ECE 2800

‘Not’ a Lightsaber Written Report

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1. Project Definition

1.1 Background

The idea of our project was to bring life to something that a person wants to own, but didn't think they would be able to own. In doing this, we hope to bring dreams to reality for every consumer of our product. One idea we thought of is a real life version of a lightsaber from the famous movie series STAR WARS. That is when we started our product called *not a Lightsaber*. We wanted to create a product that people were able to afford, while also allowing us to make a profit. Some other factors we considered were safety of the consumer as well as longevity of our product. While doing our research, we found that there has only been one version of a lightsaber made on YouTube. This version used a plasma torch that was fueled by oxygen and propane in a connected tank, but it has not been sold commercially and was just created for the video.

1.2 Objectives

Before the design stage, we took some time to figure out what our objectives were in creating this product. Our lightsaber is being sold commercially in stores and online, so our intention is that this product is recreational use. Fans of the movies will be able to live out their dream of owning and wielding a lightsaber after purchasing our product. In buying our product, the consumer will easily be able to power and use the lightsaber in any way that they choose. One of our main objectives was to make sure that the average consumer would be safe while using it. The only dangerous part of our product is the actual saber that is created from gas. This can get very hot and will easily burn any object in its path. We assume that our product will land into the right hands and that all consumers will take safety precautions for themselves.

1.3 Specifications/Constraints

In order for our product to be successful, there are some important qualities that we must achieve. If the lightsaber isn't hot enough to melt everything, then it essentially is not doing its job. Most elements have a melting point that is feasible for our product [1], but we also need to make sure that it doesn't melt itself. Another important factor is the price of our product, if nobody can afford it, there will not be as many people buying it and in turn less money being made.

When tackling an idea like this there are clearly some objects in our path of success. Without the technology in the movies, it isn't possible to replicate the lightsaber without a power source.[2] Another problem is creating a power source that allows for the right temperature, but is also portable or able to be worn. We want the customer to enjoy using our product, and having one that is uncomfortable and awkward will result in a bad experience.

2. Methodology

2.1 Feasibility Analysis

With such a new and revolutionary technology there are many different approaches to this design. In its most basic sense, we are taking an already existing technology in the plasma cutting torch and reinventing it to have many more purposes. There are many ways to attack this but for a first of its kind product we want to make it in the most approachable way possible. So, from the beginning we wanted to make our product around the same size as its popular inspiration, the lightsaber. Currently plasma cutters are mostly table mounted CNC style cutters far from our desired end goal. This leaves us with many avenues to go down. Our first decision we must make is our fuel for powering this tool. Most of these torches run on compressed nitrogen or argon. This is one challenge that faced us shrinking the size of those gasses to be handheld and safe. One option always was an external tank, but we did not want to have to compromise. We looked further into the matter and came up with compressing the gas further to its liquid state.

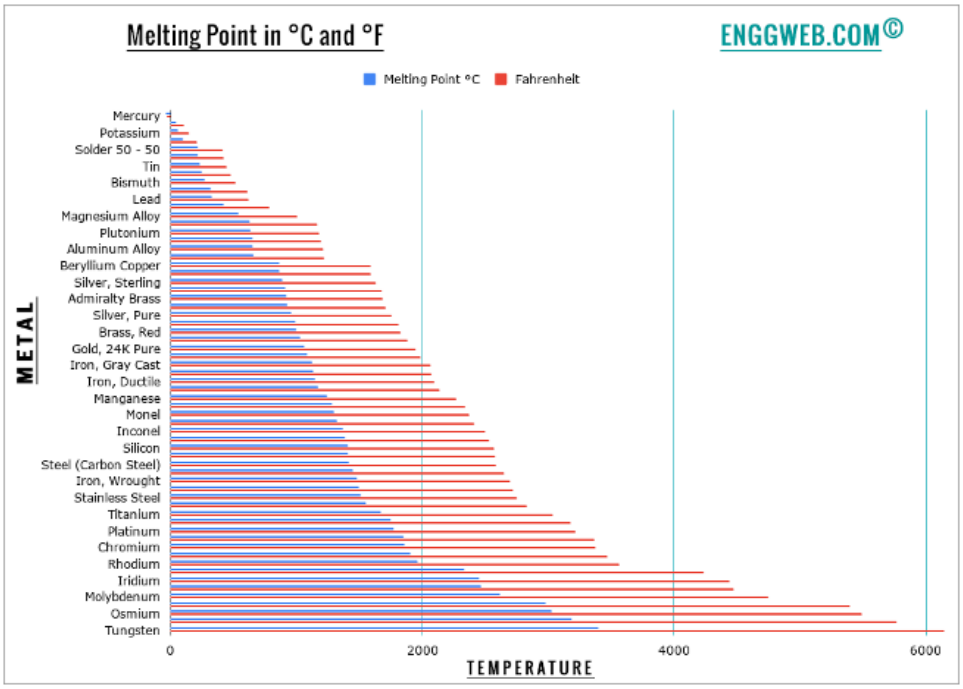
The other two big challenges that we face is providing enough power into the charged electrode. To create plasma, we need a lot of charge to the gas [3]. There are many ways to store and deliver power. We thought about doing just one battery but in our form factor we would not be able to get enough amperage out of it. This pointed us more toward a multi-battery design.

