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Improve The Effectiveness In The Solar Tracking System Using Nodemcu Microcontroller

Dr.V.Shanmugasundaram[1], Anjali Nighoskar[2], Sampathkumar R[3], Dr C Balakrishnan[4], K.Suresh[5], Dr Sudharsan Jayabalan[6]

[1]*Assistant Professor, Department of EEE, Sona College of Technology ,Salem, Tamil Nadu-636005*
[2]*Assistant Professor, School of Engineering and Technology, Jagran Lakecity University, Mugaliyachap , Ratibad 462044.*
[3]*Assistant professor (Sl.G), Department of EEE, KPR Institute of Engineering and Technology, Coimbatore-641407*
[4]*Assistant Professor, Alagappa Institute of Skill Development, Alagappa University, Karaikudi-63003.*
[5]*Associate Professor, Hyderabad Institute Of Technology And Management, Gowdavelly(Village), Medchal-501401.*
[6]*Associate Professor, Department of Electronics and Communication Engineering, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad-500090, India*

Abstract
Solar energy is the only renewable energy that has swiftly acquired reputation and relevance. We can create a large quantity of energy using the solar tracker, which increases the efficiency of the solar panels. The effectiveness of the solar panel is due to its parallel proportion with the sun's beams. Financially, its setup fee is expensive, especially when cheaper alternatives are available. The planning and engineering method of a model for a solar tracking system with a fixed dimension of flexibility are explained in detail in this work. The NodeMcu microcontroller is used in the primary control circuit. The programming of this system is done in such a way that the LDR sensor, in response to the identification of sun rays, will guide the DC Motor in the position in which the solar panel would rotate. The solar panel is then positioned in such a way that it receives the large quantities of sun rays possible. Even though a boost in solar panel effectiveness resulted in a significant gain in ineffectiveness, the ideal was still a long way off.

1. INTRODUCTION

The Sun had long been regarded as a vital source of energy. Solar energy is a more eco-sustainable source than its rivals. The growth of technology has resulted in the development of ways for putting this energy into productive usage. It might be thermal energy, fuel generation. Photovoltaic (PV) and focused solar power (CSP) systems convert solar energy captured by the earth into electricity. The nationalized solar power is used by the solar tracking device through a channel of solar panels, an aligned scaffolding of photo-voltaic cells [1]. Solar cells made of materials other than silicon are somewhat more expensive to manufacture, making silicon the ideal material for solar tracking systems [2]. Amorphous silicon cells can operate at high temperatures, although their effectiveness is lower than other silicon types. [3]. The PV units are grouped in a solar panel or a PV array in such a way that photons are used to excite the electrons of the material contained within the solar cells. The average quantity of sunlight obtained by solar panels is determined by the sun's location [4].

The manipulation of the energy source is encouraged because of the numerous blooming ways in which it may be utilized to push for a change in the conservation of other resources [5]. The mechanism is responsible for providing precise motions to follow the sun's path during the day. The device's prototype has been designed to endure adverse weather conditions. The solar tracking system's operation is divided into two categories: linear scale tracker and dual-axis sensor [6]. In terms of small-scale solar power plants, single-axis monitoring might be regarded as one of the useful systems or a primary option. The tracker is set up to track a single row of data. The many configurations where a single axis tracker can be constructed are described below. All of the techniques that are maintained have the same basic operation. The relationship of the sunlight with the collectible surface is calculated and evaluated, and the collectors are then charged with tracking the sun's motion to capture a higher proportion of solar radiance [7].

