|  |
| --- |
| *SCHOOL OF COMPUTING AND MATHS, Charles Sturt University* |
| Peer Review and Usability Evaluation |
| Assignment 3: Peer Review and Usability Evaluation |
|  |
| **Alexander Wait** |
| **11652714** |

|  |
| --- |
| **Word Count: 4423** |

|  |  |
| --- | --- |
| **ITC504 Assessment Item 2 - Marking Sheet** | |
| **Total Obtained Marks** | /10 & /10 & /20 & /10 & /30 & /20 |

| **Criterion** | **High Distinction** | **Distinction** | **Credit** | | **Pass** | |
| --- | --- | --- | --- | --- | --- | --- |
| **Peer review: Does design satisfy requirements**  **(10 marks)** | Design comprehensively reviewed for requirements match, with excellent reasoning for decisions | Design reviewed in high detail for requirements match, with very good reasoning for decisions | | Design reviewed in some detail for requirements match, with good reasoning for decisions | | Design briefly reviewed for requirements match, with some reasoning for decisions |
| **Peer review: Clarity of design**  **(10 marks)** | Design comprehensively reviewed for clarity and aesthetics, with excellent reasoning for decisions and well referenced to principles | Design comprehensively reviewed for clarity and aesthetics, with excellent reasoning for decisions and well referenced to principles | | Design comprehensively reviewed for clarity and aesthetics, with excellent reasoning for decisions and well referenced to principles | | Design comprehensively reviewed for clarity and aesthetics, with excellent reasoning for decisions and well referenced to principles |
| **Peer review: Improvements to design**  **(20 marks)** | Design comprehensively reviewed for improvements, with excellent reasoning for decisions and well referenced to principles | Design reviewed in high detail for improvements with very good reasoning for decisions and good references to principles | | Design reviewed in some detail for improvements, with good reasoning for decisions and some references to principles | | Design briefly reviewed for improvements, with some reasoning for decisions and occasional  references to principles |
| **Peer Review: Recommendations**  **(10 marks)** | Comprehensive list of recommendations in priority order | Thorough list of recommendations in priority order | | Good list of recommendations in priority order | | A list of some recommendations with some priority order |
| Use a usability heuristic to evaluate a design  (30 marks) | Comprehensive heuristic based evaluation that covers all aspects of the design. It identifies all issues, and determines why they are an issue. | Thorough heuristic based evaluation that covers most aspects of the design. It identifies most issues, and determines why they are an issue. | | Detailed heuristic based evaluation that covers many aspects of the design. It identifies many issues, and determines why they are an issue. | | Adequate heuristic based evaluation that covers some aspects of the design. It identifies some issues |
| Discuss the reasoning for evaluation and remediation of usability issues discovered  (20 marks) | Comprehensive discussion of the evaluation and remediation of all issues discovered; In-depth interpretation of discoveries where conclusions and are directly drawn from the evaluation conducted is explicitly included. | Thorough  discussion of the evaluation and remediation of most issues discovered including evidence of drawing interpretation from evaluation | | Good discussion of the evaluation and remediation of many issues discovered including some evidence of drawing interpretation from evaluation | | Adequate  discussion of the evaluation and remediation of some issues discovered including some evidence of drawing interpretation from evaluation |

**Table of Contents**

[Peer Review 4](#_Toc521424256)-9

Usability Evaluation [10-15](#_Toc521424256)

[References 16](#_Toc521424256)

[Appendix 17-19](#_Toc521424256)

**Peer Review**

**Discussion of design been reviewed:**

The reviewed design consists of a circular component with rectangular components dispersed around the circle as a 3 x 3 grid. The circular component displays the current time whereas each rectangular component represents a main system of the control panel. For example, lights, air-conditioning, door access, and security are all main systems. When the user clicks on a rectangular component, extra controls appear for the selected main system within the center circle which replaces the time display. The user modifies the selected system by changing the control settings to their preference. Figures 1, 2, and 3 (under the appendix) describe the interface decisions for the inactive state, selected state, and the add/remove state respectively. The initial design is extremely attractive and has potential to be an excellent solution to the smart home problem.

