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**Compiling Historical Traffic Data to Predict Future Traffic levels in Makati**

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SS152

**AUGUST 24, 2017**

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# Abstract

As in many big cities in the world, traffic management dominates Metro Manila’s development challenge. The deterioration of transport and traffic condition has afflicted Metro Manila since the 1950s. Simply put, traffic woes in Metro Manila stem primarily from an insufficient road system, the rapid increase in car ownership, the lack of quality public transportation services, poor enforcement of traffic regulations and lack of discipline on the part of both motorists and pedestrians. These problems are again validated in the initial findings of the Metro Manila Urban Transportation Integration Study. In addition, there is a problem of overlapping of functions and duplication of services in view of the multiplicity of players involved in transport and traffic management in the metropolis. At present, more than 40 percent of all registered vehicles in the country are piling in Metro Manila. This represents 1.1 million private and “for-hire” vehicles. Of these, almost half are privately-owned cars and utility vehicles. A similar trend is also evident in areas adjoining Metro Manila (Manasan & Mercado, 1999).

Given this circumstance, we are proposing to apply predictive analytics in traffic prediction that can perform estimated and mean-ed calculations to generate near future traffic levels. In this paper, our purpose is to provide traffic prediction capabilities for the end user. The Traffic Prediction report uses the historical data that is collected to predict future traffic levels for the areas within Makati, up to a week in advance.

# Introduction

* 1. Project Context

Eric Siege, the author of Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die states that, “Predicting better than pure guesswork, even if not accurately, delivers real value. A hazy view of what’s to come outperforms complete darkness by a landslide. The Prediction Effect: A little prediction goes a long way.” Predictive analytics is a technology that is about understanding the future to predict future behavior in order to make better decisions. With the help of this technology, we can mitigate safety and reliability risks, or improve overall performance.

Makati is known as the financial center in the Philippine archipelago. Since it is a major cultural and entertainment hub, high volume of road users causes heavy traffic and condensed pollution. A reliable way of predicting the level of traffic could be a great convenience for commuters, as well as a significant energy-saver.

* 1. Statement of the Problem

The increasing road traffic congestion have had growing negative effects on business operations and on people. Therefore, this study intends to assist people in travel such as to determine likely travel times. Specifically, it seeks to answer the following question:

1. How can an analytical/deterministic tool generate traffic prediction level?
   1. Purpose and Description

It is constantly helpful to further improve previous methods which were in some cases developed based on relatively poor information of traffic conditions. Therefore, the main purpose of the proposed system is to produce traffic level predictions which can effectively enhance mobility.

* 1. Objectives

This research aims to generate traffic information regarding future road traffic levels using the techniques for retrieving historical data for the improvement of travel over roads within Makati. Thus, the objectives are:

1. Retrieve historical data to gain performance insights and understand patterns of behavior of traffic
2. Predict future traffic levels up to a week into the future
   1. Scope and Limitations

This study will cover the traffic network for point “A” to point “B” location in Makati City, which will revolve around the people who resides, go to work, shop and do business. The gathered datasets will come from Google Maps and/or Waze API.

The accuracy of the model will yield only a 30 – 40 % result due to risks such as data inconsistency and tools. Nonetheless, the researchers will still be giving the probability of the event.