The final big challenge for this product is the nozzle at the end and how it will channel the plasma. Standard plasma cutting torches have one small to keep the gas at as high of a pressure as possible. This is a good idea but isn't just one hole a bottleneck. With the very high pressure we are running our system at, we just have one larger hole that feeds to many others to have a thicker more powerful stream of plasma.

2.2 Proposed Approach

Task 1 Body

To start our design, we are going to need an outside case to hold all the internal components. One limitation for us is the amount of heat that is generated from the plasma. With this we have narrowed our choice down. With its weak thermal conductivity and high melting point we decided to make the casing out of stainless steel.

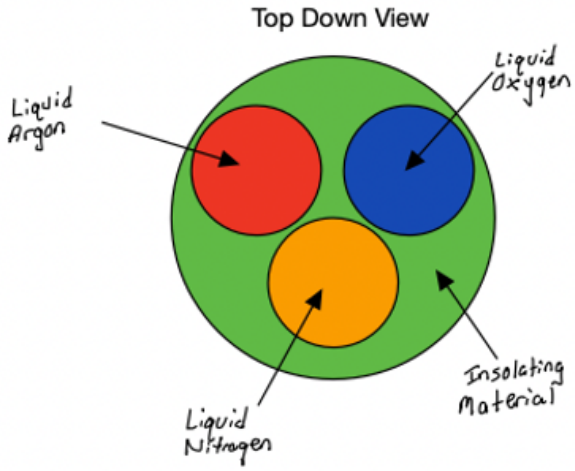


Task 2 Gas subsystem

With our choice of using 3 different gasses in our lightsaber that complicates the cold side of our system more. The plan is to have 3 separate cylinders of the liquid form of the gas in the bottom of the lightsaber. This will allow us to have a door at the bottom of the saber for easy changing of the gasses when you run out. Since these are in liquid state they are stored at very cold temperatures. Our goal for this system is for it to be completely passively cooled. This allows us to have more room for our hot side of the system meaning a better overall system. This passive cryocooler will not focus on making the tanks colder but just holding in that cold with the most efficiency. There will also be safety release valves in the system in case of an overpressure event.

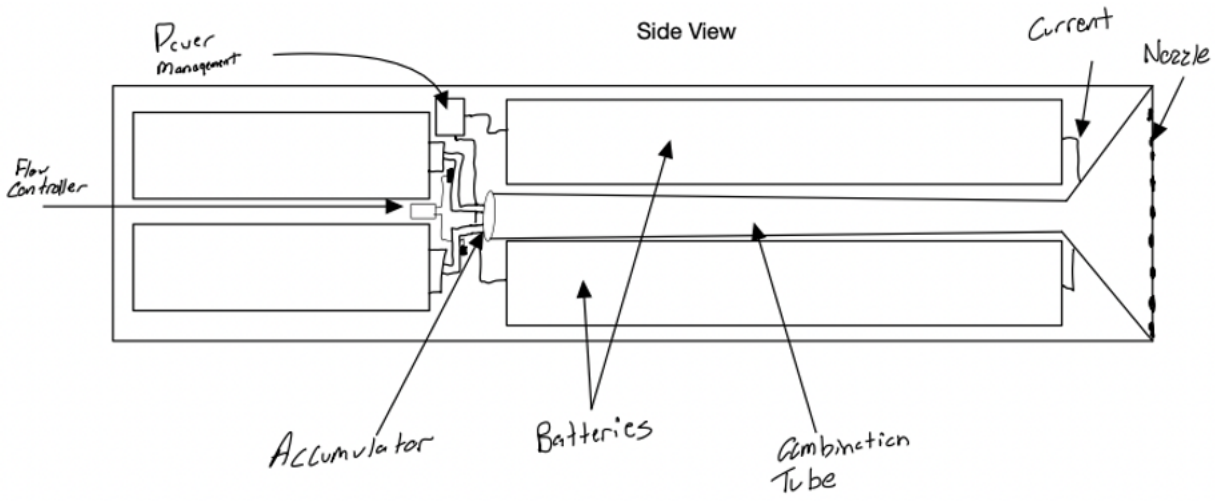
The three gasses that we have decided on are oxygen, nitrogen, and argon. Nitrogen will be our main fuel with additions of oxygen to increase the burn and transition to a plasma. The argon is mixed in as a shielding agent to protect the internals of the system and control the flow of the gasses. [4]

The mixing of these gasses will be handled by our logic board built in. In the future our plan is to be able to not just have those fuels but be able to select any fuel for different uses.



