Using smartphone sensors to predict vehicles movement to increase awareness of incoming traffic.

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ROADS ARE NOT SAFE FOR BIKES

Thousands of bicycle riders are injured and approximately 30 are killed on Victoria roads yearly [1]. Despite being the small percentage of traffic on roads, cyclists have the highest casualty rate per kilometer traveled with 11 deaths per kilometer traveled [4]. Bicycle accidents are especially high in urban areas with mixed traffic, intersections, and during nighttime. Due to bicycles' narrow fronts and bodies, bicycles on roads are hard to spot, and it can be even more challenging in the areas described

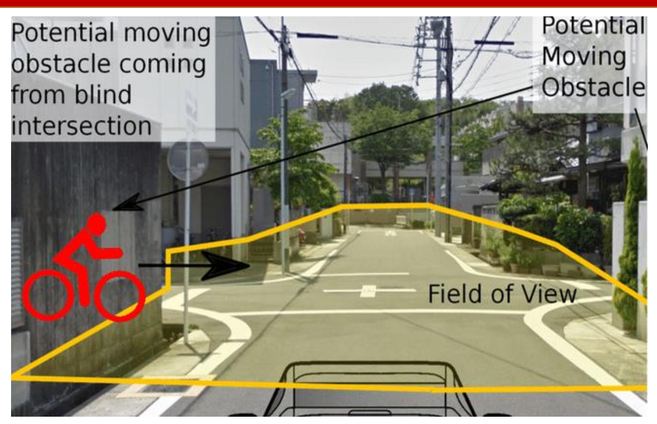


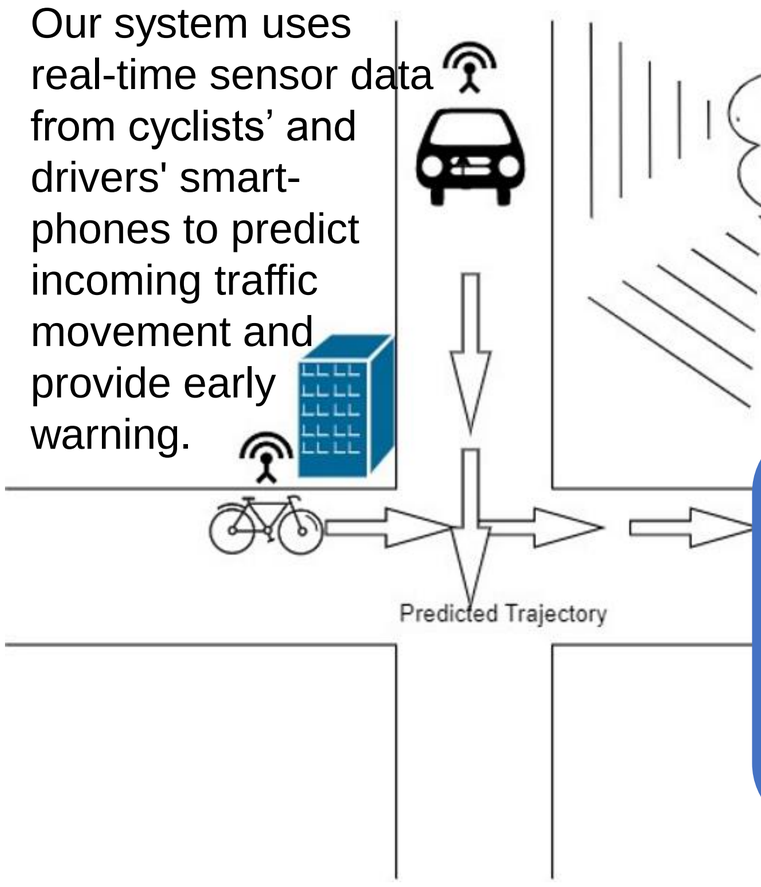
Figure 1:Blind intersection, where the driver do not have incoming bike traffic on their field of view. Source: Adapted from [5]

AIM

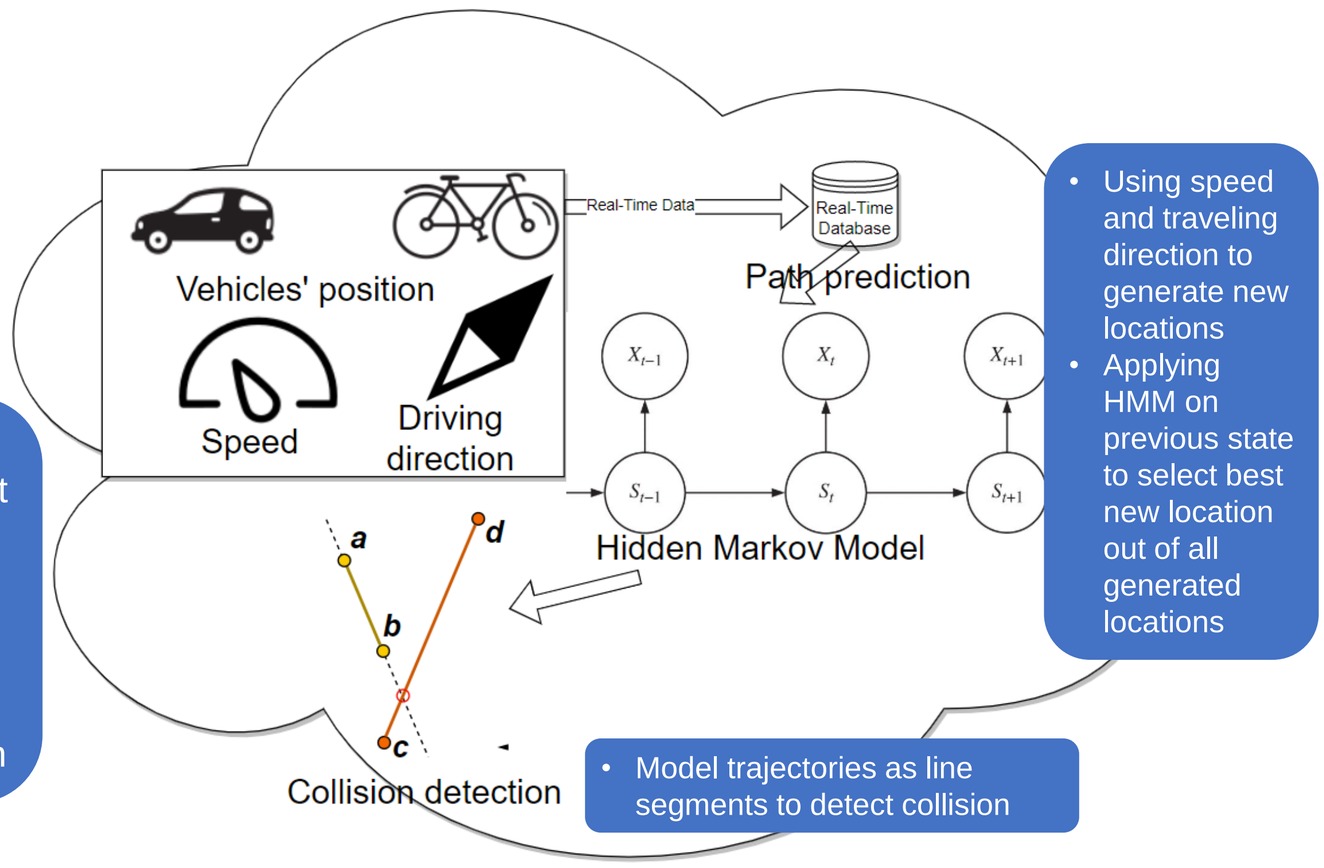
- To design a system that allows for increased awareness of smaller vehicles such as bicycles on the road
- To design a vehicle detection and warning system that utilises personal smartphone technology
- To create a system that is able to detect oncoming traffic accurately in different conditions.

VEHICLE WARNING SYSTEM USING PATH PREDICTION

Our system uses real-time sensor data from cyclists' and drivers' smart-phones to predict incoming traffic movement and provide early warning.



