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Research Article

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DESIGN A SIMPLE SOLAR TRACKER FOR HYBRID POWER SUPPLY

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ABSTRACT

This paper presents a smart power supply by using solar energy as the sources. It reduces the use of fuel in order to achieve maximize generation of electricity (during day time). The project equipped with solar tracker device which is absorbs the ultraviolet (UV) from the sun in maximum condition. The tracker operates with dual axis rotation where it can be rotating with 360° or which is 180° vertical/horizontals. This circuit is activated when light dependent resistor (LDR) detecting the light where four sensors are placed at east, west, north and south position. The solar panel is embedded with gear system to control the speed of the tracker and also obtain full charge of the 12V rechargeable lead acid battery.

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The charge controller is used to control the load for operating the system and recharge the battery, it also to protect the battery from over charge.

Keywords: solar panel; solar tracker; hybrid; power supply; photovoltaic.

1. INTRODUCTION

Solar power is an alternative technology which can replace the dependency on petroleum energy sources. In tropical region (such as Malaysia), the sunshine is always directly overhead and its intensity do not vary by season. This offer wide advantage to use solar power to be compared with the country with variety season. On the other hand, the photovoltaic system converts directly the sun radiant into useful electrical energy, which can be used as most electrical energy for today. Solar power (photovoltaic) systems is a sustainable way to convert the energy of the sun into electricity. The expected lifetime of a system is about 10-15 years. The amount of power produced by a photovoltaic panel depends on the amount of sunlight exposed to the photovoltaic panel; unable to aim directly to the sun since to the constant rotation of earth. As the result, the power produce by the system is less than the photovoltaic panel capability. To overcome this problem, the tracking system is installed to make the panel continually adjusts by aiming the photovoltaic directly to the sun. As the result, photovoltaic panel capable to harvest the maximum amount of sunlight and produce power.

In previous research, many applications on solar tracker innovation in multi applications with different techniques and methods. For examples, a design of a novel passive solar tracker [1] and new solar tracker [2, 28, 32], a very simple solar tracker for space and terrestrial applications [3], a design of a solar tracker system for PV power plants [4], design, modelling and testing of a standalone single axis active solar tracker using MATLAB/Simulink [5], design, manufacturing and performance test of a solar tracker made by an embedded control [6], simulation of a dual-axis solar tracker for improving the performance of a photovoltaic panel [7], a multipurpose dual-axis solar tracker with two tracking strategies [8], Camtracker: A new camera controlled high precision solar tracker system for FTIR-spectrometers [9], a solar tracking system with high efficiency of solar panels [10], a low cost two-axis solar tracker with high precision positioning [11], a two axes solar tracker based on solar maps, controlled by a

low-power microcontroller [12], maximum collectable solar energy by different solar tracking systems [13], machine vision as a method for characterizing solar tracker performance [14], testing the new solar tracker with shape memory alloy actors [15], a solar tracker robot using microcontroller [16], a simple neural network solar tracker for optimizing conversion efficiency in off-grid solar generators [17], development of full-automatic solar tracker and its applications [18], development of control system of two-axis automatic solar-tracker [19], an integrated solar tracker positioning unit in distributed grid-feeding inverters for CPV power plants [20], design, development and performance test of an automatic two-axis solar tracker system [21], an azimuth-altitude dual axis solar tracker [22], two-axis solar tracker analysis and control for maximum power generation [23], an improved solar PV system for Malaysian rural electrification part I: Design and testing of solar PV with tracker and reflectors [24], theoretical and experimental performance investigation of a two-axis solar tracker under the climatic condition of Denizli [25], a smart solar tracker with double modes [26], design and dynamics of a novel solar tracker with parallel mechanism [27], fuzzy control based solar tracker using Arduino Uno [29], design of a low-profile two-axis solar tracker [30], improved structure of solar tracker with microcontroller based control [31], A microcontroller-based multi-function solar tracking system [33], development of an embedded solar tracker for the enhancement of solar energy utilization [34] and many more.

