A Survey Paper on DC Motor Protection

Prof. Tamboli Madina Shajahan
Prof. Salunke Shrikant Dadasaheb
Prof. Deshmukh Narendrarao Pandurang
Prof. Suryavanshee Prashant Balaso
Prof. Bhosale Shivaji Subhash

Dattakala Shikshan Sanstha "Dattakala Group of Institution" Swami-Chincholi, Daund, Pune, Maharashtra 413130. India.

Abstract:
DC motor plays an important role in various industries. In this paper, we have present a system to provide protection, control and monitoring the condition of DC motor. We have used Arduino uno and various sensors like current, voltage and temperature sensor so, we can continuously monitor the motor condition in an app. Real time values of various parameters like current, voltage, temperature and speed can be monitored in app. The monitoring and protection can avoid various faults like short circuit fault, thermal overload and motor can give better performance.

Key Words: Arduino Uno, Control, Protection,

DOI NUMBER: 10.48047/NQ.2022.20.1.NQ22407 **NEUROQUANTOLOGY 2022;20(1):1206-1213**

INTRODUCTION

DC motors can be used in various industries because of their small size and high energy output. DC Motor is widely used in the industry for various application. To control motor of different areas of an industry the workers have to go there personally and switch ON or OFF the motor for several applications [1]. Sometimes the accurate and quick speed control is required for some unique application. It is again very time consuming and complicated for worker to go there and control the speed manually. Protection or maintenance is also very important aspect for the smooth operation of motor as well as the industry [2] . The monitoring of several parameters of motor like voltage, current, temperature and speed etc. by human is very time consuming process. We have studied those problems and developed the project called DC Motor Protection, Control and Monitoring.

In this paper, we have developed a cost effective protection and control system for DC motors which can be used in practice. The LM35 (temperature sensor) provides very accurate and precise protection to the DC motor. Also the other sensors used for particular application does their work efficiently and provides us useful information about various parameters of the motor on the application.

This project reduces the human work by controlling and monitoring the motors using bluetooth based application. In this project we have used the Embedded system to achieve the required goals [3]. Today everybody has that access, so every industry can easily access the application .

Motor Protection Scheme

In the motor protection scheme, we have provided protection against over heating and over current. We have used sensor which gives accurate and precise protection to motor in abnormal or fault condition.

NeuroQuantology| JANUARY 2022 | VOLUME 20 | ISSUE 1 | PAGE 1206-1213] DOI: 10.48047/NQ.2022.20.1.NQ22407

I. MODELING OF SYSTEM AND COMPONENTS

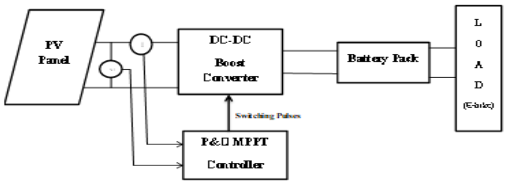

Fig.1.Block diagram of proposed system

"

The system consists of a photovoltaic panel whose output is connected to the DC- DC converter. The converter has a charge controller block and then a lead acid battery at the output as load. The organizational block diagram is consisting of solar panel, a DC-DC converter, an MPPT controller, a battery charger and a load converter. Solar panel from voltage and current input to the MPPT controller initially. According to The MPPT algorithm used to track the solar panel's maximum power point, these values can then continue. The MPPT block yield is utilized as a DC-DC converter input, which can be a voltage boundary or an obligation cycle. The DC-DC Converter assists with keeping up the full PowerPoint working voltage. A boost converter is used to increase the overall PowerPoint operating voltage between a solar panel and a load, the DC-DC power converter is linked".

A. PV Module

"250 watts module is used. In a series and parallel configuration, modules are connected to form an array of desired high voltage and high current. Using a single diode equivalent circuit, the PV module is mathematically modelled. The effect of solar irradiation allows the temperature to raise the voltage during the construction of the PV array. PV Module. PV module, to raise voltage.this module consist of photo current,diode,parallel resistor representing leakage current and series defining the internal resistance to current flow in the Fig.2.It is a device that is based upon the photovoltaic effect i.e.generates electric voltage and current on exposure to light.Light can be artificial or sunlight. PV panels comprise of many solar cells as building blocks. It is basically a current source and its voltage varies with respect to the load".

