Tae Wook (Terry) Kim
6.1800 DP Prep Assignment

Introduction

With the growing global emphasis on environmental sustainability and alleviation of traffic congestion, metropolitan areas are increasingly adopting public transportation solutions over private vehicles. Bike share systems, in particular, offer a promising avenue for reducing air pollution and providing residents with a healthy, cost-effective means of commuting (pg. 2). As a result, Bikes4All aims to design, build, and operate the bike share system in the city of Newplace with population of 1 million (pg. 2).

This paper aims to delve into the key components of the bike share system. We will begin discussion by providing overview of the system structure and properties, then continue exploring use cases and impacts. Finally, we will conclude with uncertainties that need to be addressed with further questions.

System Structure and Properties

As a complex system, it comprises three key modules—bikes, bike stations, and central computing facility—each serving distinct purposes but working collaboratively to deliver a seamless user experience (pg. 2). To accommodate the evolving demands of a scaling system, these modules must not only handle tasks reliably but also communicate securely and efficiently, even in resource-constrained or unstable conditions. These modules will work together in abstraction to provide seamless experience of sharing bike to the users that will look like this: search for reserve bikes on mobile app or website → rent bikes at a station → enjoy the ride → return bikes at a station → own your trip with trip data or personal videos on mobile app.

Bikes are the module that is directly exposed to users and collect data through various sensors like camera, GPS receiver, and health sensors (pg. 9). With three distinct types—basic, standard, and Ebikes—each presenting unique limitations, this module confronts trade-offs, balancing factors like data usefulness vs. privacy, and the reliability vs. efficiency of data transfer.

Functioning as the intermediary between bikes and the central computing facility, stations play a critical role in data transfer from bikes to the central hub, leveraging more reliable power and technologies. Stations can be divided into two submodules: docks and kiosks (pg. 12). Docks interact with the bikes and kiosks interact with users—along with mobile app and website. Fault tolerance and reliability are non-negotiable aspects, particularly as stations manage essential processes like bike rental and return (pg. 7).

Central computing facility is where data are aggregated and computed. Storing sensitive data such as locations and payment information, security is the priority of this module (pg. 13). This module employs data analytics and algorithms to distribute actionable tasks among various modules, ensuring cohesive system operations. Tasks range from load balancing stations to directing heroes and angels, enhancing overall system efficiency.

Use Cases and Impacts

The bike share system caters to diverse use cases, encompassing daily commuters, city visitors, individuals running errands, and residents enjoying recreational bike rides. While each use case is significant, the primary focus is on commuters due to their frequency and extensive use (pg. 4). Properties such as availability and reliability take precedence for commuters, ensuring a seamless daily experience in contrast to features like personal videos, more relevant for occasional users such as tourists and recreational riders.

With an anticipated membership of 50,000 and an annual completion of 20 million rides, the system's impact extends across a wide population in many dimensions (pg. 2). Our goal is to bring improvement in commute experiences to active users, but system with this scale will introduce side effects and unintentional outcomes, some of which may not be inherently beneficial.

The system aspires to offer an economic and enjoyable transportation method to both residents in urban area and suburban area with limited public transportation. Introduction of this new eco-friendly transportation mode aims to mitigate the city's carbon emission and traffic congestion in densely populated area.

However, the system's impact transcends its users. In areas lacking bike-friendly infrastructure, bikers sharing car lanes or sidewalks may pose dangers to both drivers and pedestrians, potentially increasing number of accidents. Additionally, strategically located bike stations in dense area could attract even more people, further reducing customers of small businesses that are not located in close proximity to the stations. From a macro perspective, this city-wide project that requires substantial up-front costs has potential implications for residents' tax allocation, potentially raising concerns about fairness, especially for those who do not actively use the bike share system. Recognizing and addressing these broader impacts is crucial for the system's overall success and integration into the community.

Further Questions

- In the event of a power outage, is it more likely to occur at individual stations or on a city-wide scale? In other words, if one station experiences a power outage, can we anticipate the operational status of other nearby stations?
- How probable is the expansion of this system to other cities or countries? What degree of flexibility does the system have concerning language, scope, and scalability?
- What is the variable cost of the maintenance crew (pg. 9)? Should it affect our decision on trade-off between reliability and functionality?
- What is the timeline of the development and size of the team involved in building and maintaining the system? Should it affect level of detail or complexity in the system design?
- Once a communication method (WiFi, cellular data, or Bluetooth) is implemented into the system, is there flexibility to migrate to a different method as the system scales? If so, what are the associated costs and considerations of such migration?