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Design and Implementation of Solar based mini Air Cooler cum Mosquito Trap

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Abstract : Air Cooler is one of the appliances that keeps the atmosphere cold. The basic concept of water cooling is to find a medium that can handle and transport heat more efficiently than air. Water has a very good ability to retain heat, in the mean time stay in a liquid form. This project is to design and develop a low cost air cooler which can be used in houses and office. Secondary researches have been carried out to collect data regarding the present design of air cooler. Various types of air cooler available in the market have been identified. Cooling process employs the different methods to cool the air. But considering the lower application and cost effective the water cooling system is considered for our project. The main aim of our project is to supply the cooled air with the help of water circulation. It consists of Solar panel, Battery, Fan, Water tank and Pump. The present air cooling methods are evaporative coolers, air conditioning, fans and dehumidifiers. But running these products need a source called electricity. The producing of electricity is ultimately responsible for hot and humid conditions i.e. global warming. In hot and humid conditions the need to feel relaxed and comfortable has become one of few needs and for this purpose utilization of systems like air-conditioning and refrigeration has increased rapidly. These systems are most of the time not suitable for villages due to longer power cut durations and high cost of products. Solar power systems being considered as one of the path towards more sustainable energy systems, considering solar-cooling systems in villages would comprise of many attractive features. Despite increasing performance and mandatory energy efficiency requirements, peak electricity demand is growing and there is currently no prevalent solar air cooling technology suited to residential application especially for villages, schools and offices. a light-driving bug zapper is presented for well controlling the diseases brought by insects, such as mosquitoes. In order to have the device efficient to trap the insect pests in off-grid areas.

Index Terms - Cooling, Power Cut Problems, Solar Power Systems, Sustainable Energy Systems, Water Circulation.

I. INTRODUCTION

Solar energy is the light and radiant heat from the Sun that influences Earth's climate and weather and sustains life. Solar power is sometimes used as a synonym for solar energy or more specifically to refer to electricity generated from solar radiation. Since ancient times, solar energy has been harnessed for human use through a range of technologies. Solar radiation along with secondary solar resources such as wind and wave power, hydroelectricity and biomass account for most of the available flow of renewable energy on Earth. Solar energy technologies can provide electrical generation by heat engine or photovoltaic means, space heating and cooling in active and passive solar buildings; potable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes. Sunlight can be converted into electricity using photovoltaics (PV). PV has mainly been used to power small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array.

An Air cooler is a device that cools air through the evaporation of water. Evaporative cooling differs from typical air conditioning systems, which use vapor-compression or absorption refrigeration cycles. Evaporative cooling works by exploiting water's large enthalpy of vaporization. The temperature of dry air can be dropped significantly through the phase transition of liquid water to water vapor (evaporation). This can cool air using much less energy than refrigeration. In extremely dry climates, evaporative cooling of air has the added benefit of conditioning the air with more moisture for the comfort of building occupants. In addition to verify that a UV-LED module can reduce power consumption and enhance the function of mosquito attraction, the experiments in this study explored the effect of light modulation frequency and light field distribution on the attraction of mosquitoes. Due to a positive relation between LED radiance and LED driven current. The bug zapper attracted mosquitoes by UV rays emitted by the LED light source, making the insects approach the suction inlet and forcing them into the collection tube due to the effect of wind suction generated by the DC fan. Mosquitoes are trapped in the collection box with the DC fan continuously operating, resulting in the insects' demise due to air dry or starvation. The power module consisted of a 7 W thin-film solar cell and a power management circuit. Light energy collected by the solar cell was converted and stored in a 12 VDC/7.2 AH lead-acid battery inside the system to supply necessary electric power for UV LED and fan operations according to the system settings.

II. PROPOSED METHOD

The block diagram of the proposed method is shown in Fig.1.

