On the Design of a LBS-based App for Searching Vegetarian Restaurant

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Abstract: Due to the popularity of the vegetarian movements in Taiwan, vegetarian restaurants are increasing gradually. Yet the vegetarians who are eating out while away from familiar places often have difficulties in locating nearby vegetarian restaurants. With the popularity of mobile devices and potential applicability of LBS (location-based service), developing a restaurants-finding App for vegetarians not only assist the vegetarians but also help local restaurants to get benefits from it. In this study, we developed an App on Android platform with relevant functions to meet this need. The App allows mobile device users to search nearby appropriate vegetarian restaurants. The positioning capability of LBS through Internet and mobile devices enables us to develop the real-time application to find vegetarian restaurants based on users’ location. We use the major districts of Taichung City as the demonstration sites for the design, development and testing of the prototype of the App. This paper presents the App’s design rationale and main features which include functions about maintaining, searching, and ranking of vegetarian restaurants. Preliminary trials of the prototype of this App are also described.

Key words: Location Based Service (LBS), Mobile device App, Mobile User Interface

1. Introduction

The trend of increases in vegetarian population has become a global ethos recently. People have various reasons to convert to vegetarian such as health, religion or environmental protection. In Taiwan, the promotion of vegetarian diet has led to the movement of "neo-vegetarianism”. For vegetarian people, they often have trouble finding suitable vegetarian restaurants when they are away from familiar places. With the popularity of mobile devices and popular applications (App), we envisioned that it might be helpful to develop Apps to help these vegetarians finding suitable diet places. Starting with exploring the functions needed and the technical feasibility, we exploit the location-based services (LBS) of mobile devices to develop Information and directory services [5]. The prototype of our App is based on the establishment of databases for the regional information about vegetarian restaurants. The App allows various users such as vegetarians, storeowners to collaboratively maintain the information in the App. In this paper, we discuss the background and design rationale of our App in the next section. The system analysis and design of the App is described in the third section. The fourth section gives an illustrative presentation of the implementation of the APP. A preliminary users study is shown in section five, followed by the concluding section.
2. Background and Design Rationale

Information services of mobile devices like tablet PC or smart phone enable users to communicate through the internet and the wireless network to extended space (spatial) and time (temporal) information processing capabilities. LBS (Location-based services) utilize the geo-positioning functionality such as GPS position location capability or Wi-fi positioning system function of mobile devices to provide people with information and entertainment. These services allow users to check-in shops, airports, restaurants, hotels, or even some private events or residences wherever they go, in exchange for some kinds of rewards (either tangible or intangible) [1]. Thus LBS can be defined as the ability to locate a mobile user geographically and deliver services to the user based on his or her location [5]. LBS’s main technical basis is to obtain the interactive information through the intersection of three interactive technologies, namely mobile devices, Internet and geographic information system (GIS) spatial database [2], as shown in Figure 1.

Researches on the development procedure of LBS-based Apps are still evolving. Our development of App will employ several design rationale and adopt the ADDIE model in principle. ADDIE model is an educational process design (Instructional Systems Design, ISD) model. Traditionally it has been widely used in the development of pedagogical systems. ADDIE consists of five stages: Analysis, Design, Development, Implementation, and Evaluation [4]. An illustrative diagram with brief description of each stage is shown in Figure 2.

![Image](Figure.1 LBS as an intersection of three technologies[2])

![Image](Figure.2 ADDIE model, adapted from [4])

To facilitate the analysis and design stage of the ADDIE, we use a business tool called the KJ method as a vehicle to help us during brainstorming. It is also called affinity diagram that often used as a way to organize ideas and data [7]. The general procedure of KJ method is to record ideas on cards or notes from group members, then inspect ideas that seem to be related and finally sort cards into groups until all cards have been used. The comprehensively classified results are posted on a wall or a table, plus appropriate titles for discussion and eventually the themes and contents are integrated into the system interface design and planning.

