

JumPark Bah!®: Utilizing Smart City Infrastructure in Parking Management System for Kota Kinabalu Smart City

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Abstract. Kota Kinabalu (KK) is one of the pilot cities to implement smart city infrastructure in Malaysia. Given this privilege, lots of apps are needed to enable the city folks taking advantage of the high-speed bandwidth infrastructure. One of it is moving towards smart environment and smart government through supporting the green environment and cashless payment system for parking purposes. This paper describes the effort on the development of an apps, JumPark Bah! as an alternative to the current coupon-based parking system handled by the local authorities, Kota Kinabalu City Hall (KKCH). The current approach is quite cumbersome for KK city folks as they need to have a valid parking coupon displayed on the dashboard to park their car around KK city area. They must be able to correctly estimate the parking time or else summon will be issued if the parking time is exceeded. As for the KKCH, they need to assign many parking attendants for checking and validating the parking session. Thus, JumPark Bah! has been proposed as an alternative solution for KKCH by utilizing the concept of cashless payment parking system and is able to minimize the above-mentioned issues. The apps consist of a mobile application (for citizen and parking attendant) and the web-based system (for admin, i.e., KKCH). The web-based system allows the authority to monitor the fees, generate a report and even updates the user through announcement and news functionality. Based on the user evaluation using System Usability Scale (SUS), it has been found that JumPark Bah! has achieved 71.06% score which exceed the 68% score for good usability target.

Keywords: Smart City, Smart Parking Management, Mobile Application, Usability Evaluation

1. Introduction

Kota Kinabalu (KK) is the sixth largest urban or metropolitan area in Malaysia [1]. With the recent announcement of KK as one of the pilot smart cities implementations in Malaysia, three focus area has been set – constructing transportation infrastructure, improving waste management system, and setting flood mitigation system. As part of the initiative, the introduction of free broadband and Wi-Fi installed around the city will be able to turn KK toward smart city besides its' popularity as a tourism spot [2]. The existing public transportation system in Kuala Lumpur city can be a model for KK city, in terms of the adoption of smart technologies like artificial intelligence (AI) in their ticketing system, parking system, bus route or schedule system, terminal operating system and related smarty city apps.

KK city folks are among the most active city people who constantly drives in and out of the city since most businesses and services are in the city or, if not towards the city. Lots of people still are using cars to drive in town due to the limited public transportation availability. This leads to a lot of parking



spaces built in the city area. However, the parking system of the KK city is quite medieval which is still using the old method of scratching the coupon cards to record your parking details. The coupon cards are pre-paid with prices varies from types of parking spots identified with colours.

With the current method, sometimes it is hard for the user to even park for an hour. User needs to buy the coupon cards in a pack and use it whenever they need to park around the city. User then is required to scratch the parking details and display the coupon cards on the dashboard of the car where it is visible to the parking coupon agents. When the parking time has ended, the user is required to exit the parking, or the coupon agent will issue a summon ticket to the respective car. With unexpected problems, user is forced to go back to the car to extend the parking time by scratching another coupon card. Sometimes the scratched cards are such a waste if the user decided to exit the parking earlier than expected.

The Kota Kinabalu City Hall (KKCH) highest authority and the parking attendant has also no way in monitoring the parking of citizens of KK other than relying on the coupon agents in the city. The parking attendant must walk around the parking area in order to verify each of the car, whether they do display the parking coupon. If not, they will then issue summon for the car. This is quite troublesome for DBKK and the attendants as they are all working manually and has no other way to monitor the cars digitally, let alone all the parking coupon sales in a centralized system. Not to mention that human precisions can be affected by several factors such as tire, simple human errors, weather, etc. The report of the parking data is recorded on based of the coupon cards sold within a certain period. This is quite ineffective as everything is based solely on human energy with possible large number of errors. The existing systems are also lacking several functionalities, such as there are no web-based system for the administration of DBKK to monitor the parking activity and some missing features. All existing systems have no web-based system for the administration; thus, the administrator has no efficient way of tracking the parking records within a certain amount of time other than tracking the number of the coupon cards sold to the user. They do not cover some features including summon, advertisement, and announcement for the DBKK to interact with the users. They also do not cover the geolocation of KK city, and in Sabah in general, and have no function for the use of authority and parking attendants to monitor the parking session.

