

# Survey on maximum power point tracking control for a photovoltaic-solar pump system

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**Abstract**— The source for power to operate pumping of water has a vital application by means of Solar PV systems. The present research article discusses the workability and performance of PV plants particularly in conditions of altering climatic conditions and load fluctuations. The investigated system comprises of a collection of solar panels, incorporation of DC motor, pump (centrifugal type) and algorithm of MPPT to enhance the overall efficiency of the PV module system.

**Keywords**— Photovoltaic, MPPT, DC Motor

## I. INTRODUCTION

Today the world has encountered difficult issues in the energy field. The world's fossil fuel product subordinate reserves are dynamically depleted, requiring new wellsprings of vitality. This vitality issue is similarly reliably associated with biological issues. Up until this point, fossil vitality is considered as a wellspring of characteristic sullyng. Thusly, new wellsprings of vitality are required, endless and earth neighbourly. Pretty much every nation on earth has tried to discover new, sustainable and naturally benevolent energy sources. Nation of Indonesia is one of the nations on the planet that give genuine regard for new energy source, inexhaustible and ecologically cordial. The Indonesian government has issued a law on electricity that by 2025 the contribution of power generated from renewable energy is 23%, and 2050 to 31%. The issuance of this law is proof that the Indonesian government is committed to the environment that has become an important world issue associated with energy utilization. The Government of Indonesia has energized scholastics, professionals, and specialists to discover new and potential sustainable power hotspots for use all through the nation.

Elevated sunlight exhibit yield power which can be performed by augmenting yield power dependent on sun oriented cluster execution attributes, called Maximum Power Point (MPPT). A few strategies have been applied to get maximum power in this MPPT innovation, among which are customary techniques, in addition with harmony search algorithm, ANN, as well as FLC, also including PSO, along with GA, plus the ant colony optimization, optimization by chuckoo search, and any others. Fundamentally, these

strategies work dependent on the essential rule of enhancement, which is to discover and locate the maximum power point. Notwithstanding the maximum hunt power, these strategies additionally contend as far as figuring time. The shorter the hunt times the maximum power point, the better the technique.

### A. The need for Renewable Energy

Renewable form of energy originates from common assets, for example, daylight, as well as wind, including downpour, along with tides and geothermal heat. These assets are renewable and can be normally recharged. In this way, for every single useful reason, these assets can be viewed as limitless, in contrast to decreasing traditional fossil fuels. The worldwide energy crunch has given a recharged impulse to the development and development of Clean and Renewable Energy sources. Clean Development Mechanisms (CDMs) are being received by associations the whole way across the globe. Aside from the quickly diminishing stores of fossil fuels on the planet, another main consideration neutralizing fossil fuels is the contamination related with their burning. Contrastingly, renewable energy sources are known to be much cleaner and produce energy without the destructive impacts of contamination not at all like their regular partners.

### B. Renewable Energy trends across the globe

The present pattern crosswise over created economies tips the scale for Renewable Energy. Throughout the previous three years, the mainlands of North America and Europe have grasped progressively renewable power limit when contrasted with ordinary power limit. Renewables represented 60% of the recently introduced power limit in Europe in the year 2009 and almost 20% of the yearly power generation.

As displayed in the figure 1, wind and biomass possess a noteworthy portion of the current renewable energy utilization. Late progressions in sun oriented photovoltaic

innovation and consistent hatching of tasks in nations like Germany and Spain have brought around huge development in the sun oriented PV showcase too, which is anticipated to outperform other renewable energy sources in the coming years.

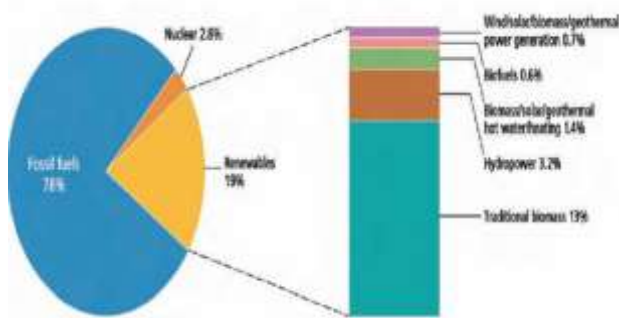


Fig.1 Global energy consumption in the year 2008

## II. LITERATURE SURVEY

**Mohamed Fawzy El-Khatiba et al.** An epic procedure was actualized to remove the maximum power from a photovoltaic (PV) framework under a DC siphoning load. The Maximum Power Point Tracking (MPPT) of the framework was broadly examined utilizing two controllers under various working conditions. These controllers are the Simplified Universal Intelligent (SUI) PID controller and the Fuzzy Logic Controller FLC. The PV framework execution with the two controllers was reproduced utilizing MATLAB/Simulink. The accompanying ends can be drawn:

