UNIVERSITY OF
EASTERN FINLAND

BIKE RENTAL FOR SUSTAINABLE ENVIRONMENT

Pranuj Rai
Rishabh Shukla
Md. Hasan Sharif
Philemon Frimpong
Gilbert Kwame Adu
S M Muzahidul Islam

Degree Programme IMPIT
University of Eastern Finland
Department School of Computing
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ABSTRACT

In recent decades, the rate of urban population growth has significantly accelerated, and cities now account for the majority of the global population. The majority of those who might be impacted by environmental and socioeconomic repercussions reside in metropolitan areas, which contribute significantly to these impacts. One of the most important human activities in cities is urban mobility. People plan many travels for a variety of reasons, such as employment, school, shopping, or fostering social connections. When many cars are used excessively to cover certain routes, considerable harm results. The environment and public health are both harmed by the pollution that automobiles generate .Urban communities commonly worry about air pollution and traffic congestion. Municipalities have put in place sustainable transportation strategies to address these issues. Bike-rental programs (BRPs) have been marketed as a further instrument to support sustainable transportation. Sustainable development, and more especially sustainable mobility, has taken center stage in metropolitan settings as a means of addressing these and other concomitant issues brought on by vehicle traffic. New approaches are thus sought in order to accomplish the objectives of sustainability. End of the 20th century saw the emergence of bike-rental programs (BRSs) as a potential remedy for transportation issues. The number of BRSs in Europe increased dramatically as more cities were convinced to deploy them. BRSs are thought to support environmentally friendly urban transportation. A bicycle rental system known as "bike-sharing" enables users to borrow bicycles at no additional cost and return them at another location where they can be hired by another person.

In this report, the effectiveness of Bike Rental Systems (BRSs) in attaining sustainability goals has been assessed using 51 case studies. In order to determine how well BRSs contribute to sustainable mobility, their impacts on mobility, the environment, health, traffic safety, and the economy are evaluated. This dissertation also specifies city characteristics and bike-sharing elements that might improve the performance of BRSs and assesses their impact on the ultimate level of BRS utilization. On the other hand, difficulties that may occur when using BRSs are noted, and some solutions are offered.

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INTRODUCTION

Cities experience a pivotal change into "smart cities" as a result of increasing social mobility, urbanization and technology advancements. The issue of the huge amount of private car use is presently the main hurdle in many urban areas. Bike rental programs are belief to be a tactful way for emphasizing alternate modes of transportation and can be used as a component of improving sustainable mobility in communities. Sustainable mobility is the communication practise of users motivated by the spatial structure and transportation in such a way that the length of the travel route is rationalized, individual motorization does not degrade public transportation and non-motorized transport (walking and cycling), and the operation of the transportation system makes it possible to maintain environmental harmony. Sustainable transportation helps to strengthen the city's image, spatial order, and public spaces by reducing the diversity in the growth and quality of life of different metropolitan districts. Modern structure solutions that integrate transportation and space planning aim to increase bicycle use as a mode of transportation. Both personal bike trips and bike-rental trips result in significant savings and benefits for both bike riders and the environment (i.e., have no negative effects on the city's quality of life). (no noise or emissions) improved transit and parking space utilisation; preservation of historical sites and natural areas Less deterioration of the road network; increased attention in the city (for commerce, culture, etc), recreation, and social life); a reduction in traffic jams and economic losses; an increase in traffic flow; increased appeal of public transportation; and feasible access to urban services for all members of society; saving time and money for parents who don't have to drive their children to school; significant time accumulations for cyclists travelling short- and medium-distances; and possibly eliminating the need for the household to purchase a second car. Users of the bike-rental system can pick up a bike at one of the city's automated stations, ride it to their destination, and then return it to the same or another station.

PROBLEM STATEMENT

The urban population growth rate has accelerated significantly over the past few decades, and cities now account for most of the global population. Urban mobility is one of the most important human endeavors in urban areas. People plan many trips for various reasons, such as socializing, working, or pursuing education or other goals. Significantly detrimental effects result from the excessive use of numerous cars to use these roads. Vehicle pollution is terrible for the environment and everyone's health. Most environmental and socioeconomic effects could negatively impact metropolitan areas, contributing significantly

to these consequences.

Sustainable development, specifically sustainable mobility, has taken centre stage in metropolitan settings to address these and other concurrent issues brought on by vehicle traffic. New approaches are therefore sought to accomplish the objectives of sustainability. The end of the 20th century saw the emergence of bike-sharing programs (BSSs) as a potential remedy for transportation issues. BSSs are thought to support environmentally friendly urban transportation. The number of BSSs in Europe increased dramatically as many cities were persuaded to deploy them.

