

ANALYSIS OF VOLTAGE STABILITY CONTROL FOR A GRID CONNECTED INVERTER

A Project report is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Electrical and Electronic Engineering.

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MAY, 2023

DECLARATION

We hereby declare that this project “**Analysis Of Voltage Stability Control For A Grid Connected Inverter**” represents our own work which has been done in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications. I have attempted to identify all the risks related to this research that may arise in conducting this research, obtained the relevant ethical and/or safety approval (where applicable), and acknowledged my obligations and the rights of the participants.

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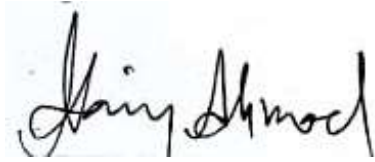
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APPROVAL

The project entitled “**Analysis Of Voltage Stability Control For A Grid Connected Inverter**” submitted by **Tasnia Benta Reza Sharila ID:191-33-5133 & Araghahaha ID:191-33-4998** has been done under my supervision and accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** in **May, 2023**.

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Dedicated
To
Our
Parents

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LIST OF ABBREVIATIONS

BAETE	Board of Accreditation for Engineering and Technical Education
DIU	Daffodil International University
PV	Photo Voltaic
PWM	Pulse Width Modulation
MATLAB	Mathematical Laboratory Software
MPPT	Maximum Power Point Tracker
HESS	Hybrid Energy Storage System
PLL	Phase Locked Loop
PI	Proportional-integral
AC	Alternative Current
DC	Direct current
THD	Total Harmonic Distortion
VCO	Voltage controlled oscillator
FFT	Fast Fourier Transform
THD	Total Harmonic Distortion

LIST OF SYMBOLS

<i>Symbol</i>	<i>Name of the symbol</i>
ωt	Angular Phase
K	Gain

ACKNOWLEDGEMENT

First of all, we want to give thanks to **Almighty Allah**. With his blessing we are able to complete our work with best effort.

We want to pay our utmost respect to our Supervisor **MS. Kanij Ahmad, Senior lecturer** of the **Department of EEE, Daffodil International University** for who has given us the chance to work on an impactful idea and taken care of every issue of development of this concept. Then we would like to take this opportunity to express gratitude to our supervisor for being dedicated in supporting, motivating and guiding us throughout this project. This project can't be done without his useful advice and help. Also thank him very much for giving us the opportunity to work with this project.

ABSTRACT

Energy consumption is rising daily while non-renewable energy sources are dwindling. We should produce more renewable energy to counter these arguments. However, one significant issue with renewable energy is that it depends on the weather to be produced. The energy generated on the grid side cannot meet the demand on the load side during cloudy and inclement weather. Non-linear loads that reduce the power quality of the energy networks or high or uncontrolled energy Demand may be the main load-side concerns. Energy sources connected to the grid via an electronic converter or inverter have quite different operational characteristics when compared to the generation of renewable energy. This research focuses on the grid's stability and how to overcome the problem of grid-to-transmission-line stability. In this work, the advantages of MPPT and PI controllers with inverters in a power system from grid to transmission line are investigated. A solid control system in which the MPPT and the PI controller with inverter address the major issue. The proposed grid system, MPPT model in BOOST converter, inverter, and LC filter are all designed in MATLAB/Simulink. To establish the tracking response of the set power references, a series of simulations for the grid-connected MPPT in BOOST converter and PI controller in inverter model were done with various step changes in the active and reactive power references.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In recent years, the installation of grid-connected photovoltaic (PV) systems and building-integrated PV systems has advanced rapidly all over the world. A number of technical problems, mostly pertaining to power quality, arise when PV penetration levels in the low voltage (LV) grid rise [1,2]. Here, issues may be brought on by excessive or uncontrolled energy production, such as that produced on a partly overcast day. The primary issues on the load side might be brought on by nonlinear loads or excessive or uncontrolled energy consumption. The ability of a power system to maintain constant voltages at all of its buses in the face of a disturbance from a certain starting operating condition is known as voltage stability. Voltage losses or decreases happen.

when the generating and load points of an electric power transmission network are connected. These voltage dips are within the grid's allowable bounds while it is working normally. The bus voltages, however, may deviate materially from the acceptable operating range (set by power system operators or grid code) as a result of disturbances, increases in power consumption, or other system changes, making it impossible for operator intervention or automatic control to stop the deviance. Under these conditions, voltages may undergo significant, progressive drops that are so severe that the integrity of the system is put in jeopardy and power cannot be provided to the loads. Voltage collapse is the outcome of this, which is known as voltage instability. Over the following decades, as electric power demand rises, it is anticipated that these voltage-related system security concerns would worsen [3]. It is unable to build new non-renewable power facilities due to restrictions on the installation of new transmission lines and ecological considerations.

1.2 Problem Statement and Proposed solution(s)

There are times when the generation of renewable energy might be quite high. However, it can also be low in other circumstances. So, when needed, the electricity generated might not be enough or might not match the demand. Voltage instability typically arises in electrical power systems that are overloaded, have faults, or lack reactive power. Two sorts of occurrences are often to blame for voltage instability issues. The first kind of event happens when the demand cannot be satisfied by the transmission capacity or reactive power reserves. This condition might be the consequence of an unanticipated rise in the system's demand or a prior weakness, such as low voltages and increasing losses. The second kind of incident is a significant occurrence that has a negative impact on the generating or transmission system and renders the capacity insufficient to meet the demand, which is the pre-fault consumption. Since we get low level energy from the PV solar panel, we use boost converter also there rise a problem in the grid side voltage instability. To overcome this problem we can use a MPPT with a function in the boost converter. To stable the output voltage of boost converter with the transmission line, we use there Inverter with PI controller .

1.3 Aims

The goal of this thesis is to create a method that can be used in the real world and that assesses voltage security while using data from a power system model to determine corrective measures. The specific sub-tasks that must be completed for this thesis include:

1. Change the value of constant voltage and we can get a stable output.
2. We can also change the boost converter output value for our needed voltage.
3. To stable the voltage output there is used PI controller.

The main focus of the thesis is to use MPPT for voltage stability assessment and use LC filter to take curative action for the noiseless output voltage. In order to achieve good results from the MPPT and PI controller, the system should be modelled accurately in the MATLAB software.

1.4 Procedures

1. Firstly we use a PV Array and give the input value of voltage and temperature.
2. Then the output side of PV Array is connected with the input of boost converter which increase the rated voltage and the internal MPPT control the stability of the voltage.
3. Then we use a PWM inverter which convert it DC to AC.
4. For measure the voltage we use a three-phase voltage measurement.
6. To get a pure signal of voltage and current we use there LC filter.
7. We use another three-phase voltage measurement and a load.

1.5 Gantt Chart



Table 1.1: Gantt Chart

1.6 Organization

It's time to compile our current goals into a concise planning document for our portfolio. In regard to our research topic, this paper will summarize the course's major themes. In the end, it will also assist us in getting ready for a more thorough research proposal that we might want to conduct at a later time. Watch for Course 5 in this series, "Why Preparing Matters," which will walk us through every phase of planning for our research proposal in great detail.

