3D Printer Recycler

(Filament Recycler)

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Summary of Hardware Review

Hardware review is the work of each group member in this project. It gives the student a chance to discuss with his professor and reviewing how the project will work in the future. Every student in this group is assigned a task in this project. These parts will be assembled together after finishing tasks in order to recycle the plastic without facing any issue in a Filament recycler project.

Melting PLA Plastic: (Nawaf Mohammed)

Plastic is an important element in this project and without it, the project will not work. Also, one of the requirements for this project is to melting the PLA plastic at a specific temperature with a specific time. Melting the PLA plastic at 215 celsius was the decision of each group member because of the range of the PLA plastic starts from 180 celsius to 220 degrees celsius. Also, the period of the melting should be from 30-35 minutes.

Buying the PLA plastic from Cline Library was the first step for melting the plastic. After buying the PLA plastic, we destroyed and smashed the plastic by a hammer because the team could not turn on the shredder and the coupler arrived before one day from the hardware reviewing day. Also, the second reason for damaging the plastic by hammer is the motor of shredder did not work until now. After damaging the plastic, we put the plastic in the container for putting it inside the oven. The temperature of the oven was 420 in Fahrenheit.

$$420\ F = 215.5\ C$$

The temperature of the oven was 420 in Fahrenheit which is equal 215.5 in celsius. After 30 minutes, the PLA plastic became melted inside the oven. In addition, the viscosity of the plastic appeared. 10 minutes was the time that the plastic became cool or normal plastic like the first time.

Figure 1: The melting plastic after heating it inside the oven in 215.5 celsius.

Wiring the motors: (Khaled Alkhaled)

Our team figured out how to connect the wall socket wires to a motor and power up both motors that were purchased by our team for the shredder and extruder. We have researched the matter and found that the motors come with a helpful diagram that shows how to power it up correctly. The diagram can be found below.

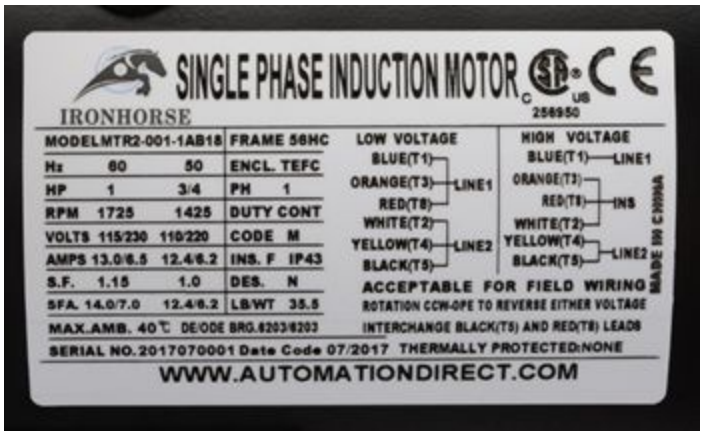

Figure 2: the diagram of motor

Furthermore, the diagram shows that the motor can be powered up on low or high voltage depending on the supplied power. For the purposes of the shredder, we will wire the motor on low voltage. Our motor at low voltage will produce ¾ of a horsepower rated at and RPM of 1425 and at the high voltage, the motor will produce 1 horsepower rated at and RPM of 1725. The diagram also illustrates which of the leads on the low voltage that should be connected which are (T1, T3, T8) to LINE 1 and (T2, T4, T5) to LINE 2. LINE 1 and LINE 2 are the black and white wires that are supplied from any wall socket. Before connecting the wires to the wall socket, we will need an open wiring power cord, a toggle switch to control the motor, and a wire nut to connect the wires together. The needed parts are shown below.

Figure 3: Wiring power cord, a toggle switch to control the motor, and a wire nut

By wiring up the motor accordingly, our team was able to power up the motor to the desired horsepower and RPM.

