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AN ANDROID APPLICATION DEVELOPMENT FOR AUTOMATIC ANNOUNCEMENTS ON PUBLIC BUSES

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ABSTRACT

This research study features an android application development for automatic announcements on public buses which aims to investigate the efficiency of the GPS function in tablets and to develop an uncomplicated and low-cost android system for automatic announcements on public buses for the convenience of the passengers. The application is developed for automatic announcements of public bus stops.

The study of the components of the computer program employed to develop the android application revealed that, for the design and content, the application was evaluated at the "good" level of suitability by experts. Moreover, the group efficiency test provided ideas for the improvement of the content design which required an increase of functions in the application. The android application for automatic announcements on public buses has the efficiency level at 2.26, which is higher than 1.00. This means that the application is efficient according to the standard criteria of the SDLC-based design analysis. Therefore, this application could be suitably used on public buses for their announcements. The screen functions, the responses of the android operating system and the Google Map API are able to function effectively, receiving locations and tracking GPS movements accurately. The system also allows for the effective addition of location data and voice recording, resulting in the convenience of the passengers and the quality services of the public buses.

Keywords: *1) Android Application 2) Automatic Announcement 3) Public Buses 4) GPS Tracking*

1. Introduction

According to the 11th National Economic and Social Development Plan (2012-2016), Thailand paid special attention to the transportation systems for both land and rail. The government projected a policy to expedite the development of such systems to enhance the convenience as well safety standard for transportation and to accommodate the entry into the ASEAN age; for example, to increase the number of routes connecting small cities and to expand traffic lanes of the main roads between large cities in different regions of the country. (Ministry of Transport, 29 July 2014; Ministry of Transport, 2012) This development has enabled the population both inside and outside the country to make more journeys especially to large cities in different regions of the country.

For a large city, public transportation is a key factor necessary to provide services for both a great number of local people and visitors from other places. Public transportation also helps alleviate traffic problems in the local area. (Tarapiah et al., 2013) The government, therefore, makes an effort to enhance the quality of its basic transportation system. At present, a standard for a good transportation system should encompass the Passenger Information System (PIS). (Lecip, 2011; Lawo, 2009; Scinteie, 2012) Figure 1 shows the bus scheduling system, the real-time tracking system for the bus location,

the CCTV system, the wireless Internet system, and the audio announcement system, etc. (Lawo, 2009) The research report states that this information system for passengers will help bring about the passengers' satisfaction with the services of public buses. (Tang and Thakuriah, 2012; Abdel-Aty and Jovanis, 1995)

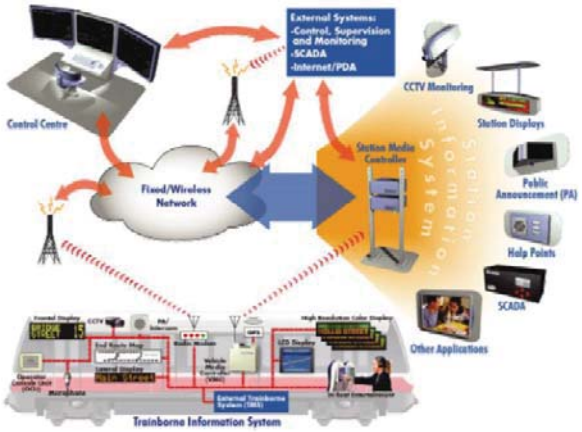

Figure 1: The Information System Standard for Passengers of Public Buses

The system for automatic announcements of the names of bus stops is a low-budget basic information system for public buses. (Patinge and Kolhare, 2012) The system requires no such advanced online technology as the coordinates tracking system or the real-time bus scheduling. In addition, the system is highly useful for passengers, enabling those who are unfamiliar with the area and the route as well as those with visual disability to feel safer, more comfortable, and less worried about reaching their destinations. (EKK, 2014) The advantages of both price and convenience resulted in the automatic announcement system being the first PIS system to have been implemented with public transports. In Thailand, the automatic announcement system has been implemented with the BTS sky trains, the underground trains and the Airport Link train. Studies indicate that the automatic announcement system is suitable for public transports in both large and medium-sized cities. (Isa et al., 2006; Patinge and Kolhare, 2012) It is also applicable for an organization with a large area and with many visitors from other areas such as a government organization with extensive grounds, a university and a hospital. From the aforementioned reasons, this research study presents a low-cost automatic announcement system for public buses operated through the application of a tablet with the GPS module acting as the announcer. The system consists of the first component which is a tablet with the GPS module and the android operating system which receives the bus location from the GPS satellite, and the second component which is an application developed to record the data of the bus stops and to make automatic announcements based on the actual coordinates data of each bus stop recorded in the database as compared to the real-time coordinates from the GPS satellite. If the coordinates match the conditions for an announcement, the announcement will be made through the speakers of the audio system installed in the bus. This system is low-cost and flexible in its function because a tablet is used as the main device in operating the automatic announcements. At present, an application can be developed to suit the users' needs and budget. Furthermore, it is a stand-alone system, which incurs no other costs in getting the data from the GPS satellite because the GPS module in the tablet can receive the data directly without having to resort to a mobile network.

