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Integration of Sun and Wind Tracking System Devices using Arduino

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Abstract

This article explains how to design and build a solar tracking system with Arduino. This method captures free solar energy, stores it in a battery and then converts it into alternating current. As a result, energy can be used as an independent energy source in ordinary homes. The system is designed to respond to its environment in the shortest possible time. Hardware and software issues will be investigated and corrected if necessary. The responsiveness, reliability, stability, and real-time security of our systems have all been tested. The architecture of the system is highlighted, emphasizing resistance to weather, temperature and some minor mechanical influences.

1. Introduction

Solar energy is an endless supply of power that, if managed wisely, can enable mankind to stop relying on traditional energy sources, as it has done for a very long time [1][2]. This project was created with a more effective utilization of solar energy in mind.

2. Materials and Methods

The solar tracking system consists of a solar panel, an Arduino microcontroller and sensors. For this system to work, there must be light emission through the sun. The LDR acts as a sensor to detect the intensity of light entering the solar panels. The LDR then sends the information to the Arduino microcontroller. The servo motor circuit is then built. The servo has 3 pins with anode connected to the +5v of the Arduino microcontroller. The negative pole of the servo is grounded. The data point on the servo is connected to the analog point on the microcontroller. The wind turbines will act as the backup system for light the emergency light if the power from the battery running out.

2.1 Materials

2.1.1 Solar Panel

A photovoltaic module is a connected, bundled arrangement of solar cells that is generally 6x10 in size. A photovoltaic system's photovoltaic array, which generates and distributes solar power for use in both commercial and residential applications, is made up of photovoltaic modules. Each module is given a rating based on how well it performs in standard tests for its DC output, which normally varies from 100 to 365 watts (W). An 8% efficient 230 W module will have double the size of a 16% efficient 230 W module. Module efficiency influences the area of the module with the same nominal power. A few of these are commercially accessible solar modules with efficiencies above 22% and maybe even 24%. A single solar module can only provide a certain quantity of electricity; thus, most setups use numerous modules. A photovoltaic system typically includes several solar modules, an inverter, some storage batteries, interconnecting wire, and an optional sun tracking device. Water heating systems using solar energy are the most popular use of these panels.

2.1.2 Arduino Uno

Due to the ATmega328, the Arduino Uno is a microcontroller board (datasheet). It includes an state-of-the-art 16 MHz resonator, 6 basic information sources, 14 computerized input/output pins (6 of which can be used as PWM outputs), USB connections, power connector, ICSP header and reset button. It includes everything needed to support the microcontroller; basically, power it with an AC-DC adapter or a battery to start it up or connect it to a PC via a USB link. The USB-Serial FTDI driver chip is not used on the Uno which is why it is different from all previous boards. Instead, it has a modified Atmega16U2 (or Atmega8U2 up to the R2 variant) to act as a USB to serial converter.

2.1.3 Light Dependent Resistor (LDR)

A photonic resistor or photocell is a light-sensitive resistor made of two materials: cadmium sulfide (CdS) and gallium arsenide (GaAs). For light detection, the solar tracking framework described here uses two cadmium sulfide (CdS) photovoltaic cells. The photovoltaic cell is an inactive component whose protection is proportional to the amount of light hitting it. It is connected in series with a capacitor. The photovoltaic cell used for monitoring equipment is defined by its ability to protect against deterioration and by its ability to protect against immersion. The term "light immersion" means that increasing the amount of light emitted by CdS cells will no longer reduce their ability to protect. Daylight brightness is about 30,000 lux and light output is measured in Lux.

2.1.4 Servo Motor

A digital servo motor with metal gears is called an MG996R. Despite being contained in a small space, the servo has a high-stall torque of 11 kg/cm. Because it is an enhanced version of the MG995, you can typically find this motor in a variety of appliances. Because of the improved features, the servo motor is more precise and effective. A new design and system for the PCB and IC's shock-proofing are among these features.

2.1.5 Wind Turbines

Wind turbines are machines that use the kinetic energy of the wind to produce electricity. The horizontal-axis wind turbine (HAWT), which has vertical blades installed on a horizontal shaft, is the most prevalent kind of wind turbine. The most popular kind of wind turbine in use today is the HAWT. By utilizing the proper rectifier circuit, wind turbines may generate voltages of up to 20 volts, which is their maximum voltage.

