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Statistical Performance Monitoring and Maintaining Constant Power Output of PV (Photo-Voltaic) System

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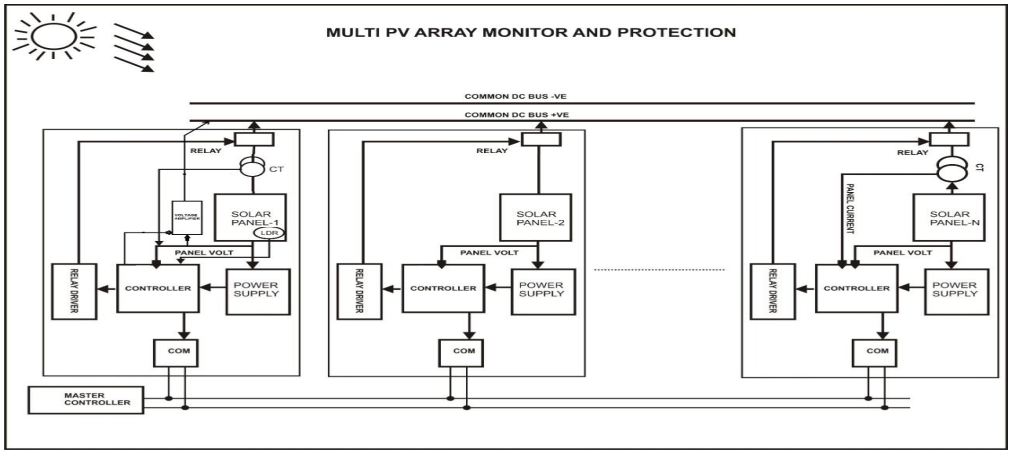
Abstract: ***Solar energy is useful to counter effect of climate change and global warming, we can use solar energy as one of the solution for climate change and global warming, also by reducing emission of greenhouse gases, by more use of public transport, etc. The main goal of this paper is to reduce the dependency on conventional resources and more use of renewable energy source which is abundantly available in nature. The circuitry sequential design which will be provided further can be used for any PV system providing set of components with specific power rating.***
In this paper the photovoltaic (PV) monitoring system, this is developed to know the easy combination of software and hardware, since the low cost microcontroller used in this paper it is very user friendly photovoltaic (PV) data monitoring system is designed by using the light sensor, temperature sensor, and current sensor and microcontroller. The light in intensity is monitored by using an LDR sensor, voltage is monitored by using a voltage sensor module by voltage divider principal, current is monitored by using current sensor and temperature is monitored by using temperature sensor. Reading the photovoltaic cell parameters from the outside world to the microcontroller to do some calculations and all these data are displayed on a LCD interface to microcontroller

I. INTRODUCTION

Now a day, major problem in front of the world is to maintain constant power output of PV system as most of the solar cells can only convert from 15% to 25% of available energy to electrical energy. Due to environmental factors (shadow, dust, wind etc.) the surrounding gets affected, a system provides variable voltage because it is not properly maintained and cleaned on daily basis. Thus a system will never provide actual data to the data collector .Change in weather and sunlight the system will provide changing data information. For smooth , safe, obtaining better performance and timely maintenance, solar (PV) systems should be continuously monitored and evaluated. The measuring solar panel parameters through sensors for data acquisition. In this system different parameters of solar panels like current , voltage, temperature and light intensity will be monitored and also create a online real time photovoltaic monitoring system. This is achieved by designing a photovoltaic system, building a control circuitry for proper voltage, current and solar radiation reading, and creating an analysis data logging that displays the accumulated data in a user-friendly charting interface. The goal is to facilitate small scale installation with more efficient and cost effective and reliable monitoring system.

II. BLOCK DIAGRAM



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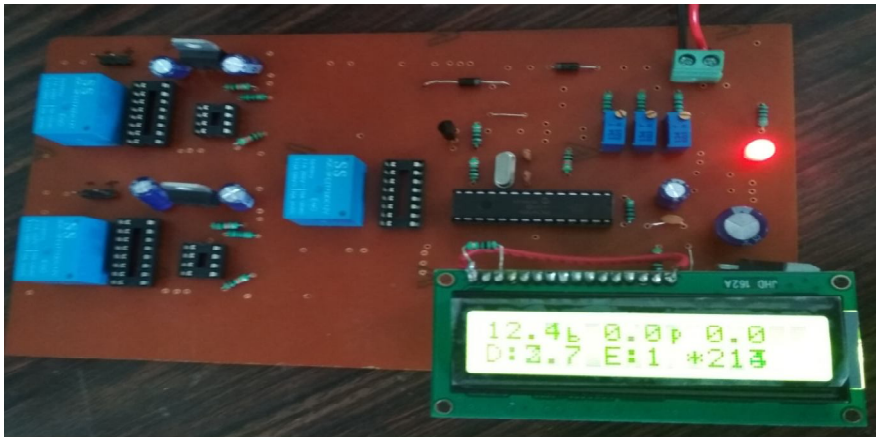
A. Block Diagram Discription