Extruder Pipe: (Hasan Alhendyani)

The extruder almost depends on the pipe so that the pipe can hold the heat produced from the extruder. So we were looking for a steel pipe. As we noticed that there should be no space between the shaft and the pipe so that the plastic will not stick to the pipe. The diameter of the shaft is 3/4 so we found a steel pipe that is 3/4 S40, but we found that the inner diameter is not appropriate and the shaft will not exactly fit inside the pipe. So we decided to try this pipe so that we can change it after if it doesn't work since the space between the pipe and the shaft is really small. The pipe cost us 10$

Figure 4: Black Steel Pipe

Shredder Shaft (Mohammd Alnajrani):

The shaft is one of the essential elements in our project. In our project, we needed two shafts one for the shredder and one for the extruder in order to make it fully functional. My first task was to find out the size and design for the shaft. I came up with several designs for the shaft, and after the weekly meeting that I had with my professor Dr. Trevas, I decided to use the hexagonal shape for the shredder shaft because the hexagonal shaft was more appropriate design for the blades. The second task was to find a way to attach the shredder with the motor by using the shaft as a connective between them. Our first idea was a bad one to weld them together which was not efficient because we would not be able to do further adjustments. Then I came up with the idea of using a coupler between them. I found the size required for the coupler which was (⅝ x ¾) shown in fig.5. And eventually, I was able to assemble the two parts together and to do further adjustments as needed.

Figure 5: The coupler attached between the shredder and the motor

Connecting the electrical components of the extruder (Abdul Alsulaiteen):

My task is to figure out how to connect the electric components of the extruder which are the heater bands, thermostats, and the relays. I have been discussing the issues I'm facing in my part of the project with my professor Dr. Trevas on a weekly basis. The first issue is do we need a relay? The previous team used a relay to connect the thermostat to the heater band, so I did some researching about the uses of a relay and I found that the main use of the relay is to connect a low voltage electrical circuit to a high voltage electrical circuits. Another use of the relay in the industry is to protect electrical components in a circuit and this type of relay is called protective

relays. Most likely, we will not need to use a relay in our circuit since we don't need to connect a high voltage and low voltage circuits together nor we need protection to expensive electrical components. Since relays are very cheap, we have purchased two relays just in case further researching showed that we do need to use a relay in our circuit. In this case, we need to find an answer to another question which is do we need multiple relays for every heater band or can we connect multiple heater bands to one relay?

A second task I have is to draw a schematic drawing of the electrical wiring between our components. The schematic drawing will give us a clear picture of the purpose of each wire in our circuit. Since we have already purchased all the electrical parts, connecting them together shouldn't take a long time. Therefore, after finding a definite answer about the relays, I will draw a schematic of the wiring and then I will connect the components together.

List of Action Items for each person to reach Hardware Review 2 :

After finishing the discussion, every member of this group knew how to work with his task for the future and the tasks are:

Nawaf: My next vision is to shred the plastic inside the shredder because the motor of the shredder needs a speed controller to control the speed of the shredder while cutting and shred the PLA plastic. Helping the team for operating the extruder which is considering one of the important processes to melt the PLA plastic when the plastic passes through the shaft to be melted by the heater. The most important point is knowing the best dimensions and size of the plastic like the length and the width because last time the width of the plastic was six inches and it should be less than six inches. The final step is focusing on how the group will organize the melting plastic after exiting from the extruder and it might be after the second hardware review.

Khaled: My action item for our next staff meeting is to find a compatible variable frequency controller for both motors in order for us to have the ability to control the speed at which the motor operates at. Controlling the speed of the motors will help with controlling the output of both the shredder and extruder.

Abdul: My next task is to find out whether we need a relay in our circuit or not. Then, I will draw a schematic of the electrical wiring between the extruder components. After that, I will connect the components together and by that, the electrical part of the extruder will be ready for use.

Hasan: So the next step is to make a square spot in the pipe so the plastic can go through it. Also, we need to make a base that connects the pipe with the motor for the extruder. Furthermore, if the pipe doesn't work we will need to find another pipe with a smaller inner diameter and reamed it so that the shaft can fit in.

Mohammed: My future task is to find out the size of the coupler that we will use in the extruder to make it fit perfectly with the other motor, and to find speed controllers for both motors in order to reduce the speed and able to adjust them as needed. Lastly I have to figure out a way to connect the speed controllers with the motors.