There are several reasons why research projects are created. They aid in directing our research and make sure it is well-planned before moving forward. They are also necessary to obtain permission to carry out the research. Remember that research can be costly, thus the proposal could also be used to request financing for the study.

Even while we don't need to be completely familiar with a study proposal at this point, it's useful to understand our goals. When the time comes, our proposal must at the very least have the following components:

a name for our study's topic. Detailed background data that contains a well-thought-out, fact-based justification for our study subject.

a study of the academic literature on the subject. The objectives of our investigation and its expected impact. We must provide evidence for why we believe the research is worthwhile and outline its advantages.

the anticipated results of the study. a study strategy outlining the methodology we've chosen, along with the strategies we'll use to gather and analyze the data, as well as why we made these decisions. We must also discuss the constraints of the study, the reasonable time frame for completion of the investigation, and any ethical concerns that may arise during its execution. We must emphasize how these ethical concerns will be handled. We will be guided through the ethics application and more in course four of this series, Why Ethics Matter. Information about the resources needed, the expenditures involved, and how the study will be carried out. Additionally, it's critical that our proposal be worded clearly. Our study supervisor, approver, ethics board, or financing board may not have the time or desire to read a lengthy text. The comprehensive research proposal won't be ready for some time if we're still in the early phases of our study. There are further courses in this series that will guide us farther

along our path. But first, let's put in some effort and finish one final crucial assignment so we can add it to our portfolio.

Create a brief planning document for our portfolio that satisfies each of the following criteria after reflecting on what we have discussed thus far.

Describe in detail our research question and why we believe it to be significant.

Who is the intended audience for this study? Consider the people who would be curious to learn about our results. Exists a theory for us? If so, how did we arrive at this theory?

What qualitative strategy fits our research question the best? Justify your position briefly. Describe the participants in our study and the method we'll use to get the necessary data.

What concerns, prejudices, or subjectivity do we bring to our research that might taint our methodology, keeping in mind the identity audit?

Share a link to our document in this paper after we're done. Spend some time reviewing at least two other group members' work and provide helpful criticism.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this paper we discuss about how we control the stability of voltage in the grid side and between the grid and transmission line. From the paper we can get a clear idea about the voltage stability, how it's work and how to solve the problem of grid system. We can know about how to transmission line work from this paper.

2.2 Related Research

We read a paper which published In 2020, where mentioned the investigation of a hybrid PV–battery/supercapacitor system and active power control in MATLAB/Simulink for a new topology are presented in detail. The first step is a more thorough investigation of research in the literature. In this study, the benefits and drawbacks of supercapacitors for active PV power regulation are examined. Supercapacitors used in active PV power regulation won't cost more since, as has been demonstrated, utilizing them on the load side lowers the cost of the storage system. Additionally, employing supercapacitors will save costs in other ways, for as by accelerating battery aging and improving efficiency. To share PV power and reduce PV peak power, a novel architecture for HESS is suggested.[10]

Modern power systems are now running more closely to their working limitations as a result of the rising demand for electricity caused by deregulated electricity markets. The power systems are working under stress circumstances, rendering them sensitive to a variety of events, as a result of deregulated markets and widespread integration of renewable energy sources. For these reasons, applying modern, efficient security evaluation and control methodologies is crucial for assessing and improving the stability of the power system. A power system's stability condition may be anticipated by computing its regions and borders, and based on these calculations, preventative steps can be recommended in order to restore the system's stability. [1]

An increasingly popular substitute for centralized, massive producing stations is distributed generation (DG; small-scale generation linked to local distribution networks). Power distribution systems now face several issues and concerns related to their operation and control because to the growing integration of DG in these systems.

In this thesis, voltage control and voltage stability in distribution systems with synchronous and induction machine-based DG are investigated. The findings indicate that DG can affect distribution systems' steady state voltage, reactive power regulation, and voltage stability margin in either a positive or negative way. The controllability of the DG is impacted by its kind and operating parameters. However, a correct voltage control may still be maintained in the presence of DG if the DG is effectively coordinated with the available voltage and reactive power equipment. Furthermore, with the right reactive power compensation devices, the detrimental effects of DG on voltage stability may be reduced.[2]

2.3 Compare and Contrast

In our paper we try to discuss the voltage stability problem and make a solution. We make an inverter by using the MATLAB simulation software. Other papers were made by mathematical calculation and we try to make a design which will be understood in a better way.

2.4 Summary

In this essay, we talk about how to regulate the voltage stability on the grid side and between the grid and the transmission line. The study provides a thorough understanding of voltage stability, how it operates, and how to address grid system issues. This document provides information on how transmission lines operate. We attempt to explore the voltage stability problem in our work and provide a solution. Using the MATLAB simulation program, we create an inverter. Other papers were created using mathematical calculations, and we work to create designs that are easier to comprehend.

CHAPTER 3

MATERIALS AND METHODS

3.1 Introduction

Equipment must be suitable for its intended use, and it must also be properly designed, placed, cleaned, maintained, and installed:

1. Suited for use in the design and testing of components, in-process devices, and final devices.
2. Ability to give reliable results.

3.2 Materials

We are using here so many component

1. **PV Array:** A photovoltaic array, which can include any number of PV modules and panels, is the entire power-generating system. Under Standard Test Conditions, the maximum DC power output (watts) of PV modules and arrays determines how well they function (STC). we are using the PV array for the input in our setup design.

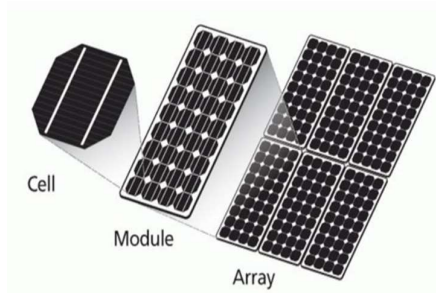


Fig 2.1: PV Array

2. **Boost Converter:** To "step-up" an input voltage to a higher level, needed by a load, the boost converter is utilized. By holding energy in an inductor and delivering it to the load at a greater voltage, this special feature is made possible. Here we are using the boost converter to increase the voltage.

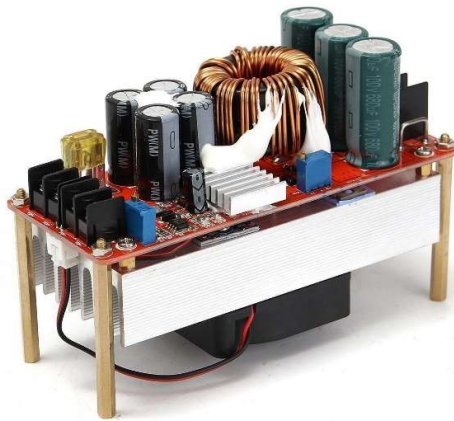


Fig 2.2: BOOST Converter

In this boost converter we are using series RLC Branch, Boost inductor, Some IGBT, Diode, Filter Capacitor, Unit Delay, MPPT controller (MATLAB FUNCTION),PI controller, Relation Operator, Repeating Sequence and some connection port.