EXISTING SOLUTION

Paul DeMaio, Metro Bike LLC (USA) grouped all existing and extinct schemes in three generations (DeMaio 2001). This classification has been adopted generally by most authors. These classification include first or traditional Generation, second generation and lastly thirdgeneration.
"Provo" is one of the earliest implementations of the bike sharing system. This was particularly an anarchist Dutch movement in the 1960's. This movement was to provoke violent responses from authorities by using non-violent bait (Wikipedia 2010). They initiated the "White bicycle plan", an action to reduce traffic congestion in Amsterdam. White Bicycles were donated and distributed freely in July 1965 throughout the city. These are a summary of the characteristics of the above scheme:

1. Bicycles are provided for free without any restrictions
2. No registration, identification, fee, lock etc. suitable for smaller cities
3. Good effect: everyone has access to it, bad effect: stolen, vandalized and confiscated.

Following the failure of the first implementation. A second generation scheme was implemented as an upgrade or successor to the first generation. In 1995, Denmark came up with its own program. They provided 5000 Bicycles. These are the summarized characteristics of the second generation:

1. Bicycle are provided for a small fee and restricted movement, 110 stations.
2. Usually managed by the community or the state. Suitable for mid size cities
3. Good effect: no registration, bad effect Fee, limited tracking system

At the end only 2000 of the bicycles were still functioning after a couple of years. This was due to theft and others. Some implementations that made the second generation better than the first was the following: The bicycles can be locked from 110 specific stations. Users just have to insert some few euro coins in a mechanical device. The coin is recovered automatically when the bicycle is correctly returned. Bicycles can only be used inside a delimited area of the city and it is enforced by the local authorities.

The first example of a third generation was developed in 1996 at Portsmouth University in the United Kingdom. The campus is divided in two areas. The system was implemented to connect both areas in an ecologic and rapid way. The implementation was later called Bike about, as part of its Green Transport Plan. The project was funded by the ENTRANCE program8. These are some of the summarized description of the above implementation:

1. Registration and identification, low fee safe, durable
2. Mostly automation, managed by private companies
3. Good effect: more sustainable, bad effect: limited tracking system

The system was totally automated. After an obligatory subscription, users received a smart card. This card was asked when renting a bike to identify the user and it opened the depots where bicycles were available. The opening of the depots to pick up and return bicycles was automatically registered. Thus, if a bicycle was too late returned, damaged or even stolen, the card holder could be punished by the operator. The subscription fee was low and the use of the 100 available bicycles located in two stations was free of charge (Black & Potter 2010).

OUR SOLUTION

4.1. MODERN FEATURES OF OUR BICYCLE

We aim to provide an electric Bicycle which has awesome modern features such as:

1. Anti-Light Digital Screen: This would track customer data for example the Speed count, distance covered, Battery Capacity without looking on your phone. This display system connects the mobile app to show the distance covered to offer discounts to the user could and use it in the next ride. This digital display system even though does not provide navigation, however with sustainability in mind, the target distance that would offer user's discounts would be displayed and users would find it more interesting and beneficial since it provides return on investment by awarding users when they ride to a particular distance.

2. Self-Riding button: This new bicycle can be adjusted to a constant speed which would help customers not to use so much strength when riding. Customers can press and hold the buttons to increase speed or release button to decrease the amount of speed. Self-riding option can be turned on and off anytime to be able to use the peddle. We want school kids to hop on our bicycles without always waiting for public buses and adults used for their daily work distance etc. Speed-set buttons are important when users want to match at least half the speed of cars at an affordable rate for all age groups.

3. Strong Rechargeable Battery: A battery is needed for an electric bicycle to operate effectively. The battery would be needed for the display system to work, speed buttons and phone charging to work. These batteries can be recharged with electricity at home.

4. Provision of mobile phone holder and charging system: We aim to encourage more people to use bicycle considering the numerous benefits, customers who wants to ride long distances can charge their mobile phones through the USB-Type B & C ports provided. The phone holders could also allow users to insert their phones for navigation purposes.

5. Mobile Application and GPS: Customers should be able to unlock the application to be able to use the bicycle. This is done through the mobile app which has registration and login features. The GPS would be enabled to identify where these bicycles are parked.

6. Big and strong wheels: Our bicycle is design to suit all weather conditions. Bigger tires with spikes would be able to use in both cold and hot places.

