

HUMAN COMPUTER INTERACTION

AIRLINE ORDERING SYSTEM

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GROUP 2

Semester 2

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Research into User Interface – Fundamentals for Design

To begin with my project, I decided to first research into the primary requirements when designing a user interface that is intuitive and not complex to interact with, and I came across an author Don Norman and his second edition of the “*Design of Everyday things*” which gave me six principles that I would be applying to my overall design. Below I would summarize the 6 key concepts and later expand on how I used these ideas to build my interface.

Six key principles every designer must consider when designing an interface include affordance, signifiers, constraints, mappings, feedback and a conceptual model. Affordance refers to the relationship between an object’s properties and the capabilities of an agent to use those properties to perform a task. Users would not need to read instruction manuals if the interfaces affordance is perceived. While affordance determines possible actions, signifiers communicate where these actions can happen. It was stated that people search for signs that would enable them understand and cope with a system therefore designers must include such clues in design. Natural mapping of elements in a design should follow universal standards such as moving up signifies more and moving down signifies less. Feedback must be immediate, because delayed feedback is normally disconcerting and discourages users to continue task. Feedback is advised to be more informative than critical and poor feedback is worse than none. This is because poor feedback can be irritating and anxiety provoking. Feedback must be planned and presented in a way that is unobtrusive, prioritizing important feedback, if every action gives a feedback it creates noise and nothing is gained. Conceptual models are mental models users create of how a device works. Without a good model users tend to blindly operate the device on a try and error mode, without fully appreciating how the interface works. (Don Norman, 2013, p.72).

User Experience

Don Murray (2013, p.63) also mentions that users tend to blame themselves when something doesn’t work and think they are not smart enough instead of blaming their actions on the bad design. This can cause helplessness. He says designers ought to bridge the gap between the gulf of execution (where users try to figure out how it works) and the gulf of evaluation (where they figured out what happened). Another important aspect mentioned is minimizing the chance of inappropriate actions, designers should anticipate such mistakes and design to enable users rectify them.

Users do rely heavily on knowledge of the world to perform a task, if knowledge in the head and knowledge in the world is combined performance is improved (Don Murray, 2013, p.77). Knowledge in the world include simple cues that tell the users what to do, while knowledge in the head is some of the basic knowledge users have from using previous interfaces. Short term memory or working

memory only has the capacity to hold information for 5 – 30 seconds and based on research the storage capacity of short term memory has decreased from 7 ± 2 to a size of 3 - 4 items today (Koyani et al, 2004 cited in Wilbert O. Galitz, 2002, p.78), keeping in mind that these capabilities deteriorate with age.

In conclusion, my design should be effective, efficient and satisfactory to user's needs keeping in mind all the factors that affect users when confronted with an interface. To meet such requirements my design would have helpful messages that enable users continue to carry on task, a lot of the task in the interface would not rely on users having to enter in data because as mentioned above this can lead to a lot of mental errors especially if attendants are older. Other factors such as background colors, fonts and button sizes will be discussed below.

DESIGN DECISIONS – RESEARCH

After reading on general guidelines of how to create an effective user interface, I decided to do more specific research on elements that would enhance the user experience with my graphical user interface. What people preferred when using touch screen devices to perform a task, and using scientific theories to back up some of the decisions I have made.

Colors

Color is an important factor when designing, color has helped users improve performance (Kopala, 1981; Navy and Sanchez, 1992; Sidorsky, 1982 cited in Wilbert O. Galitz, 2002, p.700), research has found that people find it difficult to ignore color similarities of grouping principles. It was suggested that users have stronger perception for colors than grouping or proximity (Beck and Palmer, 2002 cited in Wilbert O. Galitz, 2002, p.695). Studies have shown that people read text on lighter backgrounds with dark text up to 32% faster than light text on a dark background (Koyani et al. 2004 cited in Wilber O. Galitz, p.177). With today's high resolution screens, it was recommended a background of low-intensity or desaturated colors. Therefore, I have chosen my background color to be a **light grey color with text color black or dark blue**. About 8% of males and 0.4% of females have a kind of color blindness and the highest deficiency being the green-viewing deficiency (6.3%), followed by the red-viewing (2.04%) and then blue-viewing (0.003%) (Barnett 1993; Fowler and Stanwick 1995, p.698). With this being stated I have decided to use a blue background for my buttons with white text, in some areas of the design while most of the design would have a light background with dark text, this is because the red and green viewing deficiencies do not have any problem viewing blue, but for people with the blue – viewing deficiency tend to view the color as green which from the color connotations known is not an alarming color it is normally

optimistic (Gotz 1998; Stone et al 2005, p.698) and the user should rely on the text to continue task. Studies have also shown that the maximum number of colors that a user can handle at a time is with 4-10 colors the smaller number being more acceptable (Luria et al, 1986, p.700). Therefore, I would be introducing blue and shades of grey to demarcate sections and on occasions serve as signals for active buttons.