2.2 Methods

Fig. 1 shows the flowchart that concentrates on the sensing unit, which is derived from the LDR sensor on the solar panel. The flowchart will demonstrate how the system works in order to collect data. And the wind turbines will serve as a backup for the system's emergency lighting.

2.3 Block Diagram

According to this block diagram in Fig. 2, the wind turbine is connected to the rectifier, also known as the wind turbine charges controller, before transmitting the charges to the battery bank. This is done to prevent the battery bank from becoming overcharged. Because solar panels cannot store power and can only provide direct current from panels to loads, they are connected to the pwm charge controller before being connected to the battery bank. In addition, because the charges from the battery bank are direct currents, an inverter must be installed before using domestic equipment.

According to Fig. 3, the solar panels are obscured by servo motors using LDR sensors that are controlled by an Arduino microcontroller.

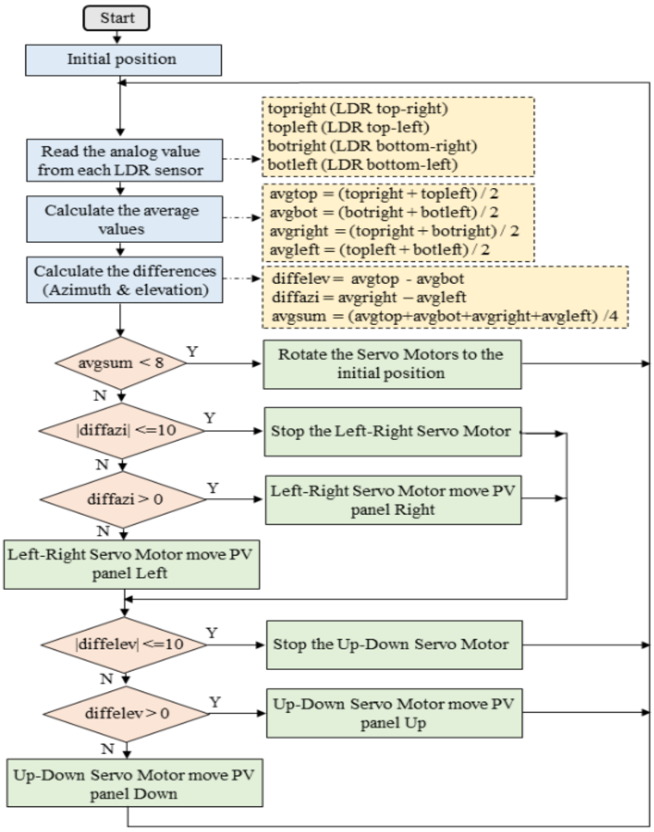


Fig. 1 *Solar Tracking System Flowchart*

Fig. 2 *Solar and Wind Tracking System Block Diagram*

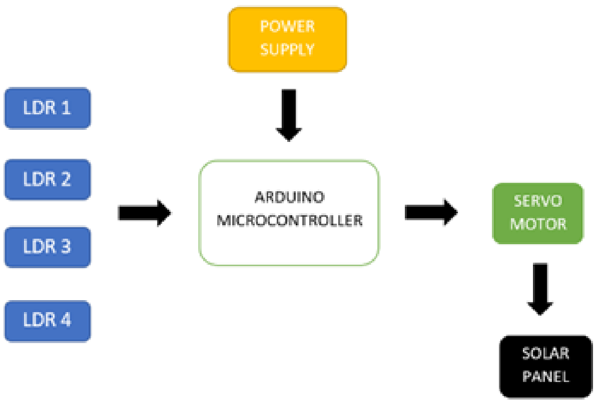


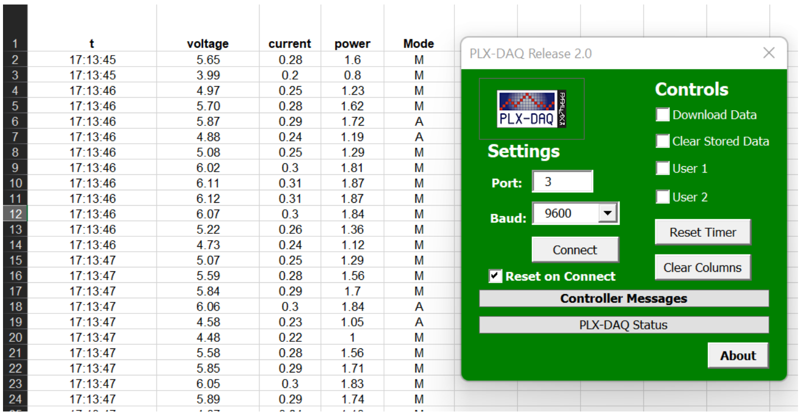
Fig. 3 *Solar Tracking System Block Diagram*

