A STUDY ON SOLAR PV POWER GENERATION INFLUENCING PARAMETERS USING CAPTURED DATA FROM FACULTY OF ENGINEERING, UNIVERSITY OF JAFFNA SOLAR MEASURING STATION

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ABSTRACT

A number of parameters such as solar irradiance, temperature, wind speed, wind direction and soiling are influencing the solar energy harvesting. It is essential to develop deeper understanding of the factors influencing the solar energy production in a particular region and have reliable models to forecast energy production. For this research study, Killinochi district was chosen as it has a lot of potential for solar PV, and solar thermal compared to other districts. In this paper, initially it was analysed how the weather data and solar irradiance vary on a daily and yearly basis. Subsequently, the correlation between individual weather parameters, solar irradiance and silicon voltage are studied. Pearson correlation estimation was used for correlation studies. Based on correlation studies, it was found that the solar parameters are influencing the solar power generation. After that, temperature variations were modelled using ARIMA modelling and the model were used to forecast the next hour data. Similarly, the diffused horizontal irradiance (DHI) and global horizontal irradiance (GHI) data can be forecasted using ARIMA modelling, and the next hour data can be predicted. Future study will include modelling of correlation between solar irradiance and temperature or humidity using support vector regression methods; and DHI and GHI will be forecasted based on weather data. These prediction models are useful for power generation entities and households. The effects of soiling on PV modules which vary with soil type, location and weather patterns will also be considered.

1. Introduction

Nowadays home owners and medium and large size investors are trying to have their own solar power plant. This trend has come as the capital investment for building solar power plant has significantly reduced and the utility is charging more when the electricity consumption is higher than 120 units. In order to build profitable power plant, a number of factors needs to be investigated: (1) how the weather parameters vary, (2) how the solar irradiance vary, (3) what's the correlation between weather parameters, and (4) forecasting solar irradiance by analysing weather parameters. All these parameters differ from site to site. Thus it is essential to measure the weather parameters and local solar irradiation to design profitable solar power plants. For our research study, we have chosen Killinochi district as it has a lot of potential for solar PV, and solar thermal compared to other districts. Hence, it is essential to develop deeper understanding of the factors influencing the solar energy production in this particular region and have reliable models to forecast energy production.

Faculty of Engineering, University of Jaffna has its own solar measuring station which was donated by Sri Lanka Sustainable Energy Authority (SLSEA) with the support of Asian Development Bank (ADB). The solar measuring station data logger captures temperature, wind speed, wind direction, humidity, air pressure, diffused solar irradiance, global solar irradiance, silicon voltage. The measuring station will continue to give valuable data to improve the understanding on solar energy production capabilities of the region and improve forecasting models.

Previously, Ituen *et al* investigated the global solar radiation using relative humidity, maximum temperature and sunshine hours in Uyo [2]. Jakub *et al* investigated the relation of irradiation values to the power load on a yearly and daily basis and how should photovoltaics (PV) be integrated in the Polish power system [3]. Lave *et al* found that the Wavelet Variability Model (WVM) can be used to simulate a PV plant anywhere a single high-frequency irradiance sensor exists [4,5]. This can greatly assist in module siting, plant sizing, and storage decisions for prospective PV plants. Mejia *et al* found that soiling, the accumulation of dust on solar panels causes a decrease in the solar photovoltaic system's efficiency [6]. Kleissl et al studied the solar resource variability, solar forecasting methods, simulating solar plant variability using irradiance data [7]. Cadenas *et al* investigated wind speed prediction using a univariate ARIMA model and a multivariate NARX model [1]. Cyril *et al* present a review of state of the art machine learning approaches to predict solar radiation including support vector regression which will be used in further studies [9].

In this paper, it is initially analysed how the weather data such as temperature, humidity, wind speed, pressure and solar irradiance varies on a daily and yearly basis. As all the weather parameters are not influencing power generation, subsequently the correlation between individual solar parameters and