**Multidisciplinary Senior Design Project**

**GE 497**

**College of Engineering**

**Valparaiso University**

**Valparaiso, Indiana**



**System Design Requirements**

**for**

**Filament Recycling**

**Filament Recycling Squad**

**Date: August 30, 2020**

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**Honor Code Statement**

I have neither given or received, nor have I tolerated other’s use of unauthorized aid.

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**Goal Statement**

The open-source filament recycler is a machine that will take ground up plastic and melt it down to extrude it into a usable filament for a 3-D printer to be used as an educational tool for school age children.

**Objectives**

In order to achieve success, the system shall:

1. Be able to move to various locations
2. Have a User Interface to control the system
3. Meet OSHA safety requirements
4. Have documentation for open source
5. Be tested to find optimal settings for different plastics

**System Requirements**

1. Electrical Systems
   1. The system shall be able to use an input between 95-125 VAC or 195-255 VAC at 60Hz.
2. Mechanical System
   1. The system shall fit in a cuboid with dimensions of 82 inches by 50 inches by 46 inches.
   2. The system shall have an in-house sensor to measure the output filament diameter.
3. Filament
   1. The barrel nozzle shall maintain a temperature accuracy of ± 2.5 degrees Celsius from the set value.
   2. The output filament diameter shall be 1.75 ± 0.05 mm.
   3. The filament shall be extruded onto a nominally 1 kg spool.
   4. The system shall accept shredded plastic with no dimension exceeding 7 mm.
   5. The system shall be capable of extrusion at a rate of at least 0.2 kg per hour.
4. Safety

4.1. The system shall cut off power within 1 second of using the emergency stop.

4.2. The system’s mechanical components shall stop within 5 seconds of using the emergency stop.

4.3. The system shall be built such that external surfaces that can be touched will not exceed temperatures of 49 degrees Celsius.

4.4. Any opening of the system shall comply with Table O-10 of OSHA 29 CFR 1910.217(c)(2)(i)(a) and 1910.217(c)(2)(i)(b).

1. User Interface
   1. The system shall maintain storage specified settings even after power loss.
   2. The system shall allow for manual temperature control between 130 and 180 degrees Celsius.
   3. The system shall allow for manual flow rate control between 0.1 kg and 0.2 kg per hour.
   4. The system shall display the current temperatures of the nozzle.
2. Budget
   1. The budget shall not exceed $5,000.
3. Documentation
   1. A bill of materials shall be included in the documentation.
   2. Mechanical drawings shall be included in the documentation.
   3. Electrical schematics shall be included in the documentation.
   4. Wiring diagrams shall be included in the documentation.
   5. Source code shall be included in the documentation.

The estimated cost of meeting the above requirements will be $2000.

1. Reach goals:
   1. For an additional $30 a scale shall be implemented to measure the amount of filament on the spool. The total weight of filament will be displayed on the user interface.
   2. For an additional $20 a distance control option shall be added to the control module. This will allow the control panel to be moved up to 15 feet away from the print but still attached with a cord .
   3. For an additional $20 the hopper size shall be able to hold 1 kg of shredded filament.
   4. Laser Micrometer at exit to determine filament diameter at an additional price of $1500. This will provide the current diameter of the output filament on the user interface in place of the in-house sensor specified in 2.2.