Development of android-based apps for courier service management

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Article Info	ABSTRACT
	E-commerce has grown exponentially over the years. The growth has been characterized by strong consumer demands and the increasing number of various products available online. This in turn creates a logistical problem and a high demand for an efficient courier service to support the growing markets. It is very important for courier service provider that the delivery of the parcel is being done as fast as possible. One of the courier service's vital and most crucial business process is in the last mile parcel delivery. This is where an efficient delivery service will be of utmost importance. An efficient system needs to be developed in order to facilitate the interaction between the courier service provider and consumer to precisely determine the optimal route for the parcel delivery. In this paper, an Android-based application system for courier service management with last mile route tracking module is developed. It is a mobile application that eases the courier delivery personnel in finding their way to deliver the parcels to the customer's doorstep. The application will guide the courier personnel to get a list of courier data such as address and contact information and then navigate them to the selected customers' addresses based on traffic data retrieved from Google Maps API. It will choose the best route to the address and notify the customers before arriving so that the customers are ready to receive the parcel. This last mile route tracking for parcel delivery will provide the basis for an efficient courier service system.

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1. INTRODUCTION

Nowadays, e-commerce stores have been mushrooming thanks to the shift in consumers behaviour as more and more shoppers prefer to shop online. Recent statistics show that Malaysia boasts a 15.3 million online shoppers constituting 50 percent of the population and 62 percent of mobile users shop online [1]. The rise of online shopping requires the modernisation of the parcel delivery services especially in the last-mile delivery [2-4]. Currently the last-mile delivery service, especially of parcels, is getting a great deal of attention in the media and from customers as well as investors around the world [5-8]. In Malaysia, the number of Courier Service Companies has been increasing to support the need for the parcel delivery services. As of 1st Quarter of 2017, a total of 122 Courier Service licenses have been issued by the Malaysian Communications and Multimedia Commission (MCMC) [9].

In Courier Service System it is crucial that the parcels arrive on time at the destination to the satisfaction of the customers. In order to ensure the fastest delivery of parcels to the customers, it is required to find the fastest route with minimum traffic from the point of delivery to customer destination. At the same

time the customers should be informed of the delivery time on continuous basis or in a suitable time period. Responsive communication between these two parties will definitely improve courier service efficiency and customer satisfaction. The purpose of the research is to develop a framework and android application that can help in building the platform for more intelligent parcel delivery system by combining the use of the current communication technologies such as GPS, Waze, Android tools and cloud services. It will help the courier service systems to intelligently manage the parcel delivery process and to deliver the parcels at a convenient time to the customers.

Based on traffic data obtained in a survey done by Malaysian Communications and Multimedia Commission (MCMC), courier traffic data shows an increasing trend in the past two years as shown in Figure 1 [10]. Thus, this application must provide navigation service for the courier personnel to efficiently dispatch and deliver the parcels. Based on the system that is now available, they usually have to navigate themselves to the customers' addresses and have limited ways to determine the fastest route.
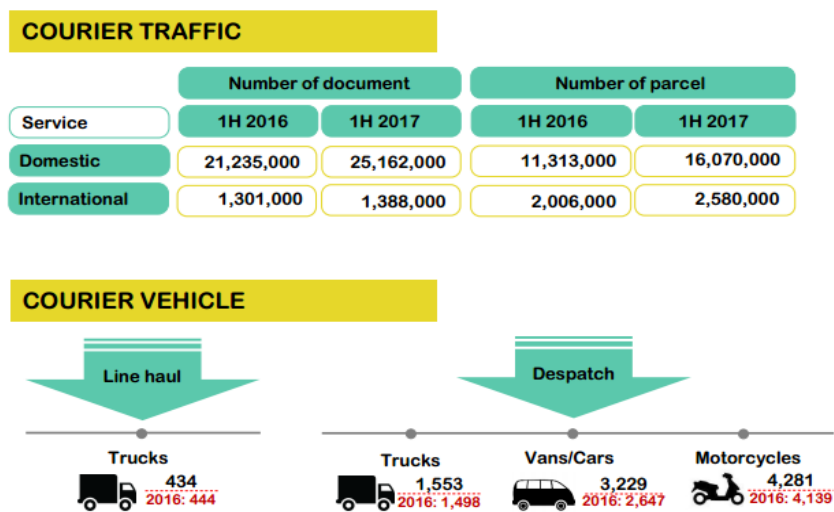

