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Solar Forecasting Analysis based on Regression Analysis and Classification Technique using Machine Learning

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ABSTRACT

The improvement of solar power plant output prediction will significantly simplify power system operation mode planning taking into market procedures and active power generation reserves allocation. As a case study the authors use meteorological data for a real operated solar power plant. As results of regression modeling the statistical significance of the meteorological parameters was analyzed. The optimal mathematical formulation of regression model was provided. In addition, the paper gives the idea of empirical cauterization approach, providing significant improvement of prediction accuracy. The results of the verification on real data allow deciding on the applicability of the proposed methods in industrial operation. The proposed solar forecasting analysis used machine learning SVM algorithm to predict the weather forecasting.

Keywords: Machine Learning, Weather Prediction, Languages and compilers, Optimization, Classification.

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I. INTRODUCTION

To achieve the forecasting model for solar power generation we need to have large amount of data to be processed. This data can be obtained from various solar power plants and can be used as dataset for further processing. Dataset should cover maximum parameters such as temperature, humidity, cloud cover, wind speed, power unit generated, date, time, etc. As there is no standard dataset for this, we will be using some dataset as collected data from solar power plants. This data will go through machine learning algorithms and can generate models on which current data and statistics are to be mapped to get predictions as forecasting for desired time period. The energy generation forecasting problem is closely linked to the problem of weather variables forecasting. Indeed, this problem is usually split into two parts, on one hand focusing on the forecasting of solar PV or any other meteorological variable and on the other hand estimating the amount of energy that a concrete power plant will produce with the estimated meteorological resource. In general, the way to deal with this difficult problem is usually related to the spatial and temporal scales we are interested in, which yields to different approaches that can be found in the literature.

Problem Statement:

The rapid increase in solar power plant installed capacity leads to considerable difficulties in terms of power system operation and control, resulting from highly stochastic nature of solar energy harvesting. The paper considers the problem of day ahead solar power plant output forecasting, based on the meteorological data. The improvement of solar power plant output prediction will significantly simplify power system operation mode planning taking into market procedures and active power generation reserves allocation.

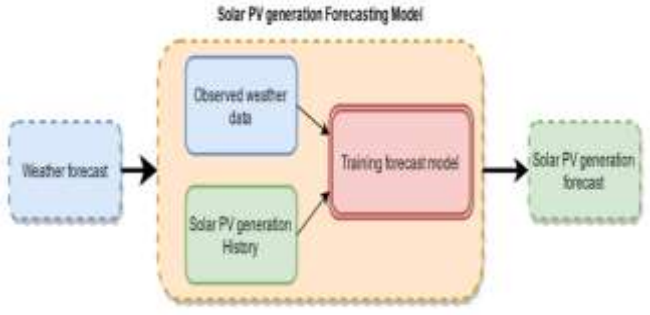

Fig 1. Typical solar PV generation forecasting process

II. LITERATURE SURVEY

[1]Denis A. Snegirev, Stanislav A. Eroshenko, Alexandra I. Khalyasmaa, Valeria V. Dubailova, Alina I. Stepanova during this paper, The rapid increase in solar power plant installed capacity leads to considerable difficulties in terms of power system operation and control, resulting from highly stochastic nature of solar energy harvesting. The paper considers the problem of day-ahead solar power plant output forecasting, based on the meteorological data. The improvement of solar power plant output prediction will significantly simplify power system operation mode planning taking into market procedures and active power generation reserves allocation. As a case study the authors use meteorological data for a real operated solar power plant. As a results of regression modelling the statistical significance of the meteorological parameters was analyzed. The optimal mathematical formulation of regression model was provided. In addition, the paper gives the idea of empirical cauterization approach, providing significant improvement of prediction accuracy. The results of the verification on real data allow deciding on the applicability of the proposed methods in industrial operation.

[2] Graeme Vanderstar, Petr Musilek, Alexandre Nassif, in this work it is the need to accurately forecast available sola irradiance is a significant issue for the power industry and poses special challenges for utilities who serve customers in isolated regions where weather forecast data may not be abundant. This paper proposes a method to forecast two hour ahead solar irradiance levels at a site in Northwestern Alberta, Canada using real-time solar irradiance measured both locally and at remote monitoring stations. This paper makes use of an Artificial Neural Network (ANN) to forecast the solar irradiance levels and uses the genetic algorithm to determine the optimal array size and positioning of solar monitoring stations to obtain the most accurate forecast from the ANN. The findings of this paper are that it is possible to use as few as five remote monitoring stations to obtain a near-peak forecasting accuracy from the algorithm and that providing adequate geospatial separation of the remote monitoring sites around the target site is more desirable than clustering the sites in the strictly upwind directions

