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A New Technique to Improve the Efficiency of Output Power Solar Panel Using PIC 18F4550 Microcontroller

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Abstract. Together with advancement associated with technologies things have gotten simpler and less complicated for people. Automation is usually the employment of manage devices along with details technologies to scale back the need regarding human being do the job inside creation associated with things along with products and services. Solar photovoltaic (PV) technology is regarded as the famous energy source amongst renewable energy sources which in turn that utilize to relieve usage of fossil fuel. PV energy is usually a lot of abundant energy sources among renewable energy. PV technology is change sunlight energy into electrical energy. The performance of electricity of PV module can be affected by solar irradiance and ambient temperature. When PV technology is process solar irradiance, producing lowered performance of PV modules and increasing temperature of PV module. When the temperature of PV module is reach at or more than 35 ˚C that detected by LM 35, PIC 18F4550 is switched ON the DC cooling system and vice versa. After switch ON the cooling system, the temperature of PV module is reducing. This controller system is an intelligent system because it will run the cooling system automatically when the temperature of PV module reaches setting level that detected by temperature sensors. The higher efficiency of PV cell, the payback period of the system can be shorted and the lifespan of PV module can also be longer.

Introduction

Automation is usually the employment of manage devices along with details technologies to scale back the need regarding human being do the job inside creation associated with things along with products and services. Controlling system is an extremely essential process in lots of utilizations. Electrical energy with controlling system is very important for the appropriate delivery electricity as well as essential of not necessary utilization of electricity. The energy is dividing into two types which are conventional energy and non-conventional energy. As the result of development's world economic and growing energy demand, the energy of conventional (coal, oil and natural gas) is rapidly increasing. Environmental phenomenon, such as global warming and depletion of the ozone layer attributed to emissions from massive fuel combustion are slowly but surely causing widespread problems to every living thing on earth [1]. Thus, it is important to explode non-conventional energy to replace conventional energy sources. Non-conventional energy also called as renewable energy such as solar energy, biomass energy, tidal wave energy, wind energy, hydropower, and so on.

PV technology is any of a very effective solution for renewable energy, because it is a natural resources and pollution-free. Besides that PV technology can to decrease greenhouse gas emission. The PV cell basic material is silicon semiconductor (Si). A PV module involves 36 cells in a series circuit.

The specific ambient temperatures and also solar irradiance participate in significant aspect intended for productivity of the PV module. When the ambient temperature of PV module is usually raise, the actual efficiency of PV module is decrease and vice versa. This standard rule is certainly the decline through the open cell voltage drop is determined. Consequently, an efficient PV performance circumstance required cooling. Although PV module operating outside; PV modules have a high irradiance condition upon attaining high temperatures. Therefore, the cooling system of PV modules is an important key to improving the efficiency of the PV system.

H.G Teo et al. [2] presented the efficiency of different configurations of PV module. Without active cooling, the temperature of the module was high and solar cells can only achieve an efficiency of 8-9 %. However, when the module was operated under active cooling condition, the temperature dropped significantly leading to an increase in efficiency of solar cells to between 12 % and 14 % [2]. Arab, A. reported the water spraying is atomized by control system and spraying unit. The control system includes temperature sensor and microcontroller circuit [3].

Methodology and Material

1. Block Diagram

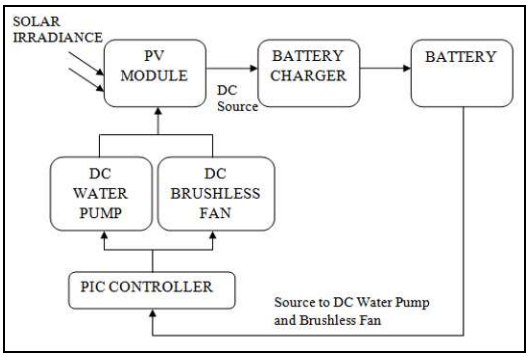

Fig.1 Block diagram overview of the investigation.

Figure 1 shows the block diagram overview of the investigation. The PV module produces electrical energy and supply DC source to battery. The output power of PV module is used to charge the 12 V_{DC} batteries by using battery chargers. It continuously charge the battery until it shows at the sign of full status on and will cut-off charging process. The utilization of battery is used to keep electrical energy that generate by PV module. Battery supply DC source to DC water pump that is places at front side of PV module and DC fans that place at back side of PV module. DC water pump and DC fans as DC cooling system to decreases temperature for improving efficiency output power of PV module. Besides that, PIC microcontroller is to switch ON / OFF the DC cooling method automatically. In the temperature of PV module reach at or more than set level in which detected by simply LM 35, the PIC 18F4550 is switched on the DC cooling method and the other way around. After switch on the cooling system, the brushless fan was blowing at the backside of PV module or water pump was spray water at front side of PV module to cut back the temperatures of PV module.

