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Enhancing Accessibility in Urban Transportation: Integrating Electric Bicycles as Feeder Services Along BRTS Corridor-1 of Surat City

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Abstract: The research focuses on how to improve the accessibility of Bus Rapid Transit System (BRTS) facilities in Surat City's Udhna area by including electric bicycles (E-bikes) as feeder services. Urban transportation systems have been dealing with an increasing number of challenges in the last few years, such as traffic, pollution, and accessibility issues. environmentally friendly urban transportation solutions now need feeder services, which offer last-mile connectivity to key transit hubs. Using current developments in electric mobility technology, the aim of this study is to investigate the potential and benefits of using E-bikes as feeder services. The research finds areas for improvement by conducting an in-depth study of the present transportation environment, including the limitations of the current bicycle-sharing programs as feeder services.

Keyword: E-bike Sharing System, Share E-Bike, Public Bike Sharing.

I. Introduction

The rapid rate of urbanization and economic development in India have caused severe traffic congestion, pollution and other associated difficulties for the greater majority of the million plus cities. In particular, big cities are facing a dramatic increase in personal vehicles and different modes of indirect public transport operated by the informal sector in small and medium - sized towns are grappling with the demands of urban resident with mobility. This has brought about increment in trip lengths and higher utilization of private vehicles, problems of pollution and increased demand of infrastructure. The research paper explores the implementation of an E-Bike Based Feeder System in the Udhna Zone of Surat City, aiming to improve Bus Rapid Transit System (BRTS) facilities. The study focuses on reducing carbon emissions and addressing traffic congestion, examining the synergies between electric mobility and public transit infrastructure. Some of the BRT systems implemented have not achieved their expected targets. The poor performance has been occasioned by increased motorization and poor land use planning (Akkarapol et al., 2009). The aim is to contribute to eco-friendly urban transportation initiatives while addressing the specific needs and challenges of Surat City's transportation network. The objectives are to study of existing research on e-bike sharing, existing routes of BRTS and feeder vehicles. The scope of work includes evaluating feasibility, determining optimal routes for E-bike based feeders, and developing a comprehensive plan for integrating E-bike based feeders with the existing BRTS network, addressing coordination, ticketing, and infrastructure requirements.

II. Literature Review

Feeder systems, such as shuttle buses, bicycle-sharing programs, and micro-mobility solutions, are essential for improving the accessibility and efficiency of public transit systems, especially in densely populated urban areas, and have been implemented globally to enhance connectivity within urban areas. (de Almeida Correia & da Silva, 2019) Studies suggest that EVs can enhance public transit infrastructure, like BRTS, thereby promoting sustainable and efficient urban mobility. Research on integrating electric vehicles (EVs) into urban transport systems has shown promising results in reducing carbon emissions and improving air quality. (Bauer et al., 2020) This review analyses the modal shift behaviour in early North American bike sharing systems to understand factors influencing consumer adoption. It identifies key determinants such as convenience, accessibility, and perceived benefits, shedding light on strategies for promoting e-bike sharing uptake. (Shaheen, S., Cohen, A., & Martin, E., 2019)

Focusing on smart city integration, this review explores the technological advancements driving e-bike sharing systems. It highlights the role of technology in enhancing accessibility, efficiency, and sustainability of urban mobility, offering insights into future innovation pathways. (Cheng, Y. H., Zhang, X., & Yang, X. , 2019) Exploring integration strategies, this review discusses benefits such as enhanced connectivity and accessibility. It examines spatial evolution and diffusion patterns of dockless bike-sharing, providing insights into effective integration with public transit systems. (Li, Z., Zhang, Y., & Bai, Z., 2020)

This comprehensive review evaluates the impact of e-bike sharing on urban traffic dynamics. It examines modal shifts, congestion mitigation, and the role of e-bikes in promoting sustainable mobility solutions. (Zhang, H., Cao, J., & Huang, H., 2020) Assessing economic viability, this review evaluates revenue models, cost structures, and potential impacts on transport economics. It provides insights into the role of e-bike sharing in reducing car usage and promoting sustainable urban mobility. (Le, T., Luttinen, T., & Toivonen, T, 2020) etc.