3. Result and Discussion

This section will go through the proposed research design. This research is divided into two important parts for the pre-develop phase: the design analysis for integration of sun and wind tracking system. This is important to investigate whether the system can work as it is designed. The mechanism of the system which control by using servo motor from Arduino also have been observed. After finally done the system of the integration of sun and wind, the design of the sensing unit which using LDR sensor have been done. Finally, the result of the voltage value of the light will be send to the PLX-DAQ in other to get the real time reading. After finally complete all important element, the integration of sun and wind tracking system is developed.

3.1 Results

Fig. 4 shows the data that been collected by LDR sensor using PLX-DAQ spreadsheet. From the excel spreadsheet, there are voltage value, current value and the power value that have been collected.



	t	voltage	current	power	Mode
2	17:13:45	5.65	0.28	1.6	M
3	17:13:45	3.99	0.2	0.8	M
4	17:13:46	4.97	0.25	1.23	M
5	17:13:46	5.70	0.28	1.62	M
6	17:13:46	5.87	0.29	1.72	A
7	17:13:46	4.88	0.24	1.19	A
8	17:13:46	5.08	0.25	1.29	M
9	17:13:46	6.02	0.3	1.81	M
10	17:13:46	6.11	0.31	1.87	M
11	17:13:46	6.12	0.31	1.87	M
12	17:13:46	6.07	0.3	1.84	M
13	17:13:46	5.22	0.26	1.36	M
14	17:13:46	4.73	0.24	1.12	M
15	17:13:47	5.07	0.25	1.29	M
16	17:13:47	5.59	0.28	1.56	M
17	17:13:47	5.84	0.29	1.7	M
18	17:13:47	6.06	0.3	1.84	A
19	17:13:47	4.58	0.23	1.05	A
20	17:13:47	4.48	0.22	1	M
21	17:13:47	5.58	0.28	1.56	M
22	17:13:47	5.85	0.29	1.71	M
23	17:13:47	6.05	0.3	1.83	M
24	17:13:47	5.89	0.29	1.74	M

Fig. 4 *The data from LDR sensor using*

3.2 Graph

Fig. 5 shows the graph of the data that been collected into a presentable form to apply the differences of the current and power that be captured.

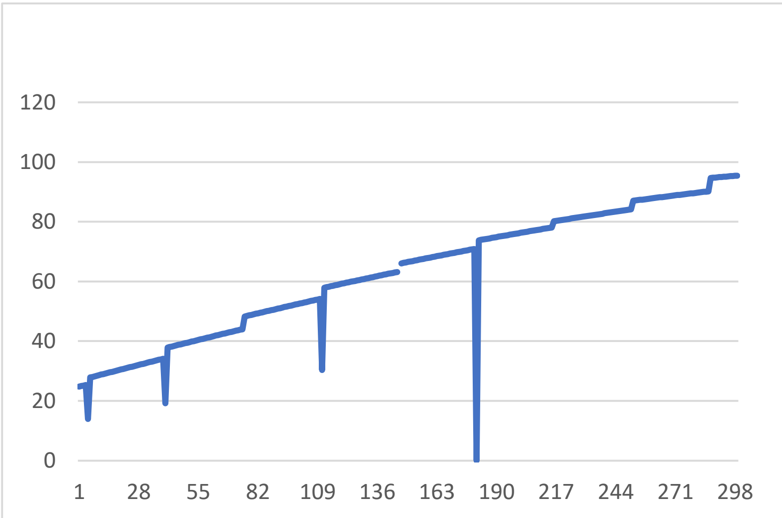


Fig. 5 *Current vs. Power*

4. Conclusion

The Arduino solar tracker has been designed and integrated into the work in progress. LDR light sensor is used to detect the intensity of sunlight impacting the photovoltaic panel. The findings of this project are summarized as follows: the current tracking system was successful in identifying the light source, even if it was light from a flashlight, in a dark room or the rays of the sun. The cost and reliability of this solar tracker makes up for in rural use. The purpose of renewable energy from this article, he came up with a new and advanced idea to help people.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors attest to having sole responsibility for the following: planning and designing the study, data collection, analysis and interpretation of the outcomes, and paper writing.

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