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Architecture of Mobile Web Application for Generating Dynamic Route Map

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Abstract: - Integrated Light Rail Transit (LRT) System in the capital of Malaysia connects some key districts where historical places, interesting places, business areas and shopping malls are concentrated. The train services are running independently but have points where they have interchanges. This may leads the traveler facing difficulty when they are choosing incorrect destination station especially on different LRT lines which contribute to time consuming and high costing. Thus, we present an architecture in developing mobile application that runs on a Personal Digital Assistant (PDA) to provide the solution for traveler to reach the desired destination. It is use to dynamically generate dynamic route map by determining the nearest station according to the specific places. The architecture, web components and its implementation are proposed and discussed in this paper.

Key-Words: - Mobile application, Web architecture, Dynamic route map, Tourism, Transport

1 Introduction

Light railway systems now criss-crosses some of Asia's megacities – including bustling Kuala Lumpur – allowing even harried business travelers to keep their trip on track and is said to be the most convenient public transport. There are three lines operated by different companies which are part of Kuala Lumpur's Integrated Transit Network (Figure 1) and it is a fully independent metro network. RapidKL operates the Kelana Jaya Rail Line and the Ampang Rail Line whereas KL Monorail operates Monorail Line. This integrated transportation network transports approximately 4 million passengers every week with 908 buses and 48 rail stations operating daily [10].

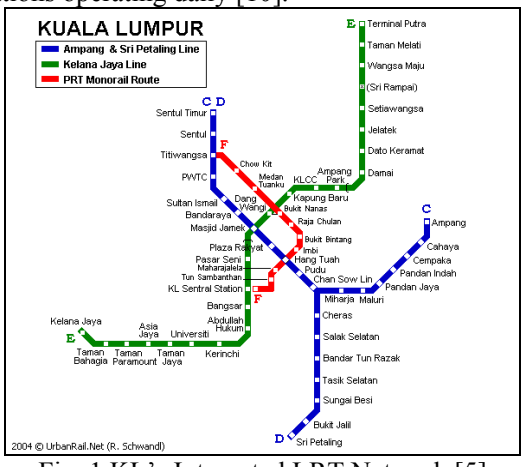

Fig. 1 KL's Integrated LRT Network [5]

Traveling from one appointment to another in this bustling metropolis can be difficult. This research addresses the problem of selecting nearest destination station to a given places of interest such as shopping places, historical places and interesting places which may involve at least two LRT lines and need of interchange station. Thus, the traveler may face difficulty when they choose incorrect station especially on different LRT lines which led to time consuming and high cost [8]. Producing a mobile application that could use in handheld device such as Personal Digital Assistant (PDA) for traveler on-the-move has becoming wide spread. People percentage having access to mobile devices is rapidly increasing and need to have access to information anytime, anywhere. Hence, we propose a mobile web application architecture to assist travelers to travel via LRT. A web application enables information processing functions to be initiated remotely from a browser and executed partly on a web server, application server and/or database server. A web application is an application which has been specifically designed to be executed in a web-based environment [19].

The paper contents are as follows. Section 2 is devoted to related work. Section 3 describes the mobile web application architecture whereas Section 4 elucidates the web components involved. Section 5 shows the implementation and Section 6 is concluding remarks.

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2 Related Work

With the rapid growth of the means of communication, mobile technologies have played an important role in the diffusion of information as well as business activity. People need to have access to information anytime, anywhere. Mobile services appear to be an obvious choice for travel and tourism as the travelers are on the move, which is the first criterion for mobile services to be relevant [9]. The travel and tourism industry have been undergoing many dramatic changes during the last decade, due to the possibilities offered by Internet technology.

PDAs and smart phones are becoming increasingly capable and more affordable, and they provide an excellent platform for business web applications running a variety of software applications from some mini version of management tools to text, document or even PDF readers [6]. The importance of supporting mobility of users has also been argued recently whereby there are many mobile frameworks/architectures has adopted technology based systems such as adaptive mobile applications [1], mobile commerce application [2], mobile web services [3], mobile tourist services [4] and mSpace Mobile [7].

