StreetSmart

Rider's Enhanced Awareness Device

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Motivation

- Over **70% of cyclist fatalities** involve a collision with a **motor vehicle** [1].
- Researchers have discovered that drivers frequently fail to notice cyclists due to "**inattentional blindness**" [2].
- The most common bike-car accident involves a driver hitting a cyclist from behind [3].

There is a need for a device that increases awareness to reduce the risk of incidents and provide peace of mind for cyclists and drivers alike.

Objective

The objective of this project is to design a bicycle safety system that:

- Increases a rider's awareness of their surroundings
- Increases the awareness of nearby motorized vehicle drivers who share the road with cyclists

Features

Table 1: Notable Features of StreetSmart

Blind Spot Detection	Provides live, tactile feedback when it detects obstacles in a user's blind spots (within 3 m and 100° behind user)
Brake Detection	Detects significant deceleration, and signals the user's intention to brake by activating the brake lights
Turn Indicators	Activates left or right turn signals with the flip of a switch
Rechargeable	Contains on-board rechargeable power system for extended usage and cost-effectiveness
User Customization	Allows the user to select haptic or visual feedback method and customize the blind spot detection distance
Reliability	Water resistant and works in all weather conditions

Design Iterations

Table 2: Design Iterations and Improvements

Blind Spot Detection	Switched from stereo camera vision to LiDAR; 4x increase in battery life
Mechanical Casing	Reduced mechanical casing volume by 55%
User Feedback	Added LEDs alongside haptic feedback
User Customization	Added multiple modes for user flexibility

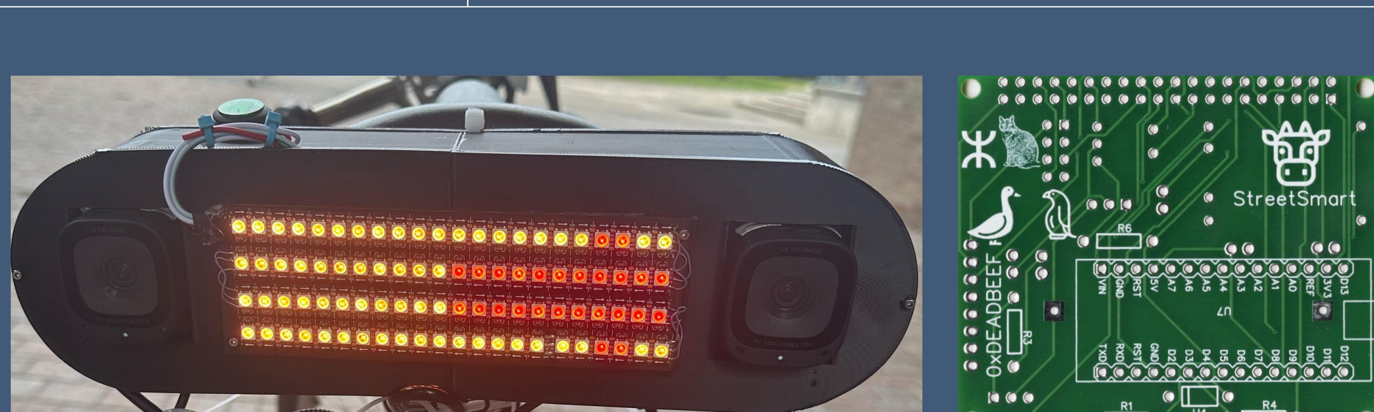

Figure 1: Initial Design of Central Controller (left) and New PCB Design (right)