In the project, a renewable source mechanism for photovoltaic panel to maximize the generation of electricity is developed. The objective of this project is to develop a system that constantly generate electric to ensure this project obtain sufficiently storing it inside the battery for variety applications. This project also capable to increase the rate of electricity from the renewable source and reduces the time to generate electricity. In the work, a solar tracker is placed to track the movement of the sun. It drives to locate the photovoltaic panel at the best angle of sunlight exposure.

2. METHODOLOGY

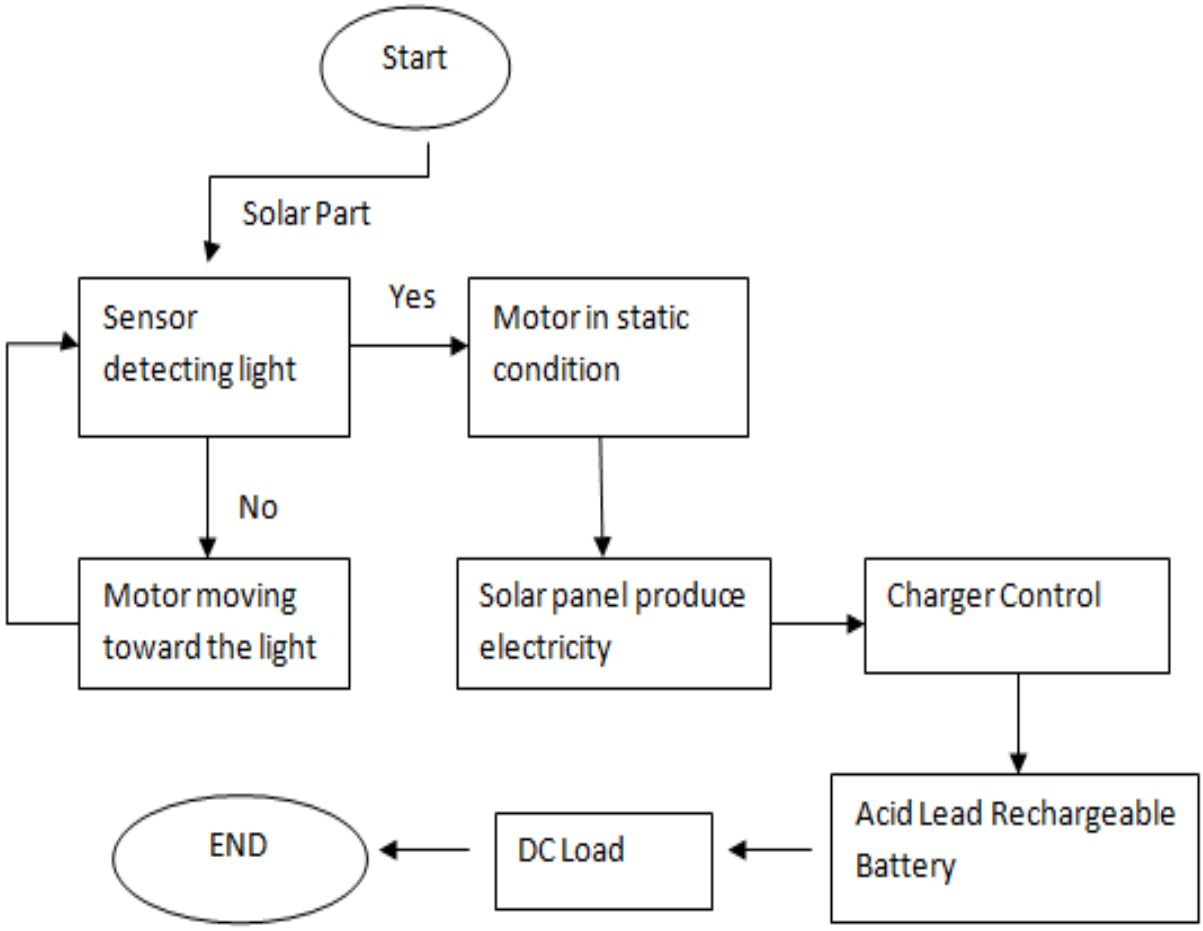

Fig.1. Flowchart of smart hybrid power supply operation

Fig. 1 shows the flowchart of smart hybrid power supply operation when light emitting diode sensor detecting light. Then, the motor is maneuver toward the light. Then solar panel will produce electricity by transferring it to the circuit charger control and store into acid lead rechargeable battery. If the sensor does not detect any light, then the motor is in static condition.

