Problem Statement And Goals

Cyclops Ride Assist: Real-Time Monitoring System

Team 9

Aaron Li (lia79)

Amos Cheung (cheuny2)

Amos Yu (yua25)

Brian Le (leb7)

Manny Lemos (lemosm1)

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1. Revision History

Table 1.1: Revision History

Date	Developer(s)	Change
2022-10-19	All	Document creation
2022-10-20	Amos Yu	Improved formatting
2022-11-09	Aaron Li	Updated content
2023-04-03	Amos Yu	Updated Problem Statement and Goals for Rev1

2. Problem Statement

2.1. Problem

As North America pursues greener goals, it is expected a higher percentage of people will adopt cycling as their primary method of transportation as for its relatively low carbon footprint compared to automobiles. However, many roads were not designed and developed with cyclists in mind. Even with dedicated bicycle

lanes, cyclists may find themselves in fear as cars, trucks, and buses dart past with a far greater speed and momentum. In the worst cases, accidents may occur leading to both physical injuries and emotional trauma for the cyclist, the automobile driver, their respective families, and the community. Therefore, it is vital that this system will provide greater safety by increasing the awareness of cyclists on the road, allowing drivers and cyclists to share the road responsibly.

Cyclops Ride Assist (CRA) is going to be an all-in-one, easily installable, and easy-to-use system that adds modern car safety features onto a bike, such as rear vehicle detection and crash detection. Furthermore, the CRA will feature automatic video, LiDAR, and accelerometer data upload to a flash drive.

This solution to this problem will deliver on the following goals listed in Section 3.

2.2. Stakeholders

Stakeholder	Representatives
Project Proposers	Aaron Li, Amos Cheung, Amos Yu, Brian Le, Manny Lemos
Project Supervisor	Spencer Smith
Teaching Assistants	Nicholas Annable, Christopher Schankula, Timofey Tomashevskiy, Samuel Crawford, Ting-Yu Wu
End Users	Cyclists

2.3. Inputs

- The user will be able to mount and dismount the system to and from their bicycle.
- The user will be able to turn the system on and off.
- The user will be able to connect the system to an external power source, such as a power bank.
- The user will be able to save footage at any time during their ride.

2.4. Outputs

- The system will stay on the bicycle until manual intervention by the user.
- The system will be powered on and fully activated with all functionalities.
- The system will increase the safety and awareness of the cyclist during their ride.
- The system will deliver on the following goals listed in Section 3.

3. Goals

3.1. Reliable Rear Vehicle Detection

The system will be mounted to the bicycle in such a way that it can monitor the blindspots of the cyclist. As soon as the system turns on, it will detect if there are vehicles within MAX_DISTANCE metres of the cyclist's rear. The system will visually notify the cyclist that there is a vehicle in their blindspot without requiring them to turn around and take their eyes off of the road.

3.2. Convenient Mounting and Dismounting

The cyclist will be able to mount the system to the bicycle and unmount the system from the bicycle with minimal effort. The system should remain mounted on the bicycle under normal working conditions and in the event of a crash. The should system should only unmount if unmounted by the user or in extreme circumstances of mechanical failure.

3.3. Accurate Crash Identification

As soon as the system turns on, it will collect data on the orientation and state of the bicycle. Using the data collected, the system will interpret if the cyclist has been involved in one of many types of accidents (crashing into something, getting hit by something, falling off) with a high degree of accuracy. The crash identification algorithm will consider acceleration due to gravity and a CRASH_THRESHOLD acceleration.

3.4. Fast Video Buffering and Saving

As soon as the system turns on, it will collect video footage at a rate of FRAMERATE frames per second. The system will buffer the past BUFFER_TIME seconds of footage and will delete all older footage. In the event of an accident, or if the user hits the capture button, the system will save the buffer footage within MAX_UPLOAD_TIME seconds to an external storage option.

3.5. Accessible Video and Data Export

Exported footage and data will be accessible to the user at any point during or after the ride. Taking inspiration from airplane electronic flight recorders, the footage and data exported by the system should clearly communicate to the user the context of the bicycle and its surroundings during each crash or capture.

4. Stretch Goals

4.1. Emergency Response Integration

A user will be able to provide the contact information of an emergency contact to the system. The system will alert the saved emergency contact in the event of any serious crashes.

4.2. Mobile App

The user will be able to interface with the system via the mobile app. The user will be able to use the app to set certain parameters and permissions for the system. The system will be able to wirelessly export footage and data to the user's smartphone via the mobile app.

4.3. Map Integration

The system will record the distance and places/roads travelled from start to finish of a trip. The system will leverage GPS and real-time traffic data to alert the user of any road closures, accidents, or heavy traffic.

5. Appendix

5.1. Symbolic Parameters

Table 5.1.1: List of Symbolic Parameters

Name	Parameter Description	Type	Units

Name	Parameter Description	Type	Units
GRAVITY	Acceleration due to gravity.	float	m/s^2
CRASH_THRESHOLD	The maximum acceleration incurred during a crash.	integer	m/s^2
MAX_DISTANCE	The maximum distance that the rear vehicle detection will monitor.	float	m
BUFFER_TIME	The length of footage before the crash that will be saved.	integer	seconds
MAX_UPLOAD_TIME	The maximum time required to upload a video to the external storage device.	integer	seconds
RESPONSE_RATE	The polling rate at which the output is updated to match the current input.	integer	Hz
FRAMERATE	The framerate of the front-facing video	integer	fps