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A NOVEL HIGH GAIN CUK INTEGRATED SEPIC CONVERTER GWO APPROACH FOR DC MICROGRID APPLICATIONS

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ABSTRACT:

An better DC-DC converter is proposed in this mission, based totally at the aggregate of the Cuk and SEPIC converters, that is properly-proper for solar photovoltaic (PV) packages. The converter uses most effective one transfer (that's ground-referenced, so easy gate drive circuitry may be used), but offers twin outputs in the shape of a bipolar DC bus. The bipolar output from the DC-DC converter is capable of ship power to the load, and leakage currents can be eliminated if the latter kind is used without the usage of lossy DC capacitors in the load present day loop. The proposed converter makes use of integrated magnetics cores to couple the output inductors and GWO algorithm, which notably reduces the input modern-day ripple and for this reason significantly improves the electricity extracted from the sun PV gadget. The design method in conjunction with simulation, waveforms, and efficiency measurements of a DC-DC converter are offered to show the idea of the proposed converter.

KEYWORDS:

MAXIMUM POWER POINT TRACKING, SINGLE ENDED PRIMARY INDUCTANCE CONVERTER, PULSE WIDTH MODULATION, PHOTOVOLTAIC, STATIC RANDOM ACCESS MEMORY, LIGHT EMITTING DIODE, SILICON ON INSULATOR, AUTOMATIC VOLTAGE REGULATOR, DIRECT CURRENT

INTRODUCTION

The prolonged dependency on fossil fuels for power manufacturing is driving the continuing upward thrust in carbon emissions leading to climatic adjustments. In addition, the big demand for fossil fuels is depleting the substances of oil and gasoline, creating a need to analyze the alternate assets of strength production. Renewable power sources are extra viable alternatives which can be non- depletable and may lessen the impact to the environment. As the call suggests, renewable strength refers to energy that naturally happens and replenish inside the surroundings and does not exhaust, not like the energy from fossil fuels. One of the promising assets of renewable power that is durable and green in nature is solar / photovoltaic strength. The sun energy with irradiance stages of as much as 1kW/m2 is amply to be had and photovoltaic energy is a capacity supply for electric electricity era. Therefore, solar cells have created sizeable interest in current applications along with distributed electricity manufacturing to offer change and easy power.

The fundamental capabilities of photovoltaic electricity which makes it terrific from other renewable energy assets are;

A) It is plentiful in nature and is loose and simply to be had unlike the fossil fuels.

B) There is no emission of harmful greenhouse gases and is a smooth supply of power manufacturing.

C) They require minimum maintenance and are reliable as they do not have any moving elements and are unfastened from vibrations.

d) The photovoltaic strength technology can be established in small-scale and distributed way, not like the conventional power era systems which require huge scale installations to perform.

E) The photovoltaic energy is available throughout the instances whilst there's peak electricity call for.

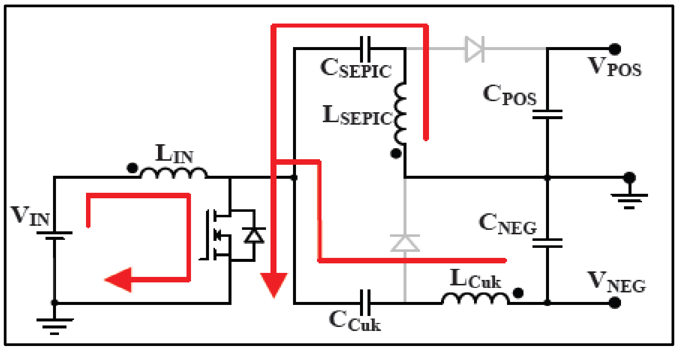
MATERIALS AND METHODS:

The proposed device is primarily based on the combination of the Cuk and SEPIC converters, that is properly-suited for solar photovoltaic (PV) applications. The converter makes use of best one switch, yet affords twin outputs inside the shape of a bipolar DC bus. The bipolar output from the DC-DC converter is able to ship electricity to the grid thru any inverter. The proposed converter reduces the enter modern-day ripple decreases the height inductor contemporary. For this PV application, it is also important to differentiate between the DC-DC converter's performance and the general gadget efficiency. The low enter contemporary ripple within the proposed converter will hold the PV device toward its MPP, in addition improving the general energy extracted.