The Global Positioning System (GPS) are widely used in various mobile applications. CYBERGUIDE [12] is a mobile context-aware tour guide to help tourists based on knowledge of location and orientation. The indoor navigation component relied on infrared as signal to generate a unique pattern that was used to display on a map. However, the outdoor Cyberguide used GPS to detect user's position before displaying on a map. Both system could be integrated and work independently. European Media Laboratory introduces the DEEP MAP [14] which focuses on mobile tourist guidance system that generates visualization and natural language for user through the city of Heidelberg. The system adapted the position of user using GPS and only restricted to area around Heidelberg castle whereas the MacauMap [16] is a mobile map oriented application to promote tourism in Macau. The system detected user's position by obtaining localization through GPS. A various map display approach is implemented to cater several PDA with different performance characteristics.

Besides GPS, the GUIDE [13] system is a location sensitivity tourist guide for the City of Lancaster which based on radio cell infrastructure. The system tailored the information for user preferences with their real context situation. Alternatively, Frankfurt airport implements the REAL [15] system which is a hybrid resource adaptive navigation assistance system by providing 3D route visualization display or guide user through incremental description using PDA. The system using infrared signal for the localization capabilities and respond to the smart location through various sensors to detect persons and object.

A similar approach is implemented for individual with cognitive impairments. The WADER [17] is a novel wayfinding system for individual with cognitive impairments using mobile that lead to a more independent life for patients especially having difficulty experience using public transport because the expected-to-arrive-time approach could save the persons from lost in direction due to early warning alert. Another just-in-time transit direction architecture on PDA using GPS and wireless technology for bus users also has been conducted by researchers from University of Colorado to provide better wayfinding system for respective users [18].

These trends have created a growing need for applications that take advantage of mobile environments. As mobile devices become more common, it becomes imperative to understand how this environment poses unique application architecture challenges. This paper will help to understand the mobile web architecture involved in DRM for mobile devices.

3 Mobile Web Application Architecture

Many factors contribute to the success (or failure) of a mobile solution. These include the mobile device, wireless network connectivity, enterprise integration, and most important, the application architecture. Many people do not realize that several application models are available for mobile development, each with a different set of characteristics that make it appropriate for some applications and inappropriate for others [11].

In this section, we introduce mobile application architecture which modeled as three-tiered client/server architecture. It is used, consisting of a thin client layer, an application server layer and a data layer which holds the databases and data stores for the application. Interactions between the client and the server operate the same way as they do in a two-tier system. This type of architecture holds many advantages over simple client/server architecture, including the easy deployment and

maintenance of the thin client layer and the inherent scalability of the middle and data layers [20]. This may provide flexibility, scalability, and high availability to the overall system. The overall Mobile Web application architecture is depicted in Figure 2.

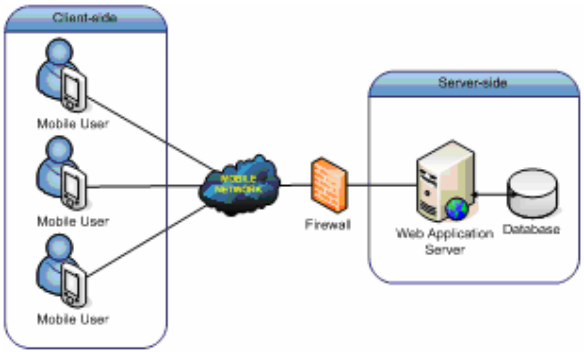

Fig. 2 Mobile web application architecture

With the knowledge and skills, mobile web application is build that target a wide variety of mobile devices and to create a single mobile web application that will be viewable on any number of devices such as web capable cell phones, pagers, and PDA.

Web Application Server
This server represents as web server consists of web and application services whereby it is configured to execute business processes and transactions, as well as data communication while accessing database server. It responds with the requested information by client through mobile devices.

