

Group 8 Design Project Proposal

Team Organization:

At the moment there is no designated team lead and tasks will be broken down evenly specific to specialization and availability.

The team along with each member's specialty is listed below:

1. Ryan Guo - Market Analyst
2. Francisco Madera - Solidworks/Modeling
3. Peter Pak - Software Development/Artist
4. John Smith - Project Manager

The Proposed Product Category or Categories:

1. Gaming Accessories

Gamers will pay high prices for just about anything that will separate their gaming setups from other people. Especially streamers that have a large audience and can act as free advertisement. Because of this, customizables are very popular in this industry. Options for customizable setups would include computer towers, headsets, mouses, and keyboards, among others. Within these groups of components, there are subcomponents that themselves can be customizable. A main product that is capable of having its needs met by additive manufacturing is keyboard caps which are essentially the keys of a keyboard that one presses. Currently on the market are differently colored key caps, decorated key caps, key caps that are a shape instead of the usual flat, and textured key caps. Because of the desire for customizability, there is not already a product where the customer can specify what they want on their key cap, only unique key caps that others have already made and sell themselves. Because of this, we can use additive manufacturing to print exactly what a customer wants on their key pad through a web interface.

2. Glasses

a. Customizable Frames

Additive manufacturing allows for the rapid production of customizable components. Glasses frames are made in a manner that is supposed to be for the general public of differently sized heads. Because of this, there is lots of variation in the fit of a given frame of glasses to an individual's head. By harnessing the advantage of additive manufacturing to make one off products, frames for glasses can be made that more closely fit the heads of those who wear glasses compared to the fixed sizes that are currently offered.

b. Glasses Accessories

One market that has not been created or infiltrated yet is accessorizing for glasses. Many people feel the need to add accessories to things that they use everyday such as cars, backpacks, rings, and many other aspects of people's possessions. However, the only customization that is currently available for glasses is color selection from the manufacturer of the glasses frame. Some accessories that are viable options for additive and glasses are form accessories such as jewelry; similar to earrings, or functional accessories such as earphone adapters that may convert regular earphones into bone conduction headphones. Exploring functional accessories may be more beneficial for product development because more people may be willing to buy something new if it doesn't feel gimmicky like non-functional accessories.

3. Redesigning Drones

The hobbyist drone is an increasingly popular recreational product. Currently, there are many different types of drones, specifically quadcopters that exist in the marketplace of all shapes, sizes, and payloads. One problem with performance is excess weight that slows down a drone or limits its ability to carry a better camera or sensors. The excess weight comes from the manufacturing process that is currently employed for these drones which is typically injection molding. By employing topology optimization on structural parts, it allows for weight reduction and increased rigidity by getting rid of excess material and redistributing loads to even it across the bulk of the entire material. Instead of designing a new drone with this methodology, we can redesign existing drones based on motor size and location, center of mass, hardware foot size, and boundary of the body, an algorithm can be made which optimizes the topology in an existing software and makes a structure that can only be made via additive manufacturing that is more efficient than the stock drone.

The Status of the Competition:

1. Keyboard Caps

a. Market

- i. Average costs for handmade custom keyboard caps are north of \$40. Our starting price point is an estimated \$5 which includes the material cost and machine time.
- ii. Currently the mechanical keyboard and therefore custom keycap market is growing rapidly[5].
- iii. Since this is a luxury item market with small volume due to customization, users are willing to pay high prices. Keycaps are an accessory to an already luxury item used by people with disposable income such as programmers or gamers.

b. Customizability:

- i. Allow customers to customize design via a website, and easily print that model.
- ii. Current competition for 3d printed keycaps does exist but it is mostly non-customizable/with poor properties. These non-customizable keycaps typically cost about 10\$+[4]
- iii. Keyboard caps can be easily injection molded, but because of the customizability we offer, it would be cost ineffective to machine a mold for every different design submitted by customers.
- iv. This is where 3D printing comes in. There is no initial cost to make a mold. Simply upload the CAD file and print the key cap.

2. Glasses Frames

a. Competition

There are currently not many companies that use AM for glasses frames despite the popularity of the product.[3] This is probably due to the current widespread success of traditional manufacturing in producing cheap and varied glasses frames. This could also be due to glasses being fairly easily adjustable.

b. Cost

Currently, glasses are manufactured in mass via injection molding. The cost of assembling an entire frame of glasses can be as low as \$10 for prescription quality frames that people wear every day. This cost includes the cost of assembly and shipping so the cost of just the plastic parts may be even cheaper.

