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Development of a GIS-Based Traffic Accident and Road Database Management System

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1. Introduction

This research was to develop a Traffic Accident Analysis System (TAAS) to aid in the identification of accident black spots and develop a statistical model to predict traffic accident severity. TAAS was developed as a set of python tools and deployed as a toolbox in ArcGIS© 10.X. There were all together more than 252,251 traffic accidents (from 2008-2014) reported in Sri Lanka. TAAS consists of data for 20,041 traffic accidents reported in the Southern province of Sri Lanka over eight years (2008-2014). All relevant attributes of traffic accidents in the possession of the traffic police were included in TAAS. (Traffic Police Statistics in Sri Lanka 2014).

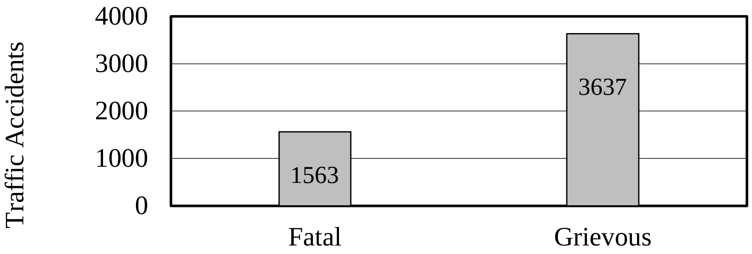

Figure 1: Fatal and Grievous Accidents from 2008-2014 in Southern Province

According to the World Health Organization (WHO) [1], more than 1.3 million people die each year in traffic accidents and more than 50 million are injured worldwide (WHO 2012).

Sri Lanka traffic police analyse traffic accidents through a software called MAAP. The collected data are not properly used for analysis because it cannot be done in a user-friendly manner. As a solution to this weakness, a GIS-based accident analysis system [2] which links a great volume of accidents was developed. As for the second objective of this study a logistic regression model was developed to predict the traffic accident severity. 2,802 serious and fatal traffic accidents were used in the model. Out of eight independent variables used, three were found significantly associated with traffic accident severity: ‘Time’, ‘Road Surface Condition’ and ‘Days of Week’.

2. Methodology

2.1. Traffic Accident Data Collection

Data for traffic accidents which occurred during eight years were obtained under several fields such as the location, severity, road surface information, driver’s age, etc.

2.2. Graphical User Interface (GUI) with Python

This was used to display the entire system in a desktop. Initiation of creating the GUI was done using Python 2.7 and there were altogether three tools developed.

2.3. Logistic Regression Analysis

Logistic regression analysis was performed considering a traffic accident data set of 2,802 under rural conditions which relate to fatal or grievous traffic accidents. This analysis was done using SPSS Statistics 17.0 software.

3. Results and Discussion

3.1. Traffic Accident Analysis System (TAAS)

TAAS can be identified as the main outcome, through which final results can be obtained at the end of each execution. This provides convenience to the user when data are entered to each field of the interface under 11 fields. There were altogether eleven fields for the user of TAAS to input data.

3.2. Logistic Regression Model

In order to identify the possible contributory factors related to accident severity among eight variables, a logistic regression model analysis was performed. Accident severity, the dependent variable in this analysis, is a dichotomous variable with two categories of Fatal and Grievous accidents.

As Table 1 indicates, three variables among the independent variables were found significantly associated with accident severity, namely, “Time”, “Road Surface Condition” and “Days of Week” (below 5% significance level). ‘Lunch Peak Time’ and ‘Evening Peak Time’ were identified under “Time variable”, ‘Slippery’ and ‘Flooded with Water’ were identified under “Road Surface Condition”, while ‘Monday and Friday’ were found under the “Days of Week” variables, to be most significant factors affecting traffic accident severity [3].

Equation 1 shows the model results for predicting traffic accident severity in Southern Province of Sri Lanka. Binary logistic model indicated by the Equation 1 achieved an overall classification accuracy of 70.1% as indicated in Table 2.

Table 1 - Coefficient Values for Model Variables

Variable	Coefficient (B)
Time	
1- Morning Peak Time	-.220
2- Lunch Peak Time	-.470
3- Evening peak Time	-.249
4- Daytime Without Peak	-.261
Workday or Non-Working	
1- Working day	.329
Day of week	
1- Monday and Friday	-.218
2- Tuesday, Wednesday and Thursday	.088
Road Surface Condition	
1- Slippery surface (mud, oil, garbage, leaves)	1.080
2- Wet	.135
3- Flooded with water	1.047
Light Condition	
1- Daylight	-.325
2- Night, no street lighting	-.270
3- Dusk, dawn	-.276
4- Night, improper street lighting	.081
Gender	
1- Male	-.059
Age Category	
1- Less than or equal to 20	.010
2- 21 to 35	.025
3- 36 to 50	.117

Accident severity = Coefficient for Time + Coefficient for Days of Week + Coefficient for Road Surface Condition + Coefficient for Light Condition + Coefficient for Gender + Coefficient for Age + Coefficient for Workday or Holiday - 0.383………………………………………………. (1)

Table 2 - Classification Table for the Model

Observed		Predicted		
		Severity		Correct (%)
		0	1	
Severity	0 - Grievous	1949	13	99.3
	1 - Fatal	824	16	1.9
Overall Percentage				70.1

4. Conclusions

The TAAS user interface created gives the user more than 150 different combinations of analytical methods under eleven different data categories where accidents appear in a digital map and can be displayed graphically. So TAAS can be further developed to better standard level more than MAAP since it involves more statistical information regarding the traffic accidents in Sri Lanka.

Results of the logistic regression model suggest that lunch and evening peak time, Monday and Friday, and also slippery and flood conditions, are significant causal factors contributing to traffic accident severity. These causal factors are found significant at or below 5% level implying that the conclusions could be accepted with 95% level of confidence [4].

Acknowledgement

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