REPORT

Advanced Human Computer Interaction Techniques

Automated airport check-in system interface

23 April 2009

B. Sopjani, J. Jakeman, S. Thomas, D. Marinov
Group 5

CONTENTS

Abstract

This report details the design of a user-centred interface check-in system to provide a globalised solution catering for multi-national travellers departing from any UK airport, travelling to all destinations with differing airlines, applying HCI principles.

Executive Summary

An interface design was requested for an automated airport check-in system. This interface applies HCI principles and addresses globalisation and user needs, ranging from single travellers to families and groups from any country in the world, travelling to any destination. This system creates a solution for automated multiple baggage check-in.

Introduction

This report outlines the design of an automated check-in system interface for use by travellers leaving UK airports. The travellers may be travelling both internally within the country and externally, to any destination in the world.

Currently automated check-in systems for travellers exist that provide a facility for check-in with hand-luggage only. At that same check-in point, people with more than one item of baggage may also use the automated check-in for their flight, however, they still need to queue to check-in their main baggage. None of the check-in systems currently provide for automated multiple baggage check-in.

The automated check-in systems vary by airline from one airport terminal to another in their design and branding. For example at Stansted Airport, Ryanair have their own branded check-in systems. We plan to address this anomaly by designing a multiple ‘brand’ facility within the user interface.

The user of this automated check-in interface will be from any country, will be of any age, with any ability.

Design Aim

The design aim is to provide a quick, streamlined, easily accessible check-in process that does not exclude groups of users.

Issues that could occur resulting from poor interface design are:

- Queues of people waiting to use a machine, or kiosk, could create major people management issues including a need for the airport authority to provide large waiting areas.

- A slow system would create users wishing to switch to manual staffed check-in system as opposed to using the automated interface to check-in.

- A negative view would create an issue of people not wanting to use the system.

User groups identified

The system needs to accommodate people with:

- language issues
- families
- people with pushchairs
- people with babies
- groups of travellers
- people in a rush
- frequent flyers
- single traveller
- someone who's never travelled before
- people with a visual impairment
- people with a hearing disability
- people with a physical disability
- people with learning difficulties
- hand luggage traveller
- multiple baggage traveller

System Ergonomics

The system will be in continual 24-hour use by a wide variety of people. It will be used within the airport Terminal building and does not need to be weatherproof. It does need to be robust to withstand the constant use by the general public.

Any technology used needs to reliable and stable. A touch screen would be needed as this cuts the need for a keyboard and mouse which can have a tendency to break down when in constant use and therefore more prone to faults and increased maintenance costs. A tough touch screen would be used within our proposed system as they can withstand a large amount of force before breaking.

Along with the touch screen the kiosk would also need a computer terminal, printer, RFID reader / writer and scanner.

The system would need to communicate with the terminal's database for all the flight and passenger information however for this report the technical information will not be covered

When a user first enters the airport, they will be met by a large prominent overhead sign which says, 'Self Check-in'. There will be a lounge area, cafe and other facilities, information notices about the check-in system as well as flight information, and the main central focus of attention will be the kiosks themselves which will be placed centrally, with no obstacles in front of them, so that are the first visual point of contact for people entering the terminal building.

Kiosk design

Although the average height of a person differs from country to country it is proposed that the kiosk will be of two different height variants. The first will be at a height accessible for people of the worldwide average height at 5'6' and above, the second will be of a height that allows both wheelchair-users and people who are height challenged to use the kiosk comfortably.

The style of the kiosk was designed to have a streamlined look with smooth, curved edges to create a safe, easily maintainable environment that addresses some accessibility issues whilst being aesthetically pleasing at the same time. The kiosk style also creates some privacy by creating some separation and individual area by the shape of it, but without any screens or barriers, by curving the desk.

Figure (*i*) below shows the concept of the check-in kiosk, the conveyer belt and the size restrictor for the baggage. The shape of kiosk allows a user to place papers such as passport and other flight documents on the 'work-

surface'. The interface screen is contained within the kiosk. When putting baggage onto the belt, the width and height restrictor stop any oversize baggage being automatically checked in. The kiosk is designed so that when the booking-in process takes place, and the bags are placed on the conveyor belt area, there really is only one logical direction for a person to direct their bags, to put the bags on the belt as the desk shape creates a natural 'diversion' to the conveyor belt by the direction of the shape.

