BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 316 (January 2023)

Power Electronics Laboratory

Final Project Report

Section: A1 Group: 02

Solar DC to AC Inverter

Course Instructors:

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Signature of Instructor: ______________________________

Academic Honesty Statement:

IMPORTANT! Please carefully read and sign the Academic Honesty Statement, below. Type the student ID and name, and put your signature. *You will not receive credit for this project experiment unless this statement is signed in the presence of your lab instructor.*

"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), and cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."

Signature: ____________ **Full Name: Muzakkir Ahmed** **Student ID: 1906002**	**Signature:** ____________ **Full Name: Md. Sad Abdullah Sami** **Student ID: 1906011**
Signature: ____________ **Full Name: Md. Sabbir Ahmed** **Student ID: 1906004**	**Signature:** ____________ **Full Name: Rayhan Siddiq** **Student ID: 1906022**

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1 Abstract

In this age of digitalization and modernization the demand for electricity is rising day by day. At present the major portion of this demand is met by using mostly non-renewable sources like gas, coal, nuclear etc. Most of these sources are not environment friendly and they are not infinite. These resources are very limited in quantity and surely, they will be depleted down the line. In the multi-dimensional usage of electricity, a sustainable renewable source of energy is a must for us. Many solutions have been considered in this regard and solar energy has emerged as a really feasible one. Our project “Solar DC to AC Inverter” addresses this issue and provides a solution. It can easily provide rated ac current to different sorts of loads for various usage and thus reduces the need of traditional electricity generation with non-renewable sources.

2 Introduction

Solar energy is converted to electrical energy in the solar panel. The electricity we get from this is DC. The day-to-day life loads are AC so we need to build a complex inverter mechanism to convert the DC voltage to AC voltage. In a sunny day we get continuous sunlight and thus we do not require any battery to provide uninterrupted supply to loads. But in cloudy days or night-time when sunlight is not available, we fail to provide uninterrupted supply to loads. To supply uninterrupted electricity to out loads, the issue we used battery. Battery stores energy that we get from sunlight and this energy can be used when there is scarcity of solar energy. Another issue is that the generated AC voltage from the inverter circuit is not same as the rated AC load voltage. It is because of the low DC voltage that we get from our battery. To solve this, we use transformer to step up the voltage to supply the load.

3 Design

3.1 Problem Formulation (PO(b))

3.1.1 Identification of Scope

The demand for non-renewable energy is increasing and solar inverter has a great potential to solve this issue. Solar inverter components are comparatively smaller in size and so easier to construct. Sunlight is much more available to us than other renewable sources like wind, water flow and so we will have a much easier time in generating electricity from this source than other renewable sources.

3.1.2 Literature Review

Solar energy is a sustainable and renewable power source that requires efficient conversion from direct current (DC), generated by solar panels, to alternating current (AC) for use in homes, businesses, and the grid. Solar DC to AC inverters are key components in this process, with various topologies used for conversion. This literature review focuses on the use of the push-pull inverter topology in solar applications, highlighting its historical development, operational principles, efficiency, and future prospects.

Historical Perspective

The push-pull inverter topology has a long history of use in various applications, including solar power systems. It originated from early electronic power converters and has since evolved to meet the demands of modern solar technology. Early implementations of push-pull inverters were relatively simple, but advancements in semiconductor devices, control algorithms, and materials have significantly improved their performance and reliability.

Operational Principles

The push-pull inverter topology is characterized by its ability to convert DC power to AC by alternately switching two transistors or switches, typically arranged in a complementary push-pull configuration. This alternation produces an AC output voltage by driving a transformer, which isolates the DC source from the AC load. The transformer also provides voltage step-up or step-down capabilities, making it adaptable to various solar panel configurations.

Efficiency and Performance

Efficiency is a critical factor in evaluating the performance of solar inverters. Push-pull inverters, when properly designed and controlled, can achieve high efficiency levels. Their ability to minimize switching losses and maximize transformer utilization makes them suitable for solar applications. Advanced modulation techniques, such as pulse-width modulation (PWM), have further improved the efficiency of push-pull inverters.

Advantages of Push-Pull Inverters

a. High Efficiency: Push-pull inverters are known for their efficiency, making them suitable for solar power systems where energy conversion efficiency is crucial.

b. Compact Design: The push-pull topology allows for relatively compact and lightweight inverters, making them suitable for both residential and commercial solar installations.

c. Voltage Regulation: Push-pull inverters can provide stable AC output voltage even under varying input voltage conditions, enhancing grid integration and load compatibility.

Solar DC to AC inverters based on the push-pull topology offer high efficiency and compact design, making them suitable for various solar applications. Advances in semiconductor technology, control algorithms, and materials have contributed to their improved performance and reliability. Challenges, such as cost reduction and integration with energy storage, remain, but ongoing research and development efforts are expected to further enhance the capabilities of push-pull inverters in the context of solar power generation. These inverters continue to play a vital role in enabling the efficient and sustainable utilization of solar energy.

3.1.3 Formulation of Problem

Solar DC to AC inverters are essential components in solar power systems, responsible for converting direct current (DC) generated by solar panels into alternating current (AC) suitable for residential, commercial, or grid applications. The utilization of the push-pull inverter topology in these systems presents several challenges and opportunities that need to be addressed.

Efficiency Optimization: The efficiency of push-pull inverters is crucial for the overall performance and cost-effectiveness of solar power systems. The problem lies in improving the efficiency of push-pull inverters under varying operating conditions, such as changing solar irradiance and temperature levels, to maximize the energy conversion efficiency.

Control and Modulation: Effective control and modulation strategies are necessary for the precise operation of push-pull inverters. Achieving high-quality AC output voltage, especially in grid-tied systems, requires sophisticated control algorithms to mitigate issues like harmonic distortion and voltage regulation.

Cost Reduction: The cost of solar DC to AC inverters, including those based on the push-pull topology, remains a significant barrier to widespread adoption. Research is needed to identify cost-effective materials and manufacturing processes to reduce the overall system cost and make solar energy more accessible.

Grid Integration: Solar power systems must seamlessly integrate with the electrical grid to ensure stability and reliability. The problem lies in developing push-pull inverters with advanced grid interaction capabilities, including grid synchronization, anti-islanding protection, and seamless grid connection/disconnection.

Reliability and Durability: Push-pull inverters must withstand various environmental conditions, including temperature fluctuations, humidity, and electrical stresses. Ensuring long-term reliability and durability of these inverters is essential to guarantee the longevity of solar power systems.

In summary, the formulation of the problem for this project revolves around optimizing the performance, efficiency, and reliability of solar DC to AC inverters based on the push-pull topology, while also addressing cost-effectiveness and grid integration. These challenges are pivotal in advancing the utilization of solar energy and promoting its widespread adoption as a clean and sustainable power source.

3.1.4 Analysis

The problem at hand involves optimizing solar DC to AC inverters utilizing the push-pull topology in solar power systems. This analysis highlights key points:

Efficiency Optimization: Solar inverters must efficiently convert variable DC power from solar panels to AC power to maximize energy yield, especially in changing weather conditions.

Control and Modulation: Effective control algorithms are essential to mitigate harmonic distortion, improve voltage regulation, and synchronize with the grid for stable power output.

Cost Reduction: Reducing inverter costs is crucial for solar system affordability and widespread adoption, requiring exploration of cost-effective materials and manufacturing processes.

Grid Integration: Seamless grid integration is vital for grid stability, necessitating compliance with grid standards and evolving grid code requirements.

Reliability and Durability: Inverters must operate reliably under various environmental conditions, reducing maintenance costs and ensuring solar system longevity.

