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Data Management for Performance Analysis of Renewable Power Generation Systems

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Abstract

In the area of renewable power generation the number of small power generation systems like photovoltaic plants or wind turbines has been increasing during the last years. In order to determine the electrical energy generated by the systems, to analyze their performance and reliability and to detect malfunctions at an early stage it is necessary to install and to operate a measurement and information system. One key component of such a system is a tool for managing the master and measurement data of renewable power generation systems that is described in this paper.

1. Introduction

One important functionality of a software system for analysing the performance of renewable power generation systems is the management of measurement data delivered by the control and monitoring equipment of the different power generation systems and other systems e.g. meteorological stations. These data are very heterogeneous in format, origin and quality. Therefore the data management and harmonization is a complex task, especially a large number of power generation systems has to be managed.

This paper describes a tool for managing these measurement data and the master data about power generation systems. It is developed for companies like Saarbrücker Stadtwerke AG running a lot of different renewable power generation systems. This company for example has seven photovoltaic systems, one fuel cell, some wind turbines, a few hydroelectric power plants and several block heat and power plants. The data management tool provides a platform for other application systems e.g. analysis or simulation tools which are used for the performance analysis.

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2. System Architecture

Figure 1 shows the overall architecture and the environment in which the data management tool is used. The tool is a software system offering the functionality for maintaining and importing the relevant data which are stored in a database. Each power generation system has its own data-logger that is part of its control and monitoring equipment. Several sensors deliver about 100 measurement data records each day. A data-logger can store these measurement data from 20 to 70 days. At the moment the data are recalled in a defined time interval by an operator and are stored on a central server in its own format. Using the data management and integration tool the data are harmonized and imported into the database. Subsequently, users can have access to the data. The tool is based on a client/server architecture with a mySQL 4.0.17 database system. The client offers a graphical user interface which is programmed in Microsoft Visual Basic 6.0.

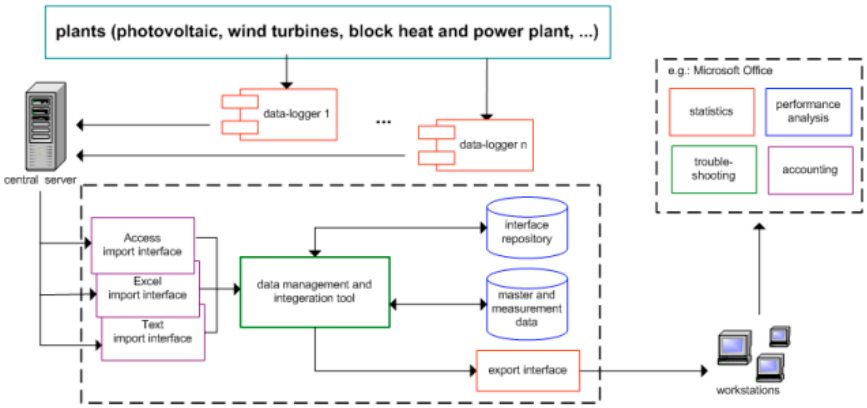

Figure 1
Overall architecture of the system

The graphical user interface allows the user to manage the master data, especially to add new master data and to change existing data concerning plants, locations, components, data-loggers, contact persons and others. For instance attributes stored for a data-logger are its type, its serial number, the capacity of its memory and the time interval in which the data is logged.

Usually different data-loggers are in use, e.g. (GÖRLITZ AG 2004, Mita Teknik AG 2004, SMA Regelsysteme GmbH 2004), delivering the measurement data in different data formats. Typical formats are ASCII text files, Microsoft Excel files or Microsoft Access files. Due to this fact and missing standards the management and integration of measurement data is a complex task. Our system supports this task by

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a flexible and configurable interface. The graphical user interface allows the user to enter the configuration data. For instance the user can decide which values should be imported and stored in the database. Some examples for possible values are the electric power, the energy, the global radiation or the temperature.

Another feature of the tool is the export of existing measurement data in uniform formats. By using other tools, e.g. Microsoft Excel or SPSS, the data exported by the data management tool can be analyzed. At the moment our tool is based on Microsoft Excel 2000. Figure 2 shows an example of an analysis.

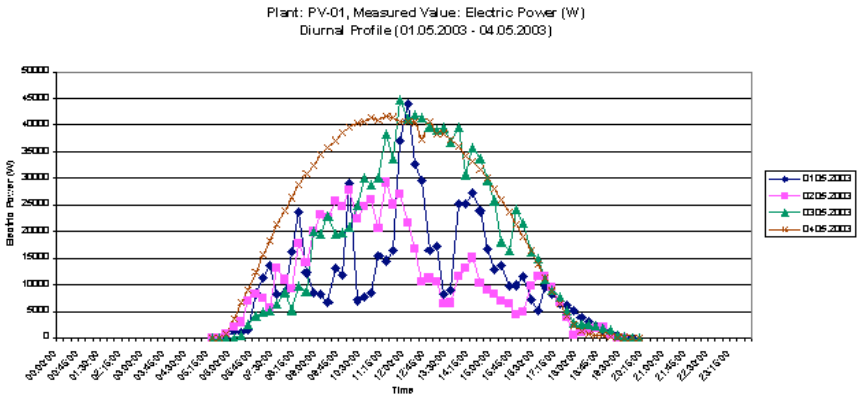

Figure 2
Diurnal profile from the electric power of a photovoltaic plant

3. Conclusions

The system described allows companies to manage the relevant master and to import measurement data for the performance analysis of renewable power generation systems. It provides a platform for the development of tools for analyzing and visualizing performance data of renewable power generation systems. The development of such tools, e.g. for trouble-shooting, forecasting of energy production depending on weather forecast data and reference analysis based on other plants of the same type will be subject of further research.

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