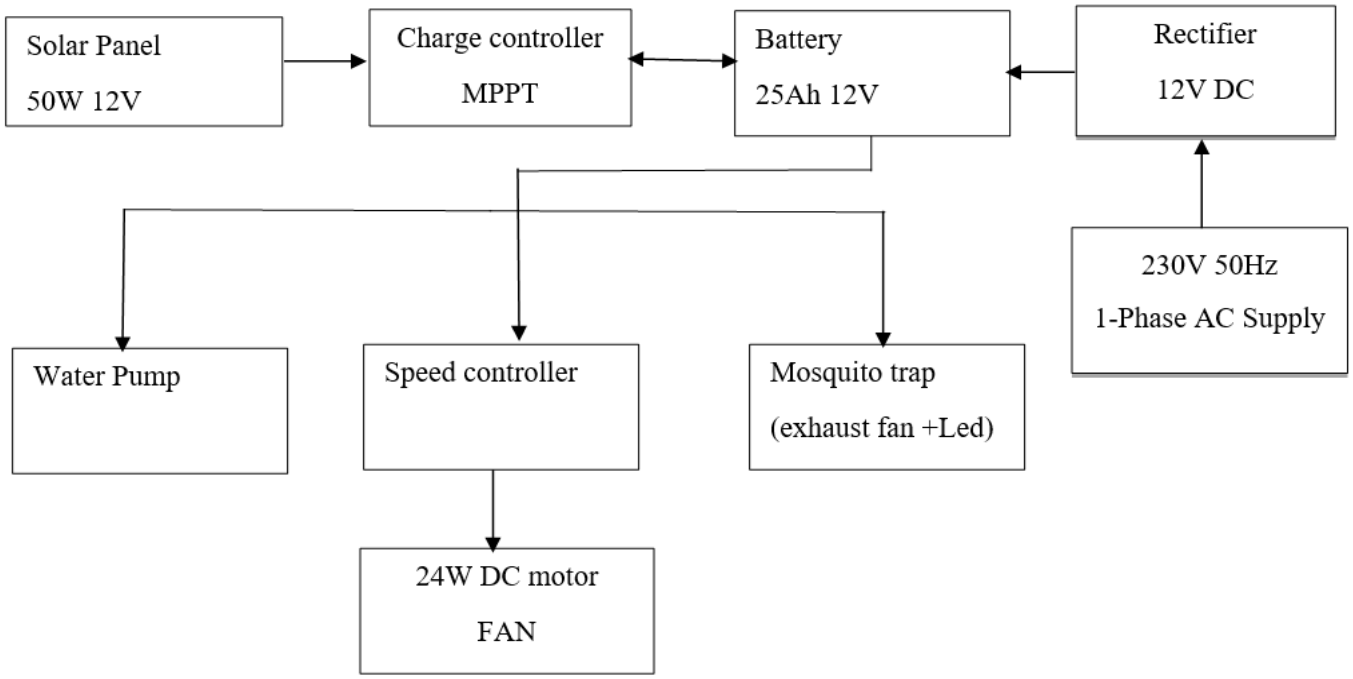


Figure1. Proposed Work Block Diagram

2.1 Solar Panel

A solar panel is a device that collects and converts solar energy into electricity or heat. It known as Photovoltaic panels, used to generate electricity directly from sunlight Solar thermal energy collection systems, used to generate electricity through a system of mirrors and fluid-filled tubes solar thermal collector, used to generate heat solar hot water panel, used to heat water. It is energy portal. A solar power technology that uses solar cells or solar photovoltaic arrays to convert light from the sun directly into electricity. Photovoltaics, is in which light is converted into electrical power. It is best known as a method for generating solar power by using solar cells packaged in photovoltaic modules, often electrically connected in multiples as solar photovoltaic arrays to convert energy from the sun into electricity. The photovoltaic solar panel is photons from sunlight knock electrons into a higher state of energy, creating electricity.

Solar cells produce direct current electricity from light, which can be used to power equipment or to recharge a battery. A less common form of the technologies is thermo photovoltaics, in which the thermal radiation from some hot body other than the sun is utilized. Photovoltaic devices are also used to produce electricity in optical wireless power transmission.

2.2 Charge Controller

The Flow chart of P&O MPPT is shown in Fig.2

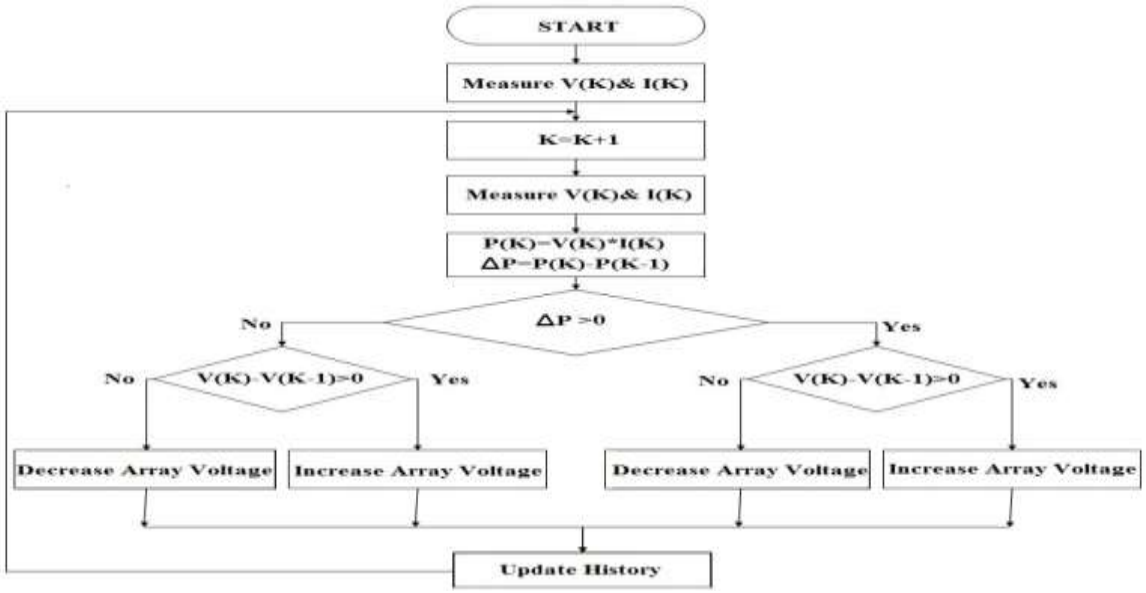


Figure 2. Flow chart of P&O MPPT

This method structures a simple regulation in closed loop incorporating only a few controlled parameters. The P&O algorithm compares the previously delivered power with the one after disturbance by periodically varying the voltage of the panel with a minuscule incremental step to reduce the oscillation around the

application in commercial systems due to its simplicity and involvement of few measured parameters. The principle of this method is described by flowchart is given in Fig 2.

