**GNG2101 Project Deliverable D**

**Universal Mask Fitting**

Detailed Design, Prototype 1 and Bill of Materials (BOM)

Submitted by

GNG 2101-D01, D2

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**Abstract**

The objective of this report is to outline the design concept chosen and the results of the first prototype constructed. Furthermore, a bill of materials (BOM) will be provided. After our most recent client meeting, where all design concepts were presented, the final concept chosen was a hybrid of a magnetic and silicone attachment system. A first prototype was hand constructed with minimal silicone and small strips of silicone. The prototype was then tested on ones face as well as the head of a Styrofoam model. The prototype proved to have potential and further testing will be executed to perfect the model. A detailed design concept will be provided further on in this report. The critical product assumption that was made about this product and which still requires testing is the proper sealing of the mask to one's face. Silicone sealant options will be explored, tested, and evaluated.

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1. **Introduction**

The prior report outlined the specific functions and subsystems of the product in the form of a functional decomposition, all the ideas that had been generated during brainstorming and the decision matrix and sketches to determine the most feasible solution. In the first report the client needs and wants, a problem statement, a set of metrics and target specifications were generated in order to be able to best satisfy the client's needs while creating the product. This report has a focus on reflecting on the feedback from the last client meeting and interpreting it to improve the design and develop the first prototype to test the critical assumption of the product.

The product being designed has the goal of increasing the visibility of the user while wearing a mask, the low visibility is due to accumulated condensation on glasses, which makes navigating the pandemic situation difficult for glasses wearers. In order to best solve the problem and satisfy the client’s needs a solution has been designed and will now be tested and improved to meet the client’s needs.

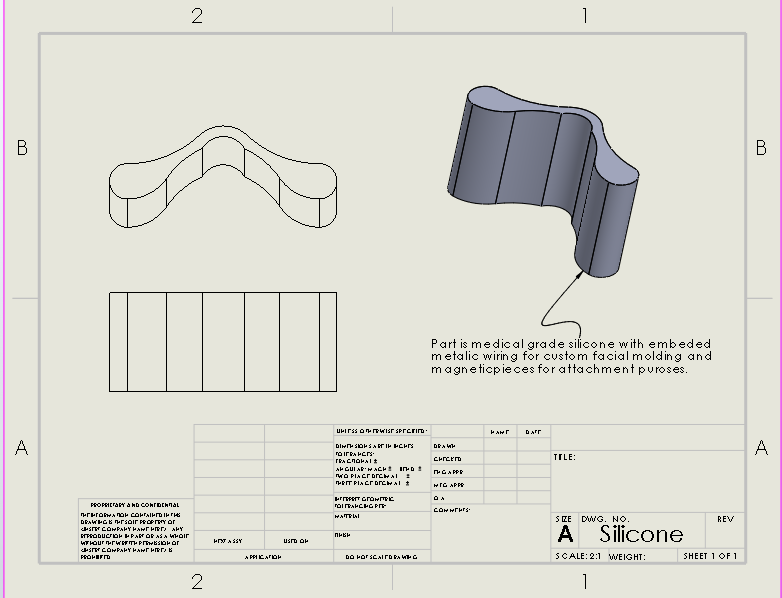
First, the client meeting was reflected on in order to take the given feedback into consideration to improve the design. Then a detailed design was created to clearly outline the different parts and subsystems of the product and how it would function. Thirdly, the critical assumption was identified as the statement to test when prototyping and the first prototype was developed. Finally, a bill or materials was created (BOM) and the information to be gathered and presented in the next client meeting was outlined.

1. **Client Meeting**

During the client meeting the team discussed top four product concepts with Mark Templeton. These concepts were the goggles concept, the magnetic paint concept, the silicone aluminum concept and the magnetic apparatus concept. A discussion was had about the infeasibility of the googles concept as manufacturing it in the time frame with the budget given would be difficult. The magnetic paint was received well however, he had concerns about the functionality of the product given that it had multiple steps and would not be efficient for short-term wearing such as running to the grocery store. As this was one of the main tasks performed by the potential product users this concept will not be further explored. The silicone aluminum concept was also well received, the idea of a barrier that adhered to the skin to prevent fogging was approved of however, he did not like the idea of the wider stirp (as it would have decreased mouldability to the face) and the small attachment clips and suggested a smaller wire inside and an outside piece to attach the apparatus to the mask instead. Finally, the magnetic apparatus was presented. This concept was also well received as he liked the concept of having two pieces, one inside the mask one outside, however, he was not sure if simply closing the mask would be enough to prevent glasses from fogging. This led to the presentation of the hybrid idea between the silicone aluminum concept and the magnetic apparatus concept. This concept included the silicon concept as the piece under the mask with wither metal or magnets attached to the outside and a piece that would fit over the mask with magnets (oppositely charged) to adhere the mask to the piece underneath. He enjoyed this idea as it had something adhered to the face with a barrier to prevent fogging and a piece to hold the mask to the apparatus to ensure there was no gapping for air to pass through.

