Monitoring and Analysis of Photovoltaic Grid System

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Abstract: *Due to huge population and the society of modern industries, the energy demand increases exponentially and the need arises to motivate use of alternate energy sources to improve the quality and efficiency of power. As for the literature survey of renewable energy sources is concerned the use of photovoltaic energy has emerged as a primary, resource because the solar energy is clean, environment friendly. As far as the power grids are concerned, the demand is a smart concept to be introduced and thus different IOT concepts need to be imperatively implemented to monitor and control the statics of grid. Solar or photovoltaic (PV) technology is perhaps the best development sustainable power assets to create electrical power in the world. The best benefits are lasting, accessible all over on the planet, perfect, free, without contamination, and have little upkeep necessities. The paper presents the complete model of simulation of 100KW solar power plant with protection circuit and filter circuit for short circuit and reduction of harmonics.*

Keywords: IOT, Smart, Grid, PV, Harmonics

I. INTRODUCTION

1.1 Background of the Study

Energy is a fundamental basic reason for the social and financial progress of a nation. The energy request is one of the serious issues that confronted the advanced life from every day without tackling because of the inaccessibility of enough assets from ordinary energy assets like fossil and atomic fills. The non-renewable energy sources, for example, petroleum gases and oil are vital in electrical age notwithstanding creating air contamination and many different issues. The air contamination adds to corrosive rain and smog other than increasing earth's temperature because of carbon dioxide fixation. Additionally, thermal power is costly, and its fuel is profoundly dangerous and required exceptionally security and safety measures innovation. Besides, atomic energizes addresses the murdering what's more, contaminations for climate and earth.

Only the renewable energy sources that will going to tackle numerous ecological issues related with petroleum derivative sources and thermal power. Sustainable power at a worldwide level can just supplant of fossil furthermore, atomic energizes in the long haul. Inexhaustible sources are normally, existing, also, they are as of now being monetarily abused. Inexhaustible resources of energy like wind, solar, biomass, hydroelectric, wave, and flowing are perpetual, safe, and limitless in the sense and their executions to help energy supplies and requests. The uses of solar PV frameworks are reached out from distant region energy benefits up to grid utilities. These usages are summed up as village lighting, solar home frameworks, road, camp lights, traffic signals, clinical offices in distant regions, telecom stations, battery charging, water siphoning, and water cleansing frameworks. The utilization of PV frameworks in power age began in the seventies of the twentieth century and today is presently developing quickly around worldwide disregarding high capital cost. Because of the developing emergency, numerous legislatures began declaring appealing motivating forces to embrace sustainable power sources, for example, solar power. By creating power from the sun, these legislatures are pointed toward decreasing reliance on coal-based force plants that produce billions of huge loads of carbon dioxide. The complete introduced limit of solar power plants worldwide for 2018 is estimate to arrive at 508 GWp. To accomplish 100 GW of this energy as an objective by 2022, the Indian government has presented various endowments, from huge PV parks to little rooftop and off-framework establishments, through different plans.

II. LITERATURE REVIEW

The chapter that follows shows the work done by various scholars. For good research, it is mandatory to have complete knowledge on the research work carried out by different scholars and researchers and even enterprises in the related field.

Sulthana et al (2020) the paper titled "Smart Energy Meter and Monitoring System using IoT" states that internet of things (IOT) presents to be a proficient and coeffective to move the data of energy purchaser remotely just as it gives to distinguish the utilization of the power the principle aim of this undertaking is measure power utilization in home machines and create it's bill consequently utilizing IoT. The exertion of gathering power utility meter perusing. The energy network should be executed in a conveyed geography that can powerfully ingest diverse fuel sources. IoT can be used for different utilizations of the shrewd network with disseminated energy plant meter, energy age and energy utilization meter keen meter, energy request side administration and different region of energy creation. [23]

Khan et al (2020) the paper titled "IoT Based Power Monitoring System for Smart Grid Applications" states that IoT is generally utilized in smart energy observing, modern robotization, furthermore, an assortment of utilizations. At different phases of Smart
 Grid (SG), IoT devices are sent to screen and control framework measurements for dependable and proficient conveyance of intensity. In spite of the fact that IoT reconciliation in the SG area gives complex advantages, the challenges in IoT-
SG coordination should be settled for the proficient activity of the network. In this paper, initially an outline of SG and IoT based SG framework is given. This undertaking depicts the IoT based force checking framework that is skilled to quantify and examine the electrical boundaries, for example, voltage, current, dynamic force, and energy utilization of loads. IoT based programming application 'ThingSpeak' is utilized to acquire the continuous electrical information of customers. In view of this information, the buyer and electric force organizations in the SG worldview can better deal with their utilization to lessen charging costs.[28]

