

LB / DON / 106 / 2016
ITD1 / 142
A

Decision Support Traffic Controlling System

Pabasara Jeewanthi Wijerathne

139188F

LIBRARY
UNIVERSITY OF MORATUWA, SRI LANKA
MORATUWA

Dissertation submitted to the Faculty of Information Technology, University of Moratuwa, Sri Lanka for the partial fulfilment of the requirements of the Honours Degree of Bachelor of Science in Information Technology.

March 2016

004 "16"
004 (043)

University of Moratuwa



TH3177

TH 3177
+ 1 DVD ROM
(TH3160 - TH3180)

TH 3177

Declaration

We declare that this thesis is our own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Name of Student

P. J. Wijerathne

Signature of Student



Date: 27/04/2016

Supervised by

Name of Supervisor

Mr. Saminda Premaratne

UOM Verified Signature

Signature of Supervisor

Date: 27/04/2016

Dedication

This dissertation is dedicated to my beloved mother who gave me endless courage whenever I was discouraged and to my family and all friends who gave me all the support and resources to achieve my tasks successfully.

Acknowledgement

I pay my heartiest gratitude to my project supervisor Mr. Saminda Premaratne on behalf of giving valuable guidelines and procedures on how to complete a project successfully and encouraging me with a suitable direction.

I also thank and appreciate Mr. Dasun Samarasiri, Mr. Gratien de Almeda and Ms. Thimali Yasoda for their enormous support and providing me the knowledge and resources to carry out the project effectively.

My heartiest thank goes to my parents who encouraged me to make this project much reliable and productive one.

Finally thanks a lot for lecturers, staff members, all friends and everybody who devoted their time on encouraging and advising me to make this project a great success.

Abstract

In Sri Lanka, Traffic congestion has been a critical problem over the years especially in urban areas which occurs mostly in peak hours and hence it has badly affected day to day life of the people. It increases fuel wastage, vehicle maintenance due to being in the traffic and consequently become responsible for loss of man hours and higher air pollution which will put people's health in danger in near future. As per the background research, the facts available on this traffic management area are lesser. It is found that there is no effective and accurate data collection mechanism and data analysing methods are currently being in use.

The prime mission of "Decision Support Traffic Controlling System" is to provide a solution for the current problem of traffic congestion in Sri Lanka. When it comes to the existing researches, majority of them are fully based on the GPS devices and make the conclusions. The uniqueness of this system is, it not only focusing on GPS data, but also considers accidents, events and road development information. Therefore accuracy of the result of real time analysis is higher compared to the other existing systems. In addition to that, all above data collected for real time analysis are used in prediction module. Therefore accuracy of the predictions will get increased gradually. These predictions allow the users to arrange their future travel schedules avoiding high traffic areas and also it helps the traffic police in decision making.

The system contains mobile application, web application, common backend and a database. Required data will be gathered from Police, Road Development Authority (RDA), GPS devices and event organizers. Some of the technologies used for implementation are Java, Spring framework, MongoDB, Google API, Google Map Direction API, Minitab and Time series model.

Contents

| | Page |
|---|------|
| Chapter 1 - Decision Support Traffic Controlling System -DSTCS | 1 |
| 1.1 Introduction..... | 1 |
| 1.2 Background and Motivation | 1 |
| 1.3 Aim | 3 |
| 1.4 Objectives | 3 |
| 1.5 Summary | 4 |
| Chapter 2 - Existing Systems | 5 |
| 2.1 Introduction..... | 5 |
| 2.2 Existing Systems..... | 5 |
| 2.3 Summary | 8 |
| Chapter 3 - Overview of Technology | 9 |
| 3.1 Introduction..... | 9 |
| 3.2 Java as a programming language | 9 |
| 3.3 Android to develop mobile application..... | 9 |
| 3.4 Google Map API | 10 |
| 3.5 Spring framework for backend development..... | 10 |
| 3.6 MongoDB as the database | 10 |
| 3.7 Minitab for data analyzing | 11 |
| 3.8 Google Direction API | 11 |
| 3.9 Summery | 12 |
| Chapter 4 - System Behaviour | 13 |
| 4.1 Introduction..... | 13 |
| 4.2 User Interaction with the system..... | 13 |
| 4.2.1 Road Users | 13 |
| 4.2.2 Traffic Police | 13 |
| 4.2.3 Road Development Authority (RDA) | 14 |
| 4.2.4 System Operator..... | 14 |
| 4.3 Summary | 15 |
| Chapter 5 - Analysis and Design | 16 |
| 5.1 Introduction..... | 16 |
| 5.2 System Architecture..... | 16 |

