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Solar Tracker using Arduino and Servo Motor

[1]V Kumar, [2]Y Maniteja Reddy, [3]P Meghana, [4]M Prashanth, [5]J Srilakshmi

[1,2,3,4,5] Dept. of Electrical and Electronics Engineering, Teegala Krishna Reddy Engineering College, Hyderabad, Telangana, India

ABSTRACT:

In this project we make a Arduino Based Solar Tracker using Arduino& Servo Motor.The solar panel tracker is designed to follow the sun movement so that maximum light intensity hits on solar panel. Thus, increasing the power efficiency. In this we have designed single axis solar tracker system. In this system the solar panel moves from east to west in a day to point in the direction of the sun. Use of solar tracker circuit in the field of energy production will increase its efficiency. This system can also be successfully implemented in other solar energy based projects like water heaters, and other solar devices.

Keywords*: Solar panel, Arduino, Servomotor*

I. INTRODUCTION

An Electrical Motor is a machine that converts electrical energy into mechanical energy. It is used for generating torque to lift loads, move objects & various other mechanical works.

An electrical motor is mainly classified into three types.

AC Motors

DC Motors

Special Motors

AC MOTOR:

The AC electric motor converts AC (Alternating Current) electrical energy into mechanical energy.

The basic working principle of AC motor is the rotating magnetic field (RMF) generated by the stator winding when an alternating current is passed through it.

The AC motors are further classified into two types.

Synchronous Motor

Asynchronous or Induction Motor[1]-[3]

DC MOTOR :

The DC motor is another main type of electrical motor that only runs on DC or Direct Current.

The basic working principle of DC motors is the Fleming's left hand rule. A current carrying conductor inside a magnetic field experience a force of thrust mutually perpendicular to each other. The DC motors can be briefly classified into following types, Brushed DC Motor, Brushless DC Motor, Coreless or Ironless DC Motors

Special Motors

There are several types of special electric motors that are the modified versions of other motor designed for special purposes. Some of these electric motors are given below. Servo motor, direct drive Linear motor, Stepper motor and Universal motor [3]-[5]

II. SERVO MOTORS

A servo motor is a rotational or translational motor to which power is supplied by a servo amplifier and serves to apply torque or force to a mechanical system, such as an actuator or brake. Servo motors allow for precise control in terms of angular position, acceleration, and velocity. This type of motor is associated with a closed-loop control system. A closed-loop control system considers the current output and alters it to the desired condition. The control action in these systems is based on the output of the motor. It uses a positive feedback system to control the motion and final position of the shaft.[6]

There are two types of current flow in these motors – AC and DC. AC servo motors can handle higher current surges and are thus more commonly found in heavy industrial machinery. ISL's DC Servo Motors are best suited for smaller applications and have excellent control-ability and feedback. In a servo motor speed is determined by the frequency of the applied voltage and the number of magnetic poles.

There are different types of servo motors are there they are:

1. ac servo motor
2. dc servo motor
3. positional rotation servo motor
4. continues rotation servo motor
5. Linear servo motor

SG 90 SERVOS MOTOR

Micro Servo Motor SG90 is a tiny and lightweight server motor with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos.

Fig 1

Table:1 SPECIFICATIONS:

Pulse Width	500µs - 2400µs
Rotation/Support	Bushing
Shaft Diameter	4.5mm
Speed	0.32 oz (9.0 g)
Torque	4.8V: 25.0 oz-in (1.80 kg-cm)
Gear Type	Plastic
Modulation	Analog
Motor Type	3 Pole Servo Motor
Range	180°
Phase Voltage	5V

MOTOR CONNECTIONS

Wire Color	Connection
Yellow	PWM
Red	Supply
Brown	Ground

III. ARDUINO BOARD

Arduino is a software and technology company. Its history is a bit of a complicated one. Nevertheless, Its origins span back to 2003 where a group of students established it. The initial purpose of Arduino boards was educational. Since then, the purpose has evolved to technology that helps facilitate the internet of things (IoT), embedded technology, and 3D printing. However, Arduino boards are still accessible to beginner electronics enthusiasts. One of the biggest advantages of using Arduino products for your project is the thriving community. Since the technology is open-source, it's a perfect breeding ground for mudding and collective advancement. You have a wealth of knowledge from some of the best software developers, designers, engineers, and other professionals when you go with Arduino. You can use them to produce simple daily objects or scientific instruments for mathematical operations and testing. They can run operating systems from Microsoft, Linux, and Windows. Furthermore, you can program the boards using the Arduino IDE and Arduino Language, which is a derivative of C/C++. You can then load the program code using one of Arduino's I/O ports.In the rest of this guide, we'll cover all the various Arduino's official boards you have at your disposal and how you can use them.[8]-[10]

