Assignment M4

Kristy Sakano
ksakano3@gatech.edu

***Abstract*—**As the cool spring days shift into warmer summer months for our Northern Hemisphere countries, the outdoor temperatures are also rising and so does our desire for drinking ice cold drinks. Filling my glass with ice cubes from my ice maker means interacting with a rather simple interface – it lets me select the type of ice and activates the gears to deposit the ice in my glass. But this interface has its shortcomings: sometimes, it deposits stale ice that has an unpleasant taste, or worse, the gears will grind and nothing will come out! A pleasant addition to any kitchen would be an ice machine that could detect and offer solutions when ice production errors occur, and also continuously provide fresh ice by monitoring ice age. Because an ice maker takes several hours to freeze ice cubes ready for consumption, an interface that could provide instantaneous feedback to the machine status would save user time in diagnosing the error or manually restarting the production cycle for new, fresh ice.

1 QUALITATIVE EVALUATION

The prototype selected for this section is an **Interactive Hologram Interface** presented as a **paper prototype**. The image associated with this prototype is available in the Appendix. The method selected for qualitative evaluation is a **think-aloud study**. Despite surveys being recommended for paper prototypes, I believe the unfamiliarity of a hologram interface induces a steep learning curve and may be correlated with a low learnability if the user struggles to interact with the interface asynchronously and without assistance from the evaluation coordinator, myself.

The participants for this think-aloud study will be drawn from a similar population as those who filled out the initial survey during my need-finding exercise – individuals who own ice machines and are 18+. This population is extremely broad, so it will be important to capture individuals of a diverse background, like various ages, technology experiences, and other demographics like physical disabilities, race, etc. Because I am particularly interested in building an inter-

face that emphasizes accessibility, I will strive to include and emphasize folks of various physical disabilities, inclusive of elderly individuals as well to investigate **Accessibility**, one of my four requirements defined in M2. I intend to do **word-of-mouth recruiting**, and recruit from friends and family via social media. A think-aloud study can be conducted via the internet, so I intend to either video call or voice call my participants. I will inform them that they are being **recorded on video or by voice**, but that I will distill each recording into a one page summary and subsequently delete the voice or video recording. By reassuring my participants that the voice or video recording will be only observed by myself (the Principal Investigator), I hope to alleviate concerns regarding intrusiveness associated with recording the system. Simultaneously, by opting for a passive form of recording, I will bypass the limited, slow, and manual recordings associated with note-taking.

I will present my participants with a paper prototype of the hologram interface, as depicted in the Appendix (if possible, I may try to digitalize the image to be more easily perceived by my audience as "realistic"). I will ask them, *"Please think aloud the steps you would take to retrieve a glass of ice using this interface."* I will subsequently ask them, *"If you desired a different shape of ice, what would you do differently?"*

The second part of my project pertains to error analysis. I will show them a paper prototype of the hologram interface with an error message, as depicted in the Appendix. I will ask my participants, *"Based on this image, can you diagnose what the problem is? Do you know what the solution is? Do you think it is possible for you to solve the problem?"* The first question asked addresses the gulf of evaluation (Step 2: Interpreting the feedback presented by the interface); the second question addresses the gulf of execution (Step 1: Identifying the goal); the third question addresses the gulf of execution (Step 2 and 3: Identifying and executing actions in interface). These questions are designed to address **Learnability** and **Functionality**, two of the four requirements I defined in M2.

I may ask for their opinions regarding the holographic interface in a post-evaluation interview. This question will be designed to assess user satisfaction regarding the interface, and see if an alternate interface may be preferable, rather than working within the confines of this holographic interface. I will also provide a rough estimate of cost, and ask my participants if they would purchase this ice machine – this question addresses the requirement of **Cost**.

2 QUANTITATIVE EVALUATION

The prototype selected for this section is a **Voice Control interface** presented as a **Wizard of Oz prototype**. A copy of this prototype's script is available in the Appendix section for reference, if needed.