A service design model called the “experience cycle” model is integrated into the ADDIE to facilitate our development at evaluation stages [6]. The experience cycle builds the producer-customer relationship from the customer’s point of view with the goal of moving beyond a single transaction to establish a relationship between producer and customer and foster a continuing dialogue. The experience-cycle model uses the following five steps:
connecting, becoming oriented, interacting with the product, extending perception and telling others. The model can help designer build a relationship of users or customers with a product or service. The main idea of the experience cycle is the process by which customers (in our case, mobile App users) get involved and become advocates and introduce others to the product to form the cycle.

In terms of the user interface design for the mobile web, cross-platform technology reduces the cost of creating multi-platform applications. Developers can create applications that run on mobile platforms with different input mechanisms, display, size resolution, and user interface style. To design applications that are easy to use, and that integrate diverse platforms and devices, we need to consider factors beyond conventional web applications and native mobile applications.

Web Apps are generally built using HTML5, CSS3 etc., which resembles an application and can be accessed through a mobile browser. The advantage of web apps is that it can be used across all platforms and devices. However, web Apps are not accepted in native App stores, thereby reduces an important distribution channel for the App developers. And web apps cannot access or use the native APIs or device specific hardware features.

A native mobile App uses the native programming language for the platform like iPhone or iPad Apps built using Objective-C, and Android application built with Java. Native Apps are fast with considerable user experience and interface design and have access to all device features for which it is built. But a native App can be used only for its specific platform, thereby restricting the reach. For example, an android App cannot be run on an iPhone and vice versa. If we want to cover a larger audience across all platforms, we will need to have separate native Apps for them [8].

As newer technology emerges, the mobile application development evolves as well. While current trend may be on the native or web Apps (mainly HTML 5 Apps), a considerable effort has been put on the third approach called hybrid mobile applications, which combines the best of both native and HTML 5 Apps [11]. A hybrid application is built using web technology, and then wrapped in a platform-specific shell. The native part makes it look like native Apps and makes it eligible to enter the Apps stores, and developers can build in some of the native functionalities into it as well. The Apps can access some of the native APIs and use device specific hardware features to some extent. A hybrid App is basically an App developed in combination with HTML 5 and native technology. For cross platform reach, developers would need to implement the native part separately for each platform but they can use the same HTML5 part across all of them.

Designing mobile user interfaces is essentially an evolving paradigm for user interaction. A quality mobile App needs to synthesized the following factors [10]:

- Smaller screen
- Touch interfaces
- Acceleration and gyroscopic sensing
- Orientation awareness
- Pervasive animation
- Simulations of physical behavior

A web UI should also be flexible to run on devices with various sizes and features. Designers must consider more adjustable variables when compared to designing traditional desktop web applications.
3. System Analysis and Design

In this section, we present the analysis and design strategies based on ADDIE model: the overall system design processes. Details of the analysis and the design stages are discussed separately.

3.1 Analysis Stage

In the analysis stage, the KJ method is employed to facilitate brainstorming and discussion. Figure 3 shows the draft of discussion resulting from using post-it and drawings to realize the KJ method.

![Figure 3: Brainstorming: discussions using post-it and drawings](image)

What are the ways and affective factors when consumers are in search of vegetarian restaurants? Through that brainstorming and discussion using the KJ method, a total of three main factors are elaborated:

- Searching Vegetarian Restaurants: Internet search, recommendation from friends, exploring directly on streets, Google map search, GPS or Wifi positioning system, Social Networking or Blog recommended.
- Restaurants within easy reach: the venue of the restaurant, the time needed to get there, and parking issue.
- Vegetarian types: Flexitarian, ovo-lacto vegetarian, pure vegetarian and allium-flavored vegetarian.

Figure 4 is depicts the final sum-up of the three main factors with suitable headings for detailed elaborations.

![Figure 4: details of the analysis of Vegetarian Restaurants Searching elaborated by the KJ Method](image)
3.2 Design Stage

The prototype application is named "NeoVege". NeoVege reflect the new vegetarian trend of the emphasis on health, organic concept, environmental protection and the new relationship to nature and animals.