2. Material

i. PIC 18F4550

PIC 18F4550 be part of PIC 18F category of microcontroller. In technology of microchip, PIC 18F4550 is one of superior Microcontrollers. It is a 40/44-Pin, High-Performance, Enhanced Flash, and USB Microcontrollers with nano Watt Technology [4]. It uses 8 (eight) analog input channels (AN0 through AN07) having 10 bit resolution ADC, in which the entire operation is controlled by the firmware [4].

ii. Temperature Sensor

The LM 35 is a temperature sensor, whose output voltage is linearly proportional to the Celsius temperature. This sensor has linear output and low output impedance make it easy for connecting it to the readout circuitry [5]. This LM35 sensor was determined by three pins which is, $+V_s$, GND, and V_{out}. When used as a basic temperature sensor (2 °C to 150 °C), any change in temperature by 1 °C will be converted to 10 mV or the output voltage (V_{out}) = 0 mV + 10 mV/°C [5].

iii. Flow Chart of PIC Controller

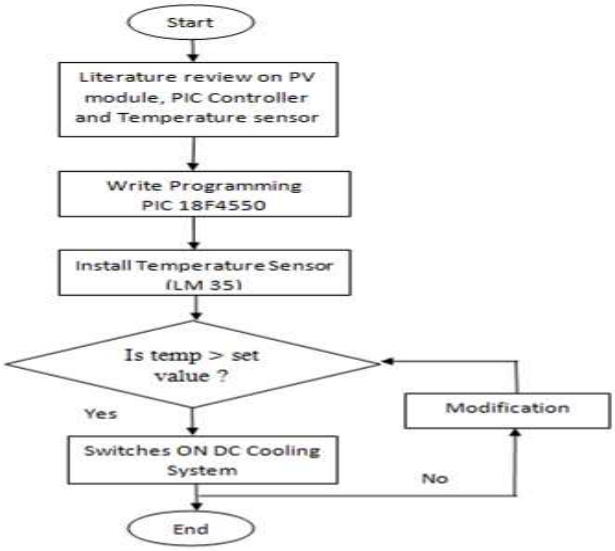

Fig. 2 Flow chart of the PIC controller system.

Figure 2 displays flow chart of the PIC controller system. The system operates as the following step. It starts with the initialization on most details desired because of the application, after that initializes LCD to indicate the process starts to function. The system after that enables serial disrupt along with ADC to read temperatures via LM 35 sensor. The temperatures of PV module are usually as compared to setting level (35 °C). In case any temperature sensor detect PV module temperatures is usually preceding 35 °C, then the threshold is usually incremented through 1 (to 36 °C) and it will to switch ON the DC cooling system. When all of temperature sensor detects temperature of PV module below than setting level, the DC cooling system will switches OFF to avoid waste power. All the PV module temperatures were displayed on the LCD.

Result and Discussion

Table 1 Operation Condition of DC Cooling System.

T1	T2	T3	T4	DC COOLING SYSTEM
0	0	0	0	OFF
0	0	0	1	ON
0	0	1	0	ON
0	0	1	1	ON
0	1	0	0	ON
0	1	0	1	ON
0	1	1	0	ON
0	1	1	1	ON

T1	T2	T3	T4	DC COOLING SYSTEM
1	0	0	0	ON
1	0	0	1	ON
1	0	1	0	ON
1	0	1	1	ON
1	1	0	0	ON
1	1	0	1	ON
1	1	1	0	ON
1	1	1	1	ON

Table 1 shows the operation condition of DC cooling system in the investigation. Four temperature sensors (T1, T2, T3 and T4) is installing at the back side of PV module to detect the temperatures of PV modules which is a couple of temperature sensors at the top side along with

another a couple of temperature sensors at the top bottom of PV module. 0 represents the temperature of PV module below than setting level (35 °C) while 1 is represents temperature of PV module is exceed than setting level. From the table seen that if all the temperatures of PV module detect by LM 35 is below than setting level, PIC controller will not switch on the DC cooling system automatically. While the any of temperatures of PV module detect by LM 35 is exceeds than setting level, PIC controller will switch on the DC cooling system automatically as DC water pump was spraying on the front of PV module and two DC brushless fans were blow at the back sides of PV module to reduce the temperatures of PV module. If any of temperatures of PV module is less than setting level, DC cooling system still will be function until all of temperatures of PV module less than setting level automatically. This controller system is an intelligent system because it will run the DC cooling system when the temperature of PV module reaches setting level that detected by temperature sensors automatically and avoid waste electrical energy.

Summary

In this investigation, 'A New Technique to Improve the Efficiency of Output Power Solar Panel Using PIC 18F4550 Microcontroller' has been design and construct by using PIC controller, LM 35, PV modules, DC brushless fans and DC water pump. According the result of investigation, the system can be function based on predefined specification. PIC 18F4550 microcontroller to control the particular cooling system that will diagnose by LM 35 either switches ON or perhaps switches OFF DC cooling system automatically. This controller system is an intelligent system because it will run the DC cooling system when the temperature of PV module reaches setting level that detected by temperature sensors automatically and avoid waste electrical energy. The ambient temperature and solar irradiance play main role for efficiency of the PV module. When the ambient temperature of PV module increase, the PV module efficiency decreases and vice versa. The efficiency of PV module with cooling system was increasing compared to PV module without cooling system; this is because the ambient temperature dropped significantly. More efficiency of PV module, investment payback period of the system can shorten and the lifetime of PV module can also be longer.

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