Figure 1. The number of Courier Traffic and Courier Vehicle in Malaysia

Traditionally, parcel delivery service only focus on Business to Business (B-to-B) market sector. However with the explosive growth of e-commerce, Business to Consumers (B-to-C) and Consumers to Consumers (C-to-C) market sector also started to expand rapidly [11]. As a result, courier service providers rapidly expand their network and implement a system to facilitate the logistical problems between the terminals/warehouses. Although the service providers invest heavily in expanding the network, the last mile parcel delivery service however, suffers from low service quality. This is due to the last mile delivery service still follows the the old B-to-B methods where low-frequency big logistics are the norm. In B-to-C and C-to-C market, the parcels are often high-frequency and small logistics [12-14].

In improving the parcel delivery service, an automatic parcel delivery system was discussed in [15]. However, the system only focusing on the task of transporting the parcel from the warehouse's rack to the delivery vehicle using a transport robot. Mckinsey & Company extended the idea of autonomous last mile parcel delivery using drone and Automatic Guided Vehicle (AGV) [16]. However, as of now the cost of implementing such system outweight the benefit. In this paper, we are proposing a more practical approach that would improve the service quality by developing a systematic Internet of Things (IoT) based application using mobile device and cloud services. The proposed cloud service could also be easily used to provide a better user's experience for the consumers to track and interact with the delivery service provider to avoid unnecessary hassles.

2.   APPLICATION DEVELOPMENT

The project development consists of several stages with the objective of providing a comprehensive route tracking courier service that would increase the courier service efficiency in terms of cost and customer experience. The application server integrated with database system is developed to support online adminstration system. The Android-based application is developed in an Android Studio platform [17, 18].

The navigation function for the application is based on Google Maps or Waze API while the alert or notification function will be sent using SMS (Short Message System) or social media platform such as Telegram or even email service. All of these functions are integrated with the database of the customers' parcels information in the administration system.

2.1. System Framework and Architecture

The system framework and architecture provides the broad overview of the system as well as the workflow of the application as shown in Figure 2. This diagram shows the system's interconnection between each module and the platforms that will be used in each of the system's components.
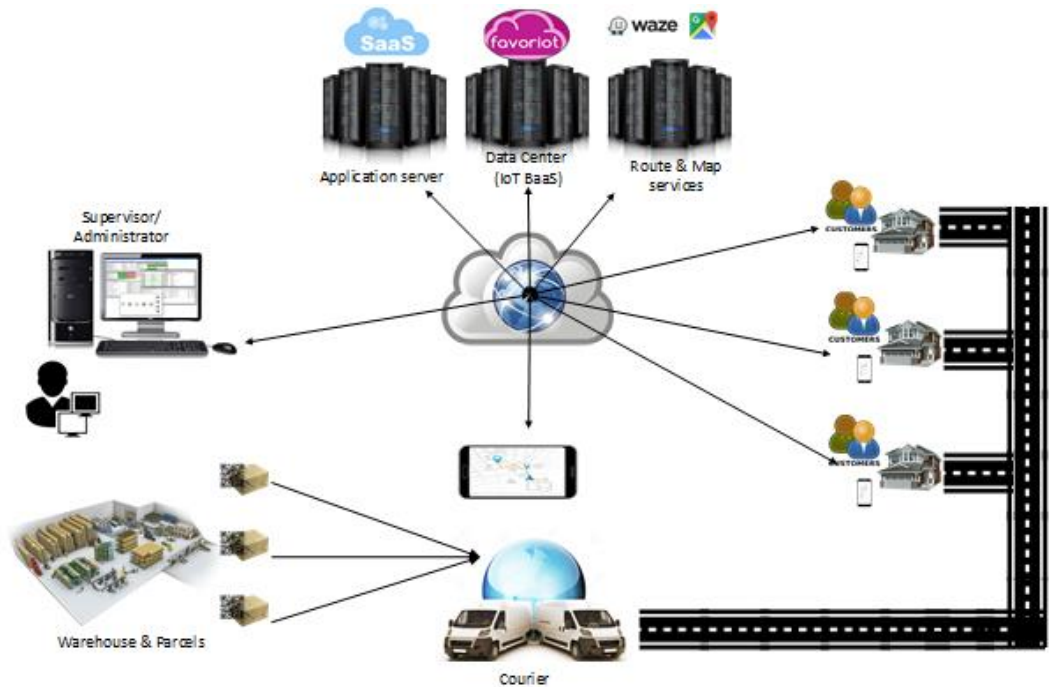

