Towards Quality Aware Crowdsourced Road Sensing for Smart Cities

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Lead PI: Chunming Qiao, Institution: University at Buffalo (SUNY)
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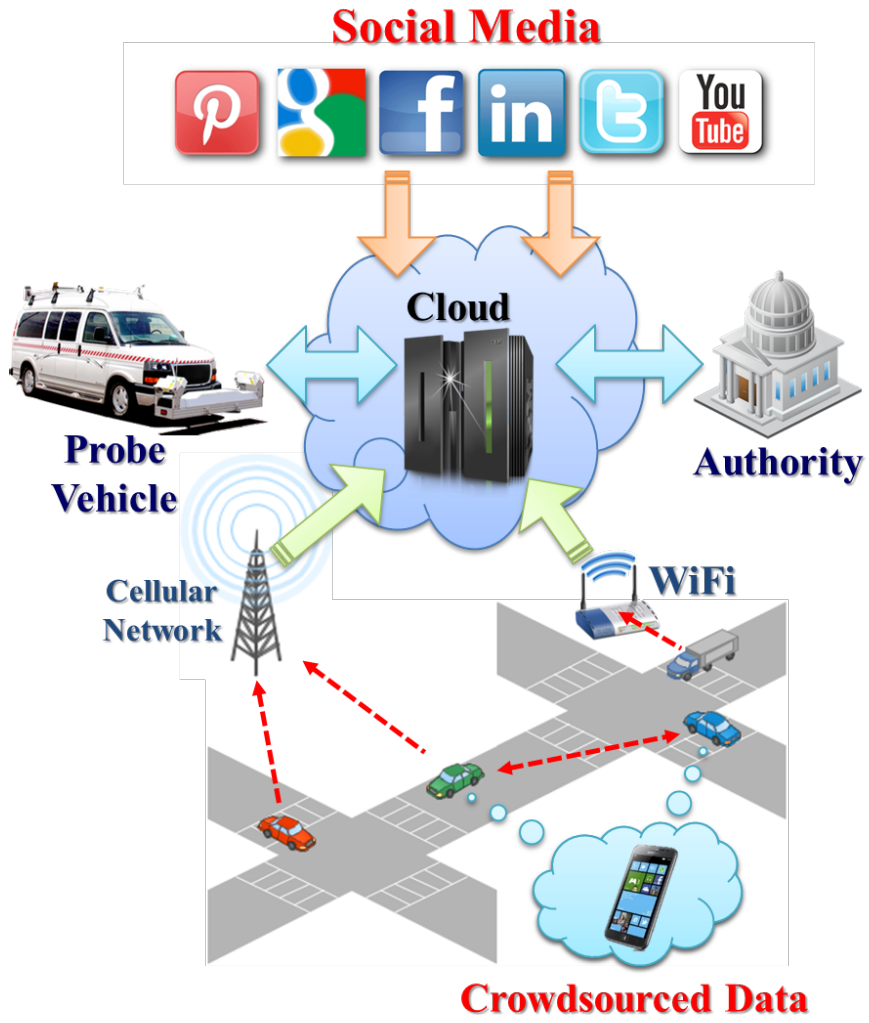
Principal Research Investigators

- Chunming Qiao, University at Buffalo (SUNY)
- Lu Su, University at Buffalo
- Jing Gao, CSE, University at Buffalo
- Adel W. Sadek, Civil, University at Buffalo
- Alex Anas, Economics, University at Buffalo

Community Partners

- Niagara International Transportation Technology Coalition (NITTEC)
- Niagara Frontier Transportation Authority (NFTA)
- Erie County Department of Public Works

Project Overview



Project Vision

- **QuicRoad: a Quality-of-Infromation (QoI)-aware, crowdsourced road sensing system, fusing from:**
  - **Smartphones (GPS, accelerometer, compass, camera, etc).**
  - **Social media, probe vehicles and other sources**
- **Goal: To make the acquisition and dissemination of road/traffic condition more accurate, efficient, and timely so as to**
  - **Improve drivers' driving safety, efficiency, and comfort.**
  - **Support authorities' policy making in traffic planning and operations.**

Project Overview

Use-Inspired Research

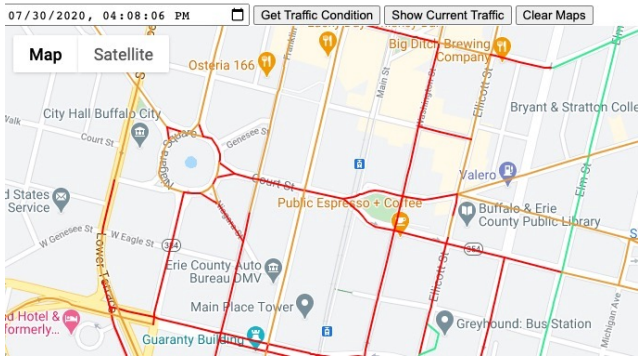
- Improve driving safety under inclement weather conditions (e.g. snows or icy rains):
  - Timely detection of poor road and traffic condition
- Deal with the high deployment cost of specialized sensors or probe vehicles:
- Work with local transportation authorities and agencies who are interested in developing crowdsourced road sensing systems.

