

'Wizard of Oz' Study for Controlling Living Room Lighting

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Abstract. Solid state lighting is changing the way humans experience artificial lighting and enhancing the possibilities of control over our built environments. The goal for this research study was to provide insight for designing human centered controls for tunable solid state lighting for the familiar residential application of living room lighting using a 'Wizard of Oz' methodology. Eight internal subjects and twenty externally sourced subjects experienced controlling the lighting for common scenarios such as reading, watching TV, having a party, saving a scene and recalling a scene. Three Android based mobile device applications were prepared for voice-only, gesture-only, and voice and gesture combined control. One or more "wizards" were employed to close the control loop between the subject's verbal commands and gestures and the tunable solid state lighting settings. Voice clips and sensor data were recorded on the phone, video and audio were captured via a wall mounted camera, and observed and documented. The subjects were aware of the audio, video, data, and note taking but not the "wizard" control. The data was analyzed to extract the unique ways subjects used to control the lighting, think-out-loud information and interview answers were analyzed to develop the mental models behind their control attempts and their thought processes used to reach their high level task goals. Conclusions drawn from this research help shape design decisions for tunable solid state lighting solutions and next-generational controls.

Keywords: Human computer interface · Wizard of oz · Solid State Lighting · Voice · Gesture

1 Introduction

Solid state lighting (SSL) provides possibilities not readily available from legacy lighting technologies and is disrupting the lighting industry: for example there are now many color temperature controllable, as well as color controllable, lighting products on the market. Lighting products are experienced in ways other appliances like toasters and dishwashers are not and now SSL is providing new lighting experience possibilities. This study was conducted as part of internal research by our Central Innovation application and design department within projects on user-experience and advanced natural user interfaces, with the primary goal of developing natural user interface solutions for

advanced lighting control. The objectives and benefits of this project specifically were multifold. Systems Engineering and Human-centered design principles were used extensively to envision, re-search, and realize lighting solutions that control complex technology yet are compelling, engaging, easy to understand, and enjoyable for people to use. Such concepts may ultimately anticipate human needs and enhance human experience thereby pushing the boundaries of SSL solutions and applications. Natural language interfaces (NLU), voice control, and natural gesture interfaces now being explored for gaming, automotive, medical, and other applications can also be used in advanced lighting applications. A working prototype using Android-based mobile devices was architected and developed to control advanced lighting systems consisting of color tunable lighting and multiple sources.

The experimentation involved subjects controlling tunable lighting in a natural environment of a living room to set the lighting environment to their liking for common tasks within these applications. They controlled the light level and color of multiple lighting fixtures using voice commands, gestures, and a combination of both voice and gesture. They were intentionally not given instruction on what to say or how to gesture with the phone, but instead asked to just try whatever seemed natural to them. Care was taken not to provide language or example gestures for any of the tasks. To close the control loop, one or more “wizards” were employed to actuate the advanced lighting unbeknownst to the subjects.

Voice data and sensor data was recorded on the phone, video and audio was captured via a wall mounted camera, and observer notes were taken. The data was analyzed to extract the unique ways subjects attempted to control the lighting and reach their high level task goals. For example, natural ranges of acceleration data attempted by the subjects for dimming were statistically analyzed and compared to those attempted for shutting off the lights. The common and unique verbal commands and naming conventions were extracted. Mental models of the subjects were gleaned from think-out-loud methodology, as well as, moderator conducted interviews.

The subjects agreed to being recorded and to not disclose what they experienced outside of the experiment. All subjects were provided non-disclosure (NDA), consent, and release forms in advance. The light intensities and modulation levels were limited to well within the levels of normal lighting experience. No excessive glare or flicker was present. The study was approved by our internal review board.

2 Study Development

The approach taken to study natural ways people use to control lighting was to provide a well known and comfortable environment, to refine the instructional script and answer questions in such a way as to not influence the subjects’ behavior, to encourage experimentation by saying “just try it”, or asking the subjects to demonstrate how they would control the lighting for a given situation, and by employing expert trained personnel known as “wizards” to provide fast feedback. Internal subjects were used to refine the experimental procedure and to train “wizards”, moderators, and observers. It was then extended to external subjects recruited by an outside firm.