The belt doubles as a weighing scale to weigh the baggage, one item at a time, and once the process is complete, the tag is placed on the bag handle by the owner, and the conveyor belt RFID reader reads the tag and slowly moves the baggage off the scale onto the moving belt to take that item of luggage. At this point, a laser barrier system becomes operational and will sound an alert if anyone breaks the barrier. The user may then start the process of 'check-in' of the next bag. The timing of the screen display and the system design dictates that the laser will be off before the next bag RFID tag is printed.

Customer Service Agents will work on the orange area and be available to address any issues as they arise.

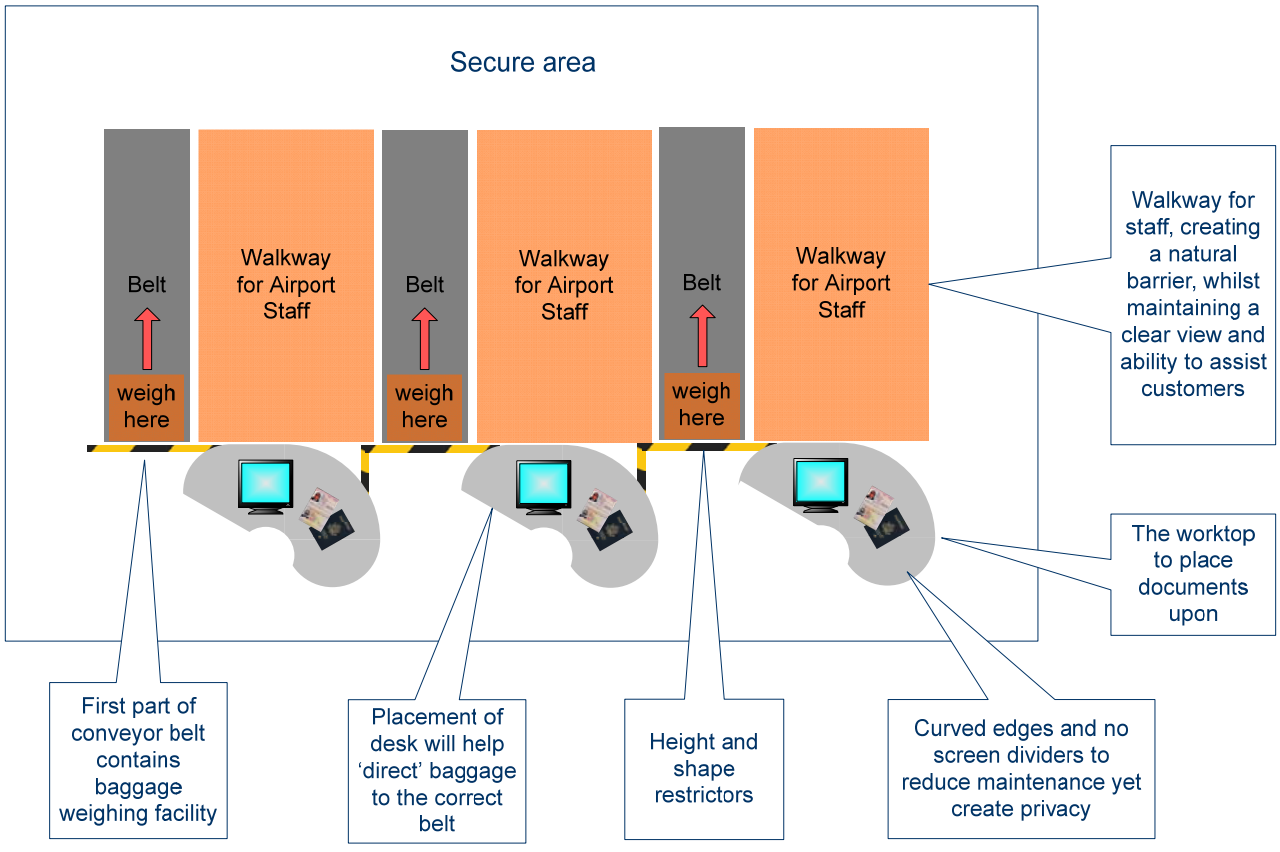

Figure (i) – Draft of baggage handling concept

Surrounding Area

Although the kiosk is designed as an express check-in system as more options are available to the system such as multiple travellers on the same booking number, missed flight options and baggage management, queues are inevitable, especially at busy times of the year.