- 3. Inverter :** For making the inverter we are using some IGBT and connect them with the PWM port of boost converter . VR,VY,VB will the output of the inverter.



Fig 2.3: Inverter

- 4. Voltage Measurement Block:** The voltage between two electrical nodes is measured instantly by the voltage measurement block. Other Simulink blocks can use the Simulink signal that is provided by the output.

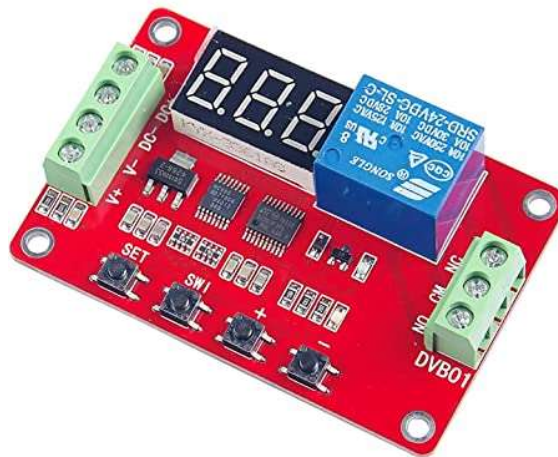


Fig 2.4: Voltage measurement block.

- 5. Three-Phase VI measurement Block:** To test the instantaneous three-phase voltages and currents in a circuit, use the Three-Phase V-I Measurement block. It reproduces the peak voltages and currents from three-phase components linked in series with ground or between phases.
- 6. Series RLC Branch:** Resistor, inductor, and capacitor are connected in series by a series RLC branch. Either a single phase or three phase Series RLC branch is possible. By choosing the branch type, the user may determine which components will be in the branch.
- 7. Three-Phase Measure VI Block:** Three-Phase V-I Instantaneous three-phase voltages and currents in a circuit are measured using measurement blocks. It reproduces the three phase-to-ground or phase-to-phase peak voltages and currents when coupled in series with three-phase components.
- 8. Three-Phase Source:** Three single phase sources of equal amplitude and 120° phase shift make up a balanced three-phase source. The neutral, which is coupled to the ground reference, is a fourth conductor in this arrangement.



Fig 2.5: Three phase source

9. Voltage Transformation Block: A three-phase system's time-domain components in an abc reference frame are transformed into direct, quadrature, and zero components in a rotating reference frame via the Park Transform block. By using an invariant version of the Park transform, the block may maintain the active and reactive powers together with the powers of the system in the abc reference frame. The zero component is equivalent to zero in a system that is balanced.

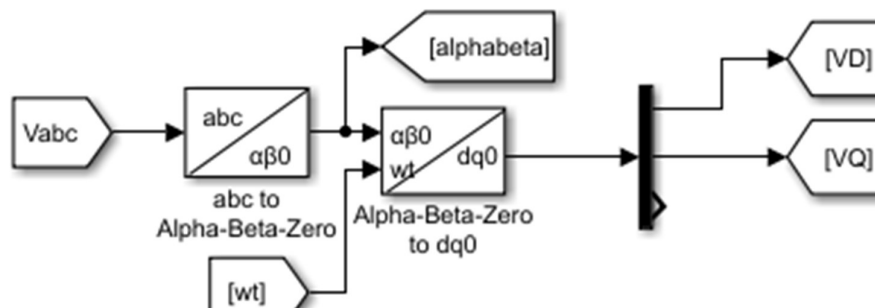


Fig 2.6: Voltage transformation block

10. Current transformation Block: It using in loop for the stable current. A three-phase (abc) signal is transformed into a rotating reference frame (dq0) using a Park transformation in the abc to dq0 block. The input ωt , in rad, provides the spinning frame's angular position. The dq0 to abc block converts a rotating reference frame of type dq0 to a three-phase (abc) signal via an

inverse Park transformation. The input ωt , in rad, provides the spinning frame's angular position.

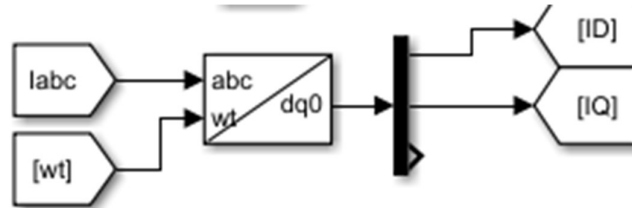


Fig 2.7: Current transformation block

11. PWM generation Block: In order to create low frequency output signals from high frequency pulses, a method called pulse width modulation (PWM) is used. The low frequency output of an inverter leg may be seen as the average voltage across a switching period, quickly switching between the upper and lower DC rail voltages.



Fig 2.8: PWM generation block

12. Voltage and current controller block:



Fig 2.9: Voltage and current controller block.

In our voltage and current controller we take a value 600 for voltage and 0 for current, some PI controller and a dq0 to abc block for the input port for PWM.

13. Phase Locked Loop: A control system that creates an output signal whose phase is correlated to the phase of an input signal is known as a phase-locked loop (PLL). A phase detector, a loop filter, and a voltage-controlled oscillator make up a basic PLL (VCO). There are various distinct kinds; the simplest is an electrical circuit made up of a feedback loop and a variable frequency oscillator. The phase difference between two signals and the capacity to detect it are essential for the proper operation of a phase locked loop, or PLL. The frequency of the loop is then controlled using the knowledge of the phase error or difference between the two signals. Two waveforms, which are often observed as sine waves on an oscilloscope, can be visualized to better grasp the concepts of phase and phase difference. Both signals will show at separate locations on the screen if the trigger is fired simultaneously for both signals.

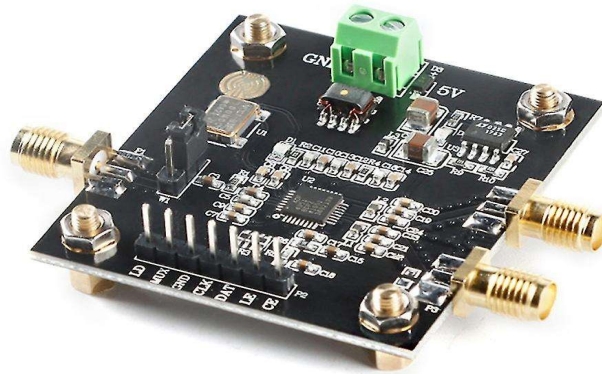


Fig 2.10: Phase Locked Loop

3.3 Design Specifications. Standards and Constraints

In our design we want to show the voltage stability. In the model we are using a BOOST converter to gain our voltage. Another issue that high frequency boost converter designers must deal with is stability. At MHz frequencies, electromagnetic fields radiating between circuit components can cause both positive and negative feedback, particularly in surface mount layouts where the circuit components are very close to one another. In order to increase stability and avoid potential oscillation brought on by unforeseen positive feedback, parallel capacitor is included. Then we use a PWM inverter. By changing the width of each pulse in a pulse train in direct proportion to a modest control signal, a method known as pulse-width modulation is used. The wider the control voltage, the broader the subsequent pulses become. It is feasible to create a high-power waveform whose average voltage fluctuates sinusoidally and is ideal for controlling ac motors by employing a sinusoid of the necessary frequency as the control voltage for a PWM circuit. It elaborates on the design and functionality of a drive system using an LC filter linked to the PWM inverter's output terminals. The filter's main functions are to minimize Total Harmonic Distortion (THD), smooth out the voltage and current waveforms, and eliminate high-frequency harmonics from the inverter's five-phase output voltages. A comparison is made between an LC filter and a three-phase or five-phase induction motor drive. The study presents the simulation results of the three-phase and five-phase induction motors using