To design the Apps for NeoVege prototype, we use wire frames to depict the screen layout and the red arrows to illustrate the flow of users’ operations. Figure 5 is the overall sketch-up of our design. Though the wire frames illustration seems low-fidelity, it helped the communication of developers and proved a good blueprint for the realization of NeoVege prototype.

Figure 5 Overall wire frames sketch-up of our design of the NeoVege prototype

In terms of the functional view of the NeoVege prototype, Figure 6 shows a top level chart depicting the five main functions and their screen layout. These functions are called search restaurant, recommendation, restaurant member, vegetarian and contact us.
4. Implementation

To implement the five main function of NeoVege prototype, we need to consider the user types and the authorized functionalities of each type. The users are categorized into four types: general users, vegetarian restaurants, vegetarians and system administrators. Table 1 presents various functions available for each kind of users. In the subsequent subsections, we describe the software used and the details of each function.

Table 1. Authorized functionalities of the users of NeoVege prototype

<table>
<thead>
<tr>
<th>authorized functionalities</th>
<th>general users</th>
<th>vegetarian restaurants</th>
<th>vegetarians</th>
<th>system administrators</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS positioning</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Google map labeling and viewing</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>vegetarian restaurants browsing &amp; Searching</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Direct phone dialing to vegetarian restaurants</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Social Networking recommendation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Route planning navigation</td>
<td>●</td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Personalized restaurant list</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>membership management (add, modify, delete)</td>
<td>●</td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>System administration</td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

4.1 Developing tools

We explore considerations on issues relevant for native mobile application design and focus on cross-platform design in this research. Considering the popularity and relative market share of platforms, the Android is chosen to be the platform for implementing the prototype.

Several software tools such as Illustrator, Photoshop, Dreamweaver of the Adobe CS6 Suite, together with jQuery Mobile [11], HTML5, Javascript, PHP, are employed to develop the frontend user interfaces and functions. In terms of the backend development, the localStorage of Web SQL Data is used to store personalized
data of vegetarian user. The information of vegetarian restaurants is kept in the server by PHP MySQL data base. The PhoneGap software is utilized to pack the jQuery Mobile program to facilitate the cross-platform capability. Table 2 sums up the frontend and backend tools [9].

Table 2. Developing tools for the NeoVege Prototype

<table>
<thead>
<tr>
<th>Category</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>frontend</td>
<td>AdobeCS6- Illustrator, Photoshop, Dreamweaver</td>
</tr>
<tr>
<td></td>
<td>jQuery Mobile, HTML5, Javascript, PHP</td>
</tr>
<tr>
<td>backend</td>
<td>PHP MySQL(for vegetarian restaurants)</td>
</tr>
<tr>
<td></td>
<td>Web SQL Data / localStorage(for vegetarians)</td>
</tr>
<tr>
<td></td>
<td>Android 4.0</td>
</tr>
</tbody>
</table>

4.2 A scenario for searching vegetarian restaurant

The entry screen for the App to search restaurant is divided into two parts. The upper part is a diagrammed map for the decomposed region and the lower part is a grid of district button for linking to restaurant lists of the depicted region (see Figure 7).

Figure 7 Screen layout for the Search restaurant function
The flow of operation is presented by red arrows tagged with sequence numbers. The main features are the provision of map and indicators, zooming in details of selected restaurant and associated information such as restaurants’ name, address, phone number and representative dishes photo. In Phone Number button link number (7), users can press the call button to directly call up the restaurant without the dialing of phone numbers.