Thus, this paper will explain the development of paperless parking system which will be one of the possible solutions towards the smart city agenda in Kota Kinabalu.

2. Related study

2.1. Smart City Infrastructure

Attributes, themes, and infrastructure are all part of the smart city. A smart city's attributes are often referred to as smart city characteristics. Themes are referred to the pillars of the smart city because they are responsible for the city's continual development. Infrastructure, in fact, is a critical component of any smart city since it serves as the operating foundation. Typically, there are three themes for smart city concept [2]:

- Addressing urban challenges using information, communication and digital to improve urban management and quality of life, sustainability, efficiency, and security.
- Addressing the issues to increase economic and business activities.
- Continuous public participation and urban innovation.

The Malaysian Government has introduced national-level framework called “The Smart City Framework Malaysia (MSCF)” as a guideline and reference for planning and developing smart cities that in line with the current developments [2]. Stakeholders in this context refers to the Local Authorities as city manager, state governments, federal ministries and departments, industry players, academician, and other stakeholders. There are seven major components for smart cities in Malaysia (refer Figure 1)

to address the urban issues and challenges towards three main pillars namely, competitive economy, sustainable environment, and enhanced quality of life.

With the population of 457,326, Kota Kinabalu (KK) has been selected as one out of five cities in Malaysia as a pilot for the smart city project. As part of the initiative, the introduction of free broadband and Wi-Fi installed around the city will be able to turn KK toward smart city besides its popularity as a tourism spot [3]. Utilizing this smart city infrastructure, more applications can be developed to support the smart city project. One of the examples is the development of this JumPark Bah! project, where it will help DBKK as well as public users related to parking management system.

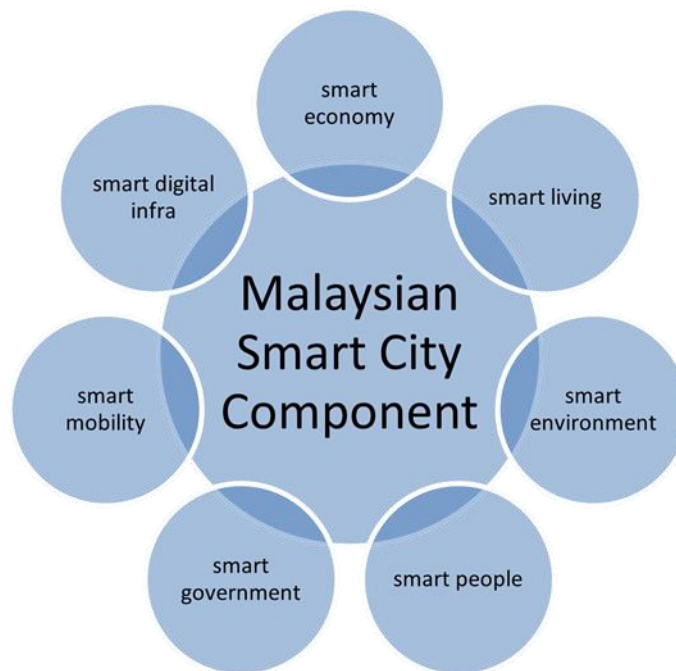


Figure 1. Malaysia Smart City Component [2].

2.2. KK Parking Management System

Coupon Parking System is a paper-based system which allows the user to buy a coupon book ahead of time. When the user stops in an assigned parking spot, a coupon needs to be removed and scratched out the present date and time. It must be displayed on the dashboard so authorization officers can see the day and time the vehicle is parked. Physically the coupon is much the same as a scratch-off lottery ticket, with the driver scratching off the date and time they are paying for.