Fonts

Based on preference it has been found that users prefer the sans serif fonts to the serif fonts even though there was no difference when subjects were asked to do a proofreading task (Tullis et al. 1995, p.170). Another comparison of 8 fonts was carried out by Bernard et al (2001a, p.170), he compared the serif fonts of Century Schoolbook, Courier New, Georgia, and Times New Roman and the sans serif fonts of Tahoma, Verdana, Comic Sans and Arial and it was found that Arial and Times New Roman were read reliably faster than the other fonts. Therefore, in my prototype design these two fonts will be used. Since there are from different font races Arial(sans-serif) and Times New Roman(roman), they will be allocated different tasks the Arial type face will be used for naming buttons, labelling and heading while the Times New Roman will be used solely for labelling where it is appropriate. Thereby allowing the sans-serif typeface to dominate as recommended by Wilbert O. Galitz, (2002, p171). Bernard and Mills (2000) analyzed 10-12 point Times New Roman(serif) and Arial (sans serif) and the 12-point size was preferred. For older users Bernard, et al. (2001b, p.172) evaluated the font size 12- 14 for the same fonts and the average of 70 years with a range from 62 – 83 years had better reading efficiency with the 14-points using sans serif. Wilbert O recommends that 12 points yields faster reading speeds and is preferred by a wide range of users. Therefore, this size font will be used in the interface.

Icons

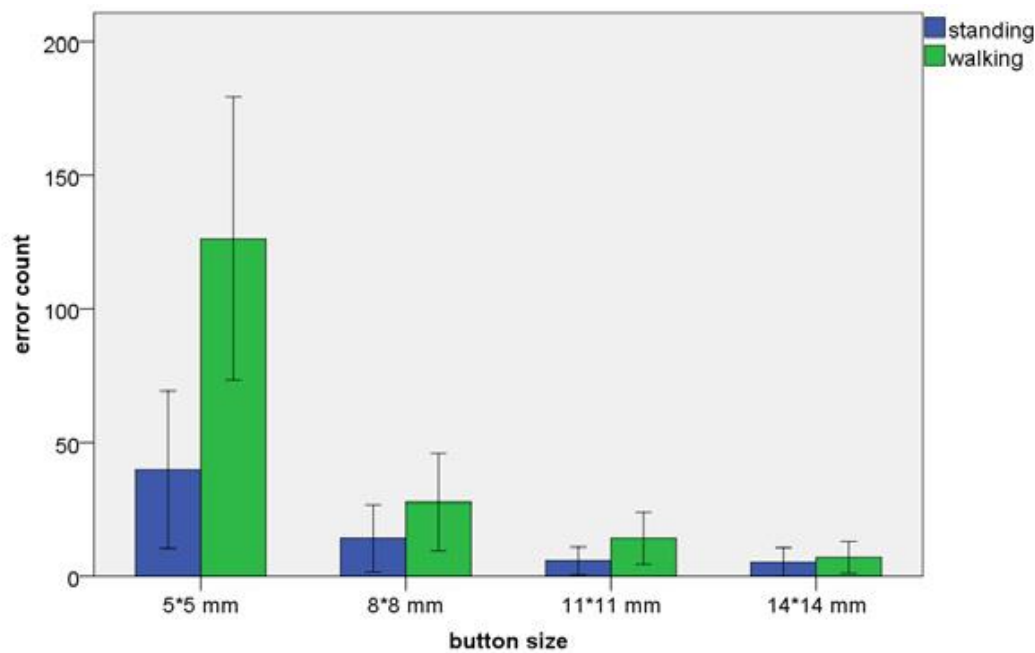
According to Wilbert (2002, p.657) the use of icons speeds up recall and learning and it yields a more effective system. Some of the general guidelines stated by Fowler and Stanwick (1995, 658) include what the icons used in an interface design its function must be obvious and interpretable. They also stated that the minimum icon size should be 16 x 16 although a more effective icon will be a 24 x 24 or 26 x 26 in a 32-pixel square icon which is what I have adopted for my design. Byrne (1993, p.662) discovered that using icons with less graphical elements were found faster in a visual search other than icons with complex components. To further choose icons the ISO standards were used focusing on Function – using back buttons and the home button, Abstraction the use of check marks and crosses, Generic Object the use of the basket to indicate what the attendant has

put in the basket and the caution button to relay important information (ISO, 2011). A representation of icons used is shown below.



Buttons

Visual acuity is reduced by 20% while walking, this shows that walking influences human capabilities (Jessica, Olivia & Thomas, 2015). It gets more difficult to be precise when interacting with buttons on an interface while walking, this leads to higher effort and increased errors depending on button sizes (Jessica et al, 2015). Below is a table that shows the standard deviation on error count while standing and walking. From the table I concluded that error rates reduce as button sizes increase



Button size – (Jessica et al, 2015)

Smaller buttons such as 5*5mm button sizes are too small for interacting while standing or walking. AN 8*8 would still trigger errors but the time on task does not differ from larger buttons. 11 * 11 a 14*14 mm have the lowest error count, and the 14*14 was recommended for suit the conditions for walking and standing. Smaller buttons such as 8*8 can still be used if there is an affordance for undoing errors (Jessica et al,2015). Due to my findings, the button sizes on my interface will be

majorly larger buttons 11*11mm (41x41 pixels) and 14*14mm (53 *53 pixels), and in places where I use 8*8mm (30 x 30 pixels) or less the design will have an affordance for undoing mistakes.

