DEVELOP A BICYCLE NETWORK PLANNING MODEL FOR URBAN AREAS IN SRI LANKA: A CASE STUDY OF THE UNIVERSITY OF MORATUWA AS THE DESTINATION

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ABSTRACT - The primary goal of this research is to analyze the factors that influence the creation of a successful bicycle network (BN) and the critical role of bicycle network planning (BNP). This study identifies crucial factors that impact the development of BNs. Additionally, qualitative data was collected through a survey to supplement quantitative data. It was discovered that community engagement and collaboration with stakeholder groups, ensuring that the network accommodates the requirements of all users. Another objective of this study is to develop a BN plan for the University of Moratuwa (UoM). By combining Geographic Information System (GIS) analysis with a participatory approach, the study identifies priority routes for cycling. By weighting alternative routes for each Origin Destination (OD) using the equal weighting method and weighted mean formula, some of the identified routes were found to be similar to those currently utilized by cyclists, while others were not. The study also identified areas for improvement by validating the results. The findings of this study can be used by policymakers and city planners to create a more sustainable and equitable transportation system. They cannot solely rely on technical analyses, and there are numerous factors to consider to ensure the success of a BNP.

Keywords: Bicycle Network Planning; City planners; Cyclists; Key factors; Transportation

1. INTRODUCTION

Olmos et al. [1] argue that incorporating information on accident-prone areas would enable the prioritization of interventions that consider security measures, thereby improving the livability and overall well-being of cyclists. It can be identified a lack of research that prioritizes safety in the development of a BN. This study prioritizes user perception to address cyclist safety. Users are less likely to use a BN if they feel unsafe or uncomfortable, limiting the benefits of active transportation. Planners can enhance ridership and improve health and the environment by examining user views and attitudes [2]. The research aims to achieve three objectives. Firstly, it aims to identify the significance of BNP in promoting cycling. Secondly, to determine the level of importance of various factors that affect the development of a BN, considering the user experience. Finally, to develop a model for a BN that can be utilized to promote cycling in the area.

2. MATERIALS AND METHODS

The study has considered both the home or boarding house and the UoM as possible origin and destination points. The study has considered only 6 DSDs (Bandaragama, Homagama, Horana, Kesbewa, Moratuwa, Panadura) for the locations of cyclists' origins. When developing a BN model, a participatory approach involves engaging with cyclists and actively involving them in the process of creating the model. By involving cyclists in the process of creating the model, it can help to ensure that their needs and preferences are accurately reflected in the final design. For the purpose of this study, the target population is specifically individuals who cycle to the University. A sample size of 31 has been chosen for the research. To gather information for this study, both primary and secondary data were utilized. The primary data was collected through online survey and face-to-face interviews using a structured questionnaire. The survey was conducted by sharing a Kobo Toolbox form within the UoM premises.
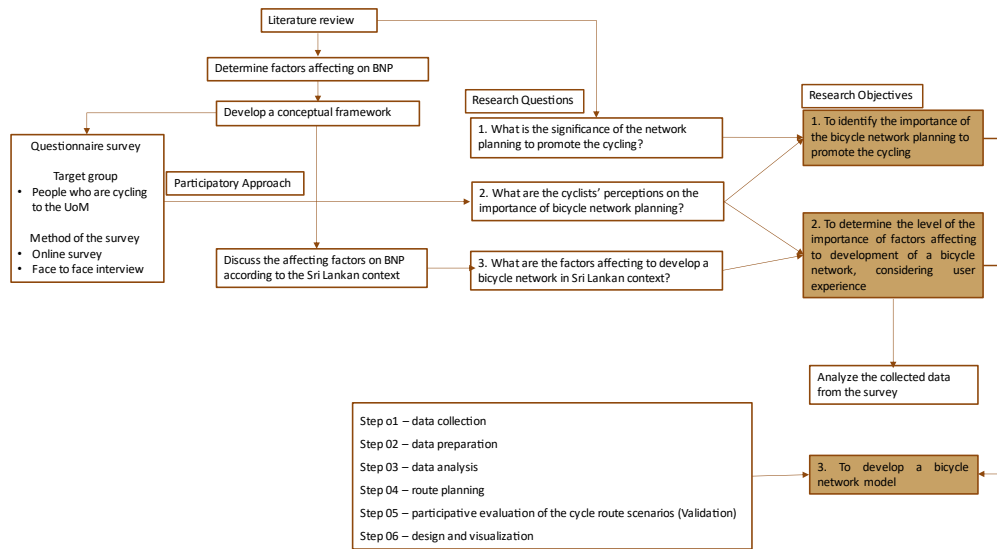
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Figure 2. Methodology diagram

14 number of factors (Distance between origin & destination, Availability of the Intersection, Availability of number of bends, Availability of Natural elements, Centrality, Accessibility to activities, Accessibility to public transportation, Traffic volume, Traffic speed, Theft risk, Desire for comfort, Sensitivity to time, Desire for economy, Weather) has been ranked using relative important index. Accordingly, desire for economy takes 1st position while centrality takes last rank.