2.3 Battery

In our project we are using secondary type battery. It is rechargeable type. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy. Primary batteries can only be used once because they use up their chemicals in an irreversible reaction. Secondary batteries can be recharged because the chemical reactions they use are reversible; they are recharged by running a charging current through the battery, but in the opposite direction of the discharge current. Secondary, also called rechargeable batteries can be charged and discharged many times before wearing out. After wearing out some batteries can be recycled.

2.4 DC Pump

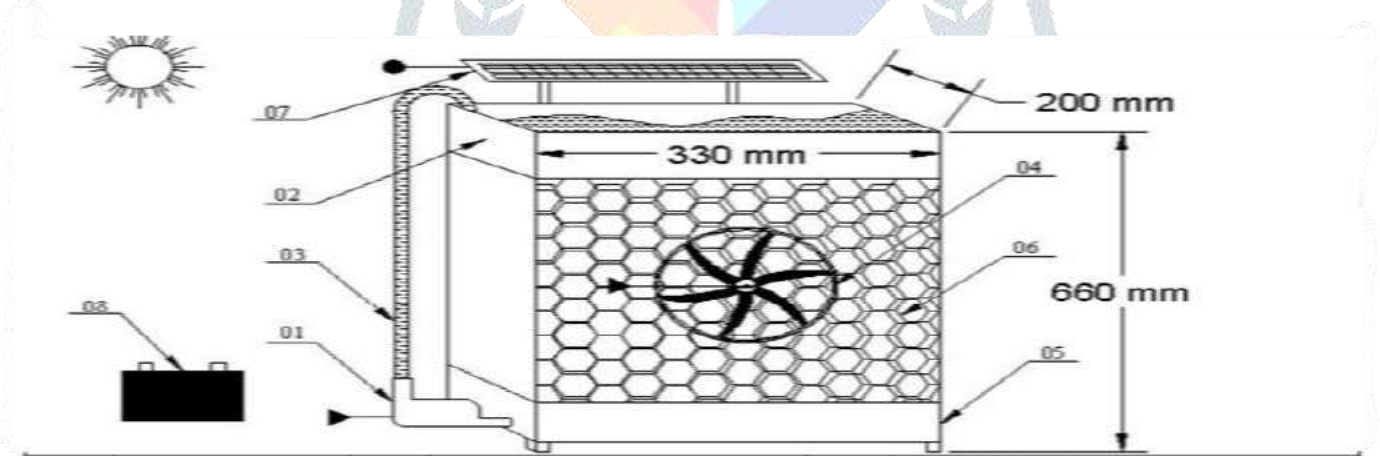
A pump is a device used to move gases, liquids or slurries. A pump moves liquids or gases from lower pressure to higher pressure, and overcomes this difference in pressure by adding energy to the system such as a water system. A gas pump is generally called a compressor, except in very low pressure-rise applications, such as in heating, ventilating, and air-conditioning, where the operative equipment consists of fans or blowers.

2.5 DC Motor (Fan)

A standalone fan is typically powered with an electric motor. Fans are often attached directly to the motor's output, with no need for gears or belts. Smaller fans are often powered by shaded pole AC motors or brushed or brushless DC motors. In our case it is powered by dc motor having three blades.

III. WORKING PRINCIPLE

Solar panel consists of number of silicon cells, when sun light falls on this panel it generate the voltage signals then these voltage signals are given to charging circuit. Depending on the panel board size the generated voltage amount is increased. In charging circuit the voltage signal from the board is gathered together and stored in the battery. There are two tanks provided one at the top and another one at the bottom. The water from the top tank is made to pass through the tubes which are fixed between the two tanks. A fan is provided at the center of the tank in such a way that the supply for the fan is coming from the battery which stores the current from the solar panel. When the water falls from the top tank to the bottom tank due to gravity, the fan is made to run, so that the cool air will be supplied all the way through. At the bottom of the tank, there will be a DC pump which pumps the water again to the top tank. The power for the DC pump is coming from the battery connected to the solar panel. The fan and pump is controlled separately with help of manual operated switch.



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	PUMP	04	FAN	07	SOLAR PANEL
02	WATER TANK	05	WATER COLLECTOR	08	BATTERY
03	WATER TUBES	06	HONEY COMB WATER ABSORBER	▶	TO CONTROL UNIT

Figure 3. Solar Air cooler Fabrication

The Mosquito Trapper attracted mosquitoes by UV rays emitted by the LED light source, making the insects approach the suction inlet and forcing them into the collection tube due to the effect of wind suction generated by the DC fan. Mosquitoes are trapped in the collection box with the DC fan continuously operating, resulting in the insects' demise due to air dry or starvation.