Solving these challenges is pivotal for efficient, reliable, and cost-effective solar energy conversion, promoting renewable energy adoption and grid integration in a sustainable energy future

3.2 Design Method (PO(a))

As the problem was mentioned above, we did necessary mathematical calculation to solve this problem.

At the beginning, we assumed we want to give power a 10W load with a runtime of 1 hour

I. Load = $10W$

Load Runtime = 1 hr
Energy = $(10 * 1)\ W.hr\ =\ 10$ W-hr

II. Selected Battery = $12V$

Battery A-H = $\frac{10\ W-hr}{12\ V} = 0.833$ A-H
We added 20% to calculated value = (1.2*0.833) ≈ 1 A-H
Closest we get in market: 12V, 1.3 A-H

III. We want to charge the battery in 0.5 hour of effective sunshine.

Panel Power = $\frac{10\ W-hr}{0.5\ hr} = 20\ W$

IV. Charging current from panel power = $10\%\ of\ A - H\ rating\ of\ the\ battery = 1.3 \times 10\% =\ 0.13\ A$

V. Transformer current (Assuming no power loss in transformer) = $\frac{10\ W}{12\ V} = 0.833\ A$

Our transformer rating: $3\ A\ rated$

So, based on these approximations, we designed and built our model for this project.

3.3 Circuit Diagram

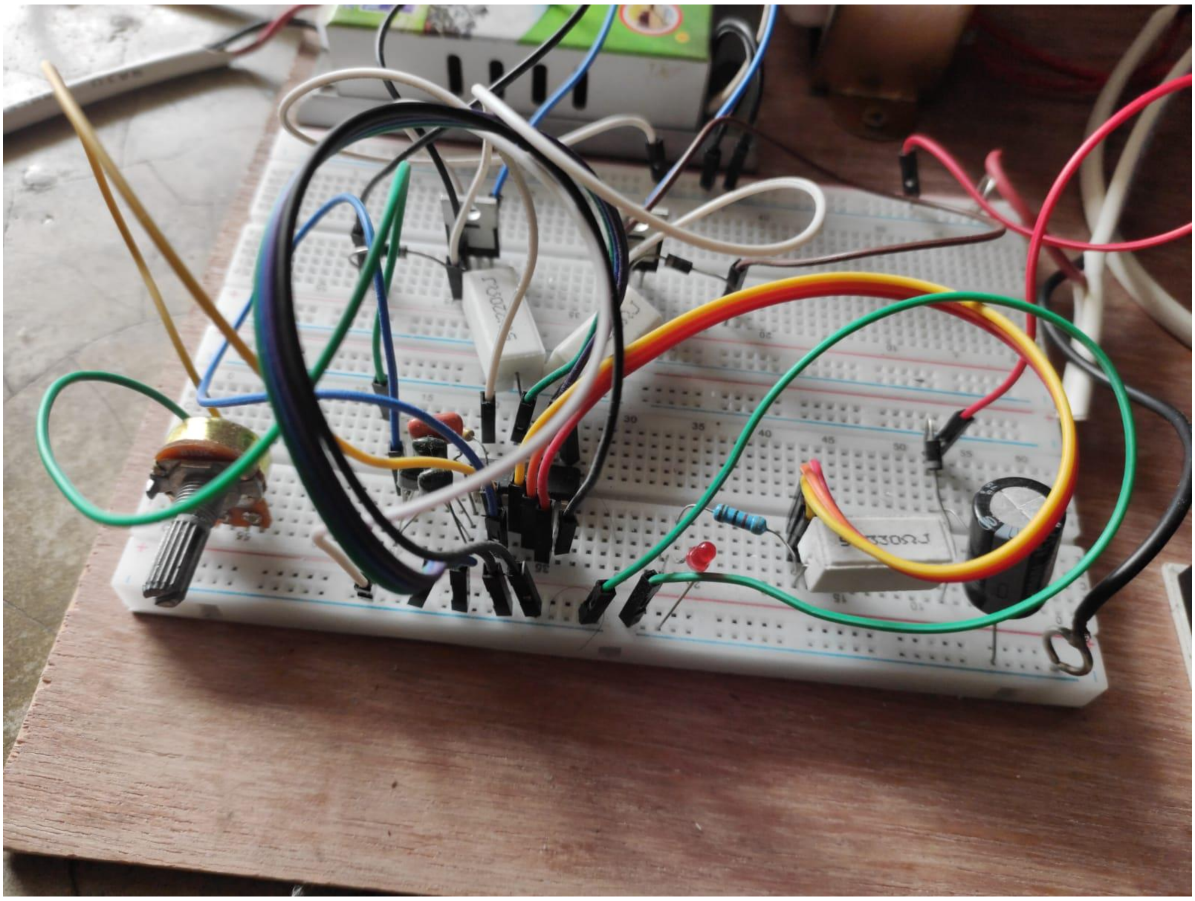


Fig. Inverter Circuit Diagram

3.4 Simulation Model

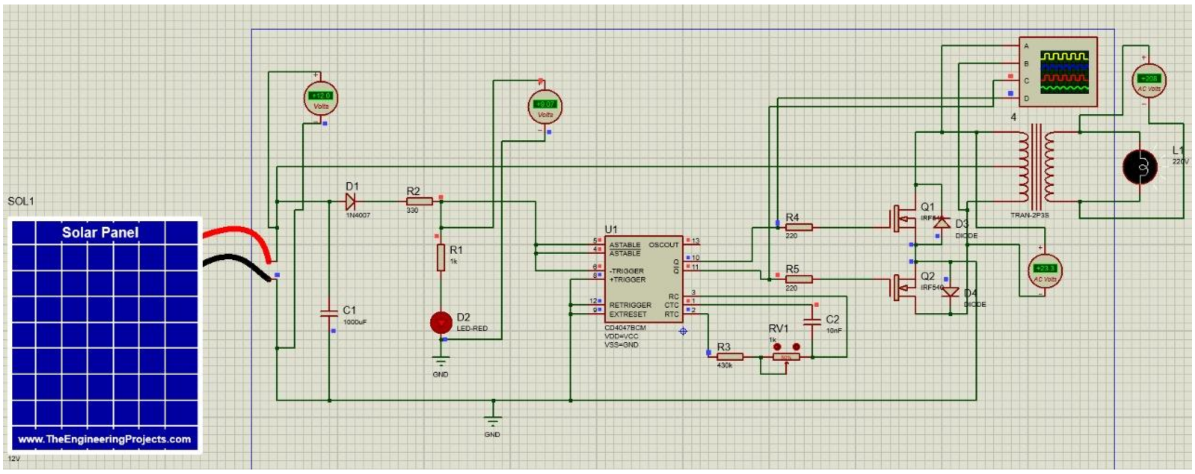


Fig. Solar Inverter Proteus Simulation

3.5 CAD/Hardware Design

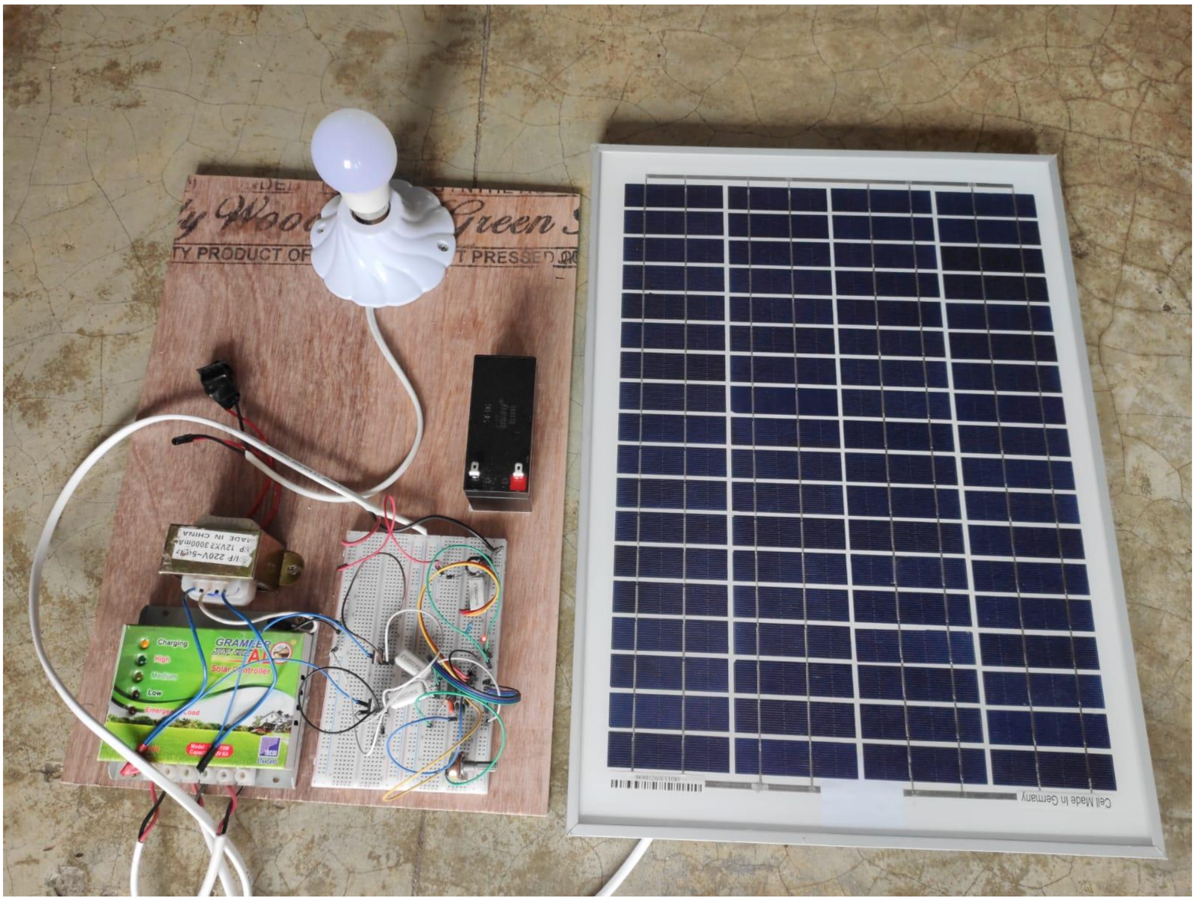


Fig. Hardware Design

4 Implementation

4.1 Description

This is the description of our project

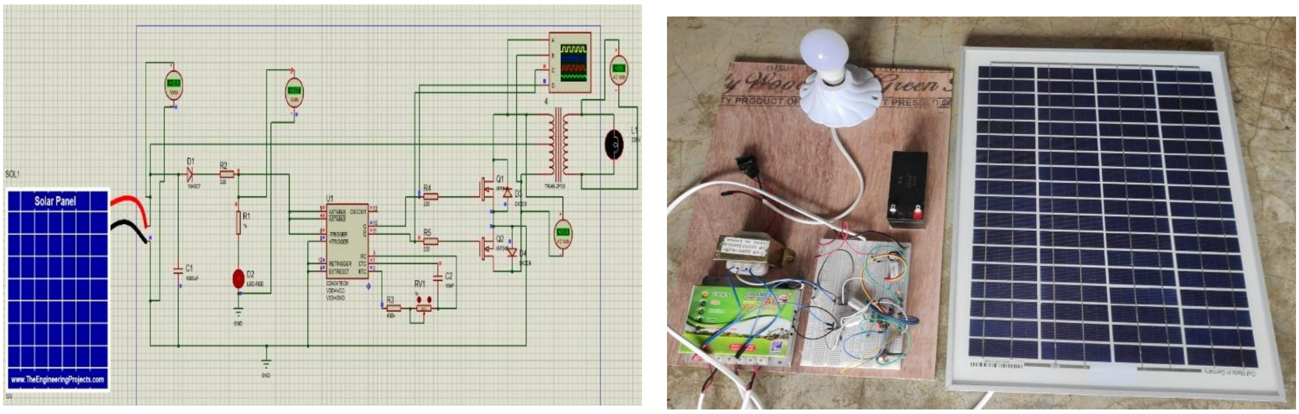


Fig. Proteus Design (Left) and Implementation of the Design (Right)

We collected our energy from solar panel and then the energy stored in the battery. Our battery was of 12V.

The inverter we used here is a push pull type inverter. We got our gate signal from the output of IC CD4047 and feed this signal to the gates of the MOSFETs. This IC operates in astable mode in our project. In astable mode, pin 10 and 11 of this IC produces complementary pulses. Frequency of the pulse depends on the resistor and capacitor value of pin 1 and 2 respectively. Frequency can be found by the equation $f = \frac{1}{4.4RC}$. The gate signals we observed had peak-to-peak voltage of 11.6V and had 180 degree phase difference. The frequency is seen from the oscilloscope is 49.65 Hz$\approx$ 50 Hz.

