Chapter 3
Conceptual Framework for the Application of the ANN Model in Accident Prediction: A Study of Central Kolkata

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ABSTRACT

Conceptual framework for accident prediction is an essential toolkit to curb accidents and fatalities globally. Different statistical methods and soft computing techniques are used to develop accident prediction models. Accident prediction models have been developed using two approaches, i.e., multiple linear regression (MLR) and artificial neural network (ANN). ANN has been applied to predict the frequency of traffic accidents. Adaptive neuro-fuzzy inference system (ANFIS) has been used as the feature selection method. Feature selection using ANFIS gets more accuracy with ANN was considered the most suitable based on prediction accuracy and measuring errors. It gives around 81.81% accuracy. The framework of hybrid model proposed in this chapter concludes that the prediction accuracy is high when ANN is applied for accident prediction, followed by the ANFIS as a feature selection method.

DOI: 10.4018/978-1-7998-9687-6.ch003

1. INTRODUCTION

Globally, 1.35 million deaths are recorded yearly due to road accidents. The number of injured due to road accidents counts 20–50 million and 27.5 deaths per 100,000 population (Yu, 2006). African countries record the highest number of deaths due to these accidents, while South-East Asia has the lowest (Yu, 2006). The number of death and injuries from road accidents may be reduced by 25% through the introduction of BRTS (Kapadia et al., 2022). Researchers in the field have also established a quadratic relationship between congestion and crash fatalities (Albalate & Xavier, 2021). It is accordingly of first concern to predict future traffic occurrences, to understand the severity related to speed to respond to it (Ebrahim & Hossain, ; Lee et al., 2019). Continuous inspection of significant determinants providing accidents admits researchers to act on computations concerning predicting the occurrence of severity (Mussone et al., 1999). Fact-finding on future accident spots has led to interlinking risk determinants like human traits, cab-related determinants, surroundings, and geometrical design-accompanying variables with accident severity (Chang, 2005). There are remnants of substantial significance for occurrence asperity models in forecasting city avenue accidents.

Models for predicting future road crashes are clear finishes for expressway security. Considering their skill to decide the accident occurrence helps label the determinants that transport tactics bear before identity (Abdulhafedh, 2017; Saccomanno et al., 1996). An able and trustworthy model of the asperity indicator is necessary for traffic accidents to effectively exercise an Intelligent Transport System (ITS) (Zheng et al., 2019). Researchers have established the frequency of crashes through a Poisson regression model. Few researchers have tried setting a relationship between risk factors with crash frequency (Abdulhafedh, 2016; Vogt & Barred,). One of the accepted techniques employed to evaluate predictions of severity due to injury resulting from crashes has used the logistic regression model. In this model, the categorical dependent variable was chosen over the numerical one (Pradhan & Sameen, 2020).

Similarly, a logistic regression model was applied in their analysis to derive the number of fatalities in accidents (Lui et al., 1988). It was improvised to establish that accident severity is determined by various indicators, including driver's fault, condition, visibility conditions on roads, road characteristics, and condition, time of occurrence, vehicle health, and use of safety parameters like seat belt use and the like. It was approached it using binary logit models (Sarkar & Sarkar, 2020). Though total accidents are more significant than the accident's character and number, the number of accidental injuries on roads exhibited better results in predicting severity due to accidents. Vogt and Barred 1998, identified the factors contributing to the severity of accidents on two-lane rural roads (Sarkar et al., 2016). Further, it was