ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

Dynamic Modeling and Performance Analysis of a Grid-Connected Current-Source Inverter-Based Photovoltaic System

N.Ramanjaneyulu[1], M.Chethan[2]

PG Student [EPS], Dept. of EEE, SVPCET, Putter, A.P., India[1]

Assistant Professor, Dept. of EEE, SVPCET, Puttur, A.P., Andhra Pradesh, India[2]

ABSTRACT: In this project the control structure of the proposed system consists of MPPT, a current loop, and a voltage loop to improve system performance during normal and varying weather conditions. Since the system consists of a single-stage, the PV power is delivered to the grid with high efficiency, low cost, and small foot print. In general increasing the energy crisis and environmental issues in power quality due to that problem renewable energy sources are used. The photovoltaic (PV) system is considered to be a most promising technology, because of its suitability in distributed generation. In distributed generation applications, the PV system operates in two different modes: grid-connected mode and island mode. In the grid-connected mode, maximum power is extracted from the PV system to supply maximum available power into the grid. So, in this project a single-phase, single-stage current source inverter-based photovoltaic system for grid connection is used. The maximum power point is maintained with a fuzzy logic controller. A proportional-resonant controller is used to control the current injected into the grid. To improve the power quality and system efficiency, a double-tuned parallel resonant circuit is proposed to attenuate the second- and fourth-order harmonics at the inverter dc side

KEYWORDS: Current source inverter (CSI), grid-connected, maximum power point tracking (MPPT), photovoltaic (PV)

I.INTRODUCTION

Due to the energy crisis and environmental issues, renewable energy sources have attracted the attention of researchers and investors. Among the available renewable energy sources, the photovoltaic (PV) system is considered to be almost promising technology, because of its suitability in distributed generation, satellite systems, and transportation. In distributed generation applications, the PV system operates in two different modes: grid-connected mode and island mode. In the grid-connected mode, maximum power is extracted from the PV system to supply maximum available power into the grid. Single- and two-stage grid-connected systems are commonly used topologies in single- and three-phase PV applications. In a single-stage grid-connected system, the PV system utilizes a single conversion unit (dc/ac power inverter) to track the maximum power point (MPP) and interface the PV system to the grid. In such a topology, PV maximum power is delivered into the grid with high efficiency, small size, and low cost. However, to fulfil grid requirements, such a topology requires either a step-up transformer, which reduces the system efficiency and increases cost, or a PV array with a high dc voltage. High-voltage systems suffer from hotspots during partial shadowing and increased leakage current between the panel and the system ground though parasitic capacitances. Moreover, inverter control is complicated because the control objectives, such as MPP tracking (MPPT), power factor correction, and harmonic reduction, are simultaneously considered.

On the other hand, a two-stage grid-connected PV system utilizes two conversion stages: a dc/dc converter for boosting and conditioning the PV output voltage and tracking the MPPT, and a dc/ac inverter for interfacing the PV system to the grid. In such a topology, a high-voltage PV array is not essential, because of the dc voltage boosting stage. However, this two-stage technique suffers from reduced efficiency, higher cost, and larger size.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

II. PHOTOVOLTAIC SYSTEMS

Working of a PV cell is predicated on the essential principle of photoelectrical impact. photoelectrical} impact will be outlined as a phenomenon within which an negatron gets ejected from the conductivity band as a consequence of the absorption of daylight of an explicit wavelength by the matter (metallic or non-metallic solids, liquids or gases).So, in a very cell, once daylight strikes its surface, some portion of the alternative energy is absorbed within the semiconductor material.

If absorbed energy is larger than the band gap energy of the semiconductor, the negatron from valence band jumps to the conductivity band. The electrons therefore created within the conductivity band square measure currently absolve to move. These free electrons square measure forced to manoeuvre in a very specific fifteen direction by the action of electrical field gift within the PV cells. These flowing electrons constitutes current and might be drawn for external use by connecting a metal plate on prime and bottom of PV cell. This current and therefore the voltage (created owing to its inherent electrical fields) produces needed power

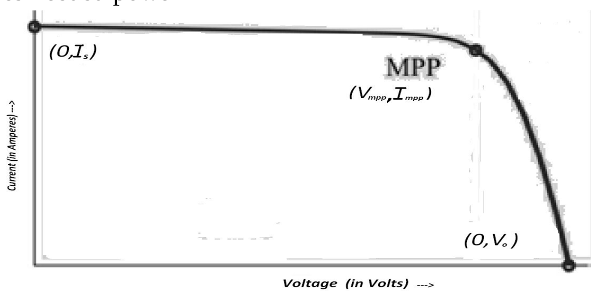


Fig 2.1 rep Characteristics of a PV cell

Photovoltaic Applications:

Photovoltaic systems are used in variety of applications. Stand alone system is a good application of PV systems. A stand alone system does not have a utility connection. It uses power as it is produced.