The KK city area has three types of parking spots coordinated by colours. Generally, there are three zones, Zone A1: Short term (red), Zone A: Medium term (yellow) and Zone B: Long term (green). Each zone is priced at RM1.05 per half an hour (maximum 2 hours), RM1.05 per hour (no maximum time) and RM0.55 per hour (no maximum time) respectively. Currently, the KKCH has selectively listed 282 parking lot number marked in red colour, 3,081 in yellow colour and 6,951 in green colours around the city area. This Parking Coupon System will only be implemented on weekdays from 8:00 am to 5:00 pm and 8:00 am to 1:00 pm on Saturday [4]. KKCH has been handling all the parking spaces as shown in Figure 2.



Figure 2. KKCH Parking Zone [4].

There are many studies that were conducted related to this project [5,6]. The previous studies shown various ways to improve parking system, and some are reviewed as the backing idea to come out with this project [8,9,10]. The parking management system has widely implemented in other countries including Malaysia itself, but none is currently implemented in the targeted location, KK city. However, the proposed system still differs from the existing systems in terms of functionality, framework, execution, technology, and processes.

A more common method of paying the parking ticket is by using the e-Wallet app, Boost. Upon opening the “Parking” page, first time user is required to enter their car plate number, description, and the colour. After adding your vehicle, user can select the location available to the app which Boost currently only covers the DBKL (Kuala Lumpur) area and MPKM (Kota Bharu) area. After selecting the location, the user will be required to insert the parking hour and confirms the parking by inserting the 6 digits pin. The money will then be deducted from the Boost wallet [11].

2.3. Cashless Payment Parking System

There was no controlled parking anyplace yet in the mid-1920s to 1930s where individuals would simply leave their car in the avenues and abandon them there until they need them once more. Traffic blockage issues were basic in huge urban communities. The first parking meter was introduced in Oklahoma City on July sixteenth in the year 1935. The concept was simple: there is a meter machine installed near the parking lots and people will insert the coin in the machine and the time will start. When the time is over, your parking time will too [8]. As more individuals got cars, the requirement for a spot to park it was becoming greater and greater. Parking turned into an issue and urban communities were searching for

an answer to park however many vehicles as could be allowed on as meagre space as could be expected under the circumstances.

In most European nations, contactless payments are permitted up to the furthest reach of €25, and for parking up to €50, which covers by far most of parking fees. As we push ahead, credit and debit cards are getting redundant, and their usefulness is being joined into cell phones. It is evaluated that cell phone and tablet users will make 195 billion versatile trade transactions every year by 2019, and many trusts that cell phone payments will in the end swap payment cards and money for littler transactions [12]. With an empowered cell phone, the user just waves or taps the phone at the payment machine, similarly as they would for a contactless bank card transaction. The payment can be done by their bank, by the phone maker, by the telecom's specialist co-op, or by a 'digital wallet' administration. These alternatives are progressively helpful for user of the car park, as they don't need to stress over having change for the payment machine, and the time spent queuing is enormously diminished. The car park administrator likewise has many benefits, such as the instalment machines require less maintenance, and, with less money on the premises, risk is lower, and security is improved.

In the least difficult ticketless arrangement, the user displays a debit or credit card to open the obstruction and enter the parking area. They present a similar card again at the exit, and the sum due is determined, considering the time passed, and charged to the card. No ticket is required, and there is no compelling reason to line at a machine. The framework checks the legitimacy of the card when it is first exhibited, and this lessens its danger being declined upon exit. If the user can't pay with this card, the person can exhibit another card or select an elective payment strategy. User who pre-book their parking spot online utilizing a credit or debit card can utilize a similar card to identify themselves at the obstruction on entry and exit. Parking administrators can likewise deliver and deal with their very own dependability or season ticket cards or encourage esteem cards related to strip malls or different retailers, to offer clients a more extensive selection of pro-motions and approaches to pay.

As mentioned earlier, KK which is the newest addition on Malaysia smart city initiative, the current parking system method is impractical and inconvenient for the people of KK city area. Thus, JumPark Bah! is proposed as an alternative solution to fix the problem. This project proposes an Android-based mobile application system for the use of citizen and the parking attendants. A web-based application system will also be developed for the use of KKCH highest authority and system administration. This will not only provide a better alternative for KK city parking system, but also and drives KK city towards a city of cashless parking system in line with the selection of KK as part of Malaysia smart city initiative.