2. IMPLEMENTATION

The "Automatic Solar Tracking System" project is created by assembling different components such as a solar panel with a 12-volt output, a NodeMcu as an MCU, a motor controller – an IC L293D, two LDR sensor modules, a 10 r.p.m. basic DC motor, a current sensor, and a 9 V batteries. The stated project's structure is made up of a wooden foundation put on the ground, iron rods fastened on both sides in a cross-shaped way, and a hollow cylindrical rod connected on both sides with a Motor drive clinging to one edge of the hollow rod. The circuit of the solar tracking system is broken into three parts. The input stage contains two LDR modules that are arranged to form a voltage divider circuit, the microcontroller is programmed using the Arduino ide software that is installed in the system, and the drive circuit, which includes a DC motor, aids in the rotation of the solar cell. The motor driver is equipped with three terminals: two for motors outputs and inputs, and a third for power input. The motor input module is connected to two of the Arduino UNO's 14 digital input/output pins, while the motor output circuit is connected to the DC motor. With NodeMcu analog inputs, the two LDR sensor components are attached to the scaffolding. The light-dependent resistors are therefore attached to each surface of the panel along its span. Figure 1 displays the NodeMcu Pin Diagram.

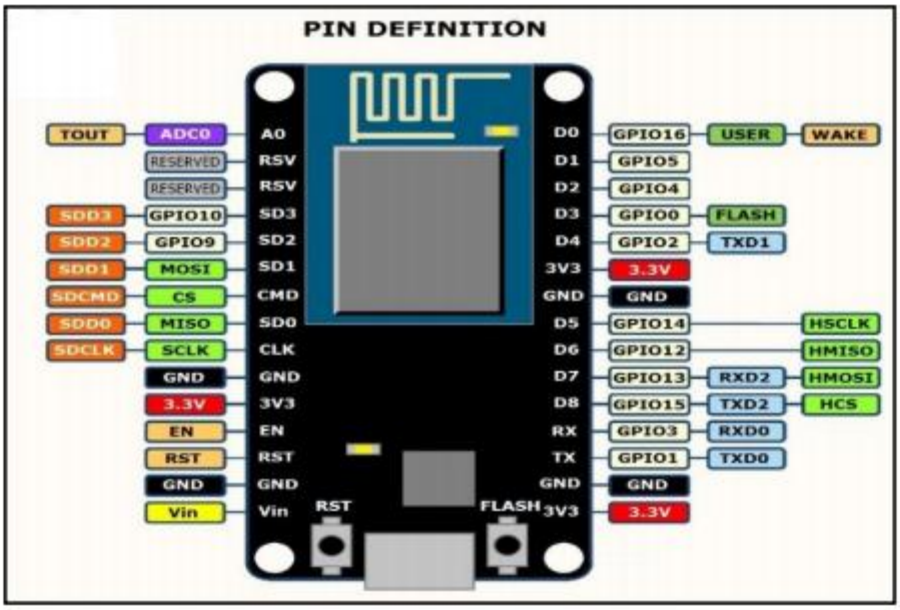

Figure 1 NodeMcu Pin Diagram

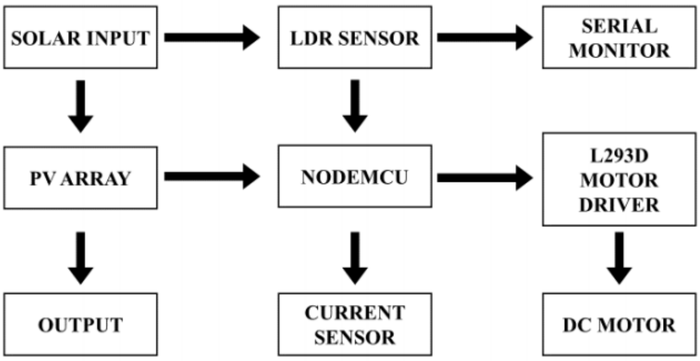

Figure 2 Sketch of Automatic Solar Tracking setup

The embedded software is composed of a basic hardware language is called processing, which is comparable to the C language put into the Arduino UNO. Three separate phases are engineered individually before being merged into one device. This method, which is comparable to incremental refinement in modular programming, was chosen because it ensures a precise and logical approach that is basic and easy to comprehend. This often guarantees that any faults are thoroughly investigated and remedied separately. The block diagram of the Automatic Solar Tracking setup is shown in Figure 2

3. WORK DESIGN

The Controlling Circuit

A microcontroller is used in the controlling circuit. The controller is programmed with a technique that compares and detects the direction of the highest light intensity. The picture sensor inputs are processed by the microprocessor, and the results are sent to the driving module after calculation. NodeMcu, an IoT-based system, is the microprocessor we utilize in our architecture. Figure 3 shows the circuit diagram for the solar tracking system.

