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Operation and Control of Photovoltaic Panel Based EC Motor by using Optimized MPPT

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Abstract: ***Solar power has crucial prospective included in each and every Non –conventional sources of energy. As utilization of Non –conventional sources of energy is an alternative resolution for overcoming the world wide warming. This paper presents, a converter, power inverter and power point tracking is employed for operation of four quadrant. The management by exploitation Particle swarm optimization (PSO) MPPT technique. When the output voltage of photovoltaic panel is step up in order to met the input of the motor. The MPPT is employed to Photovoltaic system was enforced and it's provided for a DC- DC device. The management regarding electronically commutated Motor is usually hall detector is required to determine. The position and speed and armature by manipulation. The Electronically commutated Motor is managed completely in all modes of operation and additionally power is maintained all over the regenerative mode. The paper accustomed reduces in every Mode of operation. This Proposed paper has being executed in MATLAB/SIMULATOR software system.***

Keywords: ***Electronically commutated Motor (ECM), PSO-Particle swarm optimization MPPT, step up/step down converter, PV-photovoltaic.***

I. INTRODUCTION

Consumption of inexhaustible sources of energy is changing into a lot of trends in recent years. Renewable energy sources are abundant use full as compare with Non- Renewable in terms of efficiency, maintenance and pollution. The utilization of stellar array to synchronize Brushless DC motor with four Quadrants. Solar collector which is amongst the most effective substitutes as sustainable sources of energy. The country like China has generated potentiality through Photovoltaic cell in higher extent. In India, Rajasthan state is victimization additional alternative energy.

In PV panel, light energy is regenerate into electricity as DC power. Furthermore, photovoltaic is additionally having one disadvantage of less generation. To overcome this disadvantage and many techniques were introduced.

The techniques are Perturb & Observe methodology (P&O), incremental conductance technique (INC), modified inc,Constant voltage and Constant Current.Conventional paper uses the incremental conductance methodology on control BLDC motor [1].despite the fact that, attributable to shading and dirt on the Panels some quantity of energy is got loosed detail clarification for P&O methodology was explained in [1].

In this paper PSO technique as to enhance power utmost were mentioned in [2] as were followed. Comparisons of this techniques were given in this paper [3], Comparison of assorted technique were mentioned in terms of Convergence, Complexity, detected parameters and Periodic standardization.

BLDC motor was controlled this paper in Four Quadrants. Attributable to victimization electronic Commutation like Hall sensing element, losses were reduced. Extraction of current is a adequate, correspondingly having zero losses' motors were employed in low and medium power applications.

II. PROPOSED SYSTEM

A. Schematic Represenstation :

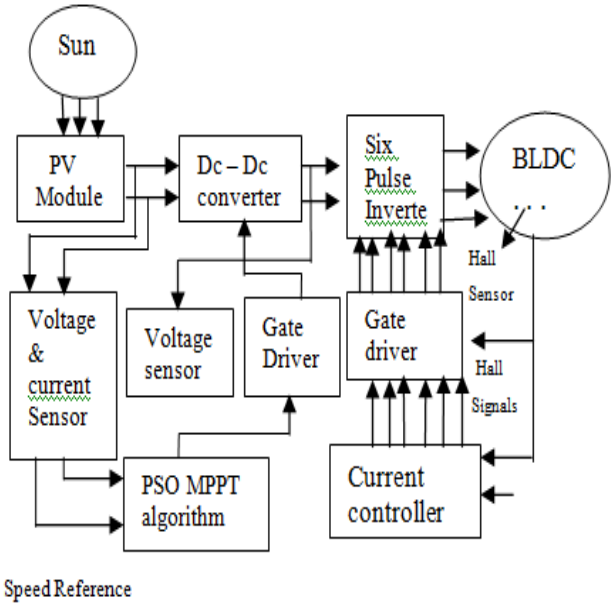

Fig.1 Schematic designed system.

