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INTEGRATING CONNECTED PEDESTRIANS IN INTELLIGENT INTERSECTION CONTROL SYSTEMS (IICS)

Keywords: Automated Vehicle, Pedestrians, V2X Connectivity

INTRODUCTION

Broader Impact: With approximately 1.3 million road traffic deaths worldwide, roadway safety is a major health problem that affects humans around the globe. Nine out of ten of those serious roadway crashes are due to human behavior. Emerging automated and connected vehicle technologies have potential to transform the transportation system by removing fatal human errors. Using a variety of sensors and terrain information, automated vehicles (AV) and connected vehicles (CV) will have the ability to communicate with infrastructure (V2I), surrounding vehicles (V2V), and all roadway users (V2X). While embracing technology, engineers must consider all road users; not just automobiles. Complete Street policies adopted across the country and require streets to be planned, designed, and maintained to enable access for users of all ages and modes of transportation. Advances in AV and CV technology must integrate all modes transportation to achieve a safer and more efficient transportation system.

Intellectual Merit: AV technology removes the ability for pedestrians to visibly communicate (i.e. eye contact) with a driver. One possibility of keeping pedestrians connected, proposed in the project, is based on connected pedestrian detection. With a large portion of the US population in possession of a “smart” or connected device, pedestrians may have the ability to connect with the infrastructure and vehicles. Pedestrians would eventually be to indicate which road they wish to cross to get the right-of-way. AV and CV vehicles in possession of pedestrian data can make safe and informed decisions to improve efficiency at an intersection. Although it is not feasible to have 100% saturation of connected pedestrians, this project develops the framework for connecting pedestrians into an intelligent intersection control systems.

RESEARCH PLAN

The goal of my Ph.D. research is to optimize intersections with AVs, CVs, and pedestrians. With the resources and support from the University of Florida (UF), I will develop, test, deploy, and analyze a pedestrian-integrated intelligent intersection control systems (IICS). My research expands ideas from my current undergraduate collaborations with Dr. Lily Elefteriadou, director of the UF Transportation Institute, Dr. Ruth Steiner, an Associate Professor at the UF Department of Urban and Regional Planning.

Broader Impact: During my research process, I will include undergraduates in my team, mentor engineering students, and present the project to multiple audiences. A diverse undergraduate research team will assist my project with accessible tasks, exposing them to the research setting, and facilitating a passion for transportation engineering by working with cutting-edge technologies. I will continue mentorship in established programs at the UF ASCE student chapter and College of Engineering. I will disseminate my work through multiple publications in Transportation Research Board and other scientific journals. I will present my work to undergraduates at their club meetings and research fairs. Practicing engineers will gain access to my work through my involvement in professional societies (ASCE) and start to integrate AV and CV technologies into their long-range plans.

Intellectual Merit: Recent publications developing system control algorithms incorporating AV and CV technologies intelligent intersection control systems (IICS) assume a mixed-traffic of conventional, connected, and autonomous vehicles in undersaturated conditions [1,2]. With my established connections at the UF, I can procure all necessary equipment including autonomous vehicle, detectors, IICS, and a testing location.

OBJECTIVE 1: INTEGRATING PEDESTRAINS IN ALGORITHM (FIGURE 1)

The central computer will receive each vehicles and pedestrian arrival information. An algorithm will compute the parameters of the AV or CV to minimize travel time delay while considering the estimated movement of the connected pedestrian and conventional vehicles. The optimized AV or CV parameters determine the intersection signalization and the AV or CV trajectory [1]. Challenges in developing the algorithm include predicting pedestrian movement with the presence of AV, CV, or conventional vehicles [3].

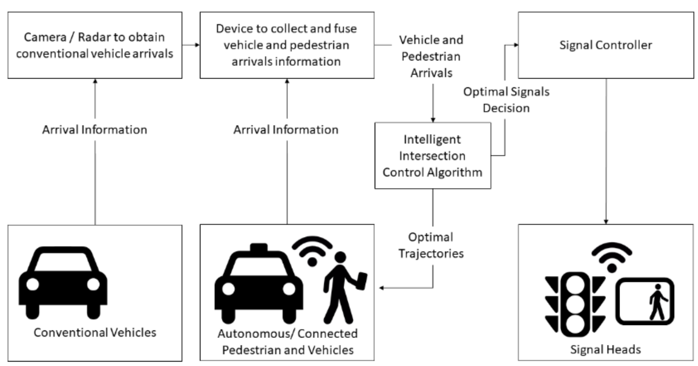

Figure 1: Intelligent Intersection Control System (IICS) with Connected Pedestrians

OBJECTIVE 2: PEDESTRAIN AND IICS COMMUNICATION

Previous research in smartphone-based detection and localization has been developed for visually impaired pedestrians [4]. Smartphone-based connectivity will be established in the IICS.

OBJECTIVE 3: TESTING AND EVAULATION

Full scale testing will take place to establish working connection between pedestrian, vehicles, and infrastructure [2]. Multiple scenarios with varying frequency and volumes will be tested and the results will be recorded and established performance measures will be analyzed.

OBJECTIVE 4: ROADWAY SAFETY EVAULATION

Additional testing will determine the intersection effectiveness of the perceived pedestrian safety. Response time and post-crossing participant survey will be analyzed to increase the accuracy of the IICS pedestrian prediction and inform future designs of vehicle-to-pedestrian communication [5]. From this testing, a series of pedestrian safety workshops will be presented to inform the public on safe interactions with AVs and CVs.

CONCLUSION

Broader Impact: This proposal strengthens the connection between transportation engineering and urban planning in development of emerging technologies. It is expected that results of the proposed project will facilitate the adoption of connected and autonomous vehicle technologies. Adopting these technologies will result in a safer and more efficient transportation system.

Intellectual Merit: This project will encourage the academic community to investigate vehicle-to-pedestrian issues including non-connected pedestrians, data security, moral dilemmas, and the effect AV will have on mode choice.

REFERENCES

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