Lighting: The availability of low pressure sodium and fluorescent lights that runs on low power DC has made PV systems an ideal source for lighting in remote places. PV systems are used to provide lighting for street lights, information signs, parking lots and homes.

Communicatication systems: PV systems are used in transmitters, cellular phones, portable computers, satellites, mobile radio systems etc.

Informative signs: Some devices like highway warning alarms, railroad signs, navigational beacons, aircraft beacons can't be connected to utility grids.

Water pumps: PV output can be directly fed to DC pumps. These pumps can be directly operated to provide water for irrigation, village water supply or for livestock.

Vehicles: Solar power can be use to charge vehicle batteries.

Refrigeration: PV systems are used for storage of medicines in remote places.

General use: Solar power is used in watches, calculators, lanterns, fans, radios and outdoor lights.

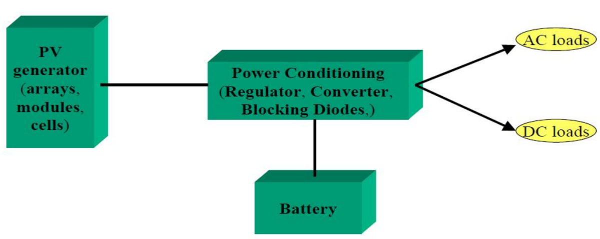


Fig 2.2 rep Elementary scheme of the components of a stand-alone photovoltaic sys-tem.

Such systems encompass a PV generator. Energy storage (for example a battery),ac and dc customers and components for power learning. Per definition, A PV generator will contain many arrays. Every array consists of many modules, whereasevery module consists of many star cellsThe battery bank stores energy once the ability provided by

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

the PV modules exceeds load demand and releases it backs once the PV provide is skimpy. The load for a complete PV system will be of the many sorts, each DC (television, lighting) and AC (electric motors, heaters, etc.). The ability learning system provides Associate in Nursing interface between all the weather of the PV system, offering protection and management.

III. MAXIMUM POWER POINT TRACKING (MPPT)

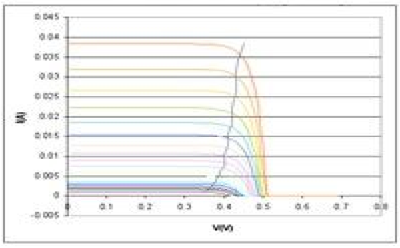


Fig 3.1 rep Solar cell I-V curves where a line intersects the knee of the curves where the maximum power point is located.

A load with resistance adequate to the reciprocal of this worth attracts the utmost power from the device. This can be typically known as the characteristic resistance of the cell. this can be a dynamic amount that changes looking on the extent of illumination, likewise as different factors like temperature and also the age of the cell. If the resistance is lower or on top of this worth, the ability drawn are but the utmost accessible, and so the cell won't be used as with efficiency because it can be. Most electric outlet trackers utilize differing types of negative feedback circuit or logic to go

looking for now and so to permit the device circuit to extract the utmost power accessible from a cell. Where *K2* is proportionality constant, just like in the fractional *Voc* technique, *K2* has to be determined according to the PV array in use. The constant *K2* is generally found to be between 0.78 and 0.92. Measuring *Isc* during operation is problematic. An additional switch usually has to be added to the power converter to periodically short the PV array so that *Isc* can be measured using a current sensor. This increases the number of components and cost. It is clear that this method and the previous one have major drawbacks; the power output is not only reduced when finding *Isc* but also because the MPP is never perfectly matched.