Arduino Uno

Fig.2

The Arduino Uno is one of Arduino's most well-known microcontrollers. As with their other technology, it is completely open-source. The board has gone through three different revisions. Arduino Uno Rev 3 features ATmega328P architecture.In total, it has 14 digital I/O pins. Six of them facilitate pulse width modulation(PWM). Additionally, it has six analog input pins, a reset button, a power jack, a USB-B port, and 32 kilobytes of flash memory. Thousands of projects are achievable with the Arduino Uno. Some projects worth pursuing include motor control, a card reader, a handheld game console, and a digital compass.

Technical specifications

Microcontroller: Microchip ATmega328P[7]
Operating Voltage: 5 Volts

Input Voltage: 7 to 20 Volts

Digital I/O Pins: 14

PWM Pins: 6 (Pin # 3, 5, 6, 9, 10 and 11)[9]

UART: 1

I2C: 1

SPI: 1

Analog Input Pins: 6

DC Current per I/O Pin: 20 mA

DC Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB of which 0.5 KB used by bootloader

SRAM: 2 KB

EEPROM: 1 KB

Clock Speed: 16 MHz

Length: 68.6 mm

Width: 53.4 mm

Weight: 25 g

ICSP Header: Yes

Power Sources: DC Power Jack & USB Port

General pin functions

LED: There is a built-in LED driven by digital pin 13. When the pin is high value, the LED is on, when the pin is low, it is off.

VIN: The input voltage to the Arduino/Genuino board when it is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.

3V3: A 3.3 vol supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND: Ground pins.

IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source, or enable voltage translators on the outputs to work with the 5V or 3.3V.

Reset: Typically used to add a reset button to shields that block the one on the board.

Special pin functions

Each of the 14 digital pins and 6 analog pins on the Uno can be used as an input or output, under software control (using pinMode(), digitalWrite(), and digitalRead() functions). They operate at 5 volts. Each pin can provide or receive 20 mA as the recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50K ohm. A maximum of 40mA must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labeled A0 through A5; each provides 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of the range using the AREF pin and the analogReference() function.

In addition, some pins have specialized functions:

Serial / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL serial chip.

External interrupts: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM (pulse-width modulation): pins 3, 5, 6, 9, 10, and 11. Can provide 8-bit PWM output with the analogWrite() function.

SPI (Serial Peripheral Interface): pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK). These pins support SPI communication using the SPI library.

TWI (two-wire interface) / I²C: pin SDA (A4) and pin SCL (A5). Support TWI communication using the Wire library.

AREF (analog reference): Reference voltage for the analog inputs.[7]

Communication

The Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows serial communication on any of the Uno's digital pins. [11]

Automatic (software) reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board 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 the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip.

This setup has other implications. When the Uno is connected to a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened.

IV. SOLAR ENERGY

Solar energy is defined as the transformation of energy that is present in the sun and is one of the renewable energies. Once the sunlight passes through the earth's atmosphere, most of it is in the form of visible light and infrared radiation. Plants use it to convert into sugar and starches; this conversion process is known as photosynthesis. Solar cell panels are used to convert this energy into electricity.

Fig 3 PV panel

A **solar panel**, or **solar module**, is one component of a photovoltaic system. They are constructed out of a series of photovoltaic cells arranged into a panel. They come in a variety of rectangular shapes and are installed in combination to generate electricity.[2] Solar panels, sometimes also called photovoltaic collect energy from the Sun in the form of sunlight and convert it into electricity

When exposed to sunlight the photovoltaic cells in a solar panel receive energy which they absorb. They transfer the absorbed energy to the semiconductor which helps create an electric field which in turn delivers voltage and current. Voltage and current combine to deliver power as per the equation P (power) = V (voltage) x I (current). The power generated is measured in watts (W).