Hierarchical Task Analysis

1. Create a new customer account for seat

Plan 1: Do 1.0, 1.4 for every customer wanting to place an order

- 1.0 Click to open ordering system
- 1.1 View categories listed for passengers on the flight
- 1.2 Click on the corresponding button depending on seat number
- 1.3 View Menu page opened

2. Add food items to account

Plan2: Do 2.0 – 2.3 in that order or Do 2.0, 2.1,2.2 and 2.4 depending on how user wants to access next category

Do 2.2.1 – 2.2.3 depending on order or if user has made a mistake

- 2.0 View the caution message box
- 2.1 Press the menu button to display a list of available options to the customers
- 2.2 Select one or multiple options by tapping the + buttons that represents item
 - 2.2.1 To select 1 item, tap + button or – button to unselect
 - 2.2.2 To select same item but more than once tap the + button desired number of times, to reduce item tap the – button the desired number of times.
 - 2.2.3 View counter to show number of item selected
- 2.3 Tap the back button to go back to previous category page
- 2.4 Or Tap the next button to view next category page

3. Modify a food- order

Plan3: Do 3.0 – 3.1 if an item needs to be removed

Do 3.0 & 3.2 if an item needs to be added or skip if order does not need modification

- 3.0 View the list of items put in the basket at the top of the screen by tapping the basket button.
- 3.1 Press the - button to remove any unwanted order that was added to the list
- 3.2 Press the + button to add to order
- 3.3 Go on to step 4

4. Place final order

Plan4: Do 4.0, 4.1,4.2 if order is to be placed

Do 4.6, 4.7 and 4.8 if order is to be cancelled

Or 4.9 if order wasn't meant to be cancelled

- 4.0 If order is final press the tick left button to order food
- 4.1 View pop up menu that ask to confirm if order is to be placed
- 4.2 Press the tick button if yes
- 4.3 View the confirmation pop up box and press the tick button
- 4.4 Press the cross button if no
- 4.5 View the review order tab

- 4.6 Press the cross button on the right-hand side if order is to be cancelled
- 4.7 View pop up menu that says ask again if order should be cancelled
- 4.8 Press tick button if yes
- 4.9 Press cross button if no

5. Recalling the order for modification

Plan5: Do 5.0 to modify order that has been placed again

Under 5.0, do 5.0.1, and then 5.1

- 5.0 Press the history button to show previous orders
 - 5.0.1 Select order you want to modify and carry on to step3
- 5.1 Tap the home icon to navigate back to home page

ERROR ANALYSIS FOR FOOD ORDERING SYSTEM

TASK	ERROR MODE	SYSTEM CONSEQUENCES	IMPLICATIONS (PROCEDURAL, DESIGN)
1.2 Click on the corresponding button depending on seat number	07 Choosing the wrong seat number	Categories tab is opened for wrong seat number	<p>Design: Seat number button should be highlighted when tapped</p> <p>Design: Seat number should reflect on the name of the form when opened</p> <p>Procedural: User can use the back button to go back to home page. The back button will provide that functionality</p>
2.1 Press the menu button to display a list of available options to the customers	A7 User presses tab for order placed but wants to start with a food Items	Form for category comes up	<p>Design: Have back button to navigate back to wanted page</p> <p>User can then navigate to required section</p>
2.0 View the caution Message box	I1 User does not see caution box	System will work fine, but consequence might be fatal to passenger health	<p>Design: Use icons and labels to relay the information in a way that is effective.</p> <p>The caution box will be above the categories so user cannot miss it</p>
2.3 Tap the back button to go back to menu page	A7 User presses the next or back button to go on	Form for that category comes up	<p>Procedural: User can either keeping on tapping the buttons to go to required category</p>

2.4 Or tap the next button to view next category	to category not intended		Or navigate to the categories menu and tap category intended
3.1 Press the - button to remove any unwanted order from the list	A7 User reduces item that wasn't meant to be reduced	Order will be reduced	Design: Add functionality to rectify mistake Procedural: Do 3.2 rectify mistake.
4.0 If order is final press the tick left button to order food	C3 the cross button is pressed instead	Order might be potentially cancelled depending on actions of the user	Design: Pop up menu to ask if order should be cancelled Procedural: User is now being given a second chance to avoid error.
4.6 Press the cross button on the right-hand side if order is to be cancelled	O7 Order was not meant to be cancelled	Order is cancelled	Design: Make all orders cancelled or placed show in the history tab so order can be modified Procedural: User views the pop up menu that ask again if the order should be cancelled
5.1 Press history button to show previous orders	O4 History button is not press appropriately to reveal list	List of previous orders or cancellations is not shown	Design: Change tab color to indicate tab has been pressed and show list of items below

First Design

Icons selected based on ISO 11581 recommendations

HTA 2.1 Categories page, user is given limited choices at a go to avoid overwhelming user

