Literature Review on Video Frame Segmentation for Position Control of Parabolic Solar Reflector Using MATLAB

Kirti Chaurasiya, Prof. Satish Kumar

Abstract: **This paper provides the elaborated summary of almost all possible varieties video frame segmentation for position control of parabolic solar reflector and its applications. Here the paper have picked up a particular field of power generation and studied numerous benefits and drawbacks of parabolic solar reflector with web cam within the sun tracking era. This paper also presents a small description of a number of the prevailing sun tracking systems for daylight power generation and their style problems. Finally at the end we have mentioned few issue associated with database style.**

Keyword: video frame segmentation, web camera, sun tracking system, parabolic solar reflector, solar cell

I.INTRODUCTION

People in unfortunate countries may benefit from the employment of a solar distributed power generation system. As mentioned higher than within the introduction, the employment of a tracking system greatly improves the ability gain from solar irradiation. This paper presents however the potency of solar cell is often inflated with the planning of parabolic solar reflector and therefore the implementation of sun tracking system. Sun tracking systems is an application of the Machine Vision (MV) and collaboration with information Acquisition (DAQ) to systems by employing a web camera as a reflector and rotor angle as an output channel to drive a motor. The motors can react because the mechanism of the camera to positive it continuously focuses on the target of sun. By employing a MATLAB computer code programming setting, closes loop management is enforced to produce interaction between camera and movement angle as a tool to regulate the motor to trace the sun. Sun tracking system with web camera is an efficient tool to extend the potency of the solar cells. Camera is that the reflector of the system be an eye fixed of the human to require care and observe the sun. As the sun is often half-track with the parabolic solar reflector, the voltage, current and power received can continuously. This analysis may offer important improvement in energy. This analysis are often continued and upgraded to urge the upper potency to the almost level.

Manuscript received May, 2015.

Kirti Chaurasiya, *Dept. of ECE, Amity University, Lucknow, India.*
Prof. Satish Kumar*,, Dept. of ECE, Amity University, Lucknow, India.*

II.SUN TRACKING SYSTEM USING WEB CAMERA

Tracking objects in video sequences of surveillance camera is now a days a demanding application. Tracking objects is much more challenging in video sequences to improve recognition and tracking performances. There are many existing methods of object tracking but all has some drawbacks. Some of the existing models for object tracking are contour-based models, region-based models and feature point-based models. There are currently many research groups active in the field of photovoltaic in universities and research institutions around the whole world. Current scenario shows they divide this research into three areas: making current technology of solar cells cheaper and more efficient to effectively contest with other energy sources; developing new technologies based on new solar cell architectural designs; and developing new materials to serve as light absorbers and charge carriers[1][8][9][10][11][12][13][14].It is known to us that solar cell operates at very slow down efficiency and thus we need an advanced control mechanism is required to directly increase the efficiency of the solar cell. In this field researchers have developed an algorithm called the Maximum power point tracking. In many researches it is told that Solar PV gives output only when Sun shines. This may on average 5 to 7 hours/day. They indicate to get best use of solar some storage will be required [8].

"**Dante Johnson et al**" determined from the experimentation done that the best option for solar tracking would be to use the light dependent resistors. Aside from their "**power consumption they are the best option because they are clearly more sensitive; their optimum angle**" is at 30 degrees. Their sensitivity is followed closely by the amorphous solar cells with their optimum angle being at 50 degrees [12].

In 1997, "**Zeroual et al"** designed "**an automatic sun-tracker system to collect optimum solar energy"**. Here they used electro-optical sensors for sun searching and a microprocessor controller unit for data processing and also controlling the mechanical drive system. This system admits solar energy collectors to follow the sun position for optimum efficiency. It had been implemented to control a water heating parabolic solar system for domestic uses. Here many parameters like temperature, pressure and wind velocity had been controlled for system security. The system also had been tested for a [9.] "**long period of time at variable irradiance"**. The result showed that it operated satisfactorily with high accuracy [13].

ISSN: 2278 – 1323

"**Jeff Muhs, et al"** form Oak Ridge National Laboratory in 2000 describes a systems-level "**design and analysis of a new approach for improving the energy efficiency with adding affordability of solar energy in buildings"**. They worked on entitled hybrid solar lighting and full-spectrum solar energy systems. They use different portions of the solar spectrum simultaneously for multiple end-use applications in buildings; the proposed system offers unique advantages over other alternatives for using sunlight to produce electricity [14].

