A Computer Vision-Based System to Dynamically Monitor Multimodal Traffic in Streets

Tara Pham*, Martin McGreal*, Paul de Konkoly Thege*

** Numina*

3407 S Jefferson Ave., 63118, St. Louis, M0, USA

email: hello@cty.io

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1 INTRODUCTION

Nationwide, poor bikeability in streets puts cyclists at risk of fatal accidents and poor public health from low physical activity rates. These problems disproportionately affect low-income and minority populations that cannot afford to travel by car and that also tend to be overburdened with obesity [1]. Recent data show that non-motorist traffic fatalities have concerningly trended upward between 2005 and 2015 [2]. Fatalities increased 13% between 2014 and 2015 alone [3] and cyclists were the most severely affected. One reason for the severity of these public health and safety problems is that planners have historically used obsolete and static data to inform the design of public places. Unfortunately, collecting empirical data on the use of streets for cities is often limited by costly collection methods. As a result, it can take years to decades for cities to measure the detrimental effects of urban designs even as they manifest acutely in some communities.

2 METHOD

We have developed a system, Numina, that substantially advances the accuracy and comprehensiveness of bicycle traffic and safety monitoring. Numina is comprised of portable, cloud-connected sensors that mount to light poles at a height of 15-25 feet and that use image analysis and pattern recognition to, automatically and in real time, differentiate and track objects in the public right-of-way. These objects might include pedestrians, cyclists, motorists driving a variety of vehicles, strollers, wheelchairs, or whatever else is of interest, including static features like trash piles or potholes. Numina performs the majority of its processing onboard the device itself via edge computing and transmits outputs to a time-series database via 4G LTE cellular networks. The resulting traffic data is anonymous and cannot be used to identify specific persons or vehicles, which is how it is able to protect privacy. Across our deployed sensor network, we have achieved a detection range for pedestrians of up to 100 feet and a 99% accuracy rating for our bicycle and pedestrian classifiers. The systems employ machine learning to refine each classifier over time, and as the system scales across additional cities and intersections, the resultant data network effects will enable increasingly deep study of safety and mobility trends.

3 STUDY CONTEXT

Currently, we are studying multimodal traffic safety in 11 sites in the City of Jacksonville, FL, with support from Health 2.0, the Robert Wood Johnson Foundation, the Clinton Foundation, and local university partners within the MetroLab Network. The study seeks to empirically validate where traffic is most dangerous to bicyclists and pedestrians and prioritize which sites to redesign to have the highest impact on safety. We are also focused specifically on training our cyclist image classifiers to detect near-misses with vehicles, which will allow more tactical measurement of unsafe behaviors and locations for cyclists.

4 CONCLUSION

Planners will be able to use data from Numina to A/B test the built environment, empirically measuring the current state of street safety and efficiency and providing long-term evaluation of these interventions. The system also provides the future opportunity to link to city infrastructure to autonomously actuate city services. We believe that the iterative approach to urban planning that this system enables can mitigate some of the risks and high costs associated with legacy traffic data collection methods.

REFERENCES

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