Joshi et al (2020) in the paper titled "Design and Development of Power Monitoring System using IoT Technology" hardware for a rapid Energy-Monitoring gadget is planned and a firmware is created, which catches the values, for example, voltage, current, recurrence, power factor, Active power, Reactive power etc. in 10 milliseconds and sends the information by means of USB in 200ms to Raspberry Pi, where a python content runs which further sends the information to cloud for constant checking. The equipment is planned utilizing Orcad and Allegro programming and the firmware was created in Keil uVision IDE. STM Microcontroller was utilized as the regulator and drivers for Energy Meter Chip was utilized for advancement of firmware. The method of correspondence between the microcontroller and the energy meter chip is SPI and equipment is associated with Raspberry Pi module by means of USB which further runs content to gather the information. Thingspeak cloud was utilized for Real-Time observing of the information on the cloud. In the cloud, the client can screen the force boundaries at a timespan sec for one every information as a piece of result. Client can likewise gather the information from the cloud and do investigation by giving the information as a contribution for a calculation, which thusly predicts power marks of the apparatus and recognizes the sort of machine associated and educates the client about it. [37]

Zhoa et al (2019) in the paper titled "Design of an Industrial IoT based Monitoring System for Power Substations" states that IoT permits objects to share information through wired or remote associations for correspondence purposes. The Industrial Internet of Things (IIoT) is an all-
encompassing idea of IoT that alludes to a joining of information securing, correspondence, and preparing
 on a continuous organization. At present, IIoT has been associated with the advancement of smart grids in numerous applications. As the activity of intensity frameworks is amazingly time-basic, low-
inactivity correspondence should be considered for most control and checking applications. Constant ability of IoT is considered as a critical element for observing and control utilizations of intensity frameworks. Along these lines, framework administrators can utilize the continuous checking framework to give better choices to both specialized and monetary related issues. In this paper, a fast IIoT-
based checking framework with recording capacities is created and executed for a force framework substation. Because of the high dependability and preparing   rate of FPGAs, a FPGA-
inserted regulator is embraced in this framework. The IoT stage likewise gives far off representation to framework ad

ministrators continuously. This paper mostly expects to give a down to earth application that was executed and tried in a genuine force substation. The framework consolidates the highlights of an IoT stage with the requirements of fast constant applications while utilizing a solitary high-

goal time source as the reference for both consistent state and transient conditions.[46]

Devadhanishini et al (2019) in the paper titled "Smart Power Monitoring System Using IoT" states that Energy saving is the most significant and testing issue. Programmed Electrical Power meter is utilized in homegrown electric power dispersion framework. The combination of the Arduino, WIFI and GSM ShortMessage Service (SMS) gives the framework as Smart Power Monitoring framework. Such a meter gives information to enhance and diminish the power utilization. This framework has motion regulator and GSM modem to communicate the data. This framework likewise incorporates a movement sensor to such an extent that if there is no human in the spot or house it will naturally cut the power supply.

Vimalarani et al (2018) in the paper titled "Internet of Things (IOT) based Power Fluctuation Monitoring System" have presented a power quality system using Arduino uno along with a high exactness accuracy rectifier unit . The system can screen voltage and current variances. This technique gives the correspondence between the Electricity Board (EB) server and client area utilizing Internet of things (IOT). It communicates the client's power utilization and bill data is determined done Arduino uno.

Load request checking is done at whatever point there is a surpass level in set estimation of power utilization, that can be distinguished and notice can be sent from the Electricity Board to the client and key (it hason/off control) is utilized to remove the auxillary burden to the client from Electricity board server.[36]

III. RESEARCH METHODOLOGY

RESEARCH METHODOLOGY USED:

The system configuration principally comprises of PV cluster ,DC to DC Converter, three stage inverter, voltage source converter, three stage transformer, MPPT regulator and grid interfacing gear here voltage source converter which controls the inverter for the interfacing of grid the PV cluster producing voltage is expanding utilizing DC to DC help converter, at that point it is taken care of to three stage inverter this rearranging controlling reason utilizing voltage source regulator this all framework block graphs are organized in figure.
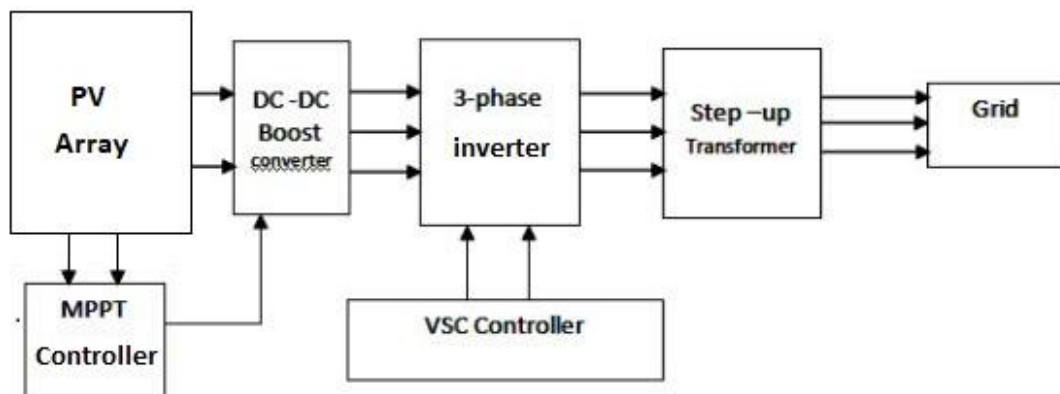

Figure 4.1: Block Diagram of Proposed system.