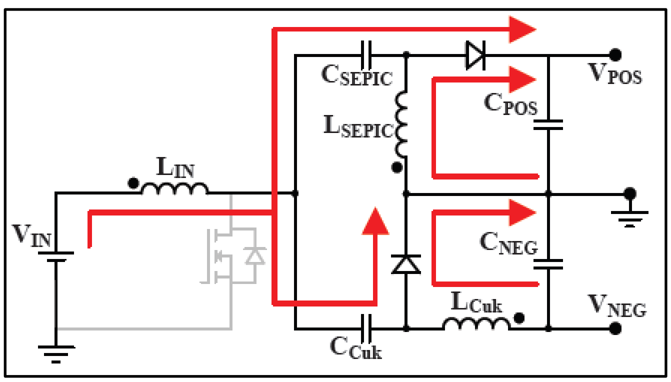
COMBINED CUK-SEPIC (CCS) CONVERTER

The Combined Cuk-SEPIC (CCS) converter, shown in Fig. 3.2a, is an emerging DC-DC converter topology this is well-applicable for this application and has therefore been investigated currently. It makes use of a unmarried switching node, that is common to each Cuk and SEPIC electricity switch degrees, to offer matching floor-referenced effective and terrible outputs. During the transfer „on" state all inductors are charging and the capacitors are discharging. When the transfer turns off , the inductor currents redirect into the two diodes and the capacitors rate at the same time as the inductors discharge. In non-stop conduction mode (CCM) operation considered on this assignment, the switch activates once more previous to the entire discharge of any inductor.

CCS operation all through switch 'on'



CCS operation throughout switch 'off'



The CCS converter can provide massive step-up, in addition to step-down voltage conversion ratios. The converter has an output/enter ratio of D / (1 - D) for each of the advantageous and negative DC output terminals, providing step-up conversion for obligation ratios more than 1/2, and operating in step-down mode for duty ratios beneath half. The converter's normal benefit (i.E. Considering the output voltage as the wonderful-to-terrible voltage) is 2D / (1 - D). This distinct output/input voltage ratio lets in regulation of larger input voltage versions with the equal responsibility cycle variety, or rather permits the converter to handle the identical input voltage variation with a narrower obligation cycle variety, taking into consideration smaller inductors to be used.

INDUCTOR MAGNETIC COUPLING

The benefits of inductor coupling in Cuk converters and SEPIC converters have been defined inside the literature. Despite latest interest in the CCS converter but, studies is but to be carried out into the effects of coupling its input and output inductors and the benefits this has for PV structures. This paper examines the impact of coupling among LIN, LS, and LC, as shown in Fig. Three.2a. This converter is henceforth known as the Coupled Inductors Combined Cuk-SEPIC (CI-CCS) converter. A multi-variable optimization has been carried out to decide the greatest coupling tiers effects. The outcomes display that this coupling can drastically reduce the enter current ripple, which allows the overall inductance – and therefore volume and weight – to be reduced.

GWO(GREY WOLF OPTIMIZATION)

The GWO algorithm imitates the management hierarchy and hunting mechanism of grey wolves in nature proposed by Grey wolves are taken into consideration to be at the pinnacle of meals chain and that they favour to stay in a %. Four styles of grey wolves which include alpha (α), beta (β), delta (δ), and omega (ω) are hired for simulating the leadership hierarchy. In order to mathematically version the social hierarchy of wolves even as designing GWO, we recall the fittest answer because the alpha (α). Consequently, the second one and 0.33 first-class solutions are named as beta (β) and delta (δ), respectively. The rest of the candidate solutions are assumed to be omega (ω).

