**Universal Mask Fitting**

Client feedback, second prototype development sketches and testing

Submitted by

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**Abstract**

The objective of this report is to outline the discussions that occurred in the third team meeting with our client Mark concerning the mask fitting project in the course GNG 2101. In this previous meeting, the first prototype was presented to the client. Mark enjoyed the first prototype. He suggested we continue along our current path and continue to improve the product. Mark presented our team with a few recommendations for future prototypes and the final product which will be outlined in this report. After the client meeting a second prototype was constructed and physically tested. Results of the testing will be explained in detail further on in this report.

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1. **Introduction**

The prior report outlined the final design and development of the product based on the feedback acquired in the second client meeting. This led to a prototype being developed to test the overall concept of the product and whether the silicone would adhere to the face effectively. Previously a decision matrix was created after brainstorming to development the most feasible solution and sketch it. 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 developing the product. This report will reflect upon the feedback received by the client concerning the first prototype created. We will further elaborate on the development of the second prototype.

The product being designed has the goal of increasing the visibility of the user while wearing a mask, the low visibility is due to an accumulation of condensation on glasses due to respiration. This 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.

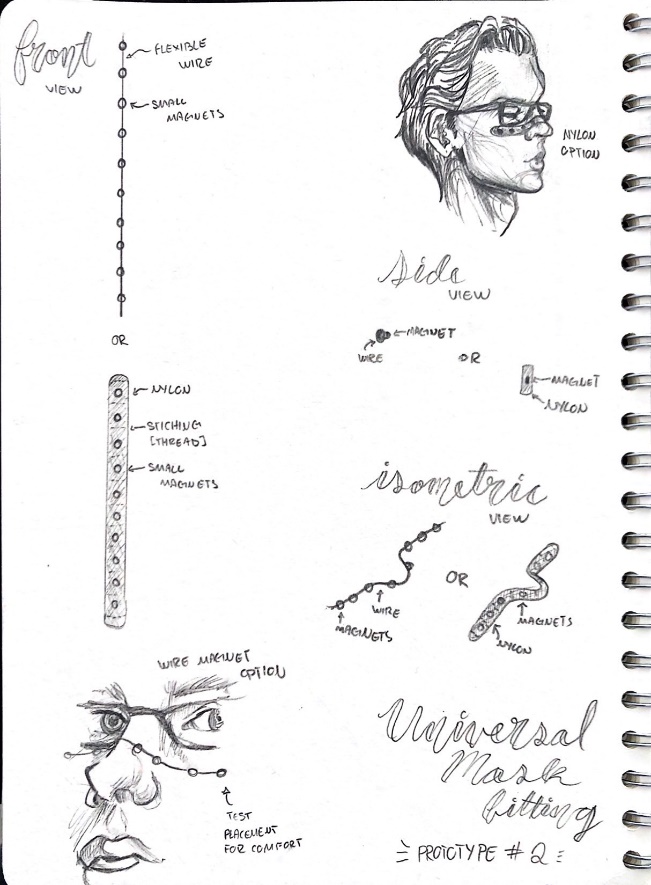
1. **Summarize Feedback**

During the third client meeting the first prototype to test the general assembly and adhesivity of the medical grade adhesive silicone to the face was presented. The progress of the second prototype and the plans for the third prototype were also discussed. When viewing the first prototype the client was able to understand the concept of the prototype as well as see that the silicone did in fact adhere to the face which would in turn prevent fogging. The client also enjoyed that the washability of the silicone adhesive had been tested and a simple wash with soap and water lead to the ability for it to be reused multiple times.

After the discussion of the first prototype the second prototype was discussed. The second prototype focused on the top piece of the mask fitting apparatus, testing the positioning of the magnets and the seal created between the two parts. The client had a few concerns that should be kept into consideration when creating this prototype. The small magnets that were to be used are very powerful and if they click together too hard, they may potentially shatter. For this he recommended using a thin barrier between the magnets on the outside and the inside piece as the mask may not be enough to prevent breakage. His other concern was the metal wire being used on the outside piece. He explained that when adding magnets to the piece of magnetic metal the more that we add the greater the magnetic field, this would cause tension between the magnets and potentially increase the chance of the magnets breaking apart from the outside apparatus. The client suggested that instead of the flexible wire the use of a plastic or a flexible nylon and sew the magnets in to reduce the field but still remain able to fit and shape to the user's face. Finally, the client also proposed that we explore the ability to resize the product, such as cutting the wire or nylon on the top piece. This would affect the magnet placement on the top part of the apparatus.

