**Motivation:**

In recent years, shared-use vehicle systems have gained a lot of popularity all over the world. These systems usually consist of a fleet of vehicles that are used by different individuals throughout the day. Shared-use vehicle systems have the potential to become an important link toward building smart and sustainable cities. These systems are attractive because they can potentially reduce the cost of commuting for an average person: people do not necessarily need to buy or lease a vehicle if their usage is limited. The focus of this thesis is to discuss a framework for developing a self-sustaining system capable of managing consumer requirements. Through an E-Vehicle Share System, a consumer can rent a vehicle at any location in the city if there is a working vehicle available at that location, return a vehicle to any location in the city after the consumer is done with its use, and report any defects the user may encounter during vehicle usage. Further, to realize the system in its full complexity, it is also capable of producing an operator interface that will allow the operator to track the location of all vehicles in the city, charge a vehicle when its battery has been depleted, repair vehicles that have been reported as defective by the user, and move vehicles around the city as and when required. To enable the manager to access all the consumer information through intuitive visualizations, a Power BI dashboard has been developed. This thesis will provide an overview of the existing software surveyed to implement the system, discuss suitable approaches to tackle this problem, and explain the design approaches implemented as well as the motivation behind choosing a particular design idea. We will also be discussing the technologies used to realize this system along with the testing procedures implemented.

Aims:

Chapter Structure:

This chapter summarized the motivation and aims behind the development of LegFree. The remaining chapters will go into broader detail and describe the working of the application and how the aims were successfully met. The structure of the remaining chapters is given below:

* **Chapter 2:** Background research of different products in the market and user response to the solutions presented in comparison to pre-existing ways of commute.
* **Chapter 3:** This chapter will focus on describing the MoSCoW prioritization technique and outline the functional and non-functional requirements for all three users (Consumer, Operator, and Manager).
* **Chapter 4:** In this chapter, we will describe the system architecture by going into the details of the deliverable and non-deliverable components of the project. This chapter will also cover the initial project planning stage by describing the ER diagram, activity diagram, paper prototypes, and wireframes.
* **Chapter 5:** The implementation chapter will focus heavily on demonstrating the product, going through different software engineering practices that were implemented, tools and technologies used, and key features and implementation details of the product.
* **Chapter 6:** The penultimate chapter will provide an evaluation of the system by going through different forms of testing methods and evaluating the product from the perspective of both the pilot user and the final user.
* **Chapter 7:** The final chapter will summarise the report, discussing any future work that can potentially make the product better while also providing an overall reflection of the project.

**2. Background Survey**

**Literature**

1. **Economics of Vehicle Sharing**

Vehicle sharing systems also have the potential to generate a vast amount of economic benefit to the city in which they are deployed: an empirical analysis (**figure 1)** in Shanghai estimated that the annual saved travel time, cost, and economic benefits from these systems was 17.665 billion min, 6.463 billion CNY (£768 million), and 15.410 billion CNY-eq (£1.8 billion eq), respectively.[[1]](#footnote-1) Despite the advantages these systems offer towards building a sustainable economy, they have a massive challenge of initially onboarding fleets of vehicles at a substantial investment. These systems typically begin generating profit years after they are first released to consumers. To generate a viable business, market demand needs to be accurately predicted. It is also important to note that after these systems have been deployed, accurate prediction of peak hours helps estimate how many vehicles should be available at a station at any given time. Although vehicle sharing systems potentially offer a viable alternative for enhancing urban mobility, they suffer from the effects of fluctuating demand that leads to severe system inefficiencies. These inefficiencies are embedded into the fabric of bike sharing because one way trips are allowed and the operator has little control over the behaviour of the user. This impedes potential users to pick up or drop off their bikes at a desired station which may lead to user dissatisfaction and eventually may result in the decline of the user base.[[2]](#footnote-2) Further, the system developed needs to offer a competitive advantage to the consumer by introducing lower prices so as to not let competition gain a higher market share.

Background Survey

1. Seoul Bike(Tta-reung-e)  
   In Korea, many local governments are running shared public bike services. Among them, I searched for the famous one, Seoul Bike. This service is an application running only on the phone. Users can download the app and purchase a voucher to use this service. This service is founded on transportation welfare, so the voucher price is reasonable.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Seasonal pass | | | Daily pass(member) | | Daily pass | |
| Product | Type | 1 hour | 2 hours | 1 hour | 2 hour | 1 hour | 2 hour |
| 7 days | 1.8£ | 2.4£ | 0.6£ | 1.2£ | 0.6£ | 1.2£ |
| 30 days | 3£ | 4£ |
| 180 days | 9£ | 12£ |
| 354 days | 18£ | 24£ |

If the user bought a seasonal pass, the user could use 1 or 2 hours a day during the pass date. If you bought a voucher, you could borrow a bike at the station. There are 3151 stations all over Seoul. And now 50,000 Seoul bikes are running.   
The user can ride everywhere he wants in service time. After the user rides, he can return to any station. When the bike has a problem, the user can report the problem after the end of use. If the user returns it late, a penalty will be charged to the user.

This service has several types of bikes. But every type of bike has no price difference. It is divided as the size of the bike. The normal bike is for adults. The normal bike has two types. But basically, it’s the same. And there is a bike for kids. It’s smaller than a normal bike.

Users can report not only bike problems but also station problems. If there are no bikes in the station, the user reports it. Operators move bikes from other stations. When the bike was reported by the user, the other user couldn’t use this bike until the operator checked this bike’s status. When the problem should be fixed by experts, the bike will move to a close local bike shop for fixing.

1. Xing xing  
   Xing Xing is an electric scooter rental service. Seoul bike collaborates with this service. This could be the semipublic transportation service. The rental price is like the other electric scooter rent service. But xing xing provides more useful options.

1. Gao et al., “Quantifying Economic Benefits from Free-Floating Bike-Sharing Systems.” [↑](#footnote-ref-1)
2. Regue and Recker, “Proactive Vehicle Routing with Inferred Demand to Solve the Bikesharing Rebalancing Problem.” [↑](#footnote-ref-2)