SOLUTION AND BENEFITS

Our solution is to analyze and highlight how efficient Bike Sharing could improve sustainability in cities across the world. Modern bike-sharing is based on a number of factors which are put in five categories: mobility, health, traffic safety, affordability and environment

4.2.1. Mobility

Spaces for pedestrians and vehicles in city centres and over-use of cars have caused traffic congestions all around Europe, Africa and Asia. With reference to the European "Green Paper" (European Commission 2007), "every year nearly 100 billion Euros, or 1% of the EU GDP, are lost to the European economy as a result of traffic congestions". Measures put in place to prevent some negative societal impacts that emanates from transport comes the existence of bike-sharing that shows new mobility concepts that try to reduce car use and promote better sustainability modes such as cycling and walking. Citizens who enjoy night leisure have experienced a relevant change of travel behaviour as a result of the operation of bike-sharing services. In cities where public transport is closed during the night and bike-sharing services are offered round-the-clock, bike-sharing bicycles have been prominently ridden during the inactivity of public transport as a convenient alternative mobility mode. Using our bicycle would improve productivity because it avoids traffic congestion. Public workers do not have to hire taxis and wait for buses but could use our bicycles for their everyday transportation at any point in time even during nights that public transports would not be available.

4.2.2. Health

With the introduction of bike-rental system, the health of the citizens has been taken into consideration. Bike Sharing can affect health in two diverse ways:

- Improved in the quality of air

People who have driven before and has stopped to use bike-sharing contribute immensely in the reduction of car traffic as well as air pollution which eventually leads to the quality health of the people and environment.

- Improved in fitness of the users

In as much as there is an availability of speed-increase button, users would be very fit by riding with the peddle for a long period of time.

4.2.3. Traffic Safety

The wide usage of bike-sharing instead of cars may lead to very low number of road accidents. If over 90% of a populace in a particular country engages in the riding of bicycles as their daily transportation, the high number of road accidents that occur yearly would be reduced drastically. With the inclusion of the modern AI functionality which ensures bicycles are very stable and do not fall down whiles a person is using it would help in safety when riding.

4.2.4. Affordability

With regards to the increase in the prices of fuel, we aim to provide affordable, safe and convenient electric bicycles which would ensure customers save a lot of money even with long distances. Parents would be able to save a lot of money and time for their kids if they engage in bike-sharing for their children instead of driving them to school. Once they ride within a particular distance, they as well get discounts on their next rides. The working age-group will also save so much, those who work at night would not have to worry when public transportation are not available since bike-sharing bicycles work 24hours