MATLAB/SIMULINK, both before and after the addition of the LC filter at the output of VSI. To verify the simulation results, experimental data for a five-phase drive system with an LC filter is given.

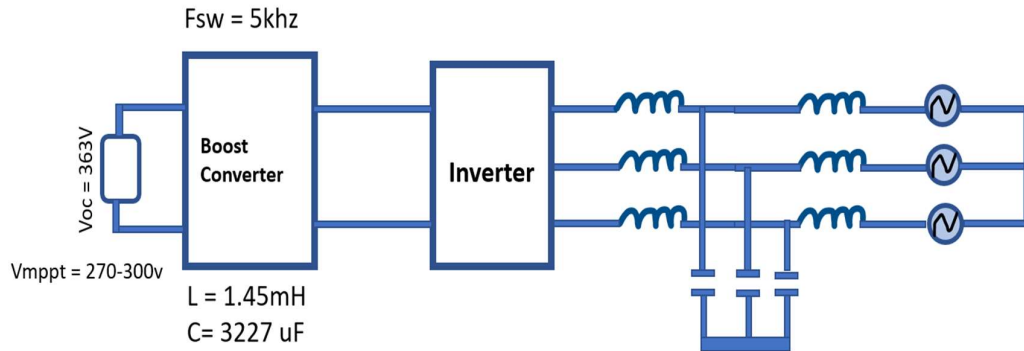


Fig 3.1: Line diagram of inverter connection

3.4 System Analysis

PV Array Parameters	
Parallel Strings	47
Series connected modules per sting	10
Sun irradiance	1000
Cell temperature in deg	25
PV irradiances (w/m ²)	[100 500 100]
PV Model	Aavid Solar ASMS-165p

Table 3.1: PV Array Parameters

BOOST Converter Parameters	
Series RLC Branch	$R=1e^{-3}, C=1000e^{-6}$
Boost inductor	$1.45e^{-3}$
Filter capacity	$3227e^{-6}$
IGBT	N=1
Unit Delay	Sample time= $1e^{-4}$
MPPT Controller	Output voltage=300
PI controller	P=0.005, I=0.001
Repeating sequence	Time value=[0 0.0002], Output=[0 1]

Table 3.2: BOOST Converter Parameters

Series RLC branch parameters for filtering	
RL	$R=1e^{-3}$, $L=500e^{-6}$, $N=6$
Filter Capacity (RC)	$N=3$, $R=1e^{-3}$, $C=100e^{-6}$

Table 3.3: Series RLC branch parameters for filtering

Three-Phase Source Parameters	
Configuration	Yg
Phase to phase voltage	400
Frequency	50
Source resistance	$1e^{-6}$
Source inductance	$1e^{-6}$
Base voltage (Vrms phase to phase)	400

Table 3.4: Three-Phase Source Parameters

Voltage transformation block parameter	Current transformation block parameter
abc to alphabeta-zero; alphabeta-zero to dq0; Demax (3 output)	Abc to dq0 Demax (3 output)

Table 3.5: Voltage and Current transformation block parameter

Voltage controller block parameters	
DC voltage	600
PI controller	$P=0.25$, $I=300$

Table 3.6: Voltage controller block parameters

D access current controller block parameters	
PI controller	$P=10$, $I=20$
Gain	$2 \cdot \pi \cdot 50 \cdot 1000e^{-6}$

Table 3.7: D access current controller block parameters

Q access current controller block parameters	
PI controller	P=10, I=20
Gain	$2 \cdot \pi \cdot 50 \cdot 1000e^{-6}$

Table 3.8: Q access current controller block parameters

PWM generation block parameters	
Repeating Sequence	Time Value= [0 0.00005 0.0001] Output values= [-1 1 -1]
Logical operator	NOT gate

Table 3.9: PWM generation block parameters

3.5 Simulation

After PV array we use a boost converter . In a DC/DC power converter known as a boost converter, the voltage is increased from the source (input) to the output (load). To see the output voltage we connect a scope with VDC by a voltage measurement. For industrial applications, a three-phase inverter is utilized to supply variable frequency electricity. Three phase inverters are controlled by voltage using PWM. The inverter comprises three phase-legs, each of which contains two IGBTs, and is powered by a constant dc voltage, Vdc. With SPWM control, the inverter's switches are managed by contrasting a triangular signal with a sinusoidal signal. The triangle wave defines the inverter's switching frequency, while the sinusoidal wave establishes the required fundamental frequency of the output. Transistors have 180 degrees of conductivity. To control the space vector modulation of the three phase inverter we use there voltage transformation and current transformation block .For filtering this DC signal we use the Phase locked loop. Then we use the voltage and current controller block . This circuit is intended for use in battery chargers that have a fixed output voltage and maximum current. It may be utilized in any application that calls for precise current and voltage regulation. Voltage supervisors and overvoltage protection are examples of other uses. From voltage and current controller block we get a fixed dc voltage which dq0 to

abc converter to Ac .Then we use PWM generation block for generate PWM signal from our AC signal and it is the input signal for PWM port of inverter. Then use the Three phase VI measurement for measure the getting voltage and the LC filter reduce the noise of the signal. For measure the noiseless signal we use there another VI measurement and it is connected with three phase source.

