International Journal of Future Generation Communication and Networking
Vol. 13, No. 1, (2020), pp. 349 - 355

Fault Detection Of Photo-Voltaic Modules Using Thermal Images

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Abstract

The improvements in an solar power industry and its importants will be more in future. Innovation in nanotechnology can increase the efficiency of solar panels and multiple its electrical input in solar power system. The degradation in the solar cells can reduce the power output and even it can failure the solar panel. To maintain longer lifespan of solar panels and improve the power output the faults in solar panels are diagnosed in an early stage. This project provides an solution for the diagnosis for the solar panels using IR thermography. IR image are used to monitor the solar panels and Fuzzy rule is used to classify the faults.IR images were acquired using an IR camera. The action need to taken are classified on type of faults.

Keywords *- nanotechnology; solar panels; infrared image ;Fuzzy rule; thermography*

I. INTRODUCTION

As, the increase in the change of climate, the world is seeking more towards the clean energy sources. The solar energy has been considered as a major non-polluting and everlasting source of energy. Since the life span of solar panels are very long it is necessary to maintain. So that the solar modules have an maximum output. The fault detection must be maintained with the uninterrupted power supply. The fault in an photo-voltaic modules using an electrical performance measurement are used and, but there are some limitation with this methods. To acquire the acqurate measurement some other methods are used. The use of IR image using thermal cameras gives the more advantage and also the solar panels are safer. A large number of thermal images are captured during the short period of time. And also detection of fault and diagnosis can be done in earlier.IR image is an simple and fast method to scan the faults in the solar panels.

In this, present project IR is used to capture the thermal images and Fuzzy rule is used to classify the faults. The purpose of the project is to solar module fault diagnosis and maintenance purpose. Thermal images of the faulty panels are compared with the healthy panels using image processing. Faults are classified into different types based on Fuzzy rule.

In this paper some popular articles of the solar panel fault diagnosis are discussed, Fuzzy rule logic and results of proposed algorithm are given. At the end Reference are given.

A. IMAGE PROCESSING

Image processing can be defined as the process of performing some operation from on an image to get an information from an image and enhance it. And it can be defined as the manipulation and analysis of an image. Image processing is separated into an 5 steps. They are,

1. Visualization
2. Image improving
3. Rebuilding

ISSN: 2233-7857 IJFGCN

4. Image reclamation
5. Quantity of pattern

B. APPLICATIONS OF IMAGE PROCESSING

1. Image sharpening
2. Remote sensing
3. Color processing
4. Video processing
5. Microscopic imaging

II. PREVIOUS WORK

There are many faults in an solar panels that are due to the damage in solar cells and breaks are accured at handling of solar panels and it does not get an saturated amount of heat from the sun to produce the electric power.

In the EL method solar panels are kept in an dark room and current are passed through the solar modules, and then cooled Silicon CentiCandela camera is used to capture the thermal images of an solar panels. The crystal with higher power output gives brighter luminous intensity. The damages like cracks and breaks are appeared as a dark region because they are not active. So, it is important to detect more number of fault detecting algorithms and make best use of the solar modules fault data. The PCA and ICA methods of thermal imaging is the clear method to find the faulty place and group the images as faulted and non-faulted.

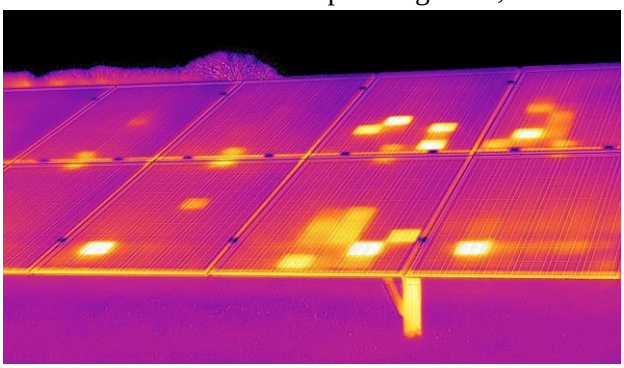
A. DISADVANTAGES

- The different types of the classification are very low.
- Detection of fault is not more accurate.
- Low efficiency when compared with other methods.

III. PROPOSED WORK

In proposed work, the fault in an solar panels are detected by using the IR image and it produce the images of an solar panels are based on invisible radio waves. IR energy are electromagnetic spectrum ,it will absorb heat and invisible to human eye. IR image are produced and that gives the image of an solar panel using the visible light.

Some examples for the captured thermal images of an solar panel are given, and solar plant are captured by using the drone cameras. Then the example images are,



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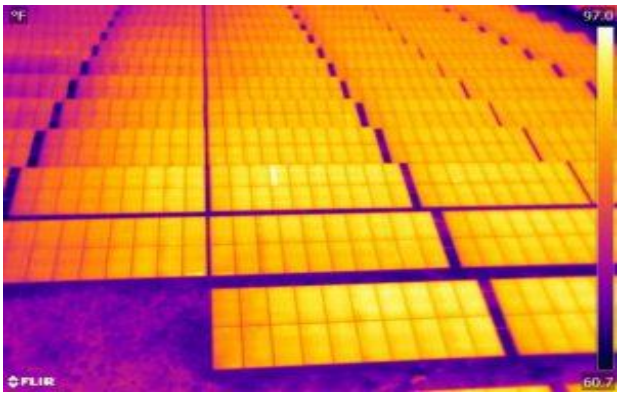
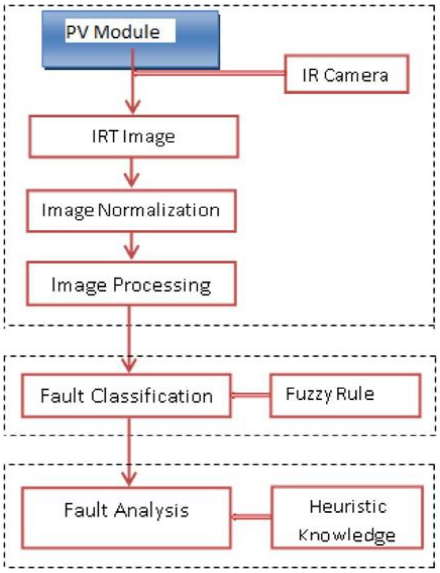
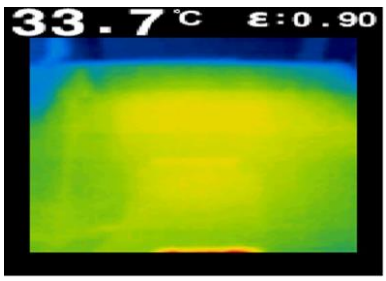


Some amount of heat energy is always emitted from all living things and objects. IR technology can be used to detect the thermogram of an given image. And the main advantage of an thermography is, it can easily penetrate into the smoke, light and fog. To determine the image as the defective or non-defective two different approaches are used. The first one is feature extraction and second one is image reconstruction from ICA basis image.

These methods consist of the considering the infrared image of the healthy solar panel and take the IR images of an fault solar panels. Then this method compare both the images and classify the defective and non-defective panels based on the fuzzy rule the characteristics obtained from an average value of the feature of the defective samples and feature obtained from an test images.



The raw image of an defective free and defective solar panels are shown in fig(a) and fig(b). It is



important to develop the more number of responsible fault detection algorithms that can make use of the available photovoltaic solar panels. It is one of the effective technique to identify the faults in an

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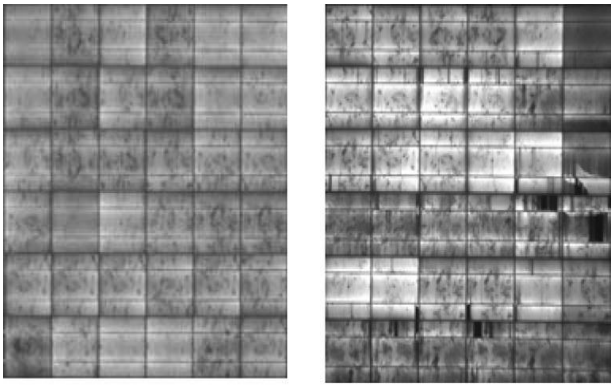
solar panels using ICA and PCA method to clearly classify the type of faults as defective and non-defective. The fig(a) defines the non-defective solar photo-voltaic cells and fig(b) defines the defective solar panels.

More than 100 IR images of the faulty and healthy panels are having the different specifications: high efficiency poly crystalline silicon cell: rated maximum power: 40W, open circuit voltage: 21.9V, short circuit current: 2.45A, rated voltage: 17.40V, rated current: 2.30V are taken with the help of IR camera.



(a) (b)

The color pattern of the faulty solar panels are different from the healthy solar panels.And the faulty panels are classified into different types based on the type of faults. These are classified into the five different categories as VL-very low, L-low, M-medium, H-high, VH-very high are classified according to the temperature range of the panels.

A raw image of an faulty solar panel with the temperature range at 33.7 degree Celcius is given and it comes under the L-low faulty panels and it does not need an immediate action.

The different types and the different ranges of the faulty panels are classified. And the action or the step to taken to maintain the solar panels are categorized. Healthy panel and faulty panel are compared pixel by pixel. More the similarity between the intensity level of healthy and faulty image, more will be chance to healthier. And more the difference between the intensity level of both the image will more the chance to faulty. MATLAB tool is used for the image processing operations. This software privide the difference between the both the image pixel by pixel and gives the comparision scace range between 0 to 1000.

IV. FUZZY RULE BASED

Fuzzy rule is used to classify the faults into the different classification of the faults. Thus, the temperature level of the each of the solar panels are different. In present work of the Fuzzy rule is based on the thermal mapping of an healthy solar panels and faulty solar panels. The fault detection and automatic decision making can be possible using the fuzzy rule. Various possible combination of the faults and temperature based panels are classified with the help of fuzzy rule. Then, these are separated into the 5 different levels according to the type of faults.

Faults are classified into five different types are given below.

- Critical Fault
- Major Fault
- Medium Fault
- Small Fault

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- Minor Fault
- No Fault

V. RESULT

This project gives an effective result for the fault detection in the solar modules using the IR technology. And fuzzy rule also implemented to classify the faults. The fault detection can be done at the real thermal images captured on a thermal camera. And the maintenance or action need to taken are based on the type of faults. The overall reliability and efficiency of the fault detection are increased. It will definitely helpful in future to maintain the solar panels for the longer lifespan. The different types of the faults that are identified in the solar photovoltaic cells are classified and the step to maintain the panels are classified. Then the samples for the different types of an faults are shown in following figures.

VI. CONCLUTION AND FUTURE WORK

By using the IR image and thermal image processing, the actual location of the fault in an solar panel and the types of fault in an solar panel also be detected. This method can find the clear difference between the normal and defective solar panels. So, this method has high efficiency and also saves the time. Fuzzy rule has used to make the diagnostic system very efficient and automatic process. And also the fault detection are done on the real IR images of the solar modules. In future the number of combination in the classification of the faults can be increased and more accurate.

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