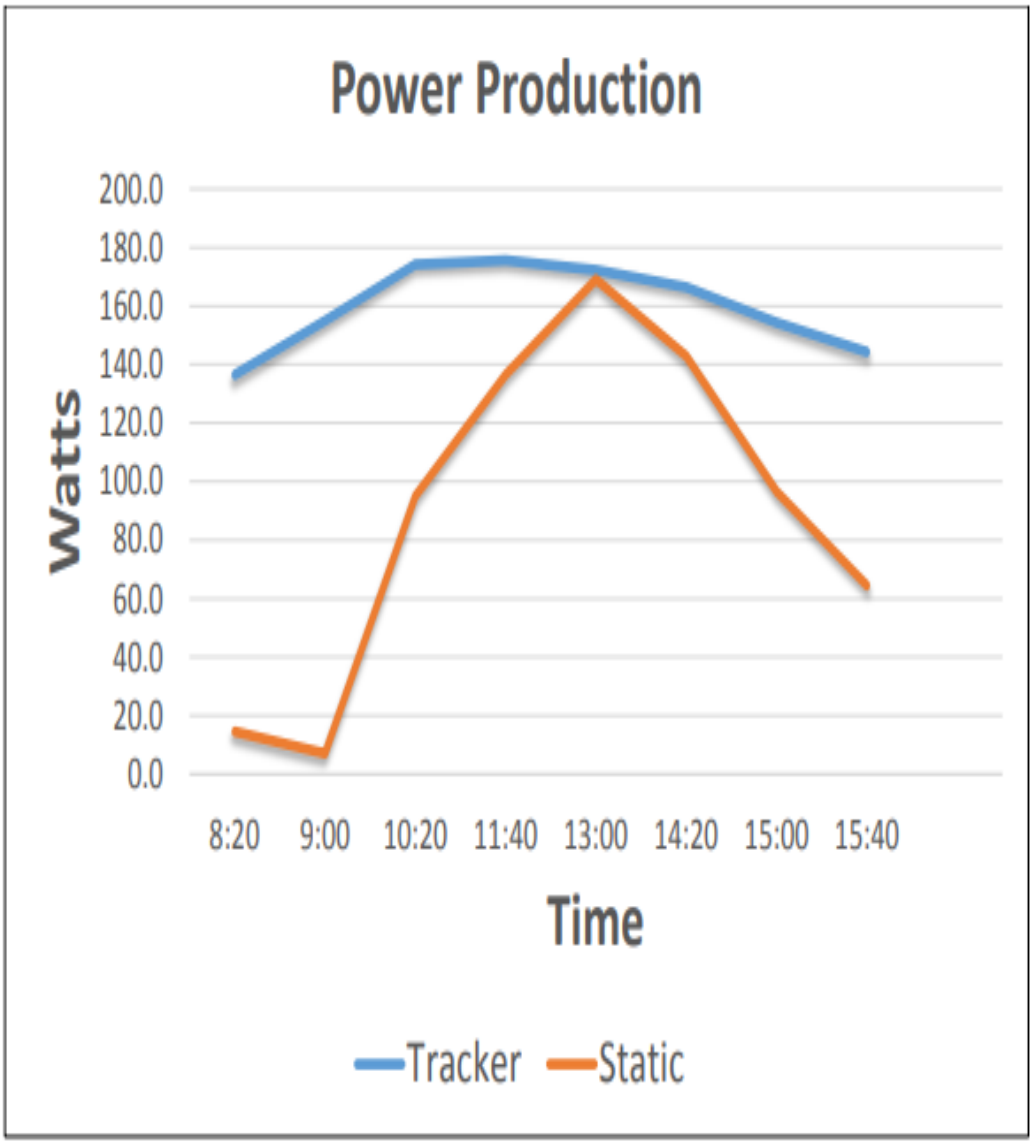

Fig 4.Static versus tracker

PERCENTAGE GAIN IN ENERGY OUTPUT	
CASE 1 (fixed solar cell)	14.7
CASE 2 (Trackable solar cell with accumulated dust)	15.8
CASE 3 (Trackable solar cell with self mainteinance)	30.6

Table 1: Power gain when panel is clean.

Parameters	***Description***	***Output***	***Measured readings/movement***
Light-dependent resistors (LDR)	These are light-sensitive devices most commonly used to indicate the presence or absence of light, or to measure light intensity.	The LDR are used to track the motion of the sun in an east/west direction.	East- 0^o to 90^o West- 90^o to 180^o Varies between 0^o to 180^o depending on the sun's position
Dust Sensor	It is a simple air monitoring module with board Sharp GP2Y1010AU0F. It is able to detect fine particles of more than 0.8 µm in diameter, even as cigarette smoke. The analogue voltage output from the sensor is linear with a dust density.	It will detect the density of the dust.	Air Quality (ug/m^3) 35 - Excellent 80 - Average 115 - Light Dust 135 - Moderate Dust 238 - Heavy Dust >300 - Serious Dust

Table2.SensorswiththeirOutputs

FromTable2, LDRs will be used as the main light sensors. Servo motor is fixed to the base that holds the solar array. LDRs sense the quantity of sunlight falling on them. Two LDR's are divided as left and right LDR's.For east to west tracking, the analog values from left LDR and the right LDR are compared and if the left LDR receives more light the right LDR, then servo motor will move in that direction. If right LDR receive more light, then servomotor will move in that direction.

