Third Eye

Blind Spot Detection System for Cyclists

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Objective

To design a robust, low-cost, and user-friendly traffic detection and collision avoidance system for cyclists.

Background

The main safety concern for cyclists is that their safety is at the responsibility of other motorists and road users. Cyclists must rely on other road users to be paying close attention to the local traffic conditions at all times; furthermore, it is an unrealistic expectation for all road users to be willing or able to pay attention to every possible distraction at any given moment.

Indeed, 84% of distracted-driving-related fatalities in the United States can be attributed to carelessness or inattentiveness [1]. Further, 92% of all bicycle-related fatalities involve motor vehicles, and 94% of those fatalities were due to driver inattention [2]. The central aim of this project was to work to lower those statistics by allowing a cyclist to be aware of dangers that they may not otherwise be aware of, such as motor vehicles closing behind them at high or low rates of speed.

Introduction

We have developed a system that will watch over a cyclist when they are in traffic. The system is called Third Eye. Third Eye uses an ultrasonic sensor mounted on the rear of the bicycle which communicates traffic information to the cyclist's iPhone wirelessly. Third Eye will then play warnings appropriate to the situation via the user's headphones, allowing the user to listen to music while increasing their safety.

Third Eye's companion app, running in the background of the cyclist's iPhone, will turn the user's music down when it receives information that the cyclist is in heavy traffic. If a vehicle is approaching quickly, the app will pause the music and play a series of user-customizable alerts that differ based on the speed and distance of the approaching object.

Figure 1 A cyclist who needs Third Eye [3].

Results

The initial field tests of Third Eye show immense promise. Currently the system is able to detect traffic from 3 meters away and can sufficiently screen sensor noise to determine whether an object is moving towards or away from it.

The prototype system uses a Blend Micro microcontroller paired with a MaxBotix MB1000 ultrasonic sensor. Custom software running on the microcontroller processes the distance data recieved from the ultrasonic sensor by averaging and smoothing the data. A linear trend is then fitted to an arbitrary number of data points, and the slope of that trend is used to find the closing speed of the object. The microcontroller uses the closing speed along with the object's distance to determine whether the object is a danger to the cyclist.

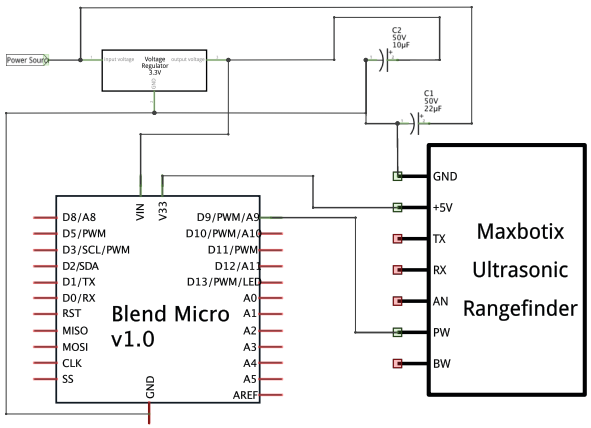

Figure 2 The Third Eye hardware schematic.

The alert is sent to the companion app running on the iPhone, and the iPhone either plays an alert or lowers the master volume.

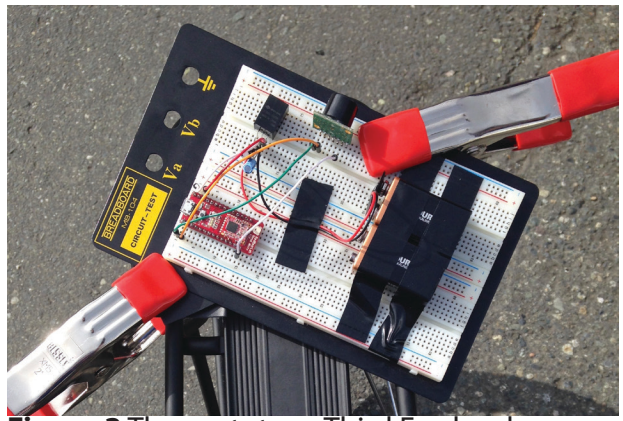

Figure 3 The prototype Third Eye hardware securely mounted on a rear rack.

Difficulties Faced

There were a number of difficulties faced during the realization of the project. The initial sensors chosen were extremely unreliable and did not work with 3.3V logic, which our chosen microcontroller required. Additionally, the lack of computing power of the microcontroller made complex calculations difficult, and resulted in many iterations of the microcontroller software that were focused purely on efficiency and speed.

Future Improvements

There are a number of future improvements that could be made to the Third Eye system. One feature is allowing the user to choose the distance (or distances) and closing speeds at which they want to be alerted about closing objects. Another feature would be to miniaturize and weatherproof the existing prototype.

Acknowledgements

We would like to acknowledge the contributions of the following individuals to the development of Third Eye: Professor Nikitas Dimopoulos, our faculty supervisor; Professor Fayez Gebali, our class supervisor; and Paul Fedrigo, Rob Fichtner, and Brent Sirna, the ECE lab technicians.

References

[1] "Traffic Safety Facts 2009," NHTSA.
[2] Nicaj et al., 2009.
[3] http://smithratliff.com/wp-content/uploads/2012/05/nyc-cyclist-riding-bike-down-fifth-avenue.jpg