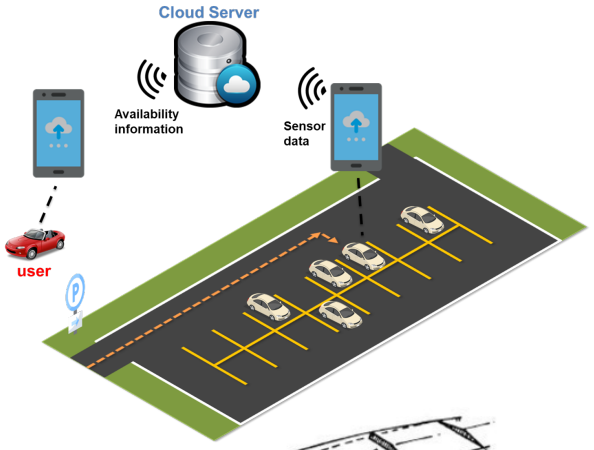
Fundamental Research Contributions

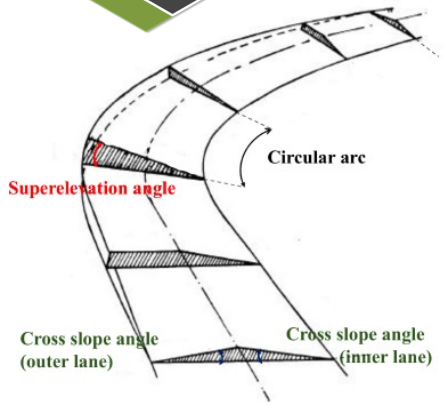
- Integrates both technological and social research
  - technological research: a novel QoI aware information integration framework:
    - jointly optimize the estimation of the QoI of various sources, their fusion and the decision-making process.
  - social research: whether and how the proposed QuicRoad system would change the social behavior of the travelers?
    - Once they are provided with the road/traffic condition information

Project Update

- We develop a deep learning framework that can predict traffic conditions with limited road sensing data that are temporally sparse and unevenly distributed across regions.
  - Collect GPS data from 150+ NFTA buses and use them to estimate and predict traffic condition in Buffalo City.
  - Visualize the estimated/predicted traffic condition on Google map.
- We propose a crowd sensing system that can provide spot-level availability in a parking lot by analyzing the behavior of the drivers using their smartphone data.
  - Leverages smartphone sensors to infer parking spot searching trajectory and the final destination of the user.
  - Take into account the variance in different drivers' parking behaviors when aggregating their data.
- We develop a crowdsourced road geometry estimation system that can leverage vehicle-carried smartphone's sensory data to estimate various road geometric features, such as road grade, cross slope, and super-elevation.







Project Evolution

- In this project, we are working with our partners to collect road and traffic data using their operated buses/shuttles.
- Our initial plan is to install an app on the smartphones of bus drivers and collect their smartphone sensor data.
- However, our partners do not allow their bus drivers to use smartphone when driving.
- Due to the budget limit, we cannot purchase and install unattended smartphones on a large number of buses/shuttles.
- To achieve larger scale of data collection, we obtained the access to the built-in GPS devices of buses/shuttles, and make use of their GPS data to estimate and predict traffic condition.

Evaluating Project Impact on Communities

- We plan to integrate our crowdsourced road sensing system into the NITTEC app (https://www.nittec.org/travel_resources/nittec_mobile_app/), which provides users with customized real-time traveler information in the Buffalo-Niagara region.
- By enhancing NITTEC app with two-way information flows between the server and app users, we will be able to not only collect data from users' smartphones, but also enable users to visualize estimated/predicted traffic/road condition on their smartphones.
- To evaluate the impact of our system, we will measure the change in the number of NITTEC app users, and collect their feedback about our crowd sensing system.

Anticipated outcomes & success measures for next year

- **Make use of video stream from roadside traffic cameras operated by our partners to estimate traffic condition of a broader area.**
  - **Combine the GPS and video information to achieve more accurate traffic condition estimation and prediction.**
- **Integrate our crowdsourced road sensing system into the NITTEC app (https://www.nittec.org/travel_resources/nittec_mobile_app/), which provides users with customized real-time traveler information in the Buffalo-Niagara region.**
  - **Collect data from users' smartphones.**
  - **Visualize estimated/predicted traffic/road condition on the NITTEC app.**