We recruited 20 participants to come to our facility to participate in a survey about natural language interfaces, voice control, and natural gesture interfaces used in advanced lighting applications. A broad demographic representation of male, female, 18-65 years old was selected but narrowed to those who would likely have or like to have home automation and use a smart phone regularly. We asked for them to be 1 h appointments Monday through Friday at 9:00, 10:30, 1:00, and 2:30. The participants were provided ahead of time and signed on site an NDA, an Informed Consent Form, and a Photo/Video Release.

During the experiments, the lighting was supervisorially or directly controlled by one or more unknown external operators called "wizards". The knowledge that the lighting was being controlled by another person was not given to the subjects. This technique is called "Wizard of OZ" after the famous scene in the well-known old movie by that title, where the wizard is unknowingly controlling equipment from behind a curtain. This technique is well known in human centered interface design (Jacko 2012) (Salvendy 2006) but is to our knowledge novel to lighting and home automation.

Living Room Study Setup Details

The experiment was conducted in our internal laboratory. The study took place in a simulated living environment that is 12 ft. (3.8 m) by 17 ft. (5.2 m) with a 9 ft. (2.7 m) high open box ceiling designed for flexible lighting placement. It was furnished with two comfortable chairs facing a wall mounted TV. This allowed for left handed and right-handed subjects to have their hand movements captured by a wall mounted video camera and directed toward a table lamp on a small table between the chairs. The camera is barely visible as a blue dot above the TV in the photo (depicted in Fig. 1). There were two wall sconces, one on either side of the TV. There were two fake windows with birch trees and grass to give the feel of a lawn in an open neighborhood. These windows could be back illuminated with an edge-lit panel, or not, in order to represent day time or night. The windows remained illuminated throughout the study and the subjects all participated in the during daylight hours. Mounted in the ceiling were six independently controllable tunable fixtures that could produce a wide gamut of colors and variation in color temperature. A coffee table was placed in reach of the comfortable chairs with magazines for reading and the TV remote control. Some details such as artificial and real plants were added to complete the realistic living room environment shown in Fig. 1.

The wizard control room was positioned behind the living room area behind a wall but the "wizards" could directly observe the subjects if need by peering around the wall while staying out of sight of the subjects but insight in the moderator and observer. The "wizards" could hear the subjects directly but had amplified audio and high resolution video from the wall mounted camera. The moderator conducted the experiment from a podium in the front and slightly to the right of the subjects, who were seated in one of the comfortable chairs. The observer was to the right of the subject and though peripherally, the observer could be seen when the subject turned their head and could on occasion add information, clarify points, or even converse with the subject.



Fig. 1. Photo of living room

Human Factors Experimental Procedure

To discover natural ways people use to control lighting, a procedure was developed whereby the subject was unaware of the control mechanisms and was not steered toward any particular vernacular or gestures. Internal subjects were used to refine the procedure and train the moderator, operators, and “wizards”. The moderators paid particular attention to making the script flow and sound natural. The observers listened closely for any moderator accidental prompts that would influence naming of light fixtures, colors, color temperature, or commands (trying not to say “save” or “store” or “setting” when we wanted the subject to save a preset was particularly challenging). The “wizards” were trained to try to quickly respond to the subjects actions. They practiced both doing what the subject wanted and intentionally not doing what the subject wanted in order to study subject response to failures, how they recover, and how it effects user experience. Both the moderators and the observers were trained in interview techniques for delving into thought processes behind the attempted actions and for discovering mental models behind those thought processes. Considerable effort was needed to coax the think-out-loud process to make sure the “wizards” could fully understand the intentions of the subjects. This was also necessary for the data analysis task of determining if the intent was met. Fortuitously natural naming conventions, light level and spectral changing commands, range and characteristics of sensor data and type of gestures, and the mental models employed were discovered, even in this preliminary phase and were verified in the external participant phase.