Now when these gates signals are feed to the gates of the MOSFETs, they work as switches which remains on and off in a complementary manner. With these two MOSFET as switch and DC 12V voltage at the center terminal of the transformer, a square shape AC voltage is generated. The AC voltage had a square wave shape with a peak-to-peak voltage of 23.2V between center and one terminal of the transformer. The frequency of our generated AC voltage was 50.4729 Hz which is near to 50 Hz in which our power system operates. As the inverter we used uses push pull mechanism, we used a center tapped transformer. So, while observing the voltage of the both terminal in the primary side of the transformer, the AC voltage peak-to-peak value was seen 46V. The center tapped transformer also served another purpose in this project. As this voltage level is sufficiently low to connect a load across it and have continuous energy flow, the transformer step up the voltage to our household usage level. The diodes used across the source and drain of the MOSFETs are 'Freewheeling Diodes'. When an inductive load is connected, diodes provide a path to conduct lagging current when corresponding MOSFET is off.

When we were generating electricity from the solar panel, we connected the battery across it and charged the battery. As the battery is charging and solar panel is generating electricity at the same time, the controller led blimps and indicates that it was charging and voltage level is high. We switched on the bulb, and it was lit.

Now that we have done charging and generating, we wanted to take reading of the voltages at no load and full load condition. Also, we wanted to measure the full load current, battery charging current, battery discharging current. Before connecting the battery, solar panel was only generating not storing energy. We took the reading of solar provided voltage and battery voltage level after charging the battery using the panel.

At the first time, our no-load voltage was below 200V (around 185V) and after connecting the load it drastically falls to 45-50 V range. This was very low voltage. To solve this problem, we tried to use a boost converter at the input side of the transformer. Although the output voltage was increased but it produces few problems including further drop of full load voltage and not supporting the current rating properly. To solve this issue, we had to rise our transformer current rating. After changing the transformers current rating from 1000 mA to 3000 mA, the no load and full load voltage was found at the desired level.

