

# Accident predictive system in Benue State using artificial neural network

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**Abstract.** Road Traffic Accident (RTA) cause serious threat to human life worldwide. Nigeria is not left out in this menace and in fact is ranked as one of the countries with a high number of RTA cases. This is alarming and a preventive measure is to be taken to avoid or reduce RTAs in the country. In this work, a system is developed to predict road accidents in Benue state using Artificial Neural Network (ANN) model. The road characteristics as well as environmental factors are used as parameters. Data of RTA from 2008 to 2014 was collected from the Federal Road safety Commission for predictions. The predictions will help policy makers as well as Federal Road Safety Commission to put in place measures to prevent occurrence of RTAs. The underlying database that store the RTA data was created using MYSQL relational database. The software was written using JAVA programming language and neuroph for the predictions.

**Keywords:** Artificial Neural Network; Neuroph; Road Traffic Accident.

## 1. Introduction

There are several means of transportation such as air, land, sea etc., but the most commonly used in Nigeria is the land (road). The invention of these means of transportation has gone a long way in aiding humans in the daily performance of their duties. In as much as road transport has various advantages, it is the most prone to accidents and the highest causes of death. According to [1] road traffic accidents are increasing with rapid pace and presently one of the major causes of sudden deaths in Nigeria. In the year 2012, not less than 4,260 people were killed in road accidents across the country and a total of 20,752 people also sustained various degrees of injuries from different crashes indicating an average of 56 people being injured in road accidents daily of which 432 deaths occurred in Benue [2].

In order to ensure a safe, efficiently and effectively road transportation system, there is need to collect, store, analyse road traffic data so as to monitor the state of road traffic accidents in Benue state and to predict the likelihood of road traffic accident occurrence. This will require the formulation and development a predictive model that can use both past and present data for forecasting accident occurrence. Thus, the model will allow stakeholders to influence positively key elements responsible for accident occurrence in a decision support system.

This paper focuses on developing a road accident predictive system for Benue state as a function of road characteristics and to evaluate the application of neural network model for predicting road accidents in the state. The paper is organized as follows: Section 2 gives a brief literature review of application of ANN to road accident prediction. Section 3 focus on the research Methodology used in this work and section 4 shows the results and discussions. The paper is concluded in section 5 with a brief overview of all that has been done.

## 2. Literature Review

Extensive research has been carried out in the prediction of traffic accidents in both developed and developing countries using various statistical techniques. Some of these techniques include regression, Poisson distribution, binomial distribution, Bayesian theory and neural networks.

One of the statistical techniques frequently used is the regression analysis.

Reference [3] developed a general accident prediction model for rural toll road sections in Indonesia. This model considered the relationship between accident frequencies, traffic flows, various roadway geometric and environment characteristics. Several other models were developed using negative binomial regression model. The resulting general accident prediction model showed that accidents at rural toll road

sections were positively correlated with annual average daily traffic and the number of horizontal curvature. The limitation to this model was that the model negatively correlated with the lane width.

Reference [4] developed relationships between traffic casualties and traffic characteristics, road characteristics and socio-demographic characteristics using both non-spatial Negative Binomial models and spatial Bayesian hierarchical models using area or ward (census track) level data. The Bayesian hierarchical models developed indicate that casualties increase with traffic flow, and households with no cars and total employment are statistically significant variables in all the models.

The numerous variables and complex relationships between the characteristics of the various traffic elements require analytical techniques other than traditional. However, the use of ordinary linear regression models is no longer in use.

A recent approach to analyze these relationships is the Artificial Neural Networks (ANN) which has been proposed and employed successfully by many scientists as an alternative to the conventional regression approach in forecasting time series pertaining to complex atmospheric and environmental phenomena. According to [5] neural network have been applied to develop complex software for road traffic management, accident prediction models, and crash estimation models etc. Neural networks are a wide class of flexible nonlinear regression and discriminate models, data reduction models, and nonlinear dynamical systems. Research by [6] shows the advantage of ANN over conventional programming. This is due to its capability to provide solutions to non-algorithmic problems and can learn how to deal with the new and unexpected situations by the help of past experience. Neural networks are able to relate input with output, allow large number of variables and are error tolerant. A neuron has many inputs and one output. The neuron basically consist of inputs (like synapses), which are multiplied by weights (strength of the respective signals), and then computed by a mathematical function which determines the activation of the neuron. Another function (which may be the identity) computes the output of the artificial neuron (sometimes in dependence of a certain threshold). ANNs combine artificial neurons in order to process information. The weights in a neural network are the most important factor in determining its function.

Neural networks are the simple clustering of artificial neurons by creating layers and interconnections as shown in figure 1.

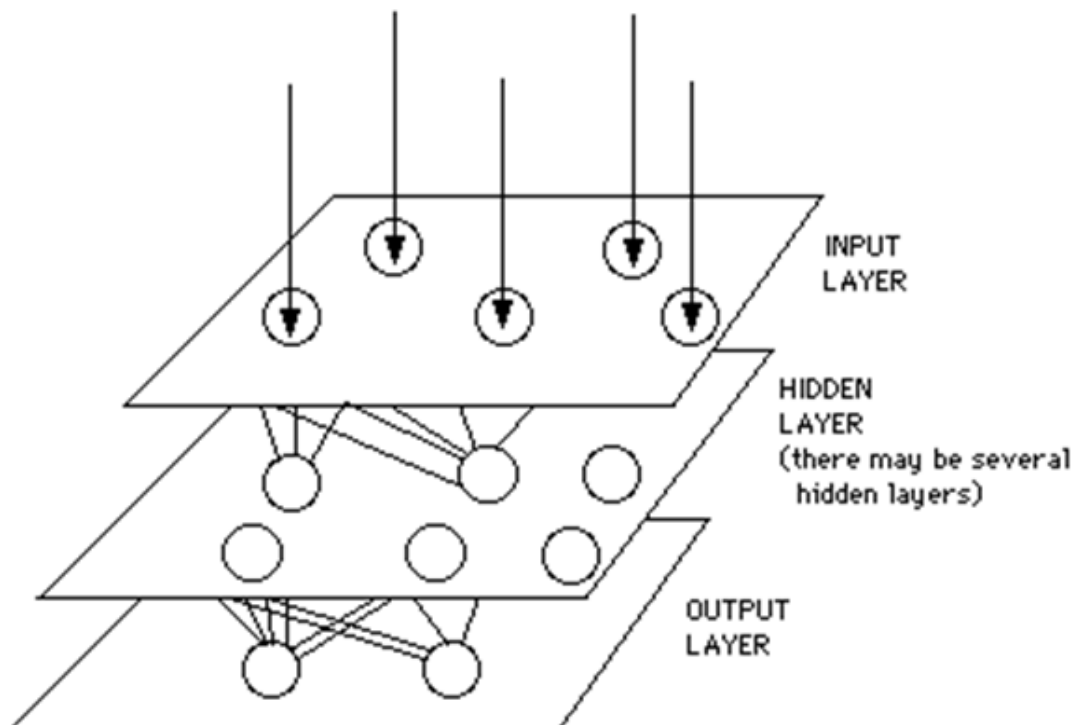


Fig.1. Layers of an Artificial Neural Network

(source: <http://www.psych.utoronto.ca/users/reingold/courses/ai/cache/neural3.html>)

Many studies on accident analysis, prevention and road safety etc have proved that road traffic accident are affected by lots of factors which are not always linear. Traffic accidents includes uncertainty and the studies already done cannot process pure explicit data.