In 2008 "**PIC Based Automatic Solar Radiation Tracker**", the sun tracking system was implemented which is based on PIC microcontroller. The controller circuit system has been designed with a minimum number of components and has been merged onto a single PCB for simple assembly. Also they use stepper motor for position tracking which enables accurate tracking of the sun while keeping track of the array's current position in relation to its initial position. They conclude the automatic solar radiation tracker is an efficient system for solar energy collection. They estimated that the sun tracking systems can collect about 8% more energy than what a fixed panel system collect [15].

"Zoltán Kvasznicza, et al" described a "**preliminary optimizing investigation of a tracking system for better utilizing of the solar cells"**. According to their conclusion at least two times energy can be obtained with solar trackers in regions of maximum sun shine [16].

"J. Rizk, et al" in 2008, in their paper shows the potential, of system "**benefits of simple tracking solar system using a stepper motor and light sensor"**. This method is increasing power collection efficiency by developing a device that tracks the sun to keep the panel at a right angle to its rays. This solar tracking system is designed, [10.] implemented and experimentally tested. The design details and the experimental results are shown on this paper [17].

"Nur Khuzairy Bin Jamaludin" (2008) in his project, he is focused to design and build the prototype of solar tracking system that would be a starting point to build the realistic solar tracking system. Therefore, this prototype will cover the scope as like it can move 30° each and total movement of this system can do is up to 180°, Using microcontroller (16F877A), and also using stepper motor (bipolar 5 pin) with help of Light Dependent Resistor (LDR) or Photo resistor as a photo-sensor. He makes use of 6 sensors (photo resistor) to detect and compare the solar intensity of light [18]. The Worcester Polytechnic Institute carried out a study to investigate the performance of 2-axis solar tracking systems. The aim of the study was to "**compare on increasing the energy output of a solar collector by using a 2-axis tracking system"**. According to their report, the 2-axis tracking system increases the annual energy by around 48% than a fixed model and by around 36% than a 1-axis system [19].

"Armstrong & Hurley" (2009) conclude "**the orientation and tilt position of the solar panel affect the amount of solar radiation"** that falls on the panel surface all over the day. So the choice of tilt angle for a solar panel is fundamental property to its efficient operation. They apply this thought various times of days with various climatic condition and location to ensure the effect of tilt angel position. They also conclude the effect of diffused and direct beam radiation and prepared a data chart for various climatic conditions [20]. It objects to find a new technique to maximize that solar energy under cloudy condition which can be useful for a country such as Ireland. The study focused on the problem of statistically predicting the power output of the solar collectors in cloudy nations and included the effect of diffuse radiation. Due to overcast skies the direct beam radiation is hugely eliminated, so a new [11.] thought is necessary that takes into account the frequency of clouds. In order to calculate the solar radiation, the methodology is proposed where combines hourly analysis and observations of cloud conditions with monthly sunshine hour's data to determine the frequency of clear, partly cloudy and overcast skies. Using these solar radiation values and knowledge of "**cloud conditions, the tilt angle, which is alignment angle between collector and sun beam"**, can be predicted to optimize the available solar radiation between the beam radiation on sunny days and the diffuse radiation on cloudy days [20].

In 2010 "**Mummadi Veerachary"** prepared detailed report on the use of a "**SEPIC converter for photovoltaic power control"**. In his report, he utilized a two-input converter for utilized the maximum power extraction from the solar cell [21].

In 2010, "**P. S. Revankar"** has added the effect of variation of sun's inclination to track down "**the maximum possible power from solar radiations**" at Second International Conference on Machine Learning and Computing. The control mechanism designs such that it alters the position of the panel when the incoming solar radiations are always perpendicular to the panels [22]. Also most of the studies that have implemented in the UK and in Europe such as the works that have been done by the European Photovoltaic Technology Platform were studying improving these systems on clear sky conditions only (European Photovoltaic Technology Platform, 2011). These studies did not consider the solar tracking performance in cloudy conditions, and therefore their results can be applicable for only clear sky locations [23].