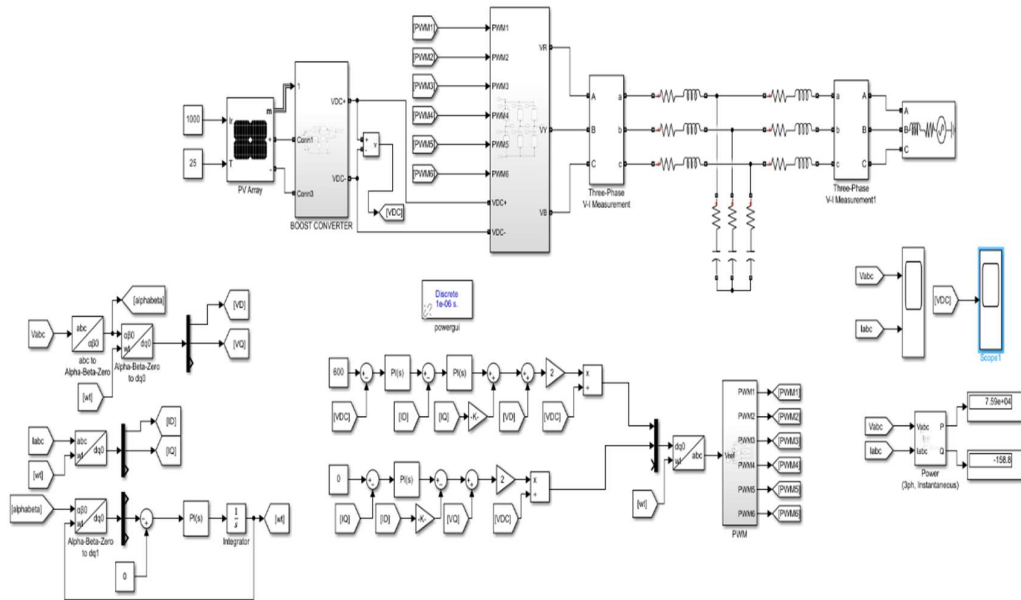


Fig 3.2: Inverter Connection Diagram

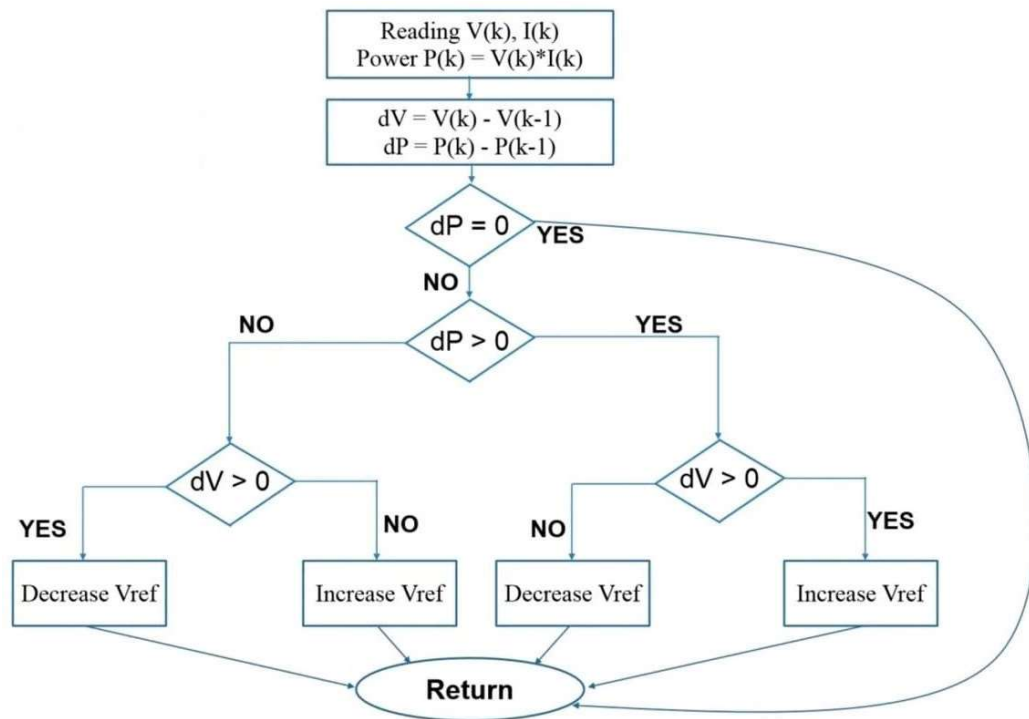


Fig 3.3:P and O flowchart

Our MPPT module work like the loop function of Fig 3.3 and it is the perturb and observe method algorithm. In this method, a slight disturbance is applied to cause the PV module's power to vary. Periodically, the PV output power is measured and compared to the preceding power. The same procedure is carried out if the output power rises; otherwise, the perturbation is reversed.

3.6 Summary

We want to demonstrate the voltage stability in our design. To increase our voltage in the model, we are utilizing a BOOST converter. Stability is another challenge that high frequency boost converter builders must overcome. In especially in surface mount layouts where the circuit components are relatively near to one another, electromagnetic fields radiating between circuit components at MHz frequencies can result in both positive and negative feedback. Parallel capacitor is added to improve stability and prevent oscillation that can be caused by unanticipated positive feedback. The PWM inverter is then used. Pulse-width modulation is a technique that modifies the width of each pulse in a pulse train in direct proportion to a small control input. The successive pulses get wider the wider the control voltage is. By using a sinusoid with the required frequency as the control voltage for a PWM circuit, it is possible to construct a high-power waveform whose average voltage varies sinusoidally and is perfect for operating ac motors. It elaborates on the structure and operation of a driving system that connects an LC filter to the output terminals of a PWM inverter. The primary purposes of the filter are to reduce Total Harmonic Distortion (THD), reshape the voltage and current waveforms, and remove high-frequency harmonics from the five-phase output voltages of the inverter. An LC filter and a three-phase or five-phase induction motor drive are compared. Equipment must be appropriate for the purpose for which it is intended, as well as being correctly constructed, positioned, cleaned, maintained, and installed. suitable for use in the development and testing of parts, working devices, and finished products. the capacity to deliver accurate findings.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Results

The PV array model is built in accordance with vendor catalogs, and the PV source parameters are configured to give this energy from PV panels. The PV output voltage that is set around the MPPT and is determined by the boost converter's load, output voltage, and the switching signal received from the MPPT output.

Run the simulation for 0.1 sec. To see the output voltage of BOOST converter we use a scope with vdc and to see the final output voltage and current we use another scope with Vabc and Iabc.

When we use sun Irradiance 1000w/m^2 and the cell temperature is 25 deg. The result of boost converter shown in Fig 4.1 and the final output result of voltage and current shown in Fig 4.2.