The dust detector can detect dust and smoke particulates in the environment. It consumes very little energy while operating, making it ideal for a permanent monitoring system.

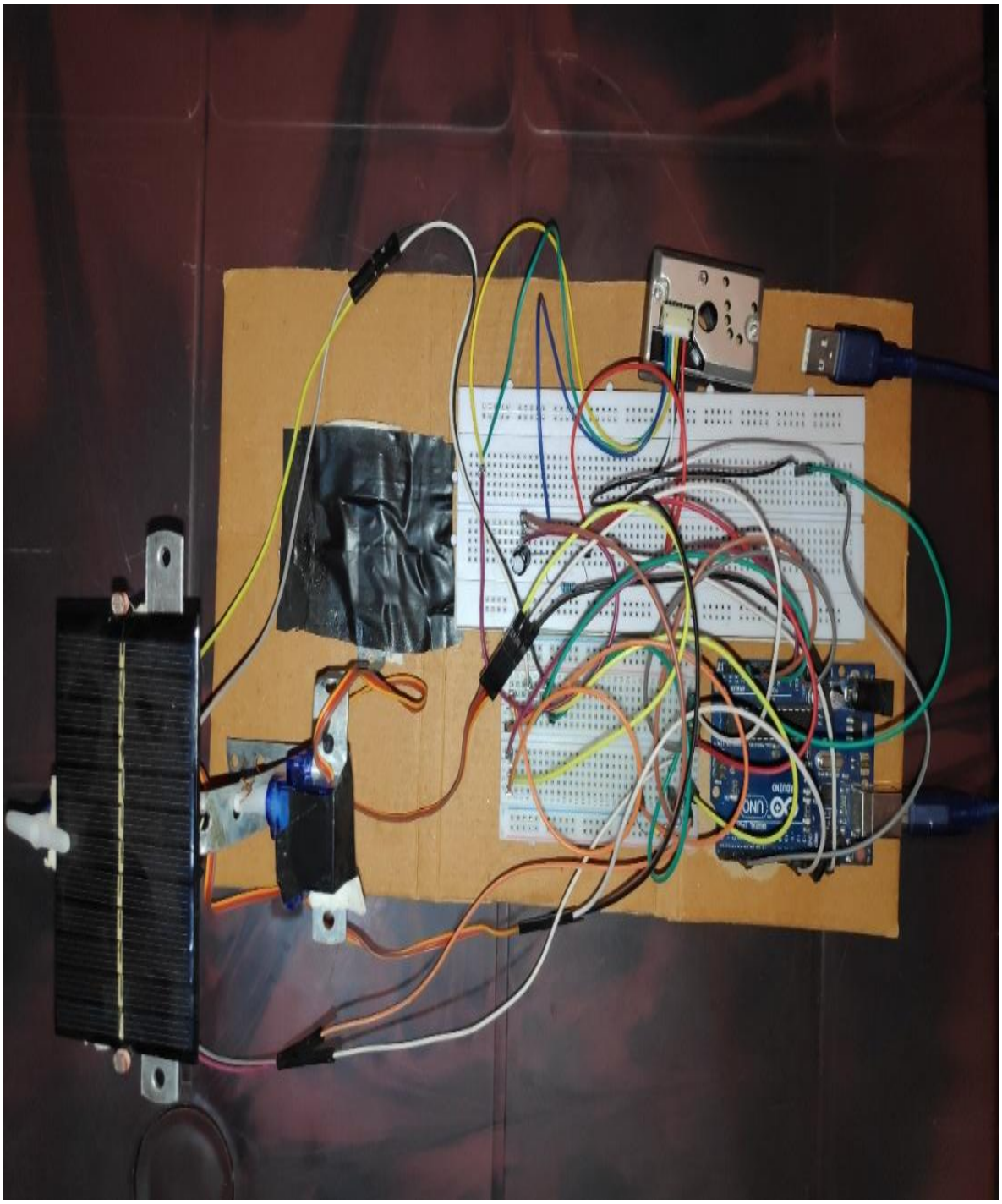

Fig – Demo Model of Self Maintenance Solar Tracking System

Limitations and Future Studies

Since the proposed prototype is a miniature of the main system, it presents certain limitations that may be mitigated by future developments.A little cardboard is turned in the system and 12v solar panel is used for analysis. As a miniature system, it works out well.A larger solar panel must be integrated in the system to prepare a better analysis of results and costs. It has been proven through our research and statistical analysis that single-axis solar tracking system with self-maintenance can increase energy output by approximately 34%. Other mechanical improvements can be made to the prototype, to implement the dual-axis follow-up.

Applications

- Solar tracker can be installed for residential purposes. Since, it collects more power throughout the day, it is economically efficient for household purposes compared to other means of energy sources.
- It can be most reliable and durable source for harnessing sun's power for agricultural purposes. Farms can produce more crops due to efficient use of solar energy.
- It can even be used in Hospitals, Schools and colleges, Police stations and other places as a alternative source of energy by harnessing the solar energy effectively.
- It is even eco-friendly, because solar energy is a renewable source of energy and has no effect on nature. It is inexhaustible.
- Solar trackers have many more applications like it can be used in producing electricity, nuclear and hydro power plants, water heaters and so on.

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