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GRID INTEGRATED SOLAR PHOTO VOLTAIC SYSTEM USING FUZZY MAXIMUM POWER POINT TRACKING

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Abstract: - An efficient, cost effective maximum power point tracking (MPPT) algorithm is required to improve the energy utilization efficiency of low power photo voltaic (PV). This paper presents an experimental evaluation of the FUZZY MPPT when employed by a standalone PV pumping system, using an experimental installation comprised of a 1080 Wp photo voltaic array connected to a 1KW Three phase ac motor. The influence of FUZZY parameters on system behavior is investigated and the energy utilization efficiency is calculated for different weather conditions. The performance of FUZZY MPPT is compared to other normal MPPT for advantage, disadvantage and application

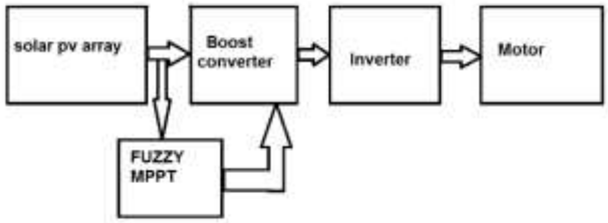
Keywords: Maximum Power Point Tracking, DC voltage, Boost converter, inverter, Three phase output.

I. INTRODUCTION

This section covers the theory and operation of "Maximum Power Point Tracking" as used in **solar**electric **charge controllers**. An **MPPT**, or maximum power point tracker is an electronic DC to DC converter that optimizes the match between the **solar**array (PV panels), and the utility grid. The most recent and best type of solar charge controller is called Maximum Power Point Tracking **or MPPT**. **MPPT** controllers are basically able to convert excess voltage into amperage. This has advantages in a couple of different areas.

II. CIRCUIT DESCRIPTION

The following figure to source 1(a) from the circuit model of solar pv array connect with motor using maximum power point tracking.
The solar pv array connect with the boost converter.



1(a) block diagram

The boost converter is connecting with inverter. In this Model the DC power is converted to AC power. The DC power is converted to Three phase ac power. The ac power is given to the motor. The FUZZY MPPT output is given to the Boost converter. The input of the boost converter is solar pv array output.

We are using matlab simulation software to implement the project model.

III. SOLAR PV ARRAY

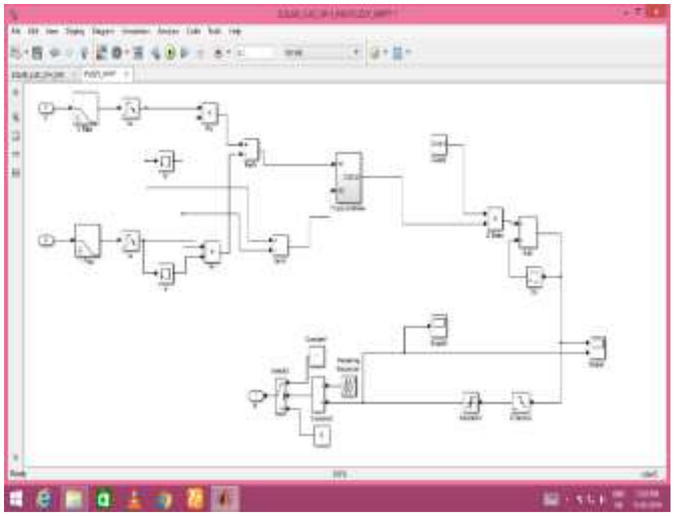
The following figure to 1(b) If *photovoltaic solar panels* are made up of individual photovoltaic cells connected together, then the **Solar Photovoltaic Array**, also known simply as a **Solar Array** is a system made up of a group of solar panels connected together. A *photovoltaic array* is therefore multiple solar panels electrically wired together to form a much larger PV installation (PV system) called an array, and in general the larger the total surface area of the array, the more solar electricity it will produce.

1(b) solar pv array

The solar pv array diagram is given above. The photo voltaic cell is serially connected in the panel.

IV. MPPT

The following figure to source 1(c)An MPPT, or maximum power point tracker is an electronic DC to DC converter that optimizes the match between the solar array (PV panels), and the battery bank or utility grid. To put it simply, they convert a higher voltage DC output from solar panels (and a few wind generators) down to the lower voltage needed to charge batteries



