| Request for Research Funding for FY 2019-2020 | | | |
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| **Requesting Office** | District VI | **Priority** | 1 of # |
| **Proposed Title** | Mining Automated Fare Collection (AFC) Data to Understand Passenger Behavior and Demand Characteristics of Public Transportation | | |
| **Justification** | Automated fare collection (AFC) systems, also referred to as smart cards, have been widely adopted by transit agencies around the world. While providing time savings, convenience and other advantages in revenue collection, they also produce massive, continuous and anonymized digital records of onboard transactions. These data present unprecedented opportunities for transit planners and researchers to capture and analyze passenger travel patterns. Smart cards provide much more comprehensive, exhaustive, and spatially and temporally precise information than traditional household travel surveys or on-board surveys could ever provide. The AFC system provide a bias-free and low-cost approach to obtaining long-term continuous observation of transit passenger travel behavior, that makes it possible to discover regularities and dynamics in passenger travel, and to assess user response to changes in the transit system (e.g. fare, route, scheduling, etc.), as well as external factors (e.g. demographic and social trends, technology and mobility service innovations, etc.).<br><br>Many studies have taken advantage of AFC data and conducted research from several perspectives, including ridership statistics and performance indicators to support operational analysis, travel pattern identification and network analysis to inform service planning and adjustment, and behavior analysis to facilitate long-term planning for public transportation (Pelletier et al., 2011). The literature also noted some challenges in dealing with AFC data, including the lack of trip purpose (which has been commonly used to segment trips), lack of alighting locations and transfer detection, and lack of demographic information for the users, etc.<br><br>This project aims to develop a tool that can produce a powerful set of visual analytics that extends the utility of smart card data with the capacity to develop a better understanding of passenger travel behavior dynamics. Data mining techniques will be employed to address the above-mentioned challenges and help identify behavioral pattern groups, and examine regularities and dynamics in passenger travel. Additional data sources including parcel level land use data, Census data, and general transit feed specification (GTFS) data will also be integrated with the AFC database to obtain the user segments and their behavioral contexts. The expected activities to be accomplished through this project are:<br><br>1. Examine urban public transportation system dynamics. Passenger flow maps will be developed to visualize the aggregate flow patterns at network level and identify temporal variations (time-of-day, daily, monthly, etc.) to inform local public transportation service planning;<br>2. Identify the spatial concentration as well as temporal patterns of various transit markets. Travel trajectories from the log data will be reconstructed and clustering method using both temporal and spatial attributes will be used to identify distinct user groups (fare type, regular vs. non-regular, etc);<br>3. Develop a tool that provides visual analytics on transit system performance based on the AFC data to support transit planning from operational, tactical and strategical levels. | | |
| **Impact** | This project will develop a tool with visual analytics to examine the passenger behavior and demand characteristics of public transportation utilizing information obtained from the AFC system. It will provide additional insights on the network performance as well as the spatial and temporal dynamics of transit demand at a resolution and scale that are impossible to obtain via traditional household travel surveys or transit on-bard surveys. Insights developed from this study will support the operation analysis, service planning and long-term strategy development of public transportation system. | | |
| **Affected Offices** | Transit Office | | |
| **Existing Work** | The Transportation Research International Documentation (TRID, https://trid.trb.org/Results) and the Research in Progress (RIP, https://rip.trb.org/) online databases were checked thoroughly. There was only one recent project focusing on origin-destination estimation using public transit smart card data. Earlier projects were mostly focused on implementation and operational issues of smart card and AFC technologies. On the other hand, there were many research papers from the academia side exploring the potential of transit smart card | | |

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| | data, including passenger behavior analysis and market segmentation, system performance assessment, impact analysis of policy changes or service improvement, and data processing (such as trip purpose inference, etc.). Existing research has demonstrated variety uses of AFC data, but no study has been done in Florida to fully explore the potential of utilizing AFC data to support the operation, service and long-term planning of public transportation system. | | |
| **Keywords Used In Existing Work Search** | transit smart card data, automated fare collection data | | |
| **Related Contracts (Give contract numbers)** | n/a | | |
| **Funding Request** | $250,000 | **Anticipated Duration** | 18 months |
| **Project Manager** | Neil Lyn<br>District Statistics Administrator<br>Planning and Environmental Management Office<br>Florida Department of Transportation - District 6<br>Phone: (305) 470-5373<br>E-mail: Neil.Lyn@dot.state.fl.us | **Contracting Method** | Direct contract with university |
| **Urgency** | 1= highest , most immediate need | With growing population, increasing congestion, and rapidly evolving technologies and mobility services, there is a pressing need to capture and monitor the trends and impacts on the transit system, as well as a better understanding of the spatial and temporal dynamics of transit demand. The massive and continuous boarding log information provided by the AFC data provide great potentials to help examine the passenger behavior and demand characteristics of public transportation to support service planning as well as long-term strategy development. | |
| **Implementability** | 1=greatest likelihood of and proximity to implementing results | This project will develop a tool with visual analytics to examine the system performance and demand characteristics of public transportation in south Florida taking advantage of the AFC data. The tool will support operation, service and long-term planning of public transportation system in South Florida. The tool can be applied to other areas that have similar AFC data. | |

**Project Benefits (Succinct, complete explanation)**

Public transportation is a key component of urban transportation solutions that help mitigate congestion, reduce vehicle emissions and promote sustainable growth. This project aims to bring new insights on passenger behavior and demand characteristics of public transportation system by taking advantage of the massive continuous digital records of boarding logs from the AFC data. Through applying advanced data mining and data fusion techniques, this project will develop a visual analytics tool and provide market and network analysis that examines the spatial and temporal dynamics of transit demand. The results from this research will support the operation, service planning and long term strategic development of public transportation system in South Florida and throughout the state. It will lead to better understanding of the system dynamics and informed investment and policy decisions that serve the mobility needs, enhance system efficiency and promote sustainable growth.

| **Project Benefits** | **Quantifiable Benefits (units, dollars, etc…if applicable)** | **Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits** |
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| **(Select all that apply and explain)** | | |
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| o Materials Enhancement | | |
| o Materials Savings | | |
| o Time Savings | Efficient analysis on transit system performance | The developed tool will provide a set of powerful visual analytics based on the AFC data on system performance and demand characteristics, which can be used to support transit planning from operational, tactical and strategical levels. |
| o Lives Saved/Injuries Prevented | | |
| o Other (Explain) | Informed and better decisions on public transportation service planning | This project will explore the AFC data and develop a visual analytics tool to examine the passenger behavior and demand characteristics of public transportation in south Florida. A robust understanding of the demand pattern and system performance will help the regions make better informed policy and investment decisions in enhancing system efficiency, promoting sustainable growth, and improving quality of life. This tool can also be applied to other transit agencies in the state to support transit planning activities. |

*Comments should explain and support urgency, financial benefit, and implementability scores