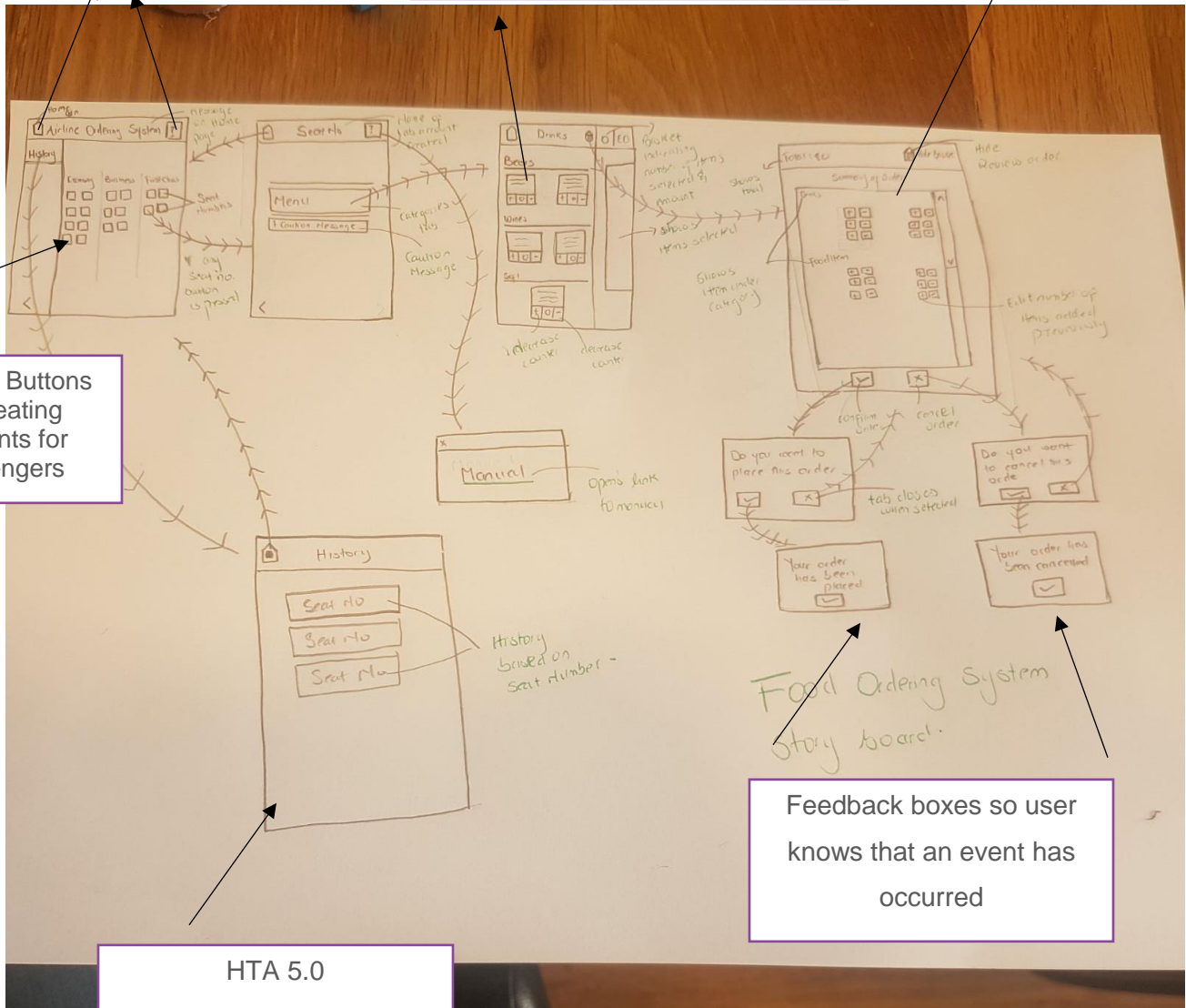
Edit page for order placed
HTA 3.0

HTA 1.2 Buttons for creating accounts for passengers

HTA 5.0

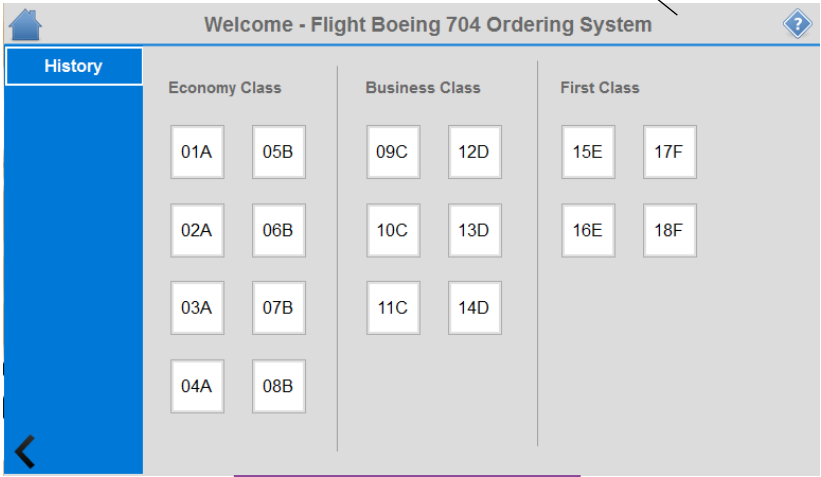
The history page to recall orders already placed

Feedback boxes so user knows that an event has occurred



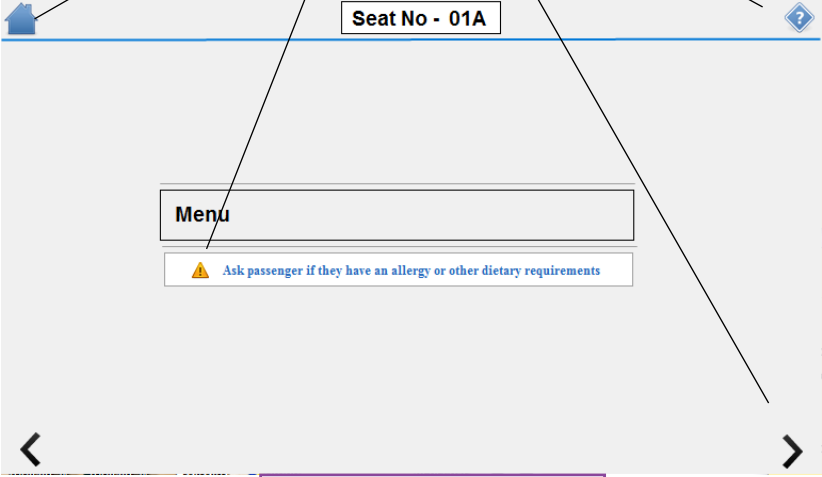
Bright background so that font can easily be read. Font Dominating is the Arial in 12pts