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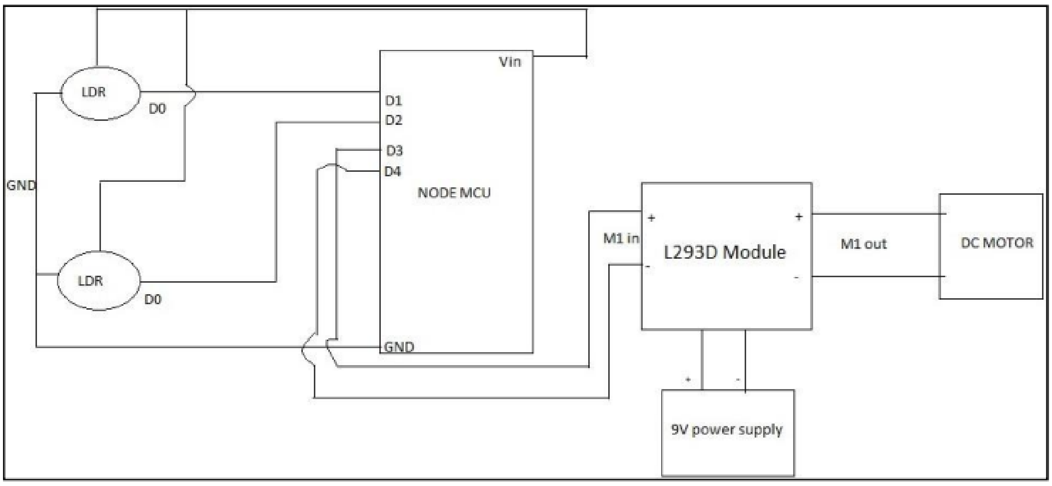

Figure 3 Circuit Diagram

Software Design

The controller is programmed using an IoT platform. In the Arduino Integration Development Environment, the methodology is created (IDE). The setup's upload frequency is increased at 9600, and it's linked to the ESP8266 board's COM5. Figure 4(a-c) shows the various set up of the NodeMcu controller for the solar tracking system.

