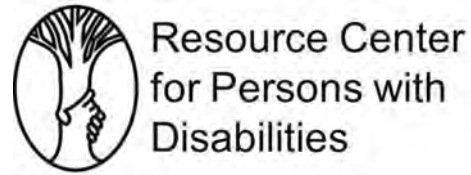
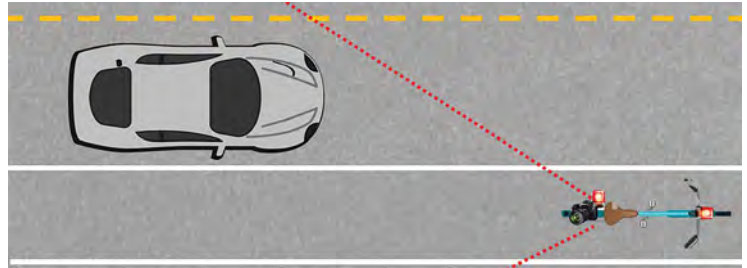


# MSU RCPD/MSU Bikes Intelligent Defense System (IDS)

In recent years, cycling has begun to be a better alternative for transportation due to the busy traffic and the air pollution in the cities. The number of distractions while driving an automobile has increased as well. As a result, every year the number of cyclist injuries and fatalities due to car collisions has increased.

Our team has been asked to help create a means of preventing cyclist injuries and fatalities due to vehicles on the road. The goal of the project is to design an affordable alert system which can detect the oncoming vehicles approaching from behind the cyclist. The team decided to use a camera to sense oncoming vehicles, alerting the cyclist and driver via a series of LEDs.

The sponsors and the team believe the low-cost, affordable intelligent defense system will prevent thousands of injuries and fatalities per year to cyclists.



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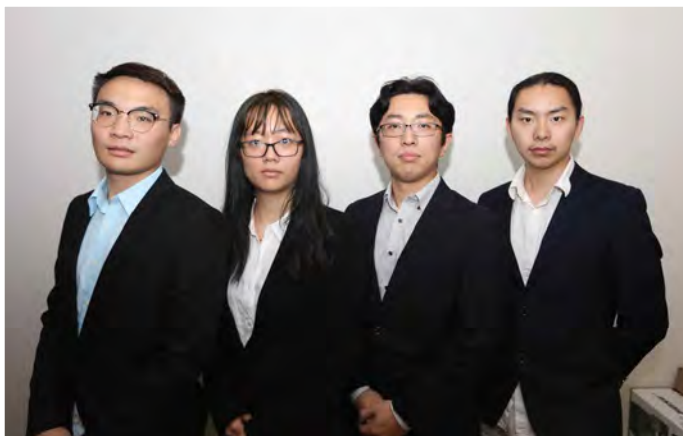
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# MSU IPF Landscape Services Salt Brine Development

The Infrastructure Planning & Facilities Landscape Services Department (IPF) is in charge of maintaining all campus sidewalks, roads, parking lots, and parking ramps on campus. For years, Landscape Services has used a salt brine mixture made by MSU and “Liquid Snow Shovel” (a commercial solution bought from a company) as a pre-treatment for sidewalks and roadways to lower the usage of salt and keep snow and ice from adhering to the surface. However, IPF is facing several problems when dealing with lower pavement temperature and high costs for de-icing materials.

The first problem was the freezing point. When pavement temperatures get colder than 15°F, the brine mixture is less effective, causing IPF to apply more salt to campus hard surfaces. The second problem was corrosion due to the brine mixture and salt application. The main component of the brine mixture is rock salt, which deteriorates campus infrastructure and causes high maintenance cost to maintain equipment due to corrosion. A product that is available on the market called “Liquid Snow Shovel” has a lower freezing point and less corrosive effects than the brine mixture, but it caused the third problem, which was a high unit price of \$2/gallon, while the brine solution made in-house costs \$0.06/gallon. The project sponsor (IPF) required our team to find a new solution, which fulfilled the following requirements: freezing point less than 15°F and unit price less than \$1/gallon. The success of this project would decrease the cost of winter maintenance and reduce the negative environmental impacts of salt. The project was successful.



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# MSU Recycling Center Food Waste Cart Coating

Every day food waste is produced in large quantities across the Michigan State University campus. In order to reduce the University's carbon footprint, food waste is collected in order to be composted. The cleaning process of food waste containers occurs at the MSU Recycling Center. Bins are raised individually by a mechanical lift that angles the food waste bin into a large food waste dumpster. The bin is angled so that food can fall out into the dumpster, but this is not sufficient to rid the bins of food waste. A heated power washer is used to remove any remaining food waste and simultaneously clean the bins for reuse. It typically takes at least 5 minutes to completely clean a single bin.

Our team focused on evaluating the current process to research and recommend solutions to reduce the time spent on washing food waste bins. Various non-stick coatings were tested to see if they performed well with food waste on the HDPE containers. The success and implementation of the methods suggested should have an impact on the washing time of the bins and thus lower the cost of the cleaning process.



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# MSU IPF Landscape Services Autonomous Mowing and Snow Removal

Michigan State University Infrastructure Planning and Facilities Landscape Services Department is responsible for many services. Of these services, lawn mowing and snow removal take up a considerable amount of time and money. Landscape Services mows 1500 acres of greenspace in the warm months and, during the winter, is responsible for maintaining 57 lane miles of roadways, 220 acres of parking lots, 113 miles of sidewalks and seven parking garages. To assist in maintaining these spaces all year round, MSU IPF purchased the first SnowBot Pro in January 2019. The autonomous vehicle from Left Hand Robotics, Inc. has the ability to perform snow removal and lawn mowing.

Our team was tasked with taking the necessary steps to ensure the safety and reliability of the SnowBot Pro on campus. With its 63-inch mowing deck, the robot mows three acres per hour. Although this is slower than human operators, it allows Landscape Services employees to spend more time on non-trivial tasks such as fertilizing. In the winter, the SnowBot Pro is equipped with a salter and broom that can clear sidewalks 14 times faster than a human. The GPS-guided robot uses radar and lidar sensors to detect nearby objects and react accordingly. Our team was challenged with creating a functional safety plan to establish success criteria that was sent to Risk Management for approval before the robot's deployment on campus. With multiple scenarios, objects, and conditions, a testing plan was created and executed to statistically evaluate the safety of the robot.



INFRASTRUCTURE  
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