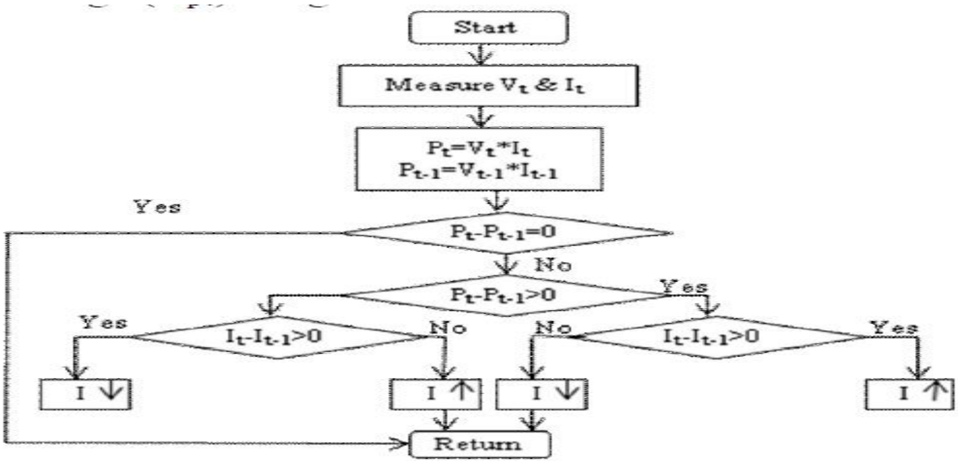


Fig rep Flow Chart of P&O Algorithm

The sampling frequency of the P&O algorithm is either simply increased or optimized to improve robustness of the algorithm. In optimized P&O method the perturb step size and sampling interval are optimized according to the dynamic behaviour of entire system. The perturb step size and perturb time step are optimized and calculated for efficient MPPT. Kumar and Gupta proposed an extended P&O technique, in which, MPP is converged using

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

conventional P&O technique then the PV voltage is maintained at MPP by regulating duty cycle on the basis of difference between maximum power point voltage (Vmpp) and instant PV voltage (Vpv)at regular interval.

Incremental Conductance Algorithm:
The incremental conductance algorithm of MPPT was developed by K. H. Hussein, I. Muta, T. Hoshino and M.Osakada; however the concept technique was developed by O. Wasyneczuk. They used derivative of conductance to determine the maximum power point (MPP). The MPP is determined by comparing instant conductance to the incremental conductance and the INC technique is based on the fact that slopes of P-V curve are zero at MPP

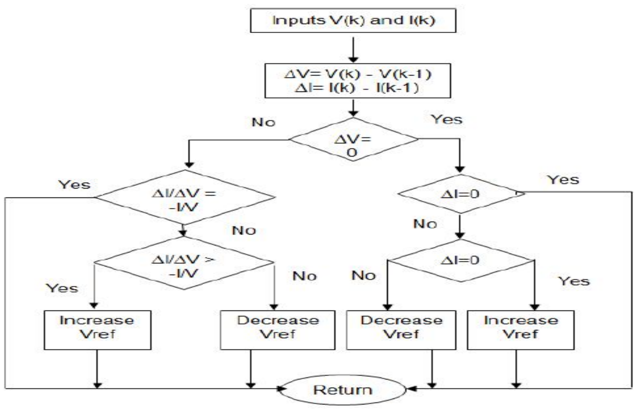


Fig 3.3. Flow chart of Incremental Conductance Algorithm

IV. CURRENT SOURCE INVERTER

For the VSI, because the full kind denotes, the output voltage is constant, with the output current dynamical with the load kind, and or the values of the elements. However within the CSI, this is almost constant. The voltage changes here, because the load is modified. In Associate in Nursing Induction motor, the developed force modifications with the change within the load force, the speed being constant, with no acceleration swiftness. The input current within the motor additionally changes, with the input voltage being constant. So, the CSI, wherever current, however not the voltage, is that the main purpose of interest, is employed to drive such motors, with the load force dynamical.

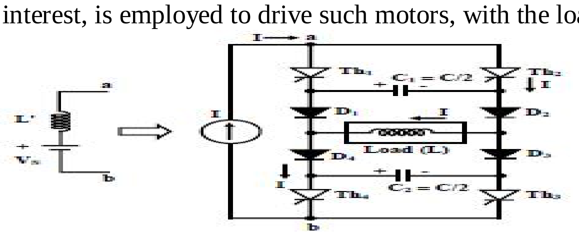


Fig 4.1. Single phase current source inverter (CSI) of ASCI type.

