



Company Information

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| Company Name | <i>EPRI</i> | Date Submitted | <i>5/2/2024</i> |
| Project Title | <i>Development of an Autonomous Robot for Electric Substations (EPRI_AUTO)</i> | Planned Starting Semester | <i>Fall 2024</i> |

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

| Discipline | Number | Discipline | Number |
|-------------------|---------------|-------------------|---------------|
| Mechanical | 2 | Electrical | 1 |
| Computer | 2 | Systems | |

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 the public interest, 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.

EPRI has collaborated with the electricity sector and its stakeholders since 1972 and our membership has grown to represent approximately 90% of the electric utility revenue generated in the United States and extends to participation in more than 35 countries. The worldwide membership that supports our work comprises more than 1,000 organizations. While most members are electric utilities, others are businesses, government agencies, regulators and public or private entities engaged in some aspect of the generation, delivery, or use of electricity.

Through their advisory roles in EPRI, its research sectors and programs, EPRI members help inform the development of EPRI's annual research portfolio, identify critical and emerging electricity industry issues, and support the application and technology transfer of EPRI's research and development.



This project will work on the development of autonomous robots being used to inspect remote electrical substations.

Project Requirements:

Substations are critical infrastructures in the realm of Power Transmission and Distribution. The routine maintenance of these nodes is important for ensuring reliability and efficiency. The use of autonomous robots for such tasks has been identified by EPRI researchers as highly advantageous.

The current method of autonomous navigation involves pre-programming specific routes for the robots to follow repeatedly. This approach is not only labor-intensive but also inflexible, as it requires programming for each new route. The challenge lies in developing a robot capable of autonomous exploration, eliminating the need for pre-programming every route.

The primary focus of this project is to develop an exploration robot that can autonomously navigate every corner of a substation. The application of this technology is to use the robot for advanced 3D scanning and/or 360-degree image capture technology to replace the manual data collection process currently performed by humans. This innovation will not only improve efficiency but also allow for the deployment of a single robot across multiple substations.

EPRI will supply a robot platform as a starting point that they have used for other purposes in the past. It is equipped with bump sensors, GPS sensors, and LiDAR. The students will need to assess the current capability and make design changes to the robot so that it is suitable for the objectives of this project. The primary focus of this project is the development of an algorithm for autonomous navigation. The budget will be used for any additional sensors and controller boards necessary to enhance accurate autonomous navigation.

The robot should be capable of:

- Starting from a designated point and autonomously navigating the entire substation, similar to a Roomba vacuum cleaner robot.
- Avoiding obstacles and ensuring safe operation within the substation environment.
- Operating in two distinct modes:
 - Interval Mode: Pausing at configurable intervals (default 2 meters) to capture a 360-degree image.
 - Continuous Mode: Navigating without stopping, providing continuous data collection.
- Upon completing the exploration, the robot will return to its starting point.

The operator will define a geofence, specifying the latitude and longitude boundaries for the



robot's exploration area. Additionally, the robot will generate a live visualization of its path planning and navigation.

Expected Deliverables/Results:

1. A comprehensive document detailing brainstorming session, design considerations, project results, and testing.
2. The complete source code is hosted on GitHub.
3. A demonstration showcasing the robot's capabilities.

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

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

- Interest in autonomous navigation
- Interest in robotics