# Related Literature



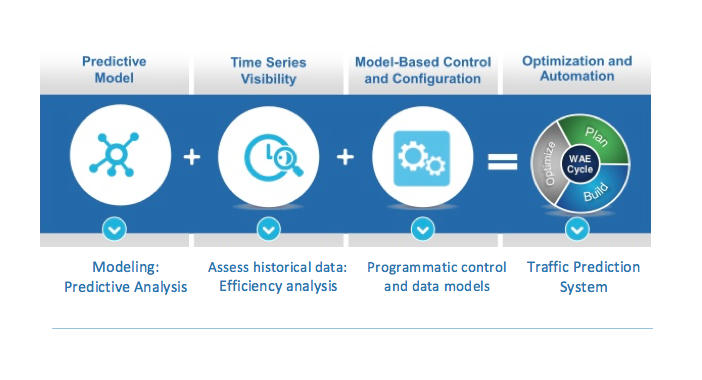
Pan, Demiryurek and Shahbi from University of Southern California conducted a study entitled ‘Utilizing Real-World Transportation Data for Accurate Traffic Prediction’. Their data sets include traffic flows recorded under-pavement loop detectors as well as police reports on accidents and events. Their system acquired these datasets in real time from various agencies collecting several main traffic parameters such as occupancy, volume, and speed. They identified that certain characteristics of traffic data, such as temporal patterns of rush hours or the spatial impacts of accidents, which can be incorporated into a data-mining technique to make it more accurate. The observations made in the immediate past are usually a good indication of the short-term future. In that case, the historical observations (same day, time, and location) are better predictors of the future. Hence, the researchers enhanced an auto-regression algorithm by incorporating historical patterns and called it H-ARIMA. (Pan, Demiryurek& Shahbi, 2012)

Scofield and six other people conducted a study entitled ‘Predicting Expected Road Traffic Conditions based on Historical and Current Data’. The researchers have an Expected Traffic Information Provider system that obtains historical traffic data from external sources such as vehicle-based data sources, road traffic sensors et cetera., and stores the historical data in a database. They concluded that historical traffic data may be combined with recent traffic flow condition information in order to provide benefits such as the use of historical data to estimate accurate travel times and speeds. After obtaining and processing the historical traffic data, the researchers then analyze it to generate average traffic flow conditions information such as vehicle speed, volume of traffic for an indicated period of time et cetera. (Scofield, Cahn, Hersch, Stoppler, Yakich, Huang & Barker, 2016)

Nagda, Li, Howlett, Fan, Yang, Fay conducted a study entitled ‘Using Location Data to Determine Traffic and Route Information’ wherein their predictive database contains historical traffic data for a predetermined time frame (e.g., three days) and traffic pattern data under typical conditions. Their traffic pattern data are based on a daily or weekly cycle where it allows the user to look up information such as the average travel speed on a specific location two days ago. The researchers specified that the predictive database does not provide information based on current situation, but on past patterns. (Nagda, Li, Howlett, Fan, Yang, Fay, 2005)

Downs, Hersch, and Chapman conducted a study entitled ‘Representative Road Traffic Flow Information based on Historical Data’ wherein the researchers use a method for a computing system to facilitate navigation of roads by vehicles based on traffic flow information. Their method comprises of retrieving historical traffic data that reflects prior vehicle travel, the historical traffic data including numerous data samples that report speed at an indicated prior time. (B. Downs, S. Hersch, C. Chapman, 2006)

# Technical Background



**Figure 1 Delivering Optimization and Automation. Source adapted from WAN Automation Engine - Develop Traffic Aware Applications Using APIs for Optimization and Predictive Analysis**

* 1. Predictive Analytics

Predictive Analytics a branch of the advance analytics. Predictive analytics uses many techniques from data mining, statistics, modeling, machine, learning, and artificial intelligence to analyze current data to make prediction about future.

* 1. JavaScript

JavaScript is a high-level, dynamic, weakly type, object-based, multi-paradigm and interpreted programming language. It is one of the three core technologies of World Wide Web content production and is used to make webpages interactive. (Eich, 1995)

* 1. Java

Java is a general-purpose computer programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible. (Gosling, 1991)

* 1. PostgreSQL

PostgreSQL is an object-relational database management system with an emphasis on extensibility and standard compliance. As a database server, its primary functions are to store data securely and return that data in response to requests from other software applications. (PostgreSQL Global Development Group, 1996)

* 1. RESTful API

REST stands for Representational State Transfer. It is an architecture that allows client-server communication through a uniform interface. REST is stateless, cachable and has property called idempotence.

* 1. The Analytics Life Cycle

Analytics is a systematic computational analysis of data or statistics. It encompassing and multidimensional field that uses mathematics, statistics, predictive modeling and machine-learning techniques to find meaningful patterns and knowledge in recorded data. There are multiple phases to implementing analytics.