The diagram as be revealed in figure.1in view of this paper. It include PV Module, DC-DC converter, six pulse electrical converter, Electronically Commutated Motor and Regulator with MPPT.The implemented technique was applicable for solar array that exacts daylight and it's regenerate electric power .

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III. PV-MODULE SYSTEM CONFIGURATION

A. *Photovoltaic cell*

PV Modules are connected asynchronous and parallel ways. It works on photoelectrical principle, as once Sun light falls on the PV panel it produces some energy [4].

This created heat may be wont to break the Bond among the molecule. These free electrons within the sense production of the ability. The fundamental structure of Module was given in below figure.

Resistors affix with in parallel and series manner appear for losses of Panel. The values of R_{sh} are a lot of and R_s are less, thus on flow the current while not circulating in Panel.

$$I = I_L - I_o\left(e^{\frac{q(V+IR_s)}{KT}} - 1\right) - \frac{V+IR_s}{R_{sh}} \quad (1)$$

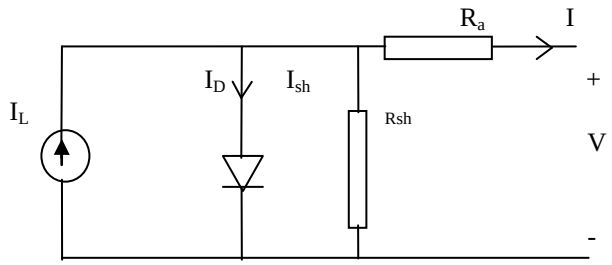


Fig.2: Basic structure of PV.

The above fig.2 represents be contingent on PV array and equation refer to current in solar panel to be contingent on temperature and therefore the power.

B) *Proposed Technique of power point tracking:*

Power generated at PV panel wasn't enough to run the load. So, to overcome the problem MPPT was introduced. These metholodthy are developed in paper [5].

1) *Proposed Technique:*

Particle Swarm optimization technique was introduced to urge higher values than INC methodology.PSO is associate intelligent based mostly Search algorithmic rule, within which it's agents (particles).These agents can rummage around for the fitness values (best solution).

Each particle searches in their coordinates and tries to trace a best resolution [6]. This best resolution is termed P_{best}.As well as, there's a best answer calculated by PSO way the other neighborhood molecule. Now, locations as well as momentum belonging to molecule are often calculated as given below equation.

$$V^{k+1}{}_i = w * {v_i}^k + r_1 * c_1 * (P_{best} - {x^k}_i) + r_2 * c_2 * (G_{best} - {x^k}_i) \quad (2)$$

$${x_i}^{k+1} = {x^k}_i + {v_i}^{k+1} \quad (3)$$

Where i represent the variable of particle vector and k represents the iteration, w represents inertia that maintains the balance between the native and world search.C_1 , C_2 are the acceleration constants.r1 and r2 are random numbers in [-1 1].

