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

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ABSTRACT OF DISSERTATION
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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 (ITS). 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 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
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Published Papers: