# Ongoing ITS Research at UAA

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# Smart-lighting for rural areas

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# Using AI-powered video camera at a roundabout

# Presentation Overview

- Introduction of smart lighting
- Objective
- Phase 1: Development of Prototype
- Phase 2: Development of Installation-Ready System
- Deployment Plans
- Use of AI-powered video camera

# Introduction

- Over 40% of fatalities from road crashes occurred in rural areas (2021 data)
- Rural areas experience twice the risk compared to urban areas (per 100 million miles traveled)
- Poor lighting plays a significant role in crashes
- Since the rural roads have low traffic volumes at night
  - drivers do not expect other vehicles (Minnesota DOT, 2015)
  - poor driver perception of conflicting traffic or the presence of an intersection

# Introduction

- The primary source of lighting is vehicle headlights
- The illumination of roadways improves motorists' recognition of crossing points, and sign and marking readability
- An increase of 1-lux in lighting reduced crashes by as much as 94 percent at unlighted intersections (Minnesota DOT, 2015)
- Most of Alaska is rural, and its intersections are isolated
- Alaskans also experience long dark hours in winters
- Rural regions in Alaska have a lower population and limited resources



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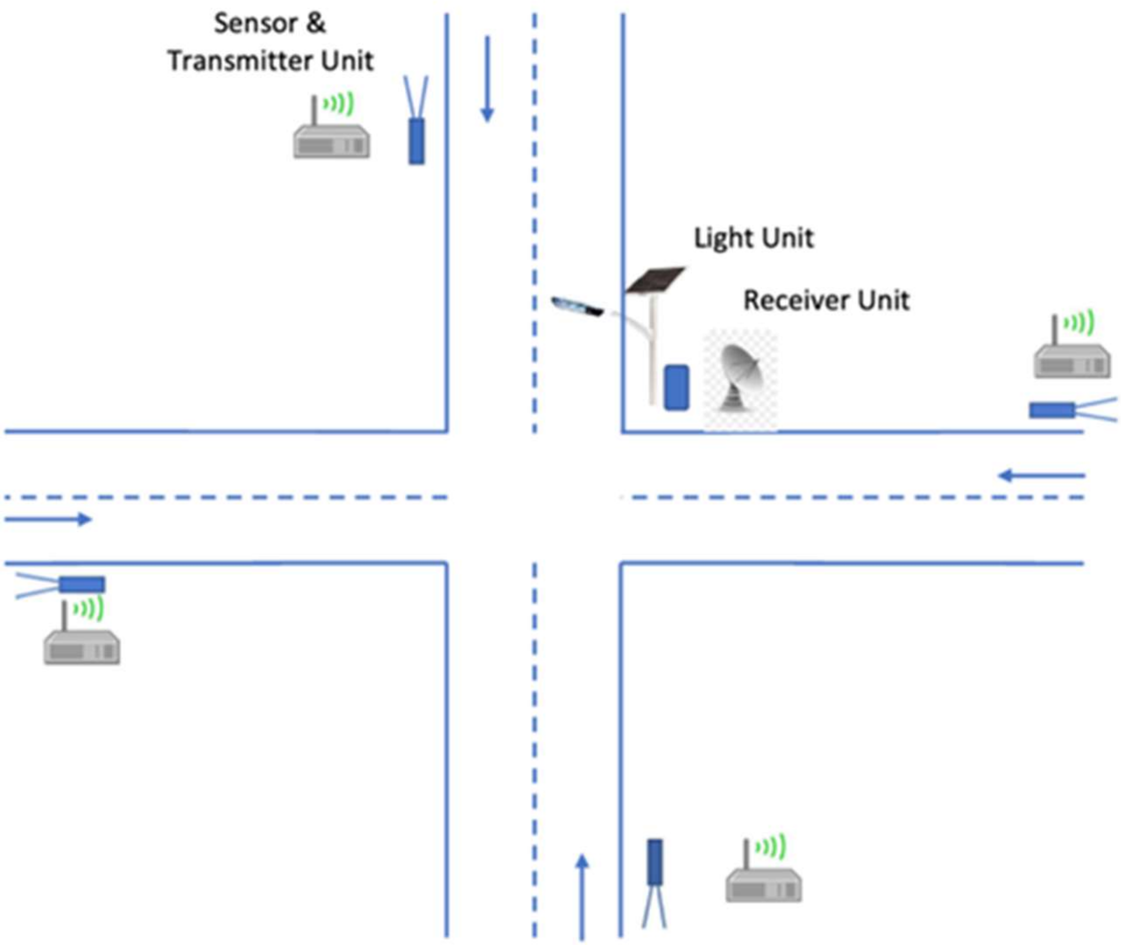
# Objective

- The objective is to develop an easy-to-deploy and affordable prototype of a smart-lighting system to enhance the safety of isolated intersections in Alaska
  - Rural areas in Alaska may not have sufficient technical know-how or workforce to develop and implement high-tech interventions