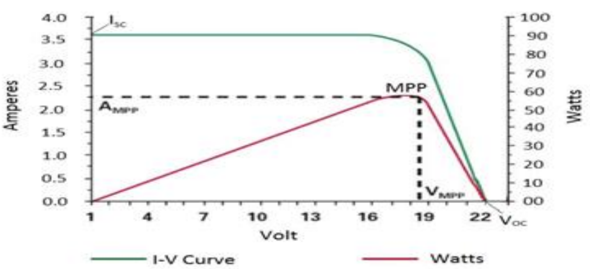

Fig.2: V-I characteristics of PV

"The graph shows the I-V curve of a solar panel. ISC is the maximum current that is obtained by joining the output terminals of the PV panel. It is also known as short circuit current. VOC is the maximum voltage across the panel that is obtained by open output terminals. It is also known as open circuit voltage. I-V curve shows the power given by the panel at specific voltage and current. To get the maximum power the panel must be operated at the knee pointIn the MATLAB simulation the panel is of 250W. The intensity of light is constant in simulation that is 1000 W/m3. The temperature is also constant that is 25deg.c".

The mathematical modeling of the PV array can be given as:

Solar cell current, = [Isc +K(T-298)]*Ir/1000 (1)

Maximum power = Vmp* Imp (2)

=30.9*8.1

= 250 watt

Table1: PV module specification

PV Module parameter	Values
PV Module(Pmax)	250 watts
Voc	36.6V
Isc	8.63A
No. of parallel PV cell	6
No. of series PV cell	10
Voltage at maximum power (Vmp)	30.9 V
Current at maximum power (Imp)	8.1 A

B. DC-DC Boost converter

The boost converter is a power transfer medium for the absorption and injection of energy from the solar panel to the DC link.the circuit component of the boost converter consist of inductor,IGBT,diode, and capacitor which acts We have Vmp = 30.9V and Imp = 8.1A. As we know that Putting values of Vmp and Vo = 23.31v, in above equation and then calculating for D,

we get D = 0.43

$$D=1-\frac{n}{0.75}=0.4 \quad (3)$$

For the calculation of inductance L of converter following expression is used

$$\Delta I_L = \frac{DVm}{2} = 6.64A \quad (4)$$

Calculating load current following expression can be used

$$I_L = \frac{Im}{D} = 18.83A \quad (5)$$

Calculate load resistance

$$R_L = \frac{Vo}{Io} = 3.5ohm \quad (6)$$

Following expression for calculation of capacitance C,

$$C= \frac{Io*D}{fs*\Delta Vo} \quad (7)$$

.

C. MPPT

"MPPT stands for maximum power point tracking. The I-V curve of a solar panel shows a nonlinear distribution of power. It forms different knee points and distribution for different sunlight conditions. So the goal of MPPT is to track the maximum power point or knee point in changing sun conditions. To understand the working of MPPT, car transmission is a classic example. In car transmission system, for the particular engine speed if the gears are not properly tuned then the speed or wheel system of the car does not produce the maximum frequency or wheel speed. In the car transmission, the two main parameters are torque and speed. There is high torque at low speed and vice versa. MPPT in the same way tracks the matching between panel and load (battery in this case). Here the two main parameters are voltage and current that are analogous to speed and toque in car transmission system. So for high voltage, current is low and vice versa. MPPT tracks the voltage and current in order to draw maximum available power from the panel. There are mainly two types of solar charge controllers; MPPT and the other one is PWM charge controller. MPPT is selected because of the following reasons. MPPT charge controllers are best suited and more efficient for high power systems and they have greater current capacity. For low temperature conditions MPPT produces high value of Vmpp It is simple to implement and cost optimized. It is easy to implement in terms of complexity and has an easy Simulink design with enough tracking speed and affordable oscillations at the output”.

BATTERY CHARGING ALGORITHM

“Electric vehicle use rechargeable batteries .battery system use lithium ion type battery. Depending on the kind of use the life of a battery pack varies. In the present case our battery is a Lead-Acid battery which is connected at the output of DC-DC converter. It has low energy to weight ratio and low energy to volume ratio. It is capable of supplying high currents in surge conception and is widely used in starters of vehicles. It is also inexpensive. There are many algorithms to charge these batteries like constant current charging, burp charging, pulsed charging, float charging etc. In this paper, constant voltage method is used. It is a simple charging method that is based upon regulating the voltage across the terminals of battery to a constant value. The battery draws the current according to its level and voltage. Now PV panel is a current source but its current varies according to the environmental conditions i.e. temperature and sun irradiance. The voltage of the panel is fluctuating because of varying insolation. In the proposed design it is regulated by the controller such that the controller adjusts the duty cycle in such a way that the voltage at output of converter remains almost constant”.