The best position of particle P_{best} is given by

$$P_{besti} = {x^k}_i \text{ if fit}({x_i}^k) \geq fit(P_i) \quad (4)$$

2) *Particle Swarm Optimization Methodology:*

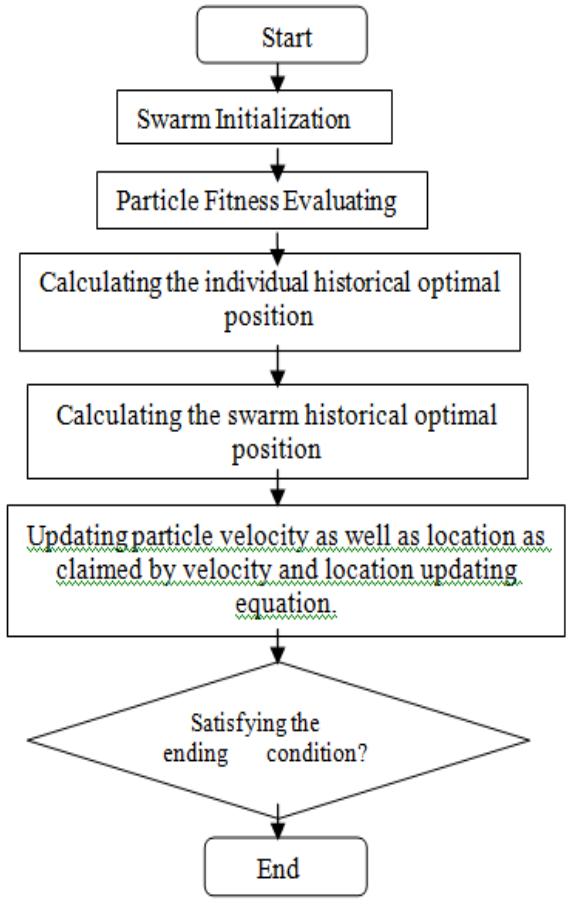


Fig 3: Schema chart of PSO MPPT

3) *Working of PSO:*

i) Initialize the values.
ii) Calculate the present fitness of agents.
iii) Attribute agents with initial position and speed.
iv) Calculate fitness worth of every agent.
v) Find world best fitness worth.
vi) Update particle location and speed.
vii) Analyze current best fitness worth.
viii) Repeat Vii and Vii until u get best values.
ix) Terminate, once the criterion is reached.

4) *PSO ALGORITHM:*

- For each particle $i = 1, ..., S$ do:
- Initiate the molecule location accompanied by invariant allocated indiscriminate variable quantity: $\mathbf{x}_i \sim U(\mathbf{b}_{lo}, \mathbf{b}_{up})$, where $\mathbf{b}_{lo}$ also $\mathbf{b}_{up}$ are the lower with upper boundaries of the search-space.
- Initialize the molecule notable location to its initial position: $\mathbf{p}_i \leftarrow \mathbf{x}_i$
- If ($f(\mathbf{p}_i) < f(\mathbf{g})$) update the swarm's best known position: $\mathbf{g} \leftarrow \mathbf{p}_i$
- Initialize the particle's velocity: $\mathbf{v}_i \sim U(-|\mathbf{b}_{up}-\mathbf{b}_{lo}|, |\mathbf{b}_{up}-\mathbf{b}_{lo}|)$ Until a

termination criterion is met (e.g. number of iterations performed, or adequate fitness reached), repeat:

- For each particle $i = 1, ..., S$ do:
- Pick random numbers: r_p, $r_g \sim U(0,1)$ Particle swarm optimization
- Update the particle's velocity: $\mathbf{v}_i \leftarrow \omega\, \mathbf{v}_i + \varphi_p\, r_p\, (\mathbf{p}_i - \mathbf{x}_i) + \varphi_g\, r_g\, (\mathbf{g} - \mathbf{x}_i)$
- Update the particle's position: $\mathbf{x}_i \leftarrow \mathbf{x}_i + \mathbf{v}_i$
  If ($f(\mathbf{x}_i) < f(\mathbf{p}_i)$) do:
- Update the particle's best known position: $\mathbf{p}_i \leftarrow \mathbf{x}_i$
- If ($f(\mathbf{p}_i) < f(\mathbf{g})$) update the swarm's best known position: $\mathbf{g} \leftarrow \mathbf{p}_i$

Now **g** holds the best found solution.

C) Dc-Dc converter:

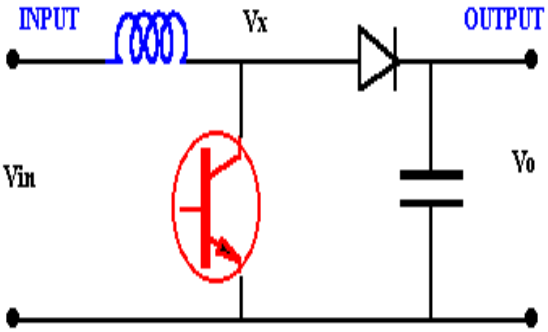


Fig 4: Electronic schematic of Boost Converter.

