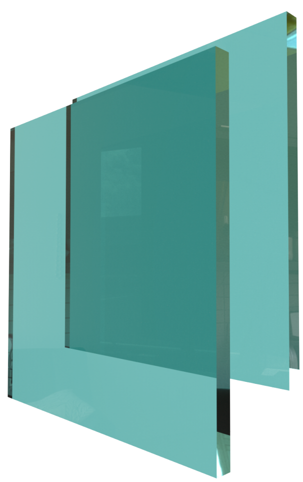
Department of Computer Science & Engineering
The University of Texas at Arlington

System Requirements Specification
CSE 4316: Senior Design I
Fall 2021



Senior Design Bois
Glass Interfaces

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Revision History

Revision	Date	Author(s)	Description
0.1	10.01.2015	GH	document creation
0.2	10.05.2015	AT, GH	complete draft
0.3	10.12.2015	AT, GH	release candidate 1
1.0	10.20.2015	AT, GH, CB	official release
1.1	10.31.2015	AL	added customer change requests
2.1	10.26.2021	LN, ZM, TN, NP	Add most pages for SRS
3.1	11.05.2021	LN, NP	Polish and complete initial SRS

Contents

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1 Product Concept

This section will outline the purposes, uses, and intended audiences for glass interfaces games. The glass interface games will be a proof-of-concept system. These glass interfaces games will reveal the extent of use-cases for business and architecture audiences.

1.1 Purpose and Use

There will be a few different games that will showcase the different types of interfaces that can be used with glass. The first two games in mind are a Simon Says and Flow Free. These two games will demonstrate fundamental interactions. In general, glass interfaces are not a specific component or product, but an extensible framework.

1.2 Intended Audience

The intended audiences are mainly for both business and architecture industries. Glass is a common material utilized in packaging, homes, buildings, and furniture making it relevant for those industries. By showing the extent and uses of glass interfaces, these industries will be able to integrate similar technologies in their own works. In short, glass interfaces are not a discrete product or component. It is intended to be extended.

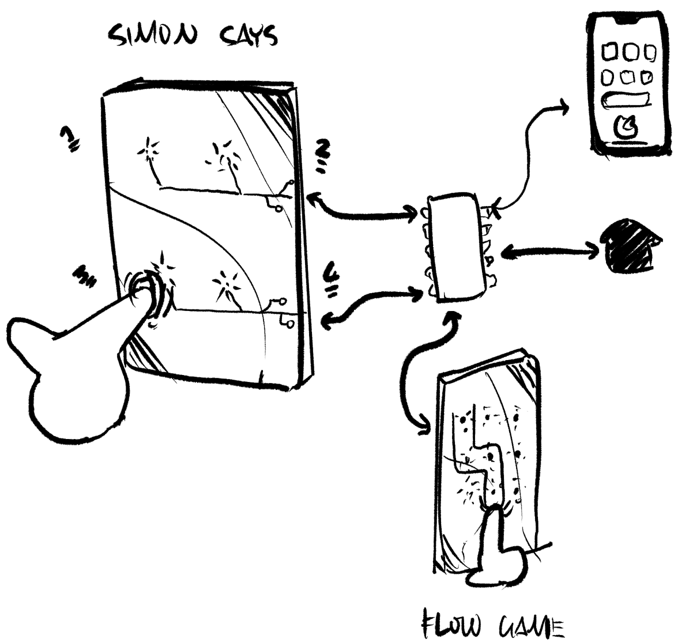

Figure 1: Glass interface games conceptual drawing

2 Product Description

This provides a general overview of Glass Interfaces. Each section below outlines, at a high level, the details of Glass Interfaces. These details are explored in multiple perspectives from stakeholders to users. Overall, the most important features, functions, interactions, and interfaces are described here.

2.1 Features & Functions

Glass interfaces will be two complete interactive games. Users will be able to play "Simon Says" [2] and "Flow" [1] on a flat glass vessel. Users should be able to press and drag across contacts. The system should react by lighting LEDs or signalling an IoT system or mobile app. The interaction system should match one-to-one with a digital counterpart for logging. More advanced applications of these games would include broadcasting inputs and outputs through a cloud websocket server.

2.2 External Inputs & Outputs

Type	Input Description	Output Description
User Touch	The user's touch will be an input for the system	Used to show the interactivity of the system
LEDs	The LED's will act as an output for the system based on the user touch	Used for aesthetic and interactive game purposes
Cloud websocket server	Broadcasting inputs and outputs of the games	Can be used to store different kinds of data about the system

Table 2: External Inputs and Outputs

2.3 Product Interfaces

The two interactive glass vessels will appear clean and transparent with electronic traces and components on top of it. Some of these electronic components can be sensed. The glass vessels will comprise of two sheets of glass with the electronics embedded in between. These traces will go to the edge of the glass vessel that will connect to an external microcontroller. The mobile user interface will likely follow a design system such as Antd.

