8-7-2023

Glass: The Augmented Reality Glass Blowing Assistant

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RIT

Glass: The Augmented Reality Glass Blowing Assistant

By

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Visual Communication Design

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Rochester Institute of Technology
Rochester, NY
August 7, 2023

Committee Approval

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Abstract

Many people desire to learn a new skill or craft, but having access to a mentor available to provide one on one feedback can be expensive or inaccessible to many. Learning a new skill can bring meaning and added value to a person's life. Glasses explores bridging the physical and digital world through augmented reality tools that assist in the hand making of products and the learning of a new craft. Though Glasses specifically focuses on glass blowing, the concept could just as easily be applied to any form of craftsmanship such as woodworking, metalsmithing or welding. The product helps inform users of the best way to move in 3D space to create their desired form. Additionally, they can view a model projected onto the material they're working to better understand and reference the form they're trying to create. It is easy to use, and relatively hands free featuring a simple, customizable physical interface. Having direct feedback from an expert is often the best way to learn a new skill, Glasses is the next closest thing for those without one. Glasses is a full product line, featuring a physical set of safety glasses and the software to go along with them.

Keywords

Augmented Reality
Glass Blowing
Mixed Reality

Introduction

Glass blowing, or really any form of craftsmanship can take years to master. Even at a high level critical mistakes can be easily made. The rate of error can be significantly reduced with an assistant or mentor present to be an outside source of perspective or information. Often when actively working, minor details can be lost in the flurry of action.

Glass (the augmented reality glass blowing assistant) expedites the challenging process of learning to work with hot glass for beginners, and makes masters more effective by displaying critical information and suggestions to the user through the use of augmented reality. After interviews with both students and master glass blowers, a system for assisting crafts people at any level develop their desired outcome was developed. While the primary focus of this product is to provide assistance to glass blowers, the same concepts can be applied to any medium.

Glass: The Augmented Reality Glass Blowing Assistant

To give context to the product's development, research was conducted by interviewing experts in the field of glass blowing from Corning Museum of Glass and RIT. First Hand experience with the medium of glass blowing was also critical in understanding the context of the problem and developing a meaningful solution.

Corning Museum of glass captivates people of all ages with their incredible hot glass program. They've brought this to a global audience by backing the show "Blown Away" available to stream on Netflix. Over the summer of 2022, the Vignelli Center offered a summer workshop in partnership with Corning. Gaining access to this event was critical in the development of this project. Some of the world's best glass blowers partnered with innovative designers to develop unique forms and push the medium of glass in directions it hadn't yet taken in its long history.

The gaffers (master glass blowers) went back and forth between the piece they were creating, and a 3D printed model that was developed for them to reference. Because glass is such a time sensitive medium, they would often have to reheat after a check of dimensions, causing further temperature strain on the glass, and increasing the likelihood of a break. Observing this somewhat flawed process was the catalyst for this project. If forms could be projected and critical information like temperature could be shown on the end of the punty (the rod glass blowers use to help shape glass) through the use of augmented reality, critical errors in production could be significantly reduced. This would lower material costs for glass producers, save gaffers time, and significantly expedite the complicated process of learning to blow glass in the first place.

Every gaffer, and most crafts people, wear some form of eye protection to protect themselves from the possibility of exploding glass. For this reason, it would be of no real inconvenience for them to integrate augmented reality into their workflow once the technology progresses far enough. With the space of mixed reality and augmented reality constantly evolving, this product could exist in the not too distant future, potentially revolutionizing the world of arts and crafts education, as well as production, democratizing the space.

Interviewing students and professors at RIT also helped significantly in the development of this product. Gaining insight from those actively involved in the process of education was critical in deciding how to properly build out a system.

Beyond secondhand experience, one of the most influential aspects of this concept's development was first hand experience with the medium. During grad school at Rochester Institute of Technology, the opportunity was presented to explore the medium of glass first hand with the help of professor David Schnuckel. Any time he was available to offer guidance throughout the process about time, temperature, rotational velocity, or tool angle, the piece would turn out significantly better. As one person, it's impossible to be over the shoulder of eight students all at once, which also helped develop this project and its potential functionality.

Glass combines augmented reality with a physical interface to provide helpful visual feedback while not distracting the user from the form they're creating. Glass blowing is an all consuming medium, requiring every ounce of attention the artist has to offer. Any distractions can be detrimental, so both the physical and digital interface had to be kept to a minimum.

Using a digital interface to turn on and off specific functions while working hot glass would be far too distracting as anything that takes attention away from the piece could result in the loss of form. For this reason, a physical interface which can be custom programmed by the user was created for quick function switching. "Toggle All" responds to the user's action and displays the most critical information to their current state. The rest of the four buttons can be programmed to a custom set of visual feedback, temperature, tool suggestion, and more which will be explored later in this paper

Glass blowers always wear safety glasses to prevent glass from exploding into their eyes. A custom pair was developed with a very circular form for this product to carry the theme of the ring throughout the brand. The ring itself was used throughout the product as a thematic form inspired by the constant rotation of the punty.