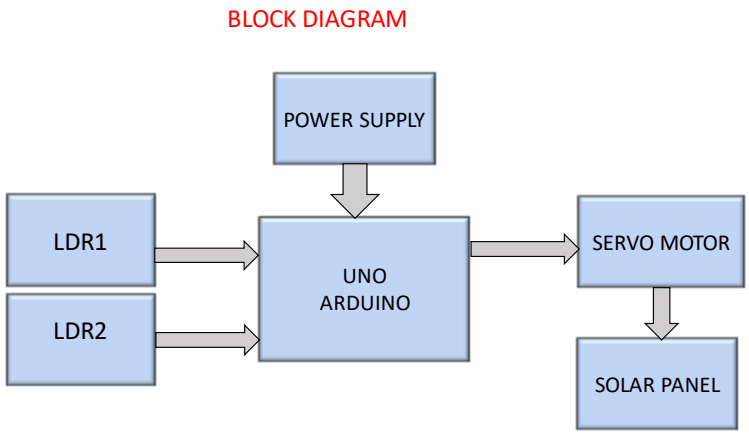

Fig.4 block diagram

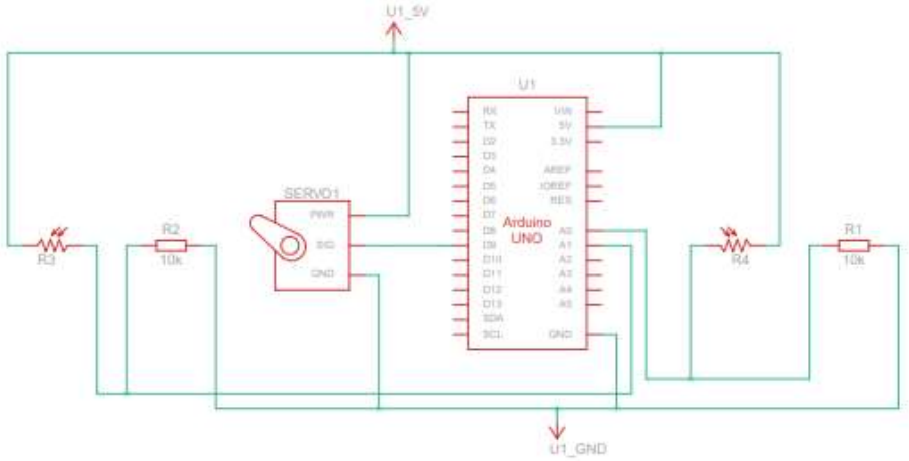

Fig.5 schematic diagram

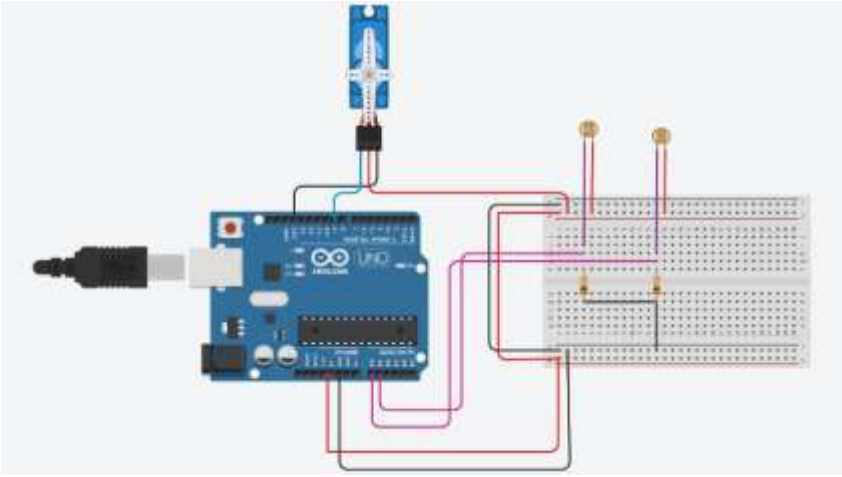

Fig.6 hardware diagram

V. CONCLUSION

This type of solar tracker is a more cost-effective choice than dual-axis trackers. It is easy to install compared to dual-axis trackers. This tracker requires a large space to accommodate. It has a better lifespan and fewer movable parts than the dual-axis tracking system. The design is user-friendly because it has fewer movable parts. Unlike rigid solar panels, these can move their angle to collect energy from the sunlight. This solar tracker can adjust in areas with less exposure to sunlight.

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