Database Server
The database server stores all information needed to obtain LRT route from depart station to desired destination by mapping it to the corresponding nearest LRT station. It serves as a central repository and can be deployed as a standard Structured Query Language (SQL) database. This server interacts with web application server with respect to data accessing and storage.

Mobile Client
On the client side, we need to have PDA in order to execute the client by using mobile browser (or micro browser), which provides some scripting application (java application client) as long as it is java-enabled browser. The dynamic route will be presented in flash as visual map with requested information. In the next section, we will discuss the interaction between the components in both client and server-side.

4 Web Components

In this section, we describe the mobile architecture that is composed of a number of components for developing mobile application. Web components provide the dynamic extension capabilities for a web server. It gives an overview of the relevant components and how they interact. The interaction between a web client and a web application is illustrated in the Figure 3. In this architecture, we distinguish two sides, a client-side and a server-side. They play distinctive roles and require different mechanisms for their implementation.

In Figure 3, each component integrates as client-server application by communicating between client-side and server-side applications where consists of 2 and 4 components respectively. Client-side has User Interface and Java Application components whereas server-side has Process Control, Map Generation, Optimization Route, and Data Management components.

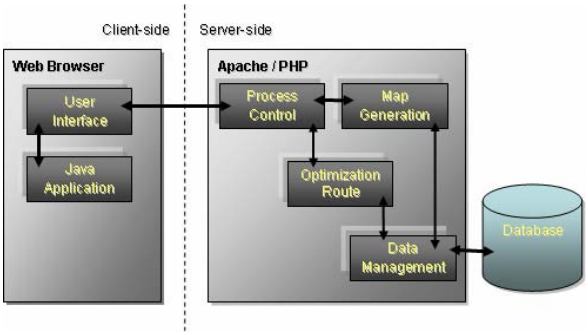

Fig. 3 Components view of the architecture

Mobile users using PDA will communicate with a web server through an HTTP request via mobile browser (or micro browser). PDA with its capability like image and browser capability and the types of markup languages supported, will allow accessing to a mobile web application. Due to the existing limitations of portable devices, the User Interface component needs to consider its screen size and resolution whereas the Java Application Client able to execute, if and only if the PDA has java-enabled browser.

Web application server serves as web server and application server where all web components reside in with their distinctive roles. Process Control (PC) component will process the requests as objects prior to respond to the mobile users. The Optimization

Route (OR) component is to generate shortest and cheapest route to desired destination by obtaining the required data from the database. Accessing to the database is through Data Management (DM) component. With generated route from OR component, Map Generation (MG) component will generate a map to visualize the route for clearer view

5 How mobile web applications work, develop and deploy

When a mobile user sends an HTTP request to the web server in which dynamically process requests and construct responses, the PC component converts the request into an HTTP request object. This object is delivered to an Optimization Route (OR) component, which can interact with Data Management (DM) components to generate dynamic route path. Optimization Route component is to generate the shortest and cheapest route to desired destination specified by mobile users. Then, it will generate an HTTP Response object to PC component and pass the request to Map Generation (MG) component to create dynamic route map to visualize the route. Eventually PC component generates a HTTP Response object and the web server converts this object to an HTTP response and returns it to the mobile user. This is how mobile web applications work across mobile users.

In order to develop and deploy a web application, the web component code has to write and compile as well as any static resources such as images or HTML pages need to be created. Web component code is either in Java-based or .Net-based and helper classes that are used by the web components. Next, deployment descriptor will be created and deploy the web application to the web container. Once a web application is deployed, then mobile users can access the web components through the mobile browser.

6 Conclusion and Future Work

Mobile applications are indispensable for everyone who needs to deliver robust, high-value mobile solutions. This paper presents the architecture for such mobile applications. We have described the motivation for a new architecture, and the components behind DRM's design. We plan to build an open source, cross-platform implementation of DRM for mobile devices, and trial this implementation as prototype. It is hoped that it is useful for travelers and capable to help them to make their decision easily, directly and successfully ubiquitously.

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