The drawing below *(see figure(ii))* details the layout of the terminal and the guide barriers at either side of the entrance direct people toward the kiosks. The focal point is the kiosk. The prominent sign overhead provides directions using arrows, and again users are directed toward the kiosk by the very structure of the overhead sign and its support. Whilst using the café/lounge areas the kiosks remain the focal point. Once at the kiosks the users may observe how other people are using the system and understand that the screens are touch screen. Customer services are on hand to help out.

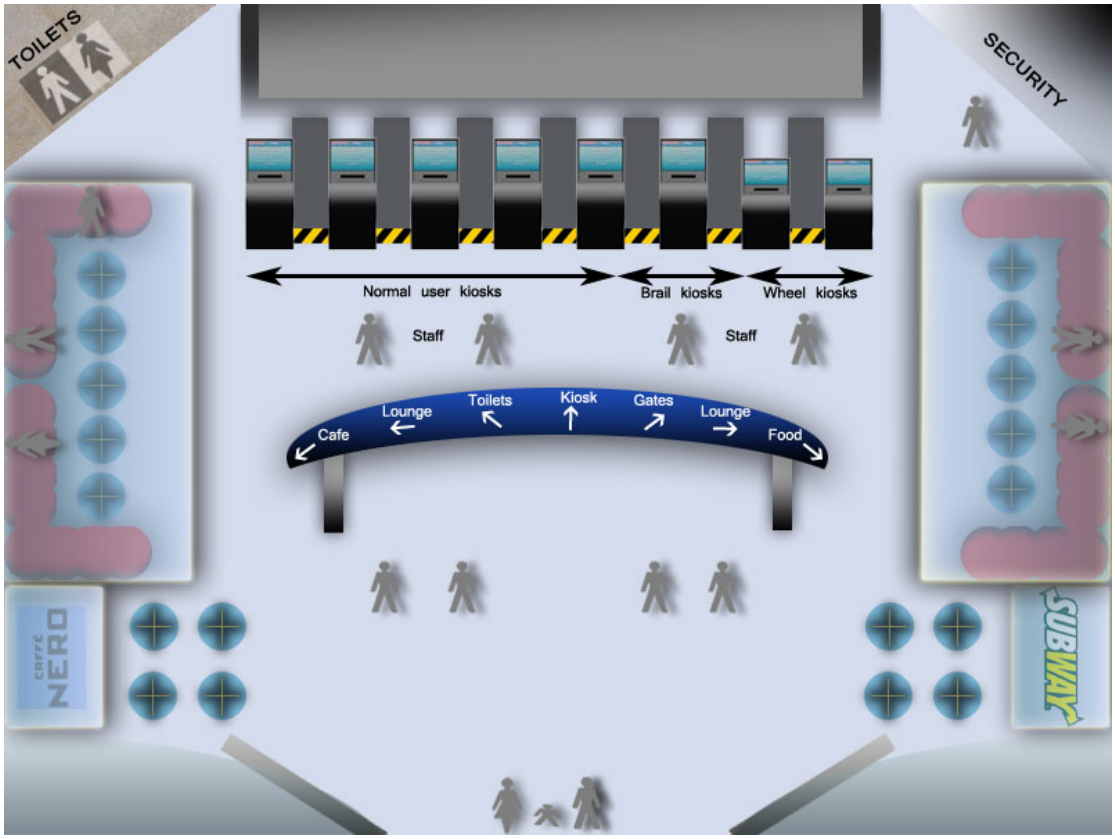

Figure (ii) Terminal Layout

The interface design

The interface is a screen, based on touch-screen technology, sitting in a custom built kiosk *(see figure(iii))* with a slot to input documents and another to output documents as well as a credit card payment machine built into the kiosk.