Each external participant was met in the lobby for briefing, signing and witnessing of forms, and then led to the simulated living room. In the living room the participant met the moderator and the observer (if different from the greeter), and were positioned in one of the comfy chairs according their handedness. The moderator read from a script (see Appendix A) that started with a brief description and introductions. Then again, verbal consent was obtained to start recording and the moderator asked the observer to start the recording even though the “wizards” were actually responsible and the observer pretended to start the recording with a remote control and confirmed it is recording. Part of the procedure was developed to intentionally deceive the subject into believing that

there were no “wizards” and that the system was a highly intelligent controller. Then each high level task was introduced and instructions were given on how to proceed. The subjects were interviewed after completing all of the tasks, escorted to the lobby, thanked, and told the agency would pay them for their time.

3 Results

Observations and verbatims showed that most of the subjects were amazed at how well the system performed. Only one subject mentioned they thought that there may have been someone controlling the lighting. There were many commonalities in naming, commands, gestures, and choice of modality. Some common mental models emerged. Unique ways in which subjects did these things were studied in more detail for use in developing natural user interface prototypes.

One common way subjects named lights was by their proximity to other objects. Some examples are “lamp on the table”, “lights next to the TV”, and “ceiling lights”. Another common naming convention was by task, “reading light”. A third way is to name where or what the light from the source(s) illuminates. Examples of this are: “the light for the chairs”, “wall wash”, or commanding “light the room”.

Common commands that were intuitive such as “turn on” or just “on” outnumbered more obscure commands. “Make the ceiling blue” was one command that emerged that was not predicted ahead of time. The use of the commands “make” and “turn” was noted but not studied in detail.

Subjects showed dissatisfaction in unique ways. For example, when the lighting was too bright, the subjects would shield their eyes with their hand or arm in more of a dramatic gesture than to actually reduce the light level to their eyes. More common dissatisfaction reactions were saying things like “no, no, no”, or “not that” separately or in combination with waving the phone back and forth vigorously.

Nearly the same vertical motion was used to dim as to shut-off a light. The acceleration versus time was different. Figure 2 depicts a typical sequence for shutting off two different lights and dimming a third. The typical shape for both is two peaks one negative

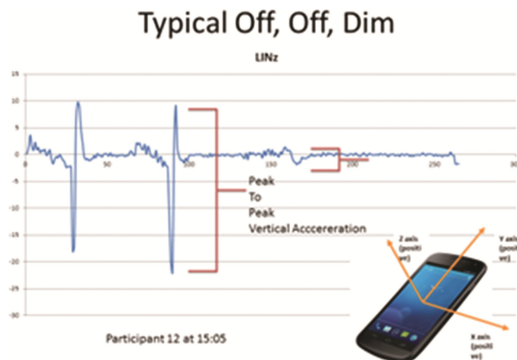


Fig. 2. Vertical accelerometer data stream (Color figure online)

and one positive caused by the slight up and down motion at the ends of a mostly downward motion. By analyzing the video feeds that correspond to the accelerometer data and observer notes the subject's intended actions could be categorized. The actions were categorized into three categories: dim, dim to off, and off. A statistically significant difference in peak to peak heights was found between off and the other categories, but not between dim and dim to off. This is graphically illustrated in Fig. 3.

Peak to Peak Vertical Acceleration

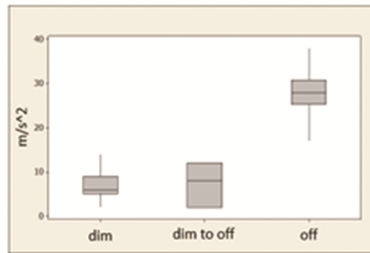


Fig. 3. Statistical analysis of peak to peak vertical accelerometer data

Cognitive models became most obvious when subjects were trying to use gestures to control color. Two major models were gleaned that correspond to peoples experience with color wheels and with color palettes. Some subjects would point the phone around a circle while observing the color change. Those subjects expected the direction or points on the circle to be arranged like color in a rainbow. Those same subjects described it as imagining a color wheel. Similarly some subjects had a color wheel in mind but used a faster circular motion to “spin the wheel” and a stopping or backing up motion to select the color they wanted.

