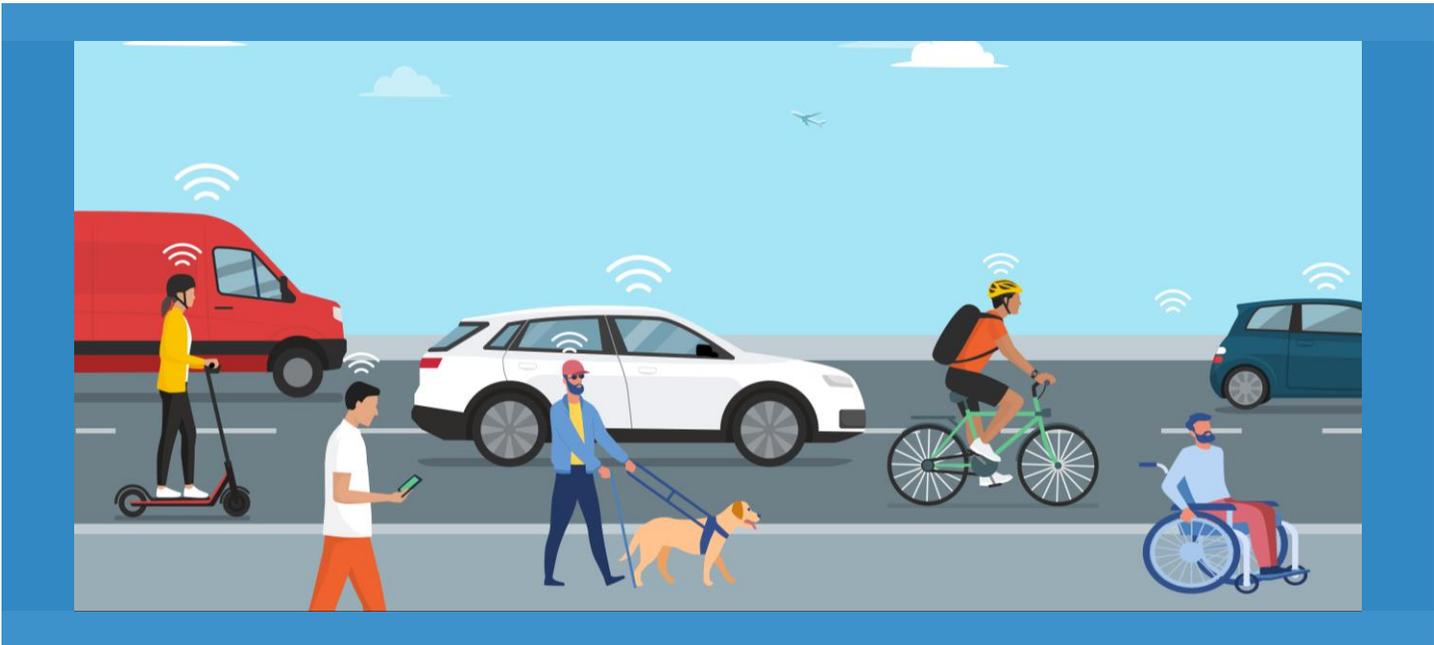




# VRUM.

VULNERABLE ROAD USER MISSION



## ROAD SAFETY

Safety of non-motorized users, or Vulnerable Road Users (VRU), is an increasing problem. By leveraging technologies developed by USDOT and the CAV industries we want to develop a messaging platform for improved VRU safety.

## OUR SOLUTION

Send messaging based on the format for the PSM from SAE J2735 used for connected vehicles. We can allow CAV vehicles, traffic apps like HERE and WAZE to receive this message and broadcast to vehicles.

## OUR IMPLEMENTATION

This solution will generate PSM based message from a cell phone app carried by the VRU and send it to a cloud platform. A vehicle app will query for these messages and send an audible notification to the driver for pedestrians in the area.

