A Web-Based Geographical Road Project Monitoring and Information System for the Department of Public Works and Highways - Cagayan De Oro District, Philippines

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Abstract—The Department of Public Works and Highways (DPWH) Cagayan de Oro District 1 and 2 is one of the regional offices of the DPWH that responsible for all the projects in the field of public works, maintenance of the city road network and irrigation system. The office is also responsible for implementing transparency on its project information through released and accessed by the public. However, most of the accomplished and on-going road projects information is not highly available and not easy to navigate in the current website.

Considering many road projects information requires it to be reliable, updated, relevant and easily accessible. A web-based geographical system as new approach is introduced in this study. The purpose of this study is to design and develop a program application that could provide information about the road projects in a more detailed and informative way that can be easily accessed by the public.

Usability test was used to evaluation the application. Based on the results, the visual clarity, consistency, and effectiveness of the project are rated as excellent. The information is presented in clearer and more satisfying view.

Index Terms—DPWH, Road projects, web-based, web mapping

I. INTRODUCTION

Roads and Highways are cornerstones of any nation’s infrastructure. For centuries, roads and highways have carried people, goods and ideas from one corner of the earth to another. Roads are identifiable routes or paths between two or more places. They are typically smooth, paved, or otherwise prepared to allow easy travel. Historically, many roads were simply recognizable routes without any formal construction or maintenance [1]. It is the responsibility of the designated executive department of the government to build and maintain quality roads and highways, maximizing public convenience [2].

The Department of Public Works and Highways is the executive department of the Philippine government responsible for all the projects in the field of public works. It is responsible for the maintenance of the Philippine road network and irrigation system. DPWH is also responsible for collecting, storing, retrieving, managing, analyzing and presenting the data to the public.

Many development projects have serious dependence on transport network. Authentic information on the transport infrastructure is fundamental requirement for many decision making process [3]. Therefore information requires it to be reliable, updated, relevant and easily accessible. This demand for information requires new approaches in which data related to transportation network should be identified, collected, stored, retrieved, managed, analyzed, communicated and presented. Considering the complexities in developing, updating and processing of the transport related data, there is an urgent need to adopt new concepts and technologies for designing and developing the information resource management of transport infrastructure in the city[4][5]. Therefore, the development in the field of information technology is especially relevant to the field of transportation engineering.

Web mapping is the process of using maps delivered by geographical information systems. The locations can be express in many different ways, such as latitude and longitude, address, or ZIP code. Many different types of information can be compared and contrasted [6]. Web Mapping clearly promises many great benefits to DPWH and to its functionality. Web mapping can be a great help in its aim to inform the citizens about their road projects as well as to build positive relations with the citizens it is serving [7].

Here in Cagayan de Oro, the DPWH consists of two districts. The 1st District office is located at RES Compound, Barangay Bulua while the 2nd District is at Barangay Puntod. The first district’s area of responsibility starts from the roads of Barangay Iponan to the Cagayan de Oro River while the second district starts from the Cagayan de Oro River to Syre Highway.

II. METHODOLOGY

2.1 Designing the graphical user interface

The first step during the creation of the website is performing a research. Getting an understanding of the client’s needs and others through thorough examination and brainstorming to learn more about the subject that is to be expose on the site is the first thing to do. There is a need to a keen gathering of information as much as possible to help develop an outline for the site and also for its design when meeting with the client. This includes asking about the target audience, goals, creative direction and other variables that
may affect what they can offer to the client. Performing some industry or market research is most likely done before and after gathering information from the client. This is as simple as looking to see what other websites in the field look like to in-depth research with focus groups. Figure 1 above is what has been come up.

2.1.2 Database Design

![Diagram of Website Architectural Structure]

**Fig. 1. Website Architectural Structure**

2.1.2.1 Entity Relationship Diagram

After gathering enough information for the database, the entities are then identify for the database designing and classify for its relationships. Throughout the long process of making lists, creating tables and normalizing, Figure 2 have come up with a design that best suits to the system they develop.

![Diagram of ERD Model of the System]

**Figure 2. ERD Model of the System**

2.1.3 The Map

On today’s Web, using map is a common feature. They are used to see the location of things, to search for the position of an address, to get driving directions, and to do numerous other things. The proposed system is design in a completely modular and open way, and allowing for the incorporation of alternative data sources and software implementations for future development. Embedding a map to the system adds to the design development and also meets the desired functionality of the system [8].

2.2 Developing the web-based graphical user interface and the geographical map of Cagayan de Oro City

The primary decision is what should be the underlying structure of the site, which determines the software to be use and what system will make the site “work.” The following are the software use:

a. HTML5. This language is use because of its cross-browser support. The language also has the ability to deliver everything from animation to graphics. As more and more elements got adopted more and more companies start to develop in HTML5.

b. CSS3. This style sheet language is use for the site’s stylish design. It also offers browser compatibility that makes the designing faster and easier.

c. jQuery. This cross-platform JavaScript library is utilize because it makes things like HTML document traversal and manipulation, event handling and animation much simpler with an easy-to-use API that works across a multitude of browsers. It is versatile and extensible.

d. JavaScript (JS). It is use for map manipulation. It is mainly use for creating polylines, markers and other overlays to fully utilize the map.