The circuit of a Single-phase Current supply electrical converter (CSI) .The type of operation is termed as Auto-Sequential Commutated electrical converter (ASCI). a relentless current supply is assumed here, which can be realized by mistreatment Associate in Nursing inductance of appropriate worth, that should be high, nonparallel with this restricted dc voltage supply. The thyristor pairs, Th1 & Th3, and Th2 & Th4, ar instead turned ON to get a virtually sq. wave current wave shape. 2 commutating capacitors C1 within the higher 0.5, and C2 within the lower 0.5, are used. Four diodes, D1, D4 are connected nonparallel with every thyristor to forestall the commutating capacitors from discharging into the load.

The output frequency of the electrical converter is controlled within the usual approach, i.e., by variable the 0.5 fundamental quantity, at that the thyristors in try ar triggered by pulses being fed to the various gates by the negative

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

feedback circuit, to show them ON, as will be determined from the waveforms. The inductance (L) is taken because the load during this case, the reason(s) that needn't be expressed, being documented. The operation is explained by 2 modes.

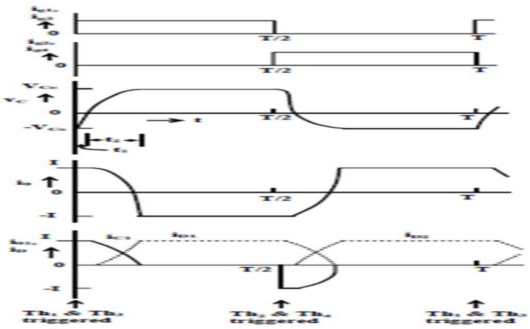
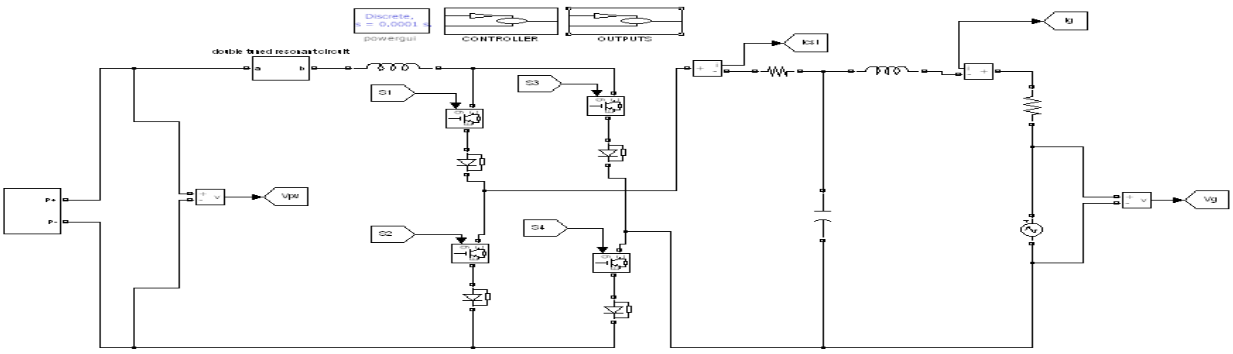


