

A Study on Shared Mobility Systems

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Abstract: Shared mobility is a transportation strategy that allows people to access transportation services on demand. Rapid growth in internet technologies has made location-based services easily available. This in turn has made the development and expansion of shared mobility agile. The present study discusses the overview of shared mobility and different bike-sharing schemes, i.e., dockless and docking based. The real time case studies of both dockless and docking-based mobility has been considered. A comparison of these two schemes considering some major parameters such as availability, security, etc. has been made. The survey has implied that docking-based mobility is a better option when compared with dockless mobility. From the observations made a basic model of sustainable mobility has been proposed.

IndexTerms - shared mobility, docking stations, bike-sharing system, sustainability.

I. INTRODUCTION

The present generation of mobility is observed to lean towards the private transportation system. This has been the pillar of urban development for decades. As a consequence, this comes with an adverse effect on socio-economic and environmental sustainability. The fossil-fueled and privately-owned vehicles lead to an increase in traffic congestion, global climatic change, and pollution.[1] A better solution to mobility needs to be presented. Therefore, public shared mobility, the greenest form of transportation can be the solution to this transition.

India is at its turning point in the development of its mobility system. Currently, there is an increase in the usage of private vehicles and consequently, reduced use of public transport. These trends have waged issues on the country's energy consumption, economy, pollution, safety, and health. Being one of the most populous countries, India can develop a more sustainable shared mobility system, which would be beneficial to all its citizens by considering statistics related to strengths in the availability of data, connectivity, and entrepreneurship.[2]

II. SHARED MOBILITY

Shared mobility is a mode of transportation that is available to the public, shared by the users on a fare basis [2]. Shared mobility constitutes the below modes of transport:

- Mass Transit** – It includes high-capacity vehicles such as buses, metros, and trains that are owned and managed by the government or the private agencies. It usually operates along fixed routes and is an affordable mode of transport.
- Cycle/Scooter sharing** – It is a low-cost solution for last-mile connectivity. Scooter-sharing is an emerging mode in the shared mobility market.
- Car Sharing** – This involves user's access to vehicles as needed on an hourly, daily basis or monthly post-paid payments.
- Ride-sourcing and Ride-Splitting** – Ride-sourcing is an on-demand service that connects riders to the drivers of commercial vehicles available for hire. Ride-splitting is a pooled variant of ride-sourcing.

Shared mobility being the better solution is noticed to have the following benefits:

- Flexibility in transit.
- Reduction in emissions and fuel use.
- Reduced traffic congestion.
- Supports individual financial savings.
- Facilitates a multi-modal transport network.

III. EXISTING SYSTEMS

Rideshare companies are initiating fleets of vehicles like bikes, scooters, and cars into urban areas, facilitating the users to hire the vehicles over a short period. Ridesharing is implemented as dockless and docking based. Dockless ride sharing allows the scooters to be left at a final destination of the user, ultimately to be retrieved by the next user or picked up for charging. A few studies done on dockless systems are discussed below.

Bounce, the only dockless bikeshare service in India was started in 2016 to provide last-mile and everyday commute solutions[6]. This dockless system claims to have around 60,000 rides per day and has serviced over 5 million commute requests. It is convenient to access via a mobile application and provides affordable services. During the real time usage of this dockless service the drawbacks are faced. It was observed that riders after using the vehicle would abandon it in improper locations leading to inconvenience and traffic violation. This is due to the absence of the docking station. The traffic control department stated that sending notice was futile because the vehicle did not belong to any individual.

In November 2017, one of the largest bike-sharing companies in China introduced the first dockless bike-share system in the USA, named Bluegog. Another scheme, Mobike was initiated in Manchester, UK for the first time in 2017[1]. Both Bluegog and Mobike failed as a business in a few months proves to be a story of misfortune for the concept of dockless bike-sharing. Mobike fell victim to theft and vandalism as a result of the poor security measures. These outcomes demonstrated that the dockless mobility system due to under-designed usage is closing down with tremendous financial and operational disappointments.