- 46–380% expansion of the water supply stream rate was accomplished by actualizing the MPPT control at various irradiance levels. The SUI-PID controller offers 2.2% more water stream rate contrasted with the Fuzzy Logic Controller (FLC).
- Quick reaction and better ascent time were acquired by utilizing the SUI-PID controller contrasted with the Fuzzy Logic Controller (FLC). The time taken to arrive at the relentless state by the SUI-PID controller was 3.7 ms, while that with the FLC was 5.5 ms. This prompts a quicker and progressively precise procedure.
- Brilliant capacity to follow the PV board maximum power point will be acquired by utilizing the SUI-PID controller during abrupt changes in irradiance levels contrasting and the cutting edge.
- The benefits of utilizing the SUI-PID controller with the Photovoltaic-Pumping frameworks are the effortlessness in plan and execution. Additionally, the SUI-PID controller actualizes a knowledge calculation which prompts quicker, simpler, and increasingly exact control process.

**S. Shabaana, et al.** presents an investigation of MPPT for PV frameworks and its application for a dc siphon load under changing light and temperature conditions. The

demonstrating of the PV module dependent on single diode Rp model accomplishes great coordinating with information sheet data. Reenactment of the PV framework with dc engine siphon has been actualized with MPPT versus direct coupling framework by MATLAB. The examination demonstrates that the PV framework without MPPT has poor effectiveness due to bungling between the PV module and the heap. The MPPT guarantee impedance coordinating between the PV and the heap for maximum power move by controlling the obligation cycle of the DC–DC support converter. Then again, it demonstrates that the MPPT procedure expands the sun based yield power from 20.1% to 82.7% more than direct coupling. Various sorts of MPPT calculations have been looked into. ANFIS MPPT calculation is recreated to accomplish maximum power move. ANFIS calculation shows better execution regarding proficiency contrasted with direct coupling. ANFIS reaction is quick, less wavering and the addition in the yield power is high at all irradiance levels. A further correlation has been made as far as speed of engine demonstrates that the framework with ANFIS calculation can siphon more water than direct coupling.

**Tourkia Lajnef et al.** presented a SIMULINK model of a photovoltaic structure made up of a PV generator, MPPT converter supplying an asynchronous motor –pump. The main conclusion remarks are summarized as follows:

- 1- A remote PV pumping system unit was designed.
- 2- Exclusive methodology is applied in removing the storage battery and implementing newer control system for the pumping action.
- 3- Incorporation of algorithm of MPPT which enhances the transfer of energy for the complete unit system.
- 4- Simulations were carried out to observe the static as well as dynamic behavior.

**RAMADONI SYAHPUTRA, et al.** design of adaptive neuro-fuzzy system-based maximum power point tracking (MPPT) for solar array system has been presented in this study. Validation test has been done to solar array system model. This validation test to ensure that the model is made correctly. Validation results indicate that the model is feasible to be used in research. Furthermore, based on the results of solar array system test with MPPT based on adaptive neuro fuzzy system show that the method used has worked very satisfactorily. The important variables observed in this research are load current, output voltage, and power output of the solar array system. Although slightly oscillatory, but overall the results showed excellent method performance. The maximum output power generated is 83 watts, this indicates that the efficiency of the solar array system maximum is 83%. Thus MPPT-based adaptive neuro-fuzzy system has worked very well.

**I. I. Ekpoudom et. al** The displaying of Fuzzy Logic Controller (FLC) for controlling the speed of a field-controlled DC engine of a crisis lube oil siphon, during lingering activity of a 5.5KW, H25 Hitachi Turbine Generator at Bonny Oil and Gas Terminal, has been introduced. The outcomes from the engine demonstrated and mimicked showed that dependent on industry parameters, the engine accomplished a maximum speed of 1414rpm. In any case, the formed FLC was acquainted into the control circle with right the speed of the DC engine to the required working rate of 1450rpm for the lube oil siphon. The reproduction results were gotten utilizing MATLAB/Simulink. The outcomes demonstrated that the overshoot, settling time, crest time and control execution improved significantly by utilizing FLC. Time space execution records, for example, crest time; rise time, settling time and relentless state blunder demonstrated that the FLC empowered the DC engine to perform quicker and better when the states of the enrollment elements of the controller were balanced in like manner.

**S. FARZANA BEGUM et. al** Transient soundness improvement byPV ranch with ANFIS-PID controller in the two territory interconnected power framework has been proposed. Thus, the PV yield power can be constrained by the ANFIS-PID controller, with the goal that the framework transient adjustment can be accomplished. To achieve both balancing out impact and maximum yield power of PV, the scale factor, Membership Functions MFs, and control rule parameters of ANFIS-PID controller are ideally tuned by Hybrid Algorithm. Reenactment results affirm that better balancing out impact and vigor of PV is gotten with ANFIS-PID control when contrasted with ideal PID control, FUZZY Control, FGS-PID control, and Adaptive FGS-PID control. Time space determinations uncover that ANFIS-PID Controller gives lesser settling time, overshoot and fast reaction. These talks speak to that associating PV age to a power framework will improve the transient dependability and make a power framework progressively steady. Likewise can be inferred that ANFIS-PID Controller indicates predominance in decreasing THD in power framework with above depicted controllers.