[3] Fatih Serttas, Fatih Onur Hocaoglu, Emre Akarslan, during this study, Photovoltaics' (PV's) are widely preferred in electricity generation market in recent years. However many parameters effect solar power generation such as irradiance, temperature, humidity etc. Therefore, solar power generation forecasting is quite significant to plan and manage energy distribution. In this study, a novel methodology called Mycielski-Markov is utilized to forecast solar power generation for short term period. This novel hybrid method is developed based on two different techniques; Mycielski signal processing technique and probabilistic Markov chain. Mycielski investigates the data history and finds the recurrence of the solar radiation data. It predicts the next data due to the recurrence in a deterministic way. On the other hand, Markov produces the transition probabilities of the solar energy states and forecast new state according to these probabilities. It is obtained that, the methods in proposed hybrid hierarchy; provide a good forecasting accuracy with a 0.87 correlation of determination value.

[4] Hossein Panamtash, Qun Zhou, Solar power has been growing rapidly in recent years. Many countries have invested in solar energy technology, especially in Photovoltaic (PV) power generation. With the increased penetration level, solar power forecasting becomes more challenging. To cope with solar power uncertainties, probabilistic forecasting provides more information than traditional point forecasting. Moreover, multiple PV sites with spatial-temporal correlations need to be taken into account. To produce probabilistic forecasts, this paper applies quantile regression on top of time series models. Considering the coherency among multiple PV sites, a reconciliation is applied using a copula-based bottom-up method or proportion-based top-down method. Numerical results show that the proposed methods efficiently produce accurate and coherent probabilistic solar power forecasts.

[5] M. Z. Hassan, K.M.E. Ali, ABM Shawkat Ali, Jashnil Kumar, in this work, Unpredictability of solar resource poses difficulties in grid management as solar diffusion rates rise continuously. One of the big challenges with integrating renewables into the grid is that their power generation is intermittent and unruly. Thus, the task of solar power forecasting becomes vital to ensure grid constancy and to enable an optimal unit commitment and cost-effective dispatch. Latest techniques and approaches arise worldwide each year to progress accuracy of models with the vital aim of reducing uncertainty in the predictions. This paper appears with the aim of compiling a big part of the knowledge about solar power forecasting, focusing on the most recent advancements and future trends. Firstly, the inspiration to achieve an accurate forecast is presented with the analysis of the economic implications it may have.

III. PROPOSED SYSTEM

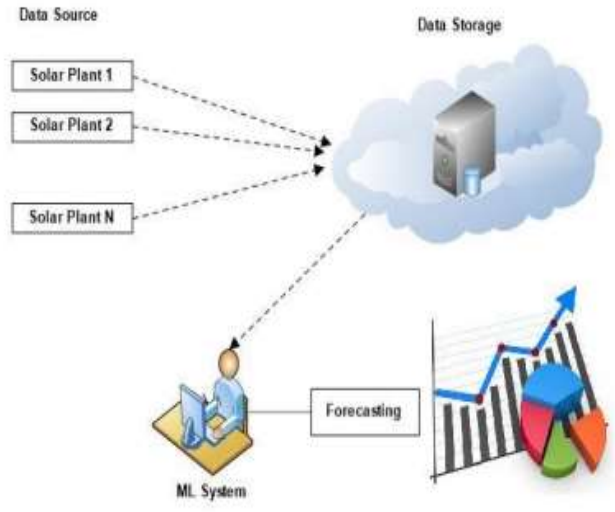

Fig 2. System Architecture

A. Description:

The energy generation forecasting problem is closely linked to the problem of weather variables forecasting. Indeed, this problem is usually split into two parts, on one hand focusing on the forecasting of solar PV or any other meteorological

variable and on the other hand estimating the amount of energy that a concrete power plant will produce with the estimated meteorological resource. In general, the way to deal with this difficult problem is usually related to the spatial and temporal scales we are interested in, which yields to different approaches that can be found in the literature.

In this sense, it is useful to classify these techniques depending on the forecasting horizon, so it is possible to distinguish between nowcasting (forecasting 3–4 hours ahead), short-term forecasting (up to 7 days ahead) and long- term forecasting (months, years...). To achieve the forecasting model for solar power generation we need to have large amount of data to be processed. This data can be obtained from various solar power plants and can be used as dataset for further processing. Dataset should cover maximum parameters such as temperature, humidity, cloud cover, wind speed, power unit generated, date, time, etc. As there is no standard dataset for this, we will be using some dataset as collected data from solar power plants. This data will go through machine learning algorithms and can generate models on which current data and statistics are to be mapped to get predictions as forecasting for desired time period.