Now that all necessary data was taken into accounts, we performed our final task that we had to do. We saw that the battery was storing energy. The purpose of introducing battery was to supply power to the load in absence of daylight. So, finally we stopped charging the battery. Removed the solar panel from the daylight or covered its face so that no light ray can fall on it. Then we connected our battery and turned on the switch. The bulb was lit. The battery is now supplying power to the load. Battery voltage level was decreasing as time passed. It was desired because now it was not charging. So, it was using its own preserved energy. Also charging of battery and supplying power to load happens simultaneously.

4.2 Experiment and Data Collection

The rechargeable battery that was used.

Fig. 12 V Lead Acid Battery

Gate pulse generated by IC CD4047BCM

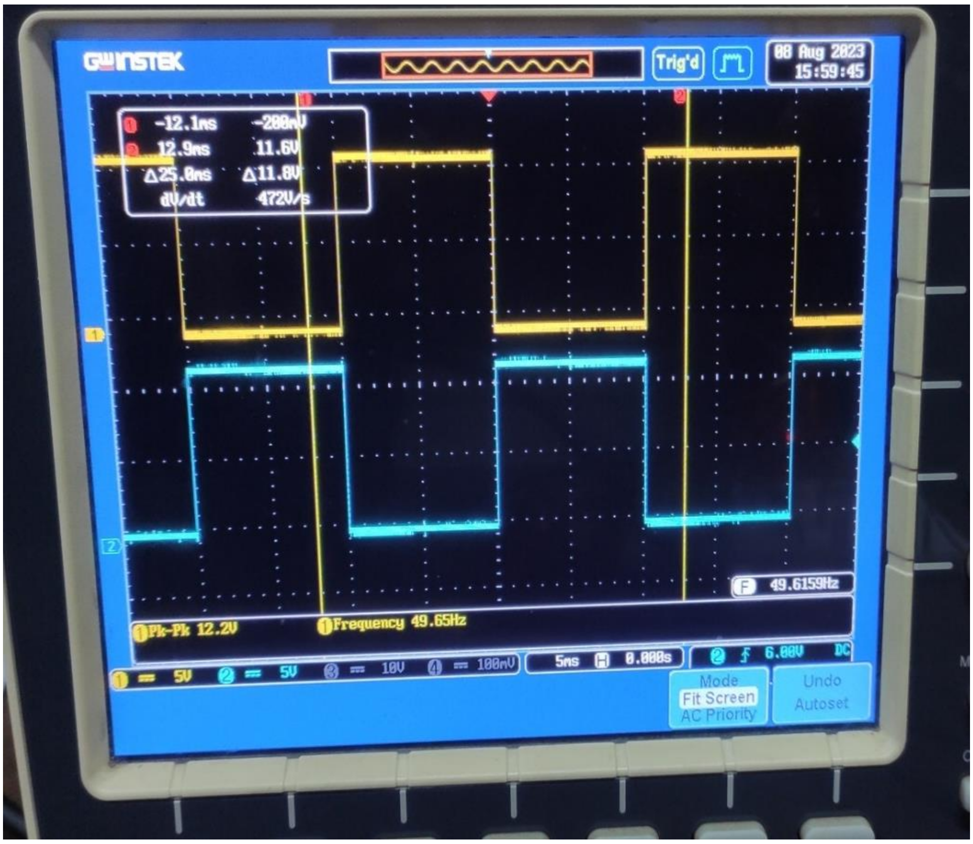


Fig. Gate Pulse from IC CD4047

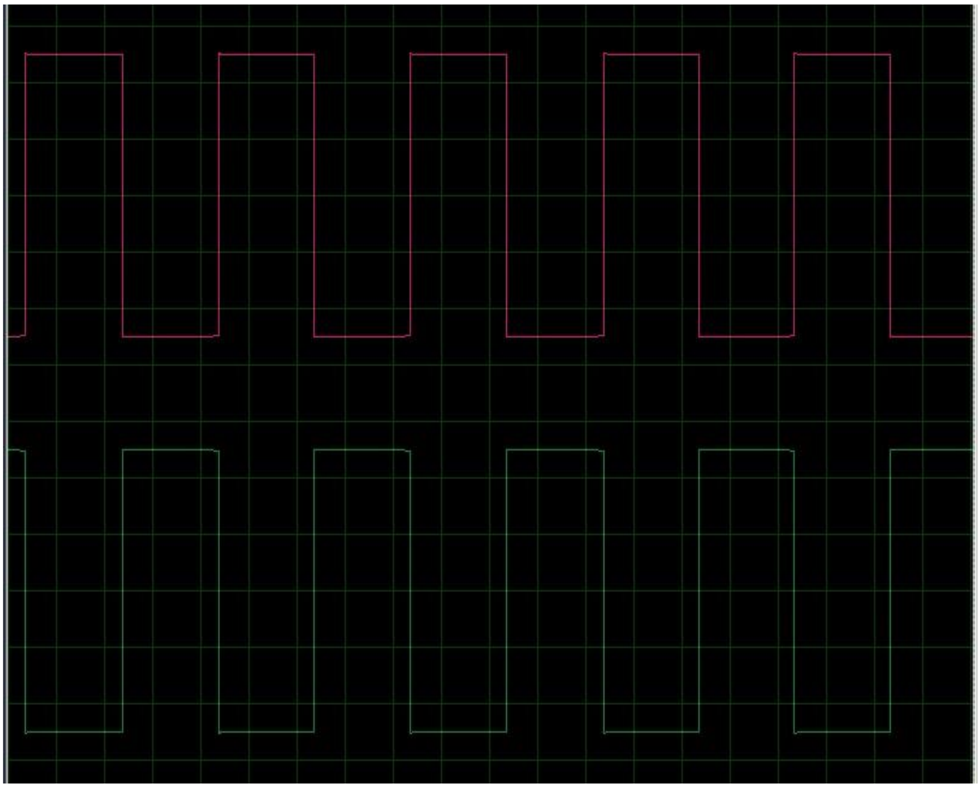


Fig. Gate Pulse from Proteus Simulation

Observed AC output from the primary side of the center tapped transformer

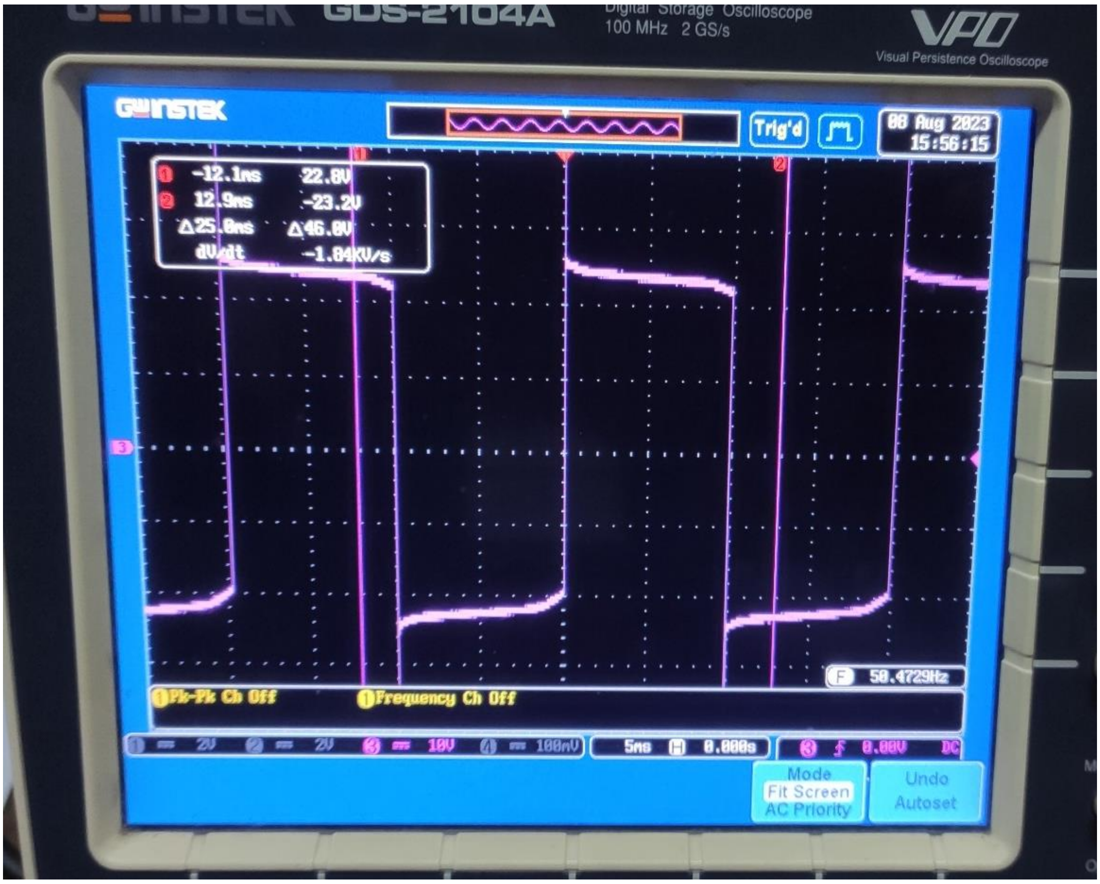


Fig. AC square voltage wave shape

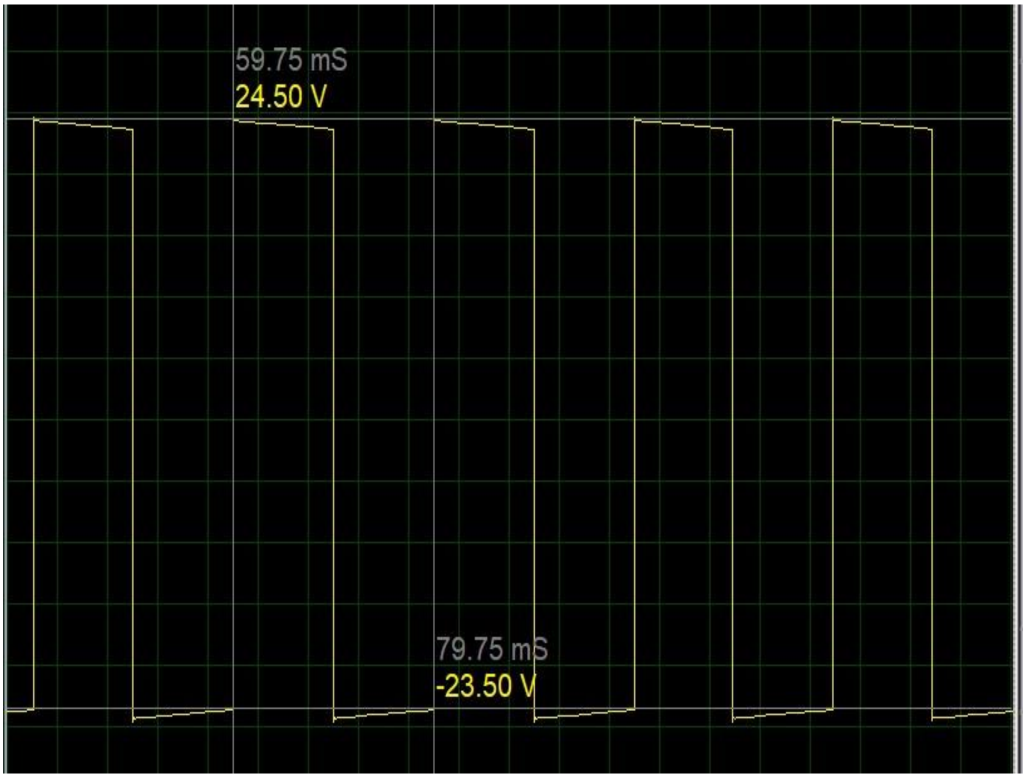


Fig. AC voltage wave shape from Proteus Simulation

Now, we put our solar panel in bright daylight to produce electricity.

Fig. Production electricity in daylight

Completed the circuit connection and turned on the switch

Fig. Bulb is turned on and the battery is charging at the same time

No load voltage and full load voltage were seen in the multimeter. It shows the rms value of the voltage. Also, full load current was measured using clamp meter.