Figure 2. The framework of the system development

From the framework, there are several components or modules that must be developed. Back-end service such as parcels and user information management, route management and application provisioning would be developed as a Software as a Service (SaaS) on the cloud platform. The SaaS framework is a platform where all the components would converged and managed to facilitate the entire system operation. It would be able to handle the requests and responses from the system administrator, courier service provider and customer application. The Android-based mobile application needs to be developed for both the courier service and the customer. In this paper only the web-based application for the administrator and Android application for the courier personnel would be discussed.

2.2. Web-based application for system administrator

The web-based application for parcel management system is hosted on the application server to provide a key functionalities to track the current inventory and status of the delivery as well as to compile the statistical data on delivery. Figure 3 shows the overview or layout of the system with the tools that are used for each module development. The management of the parcels, customers and courier information are required in order to make them available to the relevant applications in a logical manner.

The system architecture for this Android-based mobile route tracking application is based on four (4) major modules as shown in Figure 4. Mobile User Interface (UI), Control Unit, navigation (Google Maps) API and customers database modules. Each modules plays an important role and defines a specific function in the overall application and system. In particular, the web-based service uses Node.js and PHP framework to provide the service together with MySQL database management system. For mobile application development Android studio with Android SDK is used.
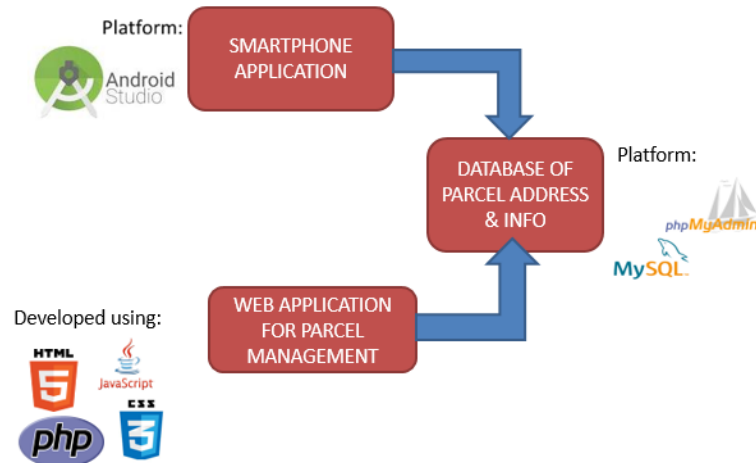
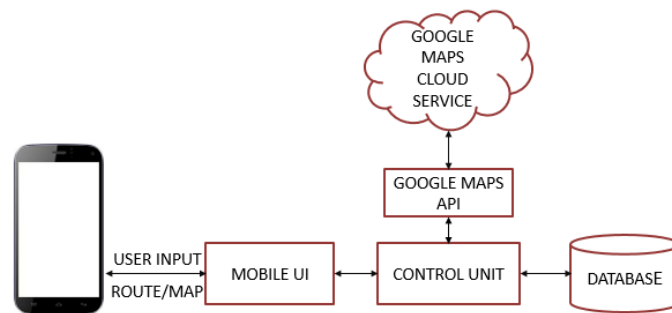Figure 3. The layout of the system and the tools used