The color pallet models were more complicated since the general understanding of additive and subtractive color space was not generally understood by the external participants. One subject explained in detail how the front corners of the living room were blue and red, and the rear of the room was yellow. Then by pointing between blue and yellow, green could be produced. Yet during this discussion, there was some confusion about how RGB displays mixed color. In additive color space, blue and yellow will produce white (for example the most typical white LED is made with blue LED light, some of which is converted to yellow using a phosphor). Some of the internal subjects (lighting experts) used the additive model consistently. Some subjects just waved the phone until the color happened to land where they wanted.

4 Conclusions

The results from this study confirm that people interact with lighting in ways that are unique compared to other devices. It is hypothesized that this is due to how central vision contributes to experience and to the nature of light itself in how it travels and reflects off of objects in the immediate world to provide people within this immediate

environment with an understanding of how this environment is constructed. The results indicate that systems could be designed with better naming conventions, large vocabulary command sets, and color control based on cognitive color models.

The control system taking advantage of this invention would allow for multiple names and encourage multiple naming by these conventions. By prompting during the configuration phase, sometimes called commissioning, the system could encourage the programmer (commissioner) to consider giving multiple names for the light sources or groups of light sources by what they are next to, by what the light sources are used for, and by where the light source(s) illuminates. In this way, novice users of the system could refer to particular light by the natural naming convention.

When considering how to make a voice controlled system robust, adding more possibilities for commands must be balanced by increased misinterpretations of words from larger vocabularies.

Artificial lighting is critical in nearly every built environment and SSL is making advanced lighting products readily available while providing challenges in the application and control of these solutions (Boyce 2003). Future studies in other applications are under consideration.

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Appendix - NUI Script V5.2

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Introduction

Mod speaks,

“Welcome to our study on natural interfaces for controlling lighting!

This study will consist of using prototype smart phone applications to control tunable lighting for particular task goals.

The purpose of this activity is to test the robustness of our prototypes. This is intended to help us develop natural interfaces for controlling lighting.

As always, your participation is completely voluntary and you are free to stop at any time during the study for any reason without any penalty and without being asked why. The information you provide is anonymous.

You will be asked to complete a series of exercises involving common residential tasks.

Your voice and gestures will be recorded and analyzed for this experiment. These recordings will be kept anonymous in the reporting of the data and not used for advertising or marketing. If it is OK with you, I am going to start the recording now.”

Moderator pretends to start recording, wizard starts recording, Mod says “Experimental run number xx”

Mod speaks,

“You will be asked to use a smart phone application to perform these tasks. This application is very universal and will respond to whatever action or voice command you give.

Before you try to use the smart phone application, we would like you to “think out loud”. By this we mean that you should verbalize what you are about to do, or are trying to accomplish and how you plan to do it in detail. The recording of your intentions will be compared to the system response and used to improve the performance of the system.

When your intentions are clear we will ask you to use the smart phone to perform the desired lighting control.

The lighting may not produce the exact color, light level, or effect that you want. The responsiveness and latency may not be consistent. Don’t be too concerned about this. We are looking for robustness in our control, and your participation will help us to improve our lighting control. Even if you say something and nothing happens, this is important feedback for the improvement of the system.

If you are ready to continue, please have a seat in the chair and while you get comfortable, spend some time looking around the area and try to imagine you are in your living room.

Mod moves left handed to right chair and right handed to left chair

Wait a minute for the subject to get comfortable

Mod speaks,

“Now I will start a short Demo of the Functionality of the lighting in the room, so you know what you can do with the lights”

Mod pretends to manually start the demo

Wiz runs Demo, - Finish with black-out

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 1 – Voice – Reading

Start the voice app running. Mod speaks,

“On this smart phone is our prototype voice control application. The voice control will be activated while you press and hold the large button in the center of the screen and will stop after you release the button. While you hold the button, the phone produces a tone to indicate you are in control. You may press and release whenever you want to start and stop controlling.