The **independent variable** (what I am testing) is the time spent using this interface. More specifically, I will be timing two different tasks: dispensing a glassful of ice in their preferred ice shape, and diagnosing an error (not including executing the actions, but the duration will include the user's comprehension of the error and actions identified to remedied the error).

The **control variable** (what I am using as a point of comparison) will be the user's own ice machine. Despite the variations in participants' ice machines, I am interested in evaluating a comparison between their current familiar ice machine and this voice control interface, rather than two new, unfamiliar interfaces. Additionally, because of the current ongoing pandemic, it is not feasible to provide participants with a new, functioning ice machine as a standard to compare the independent variable to. Hence, the control variable will be the participants' own personal ice machine; ideally, it will not be a voice control interface, and rather, a common tactile interface.

The **null hypothesis** is: There is no difference in time to obtain a glass of ice in the user's preferred ice shape between a tactile interface and a voice control interface. There is no difference in time for the user to diagnose the error and identify actions to remedy the error between the two interfaces.

The **alternative hypothesis** is: Obtaining a glass of ice in the user's preferred ice shape is faster when using a voice control interface versus a tactile interface. Diagnosing an error and identifying actions to remedy the error is faster when using a voice control interface versus a tactile interface.

The **experimental method of choice** will be a within subject experiment. Though this experimental method may be more time intensive, anticipatorily, the experiments will be relatively short so the total time duration will be of normal length. Subjects will not be assigned to individual groups but will be assigned to the starting interface (tactile or voice control) randomly to avoid any bias associated with priming. The data generated from the two above tasks for each interface – for a total of four tasks – will be recorded in seconds. Because this timed

data is considered as a ratio, I will be using the recommended linear regression technique. A potential **lurking variable** may be differences in tactile interfaces each participant has. Another potential **lurking variable** may be language comprehension skills that may affect a user's ability to understand voice control commands.

3 PREDICTIVE EVALUATION

For the third interface proposed in my M3 assignment, a minimalistic visual display with tactile buttons presented as a textual prototype, I will conduct a **cognitive walkthrough** of the prototype. A cognitive walkthrough is appropriate for this prototype as a tactile-visual interface is a common and popular interface, as indicated in the need-finding survey, and should be familiar to most users. While all users interacting with my proposed interface are considered novices, a familiar interface leverages previous interactions and knowledge, imbibing the principle of Consistency between interfaces.

There are two tasks that I will be addressing with the predictive evaluation. The **first task** is for a user to interact with the interface to fill a cup of glass with cubed ice. The particular shape of the ice is not relevant, but the user should have a premeditated ice shape selection to ensure that the ice shape selection interface section is comprehensible. The **second task** is to diagnose an error in the system – in this scenario, we will simulate a clog in the pipe. The user will need to diagnose the error and identify necessary solution steps.

The **overall goal** for the user is to be able to use the interface to obtain their preferred ice shape and to be informed as to errors and potential solutions to remediate the error. I intend to evaluate a user's navigation around this new interface to see how they figure out how to accomplish their goal.

Operators available to the user include three similarly-looking buttons labeled cubed, crescent, and shaved, and another button labeled "Recycle Ice". The user is able to press the button and the interface beeps to verify that a button has been selected. Another operator available to the user is the screen displaying visual text – the user is able to read text on the screen to be informed of the current working status and any suggested solutions. Because this display is designed to be minimalistic, there are no other operators in the form of scrolls, buttons, or touchscreens available to the user.

4 PREPARING TO EXECUTE

I plan to employ the first two evaluations for the next assignment: a **qualitative evaluation of an Interactive Hologram Interface presented as a paper prototype** and a **quantitative evaluation of a Voice Control interface presented as a Wizard of Oz prototype**. While both of these evaluations require participant interaction, I have discussed this project with several friends and family members who previously filled out the need-finding survey, and they have expressed interest in taking part in this study beyond the initial survey! While the cognitive walkthrough is an interesting option for evaluation, the best evaluation results come from when the research is centered on the user, and not the designer. By centering my evaluations on other individuals, I hope for a well-rounded evaluation process that provides valuable and insightful feedback.