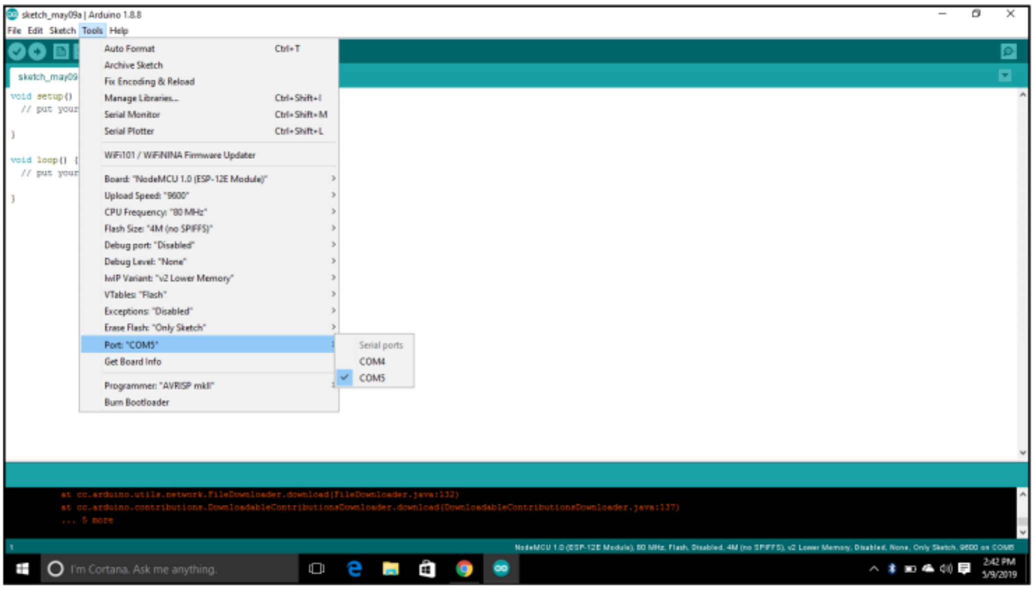

Figure 4(a): Arrangement of NodeMcu - Port link

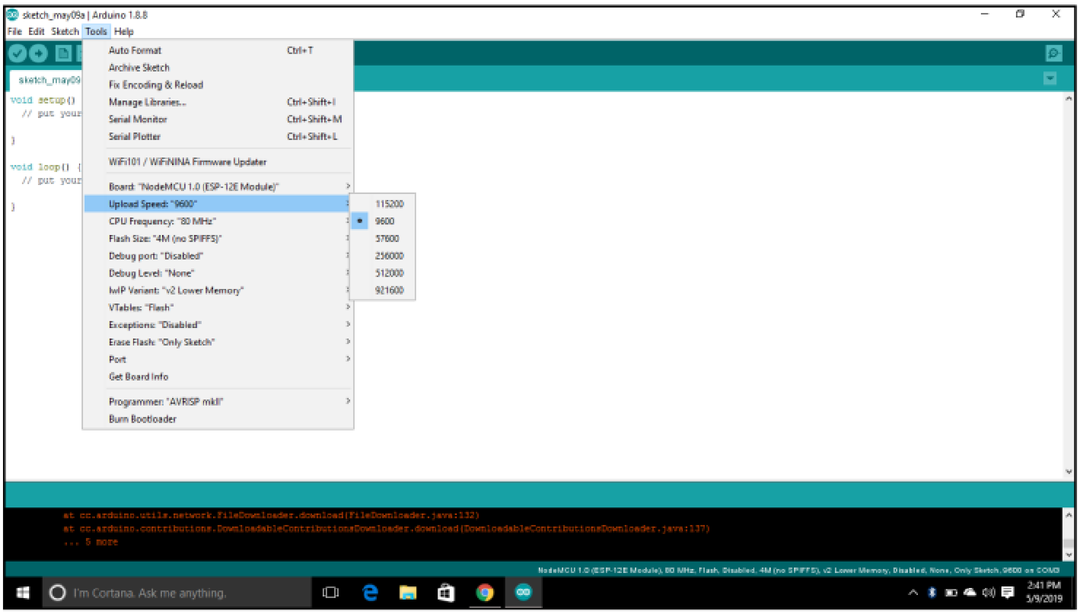

Figure 4(b): Arrangement of NodeMcu – Speed

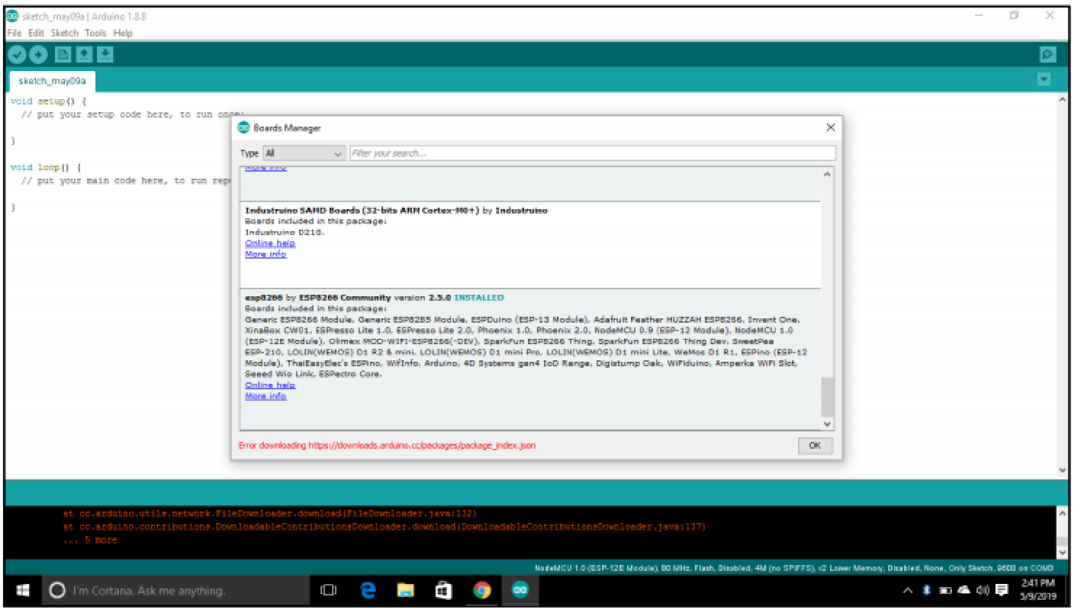

Figure 4c): Arrangement of NodeMcu - Installing Library

4. EXPERIMENT RESULTS

The project's results were derived using LDRs for the solar tracking system and the fixed-position panel. The findings were kept track of for 4 days, then tallied. The LDRs' output is determined by the amount of light falling on their surfaces. Arduino features a USB monitor that connects with the computer through USB and digital pins 0 and 1. Pins 0 and 1 can be utilized for digital output devices if these functionalities are used. The built-in serial monitor in the Arduino environment may be used to interact with the NodeMcu board. To gather the data, a model was implemented that allowed data from the LDRs to be collected each hour.

Table 1(a) Photovoltaic array at sunny day ; (b) LDR observations on a cloudy day; (c) LDR observations on a bright sunny day

Time (Hrs) PV	Array Output (V)	LDR Outputs for a cloudy day		LDR outputs for a bright sunny day	
		LDR1(V)	LDR2 (V)	LDR1(V)	LDR2 (V)
0800	8.05	0.21	0.22	1.56	1.55
0900	8.85	0.51	0.51	2.90	2.91
1000	9.34	1.88	1.67	3.21	3.33
1100	9.98	1.6	1.88	3.97	3.78
1200	10.56	1.99	1.86	4.22	4.54

At the specified intervals, the values from the two LDRs must be read and recorded. The LDRs detect the intensity of light and so provide a reliable estimate of the amount of electricity that reaches the solar panel's area. The solar panel's power production is directly proportional to the wavelength.

Tables 1 show that the greatest sunshine occurs around midday, with maximum values between 1200 and 1400 hours. The amount of sunlight decreases in the mornings and afternoons evening, and the obtained results are lower than those obtained during the day. The monitoring system is turned off