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Pedestrian Safety Intelligence System (PSIS): A Data-Analytics Framework for Urban Mobility Enhancement

Bharathi.B¹, Dhanraj C², Shreyas Maurya V², Yashwanth D J²

Assistant Professor, Dept. of Civil Engineering, ATME College of Engineering, Mysore, Karnataka, India¹

Under Graduate Student, ATME College of Engineering, Mysore, Karnataka, India²

ABSTRACT: Safe foot path, safe Road, safe vehicle and safe driver are the four important key factors along with safe environment. As Road engineers, the safe design of Road infrastructure is very important and pedestrian safety auditing provides a vital role in ensuring that the footpaths are built to the highest safety standard. Practical footpath safety auditing provides solutions to safety problems and also brings together safety audit procedure stop be followed by the agency, local authorities and other organizations involved in safety aspect. There is strong need to practice pedestrian safety auditing before, during and after construction of foot paths in order to minimize pedestrian accidents. Based on the local conditions and adopted methodologies for the planning & design the footpaths can be made safer for pedestrian. So, it is very important to identify the pedestrian safety audit parameters with reference to a given set of conditions and aggregate these parameters to a composite index. The rating of a given footpath based on priority (black spots) locations and the development of relative weight ages to various parameters as received by experts, research scientists, local authorities and also pedestrians using qualitative approach. This index measures the safety performance.

I. INTRODUCTION

Pedestrain accident in India

Pedestrians represent one of the most vulnerable road user groups in India. Pedestrian accidents constitute a substantial proportion of total road traffic fatalities, particularly in urban areas where population density and pedestrian activity are high. Unlike motor vehicle occupants, pedestrians have minimal physical protection, making them highly susceptible to severe injuries or death even at low vehicle speeds.

The high incidence of pedestrian accidents in India is primarily attributed to inadequate pedestrian infrastructure such as footpaths, safe crossings, pedestrian signals, and grade-separated facilities. Additional contributing factors include encroachment on sidewalks, poor street lighting, lack of traffic discipline, and insufficient awareness among both drivers and pedestrians. Children, elderly people, and persons with disabilities are especially at risk.

Improving pedestrian safety is critical for achieving inclusive and sustainable urban mobility. It requires integrated planning measures such as pedestrian-friendly road design, traffic calming, strict enforcement of speed limits, public awareness campaigns, and prioritization of non-motorized transport in transportation policies.

II. LITERATURE SURVEY

Mohan, D. et al. 2015,

“Road Safety in India”, Identified rapid urbanization, inadequate pedestrian infrastructure, and poor enforcement as major contributors to high pedestrian fatality rates in Indian cities.

NHTSA, 2015,

“Pedestrian Safety Report” Found that the majority of pedestrian fatalities occur in urban areas, at non-intersection locations, and during nighttime conditions; reported approximately one pedestrian death every two hours.

Nagaraj, R. et al., 2013,

“Modelling Pedestrian Delay and Level of Service at Signalized Crosswalks Under Mixed Traffic Conditions”, Developed a framework for estimating pedestrian Level of Service (LOS); showed that pedestrian delay increases significantly under mixed traffic conditions without adequate signal timing.

Rosen, E. et al., 2009,

“Impact of Vehicle Speed and Pedestrian Volume on Crash Rate”, Demonstrated that higher vehicle speeds increase both the likelihood and severity of pedestrian crashes, while higher pedestrian volumes tend to reduce crash rates due to increased driver alertness.

Eluru, N. et al., 2008,

“Pedestrian Injury Severity Assessment”, Concluded that higher vehicle speeds and poor lighting conditions significantly increase injury severity; crashes at signalized intersections are generally less severe compared to mid-block locations.

Bharathi et al., 2012,

“Methodology to develop Pedestrian Safety Index for Urban roads and its Evaluation”, An attempt has been made by the authors to develop a methodology to aggregate the pedestrian safety parameters on to a common base scale by developing value score charts, after interviewing 1158 road engineers, academicians, R & D units and mainly pedestrians in the country. The equation developed is a simple tool to measure the PSI for the existing roads and assess them through the developed index for its safety. It is possible to improve each affected factor of PSI to ensure safer footpaths.

III. METHODOLOGY

IDENTIFICATION OF PARAMETERS

1. Nature
2. Types
3. Presence of Obstruction
4. Safety and User Friendly
5. Volume/Capacity

$$\text{PSI} = \frac{\sum_{i=1}^{i=n} W_i * V_{ei}}{\sum_{i=1}^{i=n} W_i * V_{si}}$$

Table -1: Computed PSI for various footpaths under consideration

Sl. no	Road	PSI, %
1	Bannur road, Siddhatha Layout	33.40
2	Vanivilasa road	44.07
3	Krishnaraja Blvd road	42.97
4	Kanthalraja Urs road	59.13
5	Swimming pool road, Saraswathipuram	30.45

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However, the PSI and level of service can be improved by various interventions, if implemented, in increasing the value scores for parameters like:

The main bottleneck being inadequate width of footpaths for all roads based on IRC guidelines. If this is in place, value scores will be improved to a large extent. The recommended widths are shown in table 5 must be strictly adhered as the roads are widened at the cost of footpath. In addition to this, one or two important measures are suggested for various roads to improve PSI as well as the LOS.

IV. CONCLUSION

An attempt has been made by the authors to develop a methodology to aggregate the pedestrian safety parameters on to a common base scale by developing value score charts, after interviewing 1158 road engineers, academicians, R & D units and mainly pedestrians in the country. The equation developed is a simple tool to measure the PSI for the existing roads and assess them through the developed index for its safety. It is possible to improve each affected factor of PSI to ensure safer footpaths.

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