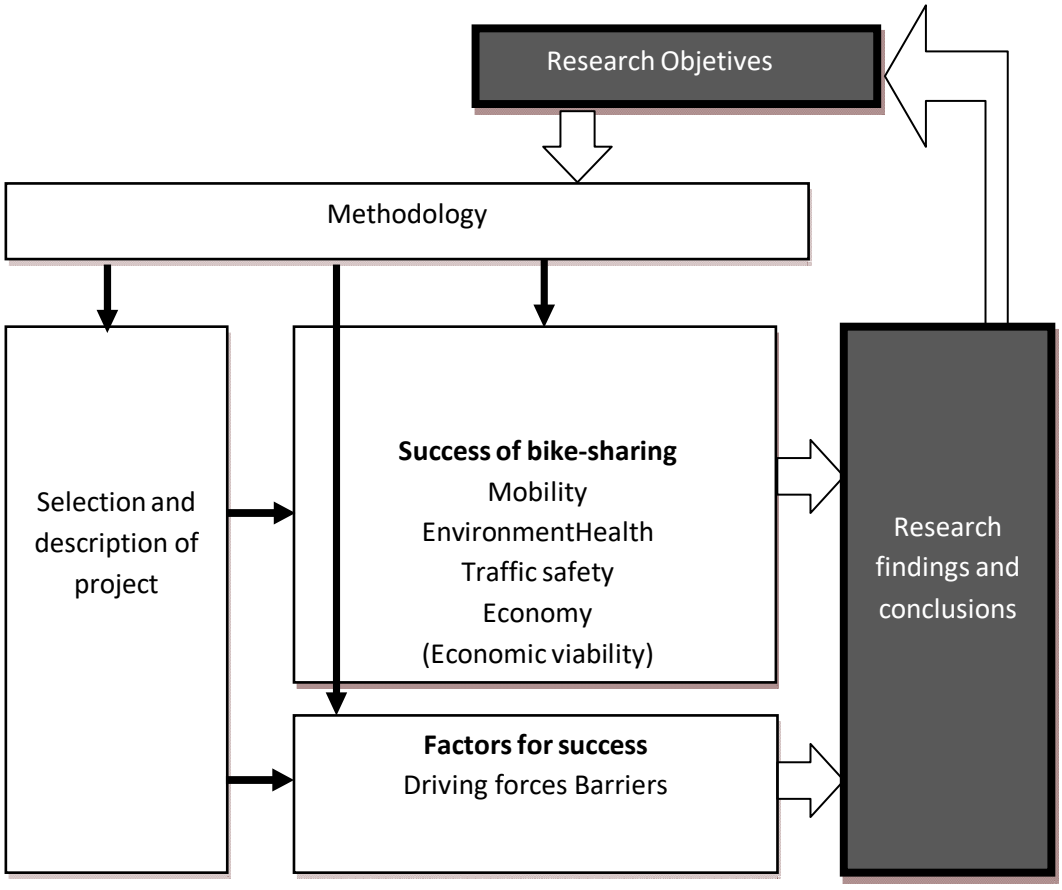
4.2.5. Environment

The ecosystem which is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life. This environment needs to be protected preserved for the future. Bike-sharing is perceived as one of the best ways to decrease the rate of CO2 emission which emanates from automobiles. By this approach, there will be reduction of noise which also impacts the environment negatively.

METHODOLOGY

Bottom Up Approach

The goals of this report have been met using a bottom-up strategy. The research objectives have been prompted by the state of the art, according to this strategy. These goals called for a specific approach that provides the most accurate responses to the queries. The following three research phases can be used to summarize the approach utilized: the selection and description of project, the examination of bike-effectiveness, sharing's and the analysis of success-related aspects. The questions outlined in the research have been addressed by these research findings. Figure below illustrates this bottom-up strategy.



Data Collection

First, the lack of information made it impossible to gather all the necessary data. The brief lifespan of the notion of bike sharing may be the cause of the lack of data. Since bike sharing is a relatively new form of transportation, it is still being developed. Thus, the current lack of data may be the result of certain operators not standardizing a systematic collection of data yet.

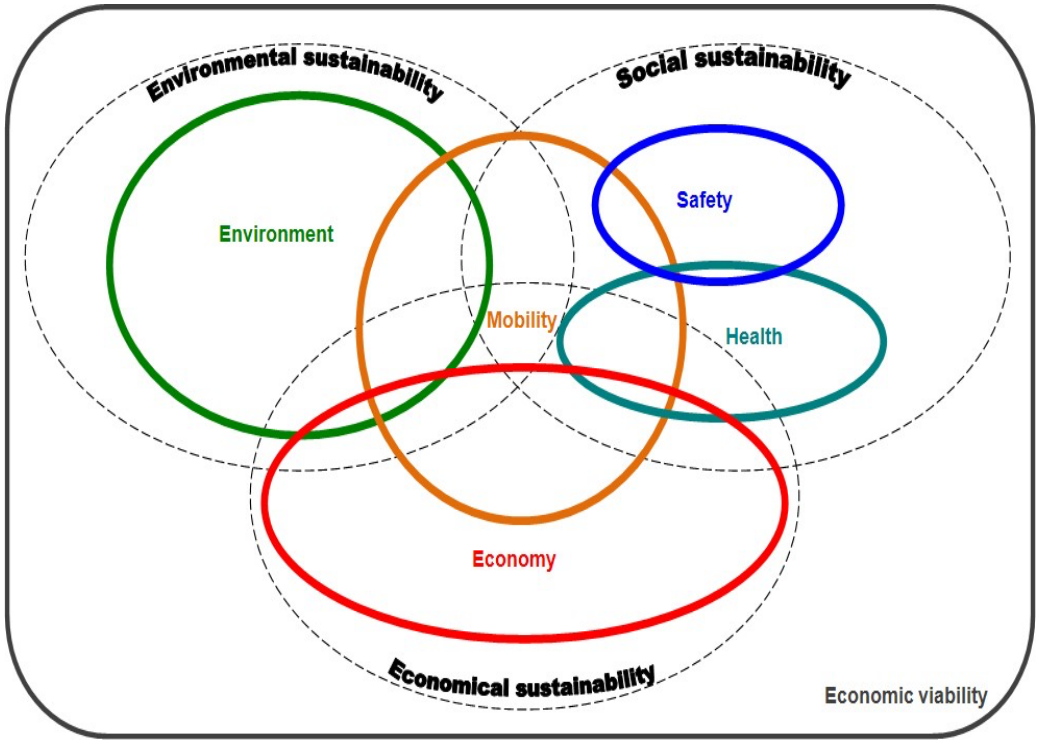
Secondly, due to the privacy policies of their owners, certain data exist but cannot be released or utilized for study. A substantial portion of BRSs are run by private enterprises, and these businesses once treated certain data as trade secrets.