"**Dr. Osama Gouda, Cairo"** University, proposed Optimum Design and Implementation of Stand-alone "**Tracking Photovoltaic Power System based on PLC and Microcontroller"**. In their paper, it is proposed to develop a solar tracking system as the normal line of the solar cell and always moves to parallel the ray of the sun. A new approach of PLC program has been proposed for solar cell sun tracking. Also a new [12.] computer (MATLAB) program has been proposed for storage of the photovoltaic array output voltage on computer. In this tracking system, is tracking the incoming beams of the sun by a DC motor which contains a position sensor. This position sensor gives a certain number of pulses during the movement of the solar cell from the east, as the initial or starting point (zero degree), to the west (180 degree) as final or stopping point. This is done by Adjusting the surface azimuth angle γ=00 when facing the south and The

slope of the incident plane with the horizontal β is controlled by moving the DC motor every half an hour by 9 degrees. The motor is moved by control of PLC program [24].

In 2011"**Mohammed S. EL-Moghany"** in his paper, "**fuzzy logic controller FLC"** was designed to maximizing the energy received from solar cells by two methods. The first method is by implementing a sun tracker controlled by fuzzy logic controller to keep the PV panel pointing towards the sun by using a stepper motor. Here LDR resistors are used to determine the solar light intensity. This controller also has been tested using MATLAB/Simulink program. The proposed solar tracking power generation system was able track the sun light automatically, so it is an efficient system for solar energy collection by their conclusion. It was conclude that the sun tracking systems is 24% more energy efficient than a fixed panel system. The other proposed method is by implementing a maximum power point tracker controlled by fuzzy logic controller and using buck DC-to-DC converter to keep the PV output power at the maximum point all the time. This controller was tested using Matlab/Simulink program, and the results was compared with a perturbation and observation controller which applied on the same system. The comparison shows that the fuzzy logic controller was better in response and do not depend on knowing any parameter of PV panel. In this paper, the fuzzy logic control demonstrates good performance. Furthermore, fuzzy logic offers the advantage of faster design, and emulation of human control strategies [25]. [13.]

Many FPGA-based PV systems fuzzy MAXIMUM POWER POINT TRACKING control was proposed, "**A. Messai"**, at el describes the hardware implementation of a "**two-inputs one-output digital Fuzzy Logic Controller (FLC) on a Xilinx FPGA using VHDL language"** in 2009 [26].
"Minor M. et al" (2010) In his work, they propose "**an innovative system for tracking the sun which is based on the use of a commercial web cam as the sensor"** element. An experimental electro-mechanism was designed and developed to evaluate its accuracy and efficacy in tracking the sun under different weather conditions. The impact on the system performance caused by intermittent cloud cover and temperature changes were also analyzed. The system showed an accuracy of 0.1º and high immunity to temperature variations. It demonstrated to be able to relocate the sun, as well as extrapolate its position when it cannot be observed for a period of time [27].

In "**Solar Tracking Strategies"**, ("**L. A. Petrov"** 2010/2011 university of DUNDEE) system builds for Solar Tracking. A unique server-microcontroller mechanism was chosen for system control. This configuration proved to be highly adaptable, maintainable and has the potential to increase system flexibility to very upgrade levels. Several characteristics of each algorithm can be derived, such as precision variation with time and latitude, and computational cost. The results of this analysis can point towards specific algorithms when decisions upon tracking applications are being made [28]. Then some studies came to compare the performance of tracking systems in different locations.

"Messenger & Ventre" have discussed maximizing of the irradiation on solar collectors. They have looked at optimizing the performance of flat solar collectors and discussed briefly the performance of solar tracking system under different conditions. They have chosen two locations at different climate condition, one at clear sky condition and another at somewhat cloudy condition. And they have found [14.] that the performance of a tracking system reduces with the increase of clouds layer at the location [29]. In most paper like "Modeling and Simulation of a Solar Photovoltaic System, Its Dynamics and Transient Characteristics in LABVIEW" try modeling a simulation in MATLAB environment. It is the basis for computer simulation of a real system, usually based on a theoretical and practical analysis of the various physical processes regarding the system and of all factors influencing these processes. The analytically expressed Mathematical models describing the system characteristics are formulated and translated into computer codes to be used in the simulation process. The most common model used to predict energy production in photovoltaic cell modeling is the single diode circuit model that represents electrical behavior of the pn-junction in best cases [30].