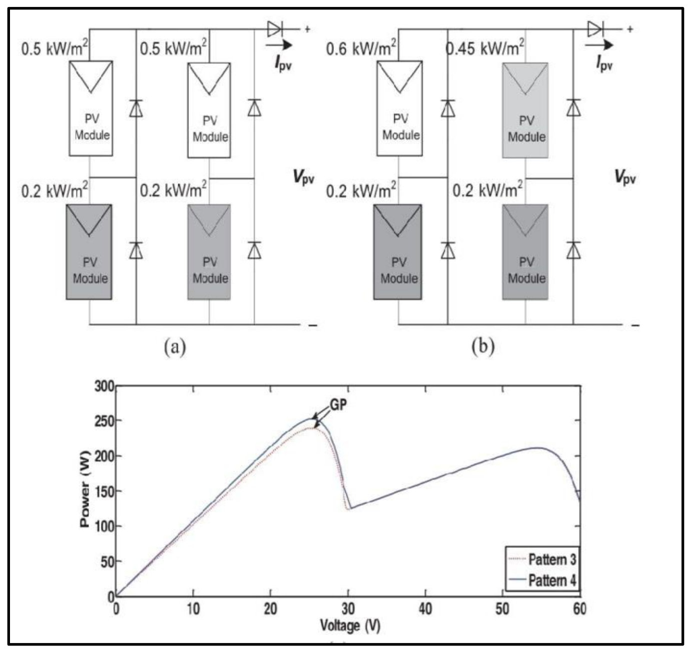
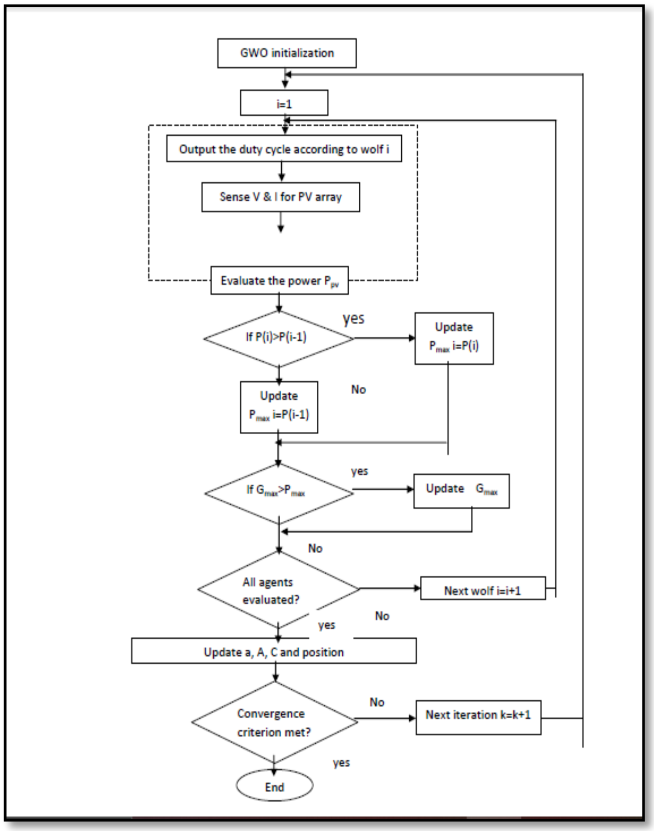


Fig. Three indicates three essential steps of GWO set of rules, namely searching, chasing wherein t denotes the modern-day iteration, D, A, and C denote coefficient vectors, Xp is the position vector of the prey, and X indicates the location vector of gray wolf. The vectors A and Care calculated as follows where components of a linearly decreases from 2 to 0 all through the course of iterations and r1, r2 are random vectors in [0, 1]. The hunt is commonly guided by means of alpha called leaders observed by beta and delta which may take part in hunting every so often. Delta and omega take care of the wounded wolves within the PC. Therefore, we refer alpha because the candidate answer having better know-how approximately the location of prey. The gray wolves finish the hunt through attacking the prey when it stops moving.