**Does the design satisfy the requirements given in the case study? Discuss your reasoning for your comments**

The dimensions of the smart home control panel with reference to the case study requirements must not surpass a 240mm x 170mm space; the reviewed design meets this requirement. Another requirement was that the design needed to support at least three separate air-conditioning zones with separately controlled temperatures. This requirement is satisfied since all three zones are accessible from the control panel and the temperature of each zone can be separately controlled and adjusted. Other systems that the control panel needed to support were lighting, door access & locks, and video surveillance. The design supports three lighting zones, four electronic locks, and four video surveillance cameras. In addition, the design needed to allow for the addition of new systems to the control panel. Clicking on the small gear icon located at the top right of the reviewed design displays a green ‘+’ button within the circle to add a new system and small red crosses ‘x’ located at the bottom right of each rectangular component to remove a system. There is no indication how new systems will be added or what controls are used to add new systems. Thus, the requirement to add new systems is partially complete in the reviewed design.

**Is the design easy to understand and aesthetically pleasing? Include your reasoning along with references to the principles of design**

Successful implementations of human computer interfaces (HCI) require adherence to important principles of design. These principles improve the understandability of designs and their aesthetics. A research study conducted by Sonderegger, 2010, concluded that improved product aesthetics amongst different mobile phone models that are otherwise functionally identical resulted in an improvement of perceived usability amongst users of the devices. Chapman, 2018, also discusses the basic design principles for interfaces which include the following: Contrast, Emphasis, Proportion, Hierarchy, Repetition, and white space. The reviewed design has good contrast. Text used throughout the interface is clearly readable and distinguishable against the background; there are no instances where the color of the text and the color of the background affect the textual readability. However, all text associated with a smart home system is grayed when the system is unselected. Thus, contrast is reduced for systems that are not selected which could be an issue if the user would like to view the status of unselected systems or read the system titles of unselected systems. Thus, contrast is adequate for a selected smart home system and may be sub-optimal for unselected systems. The design also has good hierarchy amongst titles and headings. System headings (lights, movement, access, etc.) have a larger font than other sub-headings for those systems. For example, the main heading ‘Access’ is a larger font than the sub-headings ‘Front door’. Thus, there is a strong hierarchy and emphasis since it is easy for the user to distinguish between elements of the design that are more important and other elements that carry less emphasis. However, the displayed temperature for each air-conditioning zone has a larger font size compared to the system title which may carry more emphasis than it should. All headings and sub-headings have consistent font size and formatting amongst systems as well as similar rectangular dimensions that house each system on the smart home control panel. Thus, the design incorporates the principle of repetition and all systems carry equal weight. The implementation of a digital clock contained within a circle positioned at the center of the control panel is a good aesthetic touch for the design; a clear reference to the current time is very helpful for users since time dependent controls are used in the smart home interface. Furthermore, the separate systems are nicely presented in a grid fashion around the circle. Each system is clearly demarcated from other systems with the adoption of white space between rectangular boundaries. Sharp, 2019, describes other important principles of interface design including (but not limited to) visibility, feedback, and constraints. The interface lacks the concept of visibility in some areas; the user has to guess what the settings of some controls will do to the smart home. For example, the dropdown control to set the temperature for each air-conditioning zone is sandwiched within the center circle and not as visible as the other dropdown controls to set the on/off times for the zones. Also, in the lower half of the circle there is an up arrow and a down arrow with a heading underneath called ‘Temp’. There is some ambiguity regarding which control to use for setting the zone temperature. What is the difference between the dropdown and the arrow buttons? Another example involves the controls for lighting. It is unclear what the slider controls actually do. Are they used to change the brightness of the lights? Another issue with visibility which results in the user needing to guess the outcome of a settings change is within the access controls. It is unclear what the on/off switches are used for; a user may guess that they are used to deactivate a lock since the dropdown controls in the circle are used to set the open and close times for the door locks. Therefore, visibility is a concern is some areas of the design. The principle of feedback also needs some attention. When a user changes a control setting the user has difficulty understanding whether their changes have taken effect in the smart home; the control panel should protect against accidental changes with safety built in. The principle of constrains, however, is incorporated well within the design. Certain controls within systems are correctly disabled when the control should not be changed. For example, when lighting is not selected the individual slider controls are not enabled and appear grayed out. Therefore, the reviewed design for the smart home control panel adequately incorporates some principles of design, however, there are other key principles that require more attention. The following section describes how those other design principles may be implemented to improve interface aesthetics, clarity, and usability.