I will give you a task and then ask you to “think out loud” about what you are going to do. I may ask questions to help clarify what you are planning to do. When we are clear on what you plan to do and how you plan to do it. I will hand you the phone to try to control the lighting.

Do you have any questions? Are you ready?

I am going to ask you to prepare the lighting in the room for reading. I'll give you a minute to sit quietly and think about how you want the room to be for reading.”

Pause, give time. Mod speaks,

“OK think out loud now and be explicit about what lights you want to control and how.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the smart phone with the voice control app. Go ahead, press and hold the button on the screen, and speak into the phone to control the lighting.”

Subject performs task

Mod - Take the phone from the subject

Task 2 – Voice – Like lighting, think you want to use this later

Mod speaks,

“You like the lighting as is, and you want to save it to be used later.

I'll give you a minute to sit quietly and think about how you want to accomplish the task of saving the lighting using the voice control app.”

Pause, give time. Mod speaks,

“OK, think out loud now and be explicit about how you plan to try to do it.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the smart phone with the voice control app. Go ahead, press and hold the button on the screen, and speak into the phone.”

Subject performs task

Wiz - Double flashlights – save setting

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 3 – Voice – TV

Mod speaks,

“Next I am going to ask you to prepare the room lighting to watch TV. I’ll give you a minute to sit quietly and think about how you want the room lighting to be.”

Pause, give time. Mod speaks,

“OK, think out loud now and be explicit about what lights you want to control and how.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Go ahead, press and hold the button on the screen, and use the smart phone voice control app to control the lighting. Release the button when you are finished.”

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 4 – Voice – Back to Reading

Mod speaks,

“Now you want to read again.

I’ll give you a minute to sit quietly and think about how you want to accomplish the task.”

Pause, give time. Mod speaks,

“OK think out loud now and be explicit about how you plan to try to do it.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the smart phone with the voice control app. Go ahead, press and hold the button on the screen, and speak into the phone.”

Subject performs task

Wiz – Recall READING preset

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 5 – Gesture – Party

Mod speaks,

“The next application is a gesture control application. Again the phone will be activated when you press and hold the large button in the center of the screen. I will give you a task and ask you to think out loud first. Then when I give the go ahead, press the button and control the lighting by moving the phone with gestures. I will still have you think out loud while you are gesturing to control the lighting.

Do you have any questions? Are you ready?

I am going to ask you to prepare the lighting for a party by changing the overhead lighting to some color. Take a minute to sit quietly and consider how you want to control the lighting. Particularly, consider how you are going to use gestures to get the color you want.”

Pause, give EXTRA time. Mod speaks,

“OK, think out loud now and be explicit about what lights you want to control and how.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the gesture app running. Go ahead, press and hold the button on the screen, and use the smart phone gesture control app to control the lighting. Please verbalize what you are trying to do and how. Do this even though the phone will not respond to voice commands.”

Subject performs task

Mod - Take the phone from the subject

Task 6 – Gesture – Like lighting, think you want to use this later

Mod speaks,

“Now I want you to save the lighting as is, to party later.

I'll give you a minute to sit quietly and think about how you want to accomplish the task of saving the lighting using gestures.”

Pause, give EXTRA time. Mod speaks,

“OK think out loud now and be explicit about how you plan to try to do it.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the gesture app running. Go ahead, press and hold the button on the screen, and use the smart phone gesture control app to perform the task. Please verbalize what you are trying to do and how. Do this even though the phone will not respond to voice commands.”

Subject performs task

Wiz - Double flashlights – save setting

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 7 – Gesture – Romance

Mod speaks,

“I am going to ask you to prepare the lighting for romance. Take a minute to sit quietly and consider how you want to control the lighting. Particularly, consider how you are going to use gestures to get the lighting you want.”

Pause, give EXTRA time. Mod speaks,

“OK, think out loud now and be explicit about what lights you want to control and how.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the gesture app running. Go ahead, press and hold the button on the screen, and use the smart phone gesture control app to control the lighting. Please verbalize what you are trying to do and how. Do this even though the phone will not respond to voice commands.”

Subject performs task

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 8 – Gesture – Back to Party

Mod speaks,

“Now I want you to party again.