Table2: Battery Pack specification

Battery type	Lead acid
Nominal voltage(V)	48V
Rated capacity (Ah)	39Ah
Initial state of charge(%)	30%
Battery charging Constant voltage	55.4V
Charging time	37 Min.
Maximum distance per recharge(km)	38km

P&O ALGORITHM

For tracking the MPPT, the P&O process is used. In this technique, the energy variation of the PV module is caused by a minor disturbance. Intermittently, the PV yield power is estimated and contrasted and the past force. A similar cycle proceeds if the yield power increments, in any case, the unsettling influence is turned around. In this calculation, the PV module voltage is upset. The voltage of the PV module is expanded or diminished to check if the force is expanded or diminished. This implies the working purpose of the PV module is on the left of the MPPT when an expansion in voltage prompts an increment in force. Further interruption against the option to hit MPPT is thus important. On the other hand, if an expansion in voltage prompts a lessening in force, this implies that the PV module's working point is on the privilege of the MPPT, and along these lines, more aggravation to one side is needed to arrive at the MPPT. For the charge controller, the flow chart of the adopted P&O algorithm is given in Fig. 8. It tests the PV and battery voltages when the MPPT charging regulator is associated between the PV module and the battery. It chooses whether the battery is wholly energized or not, subsequent to figuring the battery voltage. At the point when the battery is wholly energized (12.6 V at the battery terminal), charging stops to try not to cheat the battery. In the event that the battery isn't wholly energized, it begins charging by actuating the DC/DC converter. The microcontroller will at that point compute the current force Pnew at the yield by estimating the voltage and current, and contrast this determined force with the past estimated power Pold. On the off chance that Pnew is more noteworthy than Pold, the PWM obligation cycle is expanded to remove most extreme force from the PV board.The duty cycle is shortened if Pnew is lower than Pold to ensure that the machine goes back to the previous maximum capacity. This MPPT algorithm is quick and easy to implement, with high accuracy and low cost.

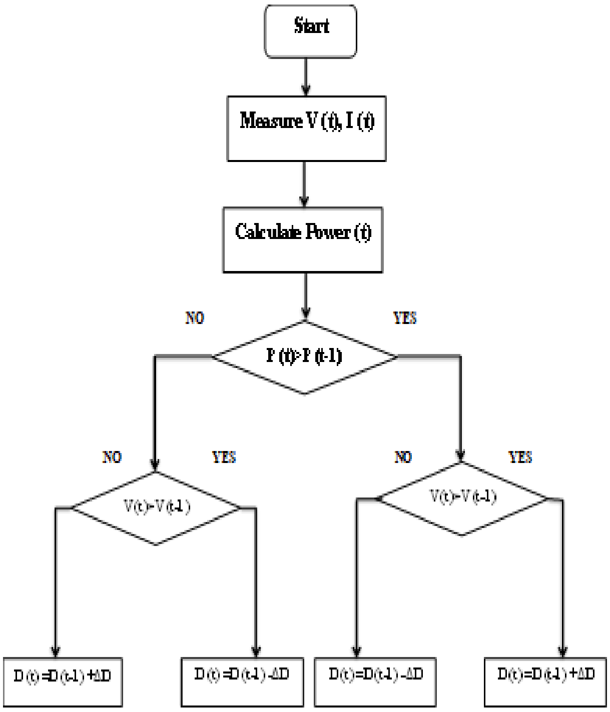

Fig.3 P&O Algorithm flowchart

DESIGN OF CHARGING STATION OF EV

"Electric vehicle charging station is composed by the following elements: Wind farm of 4.5mw, PV Farm of 4mv, Diesel Generator of 15mw, V2G of 4mw. Residential Load is of 10mw and PF 0.15.Dyn11 connection manner is used in the distribution transformer, which can prevent the three times and integer multiples of three times harmonics flow into the utility grid. Under the three-phase balance condition, only the voltage and current of phase-a are analyzed in this paper, and the conclusion of the other two phases will be the same. The output Load of Diesel, Wind and Solar power is shown in figure 9".

SIMULATION DIAGRAM

PV cells are the source of power The battery is charged genuinely from the PV cells during the time when the power is adequate and gets feed among DC to DC converter and this uploads the battery charge evidently.Solar power connected battery used in E-bike model is designed and simulated using matlab/Simulink.simulink model shown in Fig.4 and obtained the corresponding voltage, current, SOC waveform. The MPPT battery charge controller for the standalone photovoltaic system model has been simulated successfully in MATLAB/Simulink environment for performance analysis.