2.2.1 Framework

In developing the system, framework use to add system functionalities as well as improving the design. Codeigniter, a proven agile and open source PHP web application framework is use because it offers a good code separation and keep things clean. This organizes codes and keeps them in track. With Codeigniter, understanding and changing the behavior of the existing libraries is easy. It also permits the web pages to contain minimal scripting since the presentations separates from the PHP scripting. It is base on the Model-View-Controller development pattern. MVC is a software approach that separates application logic from presentation.

2.2.2 Database development

MySQL database system is used because it is open source. It is widely available in the market with no ownership cost and is also easy to learn and operate. It also contains APIs integration with PHP and easily connects with different development platforms. Lastly, the MySQL is secure as all access passwords are stored in an encrypted format restricting any unauthorized access to the system.

2.2.3 Embedding the Map

There are several mapping solutions including Yahoo Maps and Bing Maps, but the most popular one is Google Maps [9]. In order to add a Google map to the site, there is a need register to have a Google Account to get a Google Maps API key. This allows embedding of the maps into their web pages with the terms and services[10].

2.2.4 Project Testing

As the developing of the system progresses, several units testing are necessary. Performing unit tests is to ensure that the system’s need to be changed in the future can be deal with in predictable ways without causing unexpected side effects. Unit testing is a check against the programmers themselves
 inadvertently wreaking havoc when trying to modify system behavior. Unit testing gives a bit more confidence in the overall system stability.

2.3 Implementation of the web-based geographical road project monitoring and information system.

During the implementation process, the system together with the main system of the DPWH simultaneously runs. This parallel operation is done so that if the new system does not work correctly, the DPWH can still use the old system as a backup. This is made until the users, management and the IT personnel are satisfied with the function of the new system and see that it is completely utilizable.

2.4 To evaluate the web-based geographical road project monitoring and information system.

Performing an evaluation process assesses the performance of the website after the implementation. This process helps the researchers determine whether the site is effective or not.

III. RESULTS AND DISCUSSION

3.1 System Screenshots

The Figure 5 below shows the login page of the administrator. The 1st and 2nd District of DPWH Cagayan de Oro City have different administrator and they can only add and update projects according to which district they log in.

Once the admin is logged in the system, he can now add and update projects and contractors. He can also update and view the map. Figure 6 shows the administrator profile and menus that admin can access. This area is where manipulation of information that the public viewer sees on the main page.

Adding and updating project is essential in the department’s transparency of the project status. Figure 7 shows the adding section of the project which is to be done by the administrator. After adding all the project information it will then be registered on the database and those info will then be retrieved for the viewer to see the newly added project. When the admin updates, the same process occurs. In order for the viewer to visualize the data clearly, getting the main information from the database to be displayed on the table is done. Figures 8 show the said results. Base on the results it is clearer if the data are categorized according to what project category it belongs.

Once the view option is click basing on last figures mention, a new page will load. On Figure 9 the specific project location is emphasize with a colored polyline indicating what project category it belongs. Presentations of different colors on project category allow viewers to distinguish where it belongs. Viewers prefer this zoomed out image to appear if the viewer clicks the view option.
3.2 Evaluation Results

The following graphs show the results of the evaluation from the public users. There are 20 respondents who evaluate the system.

The results assess the performance of the website being implemented. Figure 11 shows the evaluation results. The first criterion deals with the visual clarity which discusses about the organization of the site from the user's perspective. The findings show that data is truly quick and easy basing on the average rating at 4.75. Necessary animations display in fact fit the site according to the 4.9 very good rating of the respondents. When it comes to the sites’ design respondents’ average rating is 4.5. A clear presentation of the data it is at 4.85 rating.

With all of these results the system achieves a very good rating which means that public users agree that it coincide the visual clarity criterion. Figure 12 shows all the said results. Rating Scale: 1 poor 2 fair 3 good 4 very good 5 excellent

IV. CONCLUSION

In the past, the DPWH road projects information is not well presented or displayed. Specific project location is not available as well as the basic information needed by the public.

Through the map, the viewer can easily locate the location of the road projects. It is clearly proven that with aid of the system the data displayed truly match the data being displayed on the map base on the computed average at 4.65. The convenience in navigating from pages is achieved basing on the 4.45 evaluation of the respondents. To sum it all, basing from this criterion the system attains a very good rating indicating that respondents agree to its consistency from each page when users access it. The conformity in the application of something, typically that which is necessary for the sake of logic, accuracy, or fairness is accomplish.

The user interface is not easy to navigate. With the Web-based Geographical Road Projects Monitoring and Information System, the information presents in an organized tabular form together with a map that presents a clearer and more satisfying view. A very good visual comprehensive presentation of the data achieves as 4.85 public’ viewer mark and at 4.67 admin’ mark.

Only the administrator can edit and update the data so that the information presented will secure and cannot be easily alter or delete. It is easy to navigate. The map is dynamic and connected to the database so it can store a lot of data that the admin can update from time to time. With the results given public viewer marks 4.75 and admin at 4.33, users mostly agree that the study reach its goal to improve the public’s
awareness while facilitating the department's capacity for growth and development. While targeting the effectiveness of the system to road project monitoring it confirms from admin rating at 4.33 which certainly mean that the study is a great help to the department.

In accordance to the Cagayan de Oro DPWH’s specification, the system’s capability will definitely give them the support they need in providing and managing for the public’s consciousness specifically on the project transparency of the department.

REFERENCES


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