SYSTEM FOR PHOTOVOLCAIC PANELS SOILING ANALYSIS

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Предложено и реализовано приложение, обрабатывающее статистические данные параметров электростанции и производящее анализ запыленности солнечных панелей. Данный анализ направлен на улучшение процесса диагностики солнечных панелей в рамках концепции цифрового двойника (Digital Twin) и направлен на оценку величины деградации солнечной панели за счет запыления с течением времени. Приложение генерирует различные виды обработанных данных в виде CSV файлов, позволяющих проанализировать характер изменения эффективности солнечной панели.

Application is written in Node.JS and uses statistical data from real solar PV power plant located in Nurnberg, Germany. Soiling is one of the major PV panel's contamination factor, especially in areas with arid climate. Soiling includes a lot of sub-factors which were studied and classified in Malaysia [1].

CSV reports are generated for various types of processed data and parameters. Data filtering includes irradiation filter (range between 875 and 925), temperature filter (range between 40 and 60 celcius degrees) and current lower border filter (only points with current higher than 2A) [2]. Median filter is applied to all remaining data points.

CSV reports are combined into two major modules depending on raw or filtered data is used for further processing.

Module with raw data includes Rainy Days and Monthly Wh sections. Rainy Days section estimates days with precipitations based on panel's parameters trend over the time [3]. Sequences of days with positive trend in current and power efficiencies are calculated and then applied to Weather API results for verification. MonthlyWh produces simple CSV file with cell's productivity calculated divided by months.

Second module with filtered data includes Params by Days/Weeks/Months, Average Params, Multi-Date Params, Diff and Division Params. Params by Days/Weeks/Months CSV reports provide ability to examine cell's degradation over specific periods of time. Average Params CSV reports include data aggregated by days and averaged values of parameters from all data points of this day. Multi-Date Params reports contain params which are structured by days and by time of the day simultaneously. Report includes data structured as separate plot of current values for each day with 15 minutes intervals of time. Most of the subplots would have some missing points due to filtering which doesn't affect the results for this particular section. Plot based on such report allows to find some days with abnormal values for future investigation and filtering improvements (fig. 1). Most of the lines should converge into similar pattern.
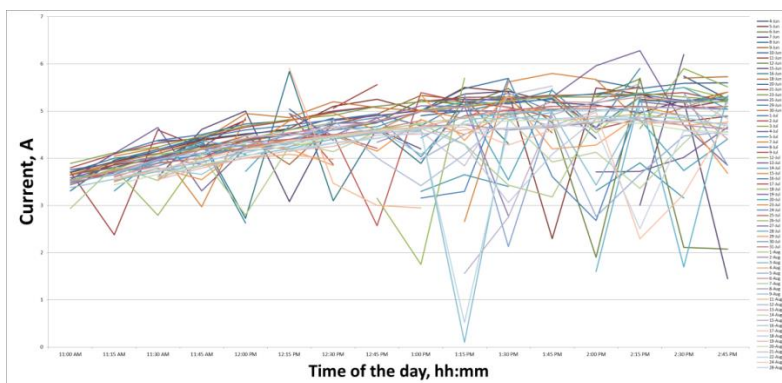
Diff and Division Params reports contain params with additional processing for current and power efficiency params and allow to create plots using relative and normalized on average efficiency values which provide better view on performance changes due to panel's soiling degradation over time. Further soiling level could be estimated using these params as degradation percentage.

Figure 1 – Multi-Date params plot for Module from String 1.1

References:

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3. Osipovich V.S., Asimov R.M., Chernoshey S.V. Digital twin in the Analysis of a Big Data // Collection of materials of the IV International Scientific and Practical Conference «BIG DATA and ADVANCED ANALYTICS», May 3–4, 2018, Minsk, BSUIR, pp. 69–78.