2. Literature Review

This study employs related theories and various aspects of knowledge as follows:

2.1 The Concept concerning providing public services

Satisfaction is an abstract emotion or attitude which takes no physical form. When an individual's needs are met, the person is happy. Satisfaction determines the individual's expressed behavior affecting his decision to do such activities that bring him happiness.

In 1943, Maslow developed the motivation theory which features the Pyramid of Requirements or the Hierarchy of Needs where human needs are divided into 5 levels, which are further categorized into 2 general levels: the Lower-order Needs comprising physiological needs and safety needs, and the Higher-order Needs comprising social needs, esteem needs and self-actualization needs. These 2 levels of needs differ in the fact that the Higher-order Needs are related to the satisfaction felt by and within an individual whereas the Lower-order Needs are related to external factors such as payment. This leads to Maslow's Hierarchy of Needs.

Michael R. Fitzgerald & Robert F. Durant (1980: 586) define Public Service Satisfaction as the evaluation of the service performance by a local government based on perceptions of a genuine provision of services. Such evaluation varies one from another. Satisfaction is an abstract attitude with no physical form. To perceive an individual's satisfaction, one needs to observe rather complex expressions. Hence, it is difficult to perform a direct evaluation of satisfaction, but it is possible to evaluate the satisfaction indirectly through assessing individuals' opinions, provided that the opinions truly represent their feelings.

2.2 The Automatic Announcement System for Public Buses

The Automatic Announcement System for Public Buses or the Public Announcement System (Pa) (Eke, 2014) records the announcements in advance and makes automatic announcements according to the predetermined physical mechanism or computer program. The system is installed in public buses in order to provide information for passengers. It is part of the Passenger Information System (PIS) which constitutes a new standard for public buses. (Scinteie, 2012; Eke, 2014; Lawo, 2009). The system is relatively simple and cost-saving when compared to other current technologies. At present, the announcement system employs a digital voice recorder which works with GPS and GPRS devices to locate the coordinates of buses, and the system is installed permanently on every bus. (LAWO, 2009) In Thailand, few companies provide such installation service and charge high prices for the devices and installation fees. This research study, therefore, presents an automatic announcement system for public buses using a tablet with a GPS applied as a voice recorder and automatic announcer though the development of an application of a system for automatic announcements of bus stops. The application features the following functions:

1. Record the locations of bus stops and announcements of the bus stops when coordinates from the GPS satellite are received.
2. Delete, add and edit the data of the bus stops and the announcements.
3. Change and edit the bus routes.
4. Show a map locating the current position of the bus on the tablet screen.
5. Calculate the movement distance using the moving average algorithm in cases where the tablet is temporarily unable to make connection with the GPS.

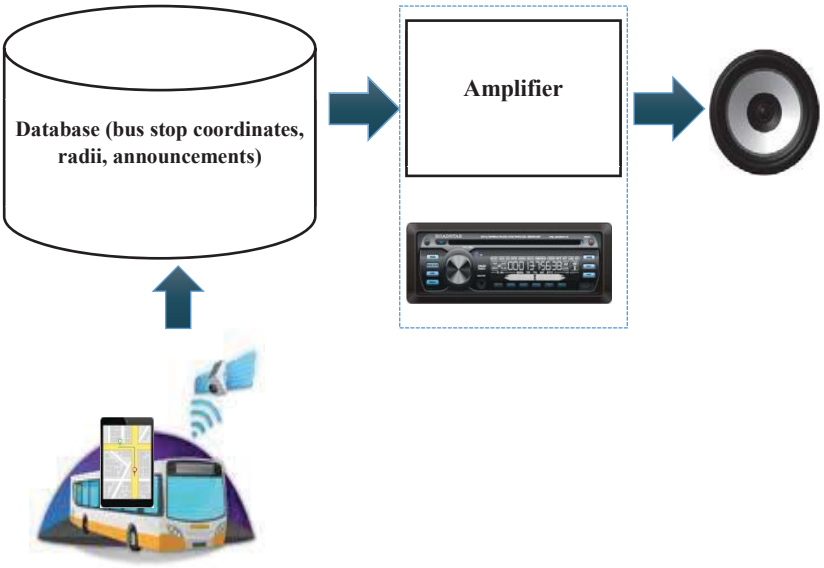

Figure 2: Components of the Automatic Announcment System for Public Buses Using a Tablet