The world of augmented reality and mixed reality is in a constantly evolving state. With Meta spending billions in the space, and Apple having recently launched their first spatial computing product, the field and product standards are rapidly evolving. Glass looks to many of these current standards in spatial computing, and seeks to push them further by communicating proper movement in the real world environment. The following are key features of the product that assist in the glass blowing process, or any form of craft that requires a specific movement through space with the goal of creating a specific final form.

Overall Temperature

Knowing the overall temperature of the piece of glass is critical in knowing when it's safe to change its form and when you need to reheat it. Constant visual feedback is given to inform the user of the temperature of the form reducing the risk of glass explosion and the loss of potentially hours of work.

Regional temperature

In certain situations (torching, pipe cooling, etc), regional temperature is just as important. This is displayed in a semicircle differentiating it visually from the full circle that indicates overall temperature. If a certain area of the glass cools to rapidly, it can result in the entire piece popping off the end of the punty and shattering on the ground

Form

To reduce time measuring models with calipers, the form is projected onto the punty through a series of rings. The inner white circle indicates the dimensions that were input, while the outer circle indicates the temperature of the specific region and whether or not it's safe to change its form/needs a reheat. This indicates a rough wireframe of the form the user is trying to create, as well as regional temperature, while not distracting from the product itself.

Grab Tool

In the hot shop, it's best practice to set up your tools in the same orientation each time. This makes grabbing the tool you're looking for becomes second nature. Being that this tool is targeted at masters and beginners, a "Grab Tool" assist function can be turned on to help new users more quickly identify what they'll need for the next step, expediting the learning process. In this scene you can also see the time remaining with the overall temperature monitor.

Angle

As previously stated using the correct tool angle throughout the glass working process is critical. The colored axis informs which direction the user is off. The smaller circles on the colored line show how far they're off, and respond to the current position. The small center circle indicates the depth in which the tool needs to be inserted into the form.

Conclusion

With a customizable physical interface providing pertinent visual feedback, Glass reduces the error rate for master glass blowers, and expedites the learning process for beginners. Additionally, it utilizes a consistent form language throughout the product to consistently and efficiently communicate critical concepts and develop a unique brand identity.

The world of augmented reality is constantly evolving, and design will play a critical role in its development. Ensuring that it will be useful not just in a digital world, but to facilitate learning and development in the real world is crucial. It’s a powerful tool that could quickly enhance the learning experience of everyone on earth.

Appendix A
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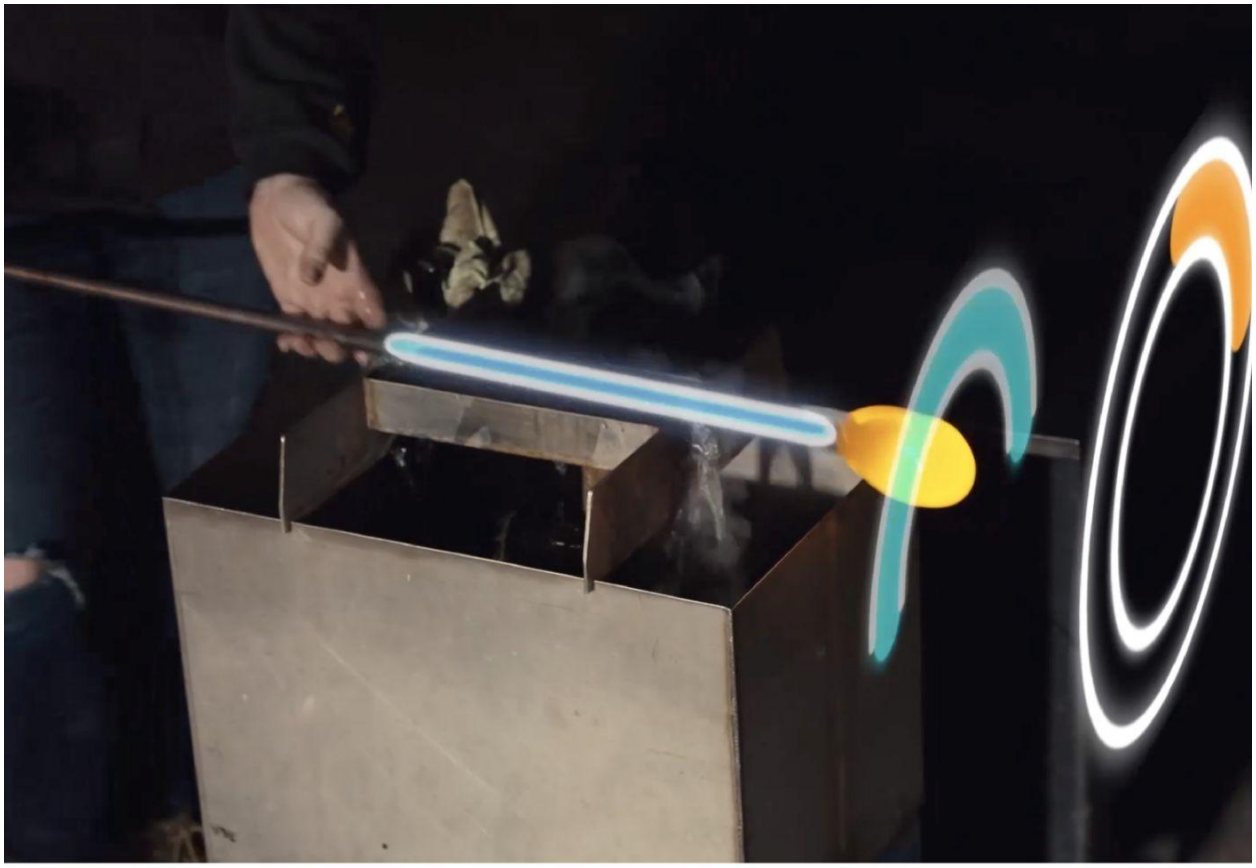
Appendix B
Semplice Project Page