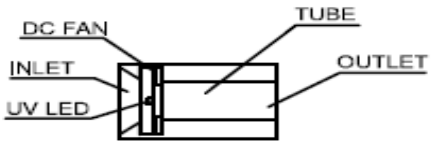


Figure 4. Mosquito Trap Fabrication

IV. SIMULATIONS AND RESULTS

4.1 The Fig. 5 shows a complete model of the Solar Photovoltaic system incorporating a boost converter that boosts the voltage from the Maximum Power Point Tracking algorithm (MPPT). The simulation of this model has been done by taking different values of Irradiance and Temperature.

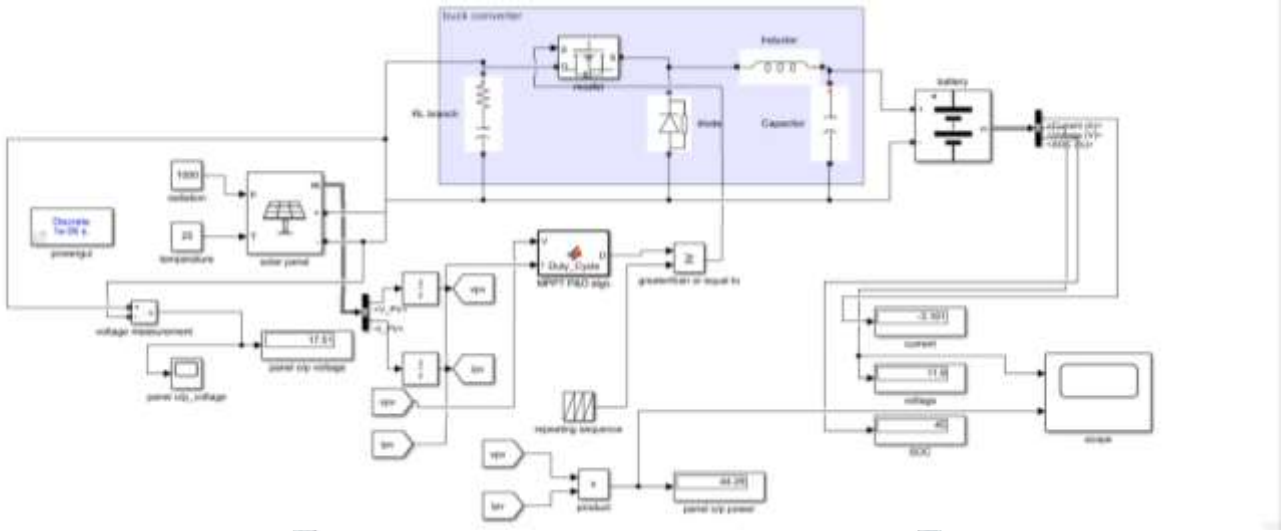