### III. DIFFERENT SOURCES OF RENEWABLE ENERGY

#### A. Wind power

Wind turbines can be utilized to outfit the energy accessible in wind streams. Current day turbines extend from around 600 kW to 5 MW of appraised power. Since the power yield is an element of the 3D square of the wind speed, it increments quickly with an expansion in accessible wind speed. Ongoing progressions have prompted aerofoil wind turbines, which are progressively proficient because of a superior streamlined structure.

#### B. Solar power

The tapping of sun powered energy owes its causes to the British cosmologist John Herschel who broadly utilized a sun powered warm authority box to prepare nourishment during an undertaking to Africa. Sunlight based energy can be used in two noteworthy ways. Right off the bat, the caught warmth can be utilized as sun based warm energy, with applications in space warming. Another option is the change of episode sun based radiation to electrical energy, which is the most usable type of energy. This can be accomplished with the assistance of sun oriented photovoltaic cells or with concentrating sunlight based power plants.

#### C. Small hydropower

Hydropower establishments up to 10MW are considered as little hydropower and considered renewable energy sources. These include changing over the potential energy of water put away in dams into usable electrical energy using water turbines. Run-of-the-stream hydroelectricity plans to use the dynamic energy of water without the need of structure stores or dams.

#### D. Biomass

Plants catch the energy of the sun through the procedure of photosynthesis. On ignition, these plants discharge the caught energy. Along these lines, biomass fills in as a characteristic battery to store the sun's energy and yield it on necessity.

#### E. Geothermal

Geothermal energy is the warm energy which is produced and put away inside the layers of the Earth. The angle in this manner created offers ascends to a consistent conduction of warmth from the center to the outside of the earth. This inclination can be used to warmth water to create superheated steam and use it to run steam turbines to produce power. The fundamental weakness of geothermal energy is that it is normally constrained to areas close to structural plate limits, however ongoing progressions have prompted the proliferation of this innovation.

### IV. MAXIMUM POWER POINT TRACKING

A MPPT is basically a DC to DC converter (electrical). This system is for the most part worked with sunlight based cluster (PV boards) and few breeze turbines to acquire maximum power transmission and convert it to coordinate with whatever heap it is being associated with utility lattice, battery bank or some other burden. The most widely recognized trouble of MPPT is that its proficiency shifts with the measure of daylight. At the point when the measure of daylight falling on the board changes, the attributes of the heap changes to a point where the framework can get maximum power productivity. The capacity of MPPT is to

find this heap point and keep up the power move to ideal and this heap is called maximum power point.

There are a few sorts of MPPT strategies, of them most ordinarily utilized and direct techniques are the Perturb and Observe Method and Incremental Conductance Method. In any case, there are a few different strategies that are backhanded and are considered very erroneous now and again.

#### A. Short-Current Pulse Method

In this method, MPP is obtained by generating an operating current ( $I_{op}$ ) to a current controlled power converter. Under various situation of irradiance level ( $S$ ), the optimum operating current is proportional to the short circuit current ( $I_{sc}$ ) for maximum power output-

$$I_{op}(S) = k \cdot I_{sc}(S)$$

Here  $k$  is the proportionality constant. Equation shows that if  $I_{sc}$  is detected then  $I_{op}$  can be determined instantaneously, regardless of any temperature changes (temperature usually varies from 00C-600C). The proportionality is approximately estimated to 92%.

So, the measurement of  $I_{sc}$  is required for this control algorithm and to obtain that a static switch is connected to the PV arrays in parallel to create short-circuit. During this short-circuit, PV array voltage ( $V_{pv}$ ) is zero also the PV system neither supplies and power nor generates any energy.

#### B. Temperature Method

The short-circuit current is directly proportional to the irradiance level regardless of what the temperature is, whereas, the open-circuit voltage ( $V_{oc}$ ) of the solar cell mainly changes with the temperature of the cell. This can be shown by the equation-

$$V_{ov} \sim V_{ovSTC} + (dV_{ov}/dT) \cdot (T - T_{SC})$$

Here  $V_{ovSTC}$  is the open-circuit voltage for Standard Test Conditions (STC), the  $T_{STC}$  is the temperature at STC and  $dV_{ov}/dT$  is the rate of voltage change against change of temperature or temperature gradient. The optimal voltage meanwhile can be shown by the following equation-

$$V_{op} \sim [(u + S \cdot v) - T(w + S \cdot y)] \cdot V_{MPP\_STC}$$

Here  $V_{MPP\_STC}$  is the MPP voltage at STC.