3. Methodology

The proposed system is developed to support the parking management system handled by KKCH in KK city area which consist of an Android-based and a web-based application. The system will apply client-server architecture as shown in Figure 3. A client-server architecture is a type of system architecture that the client will handle the presentation and application logic, whereas the server will handle all the data access login and data storage [6]. This type of architecture is chosen because the system would be able to serve client that use different mobile operating system in the future. Besides, this architecture utilizes the Internet to perform different kind of logics. Furthermore, the system will apply three-tiered architecture as shown in Figure 5, where three sets of devices involve in the system [6].

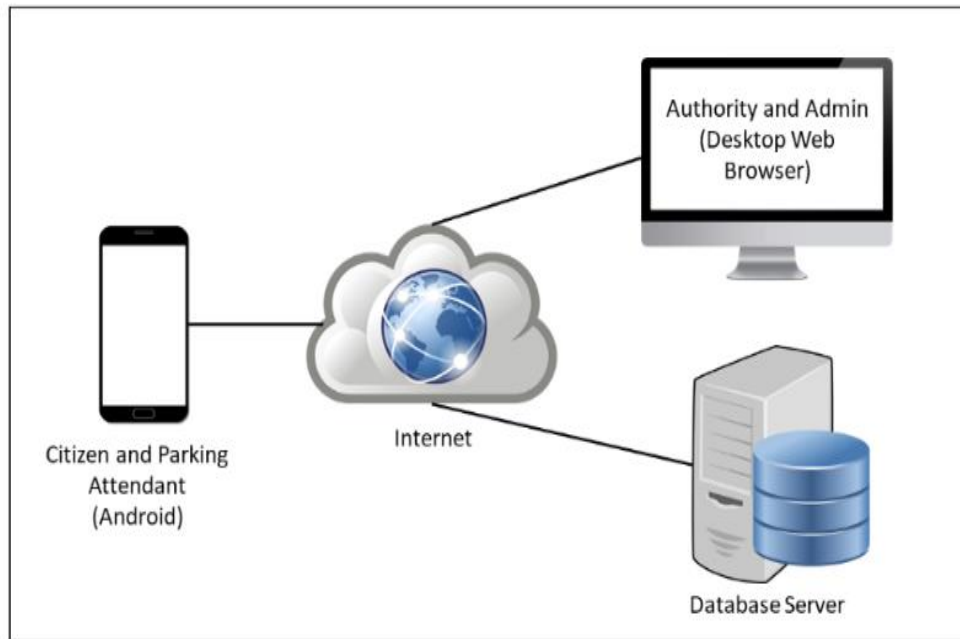


Figure 3. JumPark Bah! Architecture.

JumPark Bah! will show basic information like the KK city map, the parking area, the parking colours and its respective fees, and the city latest news and information as shown in Figure 4.

