Bike-Sharing System Based on User Behaviour Analysis

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Abstract- **This project is about a new kind of bike-sharing app that helps people travel together more comfortably and safely. Instead of just booking a random ride, the app connects two people one who needs a ride (the user) and one who is offering a ride on their bike (the rider). But what makes this app different is that it tries to find the right match between these two people by understanding their behaviour and preferences. When user signs up, they answer a few questions about how they like to travel. The app uses these answers to find a user who matches well with them, so both people feel more comfortable during the ride. To make sure everything is safe, the app also uses an OTP (one-time password) that both the user and rider have to confirm before starting the ride. This platform is trying to make bike-sharing smarter, safer, and more enjoyable by using technology to better understand people and their preferences. Overall, this project isn't just about transportation it's about building a better ride experience. It helps people travel in a way that's more comfortable, more secure, and more environmentally friendly, by encouraging ride-sharing over using separate vehicles. It can be especially useful for students, daily commuters, or anyone who wants to save money, fuel, and time while also traveling with someone who matches their vibe.**

***Index Terms*— Bike-sharing system, User behaviour analysis, Bike usage patterns, Ride-sharing data.**

I. INTRODUCTION

Getting around in cities is becoming more expensive and time-consuming every day. With rising fuel prices, traffic jams, and a growing need for eco-friendly travel options, people are looking for smarter ways to commute. While bike sharing has made it easier to travel short distances without owning a bike, most riders still end up going alone even when others nearby are heading the same way.

This research explores a new idea: what if bike sharing allowed people to team up and ride together? Imagine a system where users can find a travel partner going in the same direction, share a ride on a two-seater bike, and save time, money, and fuel. It's not just about transportation it's about making everyday travel more social, affordable, and efficient.

The proposed system uses simple data like your location, route, and timing to match you with someone nearby who's on a similar path. By analyzing user behaviour and travel patterns, we aim to design a solution that makes bike sharing smarter not just for individuals, but for the whole community.

Bike Sharing System is a web-based platform designed to make bike riding accessible to people around the world without the requirement of ownership a bike. It works by analyzing user behavior, such as where and when people ride, how long they use the bikes, and their preferred routes. This helps understand travel habits bikes in the right locations at the right times. The system not only provides a practical and environmentally-friendly option but also allows users to enjoy the experience of biking without the responsibilities of ownership.

By using data to improve bike distribution and predict demand, it enhances the user journey and supports a more sustainable way of getting around.

This paper aims to investigate user behavior patterns with display the pie chart in bike-sharing system in percentage. we seek to identify distinct user segments and their respective behaviors. These insights will inform strategic recommendations for enhancing the bike-sharing system's operational efficiency, user experience, and overall effectiveness in promoting sustainable urban transport.

This platform is built with Html, Css and JavaScript for the frontend. The backend is develop in JavaScript in Visual Studio is used, using MongoDB, NodeJs and express for database management.

II. LITERATURE SURVEY

The concept of bike-sharing systems has gained significant attention in recent years, with a growing focus on understanding user behavior to optimize these systems. Previous studies have extensively analyzed the factors that influence individuals' decisions to use bike-sharing programs, the patterns in how bikes are shared, and how these behaviors can be predicted and influenced to enhance the overall system's efficiency.

P. DeMaio's study explores the evolution of bike-sharing programs, starting from the early first-generation systems to the more modern third-generation programs. He examines how these systems have developed over time, focusing on different models for providing bike-sharing services. For each model, he looks at the advantages and disadvantages it brings, as well as the costs involved in running these programs, including both capital and operating expenses.[1]

DeMaio also discusses the future of bike-sharing programs, speculating on what a fourth-generation system might look like. This could involve new technologies or innovations that improve the way these programs operate, making them more efficient, user-friendly, or integrated with other forms of transportation. Essentially, DeMaio's paper tracks the growth of bike-sharing from its beginnings to where it stands today, while also imagining the future of these programs. [1]

In the paper by Chen et al. (2017), the authors use open data from bike-sharing systems to analyze how users engage with these programs. Bike-sharing systems generate large amounts of data, including information about when bikes are rented, returned, the duration of trips, the locations where bikes are picked up and dropped off, and sometimes even demographic data on users. The researchers leverage this data to uncover patterns and trends in how people use the system. [2]

In this study, the authors analyze bike trip patterns by using publicly available data from bike-sharing systems. They focus on understanding how people use bike-sharing programs, such as when and where bikes are most often used, how long trips typically last, and the common routes people take. By examining this open data, the study provides valuable insights into user behavior, including peak usage times, preferred destinations, and trip durations. The findings can help improve bike-sharing system planning and management by identifying trends and patterns that can be used to optimize bike availability and station locations.[2]

