Objective

Product Need
- Gutter cleaning huge nuisance for consumers
- Chore completed multiple times yearly
- Essential for preventing damage to house

Market Size Estimate
- Single Family Detached Houses = 60% of Dwellings
- 70 million in U.S., 4 million in DMV
- Increasing in size, steady in proportion relative to population
- Current Market Value = $676.4 million
- 2018 Market Value = $1.8 billion

Market Landscape

Concept Generation

Concepts
- In Gutter Scooper (A)
- On Track Fan (C)
- Proprietary Track Fan (D)

Competitive Advantage

Selection of Concept (A)
- Removed the greatest percentage of leaves of all of the concepts
- Easiest to install and remove
- Weighs the least
- Least expensive concept
- Scored the best on the Analytic Hierarchy Process (AHP)

Design

Key Features
- “Plow” in front to push leaves up and out over gutter edge
- Plate behind plow lowers to pass under crossbars but raises to let leaves ride out of gutter side

Design Assembly
- Attach wheels to drive axles
- Mount drive motors and plate motor onto body
- Attach gear rack to rising plate
- Mesh plate motor pinion gear with plate gear rack

Design Limitations
- Cleaning function relies on drive motors ability to push
- Traction between wheels and gutter surface becomes an issue
- No scooping action, only pushing

Computational Analysis
- Apply inventor to perform finite element analysis (FEA) to simulate various stress conditions
- Conduct thermal analysis to model temperature distribution at various weather conditions

Prototype and Testing

Control System
- Ensure that the gutter can complete a cleaning cycle on an empty gutter
- Calibrate the detection and telescoping plate system to ensure that the plow can traverse under cross bars

Function Assessment
- Quantify percentage of leaves that the prototype will be able to remove
- Test applying various environmental conditions such as dry, damp, and wet leaves and debris

Test Results and Future Work

Test Results
- Redesign removal methodology knowing the collection works well
- Increase shovel angle of attack
- Include scooper to dump leaves
- Design casing to protect electronic components (testing w/ damp leaves)
- Include “H-bridge” to allow forward and backward motion of the robot
- Recreate prototype with aluminum instead of plastic