Oregon Department of Transportation

Research Stage 1 Problem Statement

Number 26-06 – "Fusing Historical Data to Improve Traffic Safety"

1. Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

Traffic death has increased more 70% from year 2010 to 2022 in Oregon. Due to climate change, more inclement weather days are observed; thus, this trend may persist or become worse. It is well-known that there are new technologies such as simulations using virtual reality or augmented reality methods, and traffic flow estimation using computer vision and artificial intelligence methods that have better quantified pedestrian behavior and causes of traffic jam. Furthermore, newer vehicles have proximity sensors that can better alert drivers. Nevertheless, accidents still pose as an essential problem for traffic control. We propose to combine traffic clusters and road networks to create a knowledge-based network that contains high-level information for driver guidance.

2. Document how this **transportation issue** is important to Oregon and will meet the Oregon Research Advisory Committee Priorities

Traffic accidents are costly in terms of damage to vehicles, human, wildlife and structures. In normal situations, emergency vehicles can help save lives and protect properties. With increased inclement weather situations, more guidance is needed for the drivers who could be involved in the accidents, who could be in the vicinity or who could be en route to the accident locations.

ODOT has much data from traffic accidents, road constructions, warning signals, business establishments, wildlife migration routes, and wildfire meeting points over the years. The amount of knowledge is immense and is stored in different databases. A unified knowledge-based network for drivers can improve road use and develop emergency protocols.

3. What **final product or information** needs to be produced to enable this research to be implemented?

The aim is to extract knowledge from different databases and create a fusion of various networks for different factors. There are three main phases: first is to extract knowledge for some chosen factors by ODOT experts such as a road network and a network of traffic accident clusters, second is to develop a survey that enables the experts to annotate on these networks by selecting and highlighting components of the networks, and third is to develop metrics that quantify the importance and the relevance of the knowledge and create a fusion so that a network of unified knowledge is established. Should existing networks such as road networks are unavailable, they will be created in this project.

As the networks for each factor is typically a graph network with nodes and edges, they will be analyzed using metrics that quantify the busiest node, the most intertwined edges, and the cycles involving multiple edges and nodes. These measurements will be overlaid on the original networks. From these measurements, ranking of the importance will be done by ODOT experts along with research from literature review.

To incorporate evaluation from ODOT experts, a customized survey tool will be created. Survey tools are often seen to obtain text answers to text questions. Thus, a web tool that allow users to mark on a graph network will be developed using existing technology for ODOT experts. Based on the ranking of the important nodes and intertwined edges, super nodes and super edges will be created. New entities that represent the knowledge from the experts will be created, for instance, these entities could be some knowledge behind the causes of accidents. These new entities will be visualized using different geometry shapes. These surveys will be web based and managed by

ODOT. Should privacy need to be considered, only code names such as NewKnowledge# could be used as placeholders.

The last step is to create a knowledge-network from the survey results. Historical data will be used, so the knowledge-based network will be superimposed over the data that is time-dependent. When the knowledge extracted becomes a mismatch with a particular time frame or some time frames, some visualization of climate factors such as rainfall or slippery road conditions will be created to suggest and/or verify the influence from weather related problems. With the knowledge-network, drivers can become aware of the factors considered by ODOT while designing emergency action plans and better follow the recommended emergency routes.

4. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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5. Other comments:

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