Prototype Design



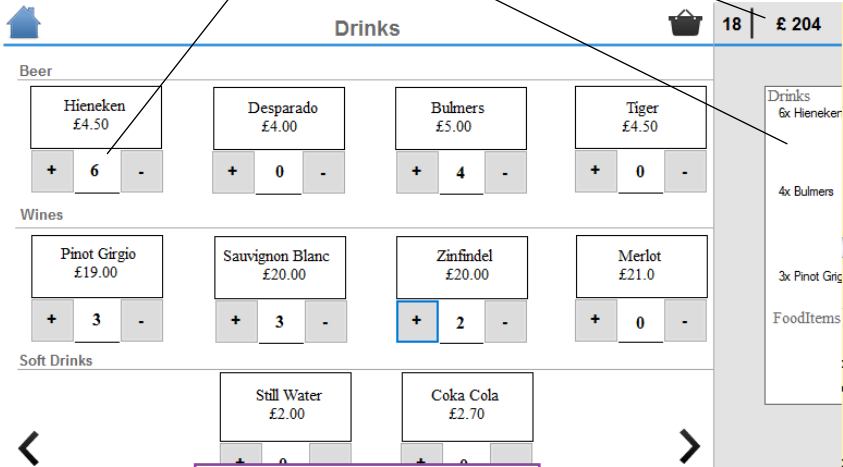
HTA 1. 0 + 1.1

Icons that clearly communicates what it is used for



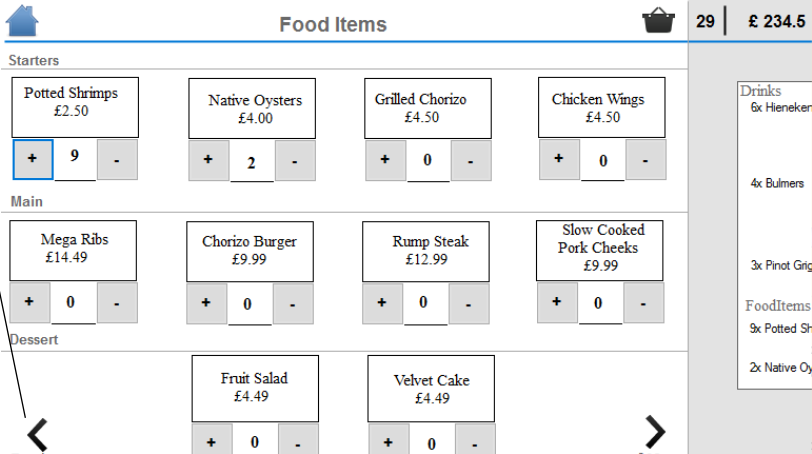
HTA 1.3 + 2.0

Visual feedback for users when plus or minus buttons are pressed



HTA 2.2

Back buttons incase user make mistakes they can easily navigate to correct destination