Figure 5. P&O MPPT Simulation in MATLAB Simulink

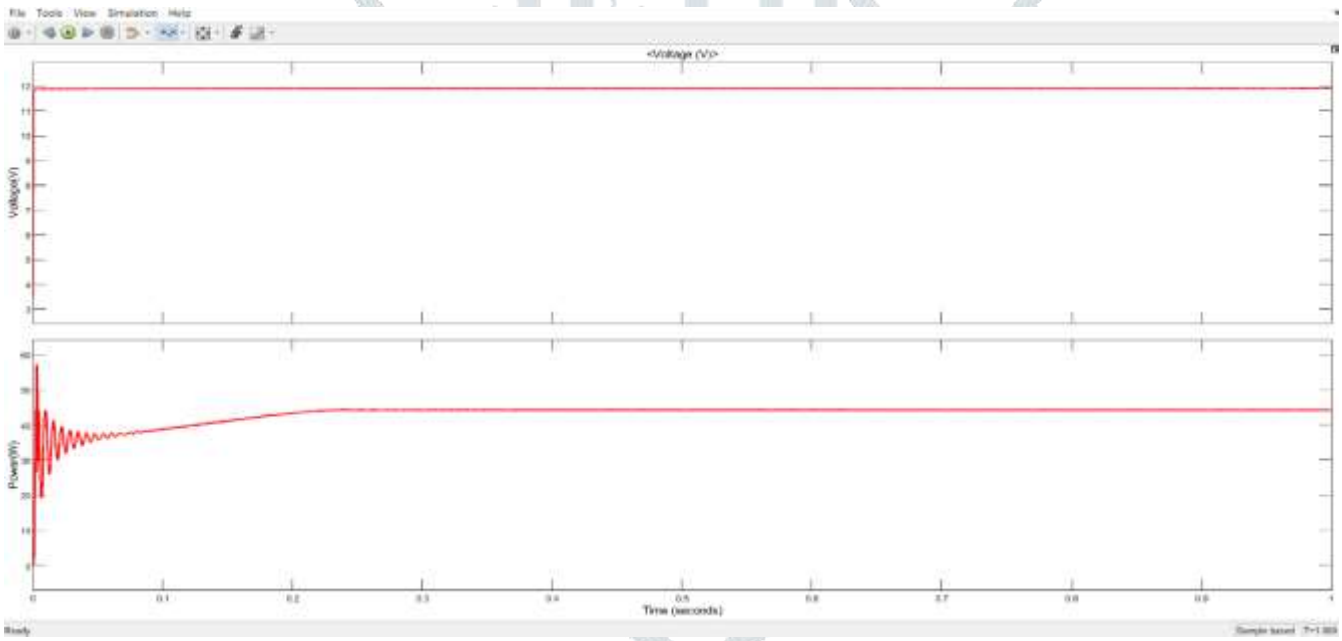


Figure 6. Voltage and Power Waveforms

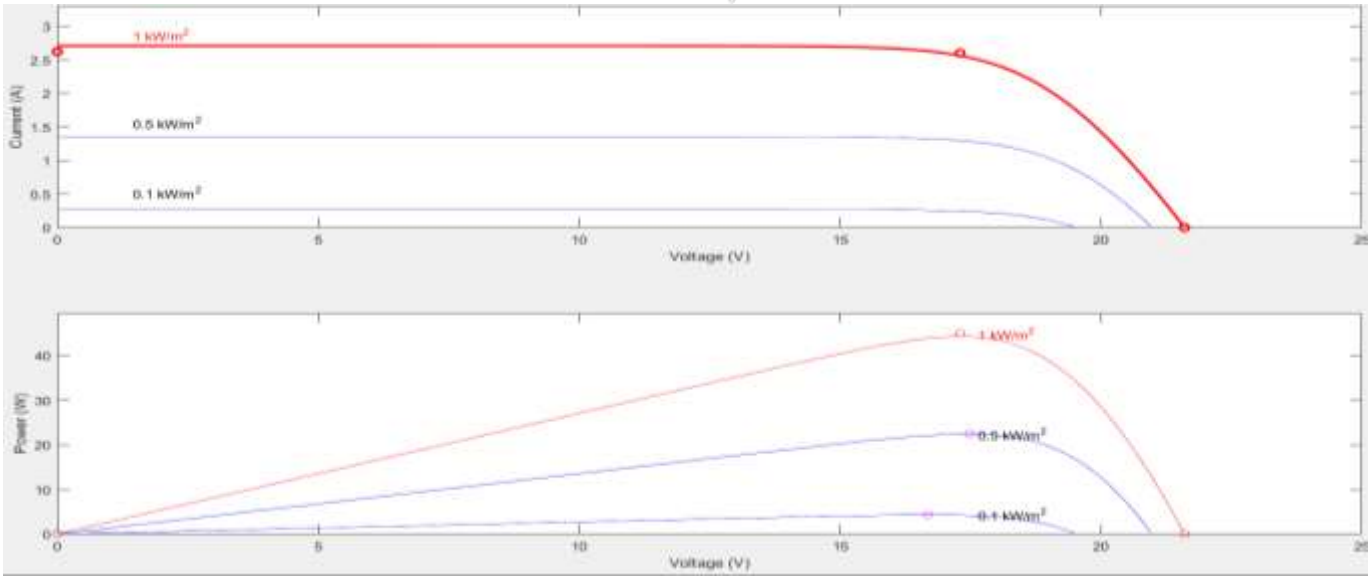


Figure 7. Current and Power Waveforms

4.2 Speed Controller Simulation

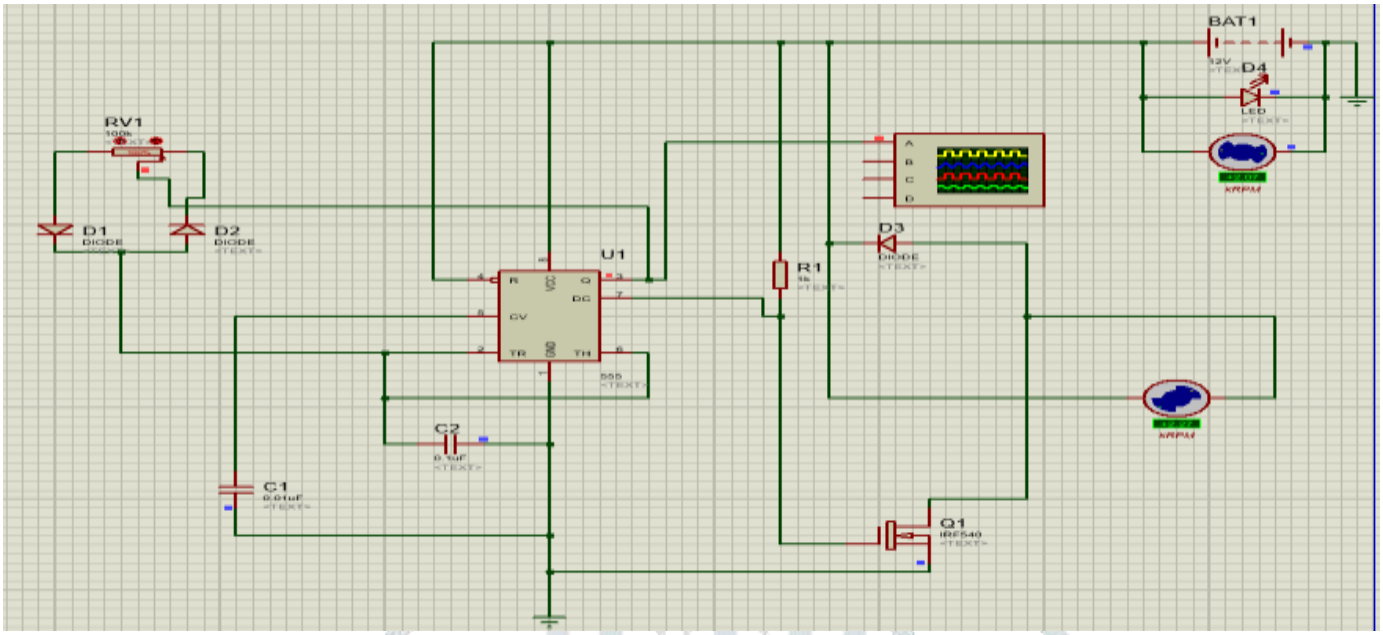


Figure 8. Speed Controller Simulation in Proteus

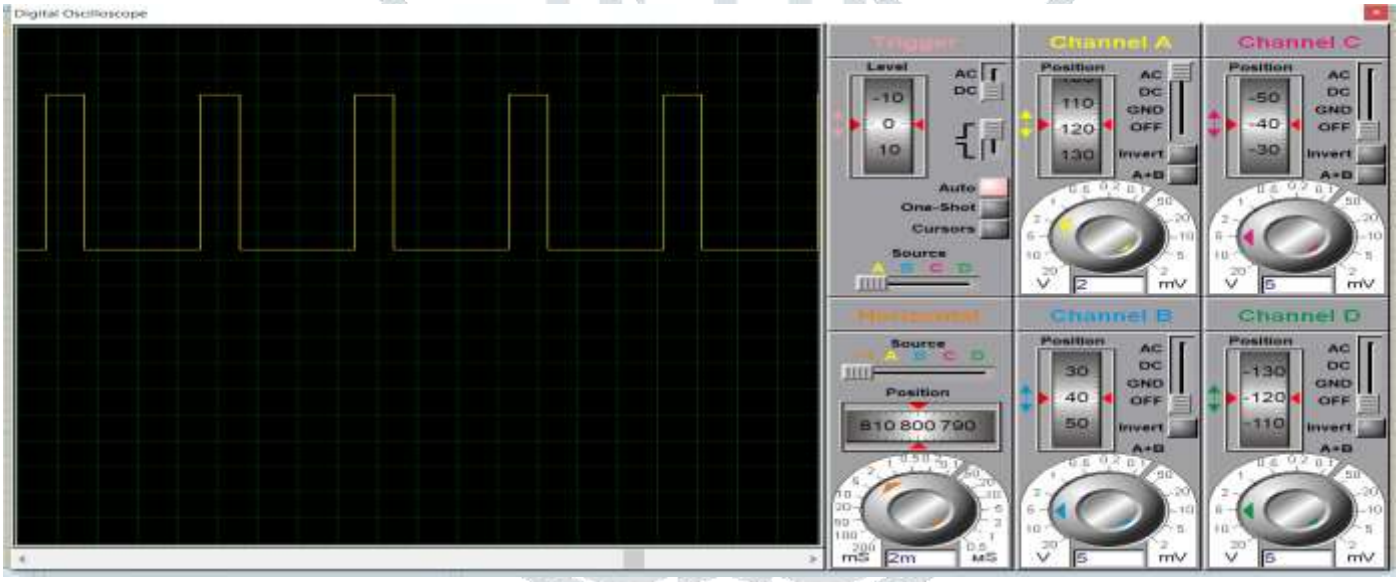