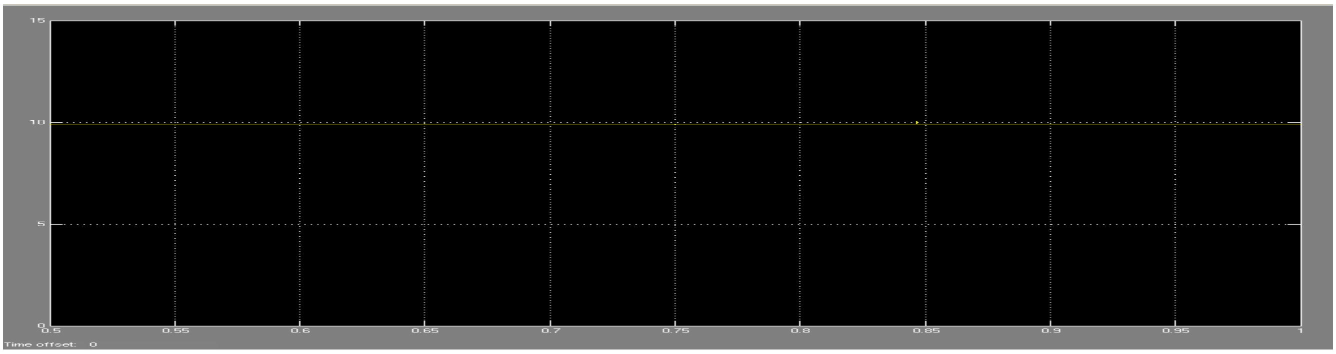
Fig 4.2. Voltage & current Waveforms

V. SIMULATION RESULTS

5.1. Simulation model for the proposed system:



5.1.1. Simulation result for PV current:



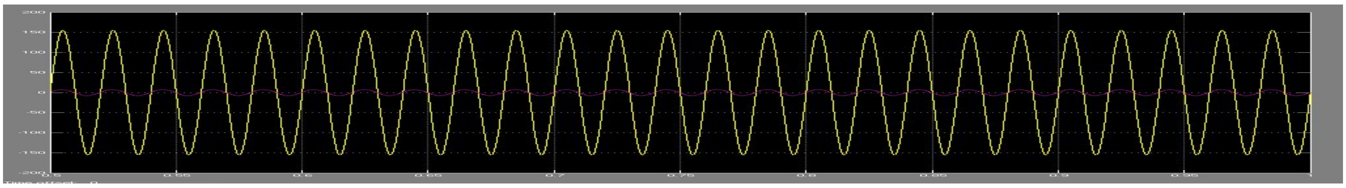
ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

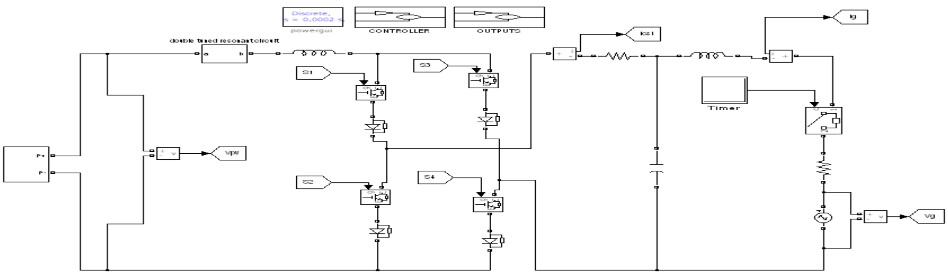
(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

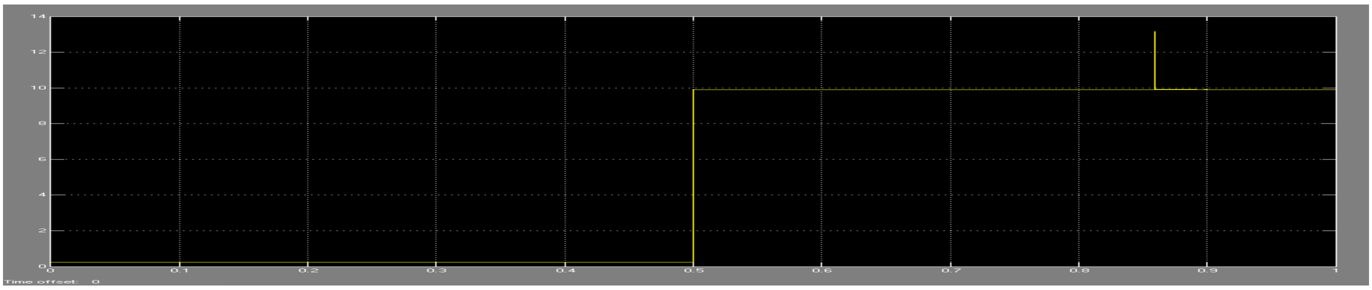
5.1.2. Simulation result for Grid Voltage & Current:



