Designing Parking Lot Finder Application

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Abstract. This study aims to create an application design that can provide information about the available location for parking lot users. Therefore, it is expected to reduce the effect of searching an available parking lot, such as traffic congestion and illegal parking. Literature study and object-oriented analysis and design were used as methods for this study. The results of this study were a design blueprint that could be used to build an application. The application was used for users search the locations of available parking lot nerby them or their destination using web or mobile web browser. Several ways can be used as a source of information about parking lot locations. First, parking lot owners can register their location. Second, users can submit parking locations and other users can verify the submitted location. Third, the government or local police can provide data regarding the parking area, for example, certain roads that allowed for parking. Thus, this application can help users to find parking lot locations and make users more obedient whenever they try to park their vehicles by not violating traffic rules.

1. Introduction

Using private vehicle is often a definite choice to travel. However, the lack of information regarding the legal parking location of public places and prohibited streets for parking result in illegal parking. This causes traffic disorder and triggering negative effects, such as reduced road width, which then causing traffic congestion. A study shows that traffic congestion in urban areas is caused by drivers who are looking for parking spaces with an influence rate of 28 - 45% [1]. By reducing the time for drivers to find a parking lot, congestion can be reduced [2]. Moreover, air and noise pollution can be reduced because drivers will find the parking lot more quickly, which means they will also turn off their vehicle engines faster.

Traffic congestion is a condition where the number of vehicles exceeds the capacity of the road. Congestion can increase carbon dioxide levels, if the level of carbon dioxide is too high, it can increase the environment temperature and affect the human respiratory system [3]. Besides, traffic congestion causes a total of 3.7 million hours of delay and wasted 2.7 million gallons of fuel [4]. One of the causes of traffic jams is illegal parking [5]. The main factor is the drivers who park their vehicle on-street make the road width decreased. Nowadays, the development of information technology has increased, information exchange can be done at any time. Information technology changes the face of the world that started from the real world into a cyber world [6]. Modern communication technology is available in various ways with each function that we can use in many ways. The scientific community began to consider the problem of finding a parking space by utilizing technology. For example, there is a parking management formation by utilizing wireless network devices or sensor communication [7]. Magnetometer sensors that are commonly embedded by smartphone users can also be utilized to detect the crowd level of a parking lot [2]. The trick is to make an application that records data carried out by...
the magnetometer sensor. Thus, each driver who uses the application will exchange information about the parking location automatically and presented its crowd level. Besides, forming an integrated city parking management with every available parking lots in that city can be done. This city parking management is commonly referred to as Intelligent Parking Assistant. This management consists of software components whose contents have the function to users for finding parking locations and reserving them, then the other components are hardware consisting of sensors as a support device of the city's parking system management software [8]. From this, we could say that the use of technology can be a solution to the problem of time-consuming parking lots search.

This study aims to create an application design that can help drivers to find parking lots. Therefore, the negative effects such as wasted time for parking lots search and the desire of illegal parking resulting in traffic congestion can be overcome.

2. Method
The method used to design this application is the study of literature as well as object-oriented analysis and design approaches.

3. Results and Discussion
There were five functions that users could use. The users itself could be a driver who looked for a parking space or a parking owner. These functions were cases from the use case diagram. Each description of the function can be found in Table 1.

| Use Case   | Description                                                                 |
|------------|-----------------------------------------------------------------------------|
| Registration | Registration was required for users who wanted to add a parking location or review and submitted parking lots location. |
| Login      | Users who had registered could enter the application as a valid user identity.     |
| Search Location | Users who had registered or not, were able to search for parking lot locations in the area they wanted. |
| Add Location | Adding a parking location function could only be done by users who were already registered. This user could be a parking lot owner or a normal user. |
| Review Location | Users could review parking lots that they had visited, regarding the accuracy of the parking location and the current condition of the parking lot (empty, crowded, or full). |

In addition to these five functions, there were two main roles in this Parking Lot Finder application. The first role was Users. These were drivers who would search for a parking lot, ordinary users who wanted to add parking location, or owners of the parking lot who wanted to add the location of parking spaces that they owned. The second role was Google Maps. It is used as a source of digital map presenters, which then would be displayed on the application. Google Maps provided an API that had features to add content for a location [9], which meant in this case, it could be used to add parking lot locations. Further descriptions of these two actors are shown in Table 2 below.

| Role | Description                                                                 |
|------|-----------------------------------------------------------------------------|
| Users | Users were able to search for parking lot locations, add parking locations, and review parking locations. The users could be an ordinary driver or a parking lot owner. |
| Role            | Description                                                                 |
|-----------------|-----------------------------------------------------------------------------|
| Google Maps     | Presents a digital map display when an area was searched by users through the application. |

When users used Search Location, Add Location, and Review Location functions, the Parking Lot Finder application would send a digital map location request to Google Maps. An overall picture of the Parking Lot Finder application system was modeled using a use case diagram in Figure 1 below.

![Figure 1. Use Case Diagram](image)

The menu structure addressed the access rights when users used this application. Several menus could only be accessed by users who had logged in. Nonetheless, users were not required to log in to search for parking lot locations. Figure 2 below is the menu structure of the Parking Lot Finder application.
This application centralized on a server. The server itself was a cloud server where the hardware computer devices could use commercial hosting services for more reliable hardware security. Costs for server security were lowered when it used cloud servers from a hosting service provider rather than providing devices and self-managed them [10]. This application was web-based, it meant the Parking Lot Finder application could be accessed using a web browser. Therefore, users could access this application through various devices. Users could access applications through smartphones, laptops, or desktop PCs that were nowadays certainly to have a web browser. In Figure 3 shown below, there is a network architecture for the application.

Figure 3. Network Architecture

Figure 4 below is the design of the Registration page display. Users who wanted to register need to fill in their email address, password, and name. After pressing the registration button, the system would
send a confirmation email address to users, then, the system saved registration data. Furthermore, users could log in and use features that could only be accessed by registered users.

![Registration Page](image)

**Figure 4. Registration Page**

Figure 5 is the Login interface design. Users needed to fill in the registered email and password form to enter the application to use the Add Location and Review Location features.

![Login Page](image)

**Figure 5. Login Page**

Figure 6 is the Search Location display. Users had to fill in the desired location, then the application system sent digital map requests to Google Maps in the desired area for the users. After the map was received, the system added available parking locations to the digital map. Hereafter, the results received
by users were a digital map display containing parking lot locations corresponding to their searched location.

Figure 6. Search Location

Figure 7 is the display of Add Location. Users was required to log in to access the page. For adding a location, firstly, users had to search for the location where the parking lot area was located. Then after the digital map display appeared, users could select which point was the parking lot located. Once the location was selected, users should give a name for the parking location.

Figure 7. Add Location
The Review Location display is shown in Figure 8. To use this feature, users must log in. Review Location was a form of verification between users. When users added a new parking location, other users should verify the submitted location. Moreover, users could send the latest conditions regarding the density of parking lot spaces, whether it was empty, crowded, or full.

![Figure 8. Review Location](image)

4. Conclusion
This research resulted in a design of Parking Lot Finder applications. This application serves the function to search for parking lots and then display locations of the parking lot in an area that is sought by drivers. The negative effects of searching for parking spaces can be reduced, such as traffic congestion, traffic violations, and increased air pollution. What makes this application different from other studies is the location of available parking lot places sourced from the users themselves without additional dedicated sensors or devices. Users will also verify the location of other locations added by other users to make the locations more credible.

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