1) Monitoring & boost circuit and the other two mini circuits for monitoring purpose only. In the first part of the circuit, the boosting part is the main feature of this project.
2) The main feature of B.C.C. is to amplify the panel voltage.
3) If panel output i.e., voltage level of panel decreases due to dust, shadow etc. then the decrement in the actual voltage level of the panel cannot be sent to the bus instead it is removed, therefore by not wasting the decreased voltage it is amplified with the help of boost circuit and then sent to bus.
4) A extra diode in series is used as a prevention so as the boosted voltage stored in capacitor should not flow back to the solar panels as it will damage the panels.

B. Components And Setup Of Pv System



1) Pic Microcontroller 18f2520
a) In this microcontroller it has inbuilt AD converter of 10bit resolution.
b) It al so has a high speed operation, maximum up to 64MHz.
c) If compared to 8085, its single clock cycle is of 200ns whereas 8085's single clock cycle takes minimum 4msec.
d) Voltage operating is from 3.3V to 6V of PIC microcontroller 18f2520 while a 8085 strictly works on 5V.
e) It has a DMA (direct memory addressing), which helps for multiple tasking.
2) Relay
a) This relay is of SPDT (single port double throw coil voltage) of 12V.
b) It is used to connect or disconnect the panel with common bus.
c) If voltage level is greater than 12V then the relay will TURN ON.
d) If voltage level is less than 12V then the relay will TURN OFF.
3) MOSFET
a) MOSFET is used for switching of inductor.
b) It is an N-type enhancement MOSFET.
c) Resistance drain to source is less than 0.005Ω
d) Current rating is 52A.
4) Inductor
a) It is a 100mH, 20Amp inductor.
b) DC coming from solar panel is stored in inductor by switching it with MOSFET to simulate an AC current, in positive half cycle only
5) Driver IC
a) Driver IC is used to amplify the current as well as voltage level of signals coming from PIC micro controller which is of 5V to convert it into 12V to drive the relay.
b) Its maximum current is 500mA.
c) Minimum input voltage is 1.7Volt Vcc (max).

6) PV Communication

a) The project also consists of communication which a serial communication.

b) It is a two way communication system.

c) The type of communication used is RS232 which is an international protocol designed on DOT NET software.

d) This is used because is easily available and also a fast way to communicate.

e) It can also be called as bi-directional communication as it can receive the data while sending it.

C. Monitoring Of PV System

1) The circuit diagram i.e., the PCB Layout is made in the software Dip Trace.

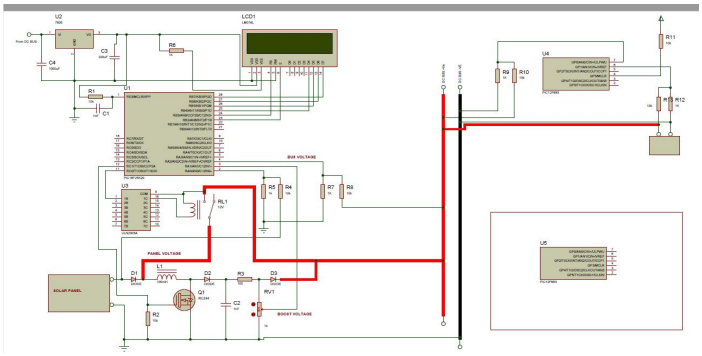
2) Our main component is micro-controller of PIC 18F25k20 SP.

3) the excess copper on the PCB and soldered the components on the board and connected the inductor, MOSFET, resistors ,capacitors and IC connecting pins and pins for monitoring panels.

4) Then we interfaced the display and connected the diodes in the series configuration for supplying power to the micro controller .And also for checking voltages output of PV system. Then we connected the diodes capacitors and pots for deserving the current through op-amp. We connected IC 7805 after the bridge rectifier to limit the voltage.