Prototype Design

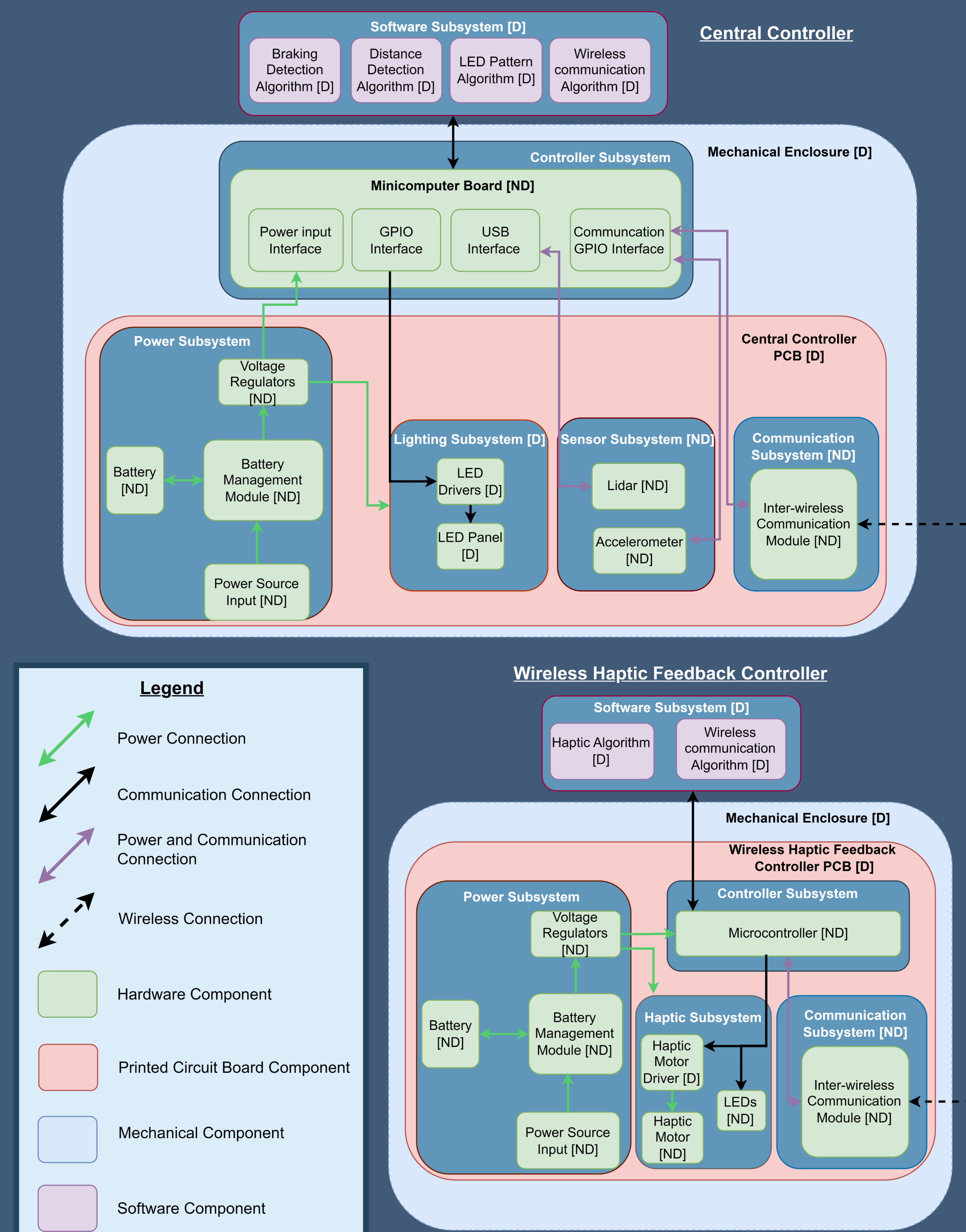

Figure 2: System Level Diagram of StreetSmart and All Components

References

[1] "Bike Safety Statistics," CAA National, https://www.caa.ca/driving-safely/cycling/bike-statistics/.

[2] S. Yeager, "Why drivers look straight at cyclists and still don't 'see' them," Bicycling, https://www.bicycling.com/news/a20043758/drivers-dont-see-cyclists-inattentional-blindness/.

[3] E. Barclay, "When bikes and cars collide, who's more likely to be at fault?," NPR, https://www.npr.org/sections/health-shots/2011/05/20/136462246/when-bikes-and-cars-collide-whos-more-likely-to-be-at-fault.