The screen is slightly larger than a standard pc, approximately 22 inches in diameter and defaults to a 'Welcome Screen'. The interface fills the screen so that there are no distractions with any other menus or any other visual distractions.

The team have selected a darker colour at the top of the layout to separate the main content page. The font is in white at the top so that it displays clearly and doesn't sit in the background but visually appears to be at the front to the user.

Figure (iii) – Design of kiosk taking into account different aspects of accessibility

Progress Bar

When a person first touches the screen, the 'check-in' process starts.
The user is presented with a new screen display, and the basis of the display is a 'progress bar' horizontally towards the top of the display *(see figure(iv)).* This has been divided into seven chunks, creating seven stages of the check-in process. Each 'chunk' is represented by a button with the title of the stage of the process displayed on it. At each stage, that particular button is red. As the process continues, the red button on the progress bar moves according to the section being completed and provides a landmark for the user by indicating at which stage the user is at. The buttons of the progress bar may also be used to 'go back' providing more than one way for a user to interact

with the interface. However a user cannot skip ahead to a section where the previous section has not been completed.

Figure (iv) – Progress Bar

The colour design of the 'progress bar' which is in the form of seven buttons incorporates:

- light blue
  - which doesn't attract much attention and means 'complete'
- red
  - attracts the most attention and lets the user know immediately whereabouts they are in the system. This colour is used to show the user 'where they are' in the process
- darker blue
  - is not as prominent as the red used for the button, but more prominent than the light blue. Creates a landmark of what is still to achieve but does not detract the user's concentration from 'where they are now' and continues the theme of getting the user through the process as quickly and seamlessly as possible. The same colour blue is used later on in the interface in other processes to create a subconscious or conscious link between 'darker blue' and 'completed'.

Confirm and Back Buttons

The buttons were designed using existing knowledge of colours, ie symbolising the colours used in traffic light systems in many countries including:

- America, Japan, France, Italy, Holland, Australia and Africa

The 'confirm' button is green, which symbolises 'go' in the traffic light system. The 'back' button is red, which symbolises 'stop' in the traffic light system. If a person wishes to 'go back' arguably they stop what they are currently doing.

Another reason the 'back' button is red is because visually it is almost the opposite of green and the interface shows the buttons as the same chroma value, so that they appear of equal depth, quality and value but they show themselves clearly to be 'opposites' (*figure v)*.

Also the design uses 'left- to-right' throughout its design. The progress bar moves from left to right, all instructions are left to right, confirm is on the right, go back is on the left. This creates consistency for the user.

Towards the bottom of the screen, horizontally across the screen there is a line. The confirm and back buttons are situated below this line. This creates a clear definition of separation between the content and information and the control buttons. It also creates a 'top down' approach, start at the top of the page, answer questions, go to the bottom of the page and select a button.

If a 'confirm' button, or a 'back' button had been coloured blue, particularly pale blue, the user would probably need to look for it, evaluate it and that could create a delay.

Figure (v) – go back / confirm button

Large screen areas

Considering how the eye perceives colour the interface design includes:

- pale non-descript blue for large screen areas
  - which also tends to keep users more relaxed
- red to attract attention
- green to confirm
- clear light writing on dark backgrounds, or dark writing on light backgrounds to create clear contrast

Languages

On the language screen the user is presented with a screen offering a choice of languages *(see figure (vi)).* An image of the world indicates the screen content relates to globalisation. The languages displayed for user selection are:

- Spanish
  - reason – the most commonly spoken language
- English
  - reason - the locale language
- Chinese
  - reason – Chinese is spoken in many dialects but in writing, particularly Mandarin, is written the same, irrespective of the dialect
- European languages
  - reason – we are part of the European Community
- Russian
  - reason – based on the popularity of the UK for Russian visitors
- Arabic

- reason – the Arabic language is used by approximately 220 million people around the world and spoken in many countries including England so adding this to the language selection seems quite pertinent.