# The Design Concept



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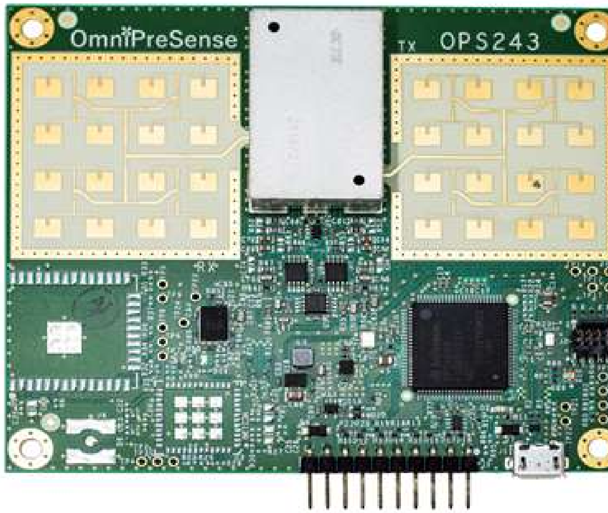
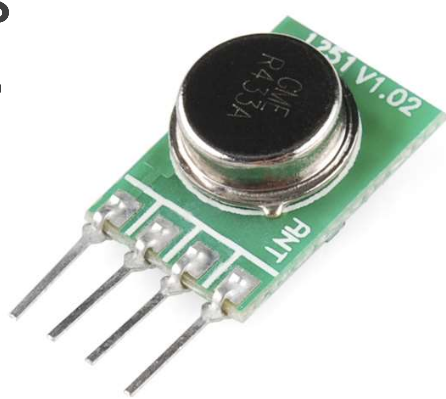
# Sensor & Transmitter Unit

- Ensures accurate vehicle detection
- Explored laser detector and Doppler radars
- Selected Doppler radars after checking viability in terms of application and maintenance requirements
- Chose OmniPresense OPS243A
  - Range: 100 m (~328 ft)
  - Sampling frequency: 1,000 to 100,000 per sec
    - Lower sampling frequency ~ higher accuracy in location, lower range in speed
    - If we use 1,000, the max. speed it can capture is 7 mph, for 100,000 the max. speed is about 700 mph

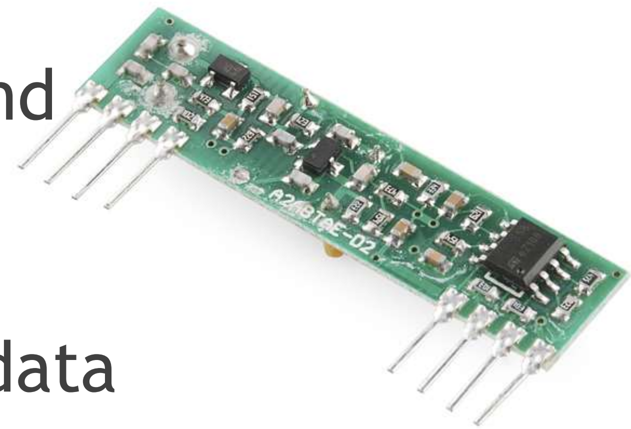


# Sensor & Transmitter Unit

- The sensor continuously monitors the detection zone for moving objects
- Once an object is detected, the information is processed to capture the required parameters such as speed and location of the detected objects
  - Processed in an Arduino interface
- Trigger transmitter if the sensed values exceed the defined thresholds
  - Customizable depending on location specifics
- Transmitter: Used RF Link 434 MHz transmitter



# Receiver Unit



- The purpose of this unit is to receive the signal from the transmitter, process it, and turn the light unit on
- Used RF Link 434 MHz receiver
- Uses an Arduino to process the received data
- Once receives the detection information from the sensor & transmitting unit, it will send a signal to the light unit

# Prototype

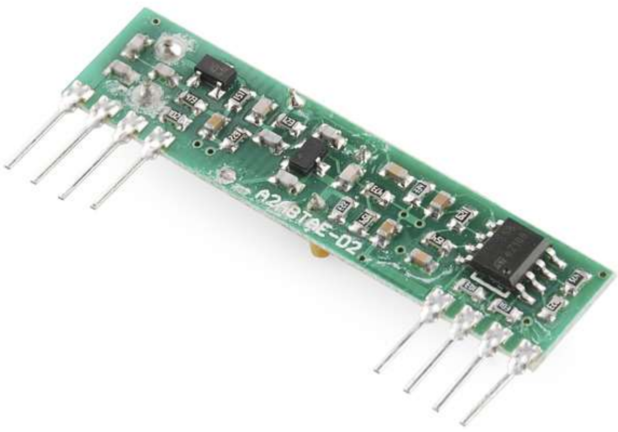
# Specifications of the Prototype

- **Maximum speed threshold:** used a frequency of 10,000 with a maximum reporting speed of 120 mph ± 0.278.
- **Minimum speed threshold:** used 3 mph as the threshold.
- **Maximum distance between the sensor and approaching vehicle:** depends on the detection range of sensors
  - In this case the range is about 200 ft
- **Maximum communication distance between the sensor & transmitting unit and the receiving unit:** depends on the communication range of the transmitter and the receiver
  - In this case this range is about 300 ft

