7a.018.UL_UVA – A Comprehensive Data Integrity/Trust Approach to IoT Infrastructures

Khalid Elgazzar[1] (PI), Stephen Adams[2] (PI), Magdy Bayoumi[1] (Co-PI), Mohamed Seliem[1] (Student), Taghreed Alghamdi[1] (Student), Sumit Shah[3] (Mentor), Steven Greenspan[4] (Mentor)

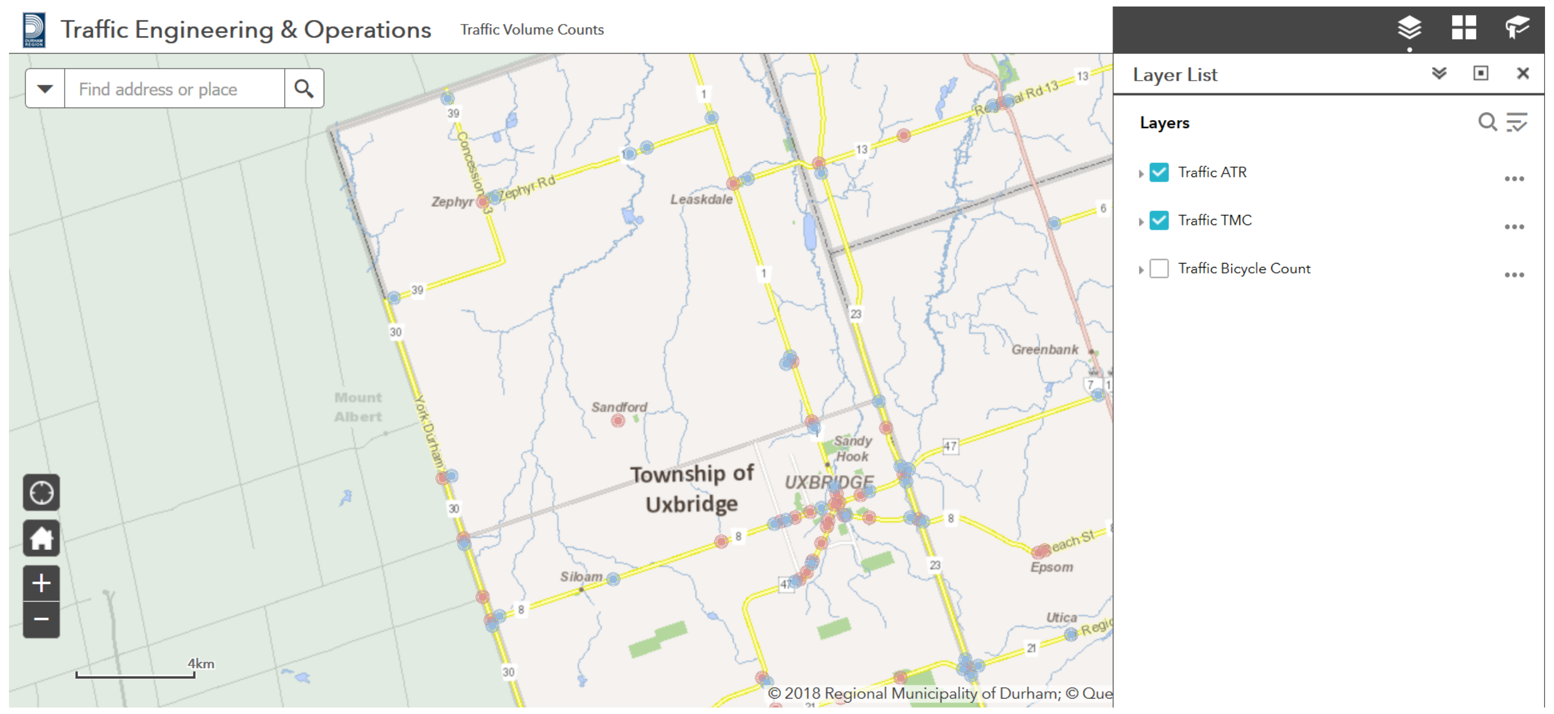
[1]University of Louisiana Lafayette, [2]University of Virginia, [3]CGI, [4]CA Technologies

Project Start: 8/1/2019	**End Date: 7/30/2019**	**Project Budget: $60K**	**Spent:**

Project Summary: In a wide range of settings, various interconnected devices and sensors are used to collect data (e.g., cameras, piezoelectric, acoustic, environmental, and magnetic sensors). Data obtained from these sensors are used to support various types of services dependent on the objective of the sensor network. The accuracy and integrity of collected data are crucial to the reliability of such services and the optimal performance of the network. Recent research has shown that hackers could compromise the sensors and send misleading data to the controller, potentially causing severe disruptions. For example, in a smart-city setting where the sensors are used to monitor traffic patterns, hackers could cause significant traffic problems and compromise the entire operation of the smart city services.

This project breaks the problem of integrity assurance in an Internet of Things (IoT) network into a two-stage process. The first stage focuses on the detection and identification of anomalous data. The second stage focuses on decision support in the presence of anomalous data, i.e. what to do once untrustworthy data has been detected and how to adjust the decision-making process in the presence of untrustworthy data. This project proposes a joint effort by ULL and UVA to tackle this problem. The ULL team will focus on the detection side of the problem, and the UVA team will focus on the decision support side of the problem. This project is a combination of two Year 6 projects which were addressing these issues separately. The combined project will leverage the strengths of each team and ultimately develop an end-to-end method for detecting and reacting to anomalous data in an IoT environment.

