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SOLAR-POWERED HYDROPONICS: AN ALTERNATIVE TO CONVENTIONAL FARMING

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The increasing population and decreasing land area has led to meet the food demand which can only be achieved through smart agriculture techniques. Furthermore, declining cultivating area and rising price of land has caused conventional agricultural system to become uncompetitive. Hydroponic agriculture cultivation technology system provides an alternative way for farmers who have a narrow field or just have a yard to carry out agricultural business. Hydroponics is a type of horticulture and a subset of hydroculture which involves growing plants (usually crops) without soil, by using mineral nutrient solutions in an aqueous solvent. The hydroponics system has advantages viz. Soil less culture helps to save land area which aids in doubling the density of plants per unit area; product quality (shape, size, flavour, colour, cleanliness or hygiene) is improved; off season planting can be done in accordance with market needs; Better supervision against insects and pests. Hydroponic cultivation is usually implemented at greenhouse to keep plant growth optimal and to protect from external elements such as pests, rainfall and climate change.

Continuity of energy supply is one of the major hindrance of hydroponic cultivation especially when using full controlled system with a number of equipment to be controlled viz. sensors (temperature, pH), controller. The use of generators is not efficient due to the high cost and environmental pollution. Utilization of Photovoltaic cell or solar cell as a renewable energy at housing or transportation can be considered as solution to reduce dependency to fossil energy. Its usage for agriculture machine and equipment still not popular among farmers due to its high initial cost. With this aim, a developed hydroponic system that used solar power as source of energy is described in the article. The prototype was developed at (Limapuluh Kota, Indonesia), can be utilized for farmers who are in remote areas and minimize operational costs in the hydroponic cultivation such as NFT (Nutrient Film Technique) system and others that require continuity of electrical power source. In NFT system, fertilisers are pumped into a catchment tank to main for given concentration by means of control system. The solution is then pumped through supply tubes to trays and canal where the plants are standing.

Solar powered system for the hydroponic system consists of a solar cell, solar charge controller, battery, inverter, temperature and humidity sensor, solar tracker system and hydroponic system. The details of the system are as described below:

A) HYDROPONIC SYSTEMS

It can be seen from figure that the system consist of reservoir as nutrient liquid container, a 25 W water pump, used to pumps the nutrient up to the tank at flow rate of approximately 13 litre per minute. In NFT system, the flow speed is adjusted to 1 litre per minute by using water tap. A floating switch was placed in the tank to control electrical current to the pump. The availability of the tank is highly recommended to avoid the pump runs 24 hour per day. Overall system work is supported by power that came from solar panel module.

B) SOLAR PANEL MODULE

A solar panel is made up of several solar photovoltaic cells to form a PV module. The solar PV systems can be configured for varying capacity, ranging from watts to megawatts to fulfil either industrial or domestic energy needs.

C) SOLAR CHARGE CONTROLLER AND BATTERY

A solar charge controller regulate battery charging and prevents overcharging of battery. It also limits the electric current drawn from battery.

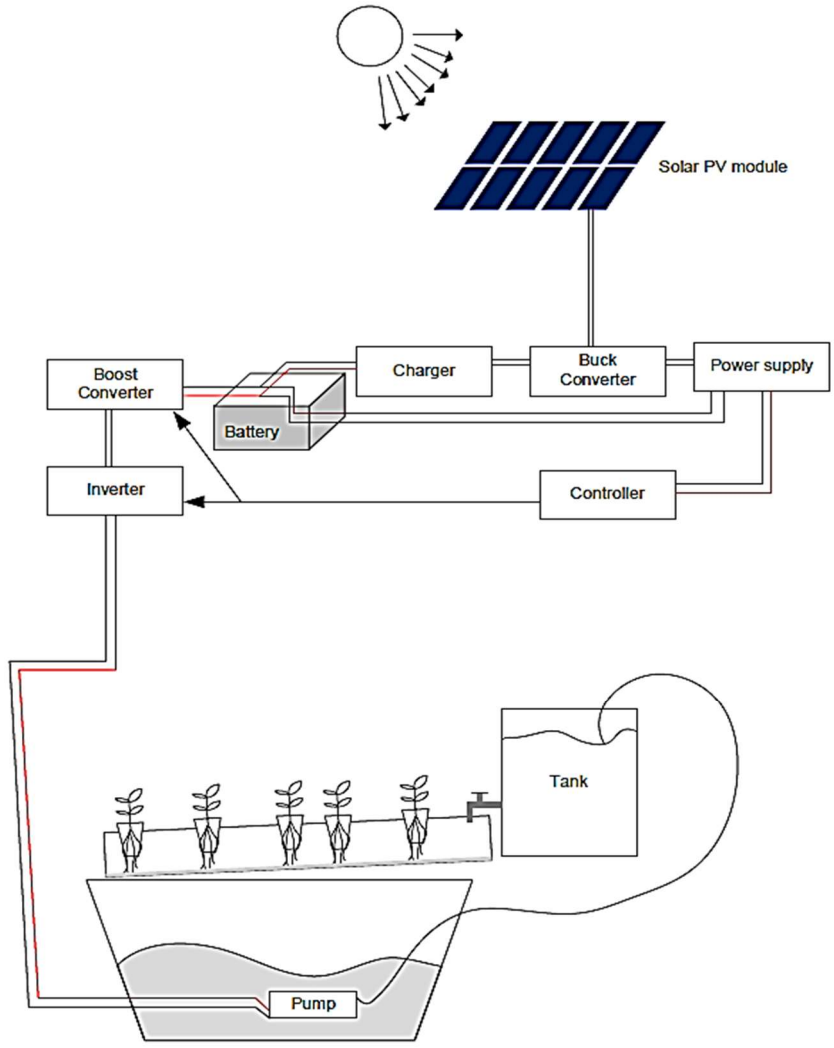

Figure: Solar-Powered Hydroponic system (NFT Technique)
Source: Putera P. et al. Int. J. of Adv. Sci. information tech. Vol.5 (2015)

In this system, the energy output from the Solar PV systems is generally stored in a couple of 100AH batteries. If the system gives power to the 25 W water pump only. It is assumed that the system can run 4 days continuously, considering 50% discharge.

D) INVERTER

Inverter is used to convert DC current into AC current. AC current from inverter may appear in: square and quasisquare wave, multilevel and sine wave.

E) TEMPERATURE-HUMIDITY AND DISPLAY

Temperature-humidity sensor used was DHT 11. This sensor detected the humidity and the temperature in analogue form. After been changed into digital signal in ADC (Analog –Digital converter) in microcontroller, this data was converted into value that can be shown in LCD.

F) DC MOTOR AND RTC

Real Time Clock (RTC) was used to keep track of the current time while DC motor was used to drive position of solar panel.

CONCLUSION

This solar-powered instrument utilized in plant cultivation in hydroponic system was developed to minimize operational cost, maintain continuity of electrical source and reduce dependency from electricity or conventional fuels. The instrument consist of solar tracker to adjust photovoltaic panel position, aquarium pump to distribute the nutrition, humidity and temperature meter to measure humidity and temperature, respectively.

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