Consultant: Dr. William Bishop **Symposium Date:** March 13th, 2024

Advantages

- Alerts everyone on the road, including the user, of any dangers
- Visual and sensory information for all types of stimuli
- Water-resistant and durable enclosure allows for all-terrain and environment use

Theory

- Rear-mounted LiDAR measures object distance data up to 3 m
- Sensor processing algorithm filters incoming distance data based on user-input range and send feedback when object is within bounds
- Deceleration algorithm filters acceleration data and identifies correct deceleration patterns to trigger brake lights
- Haptic and lighting algorithms provide comprehensive visual and sensory feedback

Analysis

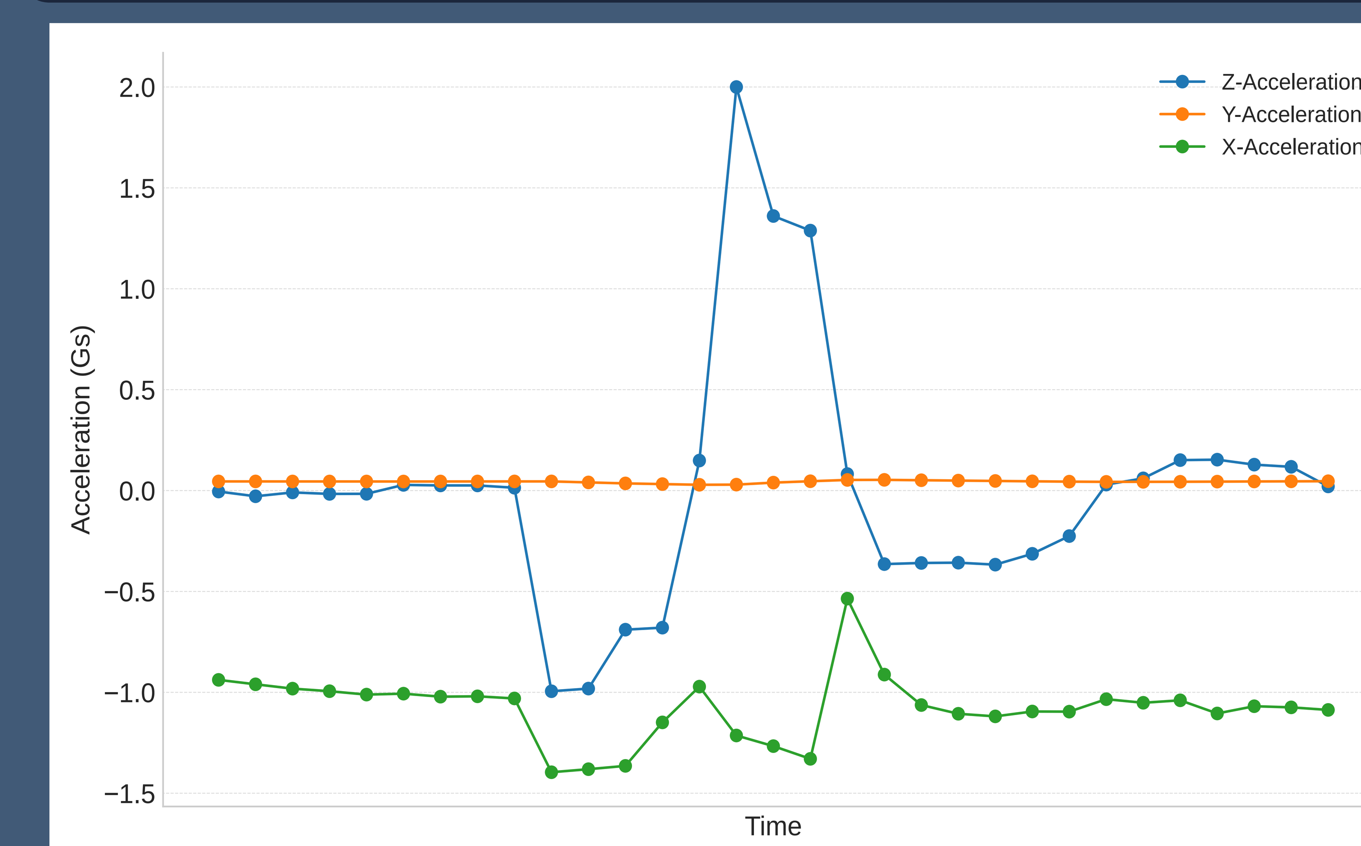

Figure 3: Acceleration Plot in XYZ Directions during Braking Event

- Implemented acceleration thresholds for each axis of movement to avoid incorrect deceleration detection