INTRODUCTION TO MATLAB:

MATLAB is a superior language fur specialized registering. It coordinates calculation, perception, and programming in a simple to-

 utilize condition where issues and arrangements are communicated in recognizable numerical documentation. Average uses incorporate:

Math and calculation

Algorithm improvement Data securing

Modeling and prototyping

Data investigation, investigation, and perception

Scientific and designing illustrations.

Application advancement, including graphical Ul building.

MATLAB is an intelligent framework whose fundamental information component is an exhibit that doesn't require di mensioning. This permits you to take care of numerous specialized registering issues, particularly those with network and vector plans, in a small amount of the time it would take to compose a program in a scalar non intuitive language, for example, C or FORTRAN. The name MATLAB represents framework research center. MATLAB was initially c omposed to give simple access to network programming created by the UN PACK and EISPACK ventures. Today, M ATLAB motors consolidate the LAPACK and BLAS libraries, installing the best in class in programming for networ k calculation.

MATLAB has developed over a time of years with contribution from numerous clients. In college situations, it is the standard instructional device for initial and propelled courses in arithmetic, building, and science. In industry, MATL AB is the apparatus of decision for high-

profitability research, advancement, and examination. MATLAB highlights a group of extra application-

explicit arrangements called tool kits. Important to most clients of MATLAB, tool kits permit you to learn and apply specific innovation. Tool stash are far reaching assortments of MATLAB capacities (M-

documents) that stretch out the MATLAB condition to tackle specific classes of issues. Regions in which tool stash ar e accessible incorporate sign handling, control frameworks, neural systems, fluffy rationale, wavelets, creation, and n umerous others.

Simulink (Simulation and connection) is created by MathWorks as an extra with MATLAB. It is a graphical program ming language which offers displaying, reenactment and investigating of multi space dynamic frameworks under Gra phical User1nterface (GUI) condition. The Simulink have tight joining with the MATLAB condition and have a thor ough square libraries and tool stash for direct and nonlinear investigations. The framework models can be so effective ly built by means of simply snap and drag activities. The Simulink comes convenient while managing control hypothe sis and model-based structure. A Simulink library window will spring up as appeared beneath:
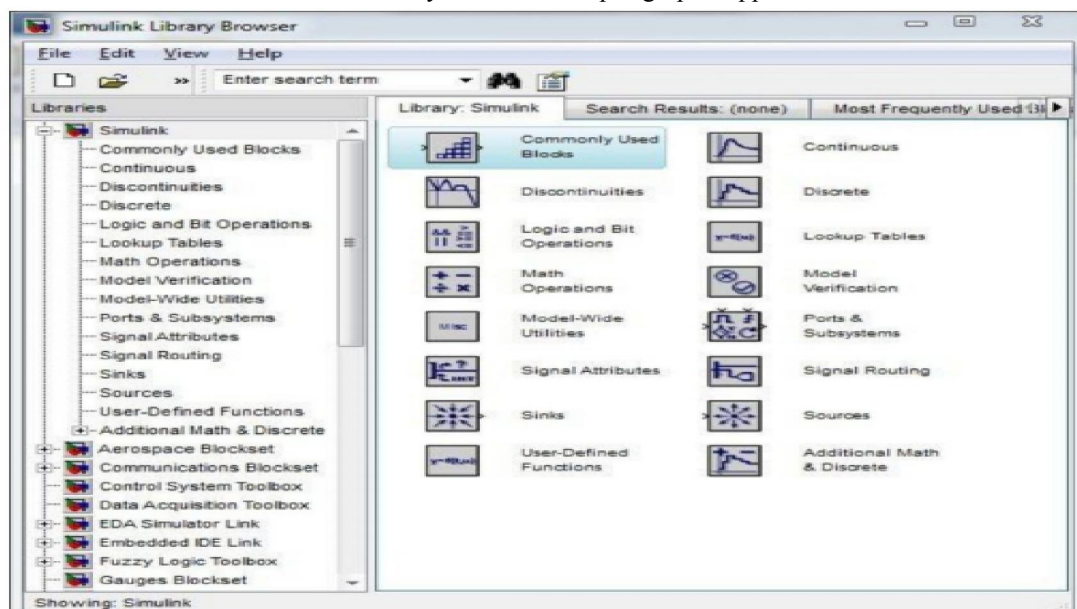

Figure 4.2: MATLAB Library.