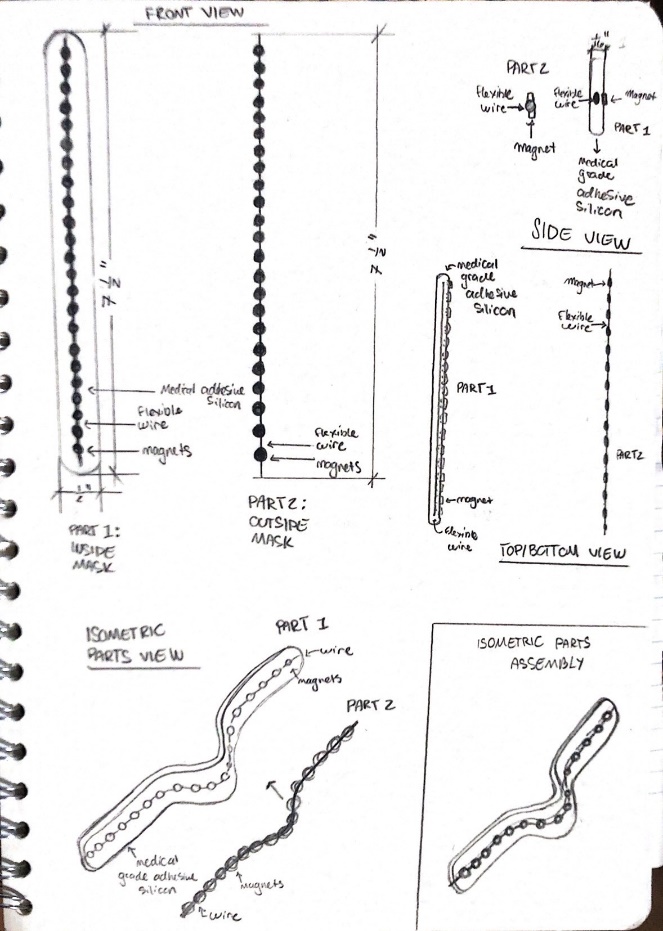
1. **Detailed Designs**

In this section the two aspects of the hybrid design will be presented. Firstly, the silicone design consists of multiple small metallic wires that can deform elastically embedded in a silicone mold. The silicone mold will take an oval shape.



**Figure 1:** Silicone mold

Second, the magnetic design consists of metallic pieces which attach to the silicone mold. These magnetic pieces may be in the shape of a long thin strip or take the shape of small thin cylinders. This set of magnets can either be glued on top of the silicone mold or be directly embedded into the mold itself.



**Figure 2:** Detailed design, different views of potential product

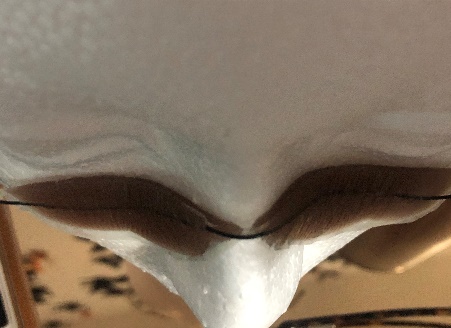
To employ the design, consumers will first place the silicone/magnetic mold over their nose and cheeks. Next a mask of the consumers choice will be placed over their face. Finally, the second set of magnets will be placed over the mask to secure the seal between mask and silicone/magnetic mold.

1. **Critical Product Assumptions**

A critical product assumption is that all the pieces of the apparatus will stick together properly without having any gaps for air and moisture to form on the users’ glasses. This assumption was important as if all materials do not stick to the face and mold to the face properly the product would not achieve its goal of keeping the user’s glasses from fogging. This critical assumption was tested in the first prototype because if the materials did not adhere and all the pieces could not properly fit together then the product would not be able to achieve its goals and the team would have to go back to generating solutions step of the design process cycle.

1. **Prototypes**

The first prototype was created to test the critical assumption. Based on the detailed designs produced for each part/subsystem the overall fit and seals between the components were tested and evaluated in the first prototype. The first prototype was also designed in order to better communicate the concept of the design to the client. During the client meeting it had been difficult for the client to clearly visualize the concept, creating this first prototype would assist in communicating the proposed solution to the client



**Figure 3:** Views of the first part/subsystem in the prototype

The prototype was first used to test the adhesiveness of the silicone adhesive, this was first tested on the skin of the group member then it was placed on a Styrofoam dummy to continue the testing process. The silicone proved to adhere to the face perfectly with no gaps, this would therefore create a good seal to prevent fogging once the mask was seamlessly attached to this piece. The silicone piece also included a wire inside to keep it molded to the face shape.