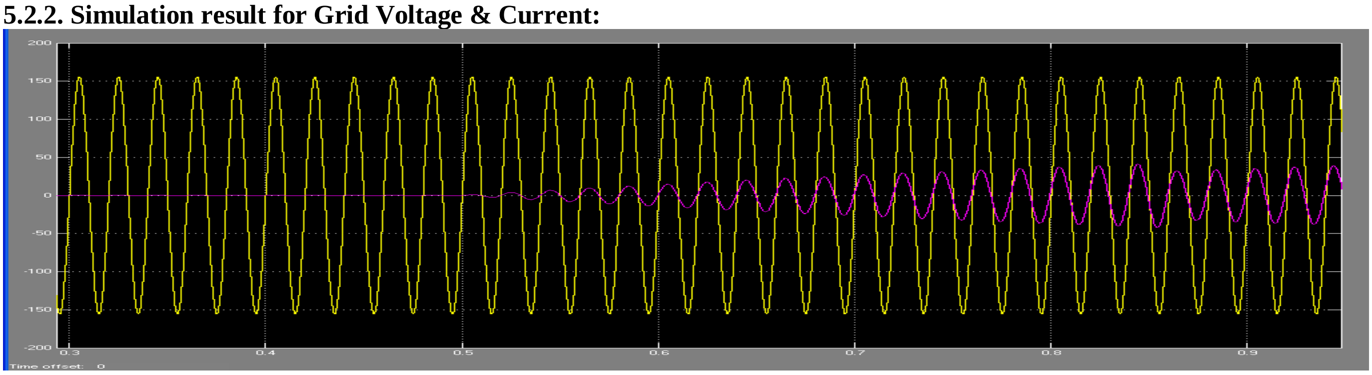
5.2. Simulation model for the proposed system with change in irradiance:



5.2.1. Simulation result for PV current:



5.2.2. Simulation result for Grid Voltage & Current:



VI. CONCLUSION

The project has illustrated the single-stage single-phase grid-connected PV system using a CSI that can meet the grid requirements without using a high dc voltage or a bulky transformer. The control structure of the proposed system consists of MPPT, a current loop, and a voltage loop to improve system performance during normal and varying weather conditions. Since the system consists of a single-stage, the PV power is delivered to the grid with

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

high efficiency, low cost, and small footprint. A modified carrier-based modulation technique has been proposed to pro-vide a short circuit current path on the dc side to magnetize the inductor after every conduction mode. Moreover, a double-tuned resonant filter has been proposed to suppress the second- and fourth-order harmonics on the dc side with relatively small inductance

REFRENCES

1. M. G. Villalva, J. R. Gazoli, and E. R. Filho, "Comprehensive approach to modeling and simulation of photovoltaic arrays," *IEEE Trans. Power Electron.*, vol. 24, no. 5, pp. 1198–1208, May 2009.
2. K. Jong-Yul, J. Jin-Hong, K. Seul-Ki, C. Changhee, P. June Ho, K. Hak-Man, and N. Kee-Young, "Cooperative control strategy of energy storage system and microsources for stabilizing the microgrid during islanded operation," *IEEE Trans. Power Electron.*, vol. 25, no. 12, pp. 3037–3048, Dec. 2010.
3. A. Mehrizi-Sani and R. Iravani, "Potential-function based control of a microgrid in islanded and grid-connected modes," *IEEE Trans. Power Syst.*, vol. 25, no. 4, pp. 1883–1891, Nov. 2010.
4. W. Fei, J. L. Duarte, and M. A. M. Hendrix, "Grid-interfacing converter systems with enhanced voltage quality for microgrid application-concept and implementation," *IEEE Trans. Power Electron.*, vol. 26, no. 12, pp. 3501–3513, Dec. 2011.
5. S. Dasgupta, S. K. Sahoo, S. K. Panda, and G. A. J. Amaratunga, "Single-phase inverter-control techniques for interfacing renewable energy sources with microgrid—Part II: Series-connected inverter topology to mitigate voltage-related problems along with active power flow control," *IEEE Trans. Power Electron.*, vol. 26, no. 3, pp. 732–746, Mar. 2011.

BIOGRPHY

N. Ramanjaneyulu Studied B.tech In Svpcet Puttur At 2012 And Pursuing My Mtech In Svpcet Jntua

M.Chethan he received the B.Tech (Electrical and Electronics Engineering) degree from the Jawaharlal Nehru Technological University, Anantapur in 2012 and Completed the M.Tech (Electrical power system) from Jawaharlal Nehru Technological University, Anantapur in 2014.