In DC bus, this manages the Photovoltaic voltage as shown. The above picture shown electromechanical device as long as the converter output voltage is higher then or but the input voltage [8] .

This device output was managed by dominant the change Gate drivers and OFF fundamental quantity .The converter that is coupled to solar array so as to regulate operational current and voltage. The device operates in 2 methods may be continuous mode and discontinuous mode. Above device could exist as boost sort converter that boosts the obtained voltage from MPPT voltage and delivers to electrical converter.

IV. BLDC MOTOR:

A) *Basic control of Electronically Commutated Motor.*

A lot of convenience as compared to electronically commutated motor as well as quiet, and quick dynamic response. Electronically commutated motor has vital motor in recent times it's a supplicant to DC motor. Hall sensing elements are often utilized in place of commentator to reduce the losses. It senses either high or low signals once rotor passes across them. These logic signals accustom calculate the sequence of commutation. The decoded output is to trigger the pulses[11].

B) *Performance of EC Motor in all modes:*

EC motor may function in four modes as shown in below figure.

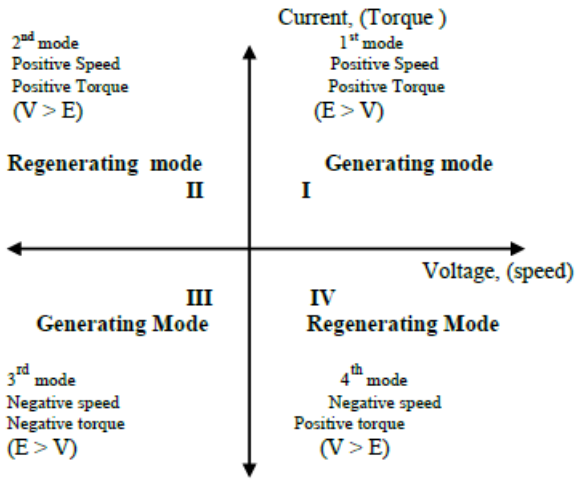


Fig 5: Modes of operation of an EC motor.

V. SIMULATION RESULTS:

Analysis and discussion of the PSO Methodology were discussed .

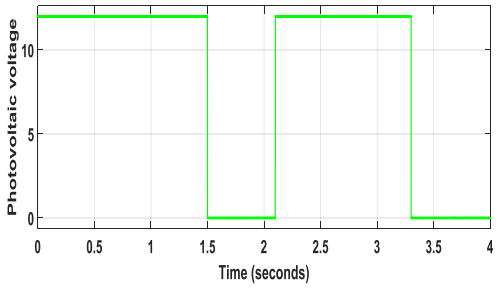


Fig 6: photovoltaic voltage.