## Problem Statement

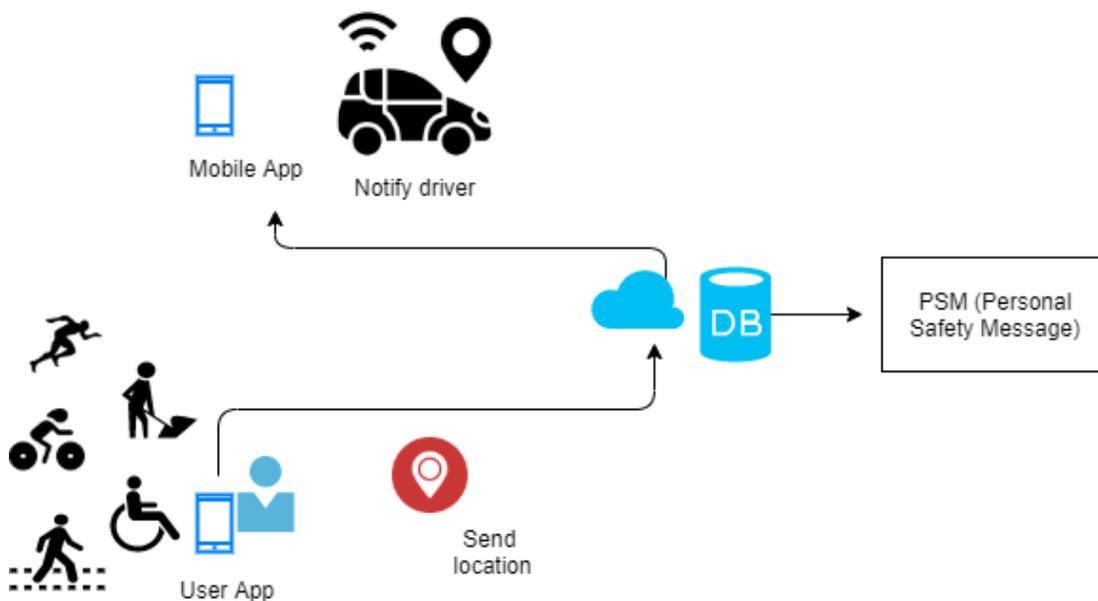
Did you know that over the past 10 years, the fatality rate of pedestrians has increased by 53% in the US? In our home state of Colorado, we have seen an 89% increase compared to the last decade. Distracted driving has caused 20% of the car-involved incidents. You should not need to worry about a car endangering your safety while crossing the street, exercising along the

roadways, or enjoying a peaceful walk around your neighborhood. Wouldn't it be amazing to have a way of notifying motorized vehicles that you, as a pedestrian, are on the road? Wouldn't you feel better knowing that cars would be aware of your location and presence on the road? Personally, I would be more motivated to get out and enjoy some fresh air with a stroll in the evening, with the peace of mind knowing cars are alerted about my presence. How might we do this? The Highlanders, FRC team 4499, proposes a solution to improve the safety of Vulnerable Road Users (VRU). We will strengthen the mental and physical health of walkers, cyclists, runners, wheelchair users, people crossing the street at intersections, and all other non-motorized road users with our solution.

## Solution

Solving this problem starts by making exercising as a pedestrian safer. We present VRUM, Vulnerable Road Users Mission. Our solution is to make exercising as a pedestrian safer and to leverage technologies used by connected/automated vehicle (CAV). We want to take this one step further and make this notification available to all road users, not just CAVs. Whether in a car or exercising in your neighborhood, people carry cell phones with GPS that can log location, speed and heading. The USDOT (US Department of Transportation) and SAE (Society of Automotive Engineers) have developed standards for messaging formats to communicate with CAVs and other motorists for general traffic information and weather notification. One of these messages, a Personal Safety Message (PSM), is a message that describes a non-motorist location, heading and speed, will be generated from the VRU and sent to the cloud to make this information available to any motor vehicle with a smartphone app. We will construct the ability to self-generate PSMs, send them to the cloud, process them and make the message available for smartphones in vehicles for an audible notification to the motorist that a VRU nearby. Everyone's location and personally identifiable information (PII) will remain anonymous.

All software, data, and design documentation will be open-source and freely available to the community to extend and use as appropriate.



Pic. 1 Layout of application environment

## Technologies

To solve the problem of pedestrian safety, we will develop a system that connects pedestrians to vehicles using a combination of technologies. These technologies include cell phones, a cross-platform mobile application, cloud storage, and computing, IMUs, GPS, SAE J2735 message standards with SAE 2945/9 implementations. With these resources, we would develop a messaging system to send and receive PSMs between pedestrians and vehicles. The mobile application will generate PSMs and audibly notify motorists of pedestrians nearby. In the future CV, AV and companies like Waze and HERE can use this information for predictive pedestrian analysis and avoidance.

## MOBILE APPLICATION PERSONAS

### PEDESTRIAN (VRU)

The Pedestrian will start the application and select an activity. This will enable the messages to generate and send to the cloud platform. No notification will be sent to the pedestrian and no PII (Personally Identifiable Information) will be captured.

### DRIVER

The driver will activate the VRUM app to be alerted about upcoming VRUs. Messages will be show on screen and have an audible notification to allow for hands-free/eyes-free use. The upcoming VRUs will also be shown on a map for clarification.

## Proof of concept

While we see this solution able to work with many use cases, we would like to focus this proof-of-concept application on pedestrians (walking or running) using neighborhood type roads. Our test case will include the use of mobile devices and internal and external GPS antennas. Future improvements would be to integrate C-V2X/DSRC chips with the cell phone to allow for direct communication between the VRU and driver (without the need for cloud connections).

## Documentation

We will create the following documents:

- Concept of Operations
- System Requirements Specification
- Interface Control Document
- Test Plans

## What is FIRST?



The mission of *FIRST*® is to inspire young people to be science and technology leaders and innovators, by engaging them in exciting mentor-based programs that build science, engineering, and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership.

We are developing this solution in partnership with FIRST to make road safety LOUD, reach a large population and make an innovative impact. In partnering with FIRST we are asked to give a presentation of an innovative idea, business plan, business pitch and impact model. With this opportunity we would like to take this into a complete working solution and implement it with organizations like USDOT, WAZE and HERE to make it even louder!