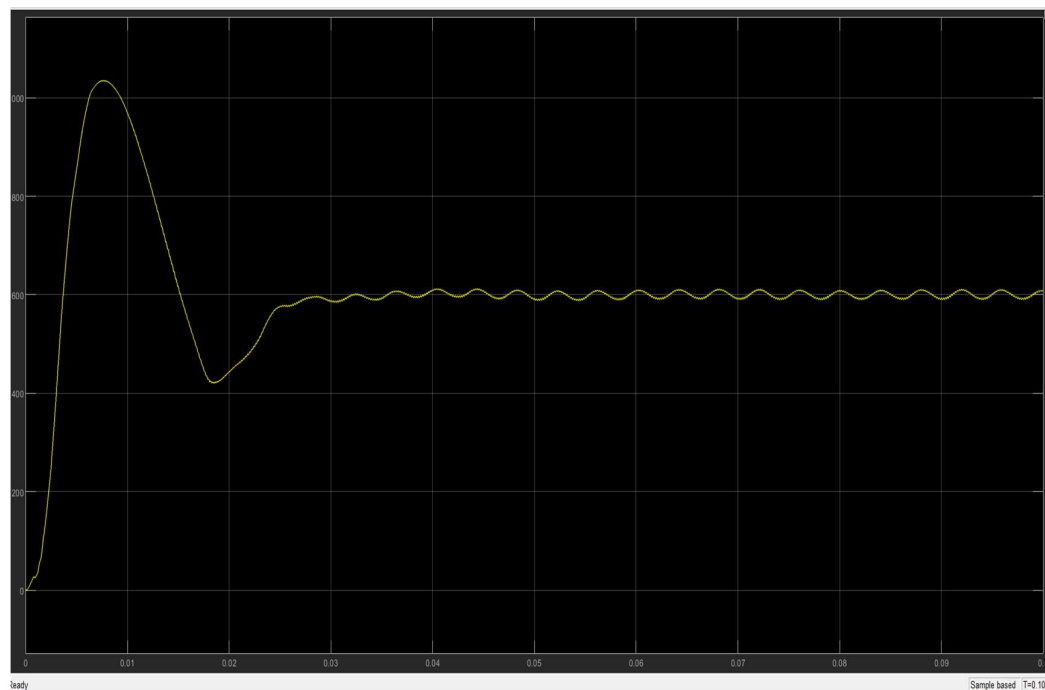


Fig 4.1: Output result of Boost converter (sun irradiance 1000w/m^2)

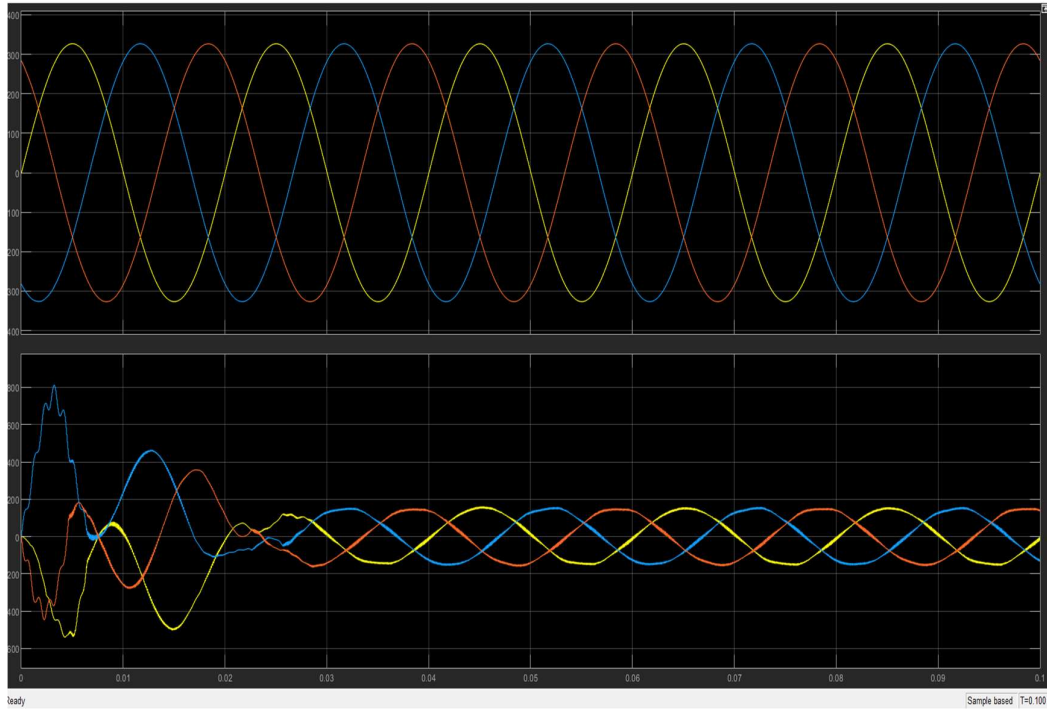


Fig 4.2: Output result of voltage and current (sun irradiance 1000w/m²)

When we use sun Irradiance 800w/m² and the cell temperature is 25 deg. The result of boost converter shown in Fig 4.3 and the final output result of voltage and current shown in Fig 4.4.

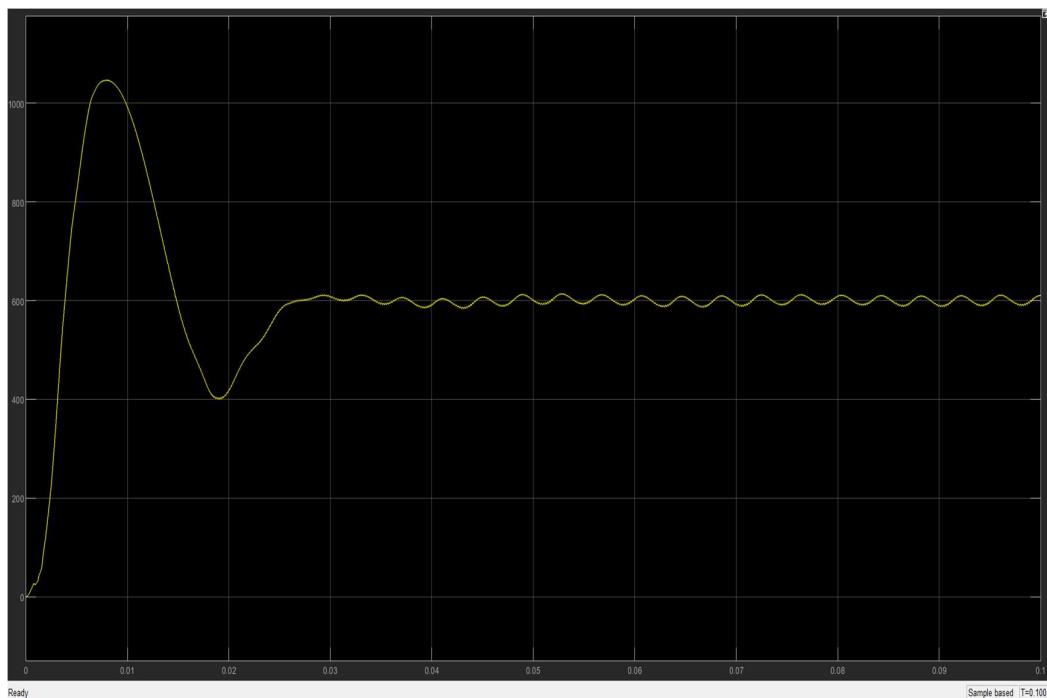


Fig 4.3: Output result of Boost converter (sun irradiance 800w/m²)