Shared mobility that is based on a docking system consist of docking stations. A docking station is a civil structure that allows vehicles to be parked and/or charged when not in use. These stations also protect the vehicle from adverse weather conditions and theft or damage.

An initiative was taken by the Government of Delhi called “Delhi Integrated Multi-modal Transport Vision 2021” (DIMTV2021). DIMTS launched a bicycle rental scheme known as “GreenBIKE—Cycle Feeder and Rental Scheme”. Users could rent a bike from the station by authenticating themselves using a valid government ID. The scheme allowed users to travel with a minimal fare. Revenues from user registration were not sufficient to cover charges of the station attendants. This was when the docking concept proved to be advantageous by becoming a source of income through ad space given at the docking stations. Similar systems have been planned to be deployed in major cities like Mumbai, Bengaluru, Ahmedabad, Gandhinagar, Panji, and Chennai [3].

“TrinTrin”, the Public Bike Share (PBS) system of Mysore, Karnataka, India is operated by Green Wheel Ride. The project was initiated to promote the culture and concept of cycling. Based on frequency and demand in different areas, the docking stations were set up throughout the city. It presently totals to 52 stations with a fleet size of 450 bicycles. A new user has to register at the registration center or through the PBS Mobile Application or the online website and collect a smart card from the registration center preloaded with a usable value. A user can then use the smart card at any docking station to pick a cycle [3].



Figure 1: TrinTrin - Docking Station

Another project – 4th Generation PBS in Bhopal, Madhya Pradesh imported 500 GPS-enabled bicycles from Germany and a network of 60 docking stations in the city. By getting an unexpected response from the citizens, the Government of Madhya Pradesh expanded the network to more than 50 km. A profitable yearly membership scheme along with other offers was introduced which attracted many users [4].



Figure 2: Solar-powered Docking Stations of PBS in Bhopal

IV. DOCKLESS VS DOCKING-BASED SYSTEM

The shared mobility is broadly categorized as docking and dockless system. A comparison against different parameters are discussed below:

Table 1: Comparison of Dockless and docking-based systems

Sl. No	Parameter	Docking-based	Dockless
1.	Description	Users can pay to obtain and return bikes at docking stations throughout the service area.	Users simply leave the bike at the terminal point of the trip.

2.	Vehicle	Secure and sheltered inside the docking station when not in use.	Left unsecured, sometimes in illegitimate parking spaces.
3.	Security	The bike is securely locked at the station, when idle.	Left unattended.
4.	Availability	Vehicles spread out uniformly	Vehicles get accumulated at the frequently populated areas which need to be manually relocated.
5.	Revenue	Additional revenue through advertising panels in the stations.	No such provisions.

V. PROPOSED SYSTEM

The survey over some of the existing mobility systems has provided a sufficient understanding to formulate a better and sustainable solution. With reference to the above comparison, the proposed system is a docking based rental system for electric scooters and electric bikes. The system incorporates some minor implementational changes. As the world is moving towards sustainable solutions for transport, usage of electric vehicles is preferred for this system. Keeping in mind the increased availability of the internet on cellular devices, the proposed system is mainly based on a mobile application.