1(c) fuzzy mppt diagram

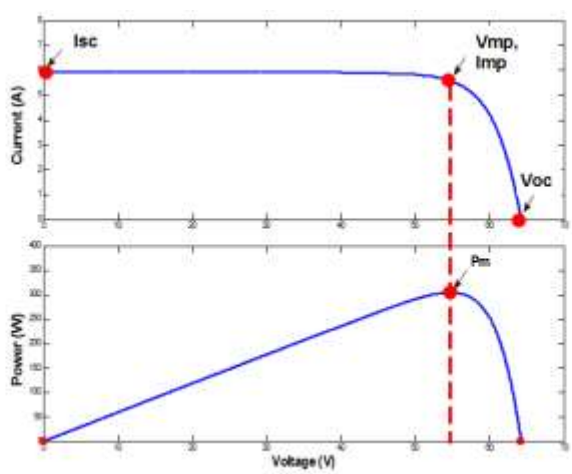
The following figure to 1(c) Maximum Power Point Tracking is electronic tracking - usually digital. The charge controller looks at the output of the panels and compares it to the battery voltage. It then figures out what is the best power that the panel can put out to charge the battery. It takes this and converts it to best voltage to get maximum AMPS into the battery. (Remember, it is Amps into the battery that counts). Most modern MPPT's are around 93-97% efficient in the conversion. You typically get a 20 to 45% power gain in winter and 10-15% in summer. Actual gain can vary widely depending weather, temperature, battery state of charge, and other factors.

Maximum power is defined as product of open circuit voltage and short circuit current.

Power = voltage*current
Maximum power = open circuit voltage * short circuit current

$P_m = V_{op} * I_{sc}$

The maximum power of the pv array graph is given below The following figure to source 1(d).



1(d)

The following figure to 1(d) Solar cell have a complex relationship between temperature and total resistance that produces a non-linear output efficiency which can be analyzed based on the I-V curve.[6][7]It is the purpose of the MPPT system to sample the output of the PV cells and apply the proper resistance (load) to obtain maximum power for any given environmental conditions.[8] MPPT devices are typically integrated into an electric power converter system that provides voltage or current conversion, filtering, and regulation for driving various loads, including power grids, batteries, or motors.

It has some algorithms,

Perturb and observe

Incremental conductance

Current sweep

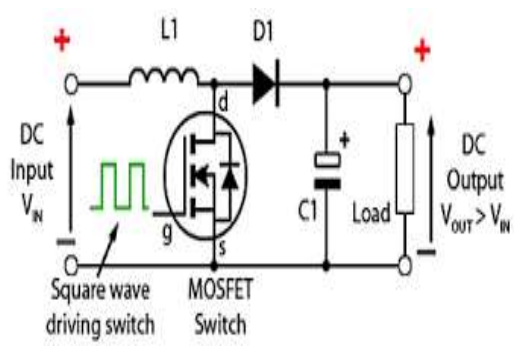
Constant voltage

Temperature method

Traditional solar inverters perform MPPT for the entire PV array (module association) as a whole. In such systems the same current, dictated by the inverter, flows through all modules in the string (series). Because different modules have different I-V curves and different MPPs (due to manufacturing tolerance, partial shading,[25] etc.) this architecture means some modules will be performing below their MPP, resulting in lower efficiency.

V. BOOST CONVERTER

The following figure to source 1(e) A **boost converter** (**step-up converter**) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

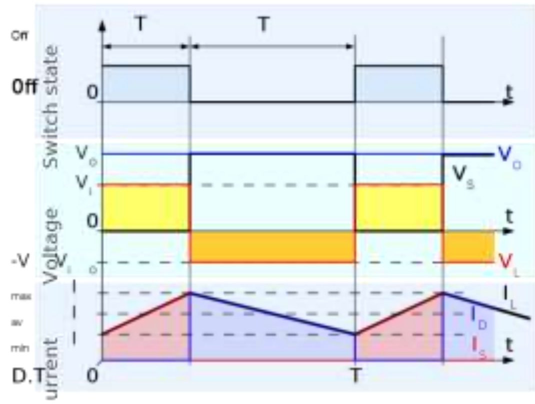


1(e)

The following figure to 1(e) Power for the boost converter can come from any suitable DC sources, such as batteries, solar panels, rectifiers and DC generators. A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A boost converter is a DC to DC converter with an output voltage greater than the source voltage. A boost converter is sometimes called a step-up converter since it "steps up" the source voltage. Since power P=VI must be conserved, the output current is lower than the source current.

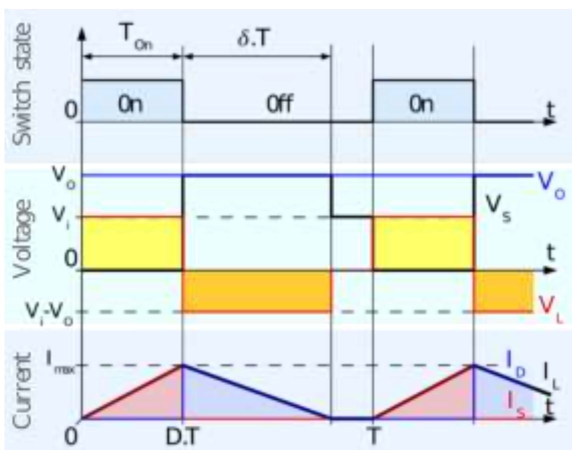
Battery power systems often stack cells in series to achieve higher voltage. However, sufficient stacking of cells is not possible in many high voltage applications due to lack of space. Boost converters can increase the voltage and reduce the number of cells. Two battery-powered applications that use boost converters are used in hybrid electric vehicles (HEV) and lighting systems.