3. Redesigning Drones

a. Cost

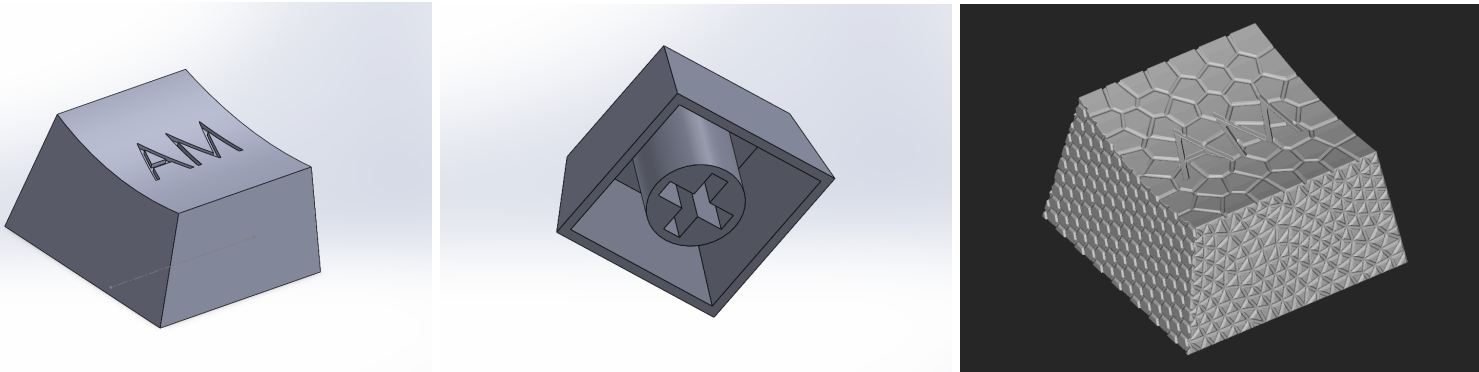
The cost of high end designer drones on the market are upwards of \$1,000 as on top of the base features, many accessories and features can be added on. Our starting point is within this range as it should provide enough margin to compensate for the manufacturing time and low volume of the product.

b. Competition

From a search of the companies there are not many consumer products which advertise additively manufactured topology optimized drones. This is possibly due to the fact that fabrication through traditional methods such as injection molding is far more effective for simple mass production drones.

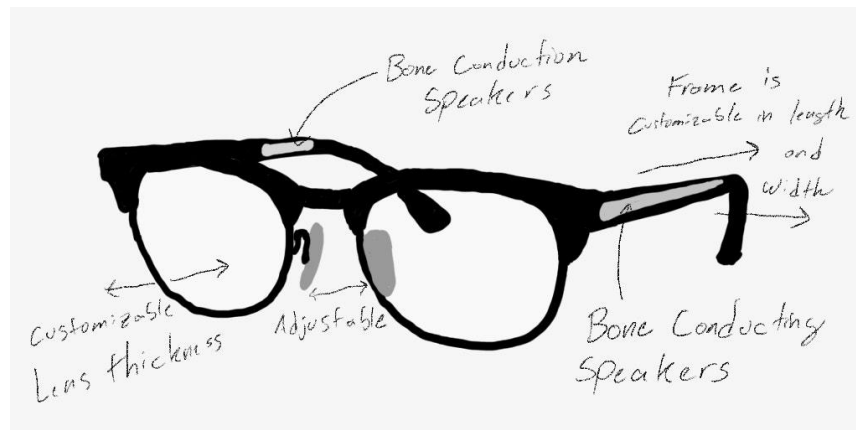
First Design Concepts:

1. Keyboard Caps



We propose a method where users would be able to submit images or 3d models, select size, colors, and texturing, then have their choices printed and sent to them. We want to compete in this space by reducing cost and improving customizability. The bottom surface would be a cross shape which is what most keyboards use. Additional customizability includes concave top surface for ergonomics, surface textures on sides of the key caps, and wording on the top.

2. Glasses Frames



Glasses are a common commodity and fit issues could be solved with DLP additive manufacturing. Frames could be made with specifications to fit the user, like nose pad size, width, temple length, and temple tips angle. These would allow a user's preferred glasses frame design to fit their head better than ones that need to be adjusted manually.

3. Redesigning Drones



The example shown above is a sketch of a proposed topology optimized drone that can be fabricated using FDM additive manufacturing. The preliminary sketch shows what the drone may look like if it were topology optimized. Note the body shows a truss-like structure which is a signature of topology optimization and it is not a shape that can be manufactured efficiently through traditional manufacturing methods which makes it a prime candidate for the application of additive manufacturing.

First Print:



We chose the key cap as our first print and used the SLA FormLabs printer to do so. For this we printed two different samples within the same print and ended up with one that resembles our intended product. Unfortunately, one of the prints failed and the other print was significantly smaller to adequately fit on the keyboard. Next time the dimensions of the keycap will be properly measured with a caliper and sliced in an appropriate orientation to print in a manner that doesn't compromise the final product.

References:

[3] <https://all3dp.com/2/3d-printed-glasses-eyewear-eyeglasses/>

[4] <https://www.shapeways.com/marketplace?type=product&q=keycap>

[5]

<https://www.prnewswire.com/news-releases/mechanical-keyboard-market-47-of-growth-to-originate-from-apac--by-sales-channel-offline-and-online-and-geography--market-size-share-opportunities-and-trends---forecasts-from-2021-to-2026-301508177.html>