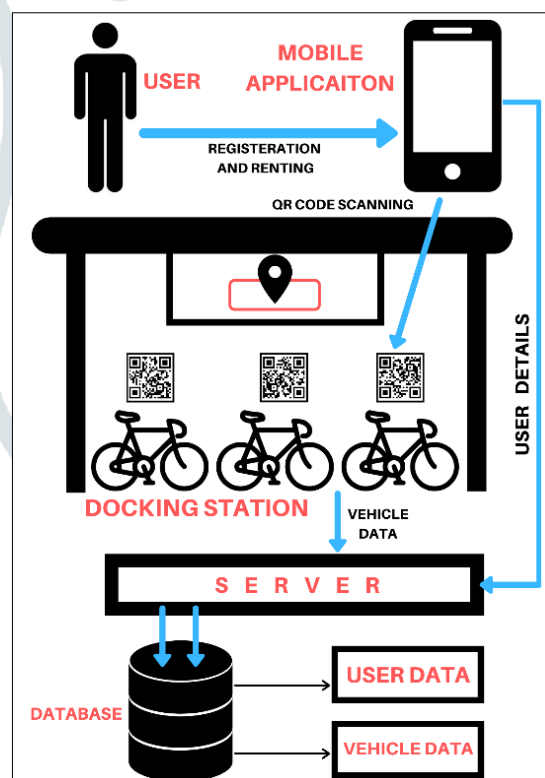


Figure 3: Architecture of the Proposed System

The main components of the system include:

- Mobile Application – The mobile application serves as a front-end interface for the user to interact with the bike-sharing service.
- Docking Station – The docking station is a hub where the vehicles can be parked and rented from.
- Server Network – A server network is used to connect various components in the system and is used for communication between them.
- Centralized Database – A database manages the data pertaining to the user and their account and the vehicle details.

A new user can register on the mobile application by submitting his credentials such as name, phone number, and driver's license number. Once the submission is verified, the user can start renting electric vehicles. Using the application, the user can check where the nearest docking station is to rent a vehicle.

Each vehicle in the system is uniquely identified with the help of an RFID tag. All vehicles are fitted with a GPS module for location tracking. The user can rent the vehicle by scanning a QR code present on the vehicle by using the mobile application. When the code is successfully scanned, the vehicle is unlocked from the dock. The backend database can now map that particular vehicle's

identity with that user's identity. Next, as the user travels in the vehicle, the GPS module helps keep track of the route which will be used to calculate the distance. Upon reaching the destination docking station, the user parks the vehicle which is again recorded. This marks the end of the trip. The fare is calculated based on the distance travelled. The user can pay using the special currency implemented on the application. The user will have to recharge the currency as and when needed.

The mobile application enables the user to view the history of their rides, the amount of currency left, the nearest docking station, and also a 'reserve-ride' feature. This feature allows a user to reserve a bike or scooter in advance at a desired docking station and time. The server sends a signal to that docking station and reserves one vehicle for the user. This vehicle is unavailable to all other users. However, if the user fails to show up at the said time, the vehicle is locked and the user is charged a penalty.

The backend database is used to store two forms of data which are user data and vehicle data. User data includes all the details of the user including their account details, the details of the rides taken. The vehicle data includes details of the vehicles in the system to uniquely identify each of them. The user and vehicle data are linked to each other through the trip data. Some security measures taken against exploitation of the vehicle is ensured by the GPS module. If the server is unable to trace the vehicle for a significant period, an alert is issued to the administrator.

One of the concerns with the docking-based system is not providing the last mile solution. So, as a solution to this problem, the region from where the users are more, we can deploy a docking station within 100mts in that locality. The dock will have advertising panels that serve as a good source of income.

VI. CONCLUSION

The improvement of the current situation of mobility is highly necessary. Increasing levels of pollution and traffic congestion in most cities are at an alarming rate. We must realize the threats that come out of this and take appropriate action on time. A good way to tackle the modern-day urban problem of mobility is to start using shared and public transit systems. These services when used regularly would contribute to a significant decrease in problems relating to the daily commute. It also helps the user financially as shared mobility is far cheaper than the ownership and maintenance of private vehicles. Statistics show that India is seeing a high penetration of data-supported technologies. Expanded utilization of cell phones is predicted to reach 530 million dynamic clients while the quantity of web clients is required to reach 450–465 million by 2020. These high numbers boost the adoption of shared mobility solutions and services.

ACKNOWLEDGMENT

We would like to express our deep and sincere gratitude to our research supervisor and co-author Mrs. Sowmya M, Assistant Professor, Global Academy of Technology for her persistent support and guidance throughout the course of this survey. It was a privilege to study and work under her. We extend our gratitude to our college, Global Academy of Technology for providing unconditional support and resources promptly.

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