Design and Implementation of a Location–Based Service With Emphasis on a Geographical Database

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INTRODUCTION

Smartphones are the most popular electronic devices nowadays. People use them to perform daily activities, like managing messages and emails, browsing the mobile Internet, and watching video, anywhere and anytime. One of the popular apps is location-based service (LBS), which is a service based on the geographical position of a mobile handheld device. One of the LBS examples is to find a nearby ethnic restaurant by using a smartphone. According to the market research reports, (i) the global LBSs market was valued at $11,994 million in 2016, and is expected to reach $61,897 million by 2022, supported by a growth rate of 26.6% (Malani, 2017), and (ii) the growing trend for the integration of location-based search with social networking websites will post a growth rate of close to 40% for the global LBS market during 2017-2021 (Technavio, 2017). They show the high importance and popularity of LBSs. However, building an LBS is not a simple task. This research tries to help developers by showing how to build an LBS.

Building a location-based system (LBS) is not easy because various disciplines and subjects are involved. This article tries to mitigate the high complication and difficulty by showing how to build an LBS from the ground up with a focus on connecting the mobile devices to a server-side geographical database. The five major components of an LBS system and our methods for implementing them are listed below:

- *Mobile handheld devices*: Android emulator (AVD), instead of a smartphone, is used for development.
- *Positioning systems like satellites*: The DDMS (Dalvik Debug Monitor Server) of an AVD is employed to send the mock locations, instead of using actual road testing.
- *Mobile and wireless networks*: URL connection, provided by Android, is used to connect the emulator to the service provider.
- *Service providers*: The LBS is to show a direction between the user and the nearest participant.
- *Geographical databases*: A small geographical database is used by the service provider.

Readers, who are interested in LBS research and applications, can use this paper to build their LBS prototypes. Based on the prototypes, they can realize their LBS research and show the advantages of their proposed methods.

The rest of this paper is organized as follows. Section 2 introduces related software, tools, and services including (i) Android and Android Studio, (ii) MySQL and MySQL Workbench, and (iii) various location-based services. The proposed LBS app is introduced in Section 3, which includes three

sub-sections: (i) the proposed system, (ii) the server-side geographical database used by the proposed system, and (iii) the result screenshots. Section 4 explains how to build the proposed system including three sub-section: (i) Android server connection, (ii) client-side code, and (iii) server-side code. The final section summarizes this study and gives possible LBS projects.

BACKGROUND

This section introduces the software and tools used to build the proposed system including (i) Android and Android Studio and (ii) MySQL databases and MySQL Workbench. In addition, various location-based services are listed to give readers an idea what the market trend of LBSs is.

Android and Android Studio

Android (Android, n.d.a) is the most popular mobile operating system as it is used by more than 80% of smartphones in 2017 (IDC, 2018). It is a software stack based on the Linux kernel for mobile devices that includes an operating system, middleware, emulators, and various key applications like phone, browser, and contacts. It was initially developed by Android, Inc., which was acquired by Google, Inc. in 2005. Since then, Android has been revised and enhanced significantly and constantly for the ever-changing newer features of mobile devices. In the past, Android app development in Eclipse with ADT (Android Development Tools) was highly recommended. Since 2014, Android Studio (Android, n.d.b) became the primary IDE (Integrated Development Environment) for native Android application development. It is freely available under the Apache License 2.0 based on JetBrains' IntelliJ IDEA software. Figure 1 shows a user interface of Android Studio and its major functions are listed as follows:

- *Attributes*, providing controls for the selected view's attributes,
- *Design editor*, displaying the layout in both the design and blueprint views,
- *Gradle console*, a screen for managing the automated build system for the Android source code,
- *Logcat*, a screen showing the logs generated from the running programs,
- *Menu bar*, providing the essential functions of Android Studio,

Figure 1. A user interface of Android Studio
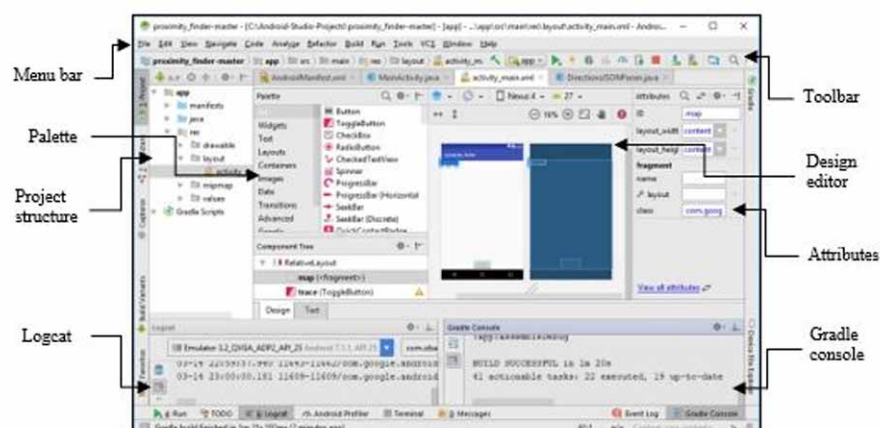
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