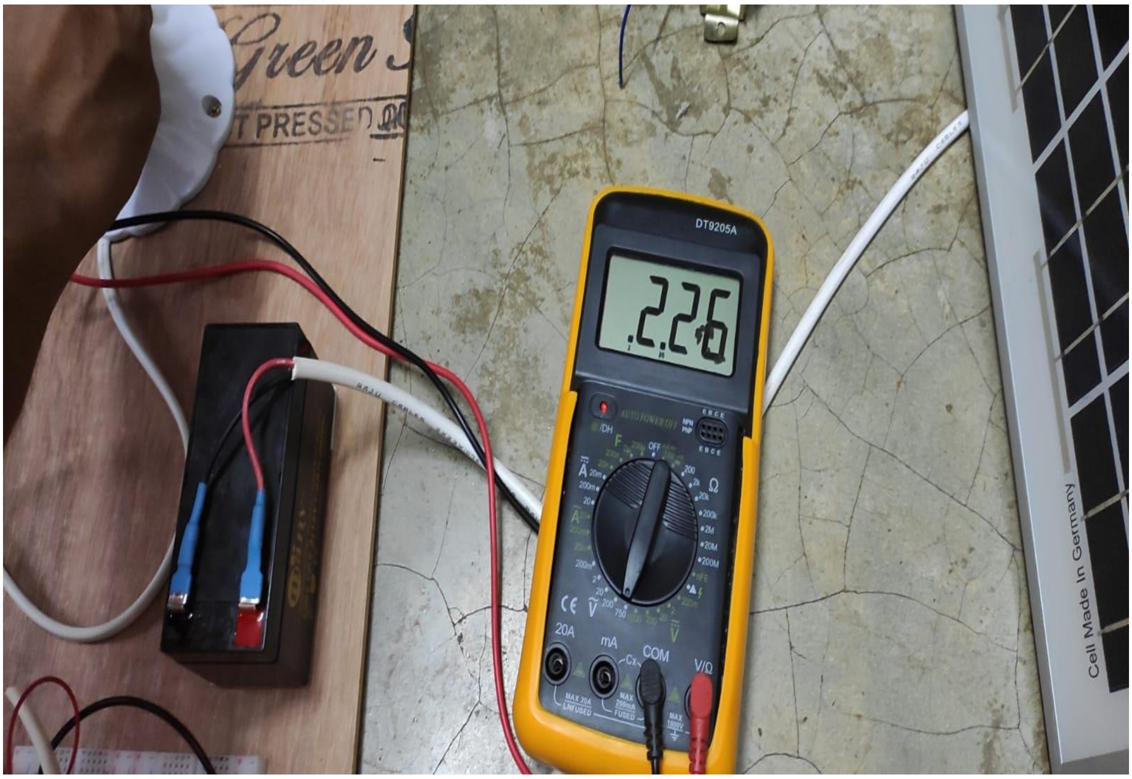


Fig: No load voltage in the secondary side

Fig: Full load voltage in the secondary side

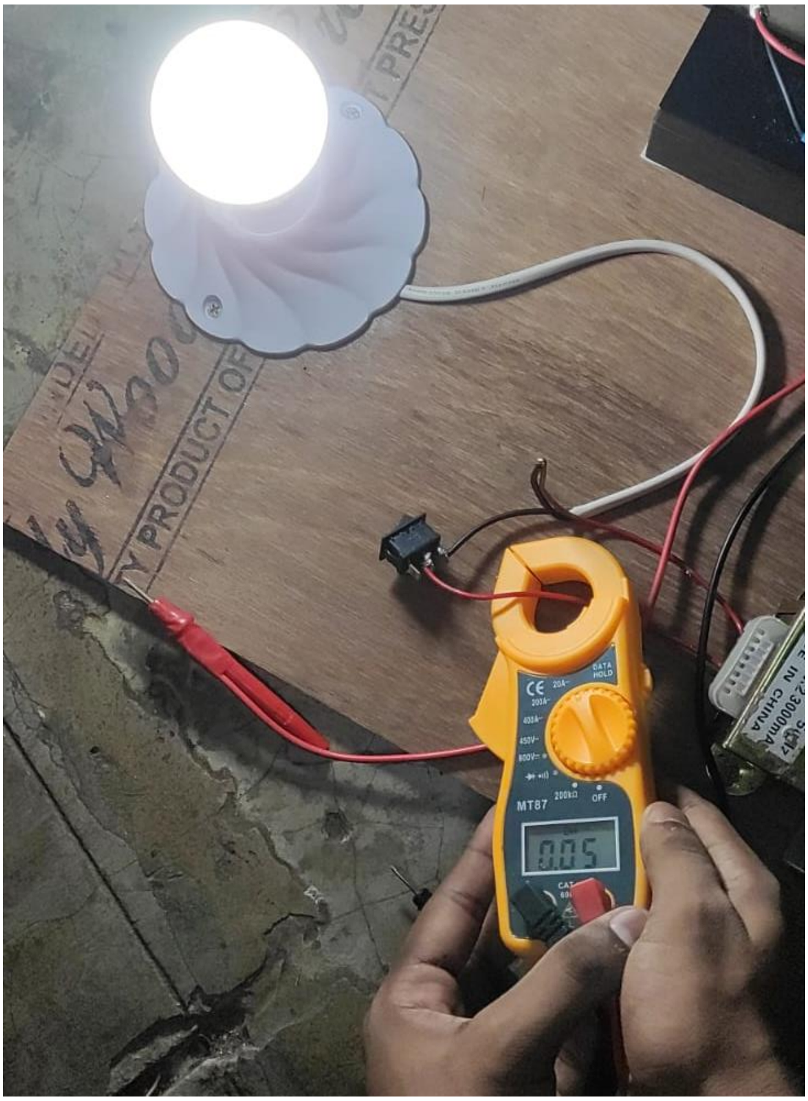


Fig. Full Load Current

DC voltage level generated from solar panel:

Fig. DC voltage level from panel

After connecting the battery, supply voltage to inverter circuit:

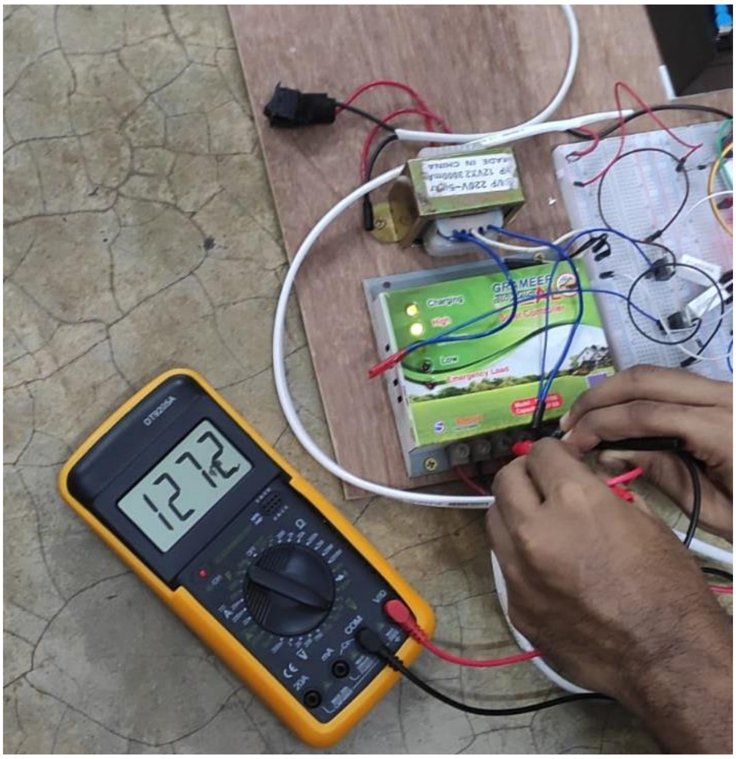


Fig. DC voltage after connecting battery

Fig. Bulb is getting power from battery (absence of sunlight)

4.3 Data Analysis

Battery voltage = 12V

Frequency in astable mode = $\frac{1}{4.4RC} = \frac{1}{4.4\times430\times10^{3}\times10^{-9}}$ = 52.85 Hz

Experimental data at scope:

Peak-to-peak voltage of gate signals = 11.6 V
Peak voltage of gate signals = 11.6 V
Phase difference = 180 degree
Frequency = 49.65 Hz$\approx$ 50 Hz
Peak-to-peak AC voltage at the primary side = 46 V
Positive peak voltage = 22.8 V
Negative peak voltage = -23.2 V
RMS AC voltage at primary = 23V
RMS AC voltage at secondary (no load) = 185V
Frequency = 50.47 Hz $\approx$ 50 Hz

Simulation data:

Peak-to-peak voltage at primary = 48 V
Positive peak voltage = 24.5 V
Negative peak voltage = -23.5 V

RMS voltage at primary = 24V
RMS voltage at secondary (no load) = 220

Experimented data from our project:

Panel produced voltage = 17.02 V
Battery voltage after connecting solar panel = 12.72 V
Rated charging current = 10% of rated battery current = $\frac{10}{100} \times 1.3\ A = 0.13\ A$
Observed charging current = 0.1 A
Discharging current = 0.5 A

RMS voltage at primary side of transformer = 25V
RMS output voltage (no load) = 226 V
RMS output voltage (Full load) = 178.3 V
Full load current = 0.05 A (At Load side), 0.5A (at inverter side)
Transformer Voltage regulation = $\frac{226-178.3}{178.3} \times 100\%$ = 26.75%

4.4 Results

After performing all necessary experiment and collecting data from those experiment, we can confidently say that our project works perfectly. The gate signal we found was exactly what we have asked for. Also we have got our desired inverter output with a frequency in which our power system operates. Battery works perfectly and stores energy in it. Solar controller gives us insight of the charging of solar panel, voltage level of battery accurately. In this project, our objective was to illuminate minimum of 5W bulb and continuously supply power to it with directly solar energy and in absence of solar energy. Also our full load and no load voltages are sufficiently high enough to supply energy to the load for a long time.

4.5 Github Link

https://github.com/jacksparrow1315/Solar_DC_to_AC_Inverter

4.6 YouTube Link

https://www.youtube.com/watch?v=OyILVtfIbOk

5 Design Analysis and Evaluation

5.1 Novelty

Solar panel is vastly used worldwide as one of the most reliable non-renewable energy. So to make our project different, we added our own inverter circuit, charge indicator in this project.