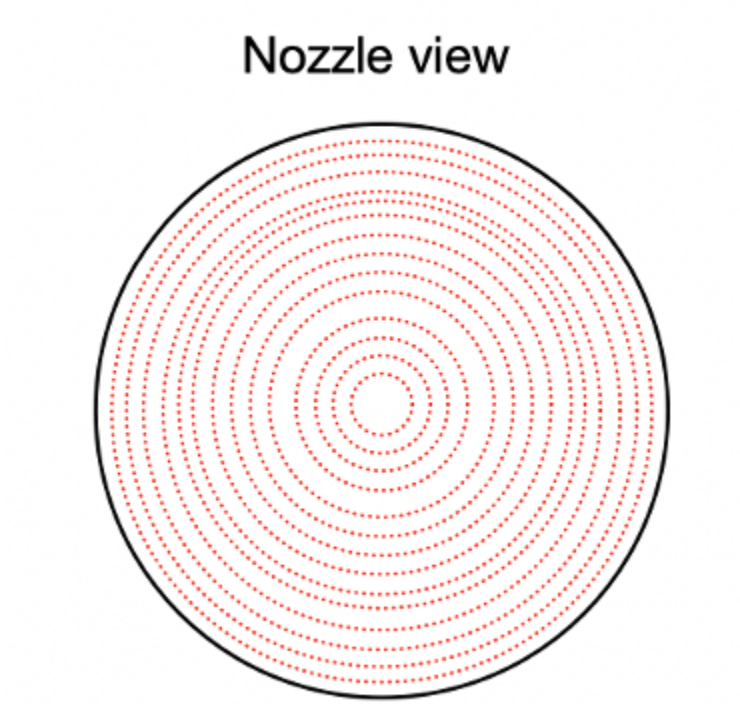
Task 3 Power subsystem

The power subsystem or hot side of the lightsaber is simple. After the gasses are combined in the right proportions it goes down a long tube right in the middle of the saber. This tube swirls and slowly gets smaller and smaller, increasing the speed and pressure of the gas. This tube separates the two batteries that are contained in the case. These 12-volt 20 amp batteries will be wired in parallel to increase our amperage. These batteries are connected to our power management unit which then feeds that power to wherever it is needed. Our final part of this system is the coil at the end of the main combination tube. This coil is almost like a carburetor in that it provides the spark and the area for the gasses to change its plasma before coming out of the nozzle.



Task 4 Nozzle

The final section that our plasma travels through before it reaches the outside air. This is our newly designed nozzle. Normal plasma torches only have one hole at the end for the plasma to get out. They must do this because they do not have as much pressure as us. In our design we have hundreds of tiny holes almost like a shower head. But it is like a shower head with the strongest pressure you have ever seen. After the spark and transformation to plasma loses some of its pressure. These tiny holes are the only way out, so the nozzle acts like a second pressure chamber before release. This gives us a long tube of plasma that is very similar to our inspiration.



2.3 Non-technical Aspects

This product is the first of its kind so there are a lot of unknowns. We understand that it could be used as a weapon but that is not its primary purpose. This type of product will need approval from most countries before being able to sell. That could slow us down some, but we believe that safety should be number one so we do not think that will be an issue. There could be some environmental and societal impacts from our product. It is creating a very hot material from its end so if not used correctly it could start fires or be used in an attack. We hope this will be mitigated from proper training videos that we will provide and a public safety campaign from our marketing team. We understand that there are a lot of ethical challenges too when it comes to making products. Our goal is to use 100 percent recycled steel and materials for batteries in our products.

3. Administration

3.1 Major Tasks

For our proposal there are really five crucial tasks in order for our company to be successful. The first task is to hire individuals who are dedicated to progressing ‘not’ a Lightsaber. There are of course many different sectors in which we need to hire employees, Table 1 shows the different roles needed for our company. The three main roles the company needs to focus on are research, business administration, and marketing. There are of course other smaller roles that will need to be filled such as assistants.