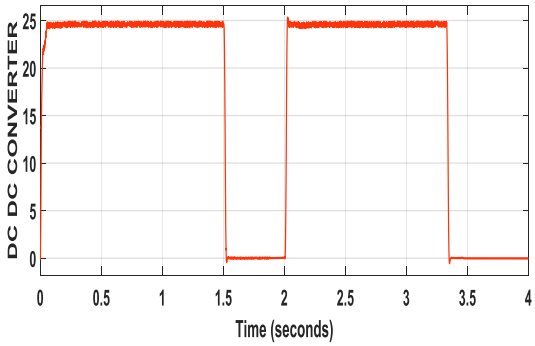
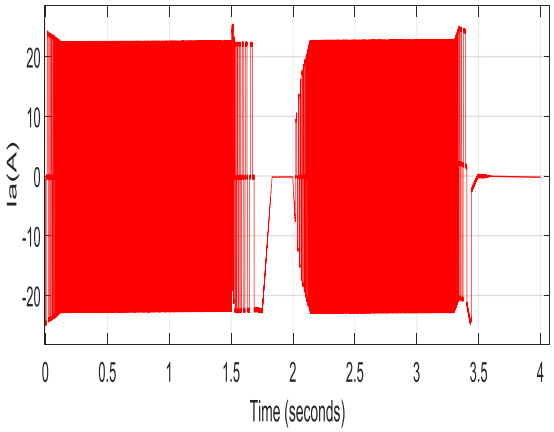
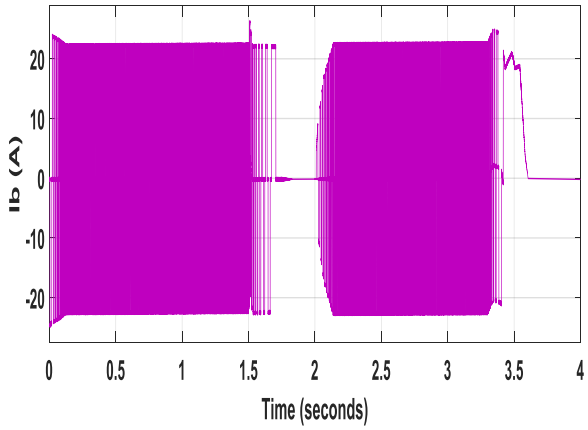


Fig 7: Boost Converter Voltage.





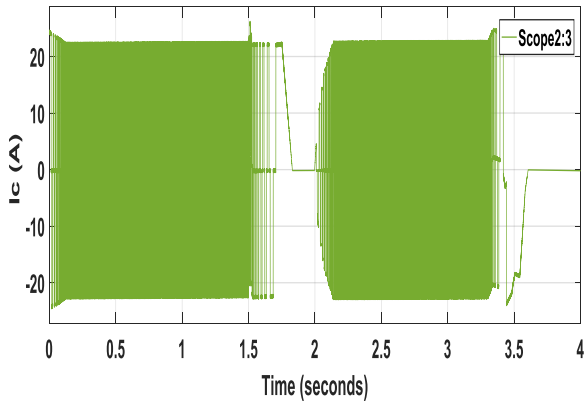


Fig 8: Phase currents of motor.

