FINAL EXAM EQUIVALENT (online equivalent-Turnitin assessment)

**COURSE CODE AND TITLE:** **User Centred Design COSC2652**

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# Section 1

## Design Principles

Affordance:

* Affordance is the interaction and relationship between an environment and its individuals – interacting agents within the environment. The term, coined by James J. Gibson in 1966, implies the complementarity of an individual and the environment [1]. An object can afford its possible uses to the environment based on its qualities or properties.
* For example, while designing an application interface, labels can afford to help new users by indicating its functions. Imagine an application that has lots of different buttons with different colours, but you do not know what the function of each button is. Labels help presenting the choices that a user can make, proving its affordance within this environment.

Learnability:

* Learnability indicates how fast and easy it is for new users to comprehend and get comfortable with the design patterns and concepts of the application. A learning curve is often mapped out and used to determine how long it takes for users to reach saturation, the point where users have learned as much of the interface as possible [2].
* For example, if you were to design a control board for a nuclear power plant, you would want to make sure the workers to quickly know which button shut down the power during an emergency. You would want to invite test users who are representative in the field to the lab. You then create different scenarios in which the users need to act quickly and perform necessary actions to prevent a nuclear disaster while measuring the time taken. You would want to invite them back again and measure again. After several repetitions of this process, a learning curve is produced and will determined the learnability of the system.

Usability Engineering:

* Usability engineering concerns with the improvements of interface designs to achieve highly interactive and user-friendly human-computer interface. Usability engineering will involve testing interface designs at different stages of a development process. These tests can be either performed with normal test users or usability experts. By adhering to the process of usability engineering, the resulting product can achieve high usability and prevent problems after release. [3]
* For example, after the initial design of your interface, you would apply usability engineering to further improve and enhance the test users’ experience and eliminate problems before deploying the application.

Empirical Testing:

* Empirical testing describes how one tests their hypothesises and theories through various experiments with real test users. The resulting evidence or data can be gained either by direct or indirect observations. These data later be analysed quantitatively, mathematical oriented, or qualitatively, creating structures through common features with unstructured data [4]. The data can later help researchers answer their empirical questions.
* For example, you hypothesize that the redesign of your user interface might be worse than the old design and driver new users away. You do some empirical testing, see if when comparing the old interface to the new one, do test users like it more or dislike it.

Usability Lab:

* Usability lab is the place where usability testing is performed. It is an environment specifically tailored to provide the researchers the ability to watch user interactions closely, make their notes and record necessary data. These data can be ranging from simple data such video and audio feedback to eye tracking and heatmaps. [5]
* For example, to perform the nuclear power plant learnability test as mentioned above, researchers would need to recreate a control room similar to those in a nuclear power plant. This room will be fitted with various camera angles and have data logging enabled on the test computers or interfaces.

Contextual Inquiry:

* Contextual inquiry is a research method in which the test user and the researcher usually have a one-on-one interview, where the researcher will observe the user doing the given tasks. The researcher will often shadow or apprenticed the test user while they are carrying out the tasks to understand the rationale and behaviour behind it. Notes and recordings are also used during the interview for later use if needed. At the end, the researcher will make final corrections to their notes. These notes can be used to find similarities between each contextual inquiry sessions. [6]
* For example, you as a researcher for CAT (Caterpillar Inc.) wants to understand how workers are using your excavators. You schedule and conduct a contextual inquiry with a construction worker. You let the worker operate the machine while you note down his actions, how he uses the different shifters, what he likes and dislikes about the machine, quirks if there are any. At the end you observed that having 2 shifters too close together can lead to mishaps where the worker operates the wrong shifter.