In their paper, Choi, Cho, and Son introduce a method to better understand the usage patterns of bike-sharing systems by analyzing both time and location data. They use an advanced technique called multilayer network fused Lasso, which allows them to look at how different factors like when people use bikes (the time of day) and where they use them (the location) interact with each other. By doing so, they can capture the complex relationships between these factors that affect how and when people use the bikes. This approach helps to identify trends in bike usage, such as peak times or busy stations, and allows for more accurate predictions about where and when bikes will be in demand. The main goal of this research is to improve the management of bike-sharing systems, ensuring that bikes are available in the right places and at the right times, ultimately making these systems more efficient and responsive to user needs.[3]

The paper titled "Supply and Demand Analysis of a Free Floating Bike Sharing System" likely focuses on understanding how the availability of bikes (supply) and the need for bikes (demand) interact in a free-floating bike-sharing system. In such a system, bikes aren’t stationed at fixed locations, and users can pick them up and drop them off anywhere within a designated area. This kind of system has its own unique challenges compared to traditional, station-based bike-sharing programs.

The authors likely investigate how to manage the distribution of bikes across different areas of a city, ensuring that there are enough bikes in places where people are likely to need them, while avoiding an oversupply of bikes in areas where they’re not being used as much. The paper might also explore the patterns of when and where bikes are used, looking at factors like time of day, weather, and local demand hotspots. Understanding these patterns helps system operators optimize bike placement and redistribution to make the service more efficient.[4]

In this paper, Shaheen, Martin, and Cohen explore the early experiences of bike-sharing programs in North America, focusing on the perspectives of both the operators and the users. The authors investigate how these programs were set up, the challenges faced by the operators, and how users perceived the service. The study offers insights into the initial successes and difficulties encountered as bike-sharing systems began to grow in North American cities. It looks at factors such as how users interacted with the bikes, what their perceptions of the service were, and what improvements were needed to make the system more user-friendly and efficient. The research sheds light on the early lessons learned from these programs and provides valuable information for future developments in bike-sharing systems.[5]

In their 2017 study, Xie and Wei looked at how social networks affect people's behaviour when using bike-sharing systems. They recognized that social factors like influence from friends, family, or online communities can play a big role in whether someone chooses to use a bike-sharing service. Instead of just focusing on individual choices, the researchers explored how these social connections could impact how often people use bikes, where they ride, and even when they decide to take a bike.

To understand this, the researchers probably gathered data on bike-sharing usage patterns and connected it to the characteristics of the users' social networks. They might have used statistical techniques to uncover any patterns or relationships between social influences and bike-sharing behaviour. The goal was to see how much social connections influence ridership, rather than just looking at individual factors like convenience or price. Through their findings, the study suggests that social networks can significantly shape how people engage with bike-sharing systems, making it an important factor to consider when planning and optimizing these services.[6]

Basile and Liguori the authors focus on understanding how users interact with and behave within Milan's bike-sharing program. They investigate what factors influence people's preferences, such as convenience, pricing, or accessibility, and how these preferences shape their usage patterns. The paper likely involves data collection and analysis to understand how people choose to use the bike-sharing system, what influences their decisions, and how the system can be improved based on user behavior. This research provides valuable insights for cities and operators looking to optimize their bike-sharing programs based on user needs and behaviors.[7]

The paper by Y. Li, Y. Zheng, H. Zhang, and L. Chen titled “Traffic Prediction in a Bike Sharing System”, presented at ACM SIGSPATIAL, explores how to accurately forecast bike usage in bike-sharing systems. The main goal is to help operators better manage and redistribute bikes across the city, so users always find bikes or parking docks when they need them. To do this, the authors developed a predictive model that works in two main layers. First, it groups bike stations based on their geographic location and how bikes move between them. This clustering helps capture the underlying patterns in how people actually use the system. Then, the model predicts the overall demand for bike rentals across the city and breaks that down to the cluster level using a method that compares similarities between different clusters in terms of time, location, and user behaviour. They tested this model using real data from bike-sharing systems in New York City and Washington, D.C. What they found was that their approach predicted traffic more accurately than traditional methods, especially during unusual conditions, like weather changes or special events. That’s important because those are the times when the system is most likely to break down. In a nutshell, the paper shows how analyzing spatial patterns and using machine learning can lead to smarter, more reliable bike-sharing operations by predicting how people are going to use the system before they even do.[8]

The paper by P. Vogel and D. C. Mattfeld, titled “Strategic Operational Planning of Bike-Sharing Systems by Data Mining – A Case Study,” is all about improving how bike-sharing systems work by using data analysis. In many cities, bike-sharing systems often face a big problem: some bike stations have too many bikes, while others don’t have enough, leading to frustration for users who can’t find a bike or a place to return it. The paper looks at how we can use data to solve this issue [9].