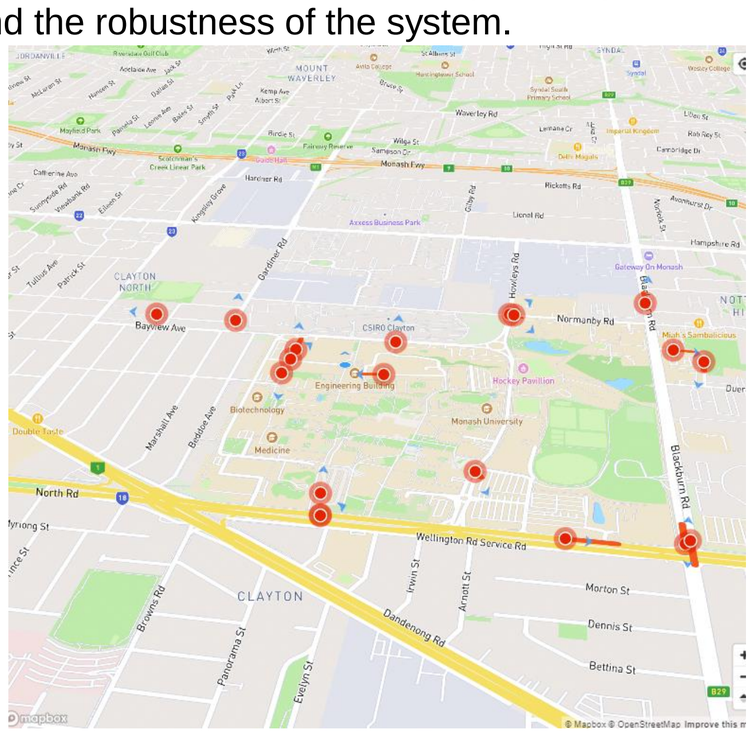
Sensor data are sent to a centralized server where it is processed, and the warning is then sent back to the cyclist interface. It requires other vehicles to be connected in order to be detected by the system



- Using speed and traveling direction to generate new locations
- Applying HMM on previous state to select best new location out of all generated locations
- Model trajectories as line segments to detect collision

ACCURACY, RANGE AND ROBUSTNESS OF THE VEHICLE WARNING SYSTEM

To test the system safely, we created a mixed-reality system where additional vehicles can be added to the system using SUMO, a microscopic road traffic simulation package. The testing was conducted by having an E-bike cycling around Monash Campus roads using the system. Applying different simulated vehicles with different routes that are generated in real-time through SUMO, we tested the accuracy of the prediction, the detection range, and the robustness of the system.



The system was able to detect nearby vehicles, as shown in the interface above as red makers, predicted the path of the vehicle shown as the line, and give visual warnings to the cyclist when there are potential vehicle collisions. The accuracy of the system did drop when the bike was traveling less than 2m/s in areas that have a cover. As the other vehicles are simulated, their path can easily be predicted with high accuracy. More testing with real vehicles is required to test the accuracy of the system.

FEATURES	OUR SYSTEM	RADAR	LIDAR	CAMERA
Range	No limits - can be extended or decreased based on amount of traffic	150m	300m	50m
Accuracy	Highly Accurate in open area, can be improved on with more data about the drivers' behaviour	Highly accurate in determining object and speed; not accurate in object classification	Highly Accurate, High-definition detection	Accurate
Cost	No-uses smartphone	Low	Expensive	Low
Robustness	Able to detect accurately in extreme weather condition, various lighting. Accuracy may decrease in tunnels	Detection range may decrease in extreme weather condition	Detection range may decrease in extreme weather condition	Affected by the lighting and extreme weather condition
Field of View	Not limited	20, Narrow	360,limited by terrains	130

Table 1. Comparison of our system with other existing vehicle detection technology

FUTURE WORK

- Apply historical data to better model different drivers' behaviours to better increase the accuracy of the prediction model
- Extending it to predict pedestrian movement
- Incorporate with other sensors to improve the accuracy of path prediction and robustness of the system
- Improve the privacy of the users by creating a decentralised system

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