4.3 Miscellaneous functions

- **Recommendation**: Upon users’ selection of the recommendation function, the screen is displayed as a list of ranked quality stores recommended in the selected region. Users can touch relevant buttons for details or buttons for external link buttons to redirect users to Facebook or Plurk screen respectively for recommending.
- **Restaurant member**: On the entry of restaurant member function screen is a form for restaurant owner to operated membership functions such as set the member id, password and the restaurant’s basic information.
- **Vegetarian**: Vegetarian function facilitates the personalized restaurant list. Upon reaching a desired restaurant, users are able to store the store information via GPS or Wifi positioning system to automatically extract store latitude and longitude and enter the store name and comments to mobile database. There is also a function for maintaining the personalized restaurant list.
- **Contact Us**: The function provides QR code for smartphone access and email connection to the NeoVege Prototype.

### 5. Evaluation and Users Study

About the preliminary test of the NeoVege prototype, the interfaces are examined from two perspectives. The first one uses the experience cycle to check the interface flow of the prototype. An illustration of this exploration is shown in the next subsection. The other users study is a field test by asking participators to complete a set of tasks. Their responses are collected and analyzed in the second subsection.

#### 5.1 Experience cycle

As we have mentioned in section two, the experience cycle is employed to examine the designer-user relationship from the user’s point of view. The five steps in the experience-cycle model are further elaborated into a more detailed checklist in Figure 8.

![Figure 8 An elaborated experience cycle](image)
When a user enters the NeoVege prototype, finds a vegetarian restaurant, gets to the restaurant and finishes the dining, the whole process forms the experience cycle. The elements in each step of the loop are illustrated in Figure 9.

i. Connect and attract: enter the system page to search restaurants, browse the functions of the prototype (Overview), recognize a district (North District) on the map shown in the upper part of the screen and uses the button in the lower part to link to the restaurants in that region.

ii. Orient: by positioning the user on the map, check the restaurants in the target area by navigating the map and the revealed restaurant list.

iii. Interact: apply visualization actions to approach a desired restaurant: enlarge the map (zoom) to see more detail street maps and other information, check a restaurant location on the store list screen (locate), or enter a keyword and retrieve a list of selected data (filter), click the menu below to select the restaurant (relate), browse screen about detailed information of the restaurant (details-on-demand).

iv. Extend and retain: users feel the usage of system, retain satisfaction after dining and the overall experience, and achieve the desired objectives, and become loyal to the application.

v. Advocate: users actively communicate, share and recommend to other people, through the connection and attraction to initiate further the experience cycle of the application.

Figure 9 The element in each step of the experience cycle

5.2 Field tests

Apart from examine the NeoVege prototype with experience cycle, we have done a field users test. Six people are solicited to complete a series of tasks and give feedbacks from the use of the application. These subjects are comprised with two male and four female with average age 29. The tasks include browsing restaurants in an assigned area, using keyword to search a restaurant, extracting the details of the selected restaurant, personalizing the restaurant by using GPS and the path-planning of the Google map, and functions for vegetarians.
The thinking aloud mechanism is adopted to collect instant response from these subjects. Although the sample size is not large enough for a thorough statistical analysis, the general feedback are quite favorable. Their suggestions are summarized from three perspectives:

- **Overall:** The applicability of partitioning the covered area into two regions might not be feasible to other area. A learning scenario might be developed to help users.
- **Functions:** Restaurants’ price might be augmented with more textual description. Recommender systems could be employed to enhance the credible support for users. The online reservation function could be developed to add an option for customers and restaurants’
- **Interfaces:** The displaying of Google map with satellite view or street view needs to be tested for choice or switch. The types of restaurant could be further delineated to help users. The placement of buttons such the “return” button can be readjusted and the design of icons should be more integrated.

6. **Concluding Remarks**

Motivated by the popularity of mobile devices and the potential of utilizing the embedding Location Based Services (LBS) to suitable applications in these devices, we developed a novel App prototype called NeoVege to assist vegetarian finding relevant restaurants through mobile devices. Our study employed the ADDIE model to develop the prototype. Through the experience cycle review and preliminary participant tests, the usability of the prototype is confirmed through positive feedback and valuable suggestions are collected for considerations in further development.

**References**