Figure 9. PWM waveforms at Potentiometer 25%

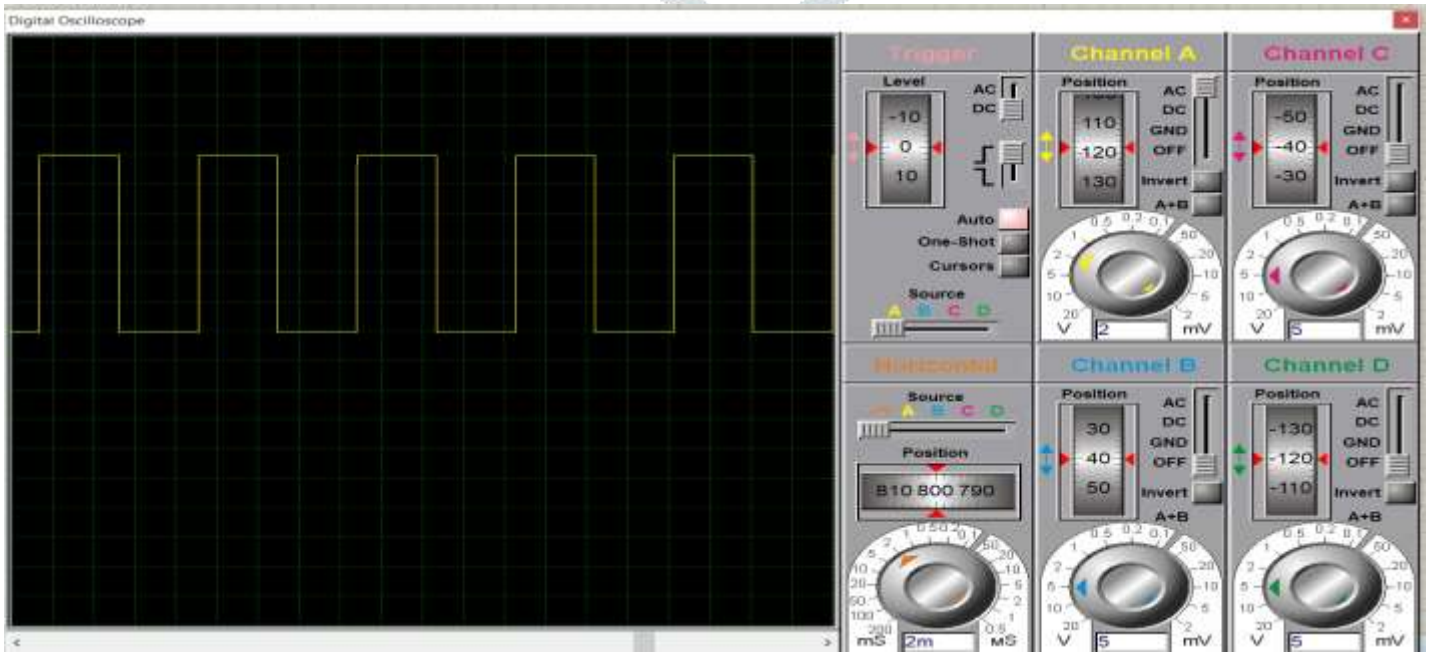


Figure 10. PWM waveforms at Potentiometer 50%

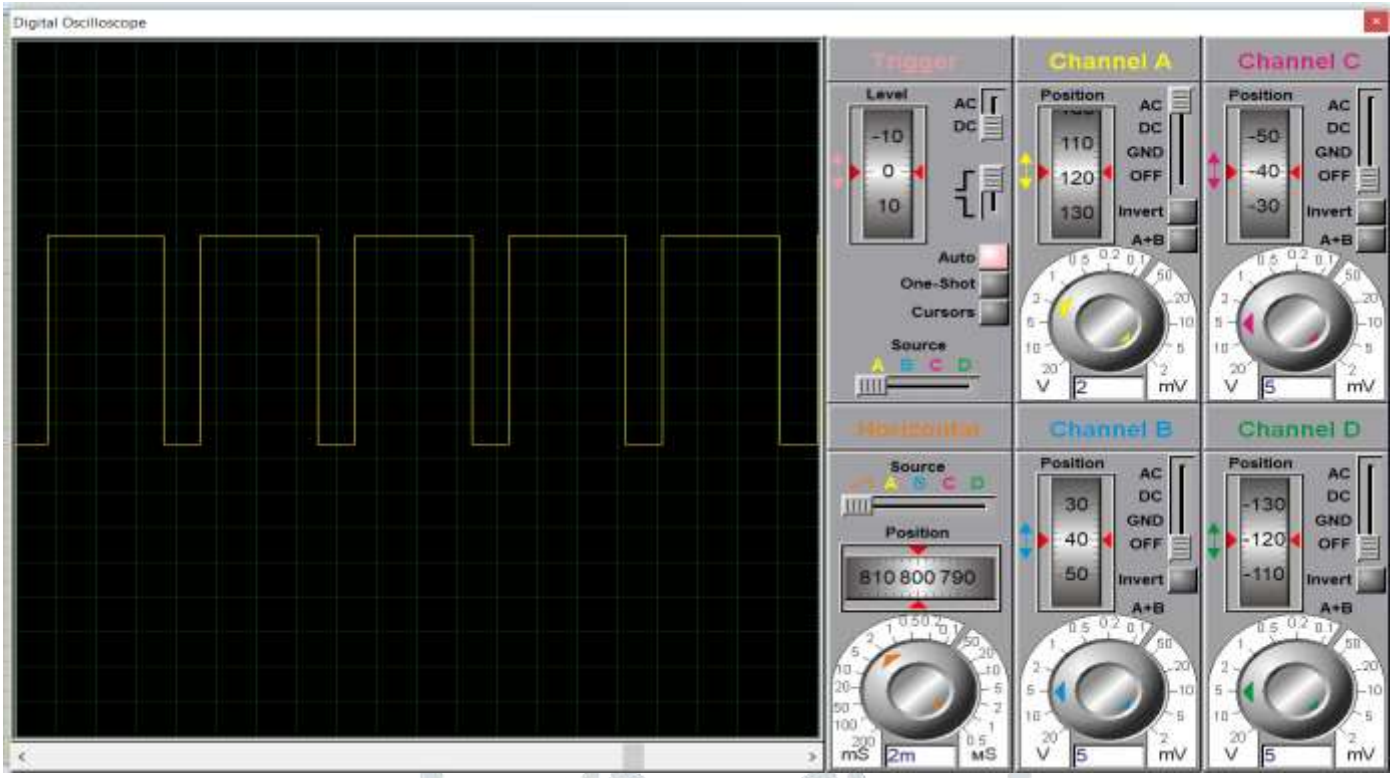


Figure 11. PWM waveforms at Potentiometer 75%

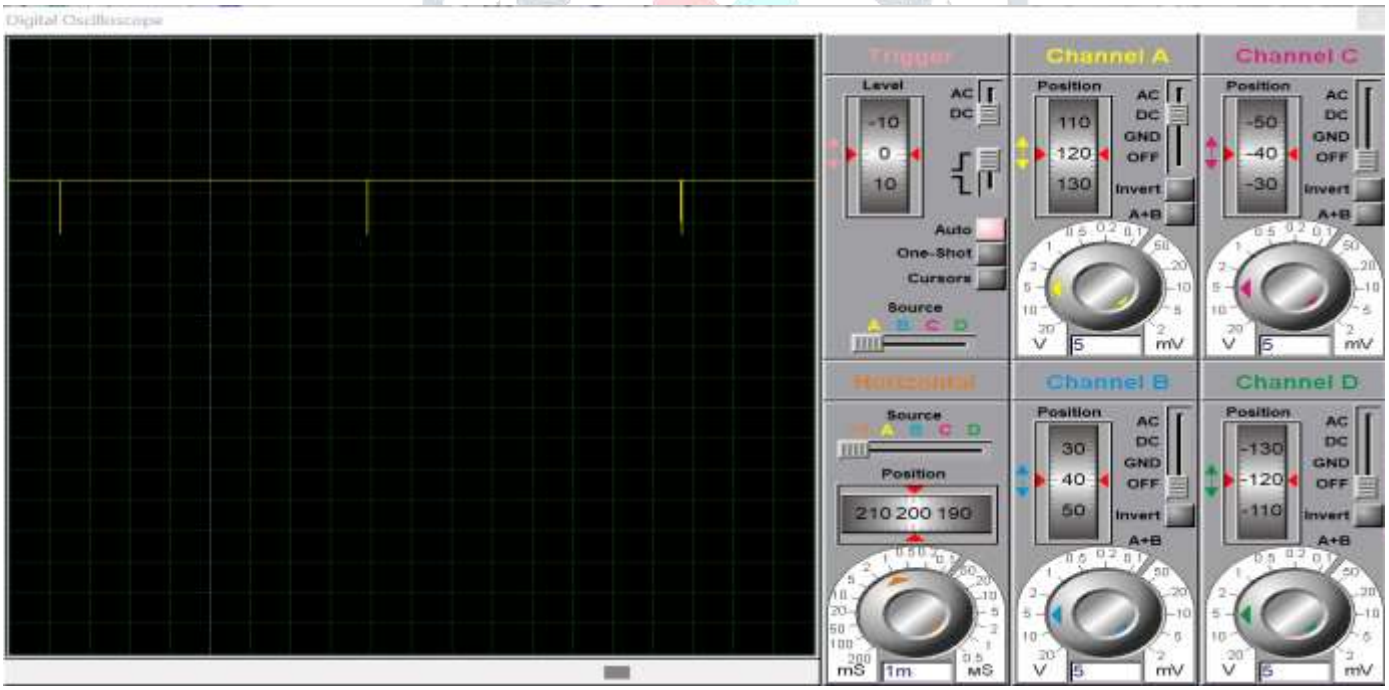


Figure 12. PWM waveforms at Potentiometer 100%

Table.1. Motor speed at Different Potentiometer Position

Potentiometer Position	Motor Speed in RPM
25%	650
50%	1210
75%	1880

100%	2270

V. CONCLUSIONS

Comparing the cost of this product with the existing products in the market is solar product appeals better and affordable by common people. This solar product perfectly suits for villages, schools and offices and thus an alternate to the power cut problems. It comprises of many attractive features such as usage of solar energy, cooler, Mosquito trap and cooling cabin at lower cost. It is eco friendly and natural, electricity savers. Durability of the product is more thus minimizing the cost. No electricity is used so this product saves the energy and saves environment from getting polluted.

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[10] *Basic Photovoltaic Principles and Methods*‖ SERI/SP- 290-1448 Solar Information Module 6213 Published February 1982 page. No. 9-15.