5 APPENDIX

5.1 Voice Control Interface as a Wizard of Oz Prototype

Here, the user has approached the interface and pushes down on the *Microphone Button*. This triggers the interface to start listening to the first command. If there are no commands after a defined period of time, the interface is terminated. A copy of the script is as follows:

5.2 General Interactions

User: "Computer, please fill my glass with ice."

Interface: "Please specify the shape of the ice: cube, crescent, or shaved."

User: "Cubed."

Interface: "Dispensing now. Say 'Stop' to terminate the dispensing." [Here, I – acting as the interface – would start pouring ice cubes into a glass.]

User: "Stop." [Here, I – acting as the interface – would stop pouring the ice.]

5.3 Special Interactions

One of the priorities I wanted to focus on was identifying and diagnosing errors in the ice machine. This may occur when there is a blockage in the tube, or the ice is old and needs to be refreshed, or the machine has malfunctioned. Here is a copy of the script that I anticipate a user would employ:

User (does not know there is an error): "Computer, please fill my glass with ice."

Interface [Option 1]: "Error. There is a blockage in the dispensing valve. Please remediate and query again." [The user will have to remove the blockage. They can query the interface again for ice, and if the error has been fixed, it will return to the General Interactions.]

Interface [Option 2]: "Warning. The ice production date is 10 days prior. Consider recycling the ice to maintain freshness. Say, 'Recycle my ice' if you would like to begin the 1 hour long recycling process. Say 'Ignore warning' to continue."

User (wants to refresh the ice): "Recycle my ice."

Interface [Option 2 Cont'd]: "Understood. Please wait one hour for the ice to recycle, and query again."

Interface [Option 3]: "Error. Please consult the manual for problem number 23 for suggested tips and solutions."

5.4 Interactive Hologram Interface as a Paper Prototype

As seen in Figure 1, there are three different holographic options presented on the interface. The user places the cup at the ice dispensing valve, and uses their hand to bisect the holographic beam. As the machine registers an interruption in the beam of light, it begins dispensing ice of that particular ice shape (cubed, crescent, or shaved). If an error occurs, the interface changes to a textual message display and the holographic image is a 3D configuration of the error; the holographic display highlights the section of tubing that has a blockage.

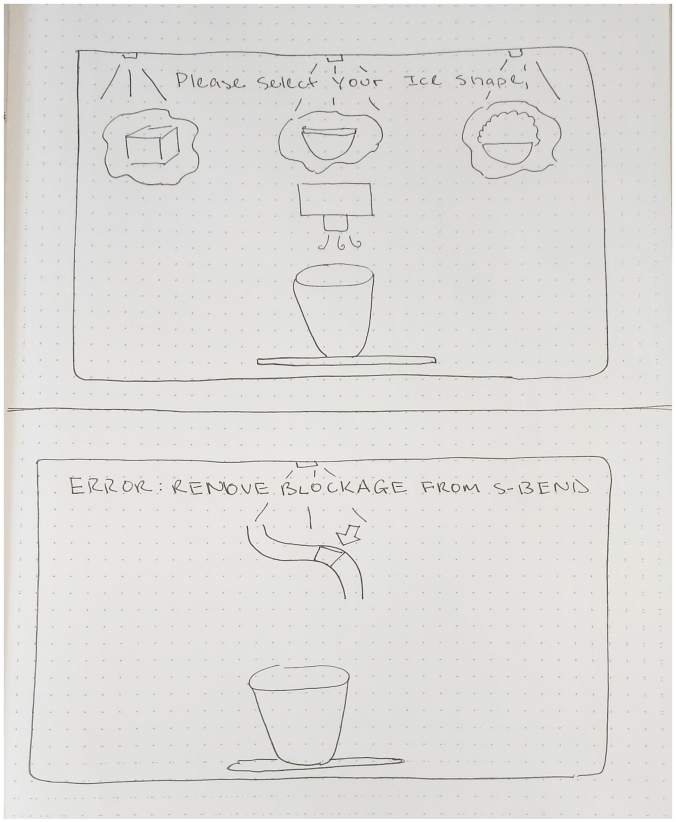

Figure 1—Holographic Interface