The Library Browser contains different tool stash in left side and comparing utilities and squares

on the correct side Creating a Model, to make a straightforward model of incorporating a sine wave and show both th e info sine wave and the indispensable stricture. To make this model we needy sine wave signal source Integrator

A Multiplexer, as I have to show the

2 signals in the Display screen. Note that the presentation screen called 'scope' has just   1 channel. So either to show

2 signs we need to utilize a mux or we need to utilize 2 screen squares.

The Solver:

Most of the time, you can just use the default settings to run your model. However, you will locate that every

 so often you'll want the model to use smaller steps, or constant width steps. That is all configurable at the Solver pag

e of the Configuration Parameters from the menu bar to your model select Solver.

Simulation:

Model Configuration Parameters:

Then on the select menu on the left-hand side, select Solver.

Simulation Time:

To the right at the top you will find the Simulation time box. I suggest that you leave the start time as zero. The stop t

ime is identical to the stop time on the icon bar at the top of your model.

Solver Options:

There are types of solver. By means of default, a variable step solver is used. This could automatically adjust the step

length because the version runs. Set the

 Max step length to a hard and fast value to enhance the smoothness of any graphs if required. Switching to a fixed w

idth solver will be important for fashions with discrete components. If it additionally has no non-

stop components, change the solver to Discrete (no continuous states). The constant solvers are numbered

 so as of simplicity. Ode1 being the best. For extra facts approximately solvers, click on at the assist button at the low

est of the configuration parameters window, even as you are viewing the solver section.

Zero Crossing Options:

At the bottom of the page you will find the Zero-

crossing options box. You can disable zero crossing control if you think it will help.

Sources Library:

The Sine Wave Block:

Most of the blocks in the source library are self-

expansionary. The basic sin wave block is easy to use. You just set the frequency and amplitude in the block paramet

ers. In the exercises we use the sine wave block to look at the frequency response of a system. However, repeatedly e

diting the block parameters to change the frequency of the sine wave is tedious. The alternative is to use an external ti
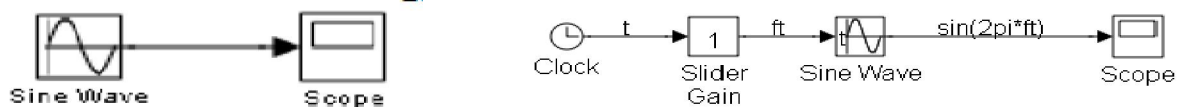
me input to the block.

Figure 4.3: Sine Wave Block.

To do this, in the Sine Wave block parameters you set the Time parameter to Use external signal and set the frequenc

y to

 2*pi. You then connect a clock to the new input via a slider gain. The slider then sets the frequency of the sine wave.

The Workspace Block:

This block is used for importing data into a Simulink model from the MATLAB workspace.

A simple way of doing this is to place the data to be imported into a matrix, as shown below.

Figure 4.4: Data Matrix.

The variable name of the matrix is then entered into the block parameters of the block. Notice that the data in the above matrix is very course. Simulink will use interpolation to calculate values at any times between the given points. The block will also read in data from a structure.

Scope Block:

Axes Properties:

Right click

 on the axes, then select Axes Properties. This allows you the change the y limits of the axis and the axes title. The default title of an axes is the label of the signal being plotted. So, it is probably better to label the signal than explicitly set the title here.

Scope Icons			
	Print		Magnify in x and y
	Parameters See below		Magnify in x only
	Auto Scale		Magnify in y only

Figure 4.5: Scope Icons.

Parameters/General:

Click on the Parameters icon, and then select the General tab. This allows you to set the number of axes and the time range of the graph.

Click on the Parameters icon, then on the Data History tab. This allows you to save the scope data to the MATLAB workspace and also limit the size of the data stored. The data can be stored into an array or a structure. The function below plots the data stored in a structure.

Parameters / Style this allows you to change the colour and markers used to plot the data.

V. SIMULATED RESULTS AND DISCUSSION

The figure that follows shows the MATLAB simulation of the proposed system. It shows the simulation of a 100kw solar PV plant. PV array is connected to a   25-kV grid via a DC-DC boost converter and a three-phase three-level Voltage Source Converter (VSC). Maximum Power Point Tracking (MPPT) is implemented.
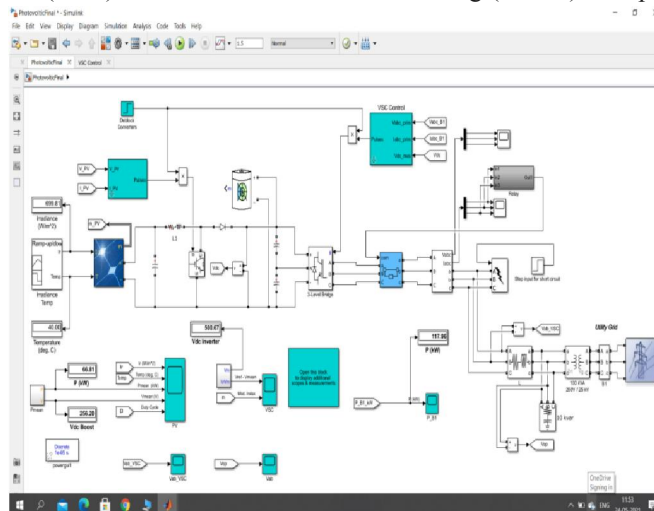
Figure 5.1: Simulation of 100KW Solar PV Plant.