For simulation part, Proteus ISIS Version 7.8 is applied. It is a software that been used to ensure the functionality of the circuit.

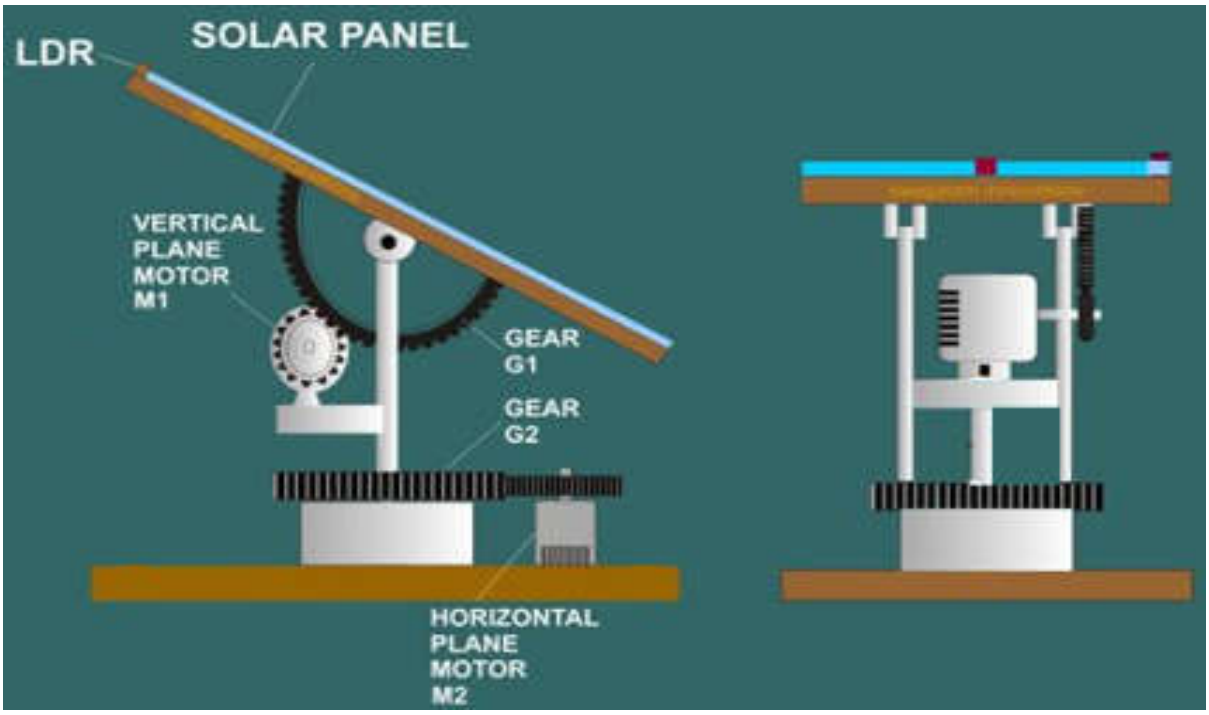

Fig.2. Dual axis solar trackers

Based on solar tracker circuit, it uses an IC LM324 to control the movement of the DC motor. There are some modifications is being made for increasing the efficiency of the circuit while to ensure the circuit can operate accordingly.