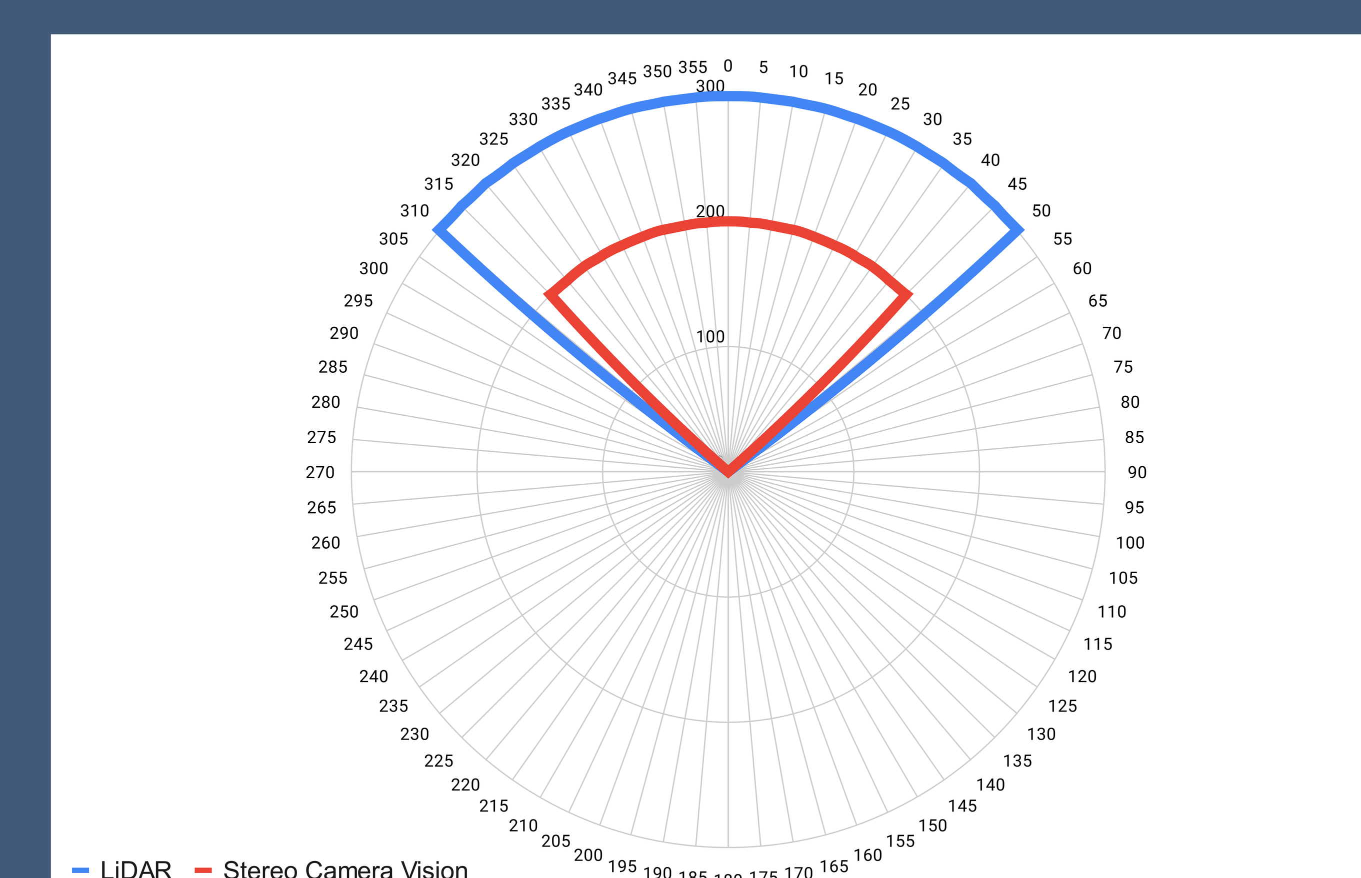

Figure 4: Radial Map Comparison of LiDAR and Stereo Camera Vision

- LiDAR field of view accommodates farther range and larger field of view compared to stereo camera vision