# Design and Methodology

* 1. Research Design

Researchers are using Quantitative Approach where the emphasis is on collecting and analyzing numerical data that can be easily compared and make an analysis on the data that is gathered in number. The researchers are also using a technique in an attempt to correlate two or more variables and the time series method that uses past trends to make projections about the future.

## Data Gathering and Procedure

The researchers will gather literature review of studies regarding historical data and traffic prediction and data from Google ready availability and quality of these data however vary. The traffic data had been counted as a moving average.

* 1. Data Analysis

While the data were compiled accordingly, a degree of uncertainty still exists regarding the reported estimates and were only allowed to provide a very marginal prediction of the traffic level. The limited results reported in this study highlight the need for greater frameworks for data collecting and predictive analytic formula. The next step is to ensure that the main sources of relevant data have been considered. Specifically, in light of the low predictive analysis, alternative strategies should be tried as these might yield greater results. One alternative strategy that also consider other factors such as weather and incidents.

* 1. **Design of Software, Systems, Product, and/or Processes**

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Description generated with very high confidence A screenshot of a cell phone

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# UML Diagrams

* 1. Use Case Diagram

A close up of a map

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### Use Case Description

|  |  |  |
| --- | --- | --- |
| **Use Case Name:** | Accept End User License Agreement | |
| **Scenario:** | User has to accept End User License Agreement | |
| **Triggering Event:** | Prerequisite to fully accessing mobile application | |
| **Brief Description:** | User has to read and agree to the ‘Terms of Use’ and ‘Privacy Policy’, and accept the license agreement | |
| **Actors:** | User | |
| **Related Use Cases:** | N/A | |
| **Stakeholders:** | User | |
| **Preconditions:** | N/A | |
| **Post-conditions:** | User accepted or declined the End User License Agreement | |
| **Flow of Events** | **Actor** | **System** |
| 1. Opens mobile application | * 1. Prompts an End User License Agreement |
| 1. Either decline or Accept End User License Agreement |  |
| **Except Conditions:** | If user does not accept the agreement, application will not proceed.  If user does accept, then can get started on the application. | |

|  |  |  |
| --- | --- | --- |
| **Use Case Name:** | Enter Current Location | |
| **Scenario:** | User enters current location | |
| **Triggering Event:** | Be knowledgeable about traffic flow | |
| **Brief Description:** | User enters current location | |
| **Actors:** | User | |
| **Related Use Cases:** | View Today’s Traffic Prediction, View Traffic Prediction within a week | |
| **Stakeholders:** |  | |
| **Preconditions:** | N/A | |
| **Post-conditions:** | User has a destination | |
| **Flow of Events** | **Actor** | **System** |
| 1. Enter Destination | * 1. Navigates coordinates |
| **Except Conditions:** | If user does not enter current location, then the moderator pauses this use case.  If user does enter, then can proceed to next use case. | |

|  |  |  |
| --- | --- | --- |
| **Use Case Name:** | Enter Destination | |
| **Scenario:** | User enters destinations | |
| **Triggering Event:** | Be knowledgeable about traffic flow | |
| **Brief Description:** | User enters destinations to gain awareness regarding traffic flows | |
| **Actors:** | User | |
| **Related Use Cases:** | View Today’s Traffic Prediction, View Traffic Prediction within a week | |
| **Stakeholders:** |  | |
| **Preconditions:** | N/A | |
| **Post-conditions:** | User has a destination | |
| **Flow of Events** | **Actor** | **System** |
| 1. Enters Destinations | * 1. System displays Traffic Prediction |
| **Except Conditions:** | If user does not enter a destination, then the moderator pauses this use case.  If user does enter, then can proceed to next use case. | |

|  |  |  |
| --- | --- | --- |
| **Use Case Name:** | View Today’s Traffic Prediction | |
| **Scenario:** | View Today’s Traffic Prediction | |
| **Triggering Event:** | Anticipate today’s traffic flow | |
| **Brief Description:** | Anticipate today’s traffic flow | |
| **Actors:** | User | |
| **Related Use Cases:** | View Today’s Traffic Prediction, View Historical Traffic Information, View Traffic Prediction within a week | |
| **Stakeholders:** |  | |
| **Preconditions:** | N/A | |
| **Post-conditions:** | User has a destination and current location | |
| **Flow of Events** | **Actor** | **System** |
| 1. Enters Current Location | * 1. Prompt ‘Today’s Traffic Prediction’ – page interface |
| 1. Enters Destination |  |
| 1. Scrolls through time bounds |  |