3 Customer Requirements

Customer requirements are those required features and functions specified for and by the intended audience for this product. This section establishes, clearly and concisely, the "look and feel" of the product, what each potential end-user should expect the product do and/or not do. Each requirement specified in this section is associated with a specific customer need that will be satisfied. In general Customer Requirements are the directly observable features and functions of the product that will be encountered by its users. Requirements specified in this section are created with, and must not be changed without, specific agreement of the intended customer/user/sponsor.

3.1 The system will be touch-friendly

3.1.1 Description

To be interactive, touch gestures must be sensed with a visible reaction. These gestures are a low-hanging fruit in terms of input interactions. At a minimum, this must be supported otherwise there is no system.

3.1.2 Source

Long Nguyen

3.1.3 Priority

Critical

3.2 The glass interface games will respond with LED flashing

3.2.1 Description

Upon input, the games must flash LEDs to give a base layer of system response. LEDs indicate the status and state of the game. Without LED feedback as a starter, there is no feedback mechanism and hence there is no interactive system.

3.2.2 Source

Long Nguyen

3.2.3 Priority

Critical

3.3 The system will log and specify data from any interaction

3.3.1 Description

Businesses need to see how glass interactions will integrate in existing business systems. The data received from our glass interaction games will reveal where and how the specific glass interactions can be integrated.

3.3.2 Source

Long Nguyen

3.3.3 Priority

High

3.4 The system should be mountable and standalone

3.4.1 Description

People who are interested in architecture will be intrigued with the design of the circuit, as well as the simple interface that is created. Anyone who works with glass can now expand their horizons with glass interfaces by integrating the circuit with their own glass product.

3.4.2 Source

Zana Malacara

3.4.3 Priority

Moderate

3.5 The system will be clean

3.5.1 Description

The glass must remain, clean, transparent, and clear to serve as a functional enhancement on traditional glass planes. If it is dirty or marred by chemicals, it will not be aesthetically desirable to business and architectural audiences.

3.5.2 Source

Long Nguyen

3.5.3 Priority

High

3.6 Glass inputs will be broadcasted

3.6.1 Description

To illustrate the IoT or smart home use case, a websocket server can broadcast these inputs to other smart devices. Smart devices, webhooks, or other automations can leverage these websocket connections to integrate glass interfaces in existing systems.

3.6.2 Source

Long Nguyen

3.7 Constraints

Cloud servers may be used to scale these inputs reliably and internationally, but this is limited by long-term maintenence costs.

3.7.1 Priority

Low

3.8 The glass games will be configurable

3.8.1 Description

By integrating a mobile or web app into the system, it enhances the product's flexibility. Hybrid-interfaces build on the projects viability as an ambient and ubiquitous system.

3.8.2 Source

Long Nguyen

3.8.3 Priority

Low

3.9 The interfaces can be made on various glass vessel sizes

3.9.1 Description

If the system can only exist on a single, surface type, it may be hard to extend. If this system can be made on multiple surface sizes, it further increases its viability on large glass surfaces. This means traces should be fabricated at multiple glass vessel dimensions.

3.9.2 Source

Long Nguyen

3.9.3 Priority

Moderate

3.10 The interface is integrated on a sliding door

3.10.1 Description

If the Simon Game [2] is used as password authentication on a color-changing glass door, it illustrates the full breadth of an integrated glass circuit system. This is a requirement that would require much research, testing, and materials beyond the scope of the class.

3.10.2 Source

Long Nguyen

3.10.3 Priority

Future

4 Packaging Requirements

This section will provide an overview of how the product will be presented. It is important for the product to look clean, neat, and professional for the consumer and provider of the Glass Interface.

4.1 Power

4.1.1 Description

Since the system needs to be powered via battery's, it is important that the battery pack used, will not get in the way of aesthetics of the system. The battery's should not hinder the customer from using the product.

4.1.2 Source

Nathen Paul

4.1.3 Priority

Critical

4.2 Wiring

4.2.1 Description

The wires will be neatly soldered in such a way that they will not hinder the customer from using the product, i.e. there will be no exposed wires in the final product. This will allow for easy use and customer satisfaction.