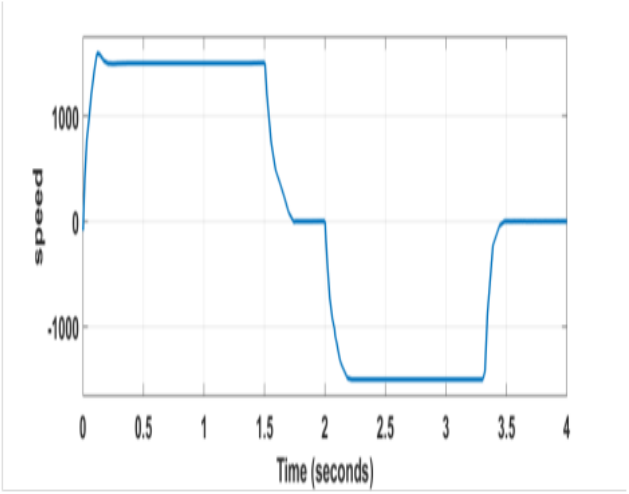


Fig 9: Speed of motor

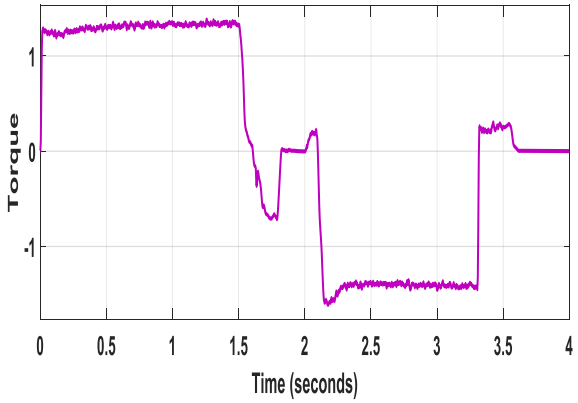
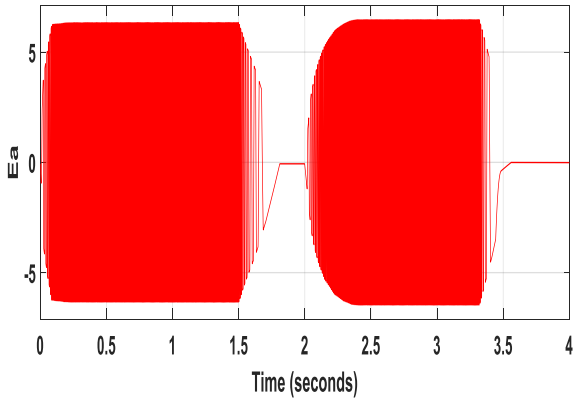
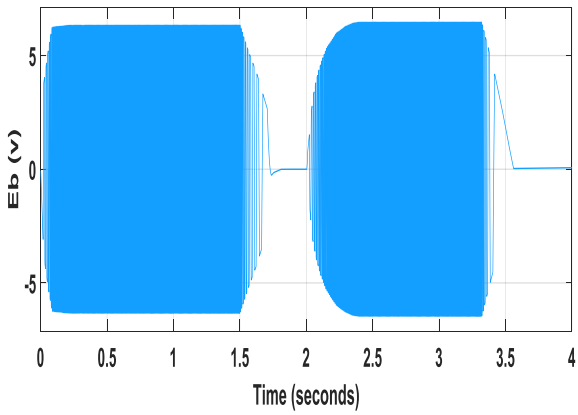


Fig 10: Torque of motor.





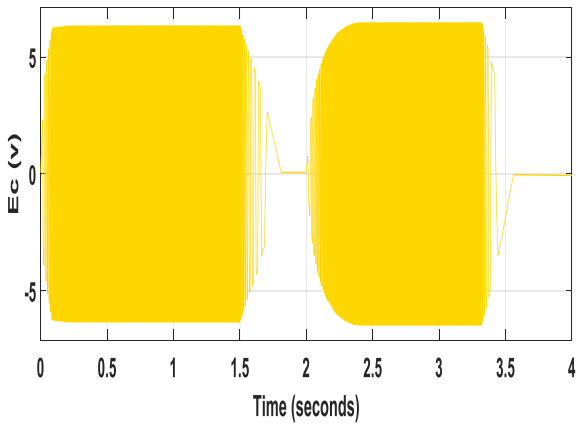


Fig 11: Counter electromotive force of motor.

A)Simulink Module :