III. Case Study

Bangalore, India's vibrant IT hub, underwent a transformative change in urban mobility with the introduction of e-bike sharing services. This groundbreaking initiative aimed to tackle the city's chronic traffic congestion and air pollution issues while offering commuters a convenient and environmentally friendly transportation alternative. The e-bike sharing platform utilized state-of-the-art technology, allowing users to locate and unlock bikes through a mobile app. This initiative gained substantial traction and adoption, particularly among tech-savvy millennials and urban professionals seeking efficient and sustainable commuting options. However, despite its promising inception, Bangalore's e-bike sharing system faced several challenges. One significant obstacle was ensuring an adequate fleet of e-bikes and their maintenance to meet increasing demand, particularly during peak hours and in densely populated areas. Additionally, issues like vandalism, theft, and improper parking necessitated robust security measures and user education initiatives. Furthermore, integrating the e-bike sharing system with existing public transportation networks and addressing infrastructure concerns, such as dedicated bike lanes and charging stations, emerged as crucial factors for its sustained success. Overall, Bangalore's e-bike sharing initiative highlights the significance of technological innovation, user involvement, and urban planning in shaping sustainable mobility solutions for rapidly expanding cities.

The general rules and regulations for electric bikes in India

Here are the general rules and regulations for electric bikes in India, including Bangalore:

Electric bikes below 250 watts and speed up to 25 km/hour: These are considered as non-motorised vehicles and don't require any registration, driving license, or insurance. Users should still adhere to general traffic rules, and it's advisable to wear helmets for personal safety.

Age limit: For electric bikes that fall into the non-motorised category, there is usually no age limit. For those in the motorised category, the rider must be at least 18 years old.

Road and Lane Usage: Electric bikes should follow the same rules as traditional bikes when it comes to road usage. Bike lanes should be used where available.

IV. Study Area

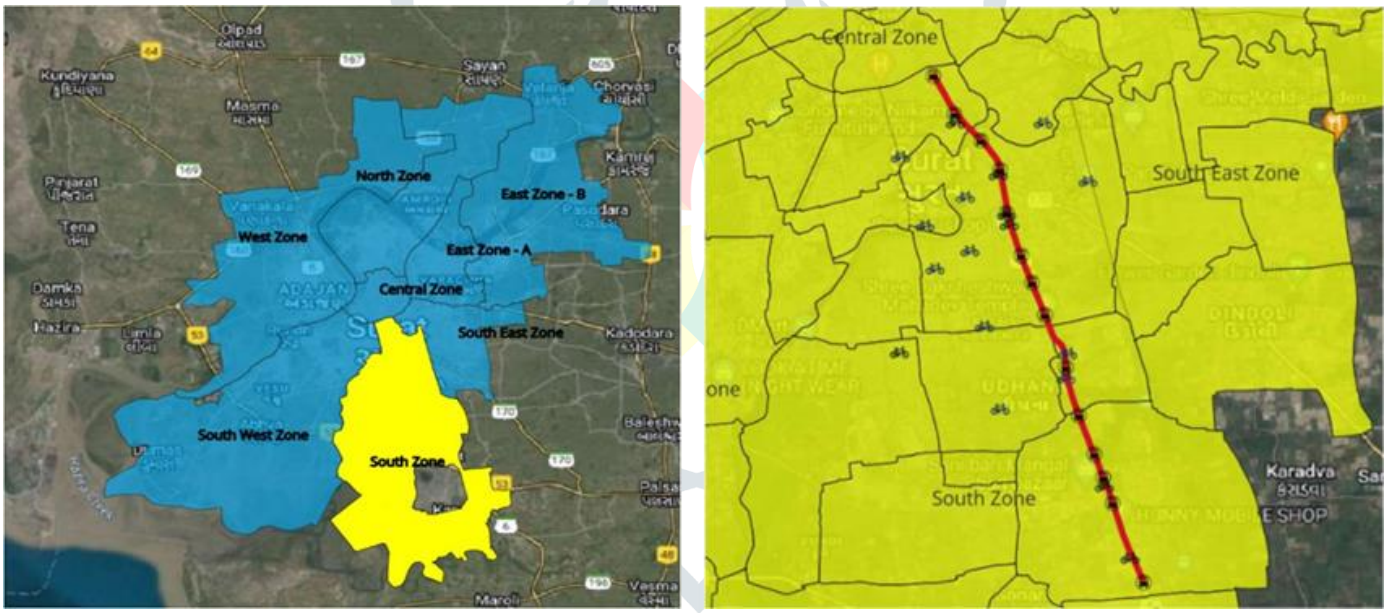

Figure 1 Selected Study area & Stretch of BRTS with Existing PBS Stations

Source: (QGIS 3.34.3 Software)

The decision to choose Corridor 1, stretching from Udhana Darwaja to Sachin GIDC Naka, as the study area for the implementation of e-bike sharing is rooted in a comprehensive assessment of various factors. The study area is located in the south zone -A of Surat City, having a high demand for transportation. This corridor serves as a crucial link within the existing Bus Rapid Transit (BRT) system, facilitating transportation between important residential, commercial, and industrial areas.

