E-management system Design for inspection and supervision of massive transportation system construction

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Abstract:- In this work it is presented a web-based computational system design for the inspection and supervision of the Trolley bus construction given in Mérida, Venezuela. This system permit to the three parts involved in the construction (government, construction company and inspection group) to have access every where to the information concerning the state of the works, financial aspects, quality control issues, meetings and special events. This system presents graphs, images and videos of the principal working places.

Key Words:- E-management, Inspection, Massive transportation, Trolleybus.

1 Introduction

Articulated Trolleybuses [1, 2] are massive transportation units that can carry up to 140 persons (more than the double of a typical bus) and is designed to have mostly-exclusive roadway and priority at traffic signals. In financial terms, the Trolley coach is clearly the most cost effective 'green' public service vehicle available [7]. The kind of Trolley bus being built in Mérida, Venezuela has both an electric and a diesel motor and is going to be used for public transportation in 18.4 kilometers route.

The administration of the Trolley buses, including the construction works is done by a Venezuelan Government autonomous institute (Insituto Autónomo Trolebús de Mérida [3]) and the inspection is given by the CITM consortium [6] between the local university (Universidad de Los Andes [4]) and a private company (Grupo AM C.A. [5]).

In this paper it is presented the E-management system designed for the inspection and supervision of the Merida's Trolleybus civil and electro-mechanical works, which allows, in an easy and effective way, to the user the tracking and status determination of the construction. The work is organized as follows: In section 2 it will be presented some basements concerning construction inspection. Then, section 3 will contain the Description of the designed system and section 4 will present the corresponding Conclusions.

2 Construction Inspection

Construction inspectors have to examine the construction, alteration, or repair of buildings, highways and streets, sewer and water systems, dams, bridges, and other structures to ensure compliance with building codes and ordinances, zoning regulations, and contract specifications [9].

There are many types of inspectors, some of them are:

- Building inspectors
- Plan examiners
- Electrical inspectors
- Elevator inspectors

- Mechanical inspectors
- Plumbing inspectors
- Home inspectors
- Specification inspectors

In Venezuela the inspection responsibilities and regulations have been defined by the government under "General contracting conditions for construction execution" (government decree 1417) [11]. In particular, massive transportation inspection involves a lot of job places at the same time, subcontratist and diverse areas (civil, electromechanical, control operational center, budget, planning, etc.), so it is important to use the computational resources in order to assist each of these areas.

3 Designed web-based system Description

One of the most important responsibilities of the inspection is to verify and supervise the execution plan, including field works and payment issues. For that reason is important to have web-based information concerning the construction and building state, which can be accessed by any person related to the work and anywhere.

People from the institute can verify the works that are being done in any moment including images and videos. Also, they can verify the original activities plan and the real one in order to take appropriate decisions concerning new plans or payment orders.

The inspection consortium can use this information for verify all the places where the works are given and the kind of jobs that are being done; it can be used also for planning new works and requirements. Inspection can also verify the places where each of the inspectors is located.

The construction company can also verify the building state and important issues determined by the inspection.

All organizations have access to the meetings agendas, technical reports, images and videos.

The Web-based system is organized in a set of marks (frames) that facilitate the navigation. It can be seen in figure 1, that the main page has a navigation bar in the superior frame, which guarantees to the user the connection to this bar from any site of the page. All the connections are loaded in the central frame. These connections constitute the static modules of the system that contains information of the inspection consortium organizational structure (figure 2). These static modules were codified in HTML.

Additionally, the system has two dynamic modules programmed in php, by means of which the archives of the system are administered, these modules are:

- Administration
- Private Access

The Administration module allows to the Web site administrator to upload files to the Web server, therefore the documents, images and video that the inspection generates are added to the page by means of a file manager, that facilitate and make agile the update of the page, since it provides an easy manipulation environment, similar to the Windows Explorer, where the user selects the files to incorporate in the respective folders.

The Private Access module (figure 3) allows to visualize the files that the administrator has upload to the server, the users of this service only can visualize, they do not have privileges to modify the files.



Figure 1. Inspection Consortium Presentation page



Figure 2. Inspection consortium organization

When the person with the appropriate access verification can reach the private site, it can be found information regarding the bridges construction evolution (figure 4), the highways and streets construction evolution (figure 5), electrical substation construction evolution (figure 6), among others.



Figure 3. Security access to inspection information.



Figure 4. Bridge construction evolution.



Figure 5. Highways and street construction evolution

The dynamic modules incorporate a new frame located to the left; this contains the connections to documents like weekly reports, monthly reports, images, work supervision and control, among others.



Figure 6. Electrical substation construction evolution

It is also presented some graphs that show the budget execution state, working delays, working state in every place, etc. (see figure 7).

It also can be found the inspection reports that are presented to the institute weekly and monthly (figure 8). It can be found the meeting agenda and agreements, organized by date or by area. Inspector can also download the forms used in their daily work.



Figure 7. Working state graph.



Figure 8. Inspection reports by week or month

4 Conclusions

Construction and building inspection is an important task, because it should guarantee that the works are being done according to the project, in the planned time, using the appropriate materials and equipments and according to quality control requirements. Also, inspection should verify that the works are doing according to all the government and international regulations and agreements.

In Mérida, Venezuela it is being constructed an articulated trolleybus as a solutions for massive transportation in the city and the regulation of these work is being done by and government institute and the inspection is hold by an consortium between the Universidad de Los Andes and a private company.

In this paper was presented the design for a webbased e-management system for inspection of the trolleybus construction, with a pleasant and very simple graphic user interface.

The essential advantage of the Web-based system is the information availability, in addition to the capability for updating the information every day, allowing detecting problems in the work advance and facilitating the decision making.

The designed system can be used by persons in the government institute, constructing company and inspection consortium, so it can be shared the relevant information and can be consolidated. This can help in time, resources and quality of the developing construction.

5 References

- [1] <u>http://www.trolleybus.net</u>
- [2] http://www.tbus.org.uk
- [3] <u>http://www.trolmerida.net</u>
- [4] <u>http://www.ula.ve</u>
- [5] <u>http://www.grupoam.net</u>
- [6] <u>http://www.humanidades.ula.ve/citm</u>
- [7] <u>http://www.tbus.org.uk/economics.htm</u>
- [8] <u>http://www.eastbrunswick.org/municipal/</u> <u>PlanningAndEngineering/construction_inspection.asp</u>
- [9] <u>http://www.bls.gov/oco/ocos004.htm</u>
- [10] <u>http://www.iami.org/aci</u>
- [11] Decreto Nº 1417. Condiciones Generales de Contratación para la Ejecución de Obras. Gaceta Oficial de la República de Venezuela 5.096. September 1996.