| | |
|--|-----------|
| 5.2.1 RDA interface (web interface)..... | 17 |
| 5.2.2 Event interface (web interface)..... | 18 |
| 5.2.3 Incident interface (Mobile Application) | 18 |
| 5.2.4 View current traffic level (Mobile Application)..... | 18 |
| 5.2.5 Report module..... | 18 |
| 5.2.6 Data collection module | 18 |
| 5.2.7 Real time analysis module | 19 |
| 5.2.8 Prediction module | 19 |
| 5.2.9 GPS devices | 20 |
| 5.3 Summary..... | 20 |
| Chapter 6 - Development Methodology | 21 |
| 6.1 Introduction..... | 21 |
| 6.2 Web Interface..... | 22 |
| 6.3 Mobile Application | 22 |
| 6.4 Backend | 22 |
| 6.5 Real time traffic analysis module | 23 |
| 6.5.1 Equations..... | 24 |
| 6.5.2 Find nearest road..... | 28 |
| 6.5.3 Find traffic level..... | 31 |
| 6.5.4 Generate data | 32 |
| 6.6 Prediction module..... | 34 |
| Chapter 7 - Discussion | 52 |
| 7.1 Introduction..... | 52 |
| 7.2 Difference from similar systems | 52 |
| 7.3 Future work..... | 52 |
| 7.4 Evaluation plan | 53 |
| 7.5 Summary | 53 |
| References..... | 54 |
| Appendix A - Abbreviations | 55 |
| Appendix B - Web Interfaces..... | 56 |
| Appendix C - Source Code | 57 |

List of Figures

| | Page |
|---|------|
| Figure 1.1 - Traffic Statistics - No. of Road Vehicles & Road Length | 02 |
| Figure 2.1 - Traffic Report for Sri Lanka | 07 |
| Figure 4.1 - Use case diagram | 15 |
| Figure 5.1 - System Architecture | 16 |
| Figure 5.2 - System Diagram | 17 |
| Figure 6.1 - Work breakdown structure | 21 |
| Figure 6.2 - Select location | 22 |
| Figure 6.3 - Vehicle density in specific area | 23 |
| Figure 6.4 - Find locations around selected point | 28 |
| Figure 6.5 - Select nearest road | 29 |
| Figure 6.6 - Define vertical area | 29 |
| Figure 6.7 - Define horizontal area | 30 |
| Figure 6.8 - Selected vehicles | 30 |
| Figure 6.9 - Find distance | 31 |
| Figure 6.10 - Road segments | 32 |
| Figure 6.11 - Generate GPS data | 32 |
| Figure 6.12 - Activity diagram of real time analysis module | 33 |
| Figure 6.13 - Data collected area | 34 |
| Figure 6.14 - Time series plot against Avg Speed of vehicle and Avg vehicle count | 35 |
| Figure 6.15 - Steps in time series analysis | 36 |
| Figure 6.16 - Time series plot of average vehicle count | 37 |
| Figure 6.17 - Trend analysis plot of average vehicle count | 38 |
| Figure 6.18 - The mean of the series | 40 |
| Figure 6.19 - The variance of the series | 40 |
| Figure 6.20 - The covariance of the series | 40 |
| Figure 6.21 - Autocorrelation Function for Avg Veh.Count | 41 |
| Figure 6.22 - Partial Auto Correlation Function for Avg. Veh. Count | 42 |
| Figure 6.23 - Time series plot after 1st differencing | 43 |
| Figure 6.24 - ACF of 1st differenced data | 43 |
| Figure 6.25 - PACF of first differenced data | 44 |
| Figure 6.26 - Fitted model Vs Actual Time series | 48 |
| Figure 6.27 - Residual plots for Fitted model | 48 |

| | |
|---|----|
| Figure 6.28 - PACF for Residuals of fitted model | 49 |
| Figure 6.29 - PACF of residuals of fitted model | 49 |
| Figure 6.30 - Forecast for future average vehicle count | 50 |

List of Tables

| | Page |
|--|------|
| Table 6.1 - Fitting ARIMA Model | 47 |
| Table 6.2 - Forecasts from period 1536 | 50 |