**Discuss how, and why, you think the design could be improved. Include your reasoning along with references to the principles of design**

There are multiple changes that can be done on the initial design to improve its usability and acceptance. Issues regarding contrast, emphasis, visibility, and safety require attention.

The following lists the changes that should be considered in the final design:

**Contrast:**

Leave the font color of system titles the same for both selected and unselected systems; titles such as ‘Access’, ‘Lights’, and ‘Motion’ should not be grayed out when a different system is selected. The reason for this is that users should always be able to read and understand the system referenced by each rectangular entity. Babich, 2017, explains that users with visual impairment (especially low contrast sensitivity) may have difficulty reading significantly greyed text against a white background.

**Emphasis:**

This principle is applied reasonably well to the design, however, consider reducing the font size of the displayed temperature which is situated below the system title; the displayed temperature of 19c should have a smaller font size than the system title ‘Bedrooms’.

**Visibility:**

There are significant flaws regarding the current design with the principle of visibility. All controls should be clearly labelled explaining to the user the effect of each control on the smart home to protect against incorrectly applied settings. For the on/off switches under ‘Access’ include labels that explain the use of the controls. Also, don’t assume the user will understand which position is on/off. Not all users possess an iPhone or an iPad and thus surprisingly not all users will know what the switch positions mean. Consider including labels and hints for the switches such as ‘slide the following switches left or right to enable or disable the device: left to disable, right to enable. Another way to address the issue is by including a label hint underneath each switch such as ‘disable < > enable’ which matches the setting of the switch. For the slider controls used to set the brightness of the lights include labels that describe the current settings.

**Feedback & Safety:**

Users may unintentionally change settings of the control panel which can be dangerous and thus not a desirable result. Modifying the settings of door locks or sliders should not take effect until users have consented to the change (West, 2018). This can be implemented multiple ways in the interface. For example, the user could be required to click a button to accept changes to the system. The user could be presented with the following text ‘click the button below to accept the change’. The principle of safety is designed well for removing systems from the control panel; the user is presented with a bottom-right positioned dialog that must be accepted before a system is removed. Consider adopting the same principle for system settings that are modified.

**Extensibility:**

The reviewed design does not allow for much extensibility/expandability; supporting this design principle will also require significant changes to the initial design. Interfaces may require the addition of new controls and functionality in the future. The smart home control panel may need to incorporate the addition of new controls for specific systems. For example, if the requirements changed such that the control panel needed to support five lighting zones instead of three, how would the five slider controls fit inside the rectangle? How would new controls be included within the constrained dimensions of the center circle? Including these additional controls may break the design because the dimensions of each rectangle will need to be expanded.

Showalter, 2018, explains that improving user experience (UX) or extensibility may be achieved by presenting the user with the bare minimum information which helps to guide them through the selection process; he explains that ‘boxing modules inside other boxes’ is a concern for UX – whitespace should be leveraged and ‘systems should be given room to breathe’. Systems could be divided into main systems and sub systems. Main systems include lighting, access, and motion whereas sub systems include lounge, living room, and front door. The home page of the control panel could include an image thumbnail of the underlying main system (this could even include an uploaded image within the user’s home) – no controls are presented on the home page. Clicking on a main system displays all the sub systems of the main system. The interface of this page would be identical to the main systems page except that the system titles will be different; sub system rectangles will also include image thumbnails to complement the headings and provide greater affordance. Clicking on a sub system will display the controls of the sub system and the entire control panel space can then be used to add new controls without dimensional constraint. Another benefit is that the time display will always be visible since no controls will need to be placed within the circle. This design change, however, is quite substantial compared to the initial design and will require the implementation of navigation which could be achieved with breadcrumbs located at the top of the control panel.

**Provide a list of recommendations for improvement, based on your comments above, in order of priority**

The following describes a list of improvements to the initial design in order of priority.

1. *Extensibility*

In practice, this design principle has the greatest priority; it also involves major changes compared to the initial design. The idea is that interface designs should be modular in order for systems to be expanded as requirements change.