FLOWCHART:



STEPS:

First initialize the Grey wolf population

- **FITNESS EVALUATION**

1. Assign duty cycle
2. Measure the V & I for PV
3. Evaluate the power of PV

- **COMPUTATION OF BEST POSITION**

1. If fitness value condition is true, update Pmax = P(i), or Pmax = P(i-1)
2. If Gmax>Pmax condition is true, update Gmax. If condition is not satisfied evaluate all agents.

- Calculate the fitness for each agent.
- Update a, A, C.
- Calculate the fitness for all search agents

1. Update the best search agent
2. K=k+1

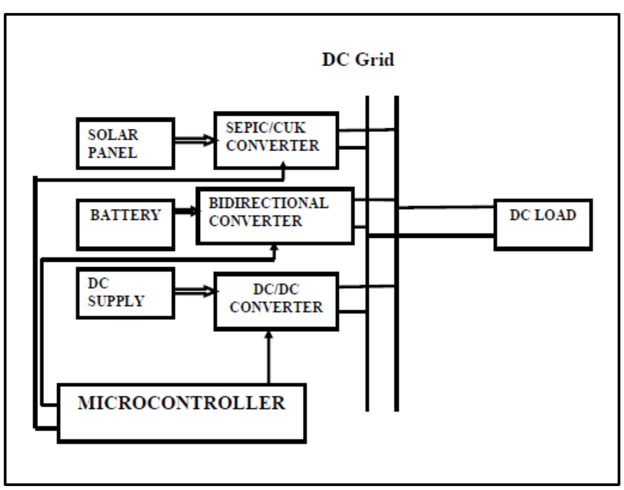
- End

GWO ALGORITHM

```
function out_duty =GWO_MPPT(power,clk)
persistent Wolf1 Wolf2 Wolf3 Wolf4 Wolf5 Wolf6;
persistent Power1 Power2 Power3 Power4 Power5 Power6;
if isempty(Wolf1)
Wolf1=0.1;
end
if isempty(Wolf2)
Wolf2=0.26;
end
if isempty(Wolf3)
Wolf3=0.42;
end
if isempty(Wolf4)
Wolf4=0.58;
end
if isempty(Wolf5)
Wolf5=0.74;
end
if isempty(Wolf6)
Wolf6=0.9;
end
23
if isempty(Power1)
Power1= 4.3850e-09;
end
if isempty(Power2)
Power2= 3.4500;
end
if isempty(Power3)
Power3= 6.9925;
end
if isempty(Power4)
Power4= 23.8248;
end
if isempty(Power5)
Power5= 70.7989;
end
if isempty(Power6)
Power6= 141.8385;
end
gate=false;
MaxIter=10;
a=2;
24
Wolfpop=[Wolf1 Wolf2 Wolf3 Wolf4 Wolf5 Wolf6];
Powervalue=[Power1 Power2 Power3 Power4 Power5 Power6];
if gate==false
for j=1:MaxIter
```

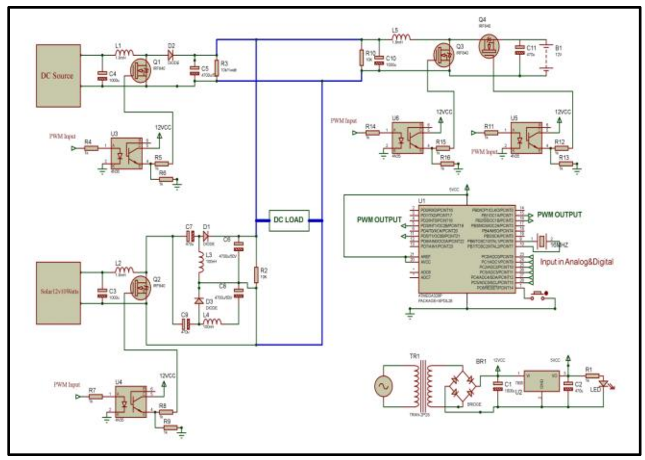
```
a=a-0.08;
grad1=(2*a*rand)-a;
for o=1:6
Wolfpop(o)=Wolfpop(o)-(grad1*2*rand*Wolfpop(o)-Wolf
pop(o));
end
%% boundary setting
Wolfpop=(Wolfpop*0.8)+0.1;
%% fitness evaluation
out_duty=Wolfpop(1);
Powervalue(1)=power;
out_duty=Wolfpop(2);
Powervalue(2)=power;
out_duty=Wolfpop(3);
Powervalue(3)=power;
out_duty=Wolfpop(4);
Powervalue(4)=power;
out_duty=Wolfpop(5);
Powervalue(5)=power;
out_duty=Wolfpop(6);
Powervalue(6)=power;
% [~,BestWolf]=max(Powervalue);
if j==MaxIter
gate=true;
end
end
end
if gate==true
[~,BestWolf]=max(Powervalue);
out_duty=Wolfpop(BestWolf);
end
```

