



Open Source Solution for Mobile GIS and Location Intelligence

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ABSTRACT

Mobile computing technology brings the opportunity to reach more Internet users and to deliver information directly to their gadgets. This opportunity opens for tourism world in which a mobile application (shortened to be "app") can be built by developers, distributed it through application market and the users can download and install the application to their gadgets. The application provides contents related to latest tourism information, favourite attraction points of interest, or offers from some service providers. However, not all areas in Vijayawada have their own app for promoting local tourism. In this research, a mobile tourism application is designed and built for Vijayawada area, the area that is in Andhra Pradesh Province of India. The application has functionalities that are proposed based on taxonomy of tourism mobile application. The application implements Bhuvan Map Application Program Interface (API) to provide location-based service for users. Moreover, the data used for the mobile application is fetched from server using web service and local SQLite database.

KEYWORDS: GIS, LBS, SQLite.

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I. INTRODUCTION

The number of Smartphone users has been growing exponentially with over 4.61 billion users in 2016 and predicted to be approximately 6.1 billion users by 2020 [1]. Smartphone has been used intensively in modern people daily activities because it helps to connect people using its communication feature and offers many applications range from education purpose, games, entertainment, sports, productivity, shopping and much more. As the result, the massive Smartphone market and open mobile platforms attract developers to build innovative mobile application. The developers integrate the mobile application with Smartphone features such as Short Messaging Service, voice call, internet connection,

Global Positioning System (GPS) technology, camera, local database, external storage and many more. These mobile technologies can also be tailored to develop tourism mobile application. Currently, there are many mobile applications in stores that fall into travel or tourism categories, but not all of them of content-specific especially for government program or dedicated for less popular point of interests. There is still needs for local-themed mobile application.

Meanwhile, there are many different platforms installed in Smartphone's, namely, the top three in INDIA: Android, iOS, Windows Phone. However, Android is currently the top platform and gains more popularity among Smartphone's users marked by increasing shipment number of

Android-based Original Equipment Manufacturers (OEMs) in 2015 [2]. The number of available mobile application for Android platform that reaches more than 1 million apps also attracts Smartphone's users to use the platform. The opportunity to reach large number of Smartphone's users is open not only for developers, but also stakeholders in tourism sector.

The tourism mobile application is named "Vijayawada Tourism" and is built only for Android platform. The selection of mobile platform is based on the fact that the number of Android Smartphone users India is larger than the amount of users of other mobile platforms [3].



Figure 1. Vijayawada on map

The paper is organized as follows: the next section explores related study on Android platform, mobile application development especially for tourism purpose, and to give example of existing tourism applications. Next, section III presents and discusses the design of the system along with the implementation of the application. Finally, section IV concludes the paper and presents the future work.

II. RELATED WORK

A. Android Platform

Android is a mobile operating system (OS) that is initially released in September 2008. The OS is developed by Google and runs on Linux kernel. On top of Linux kernel, there are the libraries, Android Runtime, Application Framework and Applications. The architecture of the building block of Android platform is shown in Figure 2. When discussing about Android mobile application, Google Play Store is the most famous Android apps store. Users can search and select apps from more than 20 categories with a total of approximately 1.6 million apps [4]. During research, author has searched information about available apps related to tourism. Keywords such as "Vijayawada Tourism", "Krishna Tourism", were

used during the study period. However, there are none Android application found in Google Store that specifically serves and provides comprehensive information about Vijayawada tourism. One app such as Tourism Guide have the closest theme to Vijayawada tourism despite the fact the information are very limited and basically do not have interactivity, Vijayawada Tourism app is developed to harvest the technology and will provide more functionality to the tourists.

B. Mobile Application Development

There are constraints that should be taken into consideration when building a mobile application, such as Android devices that have small screen, limited memory and processor capability, and security issues. Hence, these factors should be part of the designing and development process. Several examples of Android-based tourism mobile applications found by the authors during the study are the apps that utilize the back-end component [5] and the app designed and built for different platforms [6]. The categories are Navigation, Social, Mobile Marketing, Security/Emergency, Transactional, Entertainment, and Information [7][8]. The designed and built mobile application in this study is categorized into Navigation, Security/Emergency, and Information.