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The main components of the model are as follows:

PV Array: which delivers a maximum of 100KW.

DC-DC   Boost
Converter: is utilized to expand the degree of yield voltage the above graph shows the basic development of DC-to-DC Converter. In the circuit, we are attempting to give the stockpile from the dc supporter converter to inverter to convert into AC ability to meet the heap voltage and grid prerequisites.

Transformer: is with the end goal of step up the voltage to interface the grid. it has two winding essential and optional produced power from PV module is associated by changing over into dc to AC and by the cycle of common inductance among essential and optional windings then the auxiliary will instigate EMF more than its information voltage relies upon the turns. Indeed, even the voltage, current greatness is changed. The force is the essential and optional is same i.e., same force will be moved without changing the recurrence in the essential side three stage twisting in Delta design is associated and three stages twisting of star arrangement is associated in the auxiliary side of the transformer by utilizing this. we can take out the third sounds due to the star association in the auxiliary.

VSC:

Voltage Source Controller is used to enable signal to the inverter. At the point when the VSC gives the signal it changes over DC source into AC source. i.e., AC voltage and afterward venture up the voltage level up to required level by utilizing

3phase transformer. Yield from the transformer is associated with load just as to the grid to supply capacity to grid when high measure of force produced more, we required and takes power when the force is deficient. the PV module is intended to give the yield at 100KW for this task.
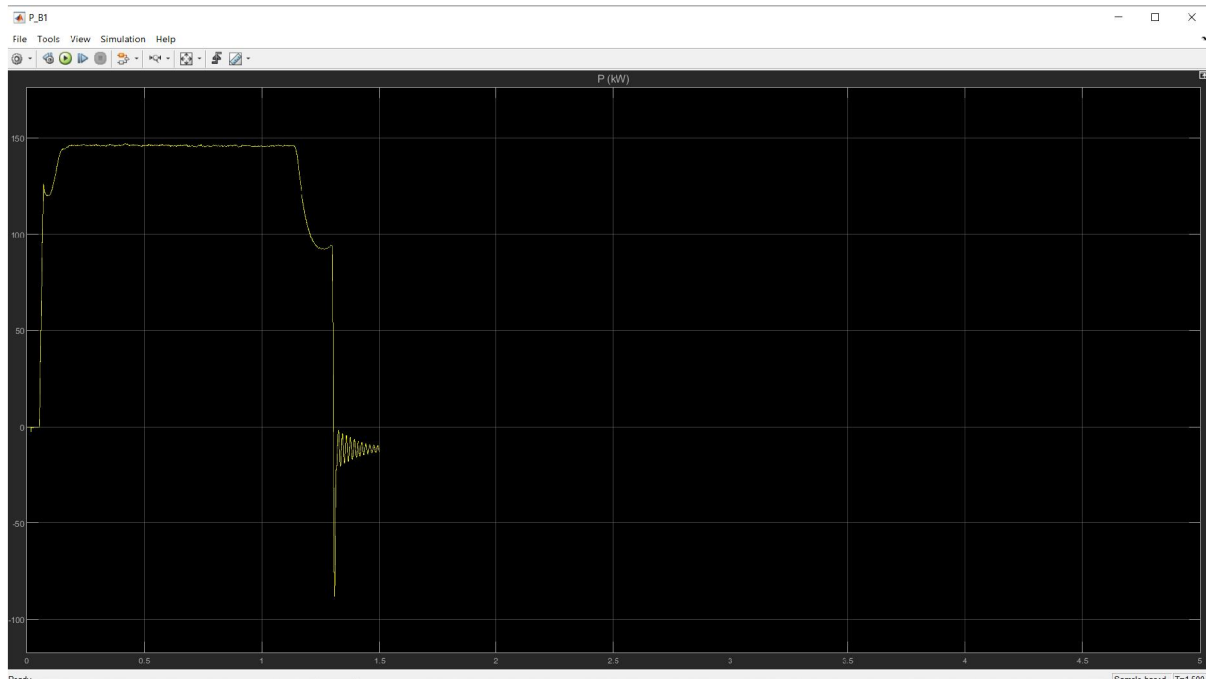

Figure 5.2:Short-circuit protection when total power is delver for time 1.5s ad fault occurs at 1.3s