BLOCK DIAGRAM:



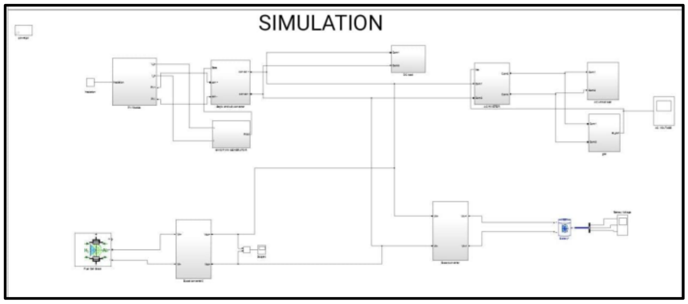
The solar panel is hooked up to combined Cuk and SEPIC converter and inverter is hooked up to load. It uses a unmarried switching node, that is not unusual to each Cuk and SEPIC electricity switch stages, to offer matching floor-referenced effective and terrible outputs. During the transfer "on" nation, all inductors are charging and the capacitors are discharging. When the switch turns off, the inductor currents redirect into the 2 diodes and the capacitors price whilst the inductors discharge. In this project used Atmega 328 controller. The controller offers PWM pulse signal to converter switching via opto coupler unit. In this machine controller monitor the sun voltage and cutting-edge through voltage and contemporary measuring unit. Battery is used to save the electricity from sun panel, and additionally to supply the voltage to operate the DC load.

CIRCUIT DIAGRAM:

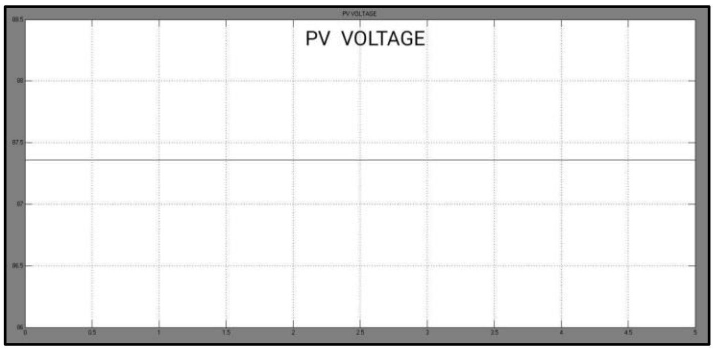


Power deliver gives deliver to all additives. It is used to transform AC voltage into DC voltage. Transformer used to convert 230V into 12V AC.12V AC is given to diode. Diode range is 1N4007, that's used to transform AC voltage into DC voltage. AC capacitor used to rate AC additives and discharge on ground. LM 7805 regulator is used to maintain voltage as regular. Then sign can be given to subsequent capacitor, that is used to filter undesirable AC factor. Load could be LED and resister. LED voltage is 1.75V.If voltage is above stage past the restrict, after which it will likely be dropped on resister. Controller used Atmega 328 controller. The supply is hooked up to controller port 8&7. GND is attached. Crystal oscillator is attached to controller port 9 & 10. It is used to offer the clock signal to controller. In this project design the cuk and sepic converter with unmarried switching mode. Controller supply PWM sign to unmarried switch of converter via opto coupler. Opto coupler IC4N35 is hooked up to controller port three, 4,10,11. Solar panel is hooked up to provide the enter of converter unit. The sun panel send energy to DC load thru converter unit. The converter output is attached to Battery. The battery is charging to converter. The 12V battery output is hooked up inverter.