## Web Design Patterns

Example 1: <https://edition.cnn.com/>

* On CNN’s international news website, a hamburger menu can be seen on the top right of the page. These hamburger menu icons are often indications of a collapsible panel.
* Upon click the icon, a large panel with sections and subsections is shown, taking up over half of the screen space.
* Although the sections can already be seen on the top navigation bar in without using on the collapsible panel. This panel provides a much more in-depth option for users. For example, the Business section has 6 subsections under it, giving users a more detailed selection of news.
* Without using the collapsible panel, selecting the section on the top bar will redirect the user to the section’s news page with subsections on top. Selecting the subsection will then redirect the user to the subsection’s news page. This takes some time if the user already knows what kind of news they want to read.
* With the collapsible panel, users can select a subsection straight away, cutting out the section middleman, and, subjectively, improving the load times. More sections can also be found inside the collapsible panel, i.e. Features, More, Weather.
* The collapsible panel used by CNN is especially beneficial in giving users more freedom and wide range of options. CNN also retained the original option of entering sections through the top navigation and replace it with subsections when redirected to a section page.

Example 2: <https://www.nbcnews.com/>

* On NBC’s news site, we can observe the same pattern. Hamburger menu icon on the top right, opening it takes up the whole screen and presents some options that are also readily available in the top navigation bar.
* NBC’s site does not seem to have subsections within sections. Opening the collapsible panel give us a wider range of sections, much more than the 8 section in the original view of the top navigation bar. But some sections are missing in the panel such as “Podcasts” and “Asian Pacific American Heritage Month”.
* Aside from the sections, the panels also provide a wide range of options from NBC’s news network, i.e. MSNBC, Dateline from NBC television shows, Asian American, NBCBLK and NBC Latino for ethnic oriented news.
* NBC’s collapsible navigation panel provide users a wider range of sections to select from while also promoting their own TV shows and news stations, keeping the users in their news network and ecosystem. Users can also discover interesting and innovative featured sections such as Think and Better through the collapsible panel.

## Mobile Design

* Scenario: We are designing a mobile application for image editing; it should provide users a wide range of options to edit their pictures with different effects and layers.
* Challenges: Since image editing has always been a difficult task, it requires a lot of inputs and precision from the user. For example, if the user wants to adjust the saturation to 70, they must type it in, which means prompting the keyboard and blocking views of the image. Furthermore, users’ mobile phones come in different size, make a stroke on the screen using your thumb on a phone with a large screen is different from one with a small screen, a thumb on a screen also blocks your view of the image because of the Fat Thumbs and Fingers effect [7].
* Solutions:
  + All inputs which requires integer precision should use a slider instead of input box. The slider should show the value it is currently at and have a snapping function that can help user snap value at a specified multiple, e.g. slider will snap at 5, 10, 15, etc.
  + For editing that requires the use of your thumb to draw or make a stroke, we will not use the users’ thumb as the stroke itself but implement a cursor or marker of sort. This cursor should be a shaped in a circle with adjustable width (or diameter) and represent the pen/brush that is going to interact with the editing image. Users can use 2 fingers to place the cursor where they want and 1 finger to use the cursor. This gives users precision in drawing/editing while also not blocking the user’s view of the image with their own thumb like before.

## Survey and Interviews

* Scenario: You are hired by a local restaurant and tasked with redesign their website to a more modern and youthful look, departing from the old 2000s design.
* A formal interview and surveys might be useful when being used at the beginning or near the end of the design process.
* At the conceptual stage of the design process, formal interviews and surveys can be used to understand what the user really wants from the new design and do not want from the old design. Knowing the general direction and what to avoid can save a lot of time and effort. Though on a larger scale, this is very ideal as everybody wants something different and have different tastes. A way to circumvent this is avoid open ended question on critical design elements and use multiple choices. You can determine which feature or design to prioritize by ranking the multiple choices from most wanted to least wanted.
* At the end of the design process, before deploying, conducting another round of formal interviews and surveys will help concrete down the designs and do last minute adjustments. We can use questions that users can rank from 0 to 5 on how much do they like the feature. Problem with these kinds of ranking questions are the neutral choices, e.g. 3 from 0 to 5, 5 from 0 to 10. Do they like it or dislike it? . To tackle this, using even numbers of rankings like 4 or 6 can force the user to make up their mind and avoid unusable data.