I’ll give you a minute to sit quietly and think about how you want to accomplish this task using gestures.”

Pause, give time. Mod speaks,

“OK think out loud now and be explicit about how you plan to try to do it.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the gesture app running. Go ahead, press and hold the button on the screen, and use the smart phone gesture control app to perform the task. Please verbalize what you are trying to do and how. Do this even though the phone will not respond to voice commands.”

Subject performs task

Wiz – Recall PARTY preset

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 9 – Both – Conversation

Mod speaks,

“The next application responds to both your voice and the gestures you use to move the phone. Again the phone will be activated when you press and hold the large button in the center of the screen. I will give you a task and ask you to think out loud first. Then, when I give the go ahead, please press and hold the button and control the lighting by moving the phone and speaking. I will still ask you to think out loud before and after you are controlling the lighting.

Do you have any questions? Are you ready?

I am going to ask you to prepare the lighting for conversation. Take a minute to sit quietly and consider how you want to control the lighting. Particularly, consider how you are going to use gestures to get the effect you want.”

Pause, give time. Mod speaks,

“OK, think out loud now and be explicit about what lights you want to control and how.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the voice and gesture app running. It may be helpful if you verbalize what you are trying to do and how. Then go ahead, press and hold the button on the screen, and use the smart phone voice and gesture control app to control the lighting.

Subject performs task

Mod - Take the phone from the subject

Task 10 – Both – Like lighting, think you want to use this later

Mod speaks,

“Now I want you to save the lighting as is.

I’ll give you a minute to sit quietly and think about how you want to accomplish the task of saving the lighting using both voice and gestures.”

Pause, give time. Mod speaks,

“OK think out loud now and be explicit about how you plan to try to do it.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the both voice and gesture app running. Go ahead, press and hold the button on the screen, and use the smart phone gesture control app to perform the task. Please verbalize what you are trying to do and how.”

Subject performs task

Wiz - Double flashlights – save setting

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 11 – Both – Cleaning

Mod speaks,

“Next I am going to ask you to prepare the room for cleaning. I’ll give you a minute to sit quietly and think about how you want the room lighting to be.”

Pause, give time. Mod speaks,

“OK, think out loud now and be explicit about what lights you want to control and how.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Go ahead, press and hold the button on the screen, and use the smart phone to control the lighting.”

Subject performs task

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 12 – Both – Back to Conversation

Mod speaks,

“Now you want to have a conversation again.

I’ll give you a minute to sit quietly and think about how you want to accomplish this task using both voice and gestures.”

Pause, give time. Mod speaks,

“OK think out loud now and be explicit about how you plan to try to do it.”

Wait for the subject to finish thinking out loud and make sure you are clear on what they want to do and how they want to do it.

Then hand the smart phone to the subject.

Mod speaks,

“Here is the phone with the both voice and gesture app running. Go ahead, press and hold the button on the screen, and use the smart phone gesture control app to perform the task.”

Subject performs task

Wiz – Recall conversation preset

Mod - Take the phone from the subject

Mod pretends to manually reset lights

Wiz - Set lighting to 50% - 3500 K preset, Mod says, “I am resetting the lighting.”

Task 13 – Wrap Up, Interview

Mod speaks,

“Thank you for participating in our study on natural interfaces for controlling lighting! Your participation will certainly help us develop natural interfaces for controlling lighting. First I would like to ask if you have any comments on your experience. Now I would like to ask you some questions regarding your prior use of lighting controls, or similar controls.

1. Have you used voice or gestures to control lighting?
 - a. If yes, please describe your experiences.
2. Have you used voice or gestures to control anything else?
 - a. If yes, please describe your experiences.
3. Specifically have you used the “Magic Wand”?
4. Have you seen the “Magic Wand” used?
5. Was the beep sound, while pressing the button, too loud or disturbing?

Thanks again, please don't share this experience with other colleagues until the end of this study, as we will need to study more volunteers, who are not yet aware of what we are doing. And have a nice day"

Observer's Notes on Participants mood, appearance, engagement ...

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