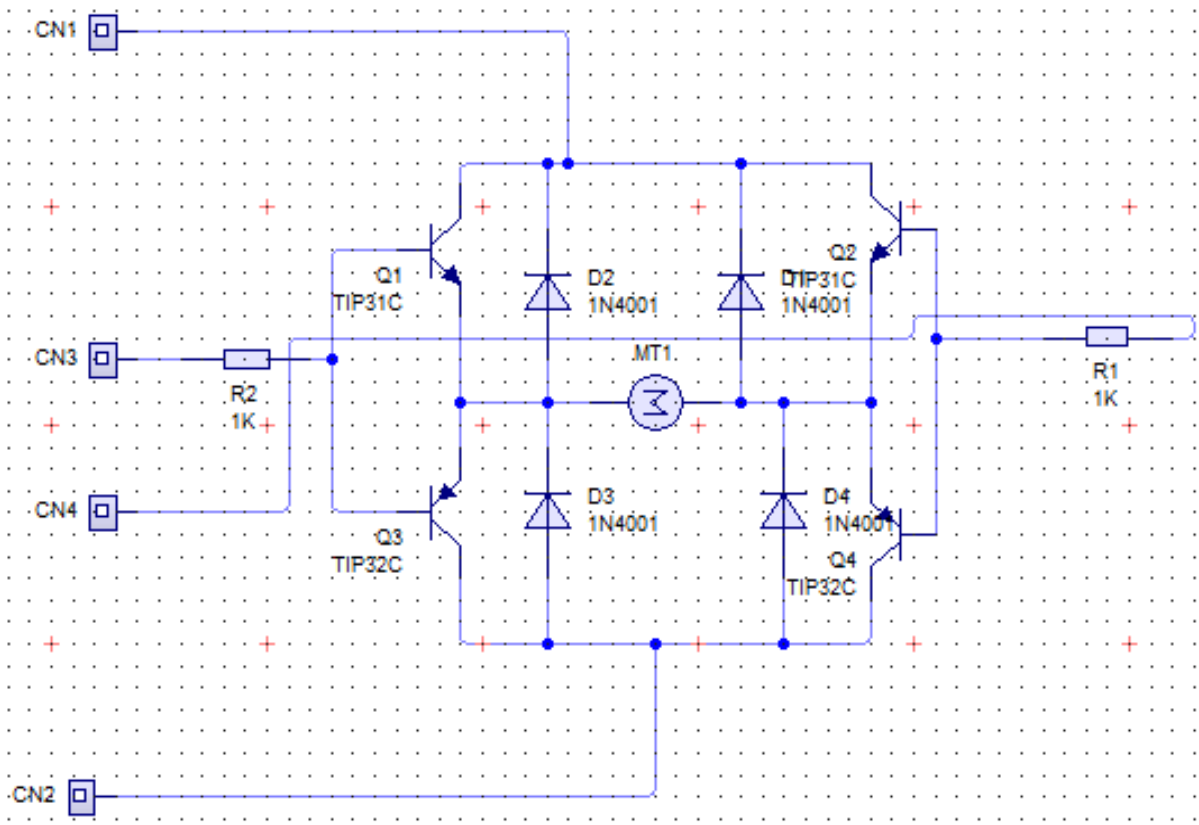

Fig.3. Circuit motor

There are 2 circuits being design to control the system, which are circuit A (east and west) and circuit B (north and south). Circuit A and B are completely similar but the differ on the path track. Circuit A controls east and west path, while circuit B controls north and south path.

