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DEVELOPING AN AVERAGE DAILY TRAFFIC (ADT) ESTIMATION AND PREDICTION MODEL FOR SRI LANKAN ROADS

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ABSTRACT - This paper suggests a model to predict Average Daily Traffic (ADT) data of road segments in Sri Lanka where timely updated ADT data are not available. This methodology can be used to predict and estimate ADT data of both major and minor roads. Many previous studies have been conducted to estimate ADT only on specific road segments instead of considering the whole road network in the country. Initially, a road segment with a considerable length is selected for the study, and a model is developed to find the relationship between available ADT data of the particular road segment and associated factors which influence the ADT. These factors include social factors, economic factors, roadway and land use characteristics, availability of public transport, infrastructure development, etc. The most significant variables that affect ADT are identified, and corresponding weights are assigned for each variable through the developed regression model. Predicted accuracy of the model is validated through manual traffic counts. This proposed methodology can be applied for both major and selected minor roads and then expanded to the entire road network. This prediction model can be used to estimate ADT of road segments where updated ADT is not available, and data can effectively be used for transportation planning, capacity analysis, and infrastructure design, etc.

Keywords: Average Daily Traffic; Prediction Model; Regression Analysis.

1. INTRODUCTION

One of the most important parameters describing traffic is the Average Daily Traffic (ADT), which represents the average number of vehicles passes within 24 consecutive hours in a particular road segment [1]. ADT is a key parameter that is used in transport infrastructure design and planning, emission estimations, capacity analysis, road accidents studies, and many more. Recently, developing countries has faced a unique challenge in traffic management and transport infrastructure designing due to the rapid growth of vehicular traffic and urbanization. As a result, numerous traffic issues arise such as congestion and road accidents. ADT is a basic parameter for traffic operations management and transportation planning, which includes congestion management, improving road safety, planning of road networks, and designing the pavement [2]. In addition to them, ADT is required for many transportation project analyses, including economic assessments for highway improvements and safety design projects, determination of highway user revenues and highway statistics, estimation of vehicle travelled distance, development and improvement of maintenance programs, and others [1].

Typically, ADT is estimated based on field data of daily traffic volumes in selected road locations [3]. The field data collection can be conducted in two different ways which are the traffic volume for an entire year by permanent traffic monitoring equipment, and short-period traffic volume for 2 or 3 days by portable traffic counters [4]. The most precise approach for estimating ADT of a road segment is the installation of an automatic traffic counter throughout the entire year. However, the number of permanent traffic counters is limited, and the installation and maintenance of the traffic counters are expensive [1].

The objective of this research is to develop an ADT prediction model for a particular road segment and expand it to the entire road network of Sri Lanka based on the existing ADT data and its

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influencing factors. Besides that, identifying the most significant factors that affect ADT in Sri Lanka is another key finding of this study. There are many prediction models that have been developed by researchers worldwide to estimate ADT. However, they cannot be replicated in other countries. Also, several studies conducted in Sri Lanka have focused only on a few selected road sections in the road network. For an example, a study was conducted in Sri Lanka considering only the Colombo Metropolitan area [2]. Therefore, this study aims to propose a methodology that can be expanded to the entire road network of the country. This ADT estimation model can be used for future traffic estimations for major roads with the available traffic data and significant influence factors on ADT. And also, it would contribute to build an effective road transportation supply system in the country.

2. MATERIALS AND METHODS

For this study, available ADT data are collected from respective authorities in the country (Road Development Authority / Colombo Municipal Council). As the initial study, two A class roads are selected (A4 and A2 which) which are 317.78 km and 430.57 km in length respectively. These two road segments lead across different administrative districts in the country which have different land use patterns, urban and rural characteristics, etc. The selected roadways are segmented into uniform 10 km road sections based on the availability of current ADT data. Additionally, the influencing variables on ADT will be identified which are area type, land use, availability of public transportation modes, transportation infrastructure, economic activities, and weather effects.

Basically, the area type variables serve to indicate the jurisdictional boundaries administered by an Urban Council, Municipal Council, or the relevant Local Authority, thereby distinguishing between urban and rural areas. The determination of land use variable related particularly with regard to commercial and industrial activities within the specified road boundary area. Furthermore, the availability of public transportation modes is assessed by considering the accessibility and distances to various public transportation services in relation to the selected road segment. Also, the economic activity variable represents the presence of business centers and travel destinations along the identified road segments. Finally, the transportation infrastructure variable focuses on evaluating the existence of expressways or other related infrastructural elements. When developing the model, the dependent variable is the current ADT value where the independent variables are the selected influencing factors as below;

$$ADT \sim f(\text{Influencing factors on ADT}) \quad (1)$$

All segments where ADT data are available with the corresponding agencies are used in developing the model. Basically, data set is divided into two as the training data set (80% of data) and the testing data set (20% of data). A multiple linear regression analysis is performed for the training data set to identify the statistically significant factors with a 95% confidence level. The model fit is evaluated using the testing data set. Further, the prediction accuracy of the model is validated by using new set of manual traffic counts. Mentioned manual data collection will be conducted for a few randomly selected segments.

Then, the second phase of data collection is conducted to collect the identified significant variables of segments where ADT data are not available.

3. RESULTS AND DISCUSSION

The study is initiated with two A-class road segments, A2 and A4 roads. The regression equation with significant variables is a good reflection of the contribution of each variable towards the ADT value. For an example, positive coefficients indicate that the presence of the independent variable or an increase of the independent variable tends to increase the dependent variable. Negative coefficients tend to reduce the dependent variable. The final ADT value is derived with the combination of all components in the regression equation. Also, R^2 value is observed to evaluate the

model fit to the data set used. Moreover, it is recommended to develop similar regression equations for road segments in different areas as socio-economic factors are not homogeneous over the country. It would help to get a more reliable approximation of ADT across the entire road network.

4. CONCLUSION

This study proposes a methodology to predict ADT of road segments where currently ADT data are not available. ADT is predicted based on influencing factors related to socio-economy, land use, availability of different transport modes, traffic generators, etc. The predictions are validated through manually estimated ADT values for particular segments. As ADT data are available only for a limited number of road segments in the entire road network of the country, this methodology can effectively be adopted for estimating ADT in different traffic engineering applications.

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