4.2.2 Source

Zane Malacara

4.2.3 Priority

Critical

4.3 Mounting

4.3.1 Description

The microcontroller, and any sensors will be mounted in such a way that the product will look aesthetically pleasing and not hinder the customer from using the product.

4.3.2 Source

Long Nguyen

4.3.3 Priority

Critical

5 Performance Requirements

In every action-response of the system, there are no immediate delays. The average response time shall be 2 seconds or less in each 5-minute period beginning on the hour. Ninety-fine percent of all response times shall be less than 5 seconds. The device should last up to 30 hours on standing mode, and up to 3 hours when fully operated. Also, the device shall take less than 5 seconds to start up.

5.1 Battery Life

5.1.1 Description

The Glass Interfaces device is powered with Lithium ion battery, with the capacity of 2000 mAh. The device takes approximately 2 hours to fully charge.

5.1.2 Source

Intertek - Navigating the Regulatory Maze of Lithium Battery Safety

5.1.3 Constraints

The battery are expected to last a minimum of 2-3 years. A processor may take 0.5 seconds to complete task, and consume 50 mW. Power consumption of a 'sleeping' processor is a fraction of when it is awake: about 1 mW (0.001 Watts) versus 100 mW.

5.1.4 Standards

IEEE 1625 - Rechargeable Batteries for Multi-Cell Mobile Computing Devices.
JIS C8714 - Safety Tests for Portable Lithium-Ion Secondary Cells and Batteries for use in Portable Electronic Applications

5.1.5 Priority

Moderate

5.2 Response Time

5.2.1 Description

This specifies how fast the system should take to handle each individual request or operation.

5.2.2 Source

Nathen Paul using Jakob Nielsen's guidelines on Usability

5.2.3 Constraints

5 seconds - The maximum time a device shall take to start up.
0.1 second - Limit for users feeling that they are manipulating objects in the UI.
1 second - Limit for users feeling that they are freely navigating the command without having to unduly wait for the system's response.
10 seconds - Limits for users keeping their attention on the task.

5.2.4 Standards

IEEE 1394b-2002 - Standard for High Performance Serial Bus

5.2.5 Priority

High

6 Safety Requirements

This provides a general overview of the safety measurements taken while creating the Glass Interfaces and the procedures that are to be taken by both the creator and consumers, should the Glass Interface shatter in some way.

6.1 Shattered Glass Cleanup Procedure

6.1.1 Description

Shattered glass can cause lacerations and puncture wounds, which could sever arteries or tendons and result in eye injuries. According to OSHA, if the glass interface does shatter, the safest way to collect the glass is with cardboard, heavy paper, or a dustpan and brush. The broken glass should then be placed in a separate wastebasket, away from other garbage.

6.1.2 Source

Zane Malacara

6.1.3 Standards

Occupational Safety and Health Standards

6.1.4 Priority

Critical

6.2 Laboratory equipment lockout/tagout (LOTO) procedures

6.2.1 Description

Any fabrication equipment provided used in the development of the project shall be used in accordance with OSHA standard LOTO procedures. Locks and tags are installed on all equipment items that present use hazards, and ONLY the course instructor or designated teaching assistants may remove a lock. All locks will be immediately replaced once the equipment is no longer in use.

6.2.2 Source

CSE Senior Design laboratory policy

6.2.3 Constraints

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

6.2.4 Standards

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

6.2.5 Priority

Critical

6.3 National Electric Code (NEC) wiring compliance

6.3.1 Description

Any electrical wiring must be completed in compliance with all requirements specified in the National Electric Code. This includes wire runs, insulation, grounding, enclosures, over-current protection, and all other specifications.

6.3.2 Source

CSE Senior Design laboratory policy

6.3.3 Constraints

High voltage power sources, as defined in NFPA 70, will be avoided as much as possible in order to minimize potential hazards.

6.3.4 Standards

NFPA 70

6.3.5 Priority

Critical

6.4 RIA robotic manipulator safety standards

6.4.1 Description

Robotic manipulators, if used, will either housed in a compliant lockout cell with all required safety interlocks, or certified as a "collaborative" unit from the manufacturer.

6.4.2 Source

CSE Senior Design laboratory policy

6.4.3 Constraints

Collaborative robotic manipulators will be preferred over non-collaborative units in order to minimize potential hazards. Sourcing and use of any required safety interlock mechanisms will be the responsibility of the engineering team.