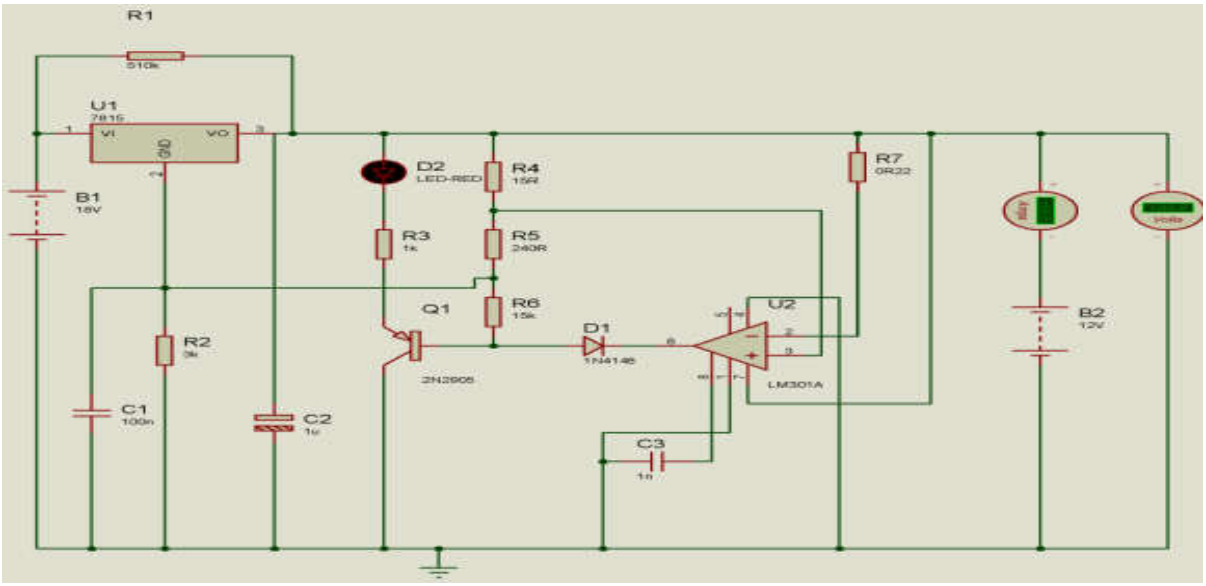

Fig.4. Control charger circuit

Based on the circuit of control charger, it consists of two ICs, LM350 regulator and LM301A op-amp which control the current follow and charging battery. This circuit is to protect the battery from damage due to overcharging.