Continuous mode



1(f)

Discontinuous mode



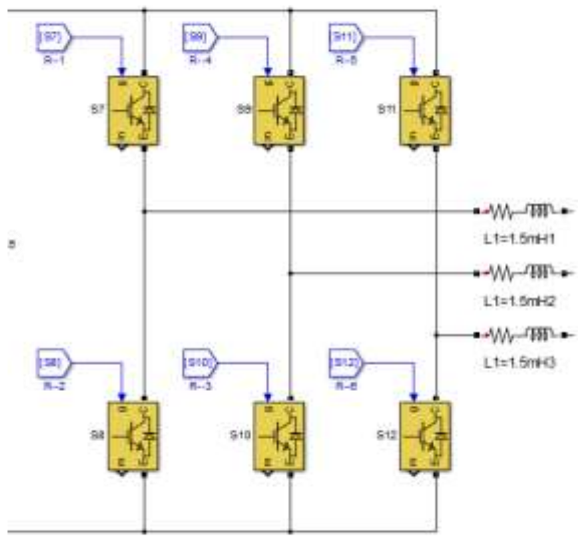
1(g)

The following figure to 1(f),1(g)The key principle that drives the boost converter is the tendency of an inductor to resist changes in current by creating and destroying a magnetic field. In a boost converter, the output voltage is always higher than the input voltage applications, such as portable lighting systems.

VI. INVERTER

A **power inverter**, or **inverter**, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC).

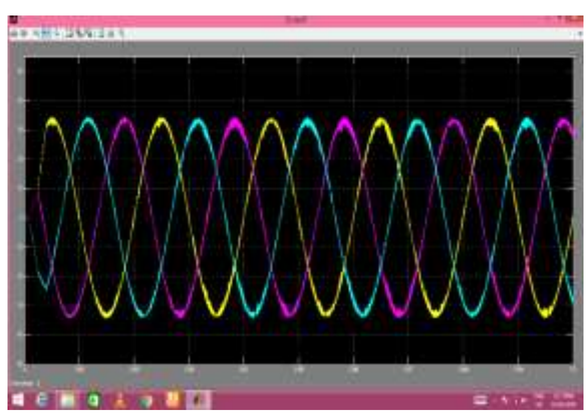
The three phase inverter converts the DC supply to 3 phase AC supply. The following figure to source 1(h)The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source .A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. **Static inverters** do not use moving parts in the conversion process.



1(h)

The following figure to 1(h)A typical power inverter device or circuit requires a relatively stable **DC power source** capable of supplying enough current for the intended power demands of the system. The input voltage depends on the design and purpose of the inverter. An inverter can produce a square wave, modified sine wave, pulsed sine wave, pulse width modulated wave (PWM) or sine wave depending on circuit design. There are two basic designs for producing household plug-in voltage from a lower-voltage DC source, the first of which uses a switching boost converter to produce a higher-voltage DC and then converts to AC. The second method converts DC to AC at battery level and uses a line-frequency transformer to create the output voltage.

The following figure to source 1(i).This is one of the simplest waveforms an inverter design can produce and is best suited to low-sensitivity applications such as lighting and heating. Square wave output can produce "humming" when connected to audio equipment and is generally unsuitable for sensitive electronics.



The following figure to source 1(i)

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A power inverter device which produces a multiple step sinusoidal AC waveform is referred to as a *sine wave inverter*. To more clearly distinguish the inverters with outputs of much less distortion than the *modified sine wave* (three step) inverter designs, the manufacturers often use the phrase *pure sine wave inverter*. Almost all consumer grade inverters that are sold as a "pure sine wave inverter" do not produce a smooth sine wave output at all,[4] just a less choppy output than the square wave (two step) and modified sine wave (three step) inverters. However, this is not critical for most electronics as they deal with the output quite well. Where power inverter devices substitute for standard line power, a sine wave output is desirable because many electrical products are engineered to work best with a sine wave AC power source.

VII. FUZZY CONTROLLER

A **fuzzy control system** is a control system based on fuzzy logic—a mathematical system that analyzes analog input values in terms of logical variables that take on continuous values between 0 and 1, in contrast to classical or digital logic, which operates on discrete values of either 1 or 0 (true or false, respectively).Fuzzy logic is widely used in machine control. The term "fuzzy" refers to the fact that the logic involved can deal with concepts that cannot be expressed as the "true" or "false" but rather as "partially true". Although alternative approaches such as genetic algorithms and neural networks can perform just as well as fuzzy logic in many cases, fuzzy logic has the advantage that the solution to the problem can be cast in terms that human operators can understand, so that their experience can be used in the design of the controller. This makes it easier to mechanize tasks that are already successfully performed by humans.