https://designed.cad.rit.edu/vcdthesis/project/john-bechtold



Glass

An AR Glass Blowing Assistant

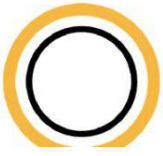
Glass expedites the challenging process of learning to work with hot glass for beginners, and makes masters more effective by displaying critical information and suggestions to the user through the use of augmented reality.

Problem

Glass blowing takes years to master, and even at a high level critical mistakes can be easily made.

Solution

Visual Feedback



Time

Working with hot glass is an extremely time sensitive practice. Too hot and you lose form, to cold and your glass could explode. This even happens to master glass blowers. Glass gives constant visual feedback on the temperature of the material to reduce errors.

Form

Currently, glass blowers go back and forth between prototypes and the piece they're creating with calipers to get accurate sizing. This wastes a significant amount of time and heat. This product takes a 3D model input, and projects it onto the end of the punty to save time and reduce failure rate.

Angle

Using the correct angle throughout the glass working process is critical. It's enormously helpful to have someone more experienced watching you work to help with this. One of the key functions of this product is a guide to help users get the perfect angle of their tool for the form they aim to create.

Features

Physical Meets Digital

Glass combines augmented reality with a physical interface to provide helpful visual feedback while not distracting the user from the form they're creating.

Glasses

Glass blowers always wear safety glasses to prevent glass from exploding into their eyes. A custom pair was developed with a very circular from for this project to carry the theme of the ring throughout the brand.

Physical Interface

Using a digital interface to turn on and off specific functions while working hot glass would be far too distracting as anything that takes attention away from the piece could result in the loss of form. For this reason, a physical interface which can be custom programmed by the user was created for quick function switching. Here they select "Toggle All" which responds to the users action and displays the most critical information to their current state.

Overall Temperature

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user of the temperature of the form reducing the risk of glass explosion and the loss of potentially hours of work.

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Grab Tool

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Thanks to:

Research

Internal & External

Reasearch was conducted by interviewing experts in the field of glass blowing from Corning Museum of Glass and RIT, as well as through personal experience with glass blowing.

Corning Museum of Glass
Vignelli Center for Design Studies
Rochester Institute of Technology
David Schnuckel

Corning Museum of Glass

I've been enamored with glass from a young age after visits to CMOG. Over the summer of 2022, I was fortunate enough to assist in a Vignelli Center summer workshop in partnership with Corning. Here I observed some of the world's best glass blowers doing their thing for three days.

After seeing them bounce back and forth from designer's 3D printed prototypes and the form they were creating, the idea for this project was sparked. They all wear protective glasses, so why not take advantage of AR to increase efficency? Forms could be projected onto the end of the punty, and critical information like temperature could be shown to reduce error rates.

Personal Experience

During my time in grad school, I was able to explore the medium of glass first hand with the help of professor David Schnuckel. I noticed that when he was giving me direct instruction as to the angle of the tool, temperature, etc., my work always turned out better. As one person, it's impossible to be over the shoulder of eight students all at once, which also helped inspire this project and its potential functionality.

Takeaways

Temperature, Form, Angle

From my personal experience and field research, I found the most critical pieces of information to creating a successful piece and reducing error are **temperature**, **form**, and **tool angle**.

Form Development

The Ring

Inspired by the rotation of the punty and blow pipe throughout the glass blowing process, the ring was used at a thematic form throughout the brand. Be it the logo, the glasses, or the interface (both physical and digital) the ring aims to unite the full product lineup and create cohesion throughout a number of products.

Conclusion

AR Glass Blowing Assistant

With a customizable physical interface providing pertinent visual feedback, Glass reduces the error rate for glass blowers, and expedites the learning process for beginners.

Thanks for stopping by!

Comittee:

Mike Strobert

Adam Smith

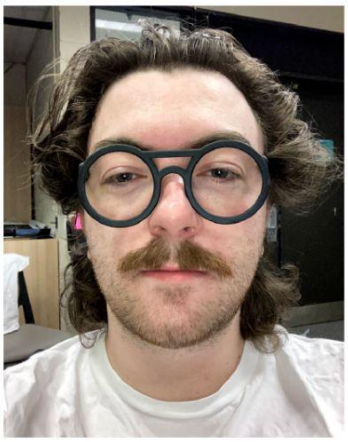
Tools Used:

Adobe Suite

Mocha

Davinci Resolve

Cinema 4D



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