The sketches and development of the second prototype were altered to reflect the client’s suggestions and improve the product to better meet his needs wants and resolve the problem statement.

1. **Second Prototype**  
   1. **Sketches and Function**



**Figure 1:** Detailed Sketch of Second Prototype Options



**Figure 2:** View of the first part/subsystem applied



**Figure 3:** Full view of the prototype

* 1. **Testing the Critical Assumption**

The second prototype was created in order to test the product’s ability to prevent the air from escaping out the top of the mask. The sketches created for the design as well as the feedback received during the client meeting, were used to generate this prototype. This prototype includes an adhesive medical grade silicon pieces that is applied to the face to form a seal. Attached to the silicon is metal wiring. The second piece to the prototype includes a strip of fabric with magnets attached. The metal wire located on the first piece is attracted to the magnets from the second piece, attaching the two pieces together with the mask held in between. One of the members of the team wore the prototype for over an hour while wearing glasses (alpha testing). The prototype was tested indoors as well as outside (-8°C). Outdoor testing was used in addition to the indoor testing as colder temperatures increase the chance of condensation. This would then test the limits of the product and permit the team to determine weak points that could then be corrected. Furthermore, multiple mask types were tested in order to determine overall efficiency.

* 1. **Analysis an Evaluation**

The testing of the second prototype was a success. The adhesive stayed properly for the entire duration of the testing period, as found in the first prototype. Once both parts were properly in place, no fog accumulated on the glasses. The prototype worked best on a disposable and thinner reusable cloth masks. One drawback found was that when the prototype is used on thicker reusable cloth masks the connection between the two parts felt weaker. This could be a problem if there is a lot of movement done by the user. The group will continue working on creating a more secure feeling product that will be fully functional even when the user is moving around quite a bit. The product still worked successfully but that is a part of the design that will be further investigated. A second problem found with the second prototype was the adhesive used to secure the magnets and wire. The gorilla glue used caused slight discomfort to the eyes when the prototype was first applied to the face. The team is looking into an alternative to the gorilla glue adhesive. Although there were issues found the main focus of this prototype was to ensure limited to no fogging of glasses when wearing a mask, which was found to be true. The group will continue to improve the design in order to fix the weaknesses found for the next prototype and the final product.

**Table 1:** Prototype compared to target specifications

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Metric #** | **Metric Name** | **Importance** | **Unit** | **Acceptable value** | **Ideal value** | **Prototype two Given value** |
| **1** | Comfort of product on face | 1 | Qualitative, scale of 1-5 (5 being most comfortable) | 4 | 5 | 4.5 |
| **2** | Adjustability to all faces | 2 | Qualitative, scale of 1-5 (5 being able to fit all face sizes) | 3 | 5 | 5 |
| **3** | Level of visibility | 1 | Qualitative, scale of 1-5 (5 being no fog) | 4 | 5 | 5 |
| **4** | Safety to style ratio | 4 | Qualitative, ratio scale of 1-5 (5 being best and 1 being worst) | 4/1 | 4/3 | 4/1 |
| **5** | Cost | 2 | Dollars | <$15 | <$10 | N/A |
| **6** | Weight | 3 | Grams | <8g | <5g | N/A |
| **7** | Washability | 3 | Qualitative, scale of 1-5 (5 being able to wash with soap and water, 1 being unable to wash) | 3 | 5 | 4 |
| **8** | Compatible with all mask types | 3 | Binary | yes | yes | yes |

1. **Conclusion**

In conclusion, our client was very pleased with our initial prototype. His suggestions for improvement were taken into account and applied to the second prototype. The second prototype exceeded testing expectations. Minimal to no fogging accumulated on the test subjects' glasses. However, it was determined that the strength of the magnet adhesion seemed to diminish for masks that were thicker. This aspect of the design will be further investigated with the intention of improving the mask fitting. In the next couple of weeks, the team will attempt to improve the magnetic adhesion as well as broaden the testing scope. In other words, multiple prototypes will be given to friends and family who will be instructed to wear the product for a minimum of 4 hours at work. They will then be asked to fill out a survey and their feedback will be analyzed.