FAU COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

"Real-Time Traffic Incidents Prediction in Vehicular Networks Using Big Data Analytics"

Nov. 8, 2018, 11 a.m.
777 Glades Road, EE 405
Boca Raton, FL

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ABSTRACT OF DISSERTATION

Real-Time Traffic Incidents Prediction in Vehicular Networks Using Big Data Analytics

The United States has been going through a road accident crisis for many years. The National Safety Council estimates 40,000 people were killed and 4.57 million injured on U.S. roads in 2017. Direct and indirect loss from traffic congestion only is more than $140 billion every year. Vehicular Ad-hoc Networks (VANETs) are envisioned as the future of Intelligent Transportation Systems (ITSs). They have a great potential to enable all kinds of applications that will enhance road safety and transportation efficiency. In this dissertation, we have aggregated seven years of real-life traffic and incidents data, obtained from the Florida Department of Transportation District 4 (FDOT-D4). We have studied and investigated the causes of road incidents by applying machine learning approaches to this aggregated big dataset. A scalable, reliable, and automatic system for predicting road incidents is an integral part of any effective ITS. For this purpose, we propose a cloud-based system for VANET that aims at preventing or at least decreasing traffic congestions as well as crashes in real-time. We have created, tested, and validated a VANET traffic dataset by applying the connected vehicle behavioral changes to our aggregated dataset. To achieve scalability, speed, and fault-tolerance, the proposed system is built based on the lambda architecture using Apache Spark and Spark Streaming with Kafka. The proposed system is used to create optimal and safe trajectories for autonomous vehicles based on user preferences. We extended the use of our developed system in predicting incident clearance time on highway in real-time, which is an important component of the traffic incident management system (TIM). We implemented time series analysis and forecasting in our real-time system as a component for predicting traffic flow. Our system uses dedicated short communication (DSRC), cellular, or hybrid communication schema to receive streaming data and send back the safety messages. The performance of the proposed system has been extensively tested on the FAU's High Performance Computing Cluster (HPCC), as well as on a single node virtual machine. Results confirm that the proposed system can predict traffic incidents with low processing latency.

BIOGRAPHICAL SKETCH
Born in Madaba, Jordan
B.S., Al-Balqa Applied University, Salt, Jordan, 2005
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CONCERNING PERIOD OF PREPARATION
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Time in Preparation: 2015 - 2018

Qualifying Examination Passed: Fall 2014

Published Papers:

Al Najada, Hamzah and Imad Mahgoub. "*Big Vehicular Traffic Data Mining: Towards Accident and Congestion Prevention.*" Wireless Communications and Mobile Computing Conference (IWCMC), 2016 International. IEEE, 2016.

Al Najada, Hamzah and Imad Mahgoub. "*Anticipation and Alert System of Congestion and Accidents in VANET Using Big Data Analysis for Intelligent Transportation Systems.*" Computational Intelligence, 2016 IEEE Symposium Series on, Athens. IEEE, 2016.

Al Najada, Hamzah and Imad Mahgoub. " *Autonomous Vehicles Safe-Optimal Trajectory Selection Based on Big Data Analysis and Predefined User Preferences.*" The 7th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)." IEEE, 2016.

Al Najada, Hamzah and Imad. Mahgoub, "*Real-Time Incident Clearance Time Prediction Using Traffic Data from Internet of Mobility Sensors.*" The15th IEEE International Conference on Pervasive Intelligence and Computing (PICom2017), Orlando, USA, Nov. 2017.

Al Najada, Hamzah, Imad Mahgoub, and Imran Mohammed. "*Highway Cluster Density and Average Speed Prediction in Vehicular Ad Hoc Networks (VANETs).*" Computational Intelligence (SSCI), 2018 IEEE Symposium Series on. IEEE, November 2018. (Accepted and registered).

Al Najada, Hamzah and Imad Mahgoub. "*Towards Congestion-Free Highways: A Data-Driven Solution.*" In the IEEE Transactions on Intelligent Transportation Systems, IEEE-ITS. (Under review).