# USE OF CROWDSOURCED TRAVEL TIME DATA IN TRAFFIC ENGINEERING APPLICATIONS

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## Declaration

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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S.P. Kumarage

Date 20/6/2018

The above candidate has carried out research for the Masters thesis under my supervision.

Dr. G.L.D.I. De Silva

Date 20/6/2018

## Dedication

This thesis is dedicated to
Ven. Lankapura Saripuththa Thero,
my parents Lalith Kumarage and Sandhya Kumarage,
my sisters Senuri Kumarage and Osuri Kumarage
and Wanuji Abewickrema.

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## Abstract

Transport planning and management are required to provide quality and reliable transport service. Collection of data required for this purpose has been always a challenge and obtaining reliable traffic information will ensure proper planning and management of transport activities efficiently. There are many methods followed in travel time data collection by incorporating both fixed detectors such as traffic sensors and moving detectors such as probe vehicles. Collection of travel time data under both methods requires significantly high investment and technical expertise.

With the development of intelligent transport systems economical ways of traffic data collection based on advanced detection principles were introduced. communication and detection methodologies have faced up with the advancement of crowdsourced data mining allowing more readily extractable information on transport and mobility. this research focuses on development of an economical method for obtaining crowdsourced travel time data. Scalability to larger networks, consistent data collection and data collection at multiple locations simultaneously and ensuring the reliability are issues which are addressed.

Travel time data obtained from Google Distance Matrix API which is a processed information released based on crowdsourced mobile phone data, is used in this study to identify use of crowdsource travel time data and transport planning activities. A cloud-based data acquisition platform was prepared for the data collection by accessing the Google Distance Matrix API. The travel time observed from Google Distance Matrix API was verified with the travel time information collected by using GPS enabled probe vehicles. The results indicate that there is a significant agreement between the travel time given by Google Distance Matrix API and actually observe data for both short distance and long-distance trips.

Several applications are illustrated to understand use of travel time information obtained by the Google Distance Matrix API. A traffic flow estimation model based on machine learning principles is proposed for urban roads, A bottleneck identification method based on spatio temporal analysis of travel time and space mean speed variation is illustrated to analyse corridor traffic. Further evaluating the traffic impact of implementation of bus priority lanes and evaluating the traffic impact of implementation of reversible lanes were discussed with respect to Colombo Metropolitan Area.

With the successful implementation of this research it was identified that use of travel time information given by Google Distance Matrix API is a reliable consistent and economical method of collecting travel time information and it is recommended that the public authorities and organisations responsible in managing city traffic use this tool to improve traffic management plans and transport policies

**Keywords:** Transport Planning, Crowdsourced data, Google Distance Matrix API, Traffic Analysis, Traffic Flow Estimation, Bottleneck Identification

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## List of Abbreviations

| Acronym | Definition |
|---|---|
| ANN | Artificial Neural Network |
| AoA | Angle of Arrival |
| API | Application Program Interface |
| AVI | Automatic Vehicle Identification |
| CMA | Colombo Metropolitan Area |
| CSV | Comma Separated Values |
| DGPS | Differential Global Positioning System |
| ETA | Estimated Time Of Arrival |
| FHWA | Federal Highway Administration |
| GPRS | General Packet Radio Service (GSM - UMTS) |
| GPS | Global Positioning System |
| GSM | Global System For Mobile Telecommunications |
| HCM2010 | Highway Capacity Manual 2010 |
| HTTP | Hypertext Transfer Protocol |
| IBM | International Business Machines Corporation |
| IEEE | Institute Of Electrical And Electronic Engineers |
| IOS | iOS operating systems |
| IP | Internet Protocol |
| ITS | Intelligent Transport Systems |
| JSON | JavaScript Object Notation |
| KNN | K- Nearest Neighbour |
| LOS | Level Of Service |
| MAC | Media Access Control (IEEE 802) |
| MAE | Maximum Absolute Error |
| OS | Operating System |
| PCs | Personal Computers |
| PHP | Hypertext Preprocessor |
| RAM | Random Access Memory |

| | |
|---|---|
| RFID | Radio-Frequency Identification |
| RMSE | Root Mean Squared Error |
| RSS | Residual Sum Of Squares |
| RTMS | Remote Traffic Microwave Sensor |
| SSID | Service Set Identifier |
| STM | Spatio-Temporal Marix |
| SVR | Support Vector Regression |
| TDoA | Time Delay of Arrival |
| ToA | Time of arrival |
| TTFF | Time To First Fix |
| Wi-Fi | Wireless Fidelity |
| WLAN | Wireless Local Area Network |
| XML | Extensible Markup Language |

## List of Appendices