|  |  |  |
| --- | --- | --- |
| **Use Case Name:** | View Traffic Prediction within a week | |
| **Scenario:** | User wants to view future traffic flow to make a better strategy out of his commute | |
| **Triggering Event:** | Anticipate future traffic flow within a week | |
| **Brief Description:** | User wants to view and | |
| **Actors:** | User | |
| **Related Use Cases:** | View Today’s Traffic Prediction, View Historical Traffic Information, View Traffic Prediction within a week | |
| **Stakeholders:** |  | |
| **Preconditions:** | N/A | |
| **Post-conditions:** | User has a destination and current location | |
| **Flow of Events** | **Actor** | **System** |
| 1. Enters Destination | * 1. Prompt ‘Today’s Traffic Prediction’ – page interface |
| 1. Enters Current Location |  |
| 1. Scrolls through time bounds (every day within scope of a week) |  |

|  |  |  |
| --- | --- | --- |
| **Use Case Name:** | Analyze Historical Data | |
| **Scenario:** | Retrieves historical data corresponding to traffic speed and volume data | |
| **Triggering Event:** | System wants to generate representative traffic flow information | |
| **Brief Description:** | System retrieves from database to generate representative traffic flow information | |
| **Actors:** | Admin | |
| **Related Use Cases:** |  | |
| **Stakeholders:** | Admin | |
| **Preconditions:** | N/A | |
| **Post-conditions:** | Admin has a data source and a database | |
| **Flow of Events** | **Actor** | **System** |
| 1. Gathers data from reliable resources | * 1. Stores into traffic observation center database |
| 1. Retrieve historical data corresponding to traffic speed and volume data |  |
| 1. Transform data into information |  |
| **Except Conditions:** | If user does not have a data, then the moderator pauses this use case. | |

* 1. Activity Diagram

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* 1. Object Diagram

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Description generated with high confidence

* 1. Deployment Diagram

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Description generated with high confidence

* 1. Sequence Diagram

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Description generated with very high confidence

* 1. Communication Diagram

A screenshot of a social media post

Description generated with very high confidence

* 1. State Machine Diagram

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Description generated with very high confidence

* 1. Timing Diagram

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* 1. Class Diagram

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Description generated with high confidence

* 1. Component Diagram

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* 1. Package Diagram
  2. Composite Structure Diagram

A picture containing businesscard

Description generated with very high confidence

* 1. Interaction Overview Diagram

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Description generated with very high confidence

# References

B. Downs, S. Hersch, C. Chapman. (2006). *Representative road traffic flow information based on historical data*. Retrieved from https://patents.google.com/patent/US7908076B2/en?q=Representative&q=Road+Traffic&q=Flow&q=Information&q=based&q=Historical+Data

Eich, B. (1995, December). *JavaScript.*

Gosling, J. (1991). *Java.* Retrieved from http://www.jetlab.com/en/services/skills/java

Inc, SAS Institute. (n.d.). *The Analytics Life Cycle.* Retrieved from https://www.sas.com/en\_ph/explore/analytics-in-action/experience.html#ask-again

Nagda, Li, Howlett, Fan, Yang, Fay. (2005). *Using Location Data to Determine Traffic and Route Information.*

Pan, Demiryurek& Shahbi. (2012). *Utilizing Real-World Transportation Data for Accurate Traffic Prediction.* Retrieved from http://infolab.usc.edu/DocsDemos/ICDM2012.pdf

PostgreSQL Global Development Group. (1996, July). Retrieved from Wikipedia: https://en.wikipedia.org/wiki/PostgreSQL

Scofield, Cahn, Hersch, Stoppler, Yakich, Huang & Barker. (2016). *Predicting Expected Road Traffic Conditions based on Historical and Current Data.* Retrieved from https://www.google.com/patents/US9257041