Imminent Collision Warning System for Bicycles

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Background

Bicycle Crashes:

- Over 48,000 bicyclist-motorist crashes and 677 bicyclist fatalities in the US (2011)
- Detailed 10-year study of crashes in the city of Minneapolis:
  - 41% of bicyclist-motorist crashes happen at intersections, another 40% occur within 50 feet of intersections
  - The most common pre-crash maneuver for bicyclists is bicyclist riding ACROSS roadway (46%)
  - Motorist fails to see bicyclist in a large fraction of accidents

Need for a black box recorder on bicycles:

- Most often, no data is available for police to analyze a motorist-bicycle crash
- Inadequate evidence to prosecute the motorist
Goals:

- Development of a sensor system and an associated imminent collision prediction system for a bicycle
- Provision of collision warnings to both motorist and bicyclist
- Implementation of a black box event recorder
Schematic of sensors and electronics on instrumented bicycle

- Rotating Laser System
- Black box & Audio Warning System
- Side Sonar System
- Electronics, Battery, and Speaker
- Rear Laser Sensor
Crash Scenarios Addressed

- Sensors on bicycle will address the following three types of crashes:
  - Rear Collision
  - Right Turn by a Side Vehicle
  - Side Collision While Bicycle is Riding ACROSS
Project Status

- Rear collision avoidance system developed
  - Works effectively in preliminary tests

- Side collision avoidance system developed
  - Novel sensor system developed that estimates both distance and orientation of side vehicle
  - Consists of 1 sonar transmitter and 2 receivers to enable both distance and orientation estimation
  - Quicker prediction of potential collision
  - Works effectively in preliminary tests
Side Collision During Vehicle Right Turn

- **Experimental Data**
- **Custom designed sonar sensor**
  - 1 transmitter and 2 receivers
  - Measures both side distance and angle
Challenges in Front Laser Estimates

- Multiple vehicles with different travel paths can be present at a traffic intersection
- Need to track multiple vehicles with very different locations
Challenges from Front Laser Estimates

Difficult to distinguish between moving and parked objects

Laser bounces from front of car

- Laser bounces from side of stationary object (e.g. parked car or building)

Need different sensor orientations for different vehicle speeds

Different sensor orientations needed

- Low speed car detection
- High speed car detection

Strategy:
- Use two front laser sensors
- Both sensors on rotating stepper motor platforms
- Rotation of +/- 10 degrees for each sensor
Conclusions

- Sensor system developed and implemented for rear collision warning
- Novel sensor system developed and implemented for side collision from right turning vehicles
- Challenges exist in estimating vehicle trajectories while travelling ACROSS an intersection
- More intensive tests need to be conducted in the future to evaluate collision prediction system.