Figure 5.3:Irradiation
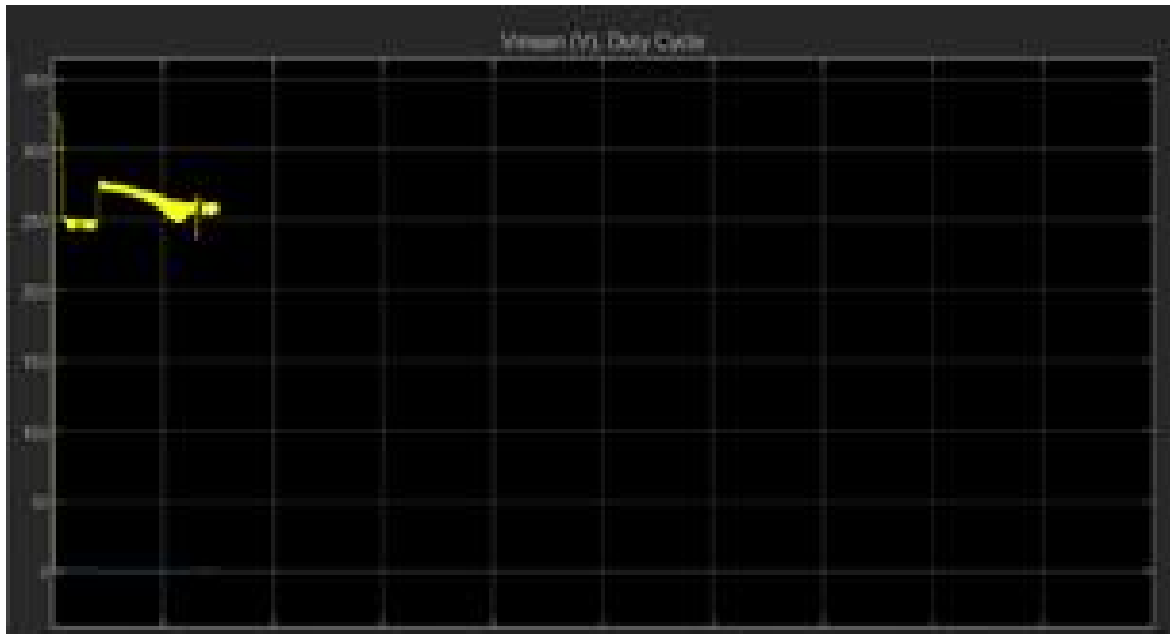

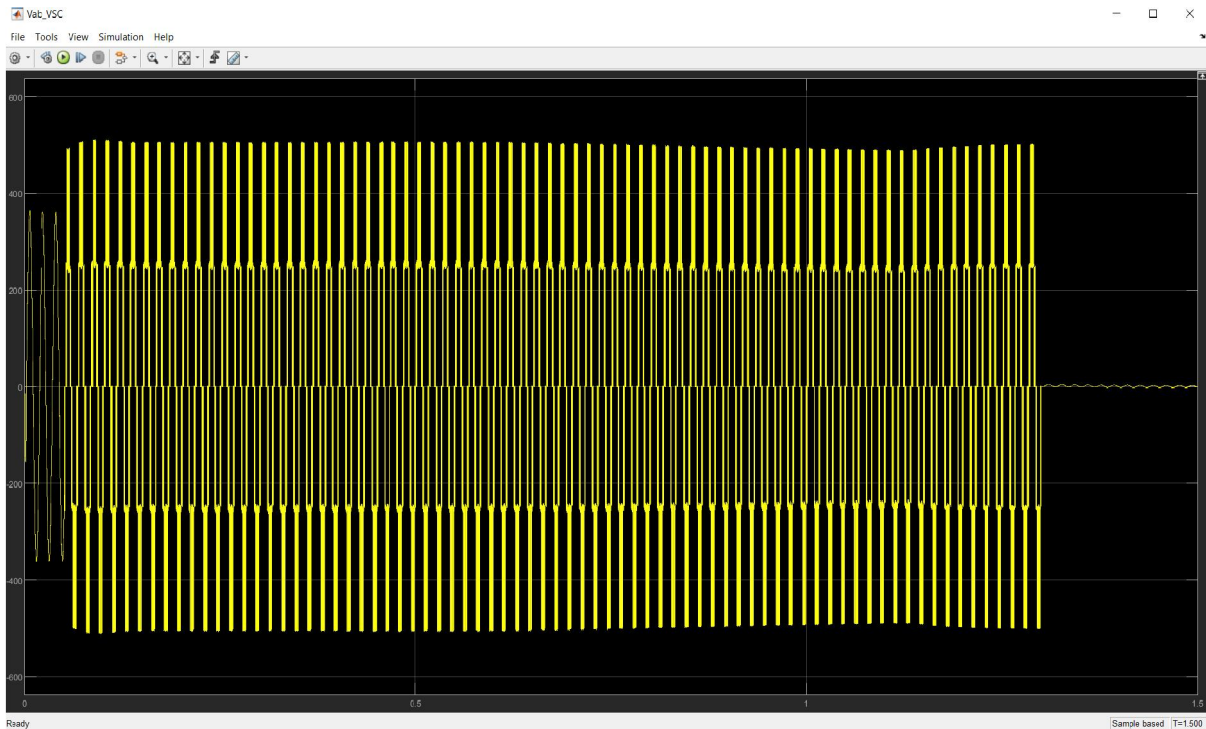Figure 5.4:Temperature

Figure 5.5:Power.