SIMULATION DIAGRAM:

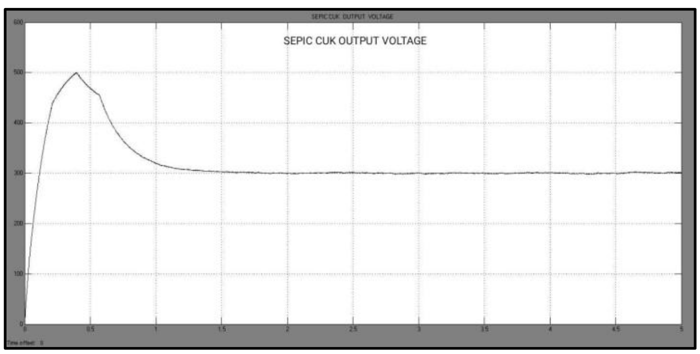


In this simulation we use the solar panel, fuel cell, battery, GWO algorithm cuk and sepic integrated converter, boost converter that is also connected to the inverter to convert DC TO AC and the load is also connected from the inverter.



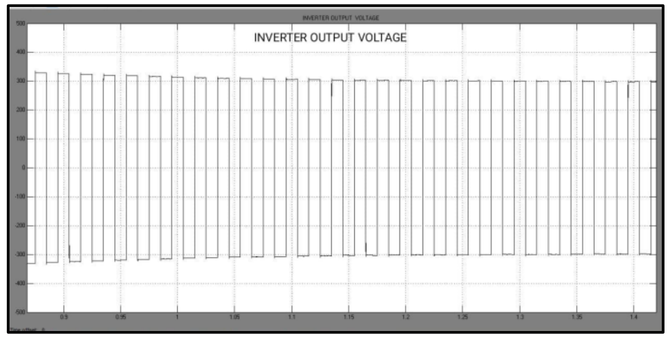
PV VOLTAGE OF OUR PROJECT

The voltage from the PV panel given to the cuk sepic converter .The wave form of the solar panel output voltage is 87v and temperature is 37c.



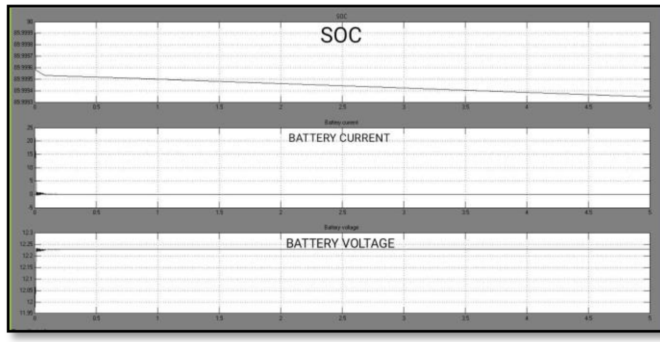
SEPIC CUK OUTPUT VOLTAGE

The sepic cuk voltage when the resistance and the capacitor is connected in series and the inductance is connected in parallel the given voltage from the pv panel is get increased by the converters we gave the 87v and got the 480v as output.



INVERTER OUTPUT VOLTAGE

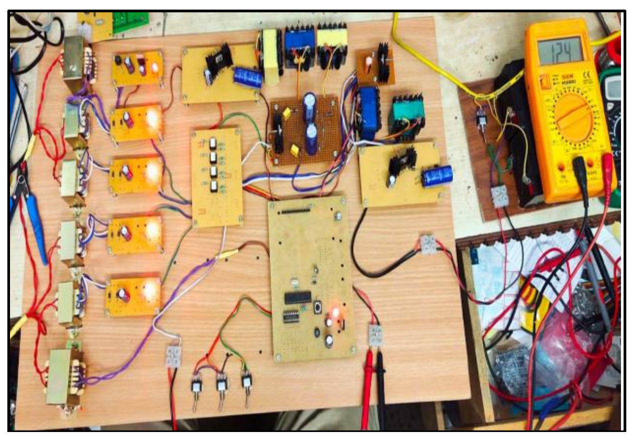
The voltage from the sepic cuk converter DC voltage is converted into AC and given to the ac critical load.



