Raa Tech

Automated Non-Destructive Cleaning of Solar Panels

Departments of Computer, Electrical, and Mechanical Engineering

Team 303

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EEL 4911C & EML 4551C

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Project Description

Create an automated non-destructive cleaning device that would remove the soil from the face of the panel while being simple, robust, and may be operated either autonomously or by one individual.

Key Goals: This project will consist of a design that will eliminate the manual labor pertaining to the cleaning of solar panels. This design will perform autonomously with the ability to operate without the use of human interaction. With the robot's main task to clean photovoltaic panels, it will do so efficiently and in a timely manner. It will accomplish this using a double sweep method in which harsh chemicals are applied to a section in the first sweep, and the robot applies a pressure wash in the second sweep.. The robot will operate with one default setting that cleans the panel to the best of the robot's ability. For the naming of the project, our robot will now be automated and not autonomous due to the face that it will run on its own but not be able to move around obstacles on the solar panel.

Markets: To begin, the automated robot will be designed for small scale residential solar arrays. Once the robot has been revised and tested, minor changes will then be made to the operating system and mechanical components. Once the robot has proven its reliability, it will then be marketed in the residential and commercial market. Individuals who might be interested in acquiring this product are the companies that distribute, install and maintain the solar panels on residential houses or commercial buildings. Further, if the system proves to be efficient and effective, power companies that maintain their own solar panels might be interested in acquiring the product so they can also clean and maintain their solar panels on a larger scale.

Assumptions: The first assumption that the group of engineers will make is that each solar panel within the array will be in the shape of a rectangle. By doing so a set of programming code can then be created for a specific orientation.

The second assumption is that the IGT workers will have the specific type of batteries needed to be able to power the robot for the time needed to clean the panels.

The third assumption is that the customer will only use the designated cleaning solution of our specification to prevent damage to their system and ensure optimal intended robotic function.

Stakeholders: With the robot consisting of a design that will operate autonomously, a variety of stakeholders could arise. Below is a list of present stakeholders of this design,

- Project Manager: Dr. Simon Foo
- Sponsor: David Arnold
- Electrical Engineering Functional Manager: Dr. Oscar Chuy
- Mechanical Engineering Functional Manager: Dr. Shayne McConomy
- Residential, Commercial, and Industrial Photovoltaic Installers
- Photovoltaic Customers

Once the design undergoes extensive testing and minor modifications, the product will then be released to the stakeholders below.

- Commercial Photovoltaic Installers
- Foreign Photovoltaic Installers

Code of Conduct

Mission Statement: Effectively collaborate with a multidisciplinary team of Computer, Electrical, and Mechanical engineers to create an environment where each member feels comfortable voicing opinions and concerns. Each member will contribute to maintaining a productive and safe work environment that promotes innovation.

Team Members

Electrical Engineers

Edward Corlett - Software Engineer

Supervise the programming aspect of the design. Using experience with Robot Operating System and Python programming to ensure that the design is developed as efficiently and effectively as possible. Furthermore, responsible for ensuring team members are up to date on necessary tasks, and to delegate and assist software development tasks.

Kristen Pepper - Electrical Mechatronic Engineer

Responsible for design of the hardware components on the system. Ensuring that the system is reliable and efficient. Also ensuring that the hardware design fits the customers' needs effectively. Responsible for keeping the meeting minutes documented.

David Sailor - Systems Test Engineer

Ensure the design performs at optimal levels that are suitable and align with consumer's needs. Conduct inspections and troubleshoot potential discrepancies that alter the operation of the design. Implement measurement tools to gather pivotal information about the design and its overall function.

Justin Green – Power Engineer

Responsible for the design of the power to the system. Making sure the device is sufficient to use and operate on the solar arrays. Also assisting on the hardware devices to ensure they are getting the correct amount of power and working

correctly. Will also work on the overall design that combines the mechanical and electrical components.

Mechanical Engineers

Caterina Arnold - Mechanical Mechatronic Engineer

Overlap between electrical and mechanical aspects to allow for proper integration of all electronics with moving parts such as motors. Design physical apparatus to ensure proper autonomous movement and motor functions.

Tanner Buis - Mechanical Controls Engineer

Design of all controllers to ensure inputs to the device will have the proper, desired outcome. Using mathematics to describe how a system will act depending on the input. Create simulations of devices to perceive shortcomings and areas of improvement with design.

All Team Members

- Work on certain tasks of the project when assigned
- Come with a positive attitude to meetings and a willingness to get things done
- Listen and contribute constructively
- Be open mined to others ideas
- Work together as a team, understanding the mechanical and electrical sides
- Respect others engineering roles and ideas
- Ask for help or feedback when unsure or stuck

Communication: The group's main form of day-to-day communication will be an iMessage group chat for the most immediate response and for notifications about any uploads of necessary documents. The primary form of communication for record keeping and document management will be the Team 303 Basecamp application. Basecamp will be updated with the current schedule and all working and completed documents throughout the duration of the project.

Another part of communication and collaboration is though GitKraken which holds the code for the project. This is where the team will work and collaborate about the code all in the same place.

Attendance Policy: There is a regular meeting in person that will occur every Thursday after the ME senior design (typically 5 PM). If this meeting cannot be attended there must be at least one days notice to the attending members. If in person meetings are not attended on a regular basis by an individual, conflict resolution steps will be taken after 3 consecutive meetings. Where the conflict resolution will include involving the T.A. or the professor if necessary.

Team Dynamics: The group will work in a collaborative manner putting forth maximum allowable effort according to capabilities. The group and each of its members will be open to constructive criticism without inhibiting the creative process for the individual or group. If members feel that team dynamics are not being met for them, conflict resolution steps will begin to be taken by the member or associated members.

Ethics: Team members will be familiar with and abide by the Engineering ethics standards within the college of engineering as well as the ethics of the sponsor company Raa Tech, and will follow these ethical guidelines.

Dress Code: The team dress code for meeting with advisors, sponsors, or any invested individuals other than just the 6 students on the team will be business casual unless otherwise specified and agreed upon by the group. For team general weekly meetings as well as senior design class there is no designated dress code for the team.

Weekly Tasks: The only weekly task allotted to the team is attendance to the weekly meeting on Thursday where all other recurring and large scale tasks will be discussed and divided between the students.

Decision Making: Decisions will be made as an entire group in the fashion of "majority rules" and voting, individual aspects of the project will be checked by another team member. If a decision cannot be made due to a split decision, the first course of action is to involve a third party member with no weight in the decision. The presentation of the decision will be given in a way that does not give weight to one or the other of the decisions in question.

Conflict Resolution:

In the event of conflict between team members the following steps will be taken:

1. Contact team member face to face and discuss issue
2. Group meeting/discussion to try to resolve problem
3. Involve T.A to give insight on conflict and resolution
4. Involve professor if necessary

Statement of Understanding:

By signing this document the members of Team 303 agree to all of the above and will abide by the code of conduct set forth and agreed upon by the group.

Name	Signature	Date
Caterina Arnold	Caterina M Arnold	09/16/2021
Tanner Bays		09/16/2021
Kristen Pepper		09/16/2021
Edward Corlett		9/16/21
David Sailor		9/16/2021
Justin Green		9/16/2021