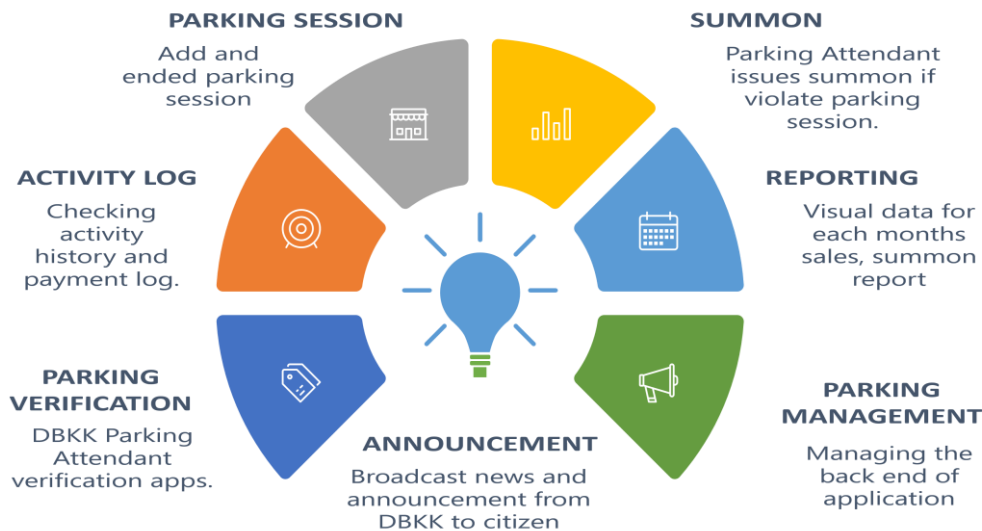


Figure 4. Summary of JumPark Bah! Functionalities.

This mobile application will be used by the users who will park their cars, etc. around the KK city. The function involves user logging in, registering their car, filling in the parking information (place, parking colour, time and time to leave), registering their card payment information and pay the parking fees with their payment card. We apply the concept of token to replace the coupon cash system where user need to buy token instead of coupon from any authorized seller as depicted in Figure 5.

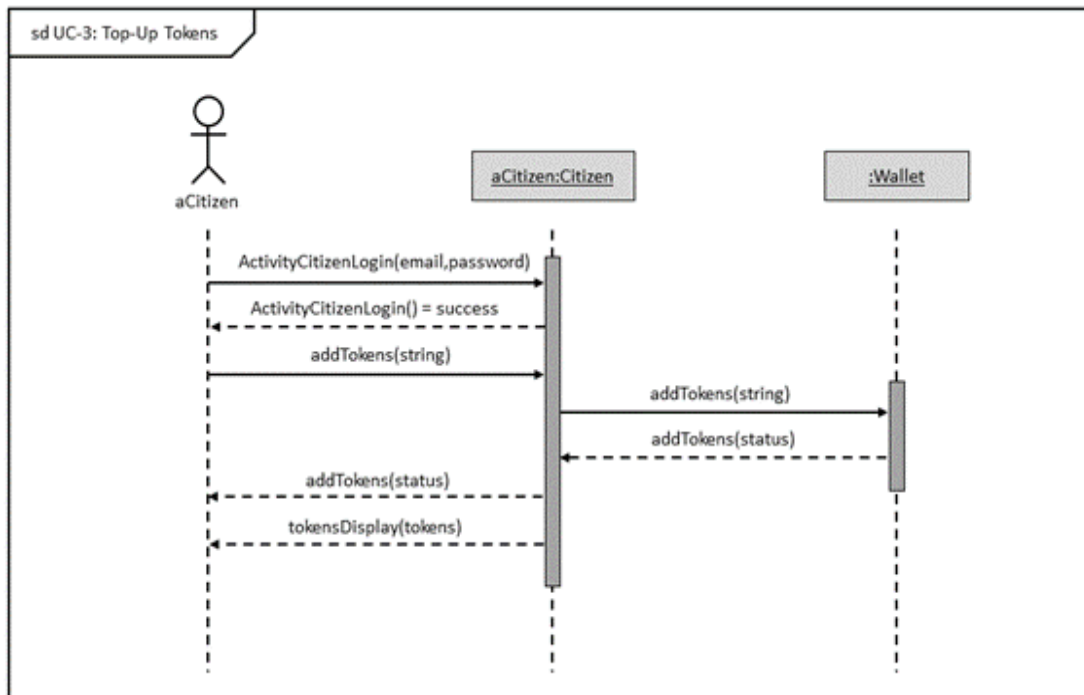


Figure 5. Sequence Diagram for Top-Up Tokens.

This system will also allow the user to check their summons, and view announcements and advertisements broadcasted by the DBKK administration. JumPark Bah! has also a login function for the parking attendant to use the mobile application for the functionality of parking session verification and issuing a summon. For the JumPark Bah! Admin, it is used by the DBKK highest authority to maintain and control the parking system, as well as to monitor all the parking details in the city, keep track of the records, broadcast news and announcements on the mobile app and view summon details. It will also be used by the administration of the system for maintenance purposes. Figure 6 shows some of the screenshots for JumPark Bah! apps.