Figure 2 shows the automatic announcement system for public buses. The tablet receives the location from the GPS and then compares it with the bus stop database. If the radius is within the predetermined area, the announcement of the coming bus stop is made by sending audio signals through the tablet's audio port to the AUX channel of the bus audio which acts as the amplifier. This research employs a tablet that features the GPS as the main tool for automatic announcements. Several advantages have been found in such employment. The system is low-cost and easy to install. Users can conveniently add/delete bus stops and adjust the bus routes through the application shown on the screen. The tablet can also be used for other purposes when the bus is out of service. The simple and cost-saving system makes it feasible to be installed in public buses by small bus companies and to be used anywhere.

2.3 The Concept of Android Application Design

The basic components vital to an efficiently-designed mobile application are as follows (cited in Nitikorn Ninsak, 2010, p.39): simplicity, consistency, identity, useful content, navigation, visual appeal, limitless usage, reliable design and spot-on operating system. Moreover, Empirical Works (Empirical Works, 2016), a leading Australian application development company, states that in order to design an effective mobile application, one must do the following: make the purpose obvious, maintain an overall simple design, avoid clutter, use icons, create short-cuts to access the data and to make use of pictures, choose a format that is suitable for all the designs in the application, develop an application on all popular platforms such as iOS and android, simplify the format for convenient use on a mobile screen, avoid colours that are too bright, create easy-to-use buttons, and use readable fonts. In addition, to design a non-website mobile application, the design must focus on simplicity and stable functions that enable users to download data faster than a website.

Therefore, application designers must consider the application's uses and usability; make the application convenient and easy to use and to understand; enable the users to learn to use it quickly, to search for desired data easily, to access the data in different parts of the application conveniently and to be satisfied with the application; and continually update the application to attract users including selecting

suitable appropriate colours, pictures and graphic designs to best represent the image of the organization. In this stage of development, a computer programming language is used in order to ensure that all the elements of the application can function together flawlessly, especially in the graphical user interface which works with the back end system. (Dawid Novak, 2016)

System Analysis and Design Theory

System Analysis is a study, analysis and classification of problems in a system in order to provide a guideline for solutions according to the requirements of the users and the financial situation of the company. System Design is the development of a blueprint for a new system as required in the system requirement documents specifying necessary components such as input output, user interface, and data processing in order to ensure the system reliability, accuracy, maintainability and safety.

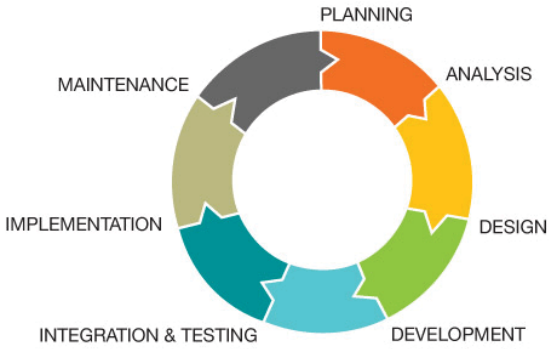

Figure 3: System Development Life Cycle (SDLC)

System Development Life Cycle (SDLC) is a logical process in the development of an information system to solve business problems and to respond to users' needs. The system could be a newly developed system or an improved version of an existing system. The cycle divides the development process into phases, namely Planning Phase, Analysis Phase, Design Phase and Implementation Phase. Each phase comprises different steps according to the methodology used by the analyst to suit the financial status and readiness of an organization.