"M. Berrera", in his project has compared seven different types of "**algorithms for Maximum power point tracking"** with the help of two different solar irradiation functions to analyses the variation of the output power in both cases using the optimized maximum power point tracking algorithms and maximum power point tracking algorithms [31].

"Nur Mohammad Tarequlkarim", in his paper present a "**microcontroller based energy efficient automatic solar tracking system"**. Here a comparative analysis was performed using four systems, i.e. hybrid tracking, dual axis, single axis and stationary module. The result showed that the use of the dual axis tracking system produced 18% gain of power output, compared with a single axis tracking system. The gain of output [15.] power with the Hybrid tracking system was much higher 54% when compared with a stationary system inclined at 23.5 degree to the horizontal [32].

"Yinghao Chu", et al in their paper not only gives a brief "**introduction about the fast developing solar technologies industry"**, but also may help us avoid long term switching cost in the future and make the solar systems performance more efficient, economical and stable. In this work, they used five of the most commonly "**studied and discussed solar technologies and reviewed their structure, performance, advantages and drawbacks"** [33].

"Asmarashid Ponniran1", et al, work on a project, where their objective is the development of an automatic solar tracking system in which solar panels will keep ordinate with the sunlight in order to maximize in harvesting solar power. When the intensity of Sunlight is decreasing, this system automatically changes its direction to get maximum intensity of Sunlight. LDR light detector acts as a sensor is used to trace the coordinate of the Sunlight by detecting brightness level of Sunlight. While to rotate the appropriate position of the panel, a DC geared motor is used. The system is controlled by two relays as a DC geared motor driver and a microcontroller as a

ISSN: 2278 – 1323

main processor. "**Single Axis Solar Tracking System prototype model"** is successfully developed. The designed system is focuses on designing controller part and the main concern is to design appropriate circuits and the circuits supposed to be able to control DC-gear motor rotation direction without considering motor speed [34].

"Saboj Kumar Ray et al", This paper represents a simple method, "**low cost microcontroller based solar tracker of two way of rotating freedom"** in order to achieve the right positioning of photovoltaic solar cell to get the much sunlight during the day light session to get more electricity. In this research a comparison has been made on a conventional solar follower plant and tracking system [35].

"Matthew Wrightn and Ashraf Uddin" in 2012 presented their paper for organic materials, have recently become of great interest for photo voltaic applications, due [16.] to their potential to utilize high throughput in solution phase processing, which will lead to low cost electricity production.

"**Hybrid solar cells combine organic and inorganic materials with the aim of utilizing the low cost cell production of organic photovoltaic (OPV)"** as well as obtaining other advantages, such a stainable absorption spectra, from the inorganic component [36].

"Okpeki U.K.", et al presented a paper concern the "**design and construction of a bidirectional solar tracking system"**. In this research test showed that power used by tracker system is less than the power gain by tracking the sun accurately. The most important conclusion of this research is that the total cost of construction of the tracker system is very low [37].

"Jay Patel" discus his paper According to "**the Simulink model of solar cell in MATLAB with boost converter and maximum power point tracking algorithm using INC method, they conclude that the maximum power point tracking controller"** adjusts the duty cycle of the boost converter on the event of any change in the irradiance to generate maximum power possible and also conclude that the P&O and INC method tracks the maximum power under various climate condition. It also improves dynamic and steady state performance of the PV system [38].

In 2013, "**Neha Sonkar**" designs a system of tracking where he using a balanced concept to compare two signals from the different sensors. Here "**Light Dependent Resistor (LDR) as a light sensor"** has been used. The mechanism just two light sensors are separated by divider which will create shadow on one side of the light sensor if the solar panel is not perpendicular to the sun. For the controlling circuit, he used microcontroller PIC16F877A which acts as a brain that controls the movement of the motor via relay. First data is received from the sensors and processed by the microcontroller to send a data to the Bi-directional DC geared motor via relay to ensure position of solar panel is perpendicular towards the Sun [39]. [17.]
The various discussions shows that the way of upgrading of various tracking tools to make collection of solar beam more efficient to fulfill the energy demand. The readily available type of tracking technique is discussed in this paper.