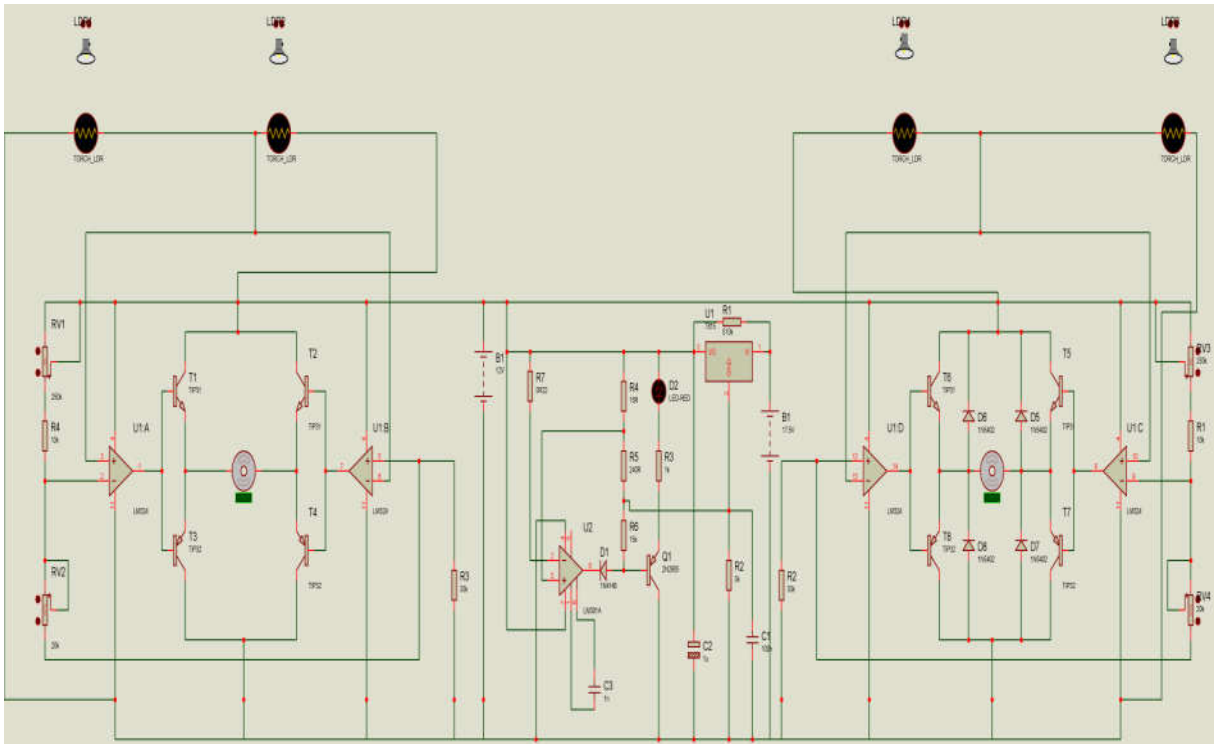

Fig.5. Completed proposed circuit

3. RESULTS AND DISCUSSION

Table 1. The specification of proposed circuit

Parameters	Value
Value of input voltage	20 -17.5 Vdc
Value of output voltage	12 Vdc
Time taken charging the battery (full)	8 hours
Current deliver from battery	7 A/H

The specifications of designed circuit where the parameter values are used are tabulated as shown in Table 1. In Table 2, the LDR sensor is used to detect the position of the sun. The sensor will send a signal to the IC LM324 and the motor will gear up until the LDR move under shadow. If the other sensors detect the sunlight, the motor will move until all four sensor stay under shadow.

Table 2. LDR operation

LDR Condition	Resistance	Voltage Input	Voltage Output
light	low	high	low
dark	high	low	high

The micro inverter is performed to modify the small-sized battery to the value of 220V AC Volt 50Hz. It composes two6wqse oscillator generator or square wave generator to drive the coil transformer that have voltage tall which about 220V at 50Hz frequencies. By changing the RC value, it can modify the output frequency. This circuit provided with 100mA depend on the transistor and transformer step down.