6.4.4 Standards

ANSI/RIA R15.06-2012 American National Standard for Industrial Robots and Robot Systems, RIA TR15.606-2016 Collaborative Robots

6.4.5 Priority

Critical

7 Maintenance & Support Requirements

The purpose of maintenance is to modify and update software application after delivery to correct faults and to improve performance. Also, the device has be to operated and used in certain ways to deliver the best result.

7.1 Hardware Maintenance

7.1.1 Description

Since the Glass Interface device is powered by Lithium-Ion battery, the device is recommended to be stored at 60°F when not used. The cells can be stored fully discharged, although the cell voltage should not drop below 2.0 for optimal safety. The maximum voltage should not exceed 4.1 volts. For any hardware maintenance or upgrade, the device must be sent back to the lab.

7.1.2 Source

U.S. Chemical Storage - How to Safely Store Lithium-Ion Batteries

7.1.3 Constraints

Storage Temperature	Charged to 40% - Capacity loss after a year	Charged to 100% - Capacity loss after a year
°C(77 °F)	40%	20%
40 °C(104 °F)	15%	35%
60 °C(140 °F)	25%	40%

The developers are in responsible for hardware maintenance. The company is not responsible for any hardware repairing operated by the user or outside the lab.

7.1.4 Standards

IEEE 1625 - Standard for Rechargeable Batteries for Multi-Cell Computing ANSI/NEMA C18 - Safety Standards for Primary, Secondary and Lithium Batteries

7.1.5 Priority

Moderate

7.2 Software Maintenance

7.2.1 Description

The purpose of software purpose is to preserve the value of software over time, which can be accomplished by expanding the user base, enhancing software's capabilities, omitting obsolete capabilities, employing newer technology. The system is able to be updated/repaired remotely by downloading patches or upgrades. Source code is stored on a shared repository that all developers have access to it.

7.2.2 Constraints

- The developers are also in charge of installing ,and maintaining system and end-user software.
- Patches shall be tested before deployment to production environments

7.2.3 Standards

IEEE/ISO/IEC 14764-2006 - ISO/IEC/IEEE International Standard for Software Engineering - Software Life Cycle Processes - Maintenance

7.2.4 Priority

High

8 Other Requirements

This section includes additional requirements related to our glass interface system that need to be taken into consideration. This includes future deliberation regarding how the customer will interact with our interface and other specifications.

8.1 Touch-Based User Input

8.1.1 Description

The user must be able to interact with the glass interface via touch input. This done by using a sensor that senses the touch via an electrical field which transmits a signal and receives based on the "return" from a finger. IEC 62908-13-10:2016(E) specifies the methods for testing the environmental durability of touch display modules, touch sensor modules and test pattern cells, and can be used for devices at the production level, the prototype level or the trial model level when they are exposed to environmental stress.

8.1.2 Source

https://webstore.iec.ch/publication/33355 Specified by Nathen Paul

8.1.3 Constraints

Constraints include being able to get a hold of a functional touch sensor that meets the specifications of the IEC in time despite global supply chain delay.

8.1.4 Standards

International Electrotechnical Commission 62908-13 for Touch and Interactive Displays.

8.1.5 Priority

Critical

8.2 Prosthetic Accessibility

8.2.1 Description

We want our glass touch interface to also consider people who may not be able to use their finger to directly interact with it. For example, people with a prosthetic arms may not be able to use their finger but instead could use a stylus to use our glass interface.

8.2.2 Source

https://www.access-board.gov/ada/ Specified by Nathen Paul

8.2.3 Constraints

One possible constraint we may have is finding an appropriate stylus for someone with finger.

8.2.4 Standards

ADA Standards for Accessible Design

8.2.5 Priority

Low

9 Future Items

9.1 Wireless Display

9.1.1 Description

In future, to further enhance the participatory affordances of our glass interface, we would like our interface to project screens from devices connected wirelessly connected to our interface, similar to many TV and monitor displays.

9.1.2 Source

Nathen Paul

9.1.3 Constraints

Some constraints regarding this requirement includes incorporating an appropriate wireless receiver that is able to connect to our glass circuit.

9.1.4 Standards

Team Planning Specifications

9.1.5 Priority

Future

9.2 Multiple glass integration

9.2.1 Description

In the future, we would like our glass circuits to connect and fit in with one another. We want our glass circuits to be able to seamless build on top of one another with the abliity to connect mutiple glass pieces easily

9.2.2 Source

Nathen Paul

9.2.3 Constraints

Some constraints regarding this requirement includes incorporating an design that is able to connect our glass circuits together.

9.2.4 Standards

Team Planning Specifications

9.2.5 Priority

Future

References

[1] Big Duck Games. Flow free.

[2] Hasbro. Simon game.