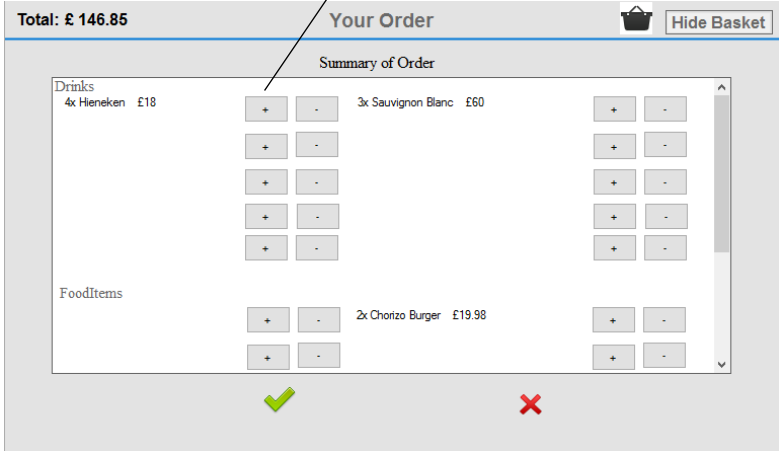
HTA 2.3 + HTA 2.4

Simple and Clear choices for users

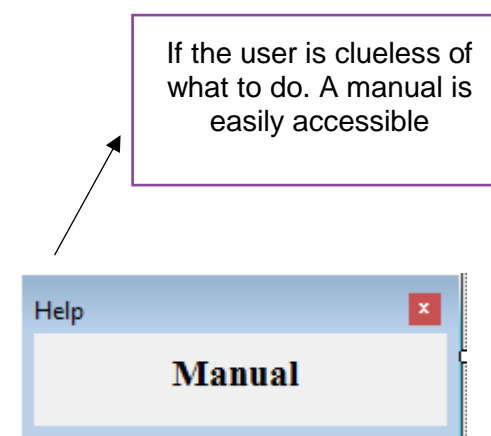
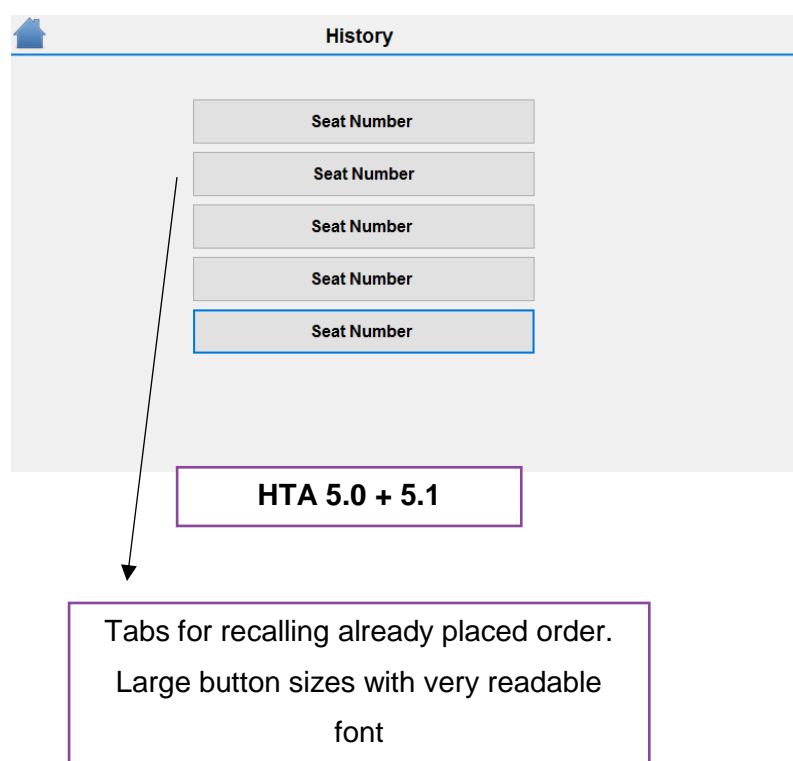
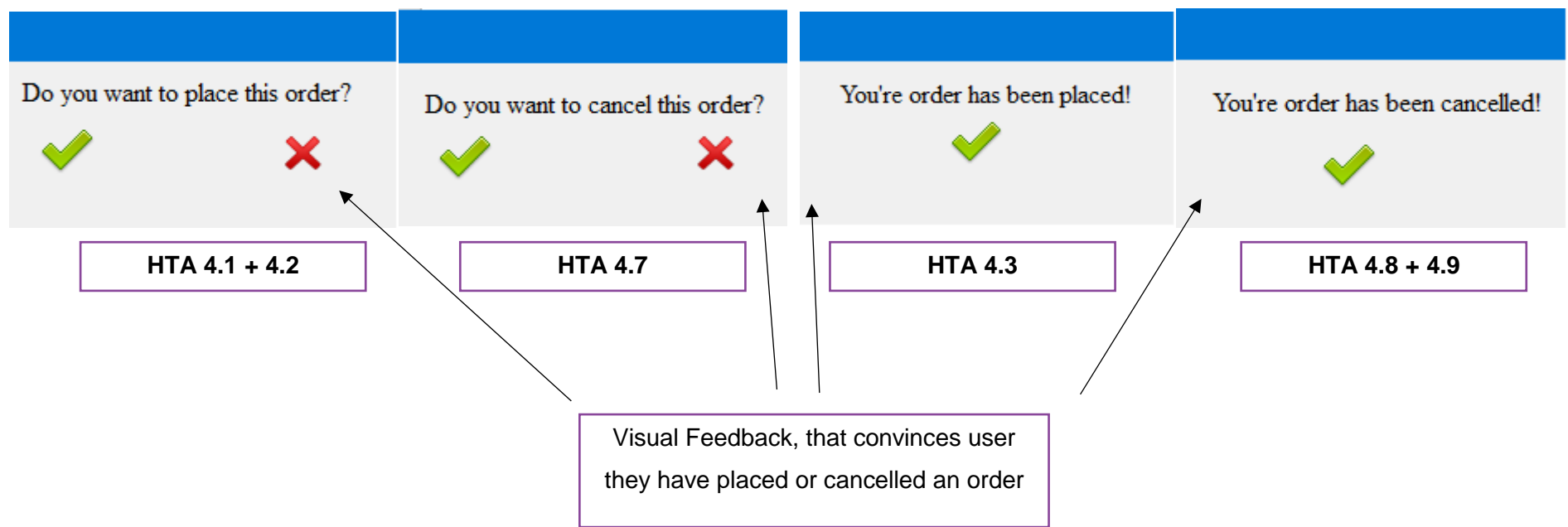


HTA 2.3 + HTA 2.4

Large buttons to help users edit orders made



HTA 3.0, 3.1 + 3.2



Testing

An initial testing was carried out with 4 users of different educational backgrounds and work experience. 2 females and 2 males, below are the details of task they were meant to carry out and their individual feedback and suggestions. First off is a friend, she studies accounting at the University of Salford, but is also a team leader at one of the Old Trafford United stadium kiosk. The second lady is a house mate, who also goes to the same University but is undergoing a master's degree in Health and Safety, she is also a part-time support worker. Another house mate, who has concluded his master's in petroleum and gas and lastly an acquaintance, who is a current master's student taking a course in procurement, logistics and supply chain management. The four users were timed and given different task to take on after which they were asked for feedback and suggestions if they had any. These users can be termed as being intermediate users with technology and are very well versed with how applications work. Although they are well skilled in that area only one of them has experience with operating ordering system (the team leader at old Trafford).

User 1

This user was asked to place a wrong order, cancel it, place the right order and then recall order placed. This task took him 4:18 secs. He felt it took him longer to finish task because he found trying to recall order a little bit difficult as it was not very clear what button would help with that. When he finally decided to select, the help button this was based on trial and error not because he was convinced that the help button would help him get the task done. He suggested that the history button be more visible to users than hidden in the help icon and he suggested that one font be used in application instead of a mixture of times new roman and Arial, he found that Arial was more appealing than times new roman. He also suggested that the background color for the categories page be a different color than the buttons that held the items so they stand out more. He thought the generally design was not too complicated and the button sizes were good enough.