## User research

* An example where a direct interview is preferable to indirect observation is when you want to have detailed feedback from test users and want to listen to the users’ thought process as well as rationale while carrying out the tasks.
* Direct observations can give a more in-depth view on the issues at hand. It can also provide us unrevealed patterns or problems on usability that we would not encounter through indirect observations.
* Contextual interviews, on the other hand, can walk us through the thought process of the user, how they reach the completion of a task. The most common model is the Master Apprentice model, where the test user acts as the Master and the researcher acts as the apprentice [2]. The Master, test user in this case, will walk the apprentice, the researcher, through their actions and the rationale behind it.
* What differentiate direct observation from contextual interview is that one is carried out in a more analytical way while the other focus on the interaction with test users in the freedom of their own environment. Furthermore, direct observation often has structure and follow a strict timeline of events while contextual interview is more natural and unstructured.

## Accessibility

* A visual disability can impact greatly on the accessibility and design of websites and applications. Visual impairments such as colour blindness, blurry vision, tunnel vision, clouded vision or blindness will add more constraints and extensive work in designing the interface. For example, an interface where the colour red and green are used in close proximity might be a hard for people with red-green colour blindness to identify the coloured sections. This restricts your choice of colour or at least where you should put certain colours when designing. And for blind users, the extensive use of images in favour of text will affect the screen reader, how blind users perceived an interface.
* For colour blinded users, avoid relying colour cueing information. Give sections of buttons a large border around to help user’s contrast different sections of the interface. Use labels or icons for buttons to express its function.
* For low vision users, going for a larger font would help as well as using a sans-serif font to help users quickly and easily identify characters.
* For blind users, we go for a more verbose and “wordy” design. A lot of text with context means a lot of information being perceive by the user through the screen reader. Prioritize the usage of keyboards over mouse or at least supply a keyboard alternative for functions that requires a mouse usage. Images should have an alt text that provides the description of that image. Implementing a way for users to skip long lists of navigational menu items. [8]

## Behaviour Analytics

Scenario:

* You are hired and task to implement a new cart function for an international shop. The shop has not had a cart feature, users can only checkout 1 item at a time. (Yes there is a shopping platform that does not implement a cart in 2020 [9])
* After implementing the function, you are permitted to conduct a large-scale experiment where you can collect users’ data whenever they use the website. The data you chose to collect are mouse heatmap, mouse click frequency and what dishes were ordered. After cleaning and sanitizing the data, you proceed to redesign the interface and add in new features.
* Through the mouse heatmap, you realised that grouping the Cart button close together to other important buttons such as Log In, Sign Up or Contact creates less mouse footprint and travel time for the users. This greatly improve the efficiency of the whole system. Even minimal increments in travel times can be very crucial for a large business [10].

# Section 2: Smart Halo 2

## Assumptions

* It seems to be equipped with almost every function that can greatly enhance a bicycle, i.e. anti-theft, GPS navigation, fitness tracking, headlight. It seems to have tackled most of the inconvenience for a cyclist.
* It is amazing that the product is an all-in-one device with a very reasonable size while being easily mountable.
* The user population for this project should be a very wide range, from basic daily commuters who bikes to work to cyclist enthusiasts who practice for the Tour De France.

## Users

* User population:
  + People who uses bicycles on a regular basis, maybe using it as the main means of transportation
  + With a reasonable price for a device that does so much, people in all financial circumstances that can own a bike can buy this device
* User groups:
  + Daily commuters
    - Age: 18-30
    - Gender: Male or Female
    - Biking frequency: at least 30 minutes per weekday
    - Physical Strength: Normal body build, cycles around 30 minutes per day
    - Tasks/Goals:
      * Cycle to work and lock it safely
      * Cycle around with friends on weekends
      * Exercise around the neighbourhood
  + Cycling Enthusiasts
    - Age: 20-40
    - Gender: Male or Female
    - Biking frequency: 1-2 hours per day
    - Physical Strength: Have good endurance, can cycle up and down hill
    - Tasks/Goals:
      * Track physical fitness data
      * Get weather data to plan out the trip
      * Lock bike safely from thieves
* Persona:
  + Name: Mike Deaney
  + Photo: 