Details of Progress/Achievements: Data Integrity is of the major challenges to IoT deployments to ensure the quality of data obtained from sensors are used to support real-time decision making (e.g., air quality estimation and travel time prediction in Smart City settings). Poor data quality can lead to major errors in analytics that will affect the service rendering. For example, in traffic monitoring systems, collected data provide an initial visualization of the traffic condition which elucidate traffic flows according to real-time volumes and incidents. The project will utilize a traffic monitoring system as its primary use case. The researchers at ULL have received access to a traffic monitoring system and are in the process of developing an API for easily extracting the data. The researchers at UVA have begun development of a methodology to incorporate estimated trust scores into decision making. The methodology relies heavily on statistical decision theory and Bayesian analysis.

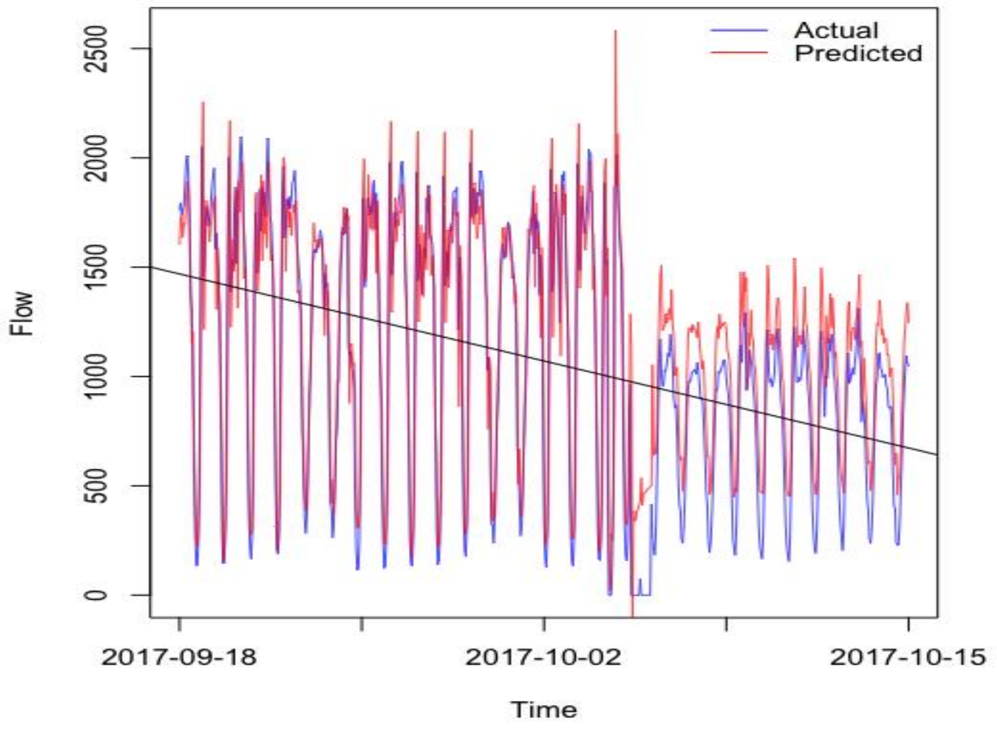


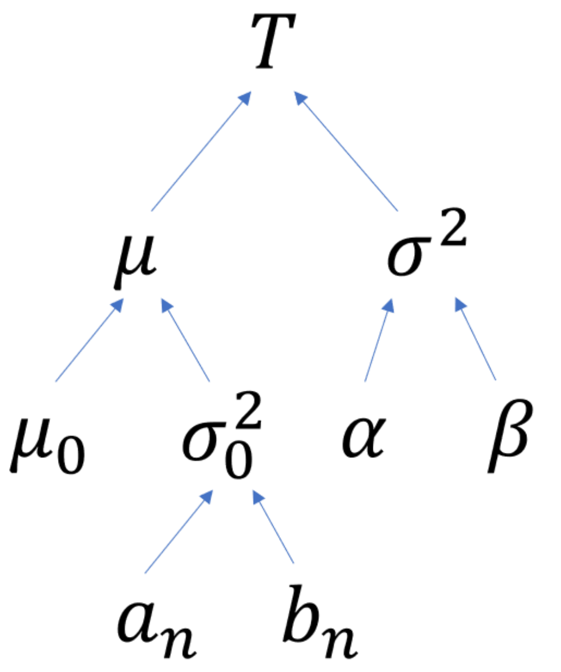
☑ Traffic ATR

☑ Traffic TMC

□ Traffic Bicycle Count

© 2018 Regional Municipality of Durham; © Que





PROJECT DELIVERABLES

Deliverable	Achievements	Remaining To Do
Spatial modeling algorithm to evaluate the correlation between neighboring data collection points. Integrate previously developed temporal modeling techniques.	Signed an agreement for real-time data access, started to implement approximate Bayesian inference	Develop a stochastic partial differential on real-time traffic data points to evaluate correlation.
Develop a methodology that weighs the costs and benefits of decisions under varying amounts of trust.	Begun development of methodology	Apply methodology to traffic use case. Refine methodology based on results.
Fully-functional proof-of-concept prototype on a real case to demonstrate the feasibility and usability of the proposed technology.	Have received access to traffic system. In process of developing API to efficiently extract data.	Apply models to extracted data and develop prototype