2. *Visibility*

Controls should be clearly labelled regarding what their underlying use is and what the positions represent without ambiguity.

3. *Feedback & Safety*

Display a dialog that requires the users consent before changes to system settings take effect on the smart home.

4. *Contrast*

Use consistent contrast for system headings for both selected and unselected systems.

5. *Hierarchy & Emphasis*

Consider reducing the font size for the temperature displays below the system titles.

**Usability Evaluation**

The following provides a usability evaluation of the reviewed design using the Nielsen usability heuristic (Nielsen, 1994). Titles represent each heading within the heuristic followed by a description of potential concerns and possible remedial actions to resolve the related issues found within each title. Descriptions under each title also include a brief discussion of the reasons for remediation decisions with reference to the heuristic.

**Visibility of system status:**

Interface systems should provide the user with prompt feedback regarding the status of the system. Within the reviewed design, the user is well informed of both the current and target temperature within each air-conditioning zone. There is however an issue with the door lock on/off switch controls under the ‘Access’ system. The user is not provided visual feedback regarding what changes to the switch positions does to the locks. This issue is a concern because the user may mistakenly assume that sliding a switch to the ‘on’ position allows them to set the lock/unlock times successfully when in actual fact it opens the lock. The issue is significant since door locks are critical to home security and safety. Interface components that control access locks must be robust and unambiguous. This issue can be resolved by simply providing text labels underneath the switch controls to explain what the positions mean regarding the status of the locks. Changing the open and close times of door locks by first clicking on the appropriate door lock button could also be improved by replacing the buttons such as ‘Front door’, Side door’ etc. with radio button controls; radio buttons more effectively define a selection. Also, consider providing the user with steps such as the following:

‘to change the open and close time of a lock, first select a lock from the radio buttons below and then set the open and close time’

These changes will afford the user with improved visibility regarding the status of the smart home because controls and their individual settings would be clearly labelled and identified.

**Match between system and the real world:**

Interface designs must speak the native language of the user without jargon or ambiguity and follow conventions and the natural order of events within the physical realm. Heading, labels, and other text within the reviewed design is clear to the user and succinct without ambiguity or jargon. There is a potential issue with the temperature drop-down control that appears within the circle when an air-conditioning system is selected. The position and size of the control does not follow the conventions. The issue is a concern because within the physical domain, the temperature buttons (on a physical remote control) are usually the largest buttons and the most prominent. Although the issue is very minor, the temperature dropdown control used within the reviewed design is neither the largest nor the most prominent. A resolution to this issue is to make the temperature drop-down control and the circular temperature buttons larger and appear first – before the timer drop-down controls. The reason why these changes are desirable is because it more aligns to the physical domain and may be better aligned to most users’ expectations.

**User control and freedom:**

Systems must enable users to easily undo and redo current actions if they inadvertently click on a system function or modify the settings of a control by mistake. The reviewed design provides excellent use if this heuristic principle during the process of removing a device. When a device is flagged for removal, the system displays a friendly popup window (located bottom-right of the control panel) to either accept the request for system removal or go back to the main screen; the user is provided a clear exit strategy. There is a concern however with user control regarding undo/redo within each system of the control panel. The reason why the issue is a concern is because if the user changes a control/s (by mistake or intentionally), there is no way to revert the system back to a previously defined (acceptable) state without arduously checking that the settings of each control matches the user’s preferences. The issue is moderate in terms of significance; however, the issue may grow more significant as the complexity of the system and its requirements increase. The problem can be resolved by providing undo/redo buttons (using backward or forward arrows) positioned top-left on the control panel. This will enable the user to *freely* change the system back to the last previous state and adjust the controls accordingly. Clicking on the forward arrow until the button is disabled will adjust the control settings back to the most recent state. Additionally the issue can also be remedied by including a separate page to the control panel that enables the user to save a list of preferences; this can allow the user to build up different profiles for their smart home and select the profile they wish to use. Incorporating these changes will improve user control and flexibility over the system because the user will have the ability to undo/redo previous states and select from a saved list of profiles.