1. Source: <https://www.dailymail.co.uk/health/article-2939322/Father-mysteriously-develops-love-cycling-receiving-heart-transplant-bike-enthusiast.html>

* + Personal Profile:
    - Mike is a 30-year-old who fell in love with cycling after his heart transplant.
    - He tried cycling before so he owned a bike before getting another one after the heart transplant.
    - He works at a paper company and loves watching football, he supports Liverpool. During his heart transplant journey, he connected with a lot of his friends and families through social media.
    - What started as a simple heart exercise for him turned into a passion for cycling. He started cycling to work then starts to cycle to the countryside on weekends too.
    - Losing his old bike at work, he wants a robust alarm system for his new bike. Also, the unpredictable weather in the UK proved it hard for him to go on a bike trip.
  + Attributes:
    - Middle class
    - Smartphone and Internet user
    - Loves cycling and travelling
    - Spends time on social media to update on his biking trips

## Tasks

* Conceptual model: A robust and all-in-one system to answer all the common cycling problems while providing an even better cycling experience for users.
* Core tasks:
  + GPS Navigation support. The Smart Halo can be connected to your smartphone through an app. You can simply set your destination, specify your preferred route type, and let the app find you the best route possible. The LED halo coupled with the screen display on the device can act as a GPS guiding you to your destination, which can also be used as a compass.
  + Anti-theft support. The device is armed with a very loud alarm that will fire off whenever there are strong movements without the owner’s phone nearby. The sensitivity level can be adjusted to the user’s liking.
  + Fitness support. The device automatically tracks the owner’s cycling data such as speed, distance, etc. and saves to a fitness app of the owner’s choice. These metrics are also displayed in real time and can be seen on the device’s main LED display.
  + Headlight support. The device also sports a bright light that have various modes and types of headlight depends on the situation. It also automatically turns on and off accordingly if it is day or night.
* Complex tasks:
  + Phone integration. The device can be integrated with a wide range of applications on your smartphone. You can call or text your friends while riding or check the weather or even calendar. All you need is to install the supported applications on your phone.
  + Shortcuts. Owners can create their own shortcut which will run a predetermined sequence of events on the Smart Halo.
* User errors:
  + A large LED screen upfront might be very distracting for users to focus on the road, especially in a situation where there are lots of traffic

## Evaluation

* Normal usability lab:
  + A suitable evaluation should have an indoor exercise bike and a large screen up front to represent the outdoors, streets, traffic, etc.
  + The focus of this research would be removing or move redundant functions out of the way, bring the most used ones up front and easily accessible. Also, the accuracy of fitness tracking.
  + An empirical evaluation would be conduct using empirical testing with qualitative analysis, determining how long it will take for a user to fully discover all the functions of the devices or how much of the functions are actually being used.
  + Types of data being collect would be time, amount of interactions, how much of the functionalities are being used. The fitness tracking data such as BPM (using an EKG), calories burned, total distance, speed, etc.
  + Through collecting the data, we would analyse what is the total amount of interactions over the total period of the session. Getting the frequency of interactions, how often users are actually going to use the device while cycling.
  + For fitness tracking, the indoor exercise bicycle’s data will be logged and compared with the data logged from the Smart Halo.
* Online testing:
  + Test users would be screened. Only those that own an indoor exercise bike will be able to participate.
  + Since an EKG cannot be hooked to the test user to track their BPM, and the users’ exercise bike won’t have data logging, only the functionalities redundancy will be tested.
  + The user would set up a camera that captures the whole cycling session as well as a smaller camera to record the screen of the Smart Halo.
  + We would collect data on the total time taken, the amount of interactions and how much of the functions are being used.
  + Analysing the data would give us the frequency of interactions, seeing how much a user interact with the Smart Halo. We can also see the amount of functions being used and rank them in a descending order, determining which one is redundant enough to be deleted.

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