Thesis Portfolio

Pedestrian and Bicyclist Safety and Comfort on Water Street

(Technical Report)

Sustainable Urban Mobility in the Context of Smart Cities: How Utilization of Non-motorized Transit Improves Lives in Urban Areas

(STS Research Paper)

An Undergraduate Thesis

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Cem Kutay
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Department of Systems and Information Engineering

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Sociotechnical Synthesis

Urbanization is accelerating at a rapid pace, exerting additional pressures on city resources and transportation infrastructure. In many cities, existing mobility systems are already inadequate, yet urbanization and increasing populations will increase demand still further. The Virginia Department of Transportation (VDOT) has identified the West Water Street corridor in downtown Charlottesville as an area of focus due to a high rate of traffic accidents between 2012 to 2016. Water Street also hosts one of the main bicycle routes in the city; however, there is a high level of traffic stress for bicyclists. Therefore, it is critical to determine pedestrian and bicyclist safety countermeasures to bolster pedestrian visibility and facilities to improve safety, comfort, and connectivity for bicyclists. In line with the objective of the technical part of the project related with the City of Charlottesville, there is ever more increasing interest in improving the lives of people in the urban areas around the world through introducing non-motorized transportation (NMT) alternatives that are safe and comfortable. Those methods, if planned carefully, will contribute dramatically to the quality of life in the cities by improving the urban mobility along with social and economic conditions in a sustainable manner. The intended objective of the STS Research is to lay the foundation towards reaching sustainable urban mobility in the context of future smart cities to improve overall quality of lives.

The focus of the Capstone Project is to research, create, and test alternative roadway designs to improve bicyclist and pedestrian safety in the Water Street corridor. The team will then test those designs using virtual reality (VR) and biometric data including both traditional surveys and novel methods such as simulation models. Alternative designs are implemented in the bicycle and pedestrian VR simulators in the Omni-Reality and Cognition Lab. A virtual reality environment that replicates the Water St. corridor has been designed, and the project team

can alter this base environment to include the design alternatives and evaluate user comfort as the subject pedestrian and bicyclist virtually walks and cycles through the new designs. The team tests those design alternatives, evaluating each alternative through user testing, and determining the preferred alternative through the feedback by the users. The end-user experimental studies are used to evaluate how different alternative designs impact pedestrian and bicyclist behavior, perception of safety, and comfort. These experimental studies are conducted within a fully immersive VR environment, where participants' behavioral and preferential information will be collected via physiological indicators such as heart-rate, skin temperature, and arm movements to be collected through wearables, as well as survey-based methods. The evaluation methodology uses different criteria such as cost, safety outcomes, operations across all modes, constructability, aesthetics and environmental impacts, equity, context sensitive design, user perceived safety and comfort, and documents all justifications for that criteria including design standards, experimental design, and data collection. Finally, a set of design plans for the preferred alternative are included in the final design report.

The STS portion of this paper focuses on sustainable urban mobility as a vital topic in the context of smart cities, through utilization of NMT alternatives to improve the quality of lives for people. While the non-motorized alternatives may be seen as the most viable option in terms of sustainability on multiple fronts, there are a number of challenges faced to reach the desired level of pedestrian, bicycle and public transit methods of transportation. The research sheds light on the complex relationships between different stakeholders while promoting the NMT alternatives to achieve sustainable urban mobility, and seeks to answer the question, how the social, economic, political, environmental, health and safety related factors influence the ultimate goal of improving the quality of lives in the context of a smart city. A strong connectivity with Actor

Network Theory is explored as the main underlying socio-technical framework in explaining those relationships.

While the provision of proper physical infrastructure is fundamental to enable mobility at a safe and convenient manner, there are numerous social, economic, environmental and policy-related factors that would influence sustainable urban mobility. Technology can provide some solutions to some of the challenges in achieving the desired results. The STS and Technical parts of this study enabled to assess how a serious consideration of those social factors that work in tandem with the technological solutions will add value in terms of improving the quality of people's lives through confronting those challenges as an engineer.