Use GIS tools to analyze the data and identify potential bicycle routes. This involves using spatial analysis tools (network analysis tool). To determine the angular changes of identified routes Spatial Design Network Analysis (SDNA) tool was used. Use the results of the survey data analysis to plan alternative routes for the BN. This involves following factors, distance between origin & destination, number of intersections, number of bends, availability of natural elements. Key terms used in literature review [3]; to quantify the selected 4 factors [matrix distance (MD); topological distance (TD); Geo-matrix distance (GMD)]. For each OD trip, four potential paths for cycling have been selected, including the shortest distance path, the route being used right now, and two other routes that may be cycled.

3. RESULTS AND DISCUSSION

The analysis reveals that certain ODs have received a high score for their presently utilized route, while others have routes that are completely distinct from the one they are presently using. To be precise, there are 13 ODs that necessitate verification with the assistance of cyclists who participated in the survey because these 13 ODs' weighted routes differ from their presently utilized routes.

In sum, 31% of cyclists would rather choose the only route that is weighted based on the results of the survey, whereas just 8% would choose the only route that is equally weighted. Almost half of cyclists (46%) are eager to go across both weighted routes. 15% of cyclists don't have a preference for any of the routes based on weighted route option and they are willing to travel the same route that they are using currently.

Based on the information provided during the validation process, it is evident that certain cyclists have declined to transition to the new routes for a variety of reasons. These reasons encompass, firstly, the inadequacy of road conditions, which results in increased traffic congestion when numerous activities are underway along the route. Additionally, though the proposed route proves advantageous compared to the present one during daytime, apprehensions arise regarding nighttime safety due to

the lack of sufficient lighting along the road. Furthermore, concerns arise about potential dog attacks while returning home at night if cyclists utilize the road recommended by the study, which may result in accidents and falls. Cyclists traversing the forested areas also frequently encounter wildlife crossing the road, and the presence of small streams along the routes contributes to flooding issues. Moreover, the roads' narrowness impedes the safe coexistence of cyclists and motorized vehicles.

Following the insights gained from the cyclists, the study sought to develop a bicycle network model that prioritizes the UoM as the primary destination.
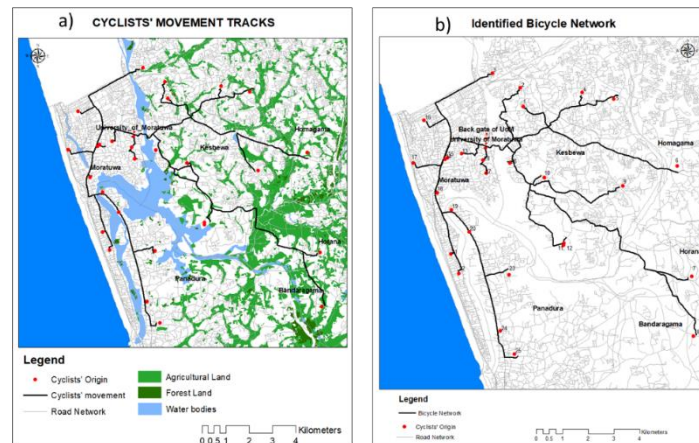

Figure 2. a) Cyclists' movement track   **b)** Identified bicycle network

There are other criteria as well that can be used to select the best route. If those criteria also taking into account, the best routes may be varied. As 54% of cyclists agree with equal weighted routes and 77% cyclists agree with survey - based routes, this model is accurate up to a limited level.

4. CONCLUSION

This research contributes to the existing knowledge on bicycle network planning by emphasizing the importance of considering user perspectives and preferences when developing BNs. The GIS-based approach used in the study can help identify optimal cycling routes not previously recognized by cyclists, enhancing the overall safety and accessibility of cycling infrastructure. The findings of this study are of significant relevance to policymakers and city planners as they seek to create sustainable and effective transportation systems that encourage cycling as a viable mode of urban transport.

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