**Consistency and standards:**

Consistency must be inherent within the system interface; there should be minimal confusion as to whether words or actions have the same intent or effect. The design under review utilizes the same types of controls for the same purpose within each system. For example, the same slider controls are used to change the brightness of the lights and the same buttons (displaying a red cross) are used to remove systems and are positioned at the same location. Labels and titles are also consistent within systems and status images such as the WiFi connection image follows the convention of other systems. There is a slight issue with the temperature controls within the centre circle. The user may feel confused as to whether the up/down coloured temperature adjustment buttons and the temperature selection drop down means the same thing and the control size is also not consistent with the size of the timer drop-downs; the problem however is only a minor concern. The issue is a concern because users should not feel perplexed regarding why there are multiple controls that achieve the same purpose. Inconsistent control sizes also may hinder communication. The solution is to remove the temperature selection drop-down and show only the up/down coloured arrow buttons. The reasons for these changes are because it facilitates improved communication and consistency amongst the air-conditioning drop-down controls. Displaying only the up/down coloured arrow buttons also conforms to the standards of temperature adjustment arrow buttons that the user may have used with a physical air-conditioning remote control.

**Error prevention:**

Systems must be carefully designed and constrained to prevent errors in the first place which would otherwise display error messages to the user or apply the wrong settings. The system should also gain the users consent by displaying a confirmation dialog before any changes to system controls are applied to the smart home. The reviewed design correctly disables controls when the underlying systems are not selected to prevent unintentional modification to system settings. There is however a global issue to the design because the user is not provided with a consent dialog before they commit to a change of the system settings. The issue is a concern because a user may be curious and play with the settings whilst believing that their actions have not yet been applied to the smart home; the user may be taken aback when it is discovered that their modifications were in fact applied. This design flaw is quite significant because users should always consent to system changes. The problem may be rectified by including a button within each system such as ‘Apply Changes’ which when clicked will present the user with a consent dialog; the user will click ‘ok’ to agree to the change. Applying these changes will reduce unintentional errors of control settings when users interact with the interface.

**Recognition rather than recall:**

User interfaces should be designed that reduce the memory load on its users through making options clearly visible and recognisable rather than forcing the user to recall information/knowledge to complete a task. Regarding this usability principle, there is a concern with how the user accesses the options menu to add/remove subsystems. The user must recall that this menu must be accessed by first clicking on the gear icon located at the top-right of the control panel; this concern is only a minor inconvenience. The reason why it is important is because accessing the add/remove systems menu depends on the user recalling that they must first click on the gear icon; the first time a user interacts with the interface they may feel baffled regarding how to add/remove devices. Utilizing the red-cross icons however is done extremely well for recognition; users inherently understand that the red-cross means to remove a system. The issue can be fixed by extracting the add/remove button out of the settings menu and making it prominent on the main page of the control panel. A button icon (showing a plus sign) could also be used which would be better recognised by users regarding its meaning. The reason why this change is beneficial to users is because they do not have to recall how to access the add/remove menu; it is clearly recognizable and visible on the home page.

**Flexibility and efficiency of use:**

Interfaces may be designed to accelerate frequently performed actions by providing two methods of interaction that cater for both experienced and unexperienced users of the system. If the control panel software supports an inbuilt keypad (similar to a mobile device or tablet) than the control panel should support the ability to program in keyboard shortcuts to access different menus or system settings; the current design does not support this feature. For example, to change the on/off times for lights the user must first select the lights system and then click one of the four buttons displayed in the circle. A keyboard shortcut could be used to immediately activate one of the buttons to change a time setting. Also, changing the temperature requires pressing one of the up/down arrowed buttons or selecting from a drop-down. Both controls may be slightly less efficient then utilizing a slider control instead. This usability principle is important because experienced users will demand a flexible and more efficient alternative for their interaction. The issue is moderate in severity and can be corrected by providing the user with programmable keyboard shortcuts and implementing a slider control in addition to the up/down temperature arrows; these controls should also be clearly labelled so the user understands they have a choice on which control to use for temperature adjustment of a zone. With these changes, experienced and frequent users may be able to navigate the system more efficiently using keyboard shortcuts and change zone temperatures with ease.