Figure 4. System Architecture for Route Tracking Application

Mobile User Interface (UI) will enable courier personnel to scan Quick Response (QR) code of parcel that they wish to deliver. The database will response to the query and provide required information such as customer mobile contact number and address or drop-off point for the parcels. The control unit will control the communication between every modules and make decision to convey appropriate information to all modules in the system. The database module as the integral storage system will store and provide information needed by the courier personnel. Basically, it stores the customers mobile contact numbers, addresses or drop off points and also tracking or order number for the parcels. The Google Map API is used to provide efficient route to the customer location and real time location of the courier personnel. The integration of the whole modules will provide a very efficient system for the last mile route tracking courier delivery service.

The devices used in the project are mainly an Android-based smart mobile phone and a computer platform. For the transport communication protocol, it mainly uses cellular data network for better coverage with a reliable connectivity.

2.3. Development of Android Application

Android Studio is an integrated development environment (IDE) that is available for free in its website [19]. It is designed specifically for Android software development and is built on top of JetBrains' IntelliJ IDEA software. The software is available on three (3) different computer operating system (OS) that is Microsoft Windows, MacOS and also Linux based OS.

The coding is done in Android Studio environment as the software has a lot of dedicated tools to support the functions required with an arranged code structure. In the development process, the files that have to be included to create and design a functioning Android UI are Extensible Markup Language (XML), Java and Android Manifest files. Each of these files have their own function in the implemented application. The XML file can be used to design the UI for each and every page of the created mobile application such as button, textbox, text editor etc. In Java file, the function of each button in the XML file is determined and established before it can be linked to other functions in another page. Android Manifest file is needed just

once for the whole application with the function to allow usage permission and to inform the specified requirement in the application.

The minimum SDK chosen for this particular project development is Android 4.4.2 [20]. Figure 5 shows the whole flowchart for Android-based application for the courier service provider. Each personnel is given individual account to access the system in order to retrieve the parcel information for the customers in the database. After logging to the system, the route to the destination will be managed by the Navigation Module. It will be integrated with Google Map API and suggest the shortest path to the customer address [21, 22]. The tracking service would handle the request from the courier application to update the status of the parcel and track its progress.
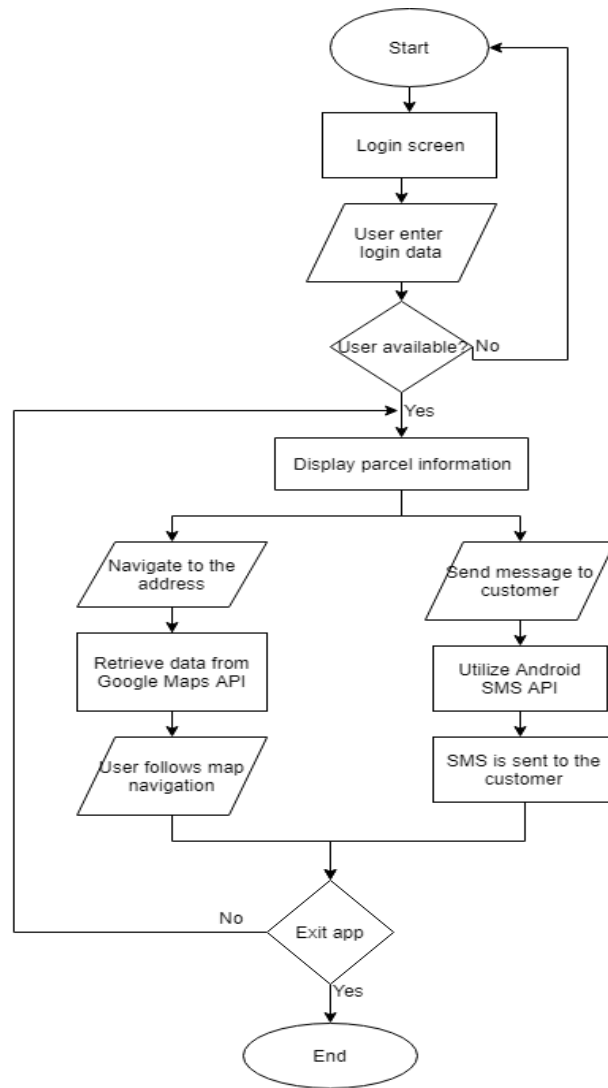