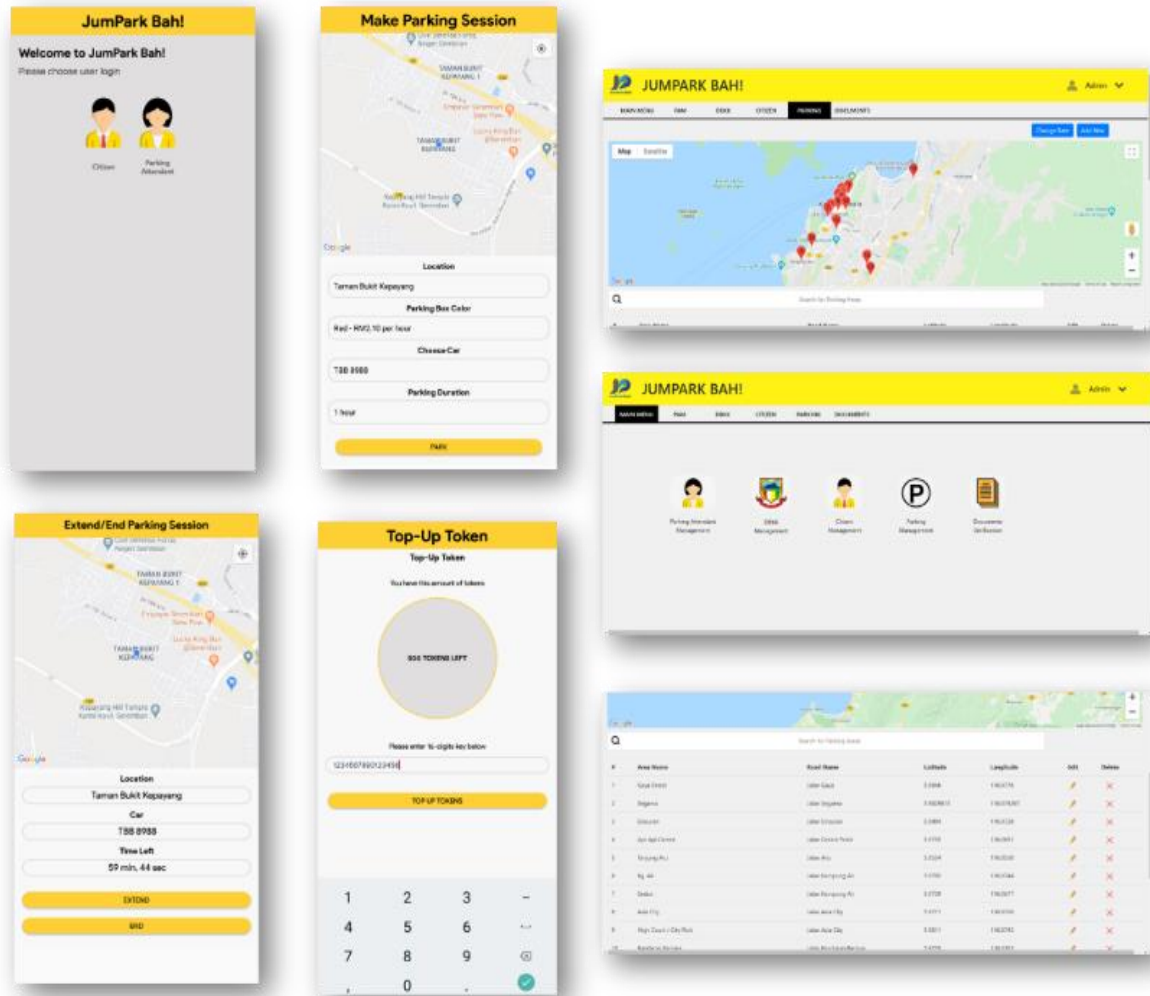


Figure 6. JumPark Bah! Apps (Mobile and Web-based)

The JumPark Bah! apps have gone through the unit, integration, and system test to ensure all the errors has been resolved before released it to the user.

