Advances in Engineering Software 67 (2014) 125–135

Contents lists available at ScienceDirect

Advances in Engineering Software

journal homepage: www.elsevier.com/locate/advengsoft

Software architecture knowledge for intelligent light maintenance

Bernard Kamsu-Foguem *, Yvan Mathieu

Laboratory of Production Engineering (LGP), EA 1905, ENIT-INPT, University of Toulouse, 47 avenue d'Azereix, BP 1629, 65016 Tarbes Cedex, France

ARTICLE INFO

Article history:
Received 9 July 2013
Received in revised form 10 September 2013
Accepted 12 September 2013
Available online 6 October 2013

Keywords:
Conceptual modeling
Industrial maintenance
Semantic formalization
Web mapping service
Architectural pattern
Information system

ABSTRACT

The maintenance management plays an important role in the monitoring of business activities. It ensures a certain level of services in industrial systems by improving the ability to function in accordance with prescribed procedures. This has a decisive impact on the performance of these systems in terms of operational efficiency, reliability and associated intervention costs. To support the maintenance processes of a wide range of industrial services, a knowledge-based component is useful to perform the intelligent monitoring. In this context we propose a generic model for supporting and generating industrial lights maintenance processes. The modeled intelligent approach involves information structuring and knowledge sharing in the industrial setting and the implementation of specialized maintenance management software in the target information system. As a first step we defined computerized procedures from the conceptual structure of industrial data to ensure their interoperability and effective use of information and communication technologies in the software dedicated to the management of maintenance (E-candela). The second step is the implementation of this software architecture with specification of business rules, especially by organizing taxonomical information of the lighting systems, and applying intelligence-based operations and analysis to capitalize knowledge from maintenance experiences. Finally, the third step is the deployment of the software with contextual adaptation of the user interface to allow the management of operations, editions of the balance sheets and real-time location obtained through geolocation data. In practice, these computational intelligence-based modes of reasoning involve an engineering framework that facilitates the continuous improvement of a comprehensive maintenance regime.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

1.1. Objective

A French Engineering/Construction company spent a maintenance contract with Pulp and paper manufacturer, manufacturing paper sheets in a commune of the Haute-Garonne department in southwestern France. The contractual objective was to maintain at least 80% of the lighting places in operating condition, which means managing 15,000 spotlights. Disturbances in the light management system have severe impacts on company critical functions and its critical infrastructures. Hence, there is a need for an approach to intelligent maintenance analyses, which assists maintenance analysis of outages in the light management system and enables investigation of cascading failures and consequences in other infrastructures [19]. An important defy associated with the systemic view may be to create major scenarios for the analysis of interdependencies within critical infrastructures [5]. The engagement of an interoperability approach assessing the dependencies among sub-areas demonstrates a valuable benefit in terms of resilience analysis [4]. In addition, the access to information and shared operating experience can exist with obtainable cross-fertilizations between safety and security engineering tools and methodologies [26].

Maintenance management information systems are indispensable to ensure control, gain knowledge and improve decision making [8]. The first step was to define the computerized procedures from conceptual structure of (formatting data that is calculated before in the Excel spread sheet) industrial data to ensure their good use, dedicated to the software maintenance management (E-candela). The second step was the setting, adapting the interface and implementation of the database of the software to allow contextual adaptation. And finally, the third step was to use the software, management of operations, editions of the balance sheets and geolocation. So, the software maintenance management employs contextual characterizations of situations to provide more relevant services or information to support users performing their tasks [31]. Likewise, it is possible to employ text mining approaches to classify material or immaterial resources into various categories based upon their geospatial features, with the aims to discovering relationships between resources and geographical zones [22]. Such

* Corresponding author.
E-mail address: Bernard.kamsu-foguem@enit.fr (B. Kamsu-Foguem).

0965-9978/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.advengsoft.2013.09.003

method can detect real-time and geospatial event features for awareness of large-scale events and risk management [23] with pervasive computing for continuous location and resources monitoring [29].