Figure 5. Flowchart of the Android-based Application

At the same time the Messaging module will send Short Messaging System (SMS) alert to the intended customer to inform the delivery of the parcel. This module will work with Android SMS API function to do the task of messaging [23]. This module is responsible to handle the communication (such as alerts and messages) between the system administrator, courier and customer. Upon receiving the alert, the customers may reply via SMS on their availability. They may directly inform the courier personnel for re-scheduling using the same application if they are not available to receive the parcel. The parcel and courier status may be monitored by the administrator in real time through web-based management system.

3.   RESULTS AND ANALYSIS

As described in the previous sections, the main parts of the overall system are the web-based application management for the system administrator and Andriod-based application for parcel and route tracking. The web-based management system will provide the back-end service for parcels and customers information management. It will be integrated with the Android application that will be used by the courier service personnel that are resposible to deliver the parcels to the customers.

3.1. Back-end Software As a Service (SaaS)

The back-end web-based application management system that have been developed for this application can be accesssed through website http://iotcourier.com/. This website is the integrated platform for the parcel and customer databases and the Android application.

The database "*iotcouri_Ecourier*", includes three (3) tables called "employee", "parcel" and "user". In these tables, the parcel initial information was inserted to store the database for the parcel. It was stored in mySQL database for data retrieval via RESTful Application Programming Interface (API) [24].

Figure 6 shows the sample customer and parcel data in the system. It is managed by the courier service administrator to keep track of the parcels in and out of the system.

	cid	track_no	parcel_name	phone	Address	courier_status	EmpName
Edit Copy Delete	7	EP1518MY	Maleeha bin Hamda	0133260431	BT 5, Jalan Garuda, Larkin Jaya, 80350 Johor Bahru...	Packed	Muhd Rafie
Edit Copy Delete	8	EP15181MY	Muhammad Karim	0127538683	Taman Mutiara Rini, Johor Bahru	Packed	Muhd Rafie
Edit Copy Delete	11	EP15183MY	Muhammad Daud	0123456789	Taman Mutiara Rini, Johor Bahru	Packed	Muhd Rafie
Edit Copy Delete	12	EP15184MY	Hisham Ahmad Ali	0129859109	Rembau, Negeri Sembilan	Packed	Muhd Rafie
Edit Copy Delete	14	EP15182MY	Marouane Fellaini	0129115473	U6A 911, Kolej Perdana, Universiti Teknologi Malay...	Packed	Muhd Rafie
Edit Copy Delete	19	EP20012MY	Kameela binti Taahir	01128966936	110 Jalan Meranti Taman Melodies 80250 Johor Bahru...	Packed	Muhd Rafie

Figure 6. The list of customer and parcel information

Figure 7 shows the main landing page for the developed web-based Courier Management System. There are three (3) options available: the Track Courier for the customers to track the courier that they have ordered or will be receiving, the Employee Login for courier personnel login for courier check-in, and the Admin Login for administrator login access for managing the system.
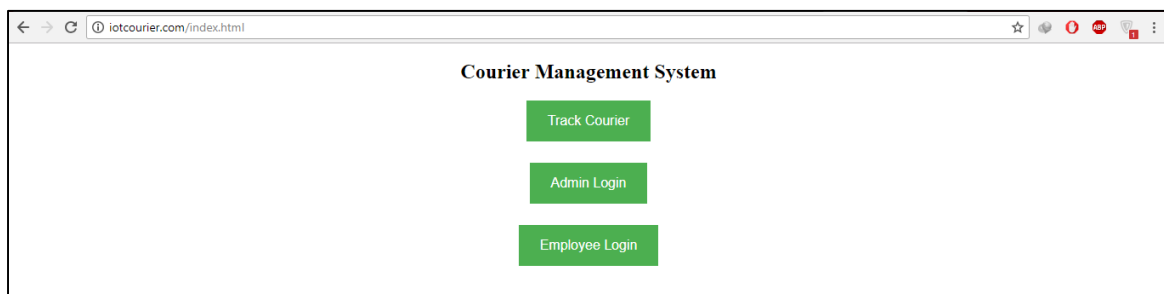

Figure 7. Courier Management System

Figure 8 shows example of the list of all available inventories that are stored in the system database. This allow the administrator to track the current inventory and current status of the delivery. This page will compile a statistical data (dashboard) on the delivery by giving and receiving alert from the courier personnel and customers.

