MJ06 - Vulnerable Road User Safety for Intelligent Transportation System

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Motivation

In Canada, many car accidents happen a year and some of these accidents result in fatalities. Vulnerable road users (VRUs) that include pedestrians, bicycle and wheelchair users etc. need protection from vehicles. The number of VRUs are on the rise as more people tend to walk and bike due to health and environmental reasons.

Our goal is to reduce the number of road accidents through an intelligent transportation system that has safety measures in place for VRUs that include a warning system design including VRUs, vehicles and infrastructure. Our end goal is to deploy a product that will result in less road accidents and protect VRUs from vehicles.

Objective

The objective of this project is to create a VRU safety system (VRUSS). The VRUSS involves interactions with the VRUs through mobile apps, warning generation and propagation to vehicles, and roadside infrastructure consisting of road side units (RSUs).
A prototype system is to be implemented on a small scale vehicular network with one or two RSUs and one or two smart cars.
A procedure must be developed for V2P, V2I and V2V communication.

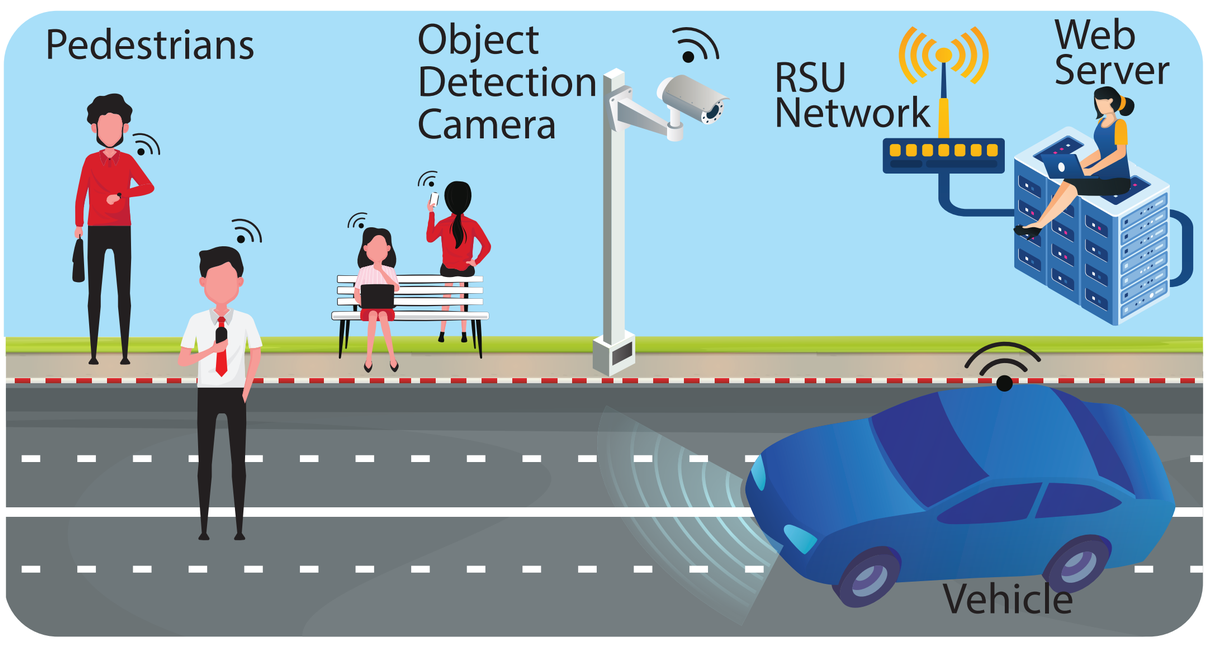

Figure 1: The VRU Safety System. Pedestrians and Vehicles receive notifications about possible collisions. The camera detects users and vehicles and sends the data to the Web Server for processing through the RSU Network. The vehicles are equipped with ultrasonic sensor, which help with collision detection. GPS data is also processed and used in determining possible collisions.