III.CONCLUSION

I have studied different papers that are related with video frame segmentation for position control of parabolic solar reflector, I can conclude that to obtain efficient electrical power from PV module, the main input parameters are solar irradiance and temperature. The combination of these effects makes better performance of the solar cell in any condition. I found that the module power and maximum power point tracking power are different at different time of the day, which concludes that to optimize power; I required a positional control system to maximize the incoming solar radiation by aligning the PV module towards the Sun. This serve also provide the motor controlling parameter, which are differential voltages between module voltage and module maximum power point tracking voltage at different condition. Using this data, I find out optimal angle of rotation of PV module, which is a vital parameter of my work. This estimation of optimal angle of the motor can be used to design tracker in practical field for optimizing solar power efficiently throughout the day. I hope that my results can be applied for more advanced system in future.

References

[1] **Liene Kancevica, Henriks Putans, Imants Ziemelis**, "The tracking system for solar collectors with reflectors" in "Renewable Energy and Energy Efficiency, 2012 Solar energy applications and energy efficiency technologies in buildings".

[2] Kanceviča L., Putāns H., Ziemelis I., Putāns A., Jesko Ž. (2007) Saules enerģijas kolektoriekārta ar atstarotājiem (Solar energy collector device with reflectors). Latvijas patents LV 13549 B. F24J2/42, 20.05.2007. Patenti un preču zīmes. *Latvijas Republikas Patentu valdes oficiālais vēstnesis* - Nr. 5. (In Latvian)

[3] Putāns H., Zagorska V., Ziemelis I., Kanceviča L., Jesko Ž. (2011) Mobilā meteoroloģisko datu reģistrēšanas ierīce (Mobile meteorological data recording device). Latvijas patents LV 14312 B. G01W1/00, 20.04.2011. Patenti un preču zīmes. *Latvijas Republikas Patentu valdes oficiālais vēstnesis* - Nr. 3. (In Latvian)

[4] Putāns H., Ziemelis I., Kanceviča L. (2008) Saules enerģijas kolektors ar divdaļīgu absorberi (Solar energy collector with a two-part absorber). Latvijas patents LV 13711 B. F24J2/42, 20.06.2008. Patenti un preču zīmes. *Latvijas Republikas Patentu valdes oficiālais vēstnesis* - Nr. 6. (In Latvian)

[5] Putāns H., Ziemelis I., Viesturs D., Kanceviča L., Putāns A., Ziemelis Ē. (2006) Plakana saules kolektora enerģijas kolektoriekārta (Flat plate solar energy collector device). Latvijas patents LV 13371 B. F24J2/02, 20.01.2006. Patenti un preču zīmes. *Latvijas Republikas Patentu valdes oficiālais vēstnesis* - Nr. 1. (In Latvian)

[6] Energy Statistics 2013 (Twentieth Issue), Central Statistics Office National Statistical Organization Ministry Of Statistics and Programme

Implementation Government Of India. www.mospi.gov.in

[7] Laue EG, 'The measurement of solar spectral irradiance at different terrestrial elevations', Solar Energy [Internet]. 1970; 13:43 - 50, IN1-IN4, 51-57. Available from: http://www.sciencedirect.com/science/article

[8] Zekai Sen, 'Solar irradiation fundamentals'-solar energy conversion and photo energy system-Vol.II, Istanbul Technical University.

[9] Saurav Satpathy, Prof. A. K. Panda, 'Photovoltaic Power Control Using Maximum power point tracking And Boost Converter', National Institute of Technology, Rourkela, May 2012.

[10] Ayan Kumar Tudu, Prof. Dr. Subrata Paul, Dr. Sunita Halder, 'Study Of Maximum power point tracking Algorithms For Pv Systems', Department of Electrical Engineering, Jadavpur University.

[11] Samer Alsadi, Basim Alsayid, 'Maximum power point tracking Simulation for Photovoltaic Systems Using Perturb and Observe Algorithm', International Journal of Engineering and Innovative Technology (IJEIT), Volume 2, Issue 6, ISSN: 2277-3754, December 2012,

[12] Dante Johnson-Hoyte, 'Solar Tracker: B-Term Report' Worcester Polytechnic Institute, December 2012.