Figure 8. An example of the list of parcels information in the system

3.2. E-courier Android Application

The E-courier Android application will be integrated with the database in the main system. This is to ensure the information of the parcels will be recorded properly and syncronized within the back-end system. This Andriod application consists of four (4) main functions namely Parcel Info, Courier Navigate, and Send Message. Each of these function plays an important role in ensuring the smooth interaction within the system. Figure 9 shows the application selection page for the main functions.

Figure 10 shows the courier navigation page that will be automatically activated when Courier Navigate button is clicked. In this interface, the destination address will be fetched and the Estimated Time of Arrival (ETA) to the destination will be calculated based on the distance shown in the Google maps [25].

Figure 11 shows the SMS alert message that will be sent to the customer. The 'Customer' text will be automatically replaced by the customer's name and the message will include the estimated time that the parcel would arrive.
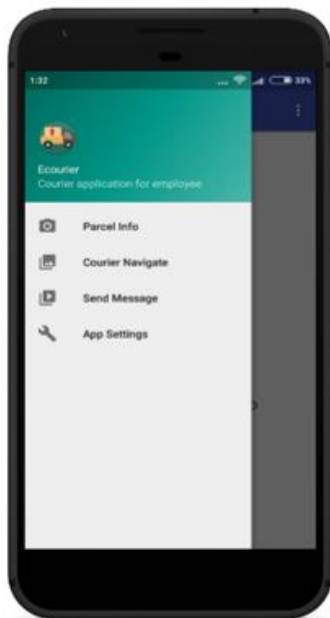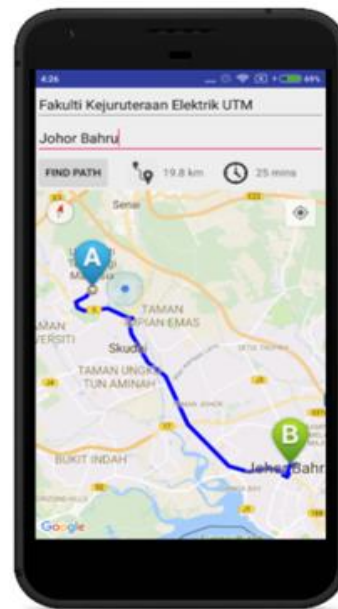

Figure 9. The application selection page
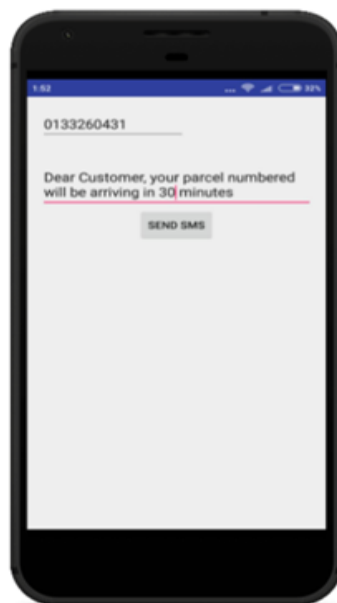

Figure 10. Courier navigation page

Figure 11. Example of SMS text to the customer

4.   CONCLUSION

The platform for back-end courier management system with Android-based route tracking system for the last-mile courier service has been developed. The web-based management system developed will ease the management of courier service and support more efficient last mile parcel delivery service. The Android-based application system is integrated with the management system to help the courier service personnel in navigating to the customers address and facilitating the communication between the two parties. This system definitely useful in helping the courier service to provide better delivery time for customers and better communication with the customers.

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