Table 1: Key Hires

Research/Scientist	Business Administration	Marketing
We need the brightest minds to be able to develop the best technology for our product	Business Administration is vital to delicate funds properly and securing the best deals for our company	A large part of our business model will be to create a huge marketing buzz around our product before we hit the market.

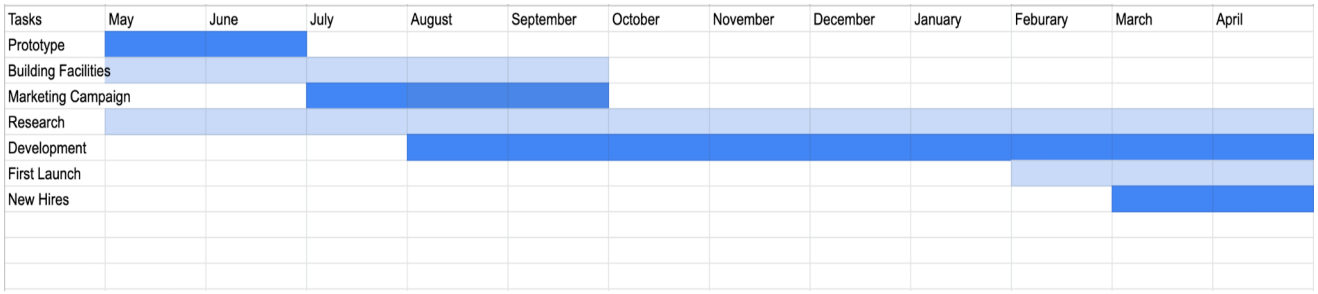
Research and engineering is of course the next major task once we have hired our personnel and spent money on the necessary equipment and space. Since we want our product to be the best it possibly can be, we want to spend lots of money from funding on creating new prototypes and versions of our lightsaber. It is vital to create the best product for our customers, and to do that we need to dedicate many of our resources to research and development.

The last crucial task we must do is focus on marketing our product. Marketing was one of the three key hires for our company as we want there to be lots of hype and “buzz” around our lightsaber months before we hit the market. This is a key aspect in making the public eager to buy our product. A good marketing strategy and personnel to accomplish this is vital for our company.

3.2 Schedule

Shown below in Figure 1 is our tentative schedule for our first year after funding. The most important aspect from this chart is that we plan to have our first launch to the public within the first year of funding. The first two months we plan on having our first working prototype, we then plan on allocating lots of time for development and research of new designs and technology we could use for our lightsaber. We also plan on dedicating three months towards the beginning for our marketing campaign to get the public excited about our product. Towards the start of our first launch, we also plan on sizing up. This includes hiring a lot more people so our company can continue to grow.

Figure 1: Tentative Schedule



3.3 Budget

For our company we are looking for $300 million in funding, this will be put towards four main components that will lead our company to a successful first year. Shown below in Table 3 is how we plan on spending the funding. The four components that we are going to spend our money on are: Salaries, Sales & Marketing, Manufacturing (including facilities), and Research.

Table 3: Budget

Employee Salaries	Expect to hire 60-70 employees, around 25% of budget	~$75,000,000
Sales & Marketing	Expected to be 25% of budget	~$75,000,000
Manufacturing	Includes facilities, discussed in Table 2, expected to be 30% of budget	~$90,000,000 - $100,000,000
Research	Expected to be 20% of budget	~$60,000,000

3.4 Facilities and Resources

We need to focus on building facilities & resources for our product to be developed and researched. We are planning on dedicating $100 million dollars to this sector and we believe that with the best resources, our product will be great quality. Table 2 breaks down how the money will be spent on facilities & resources.

Table 2: Facilities & Resources Cost Breakdown

Headquarters	$20,000,000
Engineering Space	$70,000,000
Manufacturing	$10,000,000
Total Spent	$100,000,000

Looking back at the section of major tasks, key hires were the most important first step for our company. Those key hires and the money spent on our facilities are all to insure our products will be top quality and we will have our product ready within the first year of funding.

4 References

[1] “Melting Points of Some Common Substances.” *h2g2*, 3 Feb. 2004, https://h2g2.com/entry/A2260063.

[2]“Lightsaber Components.” *JEDI HoloNet*, https://www.jediholo.net/archives/documents-2/lightsaber-components/.

[3]Valdes, Robert. “How Plasma Cutters Work.” *HowStuffWorks*, HowStuffWorks, 24 Mar. 2004, https://home.howstuffworks.com/plasma-cutter.htm.

[4]Fernández-Sánchez, María Luisa. “Plasma Torch.” *Plasma Torch - an Overview | ScienceDirect Topics*, https://www.sciencedirect.com/topics/chemistry/plasma-torch.