5) Then through a capacitor we gave the supply to main controller and other components. Due to heating of IC 7805 we added heat sink to limit the temperature of IC within the working limits. Since our micro controller does not have crystal oscillator inbuilt we connected the oscillator externally for the working of micro controller.

6) To check the proper incoming supply we added a LED along with a resistor in series.



III. OPERATION OF PV (PHOTO-VOLTAIC) SYSTEM

A. Radiation falling on the solar panels will be monitored through micro-controller.

B. Monitoring the panels it will be able to know the voltage of the specific panel.

C. For the operation of micro-controller some amount of voltage is needed, so this will be fulfilled by taking it from the panel itself.

D. The voltage level of the panel will be high whereas the micro-controller works only on 5V.

E. But the voltage level of power supply can be 36V, 24V etc. so it will be converted into 5V using ZENER REGULATORY CIRCUIT.

F. The micro-controller will also measure the amount of voltage coming from the panel.

G. If the voltage level is at sufficient level of micro-controller then through relay driver it will give ON command to the relay.

H. As the relay is switched ON, the amount of voltage coming from solar panels will go into bus bar which have loads ex. Inverter through C.T. which is in contact with relay.

I. As there is some load in bus bar ex. Inverter, and this means there is some current flowing through C.T. Therefore, now the micro-controller will also measure the current i.e., the total power consumed.

J. From all this we can observe that the panel is giving its total output or not.

K. LDR (Light dependent resistor) is us Whatever data will be collected in the micro-controller it will send the data to master controller through communication port.

L. Master controller will ask every panel for its data submission. We can say it will take attendance from each panel and this is what is called data logging.

M. According to the collected data from the panels, if it is found that the panel voltage is less then first it will turn OFF the relay and due to this current flowing from C.T. will be cut off. For this we have to amplify the voltage.

N. For amplifying, we are directly sending the panels output voltage to voltage doubler.

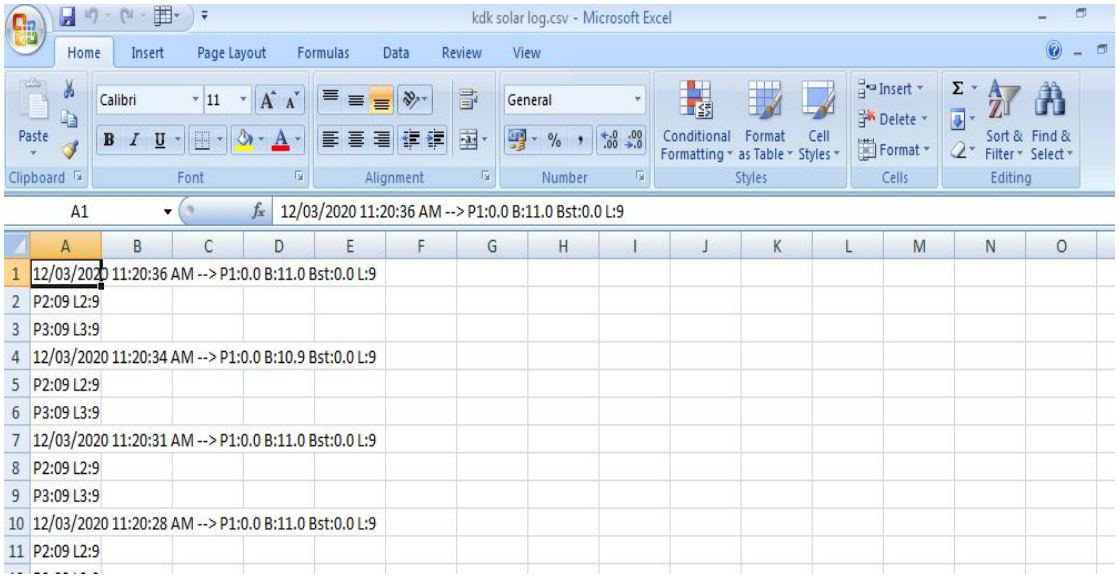
O. And it will also measure the output of voltage doubler through micro-controller.

P. And when the micro-controller gets to know that sufficient amount of voltage has been generated. Then it will send the voltage directly from voltage doubler to bus bared in solar panel which will check the radiation level on the panel and also the amount of the radiation.

Q. The main feature of B.C.C. is to amplify the panel voltage.

R. If panel output i.e., voltage level of panel decreases due to dust, shadow etc then the decrement in the actual voltage level of the panel cannot be sent to the bus instead it is removed, therefore by not wasting the decreased voltage it is amplified with the help of boost circuit and then sent to bus.

