Hotspot Detection Method for Photovoltaic System: A Review

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Abstract—To maintain the long-term reliability of photovoltaic (PV) modules while maximizing the power output, possible faults in the PV modules need to be diagnosed at an early stage. One of the problems that arises in PV system is the formation of hotspot. Numerous hotspot detection methods have been presented over the years to address this particular issue. This paper presents a review of existing hotspot detection methods for PV system. Several methods are discussed and the future possible works are recommends in this study.

Keywords—photovoltaic system, hotspot detection, image processing

COMPRE

1. INTRODUCTION

Solar electric systems or photovoltaic (PV) systems are used to harness solar energy. A large amount of energy is emitted from the sun. PV devices capture that energy and convert them into electricity. Generally, PV system requires less maintenance as the design is simple. It can be designed as stand-alone system to produce outputs from kilowatt (kW) or grid-connected system of megawatt (MW) scale. The applications of PV system including remote/off-grid area, remote communication systems, grid-connected commercial and residential buildings, as well as central power plants [1].

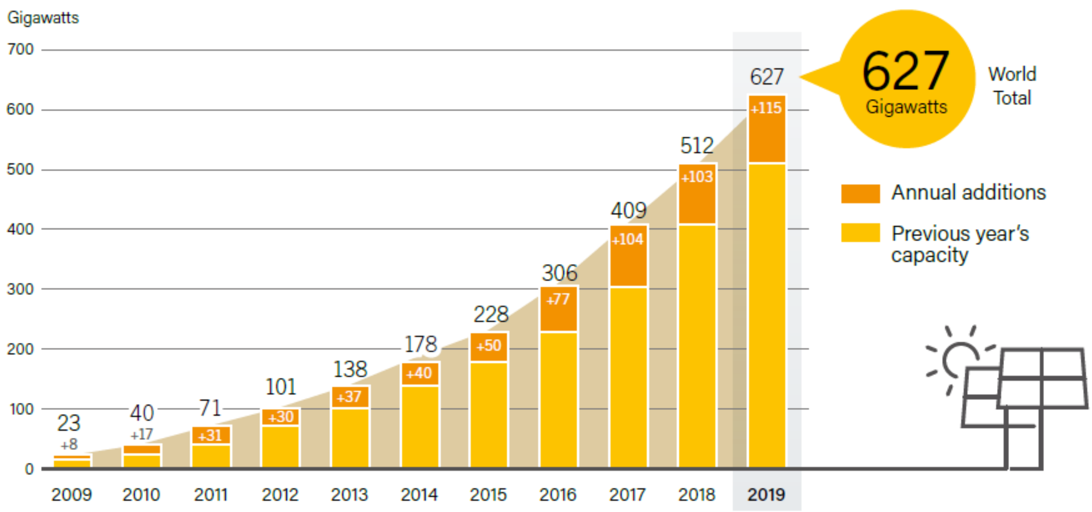

Figure 1: Solar PV Global Capacity and Annual Additions, 2009-2019 [2].

[7] D. Kaur and Y. Kaur, “Various Image Segmentation Techniques: A Review,” *Int. J. Comput. Sci. Mob. Comput.*, vol. 3, no. 5, pp. 809–814, 2014.

[8] C. Solomon and T. Breckon, *Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab*. Wiley Blackwell, 2011.

[9] J. A. Tsanakas, D. Chrysostomou, P. N. Botsaris, and A. Gasteratos, “Fault diagnosis of photovoltaic modules through image processing and Canny edge detection on field thermographic measurements,” *Int. J. Sustain. Energy*, vol. 34, no. 6, pp. 351–372, 2015.

[10] G. C. Ngo and E. Q. B. Macabebe, “Image segmentation using K-means color quantization and density-based spatial clustering of applications with noise (DBSCAN) for hotspot detection in photovoltaic modules,” *IEEE Reg. 10 Annu. Int. Conf. Proceedings/TENCON*, pp. 1614–1618, 2017.

[11] C. Aguilera, F. Barrera, F. Lumbreras, A. D. Sappa, and R. Toledo, “Multispectral Image Feature Points,” *Sensors*, vol. 12, no. 9, pp. 12661–12672, 2012.

[12] Y. Qin, Z. Cao, W. Zhuo, and Z. Yu, “Robust key point descriptor for multi-spectral image matching,” *J. Syst. Eng. Electron.*, vol. 25, no. 4, pp. 681–687, Aug. 2014.

[13] C. A. Aguilera, A. D. Sappa, and R. Toledo, “LGHD: A feature descriptor for matching across non-linear intensity variations,” in *Proc. IEEE Int. Conf. Image Process. (ICIP)*, Sep. 2015, pp. 178–181.

[14] H. Chen, N. Xue, Y. Zhang, Q. Lu, and G. S. Xia, “Robust visible-infrared image matching by exploiting dominant edge orientations,” *Pattern Recognit. Lett.*, vol. 127, pp. 3–10, 2019.

[15] C. F. G. Nunes and F. L. C. Padua, “A Local Feature Descriptor Based on Log-Gabor Filters for Keypoint Matching in Multispectral Images,” *IEEE Geosci. Remote Sens. Lett.*, vol. 14, no. 10, pp. 1850–1854, 2017.