There are two different types of method obtainable. They are-

The Temperature Gradient method (TG): In this algorithm obtaining the open-circuit voltage depends on the temperature under STC, from equation 1.3 the optimal value for the open-circuit voltage is obtained by ignoring power losses. The Temperature Gradient (TG) entails the value of the temperature and the value of the VPV for the PI regulator.

The Temperature Parametric Equation method (TP): this algorithm takes into account above equation and decides the value of the optimum operating voltage  $V_{op}$  immediately by measuring  $S$  and  $T$ . Generally, this method also requires the measurement of the solar irradiance.

#### C. Incremental Conductance Method

This is also a common Maximum Power Point Tracking algorithm. According to this method from the P-V characteristic curve there is a single peak value and the maximum power point exist where

$$\frac{dP}{dV} = 0$$

We know that  $P = V \times I$

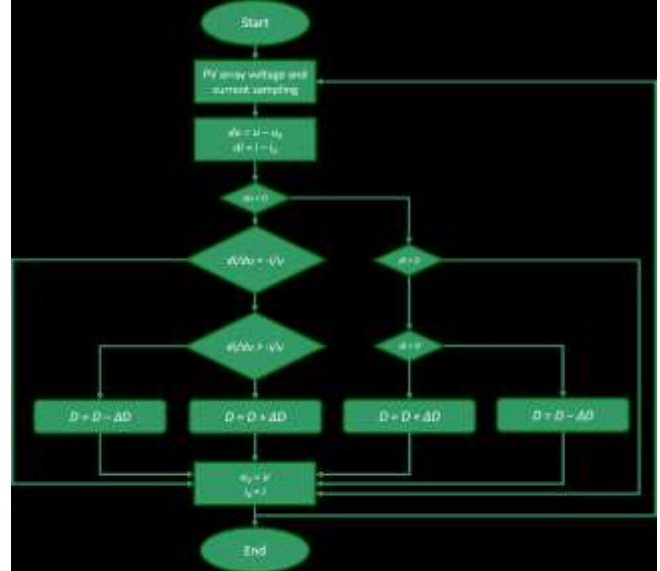


Fig.2 Incremental Conductance Method

#### D. Perturb and Observe Method

In this method, voltage from the array is adjusted by the controller by a small amount and the power is measured. When power increases, further adjustments are carried out until the power is balanced. This method is mostly used due to the ease of it.

Initially the voltage of a cell is increased and the output power is monitored. If power starts to increase the voltage is also increased until the output power starts to decrease again. This process continues until the optimal power point is reached i.e. the MPP.

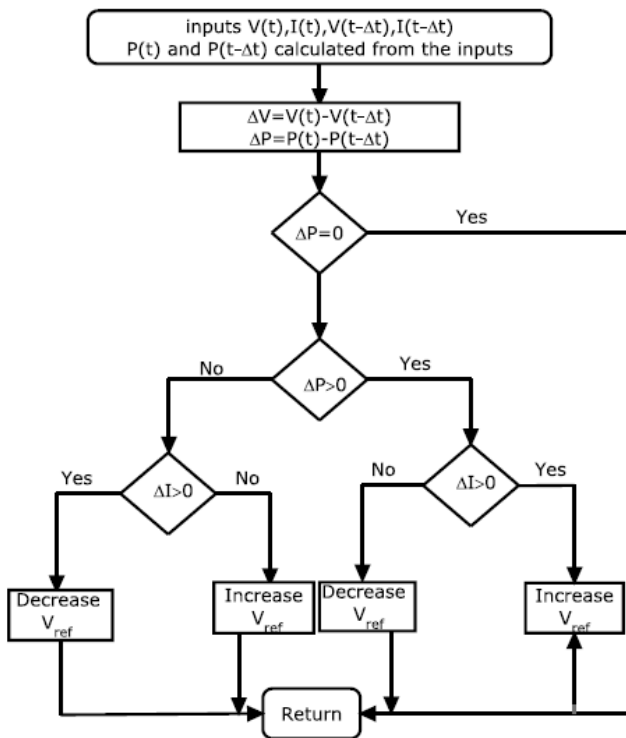


Fig.3 Flow Chart of (P&O) Algorithms

## V. CONCLUSION

In this investigation surveyed the A structure of versatile neuro-fuzzy framework based maximum power point following (MPPT) for sunlight based siphon framework. In this paper different research papers are concentrated identified with the maximum power point following control for a photovoltaic-sunlight based siphon framework. It likewise gives the presentation of the requirement for Renewable Energy. Some extraordinary renewable energy sources are presented in this paper. There are four strategies for maximum power point following techniques are talked about for increment the effectiveness of the framework.

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