4.1 Population Growth

Table 1 Growth of population

Ward No.	Area (Sq.Km)	Population		
		1991	2001	2011
34 Majura – Khatodara	2.32	48928	63217	58564
53 Bhedvad	1.68	7485	8219	12663
54 Bhestan	6.91	12938	25616	52936
55 Pandesara	2.82	21242	52389	73314
56 Udhana	6.8	105281	186860	248331

57 Bamroli (Part)	1.57	8889	45354	105130
66 Vadod	0.428	499	235	89
87 Vadod (Part)	3.77	2246	13763	41075
88 Bamroli (Part)	5.333	8576	34592	73710

(Source: Census of India, 2011)

4.2 Demographic data

Table 2 Demographic data

Ward No.	Population	Area (Sq.Km)	Density (Peron / Sq.km.)	Literates	Sex Ratio
34 Majura – Khatodara	58564	2.32	25243.1	48980	790
53 Bhedvad	12663	1.68	7537.5	9238	687
54 Bhestan	52936	6.91	7660.78	39780	602
55 Pandesara	73314	2.82	25997.87	56289	629
56 Udhana	248331	6.8	36519.26	188852	709
57 Bamroli	105130	1.57	66961.78	78540	490
66 Vadod	89	0.428	207.94	62	203
87 Vadod	41075	3.77	10895.23	30432	282
88 Bamroli	73710	5.333	13821.49	53813	537

(Source: Census of India, 2011)

4.3 Existing Ridership data

Table 3 Existing BRTS Corridor

Phase	No. of Corridor		Corridor Lengths (Km)	No. of Stations	Full day Ridership (BRTS)	Passenger Boarding (Auto)
1	2	**Co-1:** Udhana Darwaja to Sachin GIDC Naka	30	33	13500	2500
		Co- 2: ONGC Colony - Canal Road - Sarthana Jakat Naka			18200	1200
2	9	Varachha,walled City ring road, Surat Bardoli road, Katargam Drwaja to Amroli,Rander Road, Gujrat Gas Circle to Anuvrat Dwar, and Hazira road	42	75	30400	1500
3	-	Not available	30	59	Not available	Not available
4	-	Elevated corridor from Surat railway station to the City Center	3.5	Not available	Not available	Not available

Table 4 Detail Ridership Data

Modes	Actual Ridership	Passengers Boardings
Auto	85000	84564
BUS (city bus = GSRTC)	12200	12963
BRTS	4000	4169
Total	101200	101696

Source: (CMP Surat, 2046 & Surat Sitilink)

V. LIMITATIONS

Conduct field studies and surveys to gather data on current transportation patterns, commuter behaviours, and potential demand for E-bike services. This will provide empirical evidence to support the feasibility and effectiveness of integrating E-bikes with the BRTS system.

Engage with key stakeholders including city authorities, transportation agencies, E-bike vendors, and local communities to understand their perspectives, concerns, and requirements for implementing E-bike feeder services.

Analyse the infrastructure requirements for deploying E-bike stations and charging facilities along the BRTS corridors.

VI. Concluding Remark

The integration of E-bike sharing as feeder services to augment the BRTS infrastructure in Surat City presents a significant opportunity to tackle urban transportation issues such as traffic congestion, pollution, and restricted accessibility. This research advocates for an approach to urban transport planning that embraces sustainability and inclusivity through the utilization of emerging technologies and inventive mobility solutions. The examination of existing literature underscores the potential advantages of E-bike sharing in stimulating changes in travel patterns, curbing carbon emissions, and enhancing urban mobility. Nonetheless, the successful execution of this initiative necessitates thorough planning, cooperation among stakeholders, and the adoption of technological advancements. By conducting empirical studies, engaging stakeholders, and initiating pilot projects, this research endeavors to offer practical recommendations to realize a transportation system in Surat City that is more efficient, equitable, and environmentally conscious.

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