[13] A. Zeroual, M. Raoufi, M. Ankrim and A. J. Wilkinson, 'Design and construction of a closed loop Sun Tracker with Microprocessor Management', International Journal on Solar Energy, Vol. 19, 1998, Page(s): 263-274.

[14] Jeff Muhs, 'Design And Analysis Of Hybrid Solar Lighting And Full-spectrum Solar Energy Systems', Oak Ridge National Laboratory, 2000.

[15] Romy Kansal, 'PIC Based Automatic Solar Radiation Tracker', Electronics Instrumentation & Control Engineering, Thapar University, Patiala (Punjab)-147004.

[16] Zoltán Kvasznicza, György Elmer, 'Optimizing Solar Tracking Systems for Solar Cells', SISY 2006, 4th Serbian-Hungarian Joint Symposium on Intelligent Systems.

[17] J. Rizk, Y. Chaiko, 'Accurate analytical method for the extraction of Solar Cell Model Parameters', University of Singapore Kent Ridge, Singapore 0511, 2008.

[18] Nur Khuzairy Bin Jamal din, 'Solar Tacking System', University Malaysia Pahang, 2008.

[19] Adrian Catarius, Mario Christiner, 'Azimuth-Altitude Dual Axis Solar Tracker', Worcester Polytechnic Institute, 2010.

[20] S. Armstrong, W.G. Hurley, 'A new methodology to optimize solar energy extraction under cloudy conditions', Power Electronics Research Centre, Electrical and Electronic Engineering, National University of Ireland, Galway, Ireland. Renewable Energy 35 (2010) 780–787.

[21] Mummadi Veerachary, 'Control of TI-SEPIC Converter for Optimal Utilization of PV Power', IICPE, New Delhi, 2010.

[22] P. S. Revankar, W. Z. Gandhare, A. G. Thosar, 'Maximum power point tracking for PV Systems Using MATLAB/SIMULINK', Second International Conference on Machine Learning and Computing, Government College of Engineering, Aurangabad, 2010.

[23] Saboj Kumar Ray, Md. Abdul Bashar, 'Design, Construction and Effectiveness Analysis of Hybrid Automatic Solar Tracking System for Amorphous and Crystalline Solar Cells', Global Journal of Research In Engineering, General Engineering Vol 12 Issue 4 Version 1.0 Year 2012, Global Journals Inc. (USA) Online Issn 2249-4596 & print Issn: 0975-5861, 2012.

[24] 'Optimum Design and Implementation of Stand-alone Tracking Photovoltaic Power System based on PLC and Microcontroller', Proceedings of the 14th International Middle East Power Systems Conference (MEPCON'10), Cairo University, Egypt, Paper ID 129, December 2010.

[25] Basil M. Hamed, 'Fuzzy Controller Design using FPGA for Sun Tracking in Solar Array System', Electrical Engineering Department, Islamic University of Gaza, Palestine, 46- 52, 2012.

[26] J.A. Ramos-Hernanz, J.J. Campayo, J. Larranaga, E. Zulueta, O. Barambones, J. Motrico, U. Fernandez Gamiz, I. Zamora, 'Two Photovoltaic Cell Simulation Models In Matlab /Simulink', ISSN 2077-3528, IJTPE Journal- March 2012 Issue 10 Volume 4 Number 1 Pages 45-51.

[27] Minor M. Arturo, García P. Alejandro, 'High–Precision Solar Tracking System', Proceedings of the World Congress on Engineering 2010 Vol-II, London, U.K., 2010.

[28] L A Petrov, 'Solar Tracking Strategies', BSc (Hons) Dissertation, university of DUNDEE, 2011.

[29] Dr. J. Abdul Jaleel, Nazar. A, Omega A R, 'Simulation on Maximum power point tracking of the Photovoltaic Module using Lab VIEW', IJAREEIE Vol.1, Issue-3, September 2012.

[30] 'Modeling and Simulation of a Solar Photovoltaic System, Its Dynamics and Transient Characteristics in LABVIEW', International Journal of Power Electronics and Drive System (IJPEDS) Vol.3, No.2, pp. 185~192, ISSN: 2088-8694, June 2013.