1.2. Related works

Intelligent lighting systems have been described in the literature; there are some examples using the ZigBee remote sensing and management system [30]. The system comprises a group of measuring stations in the street and a base station positioned nearby [21]. The combination of ZigBee with others technologies (e.g. statistics of traffic flow magnitude, photosensitive detector (LDR), infrared photoelectric control) allows fault detection and feedback circuit to indicate the present state of the control system [32]. Hence the integrated framework permits ease of maintenance and substantial energy savings with improved performance. The method of group decision making can be incorporated to enhance the anti-interference capability and the intelligence level of the lighting control system [35]. In another domain, particularly an agricultural application, Olvera-Gonzalez et al., have proposed a LED (Light Emitting Diode)-based intelligent lighting system for plant growth [25]. Their intelligent illumination system (ILSys) examines changes in the chlorophyll fluorescence in different pulsed light treatments. Also, in the context of traffic safety with significant energy conservation, a fuzzy control procedure has been designed for tunnel lighting energy control systems [34]. However, the described applications are specifically fitting for street lighting in remote urban and rural areas. In contrast, our study involves examining an intelligent lighting system in an industrial setting for which installations are exposed to severe operating conditions, such as high temperature, projection of sparks and chemical irritants (air pollution and lubrication). A formal methodological framework has an important role to play in strengthening the industrial applications and increasing practical opportunities to support the development of intelligent environments [1]. More recently, Konrad Kułakowski et al. propose simulation experiments that allow testing the correctness of the design of the lighting inspection robot behavior model in the context of Knowledge-Behavior-Platform architecture [20]. This illustrates the need to add a knowledge dimension to the rationale behind methods for design and control of intelligent lighting systems. In our approach, we also introduce some semantic modeling characteristics [15], allowing us to achieve comprehensive reasoning mechanisms in our modeling processes with knowledge management dimension, thus facilitating information sharing and improving contextual adaptations.

2. The conceptualization for supporting maintenance processes

2.1. Proposition of the architecture for a generic model

We propose the conceptualization of a generic model for supporting and generating street lights maintenance processes. This model is based on a fully modular architecture to allow a certain level of suppleness in varying settings, making the information structuration and meta-data management by incremental mappings easy. The proposed architecture is conceptualized to provide a meaningfully more consistent organization (see Fig. 1).

The architecture is built as an assembly of a storage resource management and module layers, implementing different services useful for logical maintenance management. This development is entirely independent to the applications using the generic infrastructure. There are four types of modules: the data collection module acquires the data from target equipment, the data processing module computes operational data, the information visualization module display data with images and the supervisor module controls architecture's behavior (start, stop and watchdog actions). Storage resource management includes optimizing the effectiveness and swiftness to allow better functionality and more advanced communications with interoperability requirements. The storage layer answers requests from other modules, informs the modules of updates and assures appropriate information exchanges between them with a dedicated network protocol and needed mechanisms of data structuration. With this generic model the specialized infrastructure can address some of the most difficult maintenance management challenges in the lighting sector. This includes the very different needs for lighting quality required by the industrial processes which often call for data warehousing, data mining, decision support and alert evaluation [14].

2.2. Software architecture modeling with the ECANDELA G2

ECANDELA G2 is a management software for the lighting place, developed by ATLOG. This software is adapted to the management of public lighting. It is complex software developed since 1995 by ATLOG very rich in resources for public lighting. His features are: fleet management across an organization in the form of sheets, it is possible to keep up to date the technical points of light, materials, control cabinets,. . ., common interface between the database and mapping. It allows simplified entry of data, management consulting and customized user will facilitate to access the data by assigning access rights (filter on the common setting input masks by user, business functions or accessible (not entered, modification, access to interventions)) by user profile tools formatting data to allow export of office tools for statistics and reporting formats. There are management tools which follow interventions from the application to the work performed. Ecandela software should allow the process shown below.

Software design patterns can lead to a methodological framework for improving interactive system architectures, and these patterns support the integration of usability in the software design process [9]. Design patterns such as Model-View-Controller (MVC) allow the interactive system architecture to be partitioned between the user interfaces and underlying functionalities [7]. MVC is an architectural pattern that separates the representation of information from the user's interaction with the different architecture components. The MVC components are defined in the following manner: the model is the application object, the view is the screen presentation, and the controller defines the way the user interface reacts to user input [33].

Fig. 2 delivers a better visibility of the software functions which is achieved through sets of intuitive specifications of the interactions between its components:

- The controller's role which is to do the operations (algorithmic calculations and tests) on the data (modeling the equipment (e.g. lighting and equipment) that are the subject of maintenance. It allows among others to calculate the age of the lamps and the date of next relamping (changing lamps).
- The model includes the database with all the references, types, brands and names of the lighting zones and workshops. It also includes ways of modeling syntax settings (data format) and semantic (content conveyed by the data).
- The view contains all the elements constituting the interface (architecture park lighting), mapping, a spread sheet that is containing the list of devices in the lighting place, and editing spreadsheets. The view shows all the elements that are intended to encourage user interaction with the system.

On the network architecture that is a client–server architecture, in which the server and client machines connected to the computer

Download English Version:

https://daneshyari.com/en/article/567472

Download Persian Version:

https://daneshyari.com/article/567472

Daneshyari.com