after sundown. In the morning, it is turned back on. The LDR readings for the screen equipped with the monitoring sector are designed to be near. It is because an error is created anytime they are in various locations, allowing it to move. When the readings are the same, the panel stops moving, indicating that the LDRs get the same amount of sunshine. Since the panel is in a static position, the numbers for the fixed panel fluctuate. The LDRs do not always face the sun at the same inclination. Except for midday, when they are nearly perpendicular to the direction. The days with the least amount of cloud cover have the maximum light intensity, so the LDR outputs will become the maximum. Whenever it's sunny, the monitoring system works best. It will be able to catch the majority of solar energy and turn it into electricity. In terms of solar panel power production for monitoring and stationary systems, it is obvious that the tracking system would produce more electricity. This is because the amount of energy created by solar cells is proportional to the amount of light available. The higher the luminous source, the more electricity the photovoltaic system will create.

5. CONCLUSION

Each day brings a new task of incubating anything new and unique, requiring energy to be the ultimate source of motivation for all the hard effort. It would be more appropriate to show that commercialization has spread its wings to a degree in the pursuit of money and power that we now find ourselves in a pool of severe ignorance of the planet's resource constraints, as a result of which the whole globe has been injured. Healing the planet is the foundation cultivation with which the hour clock is ringing, and this work provides the eye, as a result, to open the corridors of decreasing pollution in the storage of energy harvested from the Sun, as well as to crank up the speed of progress.

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