Approach

This system is intended to be done with Microcontrollers or raspberry pi devices and remote control cars. We initially built the project with raspberry pi devices and switched to microcontrollers after the raspberry pi devices were to slow. We mapped out this project into 3 different use cases which include:

1. A pedestrian (VRU) is crossing the street and a vehicle is approaching the pedestrian
2. A vehicle is approaching a high populated area such as a school.
3. A vehicle is approaching without the view of a VRU

As far as implementation goes, we decided to make a smartphone app to be used by vehicles and VRUs that indicate whether that user is in a jeopardy of being in a collision. We used a green zone to indicate a safe zone (no collision), a yellow zone to indicate a chance at a collision and a red zone to indicate a high chance at a collision. The smartphone app also sent user data to a web application and web server that registered users and showed their data and updated this data. We also had an objection detection system for the VRU that would use a camera to detect if there are any vehicles in its path and send out a separate collision warning. The RSU network was also used to set this whole network system up and was the backbone of this project. Two cars were used with microcontrollers attached to them and the smartphone app was used to control these cars.

Figure 2: Use Case 1 and 3

Figure 3: Use Case 2

Fabrication & Testing

For the Object Detection Camera, we utilized a Webcam and a Python script that used machine learning models. The smartphone App was created for Android OS using Xamarin Forms Framework. The Web Server and Web Application were created using JavaScript, NodeJS, and ExpressJS. The model cars used an ESP8266 microcontroller to received data and send ultrasonic sensor readings. The Web Server would collect data from all the users and vehicles and determine whether a collision warning should be sent or not.

In our testing, we determined that the Camera was having a much harder time detecting vehicles, while detecting a person was much easy. The project was tested successfully, a warning notification was sent out in the event of a possible collision for the 3 Use Cases outlined in this project.

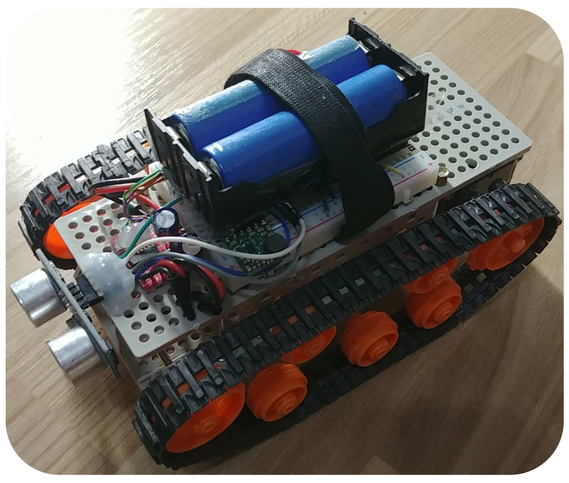

Figure 4: Model Car, used to demo the Use Cases.

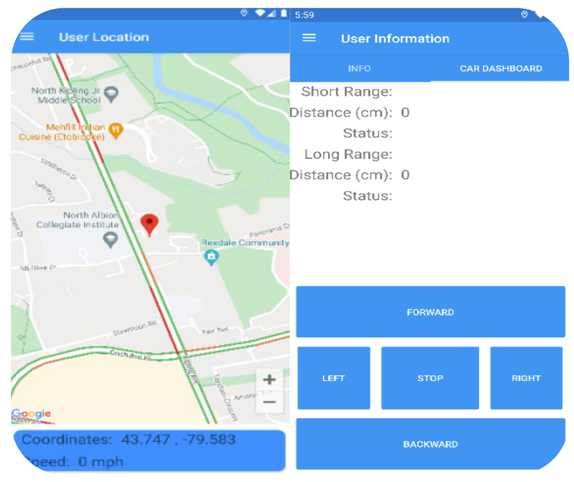

Figure 5: Smartphone App, used to send collision alerts to users.

Conclusion

Any vulnerable user road safety system that prevents collisions and lowers the amount of average accidents a year is very impactful and welcome in any society.

By using this intelligent road safety system, VRUs and vehicle users will be alerted through their smartphones when they may be in danger of a collision. Data of these users will be sent back and forth between the smartphone apps and a web server that is used to keep track of these users.

By having this intelligent road safety system in place, a lot of collision will be avoided and VRUs can feel safe while walking the streets.

Acknowledgement

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References

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