But, Finally Google have uploaded a sample data for bike sharing where it have multiple dimensions which contains date, timing, season, weather report, temperature , distance, and location which have been processed using MS Excel for analysis and future prediction using Tableau(BI TOOL).

Analysis of Success

Environmental, social, and economic sustainability are the three elements of sustainability that are covered by the success categories. The sustainability of BRSs in terms of the environment and economy is evaluated by environmental and economic goals. Social sustainability objectives might include those related to safety and health. Finally, mobility-related difficulties can be seen as the primary aim, which gives rise to the other goals and is included in the sustainability's three dimensions.

Therefore, the study areas chosen for the research are adequately representative of the objective as the primary goal of this project is to analyze the contribution of bike-rental to sustainability. It is crucial to note that each goal's framework in Figure is constrained by the need of long-term economic sustainability.



Sustainability of the categories of success used in this project to analyse bike-rental

OUR INNOVATION AND IT'S DESIGN

The objective of developing a model is coming up with the idea to construct a framework that allows the developer to create reasonable estimates of resources, cost, and schedule. These estimates are created inside a restricted time at the start of a sustainable project and may be updated often because the project progresses.
In our innovation goal is to develop a monitoring application and device for electric bike where people will be able to rent bike for their uses and monitor own activities that contribute to save CO2 emission as compared to other way of transportation. We listed down the objectives of the application :-

- Monitor how much CO2 emission save while travelling using our bike
- To suggest alternative travel route based on weather forecast and time saving route which can lead to money savings .
- To aware individuals about their role to reduce global warming and use bike sharing

- Motivate individual to fight the climate crisis by reducing carbon emission by taking environment friendly actions and use bike share in place of private vehicles
- Facilitate government in decision-making while implementing climate policy and providing data how people are contributing
- To aware individual contribution to achieve SDG 13 (Climate change)

This travel data of individual can be utilized by government because it is also helpful to track the record of individual people about bike sharing and helps in carbon-footprint to understand the trend of carbon emission in transport sector.
The Display with this built-in feature of carbon foot-print monitoring system will work as awareness raising idea by sending this small message to registered email "Save our Earth – Its on your Hand", so this is how the very crucial understanding about climate change will develop between people.

There will be a certain threshold whenever user reaches the certain limit the Display can send a alert system to the the mobile app and email, and provide 2km free ride based on average distance threshold.

User Requirements :-

User requirements are exactly what they sound like. They are specifications established by the end user. These specifications describe how a facility, piece of equipment, or process should perform in terms of the product to be manufactured, needed throughput, and manufacturing conditions. User requirements give data that is used to further specify, create, and verify a manufacturing system (i.e., the vendor's design solution to fulfil the user requirements, which is assessed during the design review/qualification process). Now a days mainly user required safety, environment friendly, good looking, privacy, easy to use, and good quality, all these features we provide in our innovation which is the best thing for future user.
We have considered to keep the feature of the application and product as simple as possible, to ensure the user-friendliness. The user-interface of the BRS Bike rental system

application contains easy-to-navigate feature on touchscreen display pane of smartphone as a built-in function. The mobile application will be free to download from mobile application download hub for any standard mobile specification without any additional software and hardware requirement. First user have to register it using valid email id, on our application after that he/she will check for the availability of bike near by or go to bike station, then they will rent it and complete their journey and pay it, In some case if he will add payment details like credit card or PayPal account he will also pay it later like monthly bill.

Figure Demonstrate How It works

USER INTERFACE

In this project we have divided user interface into three part :-

1. Mobile Phone Interface
2. Smart Display Interface
3. Desktop Interface

The main objective of our innovation is to create self-awareness among people to how to minimize carbon footprint in daily life and use bike rental to protect our environment. This solution can monitor and guide to avoid such activities related to daily travel by sending a simple notification on smart-phone display as well as company cloud database storage.