The steps in the system development cycle help the analyst to operate systematically, thus enabling him to control the operation period and budget of the system development project. The steps are similar to the problem-solving scientific management in that it follows the same scientific thread: discover the problem, find possible solutions to the problem, evaluate the solutions, select the best solution, and develop the solution into a workable option. This study observes the 7 steps of the system development cycle as follows:

1. Project Identification and Selection
2. Project Initiating and Planning
3. Analysis
4. Logical Design
5. Physical Design
6. System Implement
7. System Maintenance

2.4 Use Case (Use Case Diagram)

A Use Case Diagram is a diagram showing the user's function and the relationship of sub-systems within the overall system. It gives an overall picture of the system's operation process from the point of view of an external user. In a Use Case Diagram, the user is specified as an Actor and a sub-system as a Use Case. The

main objective for writing a Use Case Diagram is to tell the overall story of the system showing the functions of the system and gaining requirements or system stories from the user. This is the starting point in a system analysis and design. As for the symbols used in the Use Case Diagram, a human figure represents the Actor, an oval represents a Use Case, and a straight line represents the connection between the Actor and the Use Case and shows how the Actor uses the Use Case. Moreover, every Use Case must be put into the same square with the system name. The relationship between Use Cases means the relationship of the Use Cases within the same system. (Booch, 1998, cited in Kanchanee Phetthanan, 2013, pp.11-12)

2.5 A Guideline for the Development of an Andriod Application Using Java JDK, Andriod SDK

Java Development Kit or JDK (Java Development Kit i, 2015: website) is a set of tools used to develop the JAVA program of Sun Microsystems. Anyone wishing to develop a program using Java language such as Java Compiler, Java Debugger, Java Doc, Java Interpreter and Java VM must install JDK in order to compile and run Java. The latest version of JDK is Version 7 which contains programs such as the compiler program (Javac.exe), the interpreter program (Java.exe), and the debugger program. However, this version does not have an editor program.

Andriod SDK stands for Andriod Software Development Kit. It is a set of programs developed by Google to be downloaded by application developers and anyone who is interested for free of charge. This is one of the factors leading to a rapid increase of the number of android applications. The SDK features programs and libraries necessary for android application development; for example, Emulator which enables users to create applications and test run them on the emulator that simulates the context of the real android operating system.

3. Research Methodology

The development of the android automatic announcement system for public buses is the creation of a new system based on a study and collection of various data. The development consists of the following steps:

Step 1: Analyze the problems and study the data.

Step 2: Analyze and design the system.

Step 3: Develop and verify the system.

In Step 1 (Analyze the Problems and Study the Data for the System Development), the researcher studied the problems and limitations affecting the development of the system as well as theories and concepts related to the project. More specifically, the researcher studied the problems and contexts of public buses in order to gain an insight into the context and difficulties of public buses. Then, the researcher studied tools for android application development choosing JAVA as the main programming language because it is an easy-to-use language as well as the most efficient at present. After that, the researcher studied the components for android application development, meanings and types of android applications, related research studies and applications, the JAVA Script language, and android application development using Android Studio – an application software used by android application developers. Finally, the researcher designed a concept for the development of an android application for automatic announcements on public buses, which can be conceptualized as in Figure 4

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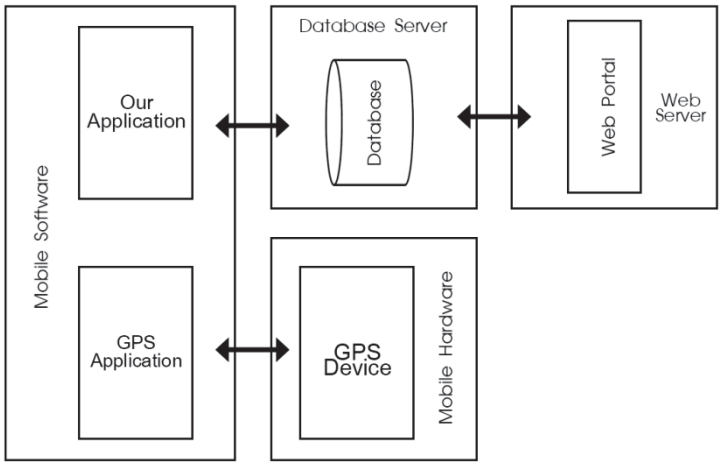


Figure 4: A Model of the Android Application for Automatic Announcements on Public Buses

Figure 4 shows the operation process of the application system which functions through the Database Server though the Web Portal function. The system acquires the GPS data through the application, relying on the GPS device within the mobile software. Then, the data are recorded in the database at intervals as pre-determined to activate the function in the announcement system.