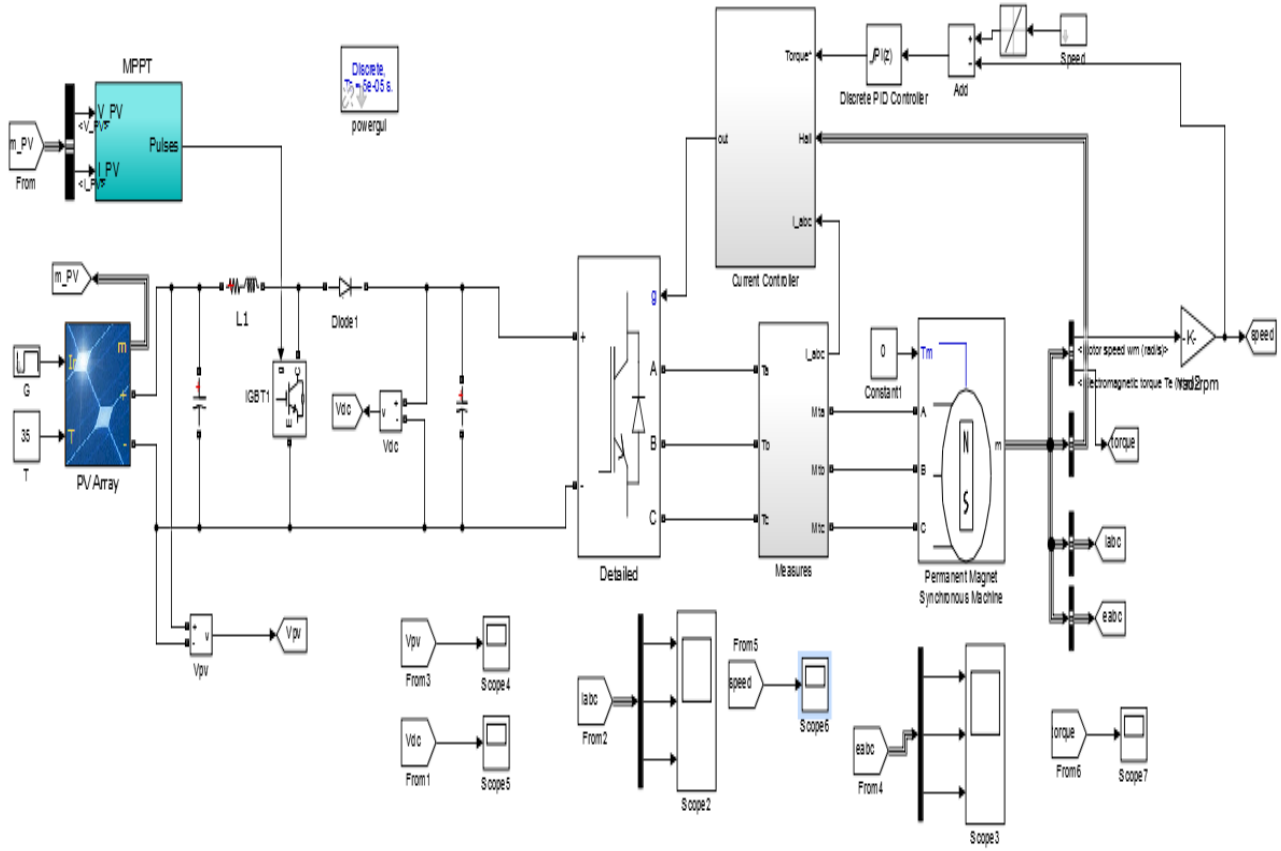


Fig 12: Ability of all modes in electronically commutated Motor

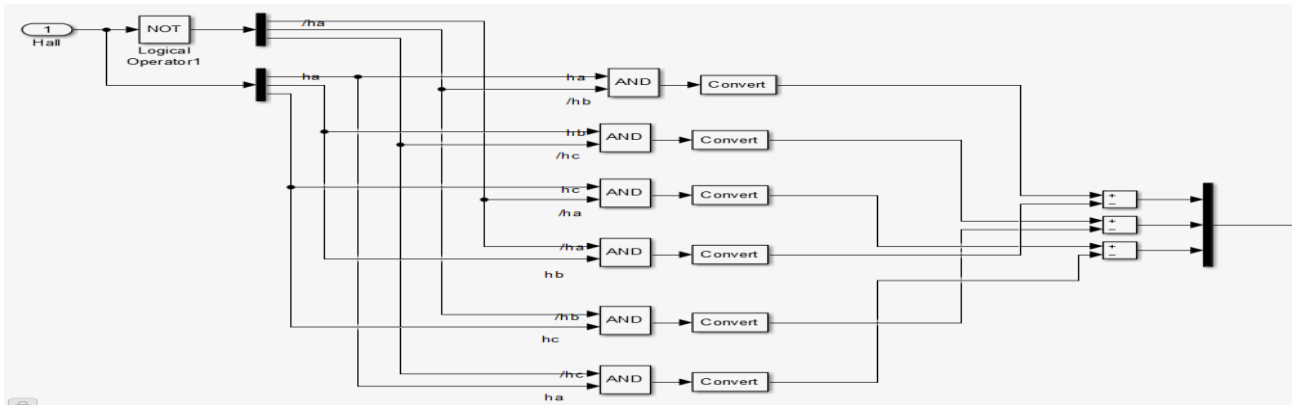


Fig.13: shows the Hall-sensor decoding setup.