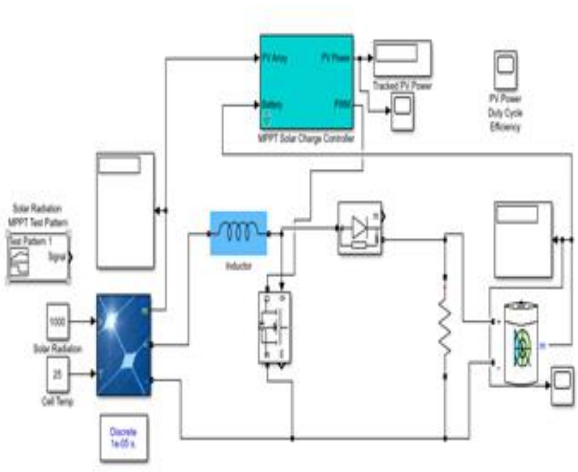

Fig.4 Simulation diagram of solar E-bike charging system

SIMULATION RESULT

"The simulation result it is clear that panel is operating at maximum power and charging the battery. State of charge of battery is continuously increasing showing in fig.6.that battery is charging. solar panel simulation result of V-I characteristics ,varying irradiance shown in figure 6".

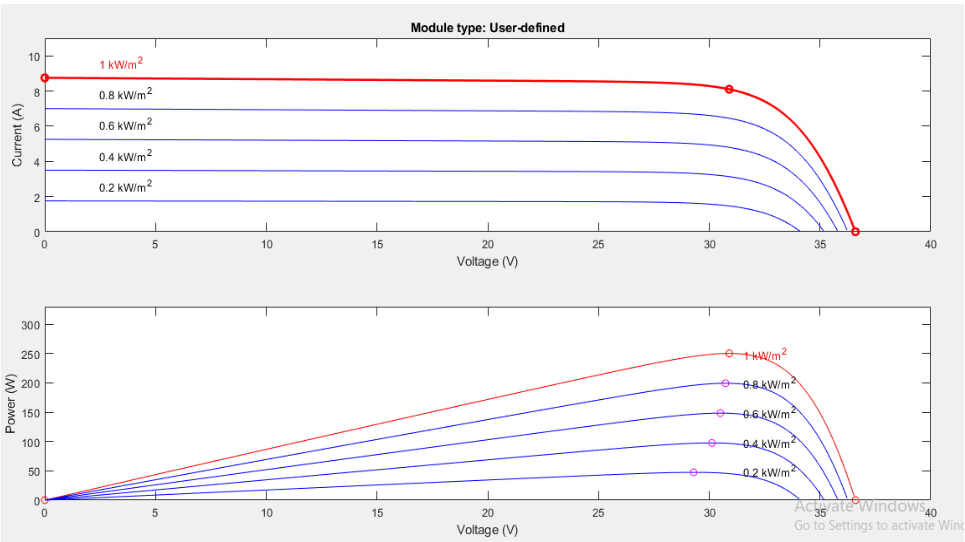

Fig.5 I–V characteristics, varying irradiance at constant temperature

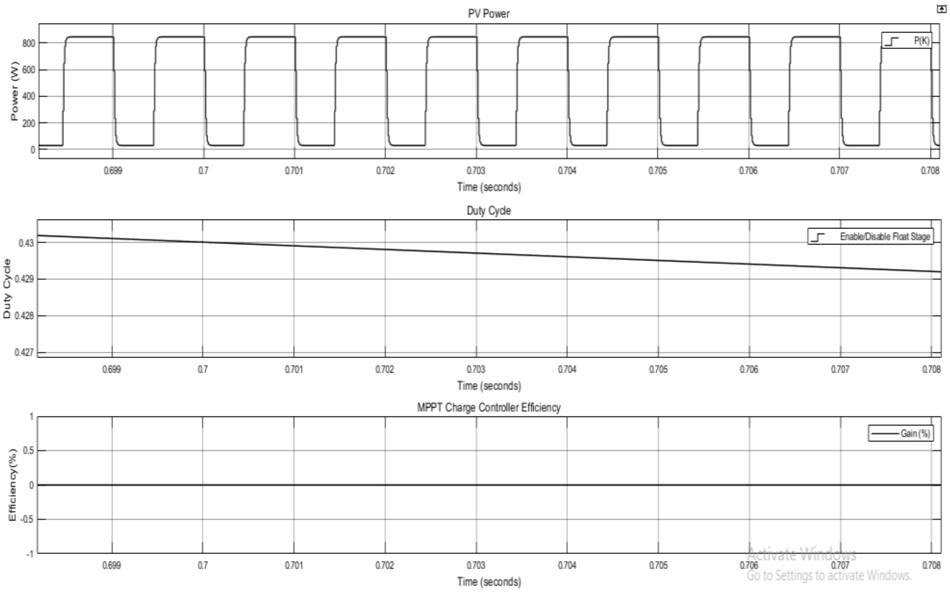

Fig.6 MPPT P&O algorithm tracking performance

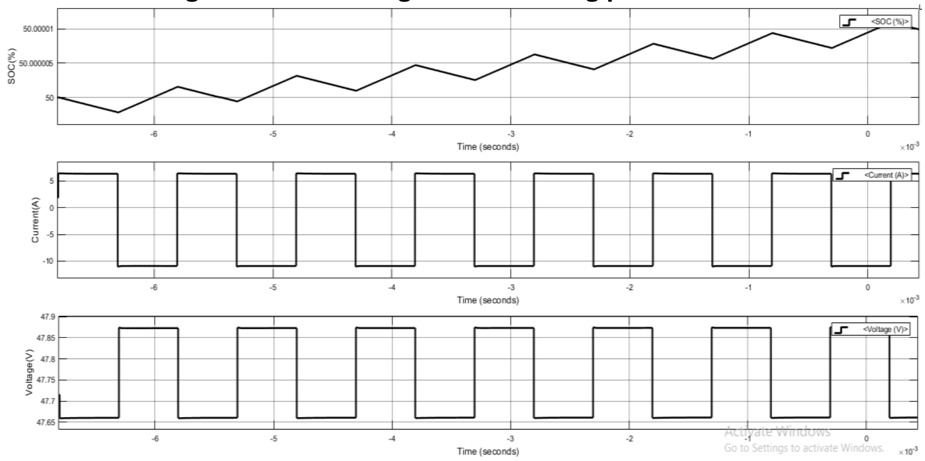

Fig.7 Battery module performance

CONCLUSION

"A detail circuitry modeling of a Solar PV MPPT battery charge model in Simulink is presented. The MPPT P&O tracking algorithm, boost converter circuit and charge controller are clearly explained. The MPPT battery charge controller is capable to charge a 48 V lead-acid battery through tracking the maximum power from the PV array power source and regulate the charging. The Simulink model of solar power based battery is presented MPPT algorithms are much effective in case of solar panel to extract the maximum power out of the panel. It is a reliable method for charging lead acid. This paper shows the best method of utilizing the solar energy for battery this battery used in EV. The purpose of the paper i.e. the development of an effective and optimized system has been achieved".