In Step 2 (Analyze and Design the System), the researcher applied the concept of Use Case Diagram (Figure 5) in designing the Data Flow Diagram (Figure 6) to show the overall process of the application operation including the language of the development and the framework used in the development. The overall picture of the application development process can be shown in the following figure:

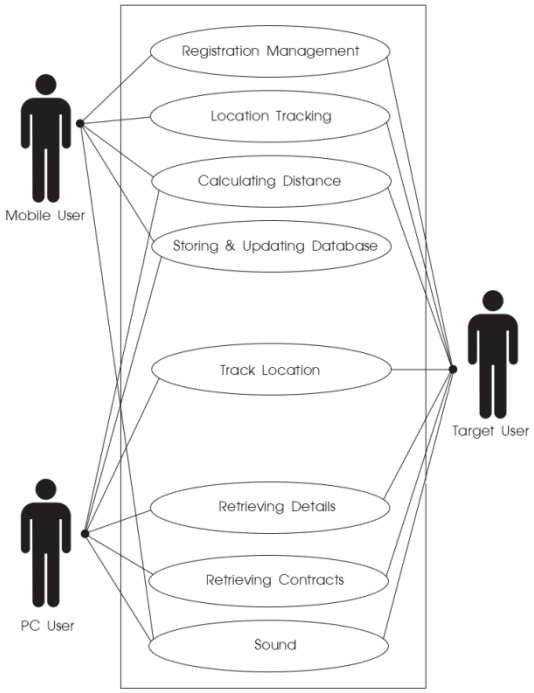


Figure 5: The Operation Process of the Use Case Diagram of the Android Application for Automatic Announcements on Public Buses

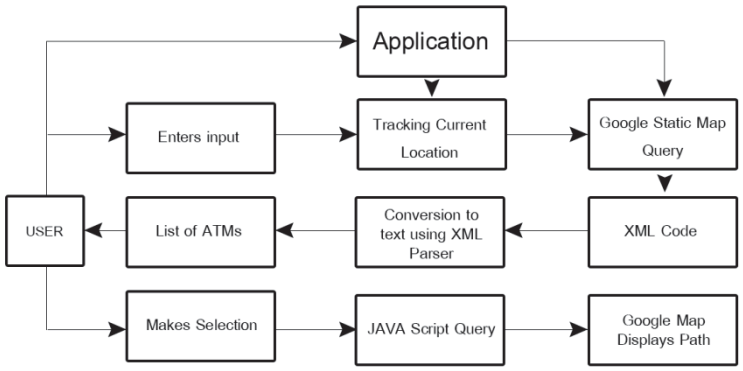


Figure 6: The Operation Process of the Data Flow Diagram of the Android Application for Automatic Announcements on Public Buses

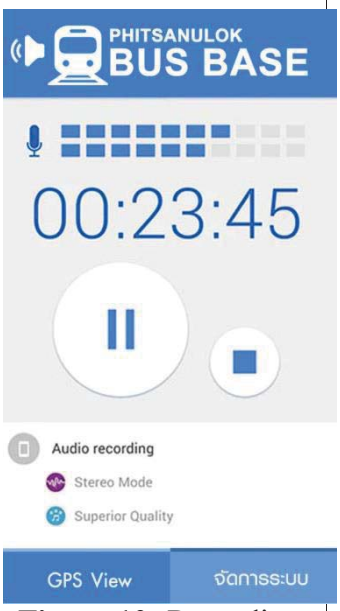
Figure 5 shows the operation process of the Use Case Diagram of the application. Mobile users can apply for membership which enables the users to manage the locations, routes and announcements to be uploaded onto the Database Server. Then, application users can activate the service through Track Location. The system will send the data, details of the journey and voice notifications to the application users through the GPS signal system on smartphones.

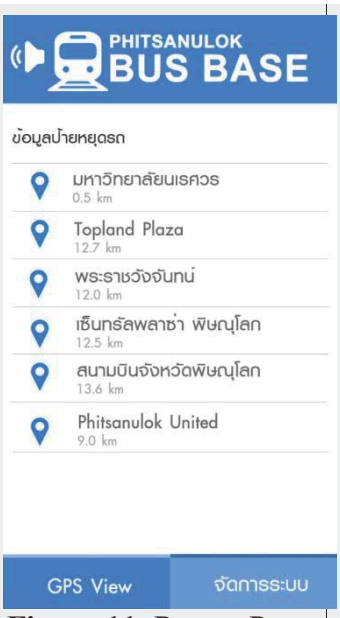
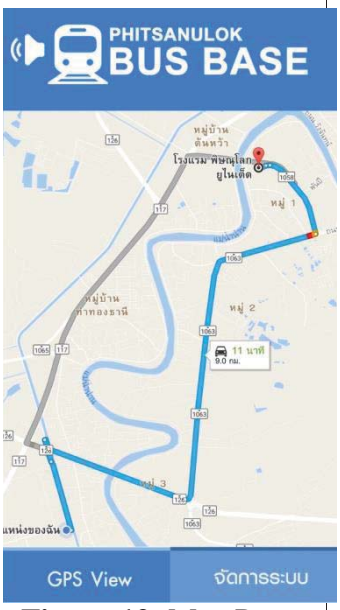
After the system design and analysis, the researcher determined the tools and technology to be used for the system development by selecting the Android Studio program to develop the android operating system, a 3G smartphone, the android emulator operating system, the JAVA Script language to develop the system, the Google Map API system to create maps, My SQL to create the database management system, and the Photoshop program to deal with pictures in order to create an application that is ready in its function and user interface before piloting the application.