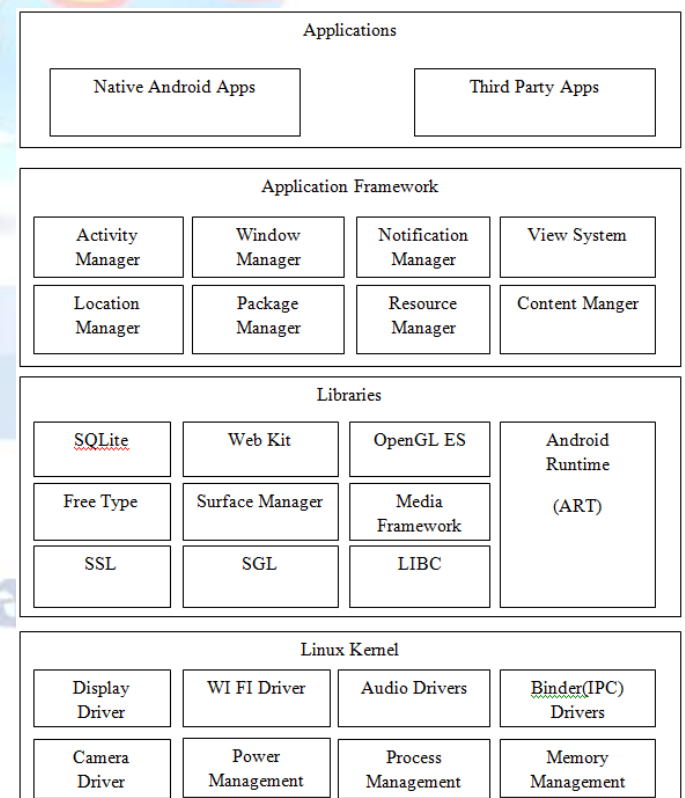


Figure 2. Android Architecture

III. DESIGN AND IMPLEMENTATION

The proposed tourism mobile application consists of three components. The first component is the back-end component of the application. In this back-end application, a database is implemented and a web-based application is created to manage the content of the database. The database consists of data used for Vijayawada tourism mobile app. Next is the front-end component that is designed to be outlet of Vijayawada tourism information. This front-end component is "Vijayawada Tourism" mobile application that will display the Vijayawada point of interests and provide the location-based service processed results. The app is designed to work in offline and online mode. The last component is web service as a middleware application for exchanging data between the front-end and back-end components.

Figure 3 shows the workflow of how the tourists use the application, The application usage workflows are:

1. Tourists as the targeted users of this application install Visit Vijayawada Tourism App in their Android Smartphone. The users can access the app functionalities that are served as mobile application menu. When user opens the app it shows the Department where it is developed after few seconds it navigates to next page where user need to select the city, Here Vijayawada city only enabled, If user select other than Vijayawada it toasts not yet enabled.
2. After selecting Vijayawada it shows the number of POI's such as Visit, Stay, Food Hubs, Economic, Religious and etc.
3. From there user can select and navigate to that place, After user would check the proximity.

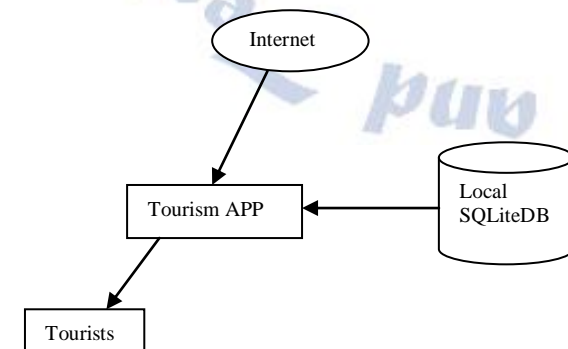


Figure 3. Application Usage workflow

The more detailed designs of each components of the tourism application for Vijayawada are explained in the next sub section.

A. Back-End Component

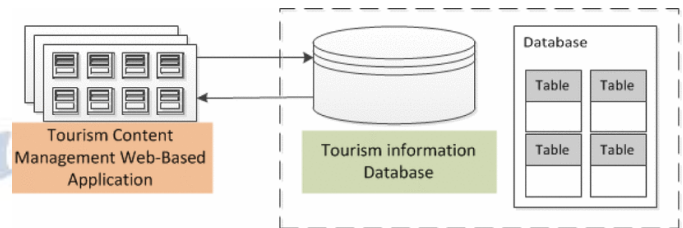


Figure 4. back-end component architecture

The tourism information database depicted in Figure 4 has tables that records information. The structure of the database can be seen in the following Table I