This paper looks at improving bike-sharing systems by making bike usage more balanced across different

stations and ensuring a better experience for users. In recent years, bike-sharing systems have become very popular, but sometimes people struggle to find bikes or return them because some stations have too many bikes, while others have too few.

To solve this problem, the paper introduces a "trip advisor" tool that helps users choose which bike stations to pick up from and return bikes to. It does this by looking at two things: stations typically have bikes available, and how to distribute bikes more evenly across stations. To make these recommendations, the system first predicts how many bikes will be needed at each station in the future. This prediction helps figure out where bikes are most likely to be in demand. The new method is quite accurate, with a prediction accuracy of 82.6%, which is a big improvement over older methods.[10]

III. EXISTING SYSTEM

In many bike-sharing systems today, bikes aren't spread out evenly. Some stations have too many bikes, and others don't have enough. This causes problems for users—sometimes they can't find a bike to ride, or they can't return one when they're done. These systems usually try to guess how many bikes are needed by looking at past data. But that doesn't work well during busy times like rush hour or weekends because it doesn't consider what's happening right now or how people's habits change. Also, bikes are often moved around on a fixed schedule, like with a truck that comes every few hours. This isn't very helpful if a station runs out of bikes sooner than expected. So, current systems aren't good at reacting quickly or keeping bike availability balanced, which leads to user frustration and wasted effort. The research paper wants to fix this by using better predictions and real-time data about how people use bikes, making the system smarter, faster, and more reliable for users. [11]

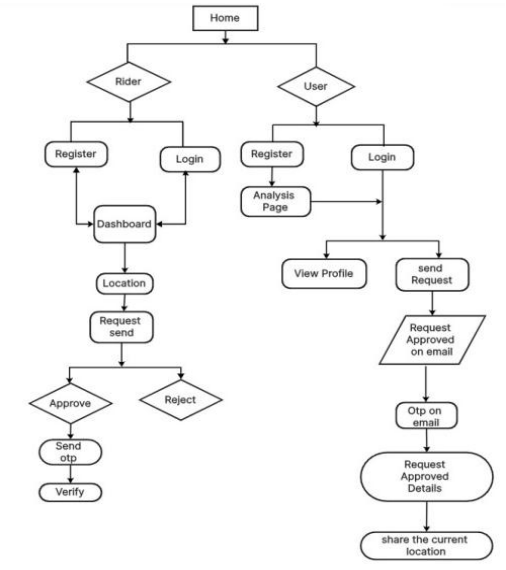
IV. PROPOSED SYSTEM

Our Bike-Sharing System Based on User Behavior Analysis is the idea is to create a platform where users can input their travel details such as origin, destination, time of travel, and choose their favoured routes to be paired with others heading the same way. This would not only help individuals reduce travel expenses but also optimize their time, as they can share the journey with a partner. Moreover, this system can reduce the overall Traffic, contributing to environmental sustainability.

The proposed system for this project focuses on helping people find travel partners for their journeys, but with an important twist: it also considers the compatibility of each potential partner based on their behaviour. The idea is to match people who are going in the same direction at similar times but also have similar preferences and habits, making the shared trip more comfortable for both parties. In this system, each user would create a profile where they enter details about their travel plans, such as their route, travel times, and preferences for things. This way, users are not only matched based on where they are going, but also on how comfortable they would feel sharing the ride with the other person.

Once a match is made, users can communicate with each other to finalize details like where to meet and confirm the timing. The goal is for this system to help reduce travel costs by saving fuel, while also saving time and ensuring that people enjoy the journey with a partner who feels comfortable to them. Ultimately, this system aims to make travel not only more affordable and efficient but also more socially engaging, allowing users to connect with others who share similar preferences.

A. Figures and Tables



V. CONCLUSION

This research paper introduces a smart and user-friendly system designed to match people with suitable travel partners based not only on their route but also on their personal preferences and behaviour. The goal is to make shared travel more convenient, affordable, and enjoyable. Instead of just pairing people going in the same direction. By helping people share rides with compatible partners, the system can reduce fuel costs, save time, and make the experience more pleasant. Over time, this could lead to fewer vehicles on the road, less traffic, lower pollution, and stronger social connections between travellers. In short, the system supports smarter, more sustainable, and more human-centered travel.

Bike-sharing systems make it easier for people to move around cities without using their own bike. This makes travel more convenient, saves money, and helps people stay active and healthy. These systems are not just good for individuals they also help the whole city. With fewer bikes on the road, there's less traffic and less pollution. So overall, bike-sharing is a smart, easy, and eco-friendly way to get around in busy city areas.

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