Figure 5.6:Voltage.

Figure 5.6:Voltage before Filter usage.

Total voltage before filter here we can see that how time scope displays noisy sine wave voltage without filter circuit.
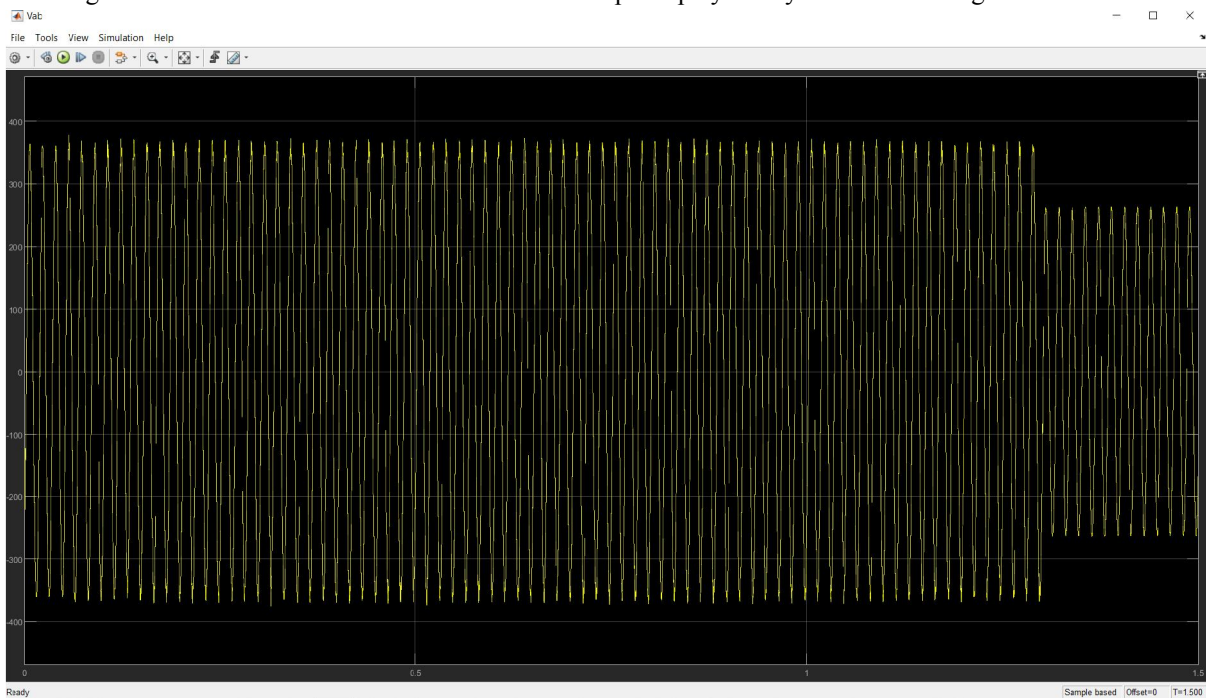

Figure 5.7: Voltage after Filter usage.

Total Voltage after filter here we can see that filtered sine wave when we use filter circuit.
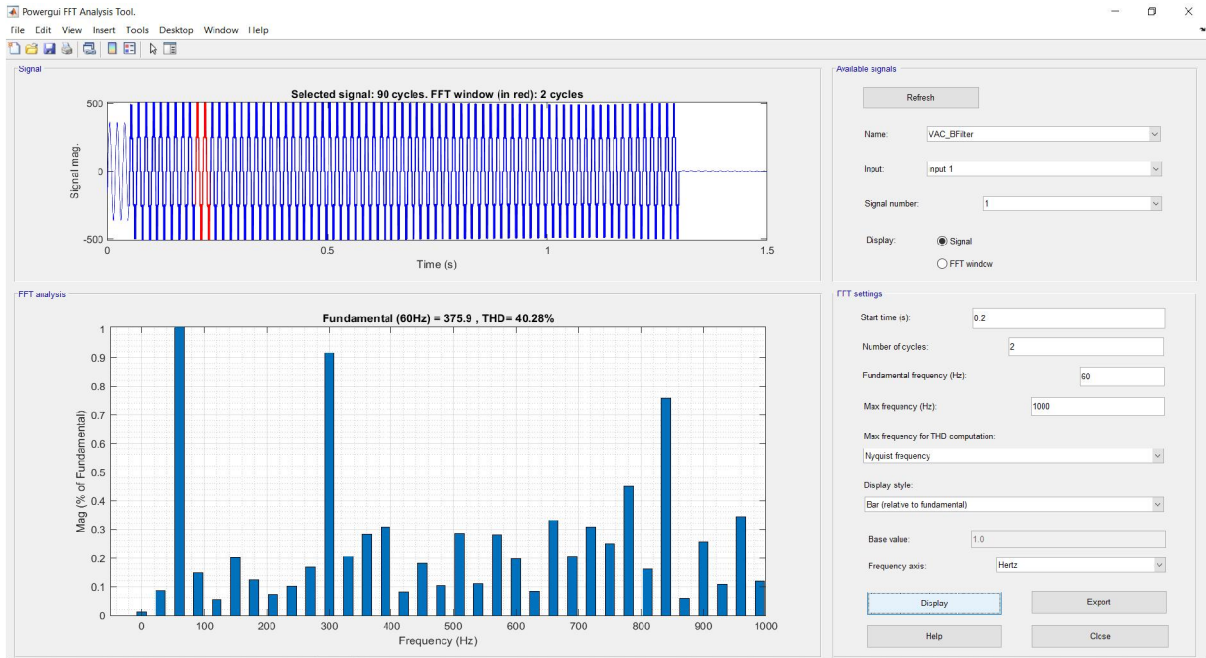
Figure 5.8: Total Harmonic Distortion before Filter usage.