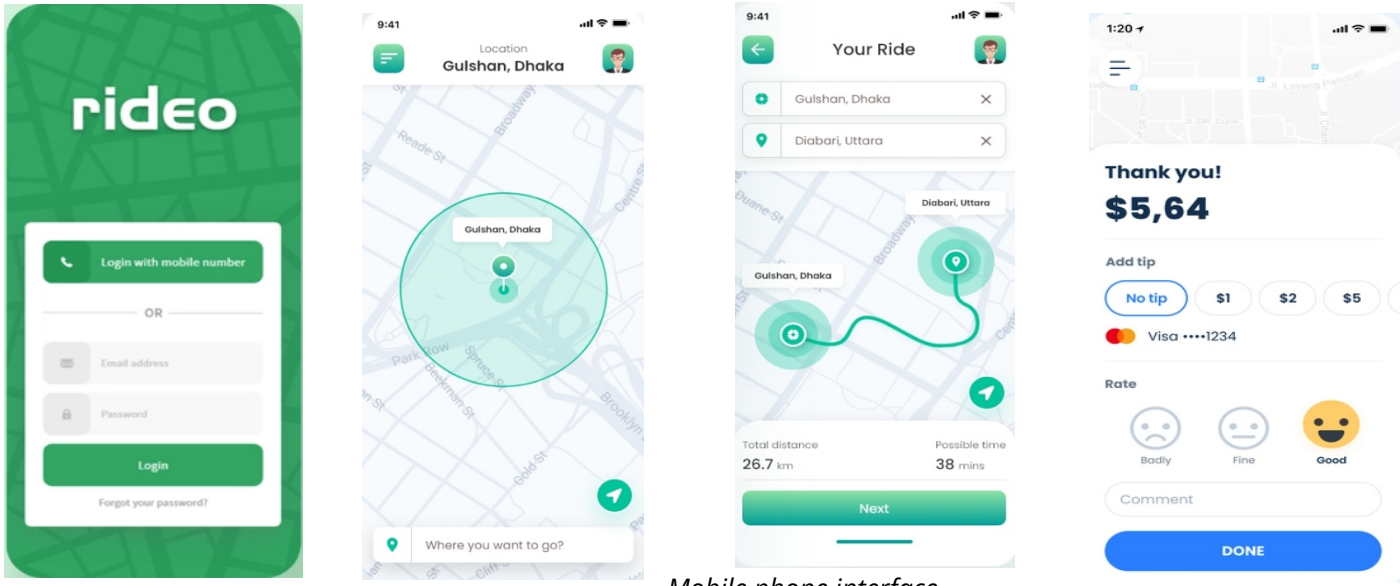
Mobile Phone Interface

A top-notch bike rental software requires a specific set of functionalities as well as a particular technological stack to function properly. Let's look more closely at the crucial components in developing traditional and electric bike-sharing apps before we discuss technology.

Features:

Basically, a bike sharing app enables users to choose a vehicle, pay for the rental, and then either lock the bike after use or return it to a docking station. If you want your bike rental app to function smoothly and draw people back, you need to choose a good development team, even though the set of functionalities might not appear complicated.

- **Login:** Users must download your bike-rental app and register or create an account. Allowing authentication through social media or email will speed up the process.
- **QR code reader:** Using the specialized app, users can unlock bikes by reading QR codes. Include a camera option to streamline code scanning. This feature is crucial for dock less bicycles.
- **GPS and geolocation:** This are the most crucial component of any bike sharing software since it allows users to find nearby bikes and discourages theft because the devices are built into the bikes themselves.
- **Payment methods:** Provide users with a range of convenient payment alternatives, including card integration, Google and Apple Pay, PayPal, and others.
- **Notifications:** In bike sharing apps, notifications are essential because they remind users about the rental period. With these apps, spending more time on the car means spending more money.