5.2 Design Considerations (PO(c))

For our project design, we barely used any components which may prove to be hazardous and harmful for public health and environment. As this problem requires significant electrical components, we tried to make it as simple as possible so that it can be explainable and acceptable to everyone. For example, as our MOSFETs in inverter circuit requires gate signal, we produced it by using a multivibrator that operates in astable mood. Also to store our energy, we avoided

5.2.1 Considerations to public health and safety

Heavy consideration was done before and during the implementation of the project. Isolation and taping was done wherever it was necessity demanded. We taped different parts of the circuit with masking tape where there is a possibility of electrical shock due to physical contact. We provided fast isolation maneuver for risky level of voltage in the output. No harmful component was used or emitted in this project.

5.2.2 Considerations to environment

One of the prime motivation for this project was ensuring an environment friendly method of generating electricity. In this project utmost consideration was given for environment. Sunlight is abundant and as we used this as source of energy no emission of harmful element or gases happened here.

5.2.3 Considerations to cultural and societal needs

Ours is a country with a huge number of population. This along with the increasing tendency of using electricity has created a huge demand for electricity in our society. Our solar inverter circuit is not very bulky in size and is not costly either. Again sunlight is a blessing that is available everywhere. So this mode of electricity generation can be used in any part of the country. In many part of the country heavy amount of load-shedding still happens. Solar inverter method can be complimentary to grid supply as it can provide electricity during load-shedding. In some remote places of our country specially hill areas national grid cannot provide electricity. There this can be an available source of electrical energy.

5.3 Investigations (PO(d))

5.3.1 Literature Review

First we needed a suitable solar panel for providing enough voltage for a 5W bulb. We calculated and decided 20W panel would be suitable for this purpose keeping in mind the very low efficiency of solar panels. We used push-pull type inverter in this experiment as in this type of inverter if one MOSFET is on than another MOSFET remains off and vice versa. This enables us to create AC voltage from DC voltage. We used this instead of half-bridge rectifier because ground separation is not necessary for push-pull inverter and we can also get comparatively our voltage in the output side in the push-pull type.

5.3.2 Experiment Design

We used solar panel solar panel to collect energy and then the energy was stored in the battery.

The inverter we used here is a push pull type inverter. We got our gate signal from the output of IC CD4047 and feed this signal to the gates of the MOSFETs. This IC operates in astable mode in our project.Now when these gates signals are feed to the gates of the MOSFETs, they work as switches which remains on and off in a complementary manner. With these two MOSFET as switch and DC 12V voltage at the center terminal of the transformer, a square shape AC voltage is generated. As the inverter we used uses push pull mechanism, we used a center tapped transformer.The diodes used across the source and drain of the MOSFETs are 'Freewheeling Diodes'. When an inductive load is connected, diodes provide a path to conduct lagging current when corresponding MOSFET is off. When we were generating electricity from the solar panel, we connected the battery across it and charged the battery. As the battery is charging and solar panel is generating electricity at the same time, the controller led blimps and indicates that it was charging and voltage level is high. We switched on the bulb, and it was lit. Now that we have done charging and generating, we wanted to take reading of the voltages at no load and full load condition. Also, we wanted to measure the full load current, battery charging current, battery discharging current. Before connecting the battery, solar panel was only generating not storing energy. We took the reading of solar provided voltage and battery voltage level after charging the battery using the panel. Finally we stopped charging the battery. Removed the solar panel from the daylight or covered its face so that no light ray can fall on it. Then we connected our battery and turned on the switch. The bulb was lit. The battery is now supplying power to the load. Battery voltage level was decreasing as time passed. It was desired because now it was not charging. So, it was using its own preserved energy. Also charging of battery and supplying power to load happens simultaneously.

Fig: Experimental setup

5.3.3 Data Analysis and Interpretation

At the start of the project, we made a software simulation where we get the overview of what we want to do and what will be the desired data that will lead to accomplish our goal. Then we used that simulation model and output data and put it into the account and designed the project's hardware part. Then we tested components in laboratory and take a note of that. After that we analyzed and compared these data with our simulation part data to see whether there is a mismatch. If found, we took necessary steps to right the wrongs.

5.4 Limitations of Tools (PO(e))

The efficiency of solar panel is low. This caused us to use higher rated devices. In rainy days when it is very hard to find sunlight charging the battery can become a difficult endeaver.

5.5 Impact Assessment (PO(f))

5.5.1 Assessment of Societal and Cultural Issues

By using this method of electricity generation we can ensure that the demand on national grid is reduced. Load-shedding will be reduced and even during load-shedding people will be able to use electricity with the help of this project. People from remote places will be the most benefitted ones as they would be able to get access to electricity which wasn't seem possible before the introduction of solar electricity.

5.5.2 Assessment of Health and Safety Issues

This project didn't use any fossil fuel nor did it emit any gas at all. So harmful element isn't a concern in this project. In this project proper isolation was done so no accident happened during the execution of the project. It is expected that people will be able to use this safely by following the safety manual and in case unexpected situation occurs they can use isolation maneuver to shut down the circuit.

5.5.3 Assessment of Legal Issues

According to our research there was no legal issue during the completion of our project.

5.6 Sustainability and Environmental Impact Evaluation (PO(g))

The sun is a formidable energy source which is clean, abundant, and renewable. One of the main benefits of solar batteries is their ability to store excess energy generated by solar panels, allowing users to reduce their reliance on the grid and fossil fuels. By reducing the dependency on fossil fuels we can reduce carbon-di-oxide and other harmful gas emission. By increasing photovoltaics longevity, using less harmful materials and improving recycling technology sustainability of solar panel can be improved.

5.7 Ethical Issued (PO(h))

We didn't face any moral dilemma while doing this project because there is nothing unethical about this project. We can proudly say that this project is fully ethical.

6 Reflection on Individual and Team work (PO(i))

6.1 Individual Contribution of Each Member

ID	Contribution
1906002	Contributed in performing experiments, data collection & analysis, soldering the cables and assembling the model, debugging of circuits.
1906004	Contributed in simulation, designing inverter circuit, building circuits in breadboard, soldering cables and assembling, data collection calculation & analysis.
1906011	Contributed in collecting materials, data collection and analysis, assembling parts and model, provided help in inverter design.
1906022	Contributed in designing the inverter circuit, simulation, building circuits in breadboard, collecting materials, debugging of circuits.

6.2 Mode of TeamWork

Our team took a collaborative approach in doing things. We tried to work as a team while completing individual responsibilities. For completing a particular **test** multiple member tried to work together (at least two) so that errors could be minimized. Decision making was done through **consensus**.

6.3 Diversity Statement of Team

In all the decision-making from preparing proposal to writing final report every member shared their opinion and each opinion was evaluated with care. This inclusiveness, this environment where every opinion was heard created a diverse environment.

6.4 Log Book of Project Implementation

Date	Milestone achieved	Individual Role	Team Role	Comments
Week 1-3	Project proposal preparation	Each member suggested four different idea	Selected most suitable two for proposal	From the beginning, we worked as a team and within due time we completed all the tests, experiments, data analysis, debugging and finally the project is completed and run successfully.
Week 4	Preparing detailed workflow of the selected project	Idea of the accepted project was given by the one who suggested it	Accepted the workflow and suggested some minor change where needed	
Week 5-7	Analysing the theories related to project, collecting the material for hardware implementation	Each member done their analysis from different website	Most suitable analysis and design idea was accepted	
Week 8-10	Doing simulation, building inverter circuit and debugging it.	Two member collected components while other two member assembled and build the circuit and debugged it.	Whole team worked as a unit to build the project	

Date	Milestone achieved	Individual Role	Team Role	Comments
Week 11-12	Completing the setup with inverter circuit, solar panel, battery, LED bulb etc. Showing progress in the lab.	Two member completed the setup and other two member took necessary data for analysis	Whole team worked as a unit to complete the assigned task	
Week 13	Solving the problems found at progress presentation and writing project report.	Two member solved some minor issue. Other two members prepared the report and presentation	Completed the project, report and presentation	

7 Communication (PO(j))

7.1 Executive Summary

Introducing the Solar DC to AC Inverter Project, the Future of Energy Conversion

[9/9/2023,xyz city] - We are ecstatic to announce the official launch of our ground-breaking Solar DC to AC Inverter project, which is going to change the world of sustainable energy. This ground-breaking inverter, created by a group of forward-thinking engineers, effortlessly converts solar power from DC to AC energy.