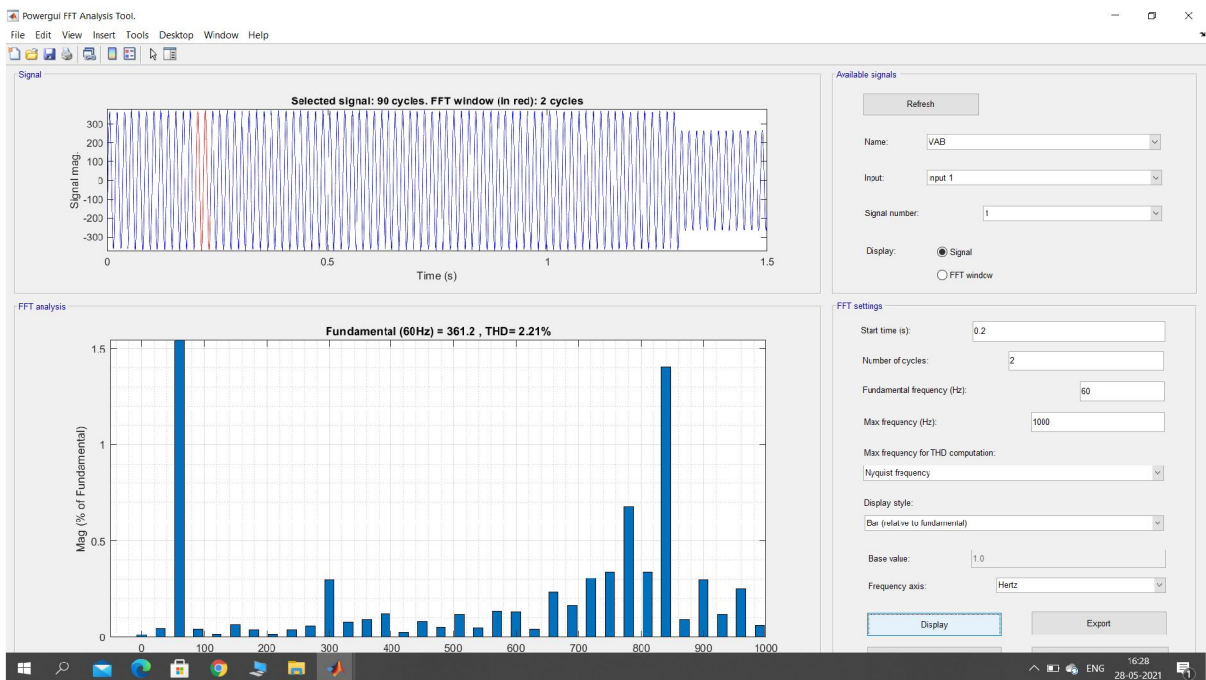Total harmonic distortion that occurs before filter is 40.28%

Figure 5.9: Total Harmonic Distortion after Filter usage.

Total harmonic distortion that occurs after filter is 2.2%

VI. CONCLUSION AND FUTURE SCOPE

CONCLUSION:

Solar PV innovation has been set up to be solid in enhancing the power demand in certain zones, and methods for addressing some power emergencies in off power crises zones in various nations.A power monitoring and control framework can be planned and created towards the usage of power grids. The system will monitor and control the overall PV grid by designing a protection circuit. Overall reduction of cost and improvement using a filtering circuit can be done.

FUTURE SCOPE:

Disturbance effect for each PV component can further be studied. The grid networks performance can be improved. Further a digital protection system for the said system should be introduced. Examine the effect on the grid execution (power quality) when various inverters are associated with a nearby grid. Particularly, the impact from various waveform generators, for the current reference, and diverse current control systems ought to be explored. Both when the grid voltage is a pure sinusoidal and when it contains music.

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