B. Flow Diagram

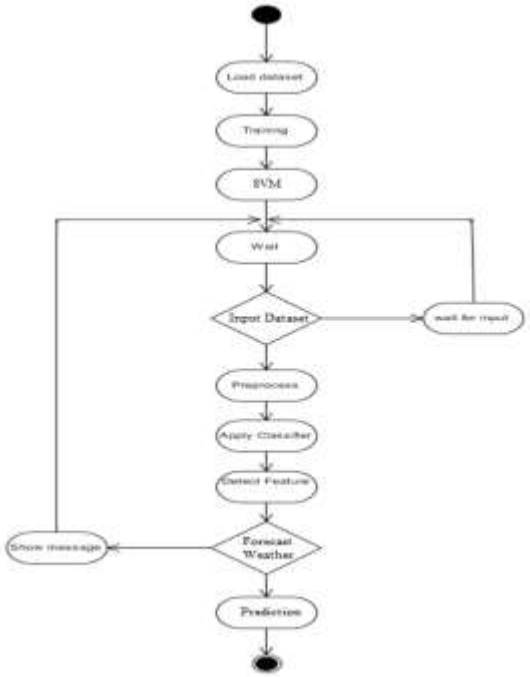

Fig 3. Flow Diagram

C. Mathematical Model

Let S be the closed system defined as,

S = {Ip, Op, A, Ss, Su, Fi}

Where, Ip=Set of Input, Op=Set of Output, Su= Success State, Fi= Failure State and A= Set of actions, Ss= Set of user's states.

• Set of input=Ip={username, password}
• Set of actions =A={F1,F2,F3} Where,
F1= Authentication of user
F2 = Input the dataset
F3= This result show and stored the database

• Set of user's states=Ss={registration state, login state, selection dataset, prediction logout}

• Set of output=Op={Show results}
• Su=Success state={Registration Success, Login Success }

• Fi=Failure State={Registration failed, Login failed}

• Set of Exceptions= Ex ={Null Pointer Exception while registration state, Record Not Found (Invalid Password) while login state , Null Values Exception while showing state}

IV. ACKNOWLEDGEMENT

I wish to express my profound thanks to all who helped us directly or indirectly in making this paper. Finally, I wish to thank to all our friends and well- wishers who supported us in completing this paper successfully I am heartily thankful to my project guide for his valuable guidance and inspiration. In spite of their busy schedules they devoted their self and took keen and personal interest in giving us constant encouragement and timely suggestion. Without the full support and cheerful encouragement of my guide, the paper would not have been completed on time.

V. CONCLUSION

In this paper, we propose a solar energy forecasting model with Machine Learning algorithm.

In order to train the machine learning model, regression analysis and time series analysis is used.

This system is useful in to improve the efficacy of solar plant.

VI. REFERENCES

[1] Day-ahead Solar Power Plant Forecasting Accuracy Improvement on the Hourly Basis- Denis A. Snegirev, Stanislav A. Eroshenko, Alexandra I. Khalyasmaa, Valeria V. Dubailova, Alina I. Stepanova-2019.

[2] Solar Forecasting using Remote Solar Monitoring Stations and Artificial Neural Networks - Graeme Vanderstar, Petr Musilek, Alexandre Nassif- 2018.

[3] Short Term Solar Power Generation Forecasting: A Novel Approach- Fatih Serttas, Fatih Onur Hocaoglu, Emre Akarslan- 2018.

[4] Coherent Probabilistic Solar Power Forecasting- Hossein Panamtash, Qun Zhou- 2018.

[5] Forecasting Day-ahead Solar Radiation Using Machine Learning Approach- M. Z. Hassan, K.M.E. Ali, ABM Shawkat Ali, Jashnil Kumar- 2017.

[6] Learning Solar Flare Forecasting Model from MagnetogramsXin Huang, Huaning Wang, Long Xu, Wenqing Sun- 2017.

[7] Solar Power Forecasting Using a Hybrid EMD-ELM Method- Irani Majumder, Manoja Kumar Behera, Niranjan Nayak2017.

[8] Algorithmic Realization of Short-term Solar Power Plant Output Forecasting- D. A. Snegirev, S. A. Eroshenko, R. T. Valiev, A. I. Khalyasmaa- 2017.

[9] Solar Forecast Reconciliation and Effects of Improved Base Forecasts- Gokhan Mert Yagli, Dazhi Yang, Dipti Srinivasan, and Monika- 2017.

[10] Data-Analytic-Based Adaptive Solar Energy Forecasting Framework- Yashar Sahraei Manjili, Rolando Vega, Mo M. Jamshidi- 2017.