**Aesthetic and minimalist design:**

Interfaces should be designed with hierarchy by showing the minimum amount of information the user needs to perform a task. The reviewed design does not communicate a strong sense of hierarchy to the user because everything is displayed on the home page of the control panel. This issue is quite significant and as mentioned in the peer review section of the critique will require the incorporation of main menus and sub menus to the control panel. The reason for concern arises due to the inability to add new features/controls to systems and the user can feel overwhelmed when presented with too much information up front. The issue is rectified by implementing a hierarchical menu system as described previously with the benefit of allowing the user to *drill down* through the menu system and interact with a specific page designated to the controls they need to adjust.

**Help users recognize, diagnose, and recover from errors:**

If errors occur when the user interacts with the interface then the errors should be displayed to the user in plain native language without codes and provide an accurate description of the error with clear steps the user needs to take to fix the error. No obvious sections in the reviewed design could be found that have the potential to cause errors. Error handling is important because sections of the control panel that display poor or inadequate messages when errors occur can be frustrating for users to solve. A user may, however, discover that changing the lock/unlock time of a selected lock causes an error because the selected lock is currently deactivated. This issue is moderate and a solution would be to provide a popup to the user that explains what the error is and why it occurred. For example, the popup could state the following: ‘you attempted to change the lock/unlock times of a selected lock. The request failed because the lock is currently deactivated. Please slide the switch control for the lock to reactivate’. Deploying error descriptions throughout interfaces is important because users should be notified and guided on how to recover from unexpected errors if they occur.

**Help and documentation:**

Interface systems should provide a help feature that explains how to use the features of a system. The help documentation should be focused to the user’s question. The currently reviewed smart home system does not provide a help utility and is a problem because users expect (and even demand) that systems have help functions built into the design. Systems that do not provide help support may be seen as unprofessional. The issue is quite significant and can be fixed by (at the very least) including a small circular button located at the top-right of the control panel that displays a question mark. Users can click the question mark to locate the support they need.

**References:**

Babich, N. (2017). Accessibility for Visual Design. In *UX Booth*. Retrieved

from https://www.uxbooth.com/articles/accessibility-visual-design/

Chapman, C. (2019). The Principles of Design and Their Importance. In *Toptal LLC*. Retrieved

from https://www.toptal.com/designers/ui/principles-of-design

Nielsen, J. (1994). 10 Usability Heuristics for User Interface Design. In *Nielsen Norman*

*Group*. Retrieved from https://www.nngroup.com/articles/ten-usability-heuristics/

Sharp, H., Preece, J., & Rogers, Y. (2019). *Interaction Design: Beyond Human-Computer*

*Interaction*. (5th ed.). John Wiley & Sons Ltd.

Showalter, J. (2018, Jun 28). *5 UX Design Tips & Techniques | UX Design Basics* [Video File].

Retrieved from https://www.youtube.com/watch?v=w6qyekgIo8I

Sonderegger, A., & Sauer, J. (2010). The influence of design aesthetics in usability testing:

Effects on user performance and perceived usability. *Applied Ergonomics*, *41*(3),

403 – 410.

West, J. (2018). Are you sure? – how user interfaces undermine consent. In *UX Collective*.

Retrieved from https://uxdesign.cc/how-user-interfaces-undermine-consent-

81551cf48777

**Appendix:**

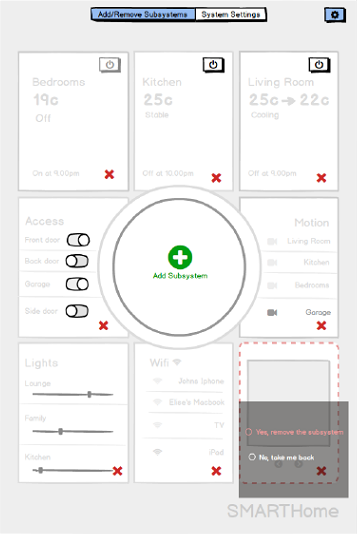
The following screenshots demonstrate the main interface decisions regarding the reviewed design discussed in this peer review and usability evaluation report. Figure one describes how the interface appears under the inactive state (no system selection). Figure two shows that the time display is replaced by temperature and time controls when the user selects the ‘Kitchen’ air-conditioning zone. Figure three shows the interface when the user clicks the ‘Gear’ icon button located top-right to add/remove a system.



***Figure 1: Inactive state (no system selection)***



***Figure 2: Kitchen air-conditioning zone selection***



***Figure 3: Adding or removing systems***