[31] M. Berrera, A. Dolara, R. Faranda, S. Leva, 'Experimental test of seven widely adopted MAXIMUM POWER POINT TRACKING algorithms', IEEE Bucharest Power Tech Conference, June 28th - July 2nd, Bucharest, Romania, 2009.

[32] Nur Mohammad, Tarequl Karim, 'Design and Implementation of Hybrid Automatic Solar Tracking System', Journal of Solar Energy Engineering 2012 by ASME, Vol.135, February-2013.

[33] Daniel A. Pritchard, 'Sun Tracking by Peak Power Positioning for Photovoltaic Concentrator Arrays', IEEE Transactions on Control System, Volume-3, Issue-3, Page(s):2-8, Aug-1983.

[34] Asmarashid Ponniran1, Ammar Hashim1, Ariffuddin Joret, 'A Design of Low Power Single Axis Solar Tracking System', Regardless of Motor Speed, International Journal of Integrated Engineering, Vol. 3 No. 3, 2011.

ISSN: 2278 – 1323

[35] Saboj Kumar Ray, Md. Abdul Bashar, Global Journal of Research In Engineering, General Engineering, Vol-12, Issue-4 Version 1.0, Global Journals Inc. (USA), Online Issn 2249-4596 & print Issn: 0975-5861, 2012.

[36] Matthew Wrightn, Ashraf Uddin, 'Organic & Inorganic Hybrid Solar Cells', A Comparative Review, Photovoltaic Centre of Excellence, University of New South Wales, Sydney, NSW 2052, Australia, 2012.

[37] Okpeki U.K, Otuagoma. S. O, 'Design and Construction of a Bi–Directional Solar Tracking system', International Journal Of Engineering And Science, Issn: 2278-4721, Vol. 2, Pp32-38, February 2013.

[38] Jay Patel, Vishal sheth, Gaurang Sharma, 'Design & Simulation Of Photovoltaic System Using Incremental Maximum power point tracking Algorithum', Birla Vishvakarma Mahavidyalaya, Gujarat, India. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 5, May 2013.

[39] Neha Sonkar, Pankaj Edla, Dr. Bhupendra Gupta, 'Hybrid Automatic Solar Tracking System for Different Types of Solar Cells', International Journal Of Engineering Sciences & Research Technology (IJESRT), 2690-2693, Jabalpur Engineering College, Jabalpur, India, Sonkar, ISSN: 2277-9655, October 2013.

AUTHOR'S BIBLIOGRAPHY

Ms Kirti Chaurasiya is presently pursuing M.Tech in Electronics and Communication Engineering from Amity University, Lucknow, Uttar Pradesh. She has done B.Tech degree course in Electronics & Communication Engineering from Dr Ram Manhor Lohia Avadh University Faizabad Uttar Pradesh in 2013. Presently, she has focused her working area within of parabolic reflector. Her research interests also include Efficiency Improvement of Solar Cell Using Compound Parabolic Concentrator and Sun Tracking System using MATLAB.

Sh. Satish Kumar, M.Tech, FIETE is an alumnus and gold medalist of IIT Roorkee (Erstwhile University of Roorkee). He has worked as General Manager and Chief Vigilance Officer in India,,s first PSU, ITI Ltd. Bangalore. He has more than 34 years of industrial experience on state-of-the-art telecom equipment and infrastructure dealing with turn-key projects. His professional experience covers the whole spectrum of switching, transmission, access, telemetry and subscriber premises equipment. He also worked for providing design, system integration and Value Engineering results for various network based turn-key projects like Army Static Communication Network (ASCON), Integrated Electronic Warfare System (IEWS), Defence Communication Network (DCN), Tactical Communication System (TCS), Network For Spectrum (NFS) etc., Presently he is working as Professor, (Electronics & Communication Engineering) Amity University Lucknow campus.

ACKNOWLEDGEMENT

The authors would like to thank Maj. General K. K. Ohri (AVSM, Retd.) Pro-VC & Director General, Amity University, Uttar Pradesh Lucknow, Wg. Cdr. (Dr.) Anil Kumar (Retd.) (Director ASET, Lucknow Campus), Brig. U. K. Chopra (Director AIIT & Dy. Director ASET) and Prof. O. P. Singh (HOD, Electronics) for their valuable comments and suggestions that helped to improve this paper.