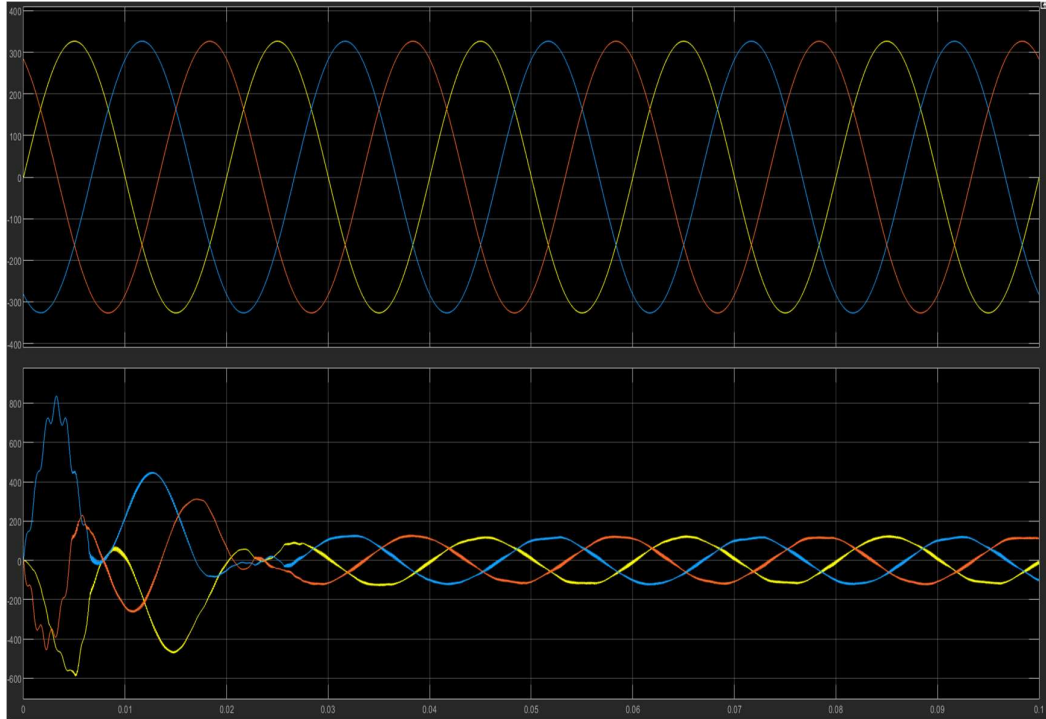


Fig 4.4: Output result of voltage and current (sun irradiance 800w/m²)

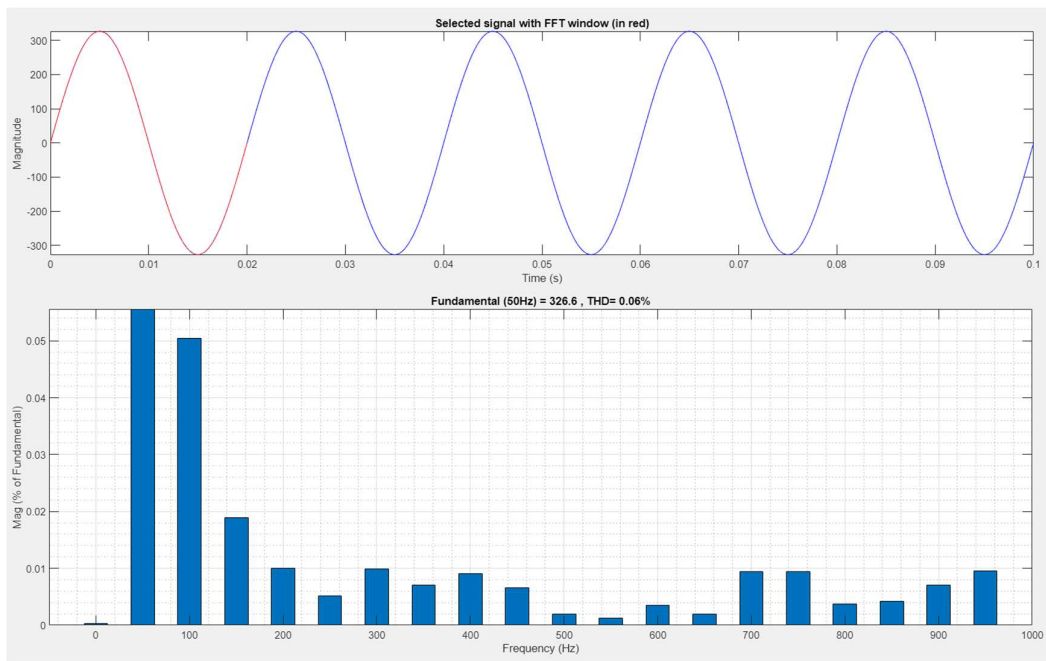


Fig 4.5: Output of THD

When we run for the FFT analysis with 50Hz frequency the THD will 0.06% for our inverter .This value will same if we change the sun irradiance.

4.2 Discussions

According to the simulation results, the Vdc is the same for temperatures of 25 degrees and solar irradiation levels of 1000 and 800. The output voltage is same. But in both cases, the current is different. This indicates that regardless of the input value, the output voltage is constant. However, both the input and output power are constant. The output current changes as a result. When the sun irradiation is 1000w/m² and the run time is 0.1 sec the active power is 7.637e+0.4 and the reactive power is 3999 also When the sun irradiation is 800w/m² and the run time is 0.1 sec the active power is 6.006e+0.4 and the reactive power is 3234. THD will 0.06% for our inverter and value will same if we change the sun irradiance. We can change the sun irradiation value but the cell temperature is 25 deg is the best efficient for PV array for better output result.

CHAPTER 5

PROJECT MANAGEMENT

5.1 Task, Schedule and Milestones

After all having a Gantt chart in the introduction part for completing the work, we use there work breakdown structure. Each project may have a distinct WBS. It might take some time to try and determine which Work Breakdown Structure is most effective for our team. The major goal is to make progress visible to all parties involved and to display the order of our initiatives. One of the well-known WBS examples is a Gantt chart. Our WBS may be arranged as a Gantt chart that depicts project milestones and relates task dependencies. The terms "Gantt chart" and "WBS" often do not refer to the same management tool. WBS is the foundation of the Gantt chart. It helps us break the project into manageable components. It provides us with a hierarchical breakdown of all the effort necessary to finish our tasks. A Gantt chart creates a broad foundation for all subsequent planning. This paper outlines the project's management and control procedures.

5.2 Resources and Cost Management

The cheapest PWM controllers start as only \$20. The price of those with extra features might reach \$200 or higher.

Depending on the features, MPPT controllers can range in price from \$50 to over \$1,000 while offering additional functionality. However, since MPPT controllers adjust current and voltage, if there is a considerable distance between your panels and batteries, you can save money by utilizing lower-gauge electrical wire between the two.

Additionally, a battery can store more solar energy because MPPT controllers may change a solar array's greater output to a battery's lower voltage. This will improve its effectiveness, maybe reduce the more expensive system's payback period, and extend your capacity to rely entirely on solar energy.