Mobile phone interface

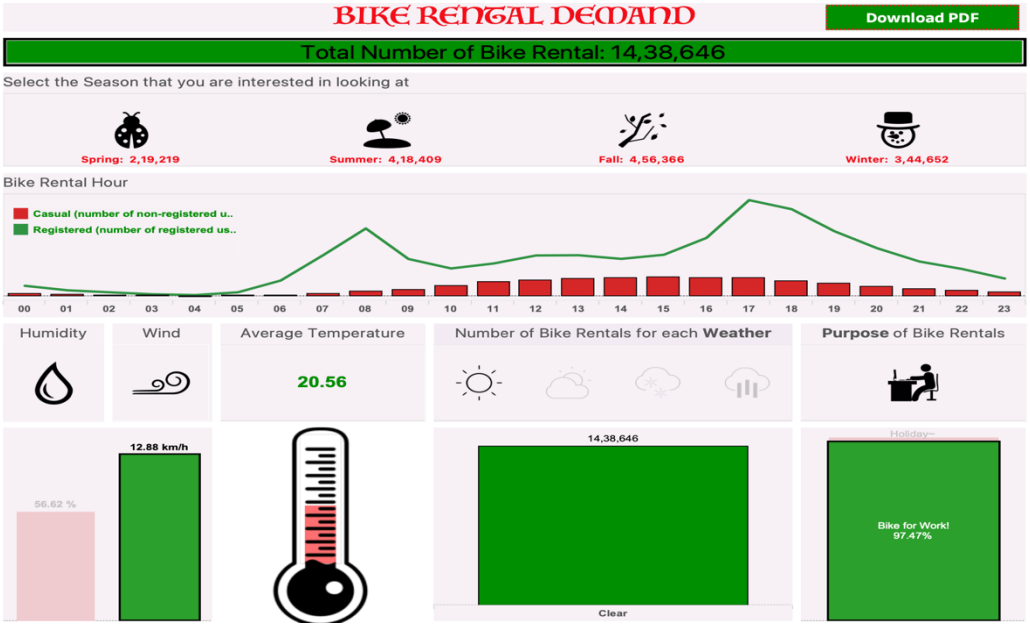
Smart Display

Smart display interface which is implemented in bike is also connect with a cloud server which have e-sim implemented inside it which helps the bike to provide the security by always monitoring the location and the interface of display will helps the user to use the bike without mobile phone just he can login with his registered mobile number or email address. Features of smart display will looks same as mobile application just here you have to enter the source destination after logging the system and by ending it ask you to pay the amount and finish the ride.

Desktop Interface

The application will start counting of travel log based on the travel made every day and in the end of day this travel data including total possible amount of CO2 emission saved by BRS along with distance that has been covered. Once data comes to cloud database, with the help of BI tool Tableau a report will be generated by comparing the travelled distance and suitable travel mode. In the report user will be able to see own saving of carbon-footprint after each travel . Alongside, the model will run a comparative analysis what travel mode user could choose depending on the distance. As output, Tableau will generate an report after certain interval of time, to inform Government and company

how user's are contributing to renting our bikes, like we can see what is the peak season, what is the busiest time of bike renting, and performance of the.



Desktop Interface on Tableau.

RESULTS

Success of bike rental will contribute in following ways:-

- To reduce car traffic
- To increase PT attractiveness
- To increase cycling
- To reduce pollution
- To improve air quality
- To increase fitness level
- To reduce traffic accidents with cyclists involved
- To create jobs
- To reduce transport costs for households
- To improve city image
- To increase city attractiveness for tourism

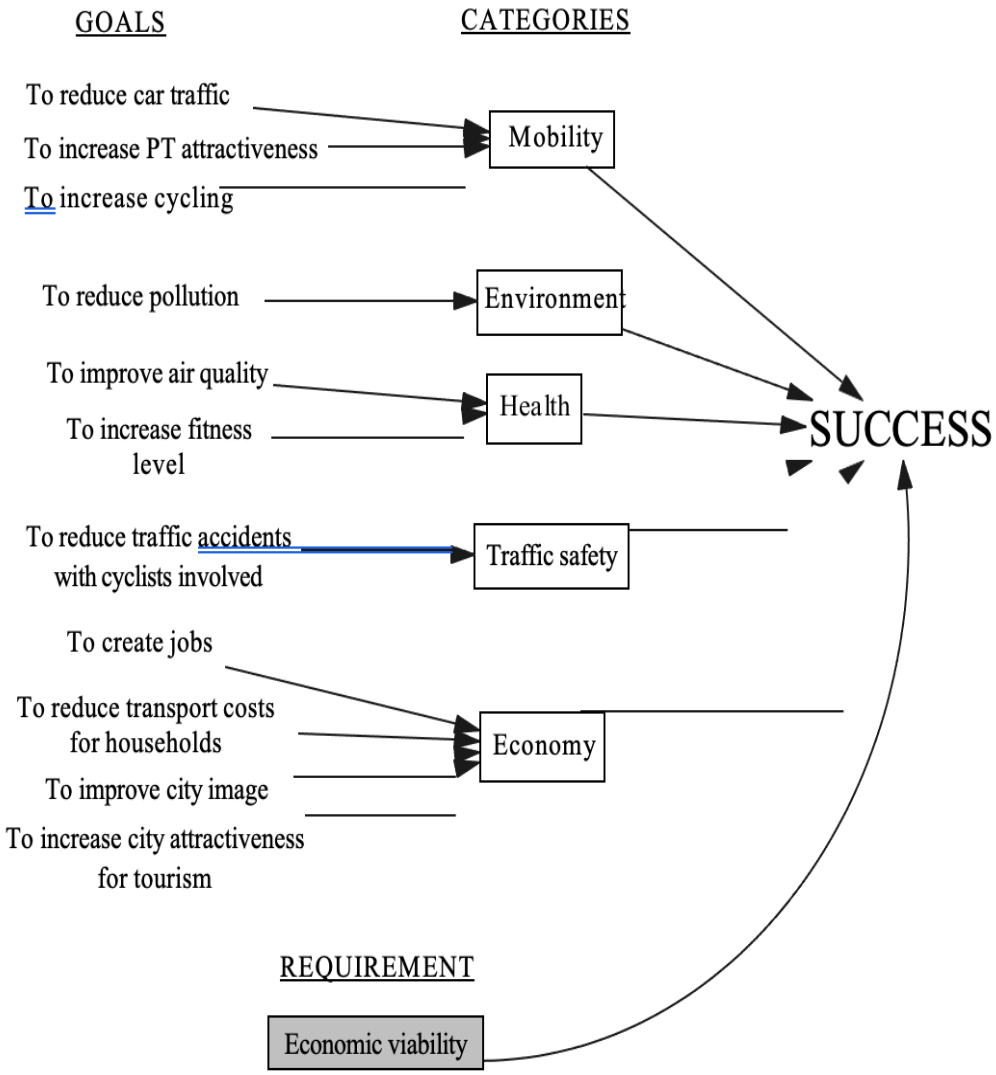
In order to enhance urban mobility, which includes lowering traffic congestion and maximizing travel time and urban space, municipalities that have as a goal reducing vehicle traffic, enhancing PT attractiveness, or/and expanding cycling in their towns have a same objective. Other towns could prioritize reducing pollution, which entails improving the environment, as a goal12. Cities that want to boost air quality and human fitness share the desire to enhance public health. The deployment of a BSS actually results in an increase in overall traffic safety due to the decrease in incidents involving bicycles. Finally, increasing the local economy is a goal shared by towns that adopt a BSS with the main objectives of boosting employment possibilities, lowering travel expenses for residents, enhancing the city's reputation, or promoting tourism.