REFRENCES

1 C.D. Ajudiya,M. M. trivedi, "Design and Development of EBike –A Review" Iconic Research and Engineering journalsVol.1 Issue 5- Nov 2017

2 Kumari, J. S., Babu, D. C. S., & Babu, A. K. (2012). Design and analysis of P&O and IP&O MPPT techniques for photovoltaic system. International Journal of Modern Engineering Research, 2(4), 2174 –2180.

3 Fred Chiou, "Solar Energy for Electric Vehicles"2015 IEEE Conference on technology for sustainability.

4 Suwannatrai, P., Liutanakul, P., & Wipasuramonton, P. (2011). Maximum power point tracking by incremental conductance method for photovoltaic systems with phase shifted full-bridge dc-dc converter. In Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), 2011 8th International Conference on (pp. 637-640). IEEE.

5 Yogesh Sunil Wamborikar, Abhay Sinha" Solar Powered Vehicle" Proceedings of the World Congress on Engineering and Computer Science 2010 Vol II WCECS 2010, October 20-22, 2010, San Francisco, USA Renewables 2019 Global Status Report, Renewables Now (REN21), 40 (2019)

6 Mohamed A. Enany, Mohamed A. Farahat, Ahmed Nasr, Modelign and Evaluation of Main Maximum Power Point Tracking Algorithms for Photovoltaics Systems, Renewable and Sustainable Energy Reviews, 58, 1578-1586 (2016)

7 E. Koutroulis, K. Kalaitzakis, Novel Battery Charging Regulation System for Photovoltaic Applications, IEE Proceeding – Electric Power Applications, 151, 191-197 (2004).