4. Results and discussion

We have conducted user acceptance test using the System Usability Scale (SUS). The System Usability Scale (SUS) provides a “quick and dirty”, reliable tool for measuring the usability. It consists of a 10-item questionnaire with five response options for respondents; from Strongly agree to Strongly disagree. Originally created by John Brooke in 1986, it allows you to evaluate a wide variety of products and services, including hardware, software, mobile devices, websites, and applications [6]. The questionnaire is given to 64 people including 52 citizens, 6 parking attendants, 4 KKCH Staff and 2 system administrators. There are 10 questions of Likert-scale 5 in the SUS questionnaires. Based on the respond received from the respondent (refer to Figure 7), the highest average SUS Score is the System Administrator with 75% followed by the Citizen with 71.07%. The KKCH Staff (70.00%) is next and lastly is the Parking Attendant with 69.17%. In average, the SUS Score is 71.06% which exceed the 68% requirement as good usability.

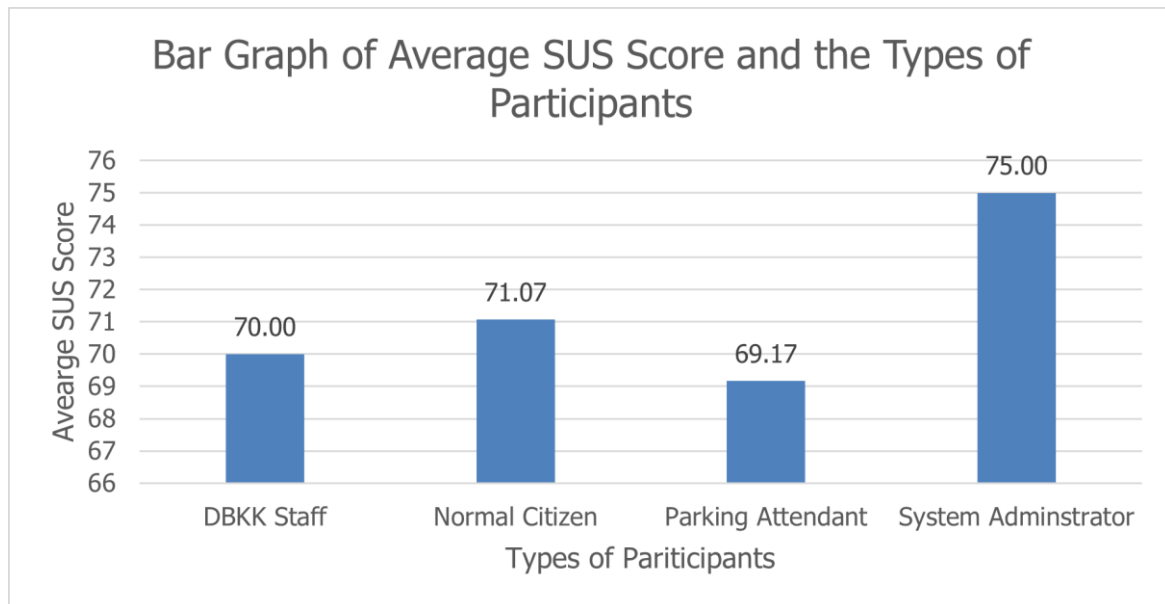


Figure 7. SUS Average Score on the Usability Aspect.

5. Conclusion

JumPark Bah! is promoting paperless and eco-friendly parking system by reducing the amount of paper usage in the current KKCH parking system. The apps will be utilizing the smart city infrastructure where users can access the apps through a freely available WIFI in the KK city centre. The KKCH parking management unit can monitor their parking system effectively by having the apps. The existing systems have no web-based system for the administration; thus, the administrator has no efficient way of tracking the parking records within a certain amount of time other than tracking the number of the coupon cards sold to the user. They do not cover some features including summon, advertisement, and announcement for the KKCH to interact with the users. They also do not cover the geolocation of KK city, and in Sabah in general, and have no function for the use of authority and parking attendants to monitor the parking. There is a high commercial potential in collaborating with KKCH for implementing the mobile application and web application system in KK City Centre.

Acknowledgement

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