User 2

For my first user, she was given the task of creating an account for a seat, taking an order, placing the order and then try recalling placed order. She managed to finish this task in 2:56 secs, when asked if she found the application difficult or straight forward and to give her reasons for her answers she said using the application was straight forward, she also thought that she had to use her intuition to view the Review Order page and felt she knew that would show her what she had ordered because she is conversant with online shopping and the baskets normally would show you what you have put in them. She advised there should be an alternative button for older users who

wouldn't have the same thought process as she did. She found that the options of what to do were clear, and had no problems with the button sizes, color or fonts.

User 3

This user was given the task of firstly locating a manual to using the ordering system, after it is then read he should create an account for two users separately, take their orders and place them. He finished his task in 4.15 seconds. User 3 is also short sighted and did not have problems with reading fonts and navigating the system. He thought the ordering system was straight forward to use.

User 4

This user had the same task as user 3 did but did not have to read the manual before doing required task. It took her 4:26 seconds to complete given task. She thought it was also straight forward and easy to use and had no problems understanding and carry out task. Although she wasn't quite convinced of which seat numbers she was placing the orders for as she had not noticed that this information was stated at the top of the page when a seat number account was created. She blamed herself at first for not noticing this but other users also confirmed that it had not been obvious. So, she suggested I made that bit stand out more so users knew who they were creating accounts for. She thought the color, fonts and layout of the application was user friendly.

Further Testing

After feedback from my first set of users I decided to make some modifications to the prototype design and then present it to a new set of users, to see if this improved usability of the application. This user testing was based on users that are novices and intermediate users.

User 5

The first user is a supervisor at the Manchester arena, he operates a till when reading off orders from suite attendants and is conversant with how taking orders work. He is a final year student at the university of Salford doing a degree in aeronautical engineering. It took user 5 a total of 2:39 seconds to finish Task 2 which was the same task given to user 1 from the group of first testers. That is half the time it took the previous user to finish the same task. User claimed he got around the system quickly because of where he works, but when asked if he could attribute his ability to either his experience or being able to manipulate the system based on the design he suggested that the two variables played a role in his ability to adapt quickly to using the system. He thought it

was simple, but the fonts would have been a bit bigger. Color for the prototype was alright, but suggested I should have been more varied with my choice of colors as seen in the systems he was used to seeing at the arena. When asked how the user was convinced he was ordering food for the correct seat number he said he assumed he was, and didn't quite notice the top bar had the seat number placed there even though changes were made from previous users using the system. After pointing out that that information was available that's when the user looked for it and found it. This made me conclude that users might not necessarily look for that information because they are more focused on the task assigned to do.

User 6

User 6 was a much older tester in his late 40's and a support worker at Manchester. He hails from Germany and often travels from the United Kingdom, to Germany and sometimes Nigeria. When given the same task as user 2 at first he wasn't clear about what he was asked to do he thought the system would be the same as booking a flight ticket to travel, the user navigated the system based on trial and error and felt that the icons did not relay the message of what to do, he felt that the icons would have been more clear if it was accompanied with some caption. It took this user a total of 5:18 seconds to complete the same task user 2 was asked to do. I would attribute this difference to their level of expertise with a computer and their individual experience.

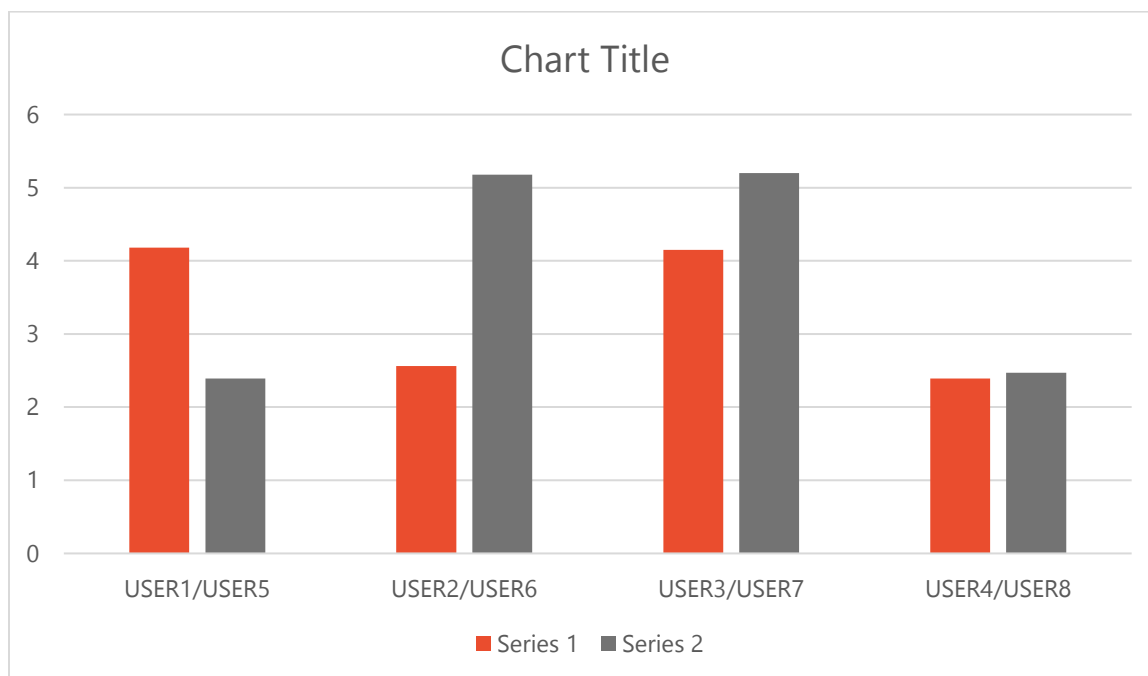
User 7

Same task given as user 3, This user is a mother of 3 with little or no experience with take food orders or food ordering interfaces. She has only ever worked in the health care sector. This user claimed she did not understand what she was meant to do at first but after proper explanation she was able to grasp a better understanding. Also, she was very indecisive with picking an order and taking her time to go through the various options (users were sometimes given free will to pick what they wanted when testing). It can be said she focused on what she was ordering more than the main task, which was quite interesting. It took user a total of 5:20 seconds to finish task, which is a minute and a few seconds less than when user 3 completed task. This user also uses glasses and felt that the background should have been brighter than it was, she felt that would have helped a lot with making the fonts more legible. She suggested that instead of clicking the buttons continuously to get the desired number she felt it would have been easier and quicker to just type in a number or select a number from a drop box.