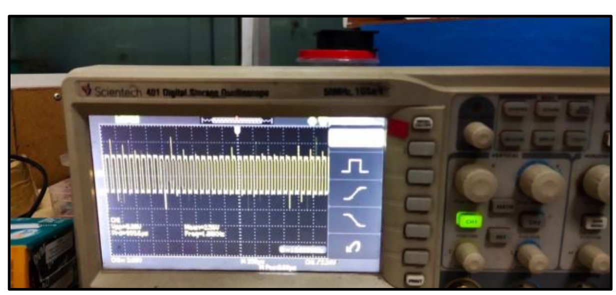
SOC, BATTERY CURRENT, VOLTAGE

The SOC is decreased and the battery current is constant while the battery is in charging condition when the pv panel and the fuel cell is not conducting the battery is discharging the stored voltage.

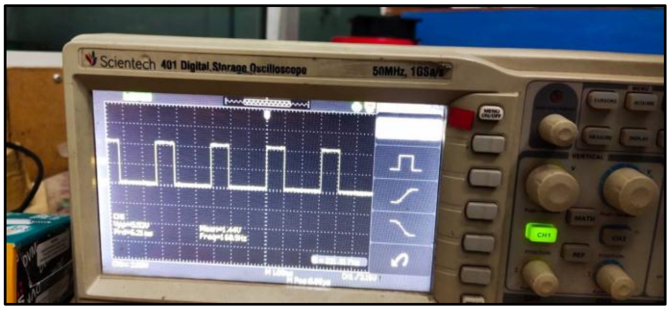
HARDWARE OUTPUT OF THE PROJECT:



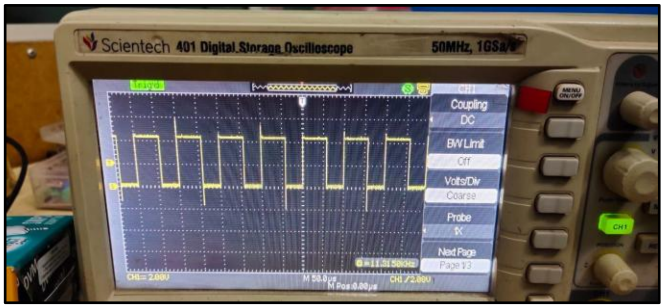
HARDWARE MODEL



SOLAR PANEL OUTPUT



BIDIRECTIONAL OUTPUT



OUTPUT OF THE FUEL CELL

RESULTS:

In our project we use the cuk-sepic blended converter to get the excessive voltage advantage, while comparing to other converters cuk sepic integrated converter gives the excessive output voltage and advantage. We also use the GWO (Grey Wolf Optimizer) optimisation algorithm to obtain the regular output voltage.

DISCUSSION:

From this figures the SOC is reduced and the battery cutting-edge is regular at the same time as the battery is in charging circumstance Which the pv panel and the gasoline cell isn't always carrying out the battery is discharging the stored voltage.

CONCLUSIONS: (OPTIONAL)

Combining the input tiers of the Cuk and SEPIC converters permits a bipolar DC output to be generated from a unipolar enter, the usage of most effective transfer. In this mission, the advantages that may be derived through magnetically coupling the converter input and output inductors are investigated. SiC energy gadgets and nano crystalline powder cores are utilized in region of IGBTs and ferrite cores, enabling much higher switching frequencies. Together with the coupled inductors, minimum enter cutting-edge ripple has been realized, which permits excessive ranges of PV utilization because the machine can continue to be close to the electricity curve's height. In addition to the decrease input contemporary ripple, a CCS converter with coupled inductors is smaller, lighter, and more green than its uncoupled equal. An inner-loop cutting-edge controller has been designed to facilitate MPPT.

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