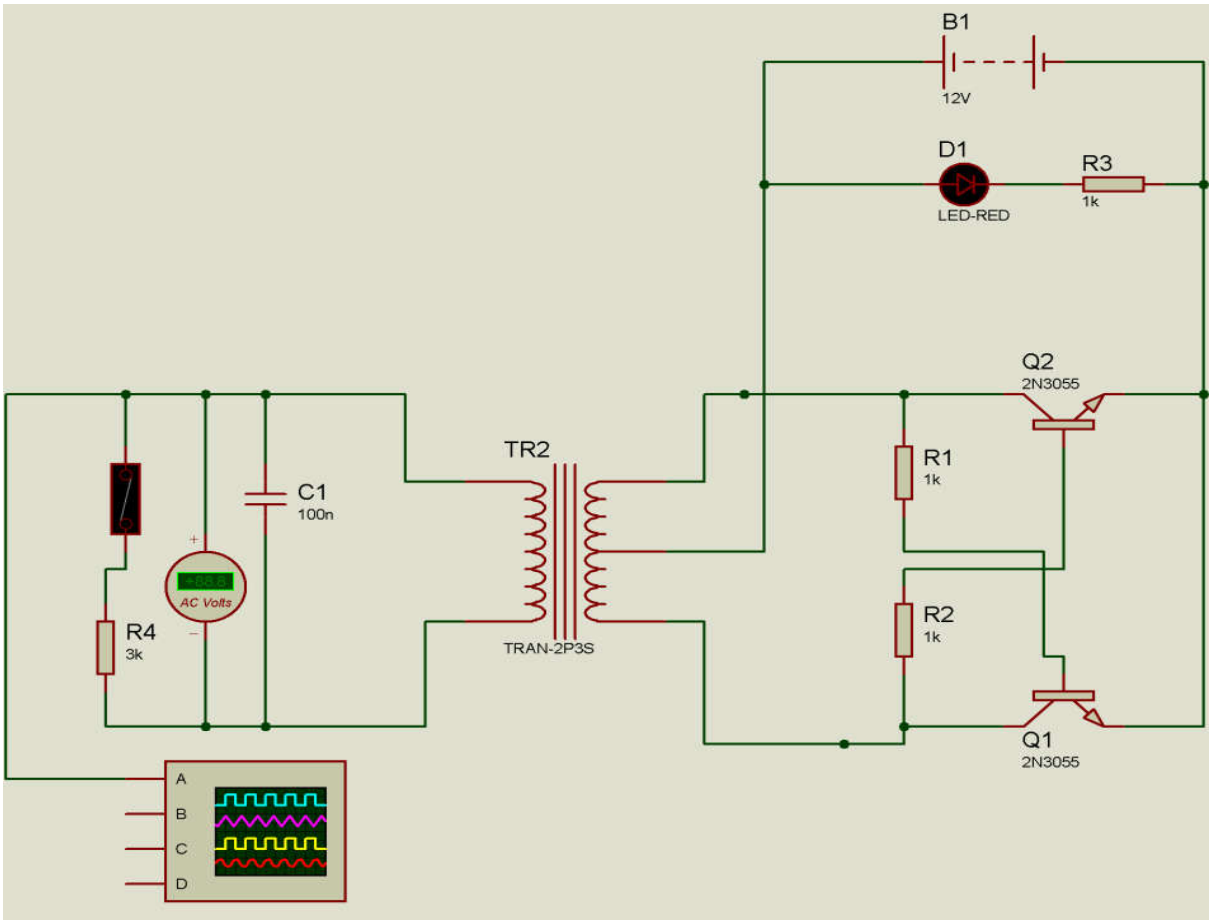

Fig.6. Simulation of inverter circuit

In this project, only the solar part using the sensor to detect the sunlight. The system equipped with photo-sensor, electronic driven control system (IC LM324) and DC motor. The radiation received from the sunlight on the photo-sensor acts as the input to controlling [39-40] system and the angular displacement caused by the DC motor is based on the input receive by photo-sensor. The system is supply with 12Vdc supply.

Fig.7. Front view

Fig.8. Side view

A pair of light dependent resistor (LDR) is acted as the photo-sensor for this tracker system. LDR act as input and sense the sun position. The resistance LDR falls with increasing light intensity. When the LDR receive the light, the resistance become low and the signal is send to the IC. The motor will move until the LDR are stay in shadow. In the dark, LDR resistance will became high and the signal will be send to the IC and the motor will be static position. Solar panel consists of two situations which are:

- When LDR detect any light then motor will rotate toward to the light, whether vertical motor moving or horizontal motor.
- The movement will stop when all four LDRs not detect any light or stay under shadow.

Fig.9. Completed prototype

The LM324 series consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. During operation, the LM350 develops a nominal 1.25V reference voltage between the output and adjustment terminal. The reference voltage is impressed across program resistor R1 and

since the voltage is constant, constant current then flows through the output set resistor R2, giving an output voltage.

The LM301A are high performance operational amplifiers featuring very low input bias current to improve the accuracy of high impedance circuits using this device. The high common mode input voltage range and absence of latch-up make these amplifiers ideal for voltage-follower applications. The devices are protected to withstand short circuit at the output. The external compensation of these amplifiers allows the changing of the frequency response (when the closed-loop gain is greater than unity) for wider bandwidth or higher slew rate.

In this project, DC motor is used to move the solar panel [35-37]. The DC motor is connecting with the gears and attach to the panel. When the motor rotate, it will move the panel through the sun position and that movement will relocate the angle of the LDR sensor. It all depends from the input provide by sensor.

DC motor [38] type that use in this project is power window motor. This type of motor is connecting with H-bridge connection. The direction of motor is depending on the direction flow of current. The motor rotation is rotate from the positive terminal to negative terminal.

4. CONCLUSION

In conclusion, this project provides the best and successfully way to solve user's problem. It will be very useful to people based on smart hybrid power supply, where it is as alternative technology that will prevent the rely on petroleum energy sources. This system design that use in the project to bring a lot of benefit and able to apply in other applications and also able to give knowledge and more experience to all people whether in the electronic field or public.

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