Fuzzy control system design is based on empirical methods, basically a methodical approach to trial-and-error. The general process is as follows:

- Document the system's operational specifications and inputs and outputs.
- Document the fuzzy sets for the inputs.
- Document the rule set.
- Determine the Defuzzification method.
- Run through test suite to validate system, adjust details as required.
- Complete document and release to production.

The following figure to 1(j),1(k) applications investigated or implemented include: character and handwriting recognition; optical fuzzy systems; robots, including one for making Japanese flower arrangements; voice-controlled robot helicopters(hovering is a "balancing act" rather similar to the inverted pendulum problem); rehabilitation robotics to provide patient-specific solutions (e.g. to control heart rate and blood pressure [5]); control of flow of powders in film manufacture; elevator systems; and so on figure to 1(j),1(k)

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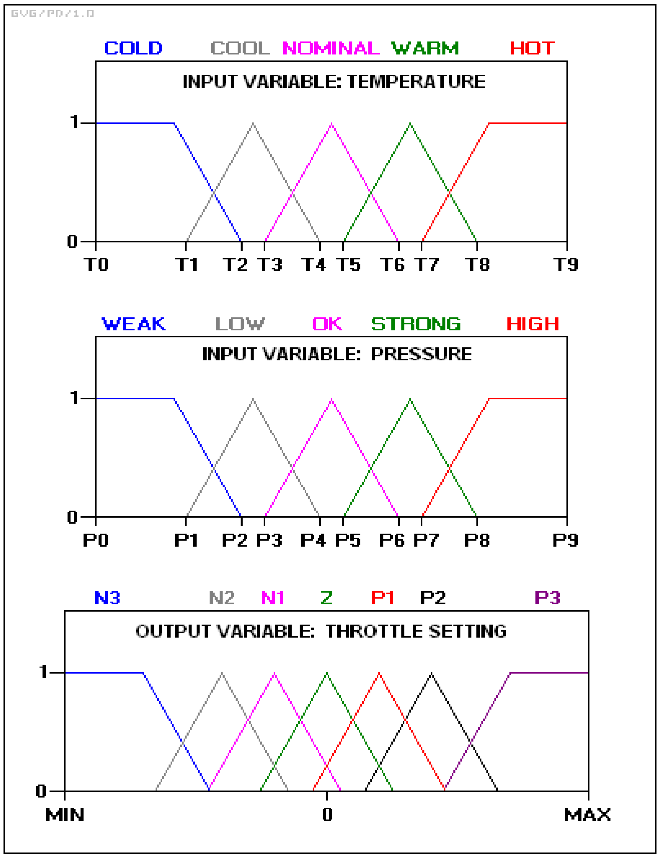
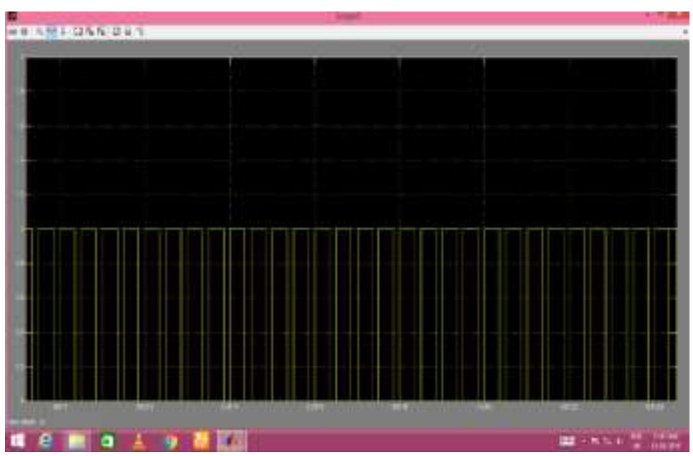


1(j)



1(k)

VIII. CONCLUSION

An efficient, cost effective maximum power point tracking (MPPT) algorithm is required to improve the energy utilization efficiency of low power photo voltaic (PV). This paper presents an experimental evaluation of the FUZZY MPPT when employed by a standalone PV pumping system, using an experimental installation comprised of a 1080 Wp photo voltaic array connected to a 1KW Three phase ac motor. The influence of FUZZY parameters on system behavior is investigated and the energy utilization efficiency is calculated for different weather conditions. The performance of FUZZY MPPT is compared to other normal MPPT for advantage, disadvantage and application was verified success fully.

IX. REFERENCES

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