B)Current Controller:

Current controller was accustomed generate the pulses. This controller decodes the values taken from Hall-effect detector and a generated current signal, that additional converts to gating pulses.

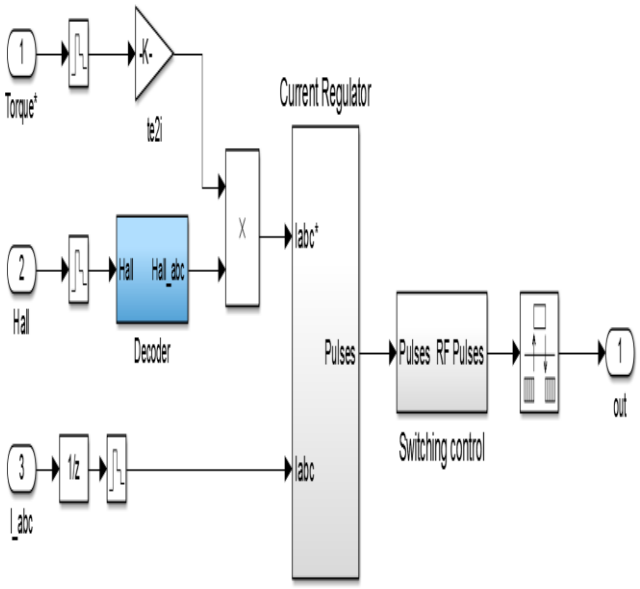


Fig.14:Simulink setup for Regulator.

C)PI Controller :

Proportional & Integral Controllers Proportional + Integral (PI) controllers were developed due to the fascinating property that systems with open loop transfer functions of kind one or above have zero steady state error with regard to a step input.

The PI regulator is:

$$\frac{(U(s))}{(E(s))} = K_p + \frac{KI}{S} \qquad (5)$$

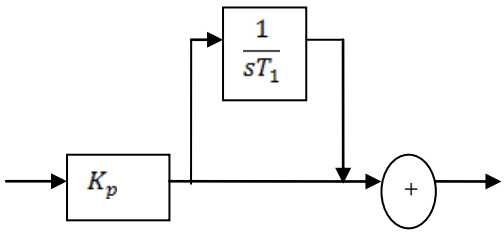


Fig 15:Pi controller.

From proposed results, there are some parameters that we'd like to require are settling time, rise time, Peak time and Overshoot.

As we've taken higher technique at MPPT, the values are of settling time for PSO and INC are of 14.660 m.sec and 19.791m.sec severally and undershoot is of 2.404% and 35.809% severally. For Overshoot it's of 1.618% and 14.720respectively.

There are some variations in speed too, Peak time for PSO and INC area unit of 0.115m.sec and 0.328m.sec .Moreover, for torque it's of 1.257m.sec and 1.504 severally, there are some less fluctuations and a lot of stability in PSO results as compared with INC technique.

VI. CONCLUSION

This paper proposed a Photovoltaic energy based mostly operates in all modes by dominant of electronically commutated motor by dynamic improved methodology at MPPT was determined. A machine reverse its direction nearly outright, it'll experience zero however the transition is simply quick. Consumed time to attain this regeneration is relatively reduced. The MPPT management algorithmic program worn at this moment, the power point tracking rapidly while not oscillations. Peak time is a smaller amount for PSO as compare with INC, thus response is quick and a lot of stable. As reaction time decreases, speed of operation will increase and accuracy of dominant is additionally will increase.

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