S. A extra diode in series is used as a prevention so as the boosted voltage stored in capacitor should not flow back to the solar panels as it will damage the panels.



IV. CONCLUSIONS

To recapitulate, it can be mentioned that dust deposition and settlement on the surface of PV cells can drop the efficiency. Likewise almost always humidity such as tower shadow causes degradation in solar cell efficiency. Monitoring panels and maintaining constant power output of all the three panels are successfully done by the project. Statistical constant output is giving the panel due to the boost circuit.

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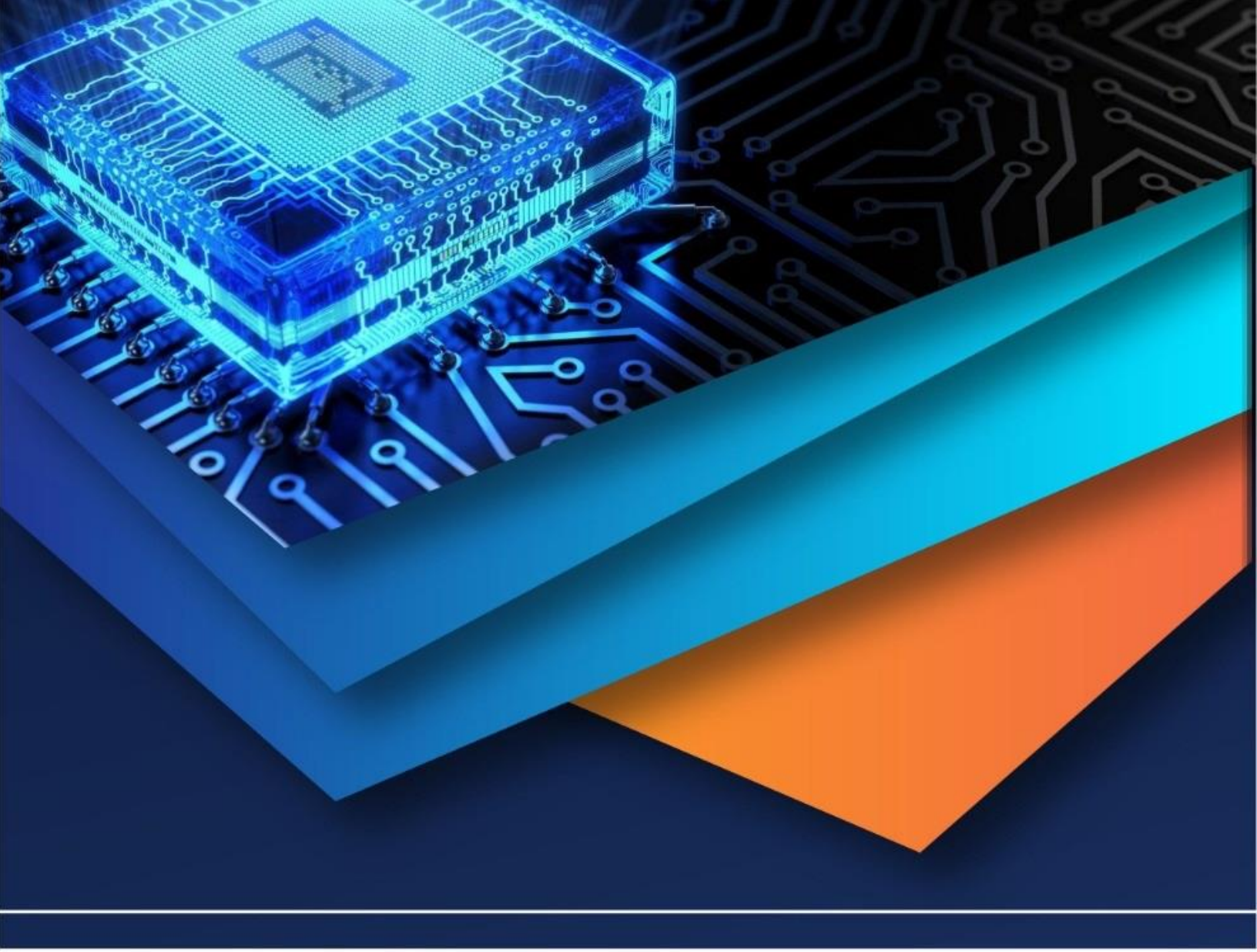

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