Our Solar DC to AC Inverter has cutting-edge technology that maximizes energy conversion efficiency while lowering expenses and having a minimal negative effect on the environment. With the help of this initiative, solar energy can now be used to generate cleaner, more sustainable electricity for homes and businesses.

Join the revolution in renewable energy with us. We can build a better, more sustainable future by working together.

Please get in touch with 01763110902 with any media queries.

Company: XYZ Renewable Energy Distribution Limited

Website: www.xyzrenewableenergydistributionltd.com

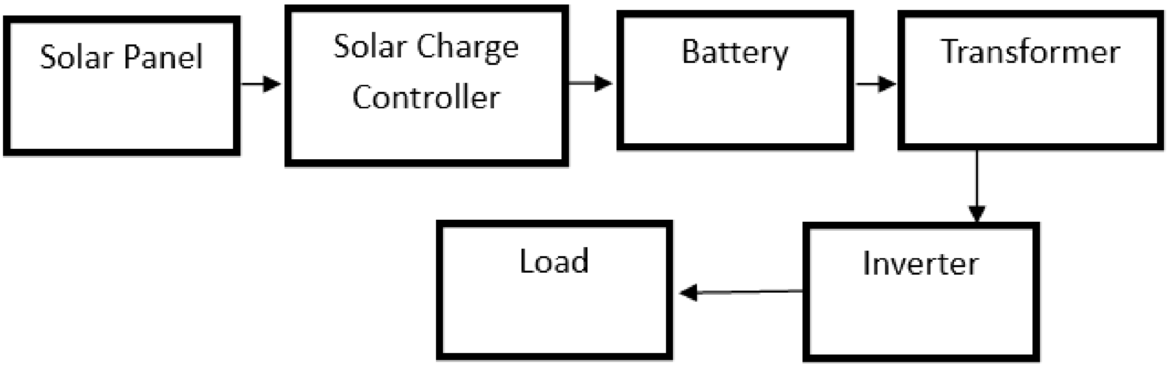
Phone: 01763110902

Gmail: sabbirahme354@gmail.com

7.2 User Manual

1. Introduction:

This PV inverter can provide power to connected loads by utilizing PV power, utility power and battery power.



2. Important Safety Warning:

Caution! Before attempting any maintenance or cleaning or working on any circuits connected to the inverter, disconnecting AC, DC and battery power from the inverter can reduce the risk of electric shock. Merely turning off controls will not reduce this risk because internal capacitors can remain charged for 5 minutes after disconnecting all sources of power.
Caution! Do not disassemble this inverter by yourself. It contains no user-serviceable parts. Attempt to service this inverter by yourself may cause electric shock or fire and will void the warranty from the manufacturer.
Caution! To avoid fire and electric shock, make sure that existing wiring is in good condition and that the wire is not undersized. Do not operate the damaged Inverter or substandard wiring.

3. Product Overview:

i. Inverter Unit
ii. Cables
iii. Solar Panel
iv. DC switch
v. Charge Indicator
vi. Transformer
vii. LED indicator

4. Installation:

i. Unpack all the elements.
ii. Place the solar panel in a suitable place where it will get maximum day light.
iii. Place the controller, inverter and transformer block where it will not have any contact with water.
iv. Connect the load with the inverter.
v. Connect all the neutral wire in a common ground.
vi. Do not connect the wire wearing wet clothes or wet hand.
vii. Make sure to wear protective gloves before installing.

5. Operation

i. The charge controller unit will give the information about the voltage level of the battery and solar panel.

ii. Turn on the switch when indicator indicates “HIGH” or “MEDIUM”.
iii. Do not connect while the indicator indicates “LOW” or “EMERGENCY LOAD”.

6. Maintenance

i. Check battery level after 2-3 days.
ii. Check cables to prevent any type of short circuit.
iii. Makes sure each component is protect from water or rain.

8 Project Management and Cost Analysis

8.1 Bill of Materials

Product	Price (Tk)
Diode (12V)	10
Resistor and Potentiometer	40
N-channel Power MOSFET	165
Transformer (12-0-12 Volt 3000mA)	370
Transformer (12-0-12 Volt 1000mA)	250
CD-4047	30
Clam meter	480
LED (5W)	120
Cardboard	90
Solar panel (20W)	1500
Battery (12 volt 1.3 Ah)	650
Solar Controller	300
Breadboard	420
Jumper and wire	150
Holder and switch	60
Total	4635

8.2 Calculation of Per Unit Cost of Prototype

To produce one unit of this prototype, the total cost is = 4635 Tk

8.3 Calculation of Per Unit Cost of Mass-Produced Unit

In our project we have produced only a single unit. In a company, production cost depends on various parameters. The initial fixed cost that an industry or a company spends depends on the amount of product they wants to manufacture. It also has to deal with the supply and demand of the product. If the demand is high and manufactures are making this inverter in a large scale, then the unit cost may come below 4000 tk in the long run. In some cases, it may reduce to 50% of the initial unit cost that we had to spend while making this project

8.4 Timeline of Project Implementation

Week 1-3	Project proposal preparation
Week 4	Preparing detailed workflow of the selected project
Week 5-7	Analysing the theories related to project, collecting the material for hardware implementation
Week 8-10	Doing simulation, building inverter circuit and debugging it.
Week 11-12	Completing the setup with inverter circuit, solar panel, battery, and LED bulb etc. Showing progress in the lab.
Week 13	Solving the problems found at progress presentation and writing project report.

9 Future Work

The future of solar inverters holds exciting possibilities as technology continues to advance and the demand for renewable energy solutions increases. Here are some potential future developments and areas of focus for solar inverter projects:

1. **Higher Efficiency**: Solar inverters will continue to improve in efficiency, enabling more of the harvested solar energy to be converted into electricity. Advanced semiconductor materials and designs will play a significant role in achieving this.
2. **Energy Storage Integration**: Inverters will increasingly integrate with energy storage systems, such as batteries, to enhance energy management and provide backup power during grid outages. Smart control algorithms will optimize energy flow between the solar panels, batteries, and the grid.
3. **Hybrid Inverters**: The development of hybrid inverters that can efficiently manage both solar and other renewable sources, such as wind or hydro, will become more common. These inverters will enable diverse energy sources to work together seamlessly.
4. **Cost Reduction**: Ongoing research and development will drive down the manufacturing costs of solar inverters, making solar energy more accessible and affordable for a wider range of users.
5. **Environmental Sustainability**: Inverters will be designed with a focus on sustainability, using eco-friendly materials and manufacturing processes, as well as being easily recyclable at the end of their life cycle.
6. **Multi-Functionality**: Future solar inverters may serve multiple functions beyond energy conversion, such as power quality enhancement, reactive power compensation, and even grid management.

10 References

1. https://www.academia.edu/24348789/Solar_Inverter_Project_Report
2. https://circuitdigest.com/electronic-circuits/solar-inverter-circuit-diagram