UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	EPRI	**Date Submitted**	4/8/2018
Project Title	A Better Approach to Vegetation Management at Utility-Scale PV Plants (Phase 3) (EPRI_MAIN3)	**Planned Starting Semester**	Fall 2018

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person. Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	2
Computer	2	Systems	
Other ( )			

Company and Project Overview:

The Electric Power Research Institute (EPRI) conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally. As an independent, nonprofit organization for public interest energy and environmental research, we focus on electricity generation, delivery, and use in collaboration with the electricity sector, its stakeholders and others to enhance the quality of life by making electric power safe, reliable, affordable, and environmentally responsible.

One of the larger costs associated with maintenance of utility-scale PV plants is vegetation management. In temperate climates, some weeds can grow 10+ inches per week. If not maintained on a regular basis, the weeds can shade PV modules, which reduces energy production, and can cause hot spots in the module, which is a fire hazard. Plant maintenance providers have tried a litany of conventional and unconventional approaches with inconsistent success over the relatively large footprint of PV plants (a 100 MW plant requires nearly 1 square mile). For instance, regular mowing can launch rocks into modules breaking the front glass (exacerbating O&M costs further) and sheep and goats are picky plant eaters requiring additional oversight by shepherds and donkeys (for protection against prey animals).

Project Requirements:

Objective

This project intends to develop a vegetation control technology that overcomes shortcomings of existing methods. It must:

1) Be more cost effective than current techniques;

2) Mow all areas of a PV plant, including under the modules and around the racking;

3) Be quickly and easily sited at a PV plant (cannot permanently integrate into the plant itself);

4) Not damage the PV site and equipment;

5) Be reliable, autonomous, and dispatchable; and

6) Not modify the environment / native habitat (e.g., cannot introduce foreign plants or scorch the earth).

Scope and Approach

Work will expand upon two previous senior design projects that happened in 2016 and 2017. In 2016, an autonomous mowing robot was built and demonstrated. In 2017, a self-sufficient charging station for the robot was built and demonstrated. This third (and final) phase of the project will install appropriate mobility and guidance sensors (as necessary) for obstacle avoidance and robot location detection; develop control and navigation algorithms to mow an entire field to spec; and field-test the fully-operational system (preferably in an actual PV plant).

Expected Deliverables/Results:

The hardware, software, and documentation from the previous two years of effort will be provided as a foundation to build upon. At the end of Phase 3, a fully working and functional prototype will be demonstrated in a real-life environment, preferably within a PV plant (to be arranged by project sponsor). Expected outcomes include:

1) Autonomously mow a field, which requires development of navigation control algorithms and improved use of the robot's existing on-board obstacle avoidance sensors and GPS controller;
2) Successful docking and charging, which requires improvement of the robot's ability to find its docking station and begin charging; and
3) Improvement in docking station modularity and mobility, which would enable easier transport and setup of the docking station in test field(s).

Disposition of Deliverables at the End of the Project:

Turn over to EPRI sponsor at end of Expo.

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List here any specific skills, requirements, knowledge needed or suggested (If none please state none):

- Autonomous mobility w.r.t. sensors and navigation algorithms
- Strong programming skills