CHAPTER 6

IMPACT ASSESSMENT OF THE PROJECT

6.1 Economical, Societal and Global Impact

Technology advancements and environmental concerns are pushing power systems to a new level where traditional fossil fuel-based power plants are being replaced by renewable energy sources (RES). This transformation improves sustainability and ecological credentials, but it also poses significant challenges related to low-inertia systems, novel dynamics of generations with electronics interfaces, and their control and interaction with the rest of the system. Different types of power generating have different environmental effects on our air, water, and land. An major component of each person's environmental footprint is the consumption of electricity, which accounts for around 40% of the total energy utilized in the United States. The quantity of fuel required to produce and utilize power more effectively decreases, as does the amount of greenhouse gases and other air pollution that is released as a result. Since no fuels are burned while producing electricity from renewable sources like solar, geothermal, and wind, it typically has no impact on global warming or local air pollution. No inverter is capable of efficiency at 100%. Although inefficient components, system design, environmental conditions, and other factors play a role as well, conversion losses are what cause the inverter to lose efficiency. A lot of power is wasted when converting from AC to DC and back to AC, which lowers the inverter's efficiency. Genus inverter can help us conserve energy and cut down on our electricity costs. Because of this, the batteries can only store electricity in the form of direct current (DC), whereas the grid uses alternating current (AC). In order to charge the batteries and store energy, your inverter must first convert AC to DC. Since your appliances can only operate on AC, the inverter rapidly transforms this stored DC back to AC should the mains fail. Energy influences a country's economic and social development, and as GDP rises, so does energy demand, hence there is a relationship between the production and consumption of energy.

6.2 Environmental and Ethical Issues

We want to show how our architecture maintains voltage stability. While non-renewable energy sources are running out, everyday energy usage is growing. To refute these claims, we should increase the production of renewable energy. All workers must realize that the exercise of power in organizations and groups is a feature of organizational life. All employees, however, have a right to know that the use of authority inside the company will be constrained by moral principles that forbid abuse or exploitation.

6.3 Utilization of Existing Standards

1. The suggested cooling system must thus be evaluated to see if it is acceptable and has enough capacity as early as the design stage. It is quite prudent to frequently check the cooling during the operational phase and confirm that the ventilation or cooling system is indeed functioning as intended.
2. The "isolation fault" is yet another frequent issue. The inverter will then emit a "isolation warning" if there is a short-circuit between many circuit components, which causes this issue. The short-circuit is typically caused by a combination of moisture and damage to the cable's sleeve, improper installation, shoddy DC cable connections, or moisture in the PV module's connecting area. In regions with high humidity and/or adjacent to the ocean, this will occur more frequently. The solar inverter will either entirely cease operating or operate at the minimal "necessary" isolation level in the case of an isolation problem. The solar inverter is currently having issues and is not operating to its full potential. The production is lost in both scenarios. Therefore, it's crucial to check that the DC cables are placed appropriately and are of excellent quality, meaning that the cable bushing is waterproof. It's crucial to choose the proper degree of protection (IP) for the inverter cabinet and the inverter construction in order to avoid this issue. The conducting portions of the system may experience voltages that might be lethal as a result of an isolation malfunction. Make certain that all maintenance is done in compliance with the relevant safety regulations.

3. Here we are using MATLAB function so that we have to careful about the programing code. There are three different sorts of errors that might happen when building programs:
 - a. Syntax mistakes: If a program contains syntax problems, it cannot execute. Such inaccuracies must first be corrected. A decent integrated development environment (IDE) often alerts the programmer to any grammatical problems.
 - b. Logic mistakes: A programming error is a mistake in the way a program functions. Although the software can execute, it does not perform as planned. A logic error often does not cause a program to crash, unlike a syntax error. Although the software won't work as intended, it will still execute.
 - c. Runtime issues: A runtime error is a mistake that happens while a program is still executing.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Energy consumption is rising daily while non-renewable energy sources are dwindling. We should produce more renewable energy to counter these arguments. However, one significant issue with renewable energy is that it depends on the weather to be produced. The energy generated on the grid side cannot meet the demand on the load side during cloudy and inclement weather. Non-linear loads that reduce the power quality of the energy networks or high or uncontrolled energy Demand may be the main load-side concerns. Energy sources connected to the grid via an electronic converter or inverter have quite different operational characteristics when compared to the generation of renewable energy. As a result, these sources act differently inside the network. Due to the considerable integration of this form of generation into the electrical grid, it is required to update the theories and practices for building and managing both inverters and power systems. If not, it could be challenging to offer a consistent power supply and power quality that satisfies the technical requirements. This study focuses on the grid's side stability problem and finds a solution for the stability issue between the grid and transmission line. The advantages of MPPT and PI controllers with inverters in a power system from the grid to the transmission line are examined in this paper. A reliable control system that addresses the primary issue with the MPPT and PI controller with inverter. In MATLAB/Simulink, the proposed grid system, MPPT model in the BOOST converter, inverter, and LC filter are constructed. A series of simulations for the grid-connected MPPT in BOOST converter and PI controller in inverter model were done using different step changes in the active and reactive power references in order to find the tracking response of the set power references. The simulation results demonstrated the effectiveness of the control system, which was developed to track the established benchmarks and provide better power quality.

7.2 New Skills and Experiences Learned

From our paper we can develop our programming skill and how to make an inverter design in MATLAB Simulink software. We can learn about the solving of complex problems of a project.

7.3 Future Recommendations

The use of power in companies and groups must be understood by all employees as a part of organizational life. However, every employee has a right to be aware that the exercise of power inside the organization will be restrained by moral norms that ban exploitation or abuse. In our project we use many PI controller, IGBT, LOOP and so many other equipment. We are using MATLAB function for control the BOOST converter. BOOST converter gain the voltage. In future we can try to improve the inverter design and also improve the function loop for more better performance. While non-renewable energy sources are running out, everyday energy usage is growing. To refute these claims, we should increase the production of renewable energy. The fact that renewable energy production is weather-dependent is a big drawback.

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APPENDIX A

TURNITIN REPORT

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APPENDIX B

PROGRAM CODE

```
function Vref = Refgen(V, I)

Vrefmax = 363;
Vrefmin = 0;
Vrefint = 300;
deltaVref =1;
persistent Vold Pold Vrefold;

datatype = 'double';

if isempty(Vold)
    Vold = 0;
    Pold = 0;
    Vrefold = Vrefint;
end

P = V*I;
dV = V-Vold;
dP = P-Pold;

if dP ~= 0
    if dP<0
        if dV<0
            Vref = Vrefold + deltaVref;
        else
            Vref = Vrefold-deltaVref;
        end
    else
        if dV<0
            Vref = Vrefold - deltaVref;
        else
            Vref = Vrefold + deltaVref;
        end
    end
else Vref = Vrefold;
end

if Vref >=Vrefmax | Vref <= Vrefmin
    Vref = Vrefold;
end

Vrefold = Vref;
Vold = V;
Pold = P;
```