A BSS is successful if any of these main objectives is accomplished. However, if a BSS is not financially viable, it cannot be deemed successful. For instance, a BSS cannot be deemed successful if it achieves excellent CO2 reduction outcomes but must close few months after start due to limited financing. Long-term success must be sustained. As a result, maintaining economic viability is a criteria that must constantly be addressed in addition to objective attainment.

This project has grouped the likely goals of bike-rental into five categories:-

- Mobility
- Environment
- Health
- Safety
- Economy

Five "categories of success" are implied by the accomplishment of these five ultimate bike-sharing goals. The topics of research that this dissertation has examined for the assessment of bike-rental success globally include these success categories and the necessity of economic sustainability.



USER EVALUATION

The main focus of usability evaluation is on how easily people can understand and use a product to accomplish their goals. It also relates to the degree of user satisfaction with the procedure. Practitioners employ a range of techniques to collect this data in order to learn how consumers feel about an existing site or about ideas for a new one.

Usability is the term used to describe how well a user can engage with items or systems,

such as websites, software, hardware, or applications. Usability is all about the user's total enjoyment, efficacy, and efficiency.

we can see real-world example of user evaluation for application that is used with the bike .In login screen user chose to sign in with mobile number. When in the application user clicked login button that opened the selection screen. User first clicked where user want to go. Then user will see its source and destination page. And below that page the user will get to see the total distance and possible time. When clicking on next button the user will get to see the payment selection page whether the user would pay by card.

For user evaluation we also use short questionnaire in which user will be allowed with all the possible questions with respect to experiences which user will have when riding the bike.

Here is the questionnaire survey for user after completing the ride on our RIDEO app.

https://docs.google.com/forms/d/e/1FAIpQLSfoyjbQxZT5du_YoBC_P8_alW7_acoaTmI1dQRbSrRHiU0jVw/viewform?usp=sf_link

CONCLUSION

The energy and emissions produced by the transportation sector are significant. With economic growth and lifestyle changes, the transport sector's contributions rise. A sharing economy, like the bike or car sharing, is a potential means of lowering emissions and energy consumption in the transportation industry. Studies have shown that bike-sharing programs can increase the use of bicycles in urban areas. As a result, bikes can partially replace other forms of transportation (such as private cars, cabs, and buses), especially regarding the "final mile dilemma." Bike sharing is expanding quickly in many places across the world. In China, it is anticipated that shared dock less bikes will increase by around three times from 2016 to 2017. As a result, bike sharing will have a more significant positive impact on the environment by lowering energy consumption and emissions in the transportation industry.

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EFFORT DAIRY

MEMBER'S NAME	TASK ASSIGNED	PERCENTAGE COMPLETED
Rishabh shukla	Introduction, User Evolution	100%
Pranuj rai	Methodology, User Interface, result	100%
Philemon Frimpong	Our Solution	100%
Md. Hasan Sharif	Problem statement, Conclusion	100%
SM Muzahidul Islam	User Interface	100%
Gilbert Kwame adu	Existing Solutions	100%