User 8

This user used to work at the drive way at Mc Donald's and to place an order it took 90 seconds, so she had experience with ordering system and found the interface very easy to use. This user was given the same task as user 4 and finished task in 2:47 seconds. She claimed even if she had not used a food ordering system before using the prototype design it would still have been straight forward. Overall she thought the button sizes were alright, but she felt that the background would have been a different color, other than just a white background. Arguing that dyslexic people might find it difficult to read off a white background. Which was a valid point, overall she was happy with using the system.

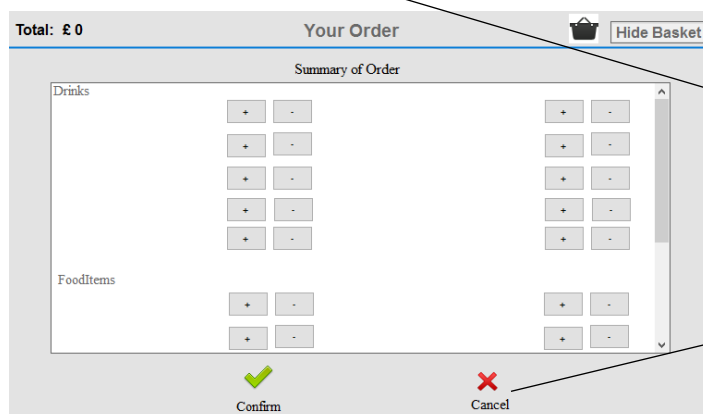
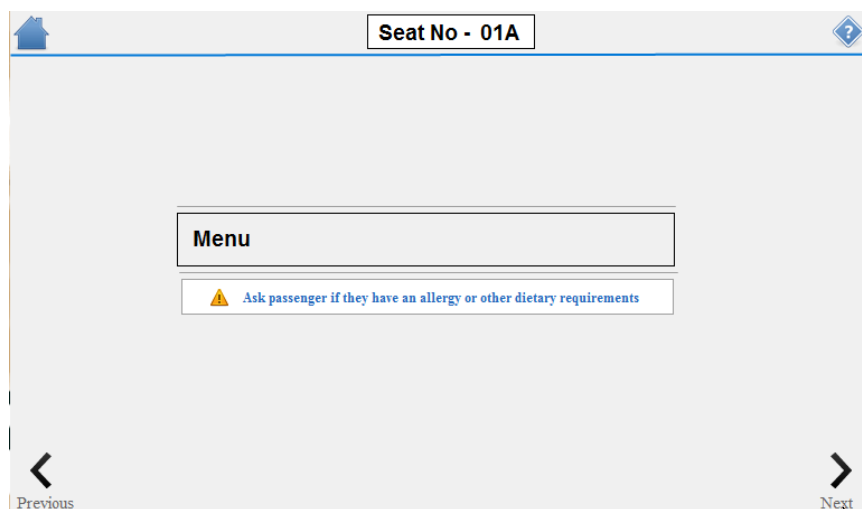
COMPARISON OF USERS BASED ON TIME SPENT ON TASK.



This chart shows the comparison between the 4 groups of 8 different users in terms of their skill set, task assigned and their experience with computers. The first group of users, user1 and user 5 even though these users have the same competency with using computers the second user finished his task on time because he had more experience dealing with systems like this, and a better design was made available for this user based on feedback from first users. Unlike the second batch of users even after changes made to the design user 6 still found it difficult to use the prototype. This was because his level of computer skills is that of a novice and needed extra help to navigate the system, and user 2 level of competency with the computers is higher that is why the user time was better with the first user even though the intention was to make the system better when the second

set of users use the system. For the next set of users, this would be the same situation as the previous statement, user 7 was also more interested in what she was putting onto the order basket than the main task. This user is also a novice user but did better than user 6, I could attribute this to reading the manual before starting to operate the system. Lastly the last batch of user have the same level of competency with computers, that's why the graph shows a slight difference between the users' interaction time. Another argument would be that some users took longer to finish task because they were given more to do than others, on **average** time to perform and finish a task is 3.8 seconds which is a reasonable time that user can use to finish each task on.

User suggestion that was implemented in design for second batch of users



Labelled icons although this was suggested by the ISO standard that icons are better communicated when labels are attached, I felt this would make my design look cluttered, but then implemented it to help novice users when interacting with my interface.

Further Suggestions

Users suggested change in background color based on seeing food ordering systems that were more colorful, but the goal for designing this interface was to make it readable to users, this might be a challenge for dyslexic people, because background used was either white or light grey, this would be put into design for improvement. Another suggestion was to type in number of drinks required instead of having to tap button an appropriate number of times, this too was a valid suggestion and would be put in for further improvement. Apart from these most users found the buttons, fonts, and background color okay and did not have a problem navigating the system or reading it.

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