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Building a pilot peer-to-peer platform for ride-sharing in Lawrence County

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FINAL RESEARCH REPORT

Traffic 21 Smart Mobility Challenge 2017

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Accomplishments

Lawrence County is primarily a rural area, with local employees living across a wide geographic radius. An estimated 40% of commuters leave the County during their daily work-related commute. In this environment, transportation is a major driver of access to job opportunities, mobility, and quality of life. Current public transportation options consist of seven to eight daily bus trips from the County to Pittsburgh and back, and are highly utilized. On the negative side, they are concentrated at certain times of the day (e.g., 5-7 am from Lawrence County to Pittsburgh, 5-7 pm from Pittsburgh to Lawrence County) and lack flexibility. Widespread ride-hailing platforms (e.g., Uber, Lyft) have recently started service in Lawrence County, but few drivers are typically available there and the costs of transportation to Pittsburgh is very high. As a result, most of the population relies extensively on private modes of transportation. This may result in high costs of travel, negative environmental impact, added congestion costs, as well as limited mobility for households that do not own a vehicle, or only one vehicle.

An important opportunity to reduce the costs of travel lies in technological solutions to better connect commuters and promote shared modes of transportation, for instance among employees of the same firm. This project proposed to develop a mobile platform to enhance information sharing and coordination among commuters, so peer-to-peer ride-sharing opportunities could be identified and leveraged. Through the pilot deployment of this platform, it will assess its impact on travel behaviors and its overall efficacy. Ultimately, this research can contribute to the ongoing development of technological solutions to promote ride-sharing, reduce the costs of travel, mitigate transportation-induced emissions, and enhance access to urban areas.

To address this challenge, our efforts have included (i) the development of the online platform to facilitate peer-to-peer ride-sharing options among commuters to and from Lawrence County, and (ii) the development of a mathematical model and a computational algorithm to optimize the matching of riders and drivers in the proposed peer-to-peer ride-sharing system.

First, a website has been developed to facilitate peer-to-peer ride-sharing opportunities within Lawrence County residents. The website enables users to create accounts as prospective riders and/or prospective drivers, to create a profile with some of their interests, to request or to propose a ride (with such characteristics as preferred time of departure and arrival, time flexibility, addresses of origin and destination), to view and comment their activity history on the platform, and to contact system managers for feedback or questions. The front-end design and the back-end database capabilities of the website have been completed. Meetings with Lawrence County representatives have been scheduled to collect feedback and discuss next steps (including deployment plan following the completion of the project).
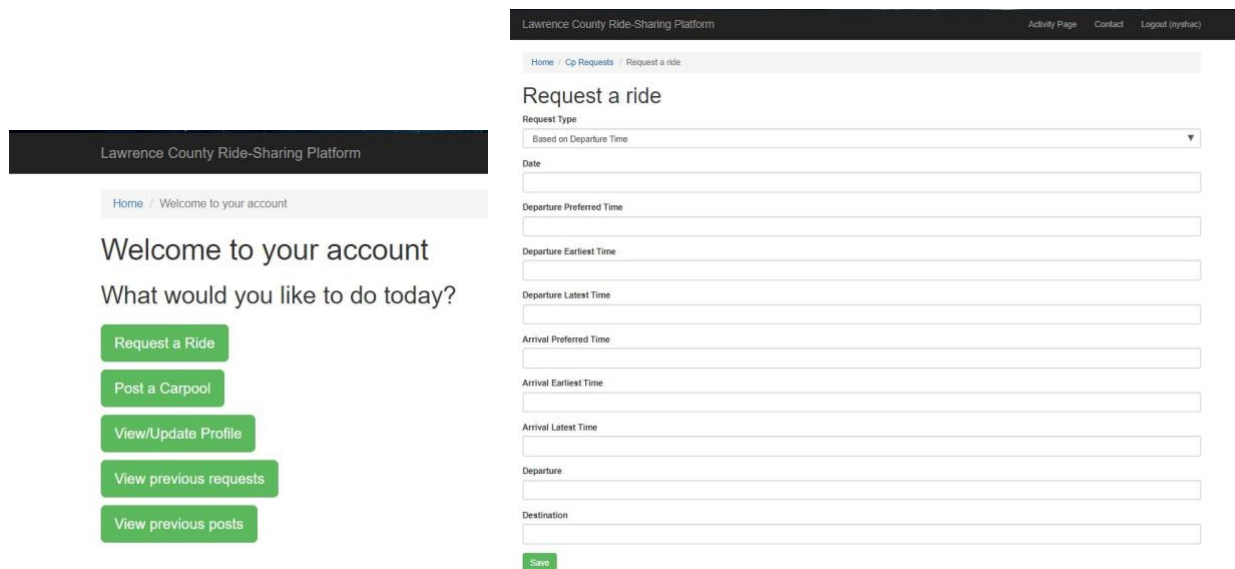
Front-end screenshots of peer-to-peer ride-sharing website

Second, we have developed and implemented a model to optimize the matching between riders and drivers. The complexity is that requests from riders and drivers come one at a time, with limited visibility into future requests from either group, and with a huge number of possible matching pairs and associated trips. Our model provides matching recommendations between riders and drivers. A mathematical model has been developed to capture specificities of the problem under consideration, such as the preferred times of departures and windows of flexibility of riders and drivers. Tailored algorithms have been implemented to solve the model is short computational times and enable its efficient integration into the online website.

The matching algorithm has been integrated into the online platform—thus enabling system operators to provide a matching solutions given all requests from riders and drivers. Ultimately, this project provides a state-of-the-art technology for peer-to-peer ride-sharing.

Impacts

The outcomes of this project include:

- Enhanced mathematical and algorithmic capabilities to capture real-world specificities arising in peer-to-peer ride-sharing issues, such as time preferences and flexibility windows of riders and drivers.
- Fast algorithms capable of providing optimal, or near-optimal, matches between riders and drivers in short computational times, thereby enabling the implementation of the platform and the underlying algorithms in practice.
- Live online web platform for peer-to-peer ride-sharing, along with technical specifications and development code.
- Deployment plan developed in collaboration with the Lawrence County, which contributes to bringing "Smart City" technologies to rural areas.

The longer-term impacts of the project include:

- Increased reliance on shared transportation systems, even in non-urban communities.
- Increased transportation options and enhanced resulting mobility within rural communities, especially for households with limited car ownership.
- Reduction in vehicle miles traveled in daily commute patterns and reduction in associated costs and environmental impact of transportation
- Growth of peer-to-peer models in transportation for daily commutes, as an alternative to fixed transit schedules and on-demand taxis

Products - Other

"Lawrence County Ride-sharing platform" website for peer-to-peer ride-sharing