4. Results

From the system analysis and design of the development of the android application for automatic announcements on public buses and the operation of the android automatic announcement system on public buses, the operating screen can be summarized as in the following table:

Application Design Results	Page	Function Qualifications
 **Figure 7:** Splash Screen	Splash Screen	The Loading page of the application shows the application logo. The principles of the Splash Screen involve creating a separate Thread to delay the time and use Intent as the command to go to the main menu, which is an essential page for all applications.
 **Figure 8**: Login Page	Login Page	The Login Page for general users and administrators categorizes the rights to access the data to add, delete and edit the locations and announcements. If a user forgets the password, he/she can select 'Forget Password?' to acquire a password to access the system anew.

 **Figure 9**: Main Menu	Main Menu	The main page of the application shows the services provided by the application including the data for the announcements, bus stops, bus routes and bus locations.
 **Figure 10:** Recording Page	Recording Page	The Recording Page is for the system administrators. Voice is recorded in the .mp3 format and then input with the GPS locations for the announcements in the application.

 **Figure 11**: Report Page	Report Page	The Report Page shows each of the locations starting from the one nearest to the user. Users can choose to view the report as a list or as a map.
 **Figure 12**: Map Page	Map Page	The Map Page shows the route from the current location to the destination.

The data analysis results of the development of the android application for automatic announcements on public buses are shown in Table 1:

Table 1: The Experts' Evaluation Results of the Development of the Android Application for Automatic Announcements on Public Buses

Item	Satisfaction		
	Mean	**S.D**	**Level**
1. System Function	4.16	0.85	High
2. Objectives Met by the Application	3.69	0.70	High
3. Convenience	3.60	1.00	High
4. Application's Result Processing	3.77	0.85	High
Total Average	3.80	3.05	High

5. Conclusion

This research study develops an android automatic announcement system on public buses aiming to study the efficiency of the GPS in a tablet and to create an android automatic announcement system for public buses for the convenience of passengers. Compared with the current technology, the system is relatively simple and cost-saving. A tablet with the GPS is applied to be used as a voice recorder and announcer of the bus stops. The application is able to record the locations and announcements of the bus stops through the coordinates sent from the GPS satellite, to add/delete and edit the data of bus stops and announcements, to change the bus routes, to show a map of the current location of a bus, and to calculate the movement distance using the moving average algorithm if the tablet temporarily loses connection with the GPS. The system is designed to be user-friendly, functioning in the Google Map API system and the android operating system that can track the current location of the bus, search for the school and information of the driver, add/delete and edit places, send notifications to the next pick-up spot, and announce the location of the next stop.

From the study of components of the computer program employed to create the android application, it was revealed that, for the design and content, the application was rated to be at the "good" level by the experts. The group efficiency test suggested modifying the components of the content design by increasing the functions in the application. The android application for automatic announcements on public buses has the efficiency level at 2.26, which is higher than 1.00. This means that the application is efficient according to the standard criteria of the SDLC-based design analysis. Therefore, this application could be suitably used on public buses for their announcements. The screen functions, the responses of the android operating system and the Google Map API are able to function effectively, receiving locations and tracking GPS movements accurately. The system also allows for the effective addition of location data and voice recording, resulting in the convenience of the passengers and the quality services of the public buses.

Therefore, the mass transportation system can make use of the android application for automatic announcements on public buses to accommodate passengers, informing them of the next bus stop and reducing the risk of missing their destination. In addition, the application is low-cost, easy to install and use and suitable for buses operated by both large and small firms. The tablet can also be used for other purposes when the bus is not in service. The driver can also use his mobile phone to operate the application. The firms are not even required to invest in the installment of GPS devices on their buses.

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