Transportation Consortium of South Central States

Combining Virtual Reality and Machine Learning for Intelligent Sustainable Traffic Management

Key Points

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Principal Investigator(s):
Supratik Mukhopadhyay
Louisiana State University
supratik@csc.lsu.edu
Yimin Zhu
Louisiana State University
yiminzhu@lsu.edu
Ravindra Gudishala
Louisiana Transportation Research Center
Rgudis1@lsu.edu

Lead Institution:
Louisiana State University

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$30,000

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Tran-SET
Louisiana State University

Total Project Cost:
$60,000

Brief Project Description

Traffic management models that include route choice form the basis of traffic management systems. High-fidelity models that are based on rapidly evolving contextual conditions can have a significant impact on smart and energy efficient transportation. Currently, existing traffic/route choice models are generic and are calibrated on static contextual conditions. These models do not consider dynamic contextual conditions such as the location, the social network structure of population inhabiting the region (socio-cultural and economic background), human behaviors, events, extreme conditions, etc. As a result, the model's predictions are made at an aggregate level and for a fixed set of contextual factors. There is a clear need to develop traffic models that take into account local contexts (and are closer to ground reality) to provide government agencies the ability to make well-informed model-based decisions and policies.

Problem Statement

In the event of a flooding or a storm (an extreme event) it is often the case that certain links of a road network have failed. This puts regular drivers of the area in a new route choice decision-making situation. When a driver runs into the road closure situation, many dynamic and emergent contextual conditions such as remaining time for travel, personality, and the proximity to gas stations with gasoline stocks, constitute a decision-making environment that is very different from when the driver starts the trip. A better understanding of factors influencing the driver's decision on spot and messages delivered to drivers for optimizing road network conditions is critical.

Routine route choice models that capture decision making rules of day-to-day commute do not reflect decision making that might occur in extreme events. Thus, it becomes imperative to use a virtual reality environment to portray alternative scenarios by varying critical contextual factors and capture decision making rules that might occur in new decision making context. Using virtual reality, one can create possible decision making contexts that might arise in an extreme scenario.

Objectives

The overarching goal of this project is to develop a powerful computation and analytic framework that integrates machine learning-based models with immersive virtual environment to improve the predictive power of existing models for traffic routing and resource allocation and deployment of resources (sensors, personnel, etc.) by taking into account contextual factors affecting human interaction with highway infrastructure. To achieve the goal, the project team will identify contextual factors that affect drivers' decisions; experiment the effectiveness of modeling such contextual factors in immersive virtual reality (IVE); and test the integration of machine learning with results from IVEs to improve predictions. Results of this project will allow researchers in the future to further develop a novel context-aware framework that combines virtual reality with machine learning to predict (1) "optimal" routing of traffic under both normal and abnormal conditions (hurricanes, disasters, football games, etc.), (2) appropriate strategic allocation and placement of resources (scheduling traffic light, deploying personnel, sensors, sign boards, actuators, and materials).

Intended Implementation of Research

Technology Transition

In collaboration with the Louisiana Transportation Research Center (LTRC), the project team will explore the possible usage of the technology for effective traffic management as well as efficient management of evacuation during a disaster. Furthermore, the project team has identified potential customers of the developed technology, which includes nMeta LLC (who may be interested in integrating the technology in an upcoming smart city initiative in New Orleans). Further discussions with these potential customers will lead to a refined model more suitable for technology transfer.

Education and Workforce Development

This study will organize and form a study group (Traffic Prediction Study Group) that will include both undergraduate and graduate students – meeting once a week to discuss and present recent papers in the areas of virtual reality and machine learning applications in traffic management. This study also plans to conduct an eminent lecture series with speakers drawn from experts in the field of traffic management (from both academic and industry).

Anticipated Impacts/Benefits of Implementation

The benefits of implementing the research outcomes of the project will be a more cost and energy-efficient, commuterfriendly, and an intelligent traffic management system that will be able to deal with extreme events effectively.

Weblinks:

- Tran-SET's website (http://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1505363)