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Sat/8/19

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Abstract ID: 15

A Study on Failure Judgement Method of Photovoltaic System based on Logistic Classification

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Abstract

Recently, there is increasing to take an interest in a new renewable energy, especially solar energy in Korea. In our existing research, we have implemented a real-time integrated monitoring system for maximum energy efficiency and heterogeneous devices of the photovoltaic system. This photovoltaic system can monitor the power generation status more than 25 plants in real-time monitoring. However, most of current monitoring systems have a problem that can know only after happening a wrong event. To solve this problem, we propose to adapt one of machine learning approaches to predict error by learning error data and patterns. In this paper, to find error prediction curve for effective energy construction, we use logistic classification that is one of the machine learning techniques on TensorFlow. These photovoltaic data are categorized into few error area and normal area. To learn more efficient is used Sigmoid instead of Linear formula. This approach may make it possible to predict and fix the photovoltaic system before a breakdown. It will be expected to be in the efficient and continuous operation of photovoltaic system.

Keywords: photovoltaic system, machine learning, tensorflow, classification

1 Introduction

In 2015, the capacity of newly added photovoltaic power generation facilities in the US has been reached 7,260MW. At the end of 2015, it is totaled 25.6GW. In addition, 29.5% of the total capacity of new power generation facilities is due to solar power generation. The global renewable energy market may expect to reach \$ 1 trillion by 2020[1]. In our existing research, we have integrated geothermal power plants with heterogeneous solar monitoring systems. Our current goal is to predict failure using machine learning.

In this paper, we can verify the fault data through the existing PV monitoring data [2] by using Logistic Classification among the machine learning techniques. By verifying the fault data, we are able to predict the failure of the photovoltaic power generation system.

The outline of this paper is as introduced below. Chapter 2 explains the solar power monitoring system and the tensor flow. Chapter 3 describes the method of predicting the failure of PV system by applying the machine learning method. Section 4 presents conclusions and future work.

2. Related Work

2.1. Photovoltaic Monitoring System

Photovoltaic systems use their own energy from solar panels or send them to power plants. Solar power monitoring systems can not only identify these solar power energy values, but also monitor information such as power, temperature and tilt sensors via inverters. Figure 1 shows the configuration of the PV monitoring system. In Figure 1, there are more than 10 local servers. The local server manages local solar energy generation. The local server transmits the monitoring data generated to the connection boxes and inverters using RS232 communication. The server that integrates them collects the converted data from the local server using TCP/IP communication that can manage all the data.

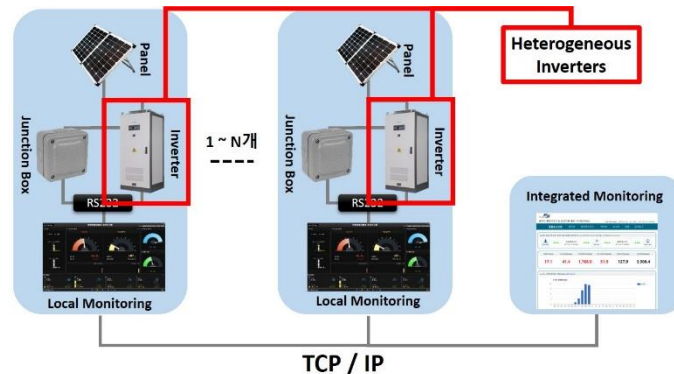


Figure 1 Configuration of the PV monitoring system

2.2. TensorFlow

The tensor flow represents the flow of the change of variables in a tensor, which uses multi-dimensional array. This tensor flow can also express in various ways through a data flow graph and operate in CPU / GPU mode without code modification. When we define only the calculation structure and the objective function, we can automatically process differential calculations.

3. Failure Prediction of Photovoltaic Monitoring System

3.1. Logistic Classification

There are about 90,000 pieces of data in PVS monitoring data as cvs file. The error code is 1 if there is an error, and 0 if not. When judging by 7 kinds of data conditions and an error is a prime number, there are many cases that there are no errors. Therefore, the machine learning technique used to predict the failure of PV system is logistic classification. When combined with PV data, a small number of error data (1) and a number of normal data (0) can be regressed with Sigmoid. Declare Hypothesis of logistic classification as $H(X)$. To minimize costs, use the following formula.

$$\text{cost}(W) = \frac{1}{m} \sum c(H(x), y)$$

$$C(H(x), y) = -y \log(H(x)) - (1-y) \log(1-H(x))$$

Where $\text{cost}(W)$ is the sum of hypothesis and cost of data. Hypothesis is set when this value is the minimum value. You must use GD algorithm to find the minimum value. However, since the cost diffuses when y is 0 and 1, the formula of $C(H(x), y)$ is used.

3.2. Failure prediction results using tensor flow

Figure 2 is a TensorFlow process. Figure 3 shows the result of the machine learning through the tensor flow on 100,000 runs, showing cost, Hypothesis, Classification result, and accuracy. Using the seven values, the accuracy of error code prediction was 0.999956, about 99.9%.

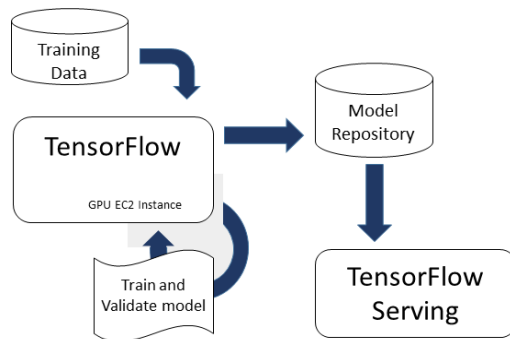


Figure 2 TensorFlow process

```

100000 0.00387555
Hypothesis:
[[ 1.02786534e-02]
 [ 1.02786534e-02]
 [ 3.95393636e-06]
 ...,
 [ 9.25221830e-05]
 [ 2.96149319e-05]
 [ 2.96149319e-05]]
Correct (Y):
[[ 0.]
 [ 0.]
 [ 0.]
 ...,
 [ 0.]
 [ 0.]
 [ 0.]]
Accuracy: 0.999956
  
```

Figure 3 The result of the machine learning

4. Conclusion and Future Works

In this paper, we propose a method to determine whether data is fault or not on when data is received by using Logistic Classification. The ratio of the fault data to the normal data is not similar in our existing data. The data is classified using sigmoid. We may expect that efficiency of solar power plant will be increased.

Now, we just have our existing data for a year. If the normal data range is not within the normal data range, we can predict the error. Therefore, we need to collect more data that are abnormal, and machine running will be more accurate.

Acknowledgements:

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References

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2. Hyun Seung Son and R. Young Chul Kim, "Modeling a Photovoltaic Monitoring System based on Maintenance Perspective for New & Renewable Energy", IJCC 2016, AACL 07, pp. 144-147, 2016.
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