# Phase 2:Installation-Ready System

# Specifications

- Battery: Green Saver12v 150 Ah
- Solar panel: Sunmac 370W
- Wind turbine: Primus Air 30 12V
- Smart controller
- Communication hub



# Deployment Plans

- The delivery of the unit was delayed by almost an year
- Need to test the solar and wind power generation during peak winter
- Currently redesigning the sensor & transmitter unit and make the entire system to a single unit

# Use of AI-Powered Video Camera for Pedestrian Safety

- Objective: Evaluate the effectiveness Rectangular Rapid Flashing Beacon (RRFB) at Dowling roundabout
- Collect pedestrian and motorist behavior data
- Analyze the data to check effectiveness
- Will collect both manual and video data



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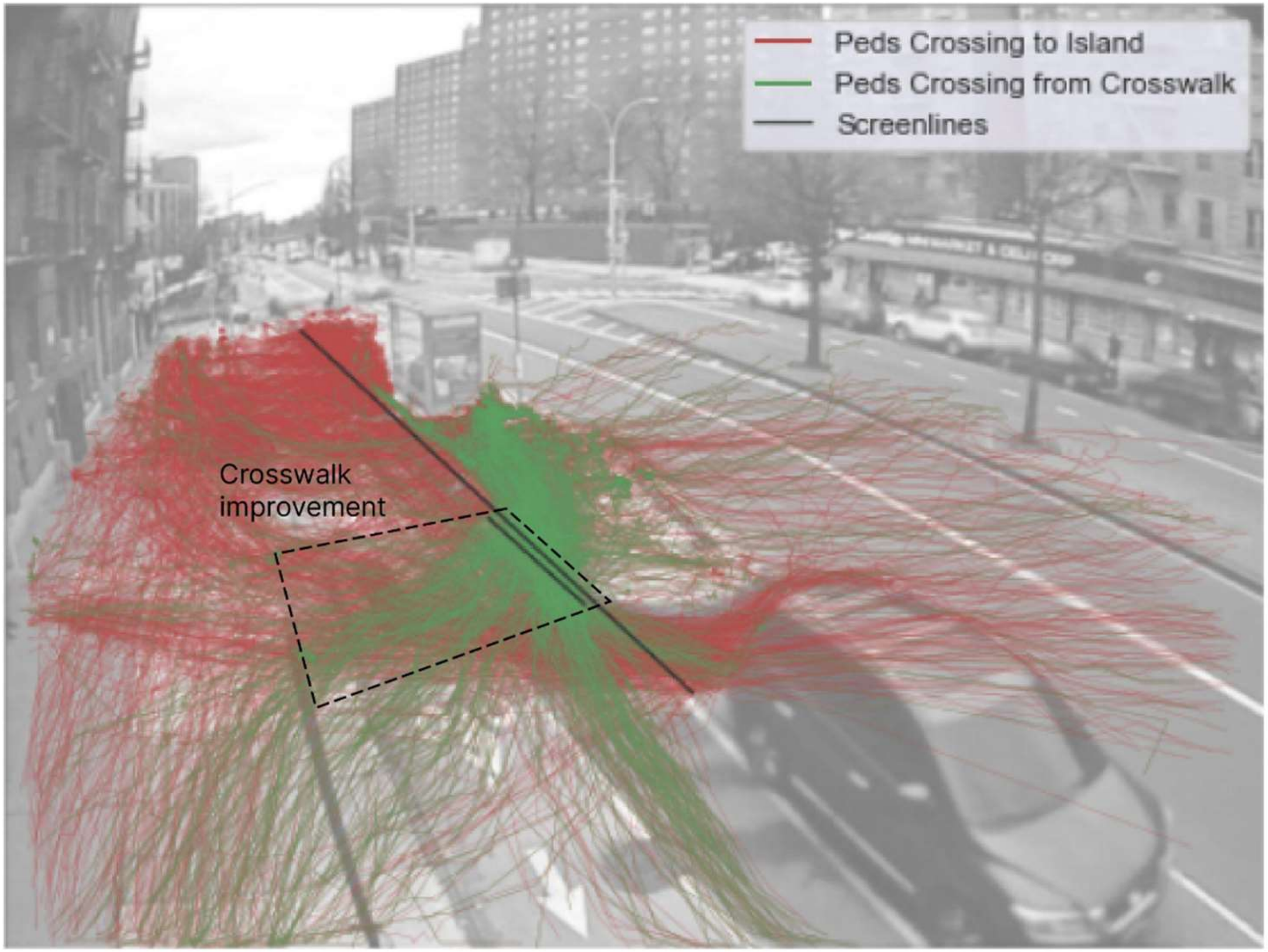
# Numina

Sensor

# Deployment Plans Numina

- Procured a couple of Numina cameras
- Will be installed at two approaches (late September)
- Will check motorist and pedestrian paths
- Will collect manual data to validate the data collected by the unit
- Help us collect data throughout the year

# Questions/Comments

Thank you!

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