**Figure 4:** Views of the overall prototype and part two

The second portion that was tested was the use of the magnets to stick the mask together. This is an example of alpha testing, meaning it is testing occurs within the group. This concept was being tested for functionality. Due to limited materials the test was mainly to see if the magnetic layers would stick together and hold the mask and all other pieces securely in place. As seen in the figures above this prototype was successful in modeling these functions.

1. **Bill of Materials (BOM)**

The bill of materials (BOM) was created in order to determine the cost of developing the product and to ensure that the team remains on budget. In the BOM the materials were identified as well as the base cost and any additional cots such as tax and shipping and handling.

**Table 1:** Bill of materials

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Material | Cost | Additional Costs | Use in Design | Link to Material |
| Medical Grade Adhesive Silicon | $16.99 | Shipping (free over $35 shipped by amazon)  Tax (13%) $2.21 | To prevent fogging and stick to face (silicon layer) | [Amazon.ca](https://www.amazon.ca/PHCOMRICH-Silicone-Pads%EF%BC%8CResuable-D%C3%A9collet%C3%A9-Wrinkles/dp/B07X3RTL1C/ref=pd_bxgy_img_2/145-1165422-2854850?_encoding=UTF8&pd_rd_i=B07X3RTL1C&pd_rd_r=aae53307-3b97-4690-aed1-a87bfdf0f708&pd_rd_w=cCdGl&pd_rd_wg=JY9Bq&pf_rd_p=42339929-297e-4141-b7b2-fe55db70f4b7&pf_rd_r=3DHH957ZAMY3GF2X847A&psc=1&refRID=3DHH957ZAMY3GF2X847A)  Two pack |
| Magnets | $14.99 (150 small round)  $16.99 (Strip) | Tax free shipping over $35  Tax & Shipping (Free over 35) | To stick bottom piece to top piece and hold mask | [Amazon.ca](https://www.amazon.ca/Deryun-120pack-Refrigerators-Whiteboard-Miniature/dp/B085Y6P3CR/ref=sr_1_28?crid=1SRPDO9SIX4MD&dchild=1&keywords=strong+small+magnets&qid=1612665791&sprefix=strong+sma%2Caps%2C359&sr=8-28)  [Amazon.ca](https://www.amazon.ca/Magcifly-Magnetic-Adhesive-Projects-Perfect/dp/B07JHKJMFJ/ref=sr_1_13?crid=1V2P3QUVYSNEX&dchild=1&keywords=strong+magnetic+tape&qid=1612538175&sprefix=strong+magnetic+%2Caps%2C199&sr=8-13) |
| Metal Wire | $1.75 (Craft wire) | Tax (13%) $0.16 | To help silicon hold its form and form to users face shape | Dollarama  Pack of many (approximately 50?) |
| Hot Glue Sticks | $3.97 | Tax (13%) $0.52 | To attach and secure magnets to silicone and metal wire | Walmart  Pack of 30 |

The BOM was also used to determine which materials would be most suited to the budget. In the table there were some materials such as the magnets that would be at a different price point depending on the product. Outlining both the materials would allow for the best choice to be made to be budget friendly but also to develop the best product to resolve the problem statement.

1. **Information to be Gathered**

The second client meeting helped ensure the team was on the right track with respect to fulfilling the client’s needs correctly. As mentioned before, the visualization of the product and how all the components would work together requires further clarity. In the next meeting the team will be able show a prototype of the concept to the client. By showing the prototype, the client will be able to see and get a better understanding of what the final product will look like and how it will function. Once it is presented to the client, the team will be able to fully gage what the client’s thoughts are with the reassurance that there are no miscommunications due to lack of concept clarity. The bill of materials will be shown to the client to ensure that they approve of the materials being used to create the product. It is important to ensure that the client is comfortable with everything being used and they do not have any concerns regarding the materials.

1. **Conclusion**

The client meeting allowed the team to show the client the ideas that had been generated, get feedback and determine the best course of action for the development of the concept with the highest feasibility. His preferred concept was the silicon aluminum and magnetic apparatus hybrid. Using the information gained in the client meeting the team began exploring the selected concept and further analyzing the idea. It is noted that the critical assumption of the product is that all the pieces will stick together, ensuring the apparatus forms a proper seal with no gaps where moisture or warm air can escape and fog the user’s glasses. A prototype was then generated using the detailed design. The prototype was used to test the product’s ability to properly adhere to a face, which it was able to do, as well as testing the strength of the magnets. The detailed design gave a good idea of what would be needed to create the product, which aided in the development of the bill of materials. The bill of materials includes, medical grade silicone, two different types of magnets and metal wire. In the next client meeting the group will present the prototype as well as the bill of materials. The prototype will help clarify and further the client’s understanding of the product. And the team will look for any feedback or comments the client may have with respect to the prototype, bill of materials or the project as a whole.