rowid	type	name	tbl_name	rootpage	sql
1	table	android_metadata	android_metadata	3	CREATE TABLE android_metadata (locali...
2	table	Country	Country	4	CREATE TABLE Country (id integer PRIM...
3	table	sqlite_sequence	sqlite_sequence	5	CREATE TABLE sqlite_sequence(name,seq...
4	table	Historical	Historical	6	CREATE TABLE Historical (id integer PRIM...
5	table	Police	Police	7	CREATE TABLE Police (id integer PRIMAR...
6	table	Museum	Museum	8	CREATE TABLE Museum (id integer PRIMAR...
7	table	Park	Park	9	CREATE TABLE Park (id integer PRIMARY K...
8	table	Tour	Tour	10	CREATE TABLE Tour (id integer PRIMARY...
9	table	Classic	Classic	11	CREATE TABLE Classic (id integer PRIMAR...
10	table	Unclassic	Unclassic	12	CREATE TABLE Unclassic (id integer PRIM...
11	table	Post	Post	13	CREATE TABLE Post (id integer PRIMARY K...
12	table	Cinema	Cinema	14	CREATE TABLE Cinema (id integer PRIMAR...
13	table	Chemist	Chemist	15	CREATE TABLE Chemist (id integer PRIMAR...
14	table	Doctor	Doctor	16	CREATE TABLE Doctor (id integer PRIMAR...
15	table	Hospital	Hospital	17	CREATE TABLE Hospital (id integer PRIMAR...
16	table	Sweet	Sweet	18	CREATE TABLE Sweet (id integer PRIMAR...
17	table	Restaurant	Restaurant	19	CREATE TABLE Restaurant (id integer PRIM...
18	table	Rail	Rail	20	CREATE TABLE Rail (id integer PRIMARY K...
19	table	Bus	Bus	21	CREATE TABLE Bus (id integer PRIMARY K...
20	table	Church	Church	22	CREATE TABLE Church (id integer PRIMAR...
21	table	Mandir	Mandir	23	CREATE TABLE Mandir (id integer PRIMAR...
22	table	Bank	Bank	24	CREATE TABLE Bank (id integer PRIMAR...

Table I. Back-end database structure.

B. Front-End Component

The front-end component is an Android-based mobile application. This application is built using the development tools that is shown by Table II.

Component	Open Source Software (Freeware)
Application Programming Interface(API)	Android Studio, Leaflet
Back End Database	SQLite
Server GIS	MapServer
Programming Environment	Java, Android, Android-SQLite, JavaScript, Html, CSS

Table II. Front-end development tools.

The front-end application is named Vijayawada Tourism App, which can be run in online and offline mode. In offline mode, the mobile app can display basic information about Vijayawada. When connected to Internet, the application can fetch

data from the server and has the fully functional application. The local storage uses SQLite database. The snapshot of the front-end application is shown in [Figure 5](#).



Figure 5. Mobile Tourism Application

ColumnID	Name	Type	Not Null	Default Value	Primary Key
0	id	integer	0	null	1
1	banks	integer	0	null	0
2	banksl	integer	0	null	0
3	bankslg	integer	0	null	0

Table III. Front-end database structure.

C. Middleware Component

The middleware component of Vijayawada tourism mobile application shown in the following [Figure 6](#). For accessing the Bhuvan Map service on front end author using the web services.

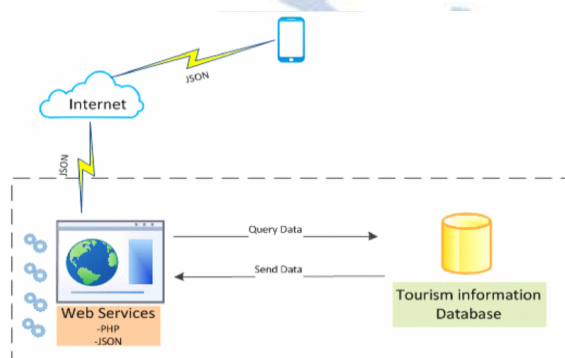


Figure 6. Middleware component.

IV. CONCLUSION

In this research, the author designed and built an Android-based tourism mobile application. The application displays Vijayawada tourism information. Three components were built for the tourism application.

In the future, it is necessary to continue improving the application to have a better-usability and on par with technological advancements and trends to keep the users active and maintain the user base. With the changing trend in future, scope exists for extending this application on 3D platform for better visualisation. The overall impression of the development of the application is that this prototype is a base for a product that can be extended almost to the infinite. The application can be further extended to support Augmented Reality with which the user can get greater amount of information, easy translation and accurate navigation. Voice recognition and enabling the application for visually impaired people will allow the application to become more user friendly in Location Based Services (LBS). Further, this application can be incorporated with Currency conversion that will allow a user to know their currency's value in Indian Rupees without much effort. The speed for data will improve with wide spread use of 3G systems. The future work can be an important pointer towards further development and the ideas presented are fully achievable.

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