Although spoken and written languages vary in dialects this system would only show the main dialects for these particular languages until a global solution is found for identifying each language and making it available.

Figure(vi) Language selection screen

A confirm button is provided because:

- if a user presses a language button and it is the wrong language, the user is taken to the wrong language screen. It could create a major issue for not understanding how to get back to the original language choice screen

- a user is more likely to succeed in selecting their language and identifying that they need to press a confirm button than finding their way back from selecting an incorrect language. The confirm button gives the user an opportunity to check with themselves that they have selected the best option for themselves

Keyboard

For the proposed system a user input is required. A Qwerty keyboard layout was suggested because:

- airlines throughout the world use only these digits and the 26-letter UK alphabet for all of their airline flight numbering globally
- it is the most common keyboard layout throughout the world with only minor changes with regards to keys to add characters, for example Finland use the following characters ä and ö
- it is typical of keyboard use in the UK

No space bar is provided on the keyboard because:

- spaces are not required for input of data at any point.
- could create errors if it was included

The negative aspect of this is that a user might 'look' for a space bar.

Measuring the estimate of errors with a space bar against time lost by a user 'looking' for a space bar, a decision was taken to eliminate the space bar based on implications of data input efficiency measured against time lost by a user looking for a non-existent space bar.

Figure (vii): QWERTY keyboard layout for proposed system

The keyboard buttons *(see figure vii above)* are:

- dark blue in the Qwerty style as is the most common keyboard layout in the world
- creates a visual effect of a complete keyboard object created from 38 separate images
- dark blue stands out from the lighter background
- added white stroke being a white line creating a border around each keyboard button to define a border between each key
- created a gradient shape similar to a finger shape to press.
- The size of the key will accommodate both people with large hands and/or fingers and small hands and/or fingers

- The space between each key both horizontal and vertical is identical creating a symmetrical effect and furthering creating continuity and symmetry from a series of objects.
- On pressing of the key, it will change to a different shade of blue to match the progress bar completion colour of blue and aid recognition of consistency of colour relating to completion of a task.

Numeric Keypad

Where numeric input is required a keypad similar to the layout for banks and phones is displayed with the same features as the keyboard *(see figure (viii)).*

Figure(viii) – numeric keypad

Text

Throughout the interface, the most important information is displayed on white bars.

The font used is Vrinda black chosen for its even appearance.

The white bar and black text create an ‘official’ image similar to a professional letter traditionally written in sharp black ink on white paper. Users will use existing knowledge to estimate, consciously, or sub-consciously that these bars contain a very important piece of information.

Yes and No

Radio buttons have been used for ‘yes’ and ‘no’ answers throughout the interface to create consistency of design. Crosses and ticks were not used for user choices of ‘yes’ and ‘no’, as they do not always mean ‘yes’ or ‘no’ respectively.

The colour green on a selected button means ‘go’ in the traffic light system, and ‘confirm’ in our system, so green for ‘yes’ on a radio button continues the consistency with colour representation and a user may use existing knowledge to interpret these signals.

Help System

The help system is targeted. This means that the help system questions have been assessed and addressed. This has been done by asking ‘What If’ and the ‘what if’s’ are listed below. The system anticipates the help required and provides the help without the user knowing about it.

Possible user actions addressed

What if a user:

1. has no bags at all
2. bags are too heavy
3. bags are too big
4. damages the RFID tag
5. missed the flight
6. lost their boarding pass
7. checks in too early:
8. credit card is refused on excess baggage
9. what if user pays, changes their mind, wants credit card refund
10. answers security questions wrong
11. puts the tag on inside out
12. doesn’t put the tag on
13. writes on the tag
14. presses the wrong button on the interface by mistake
15. types in the wrong information
16. wants to go back and change their seats
17. one member decides not to travel
18. wants to be upgraded
19. flight is over booked
20. walks away in the middle of the booking
21. doesn’t get on the flight
22. puts their bag on the wrong baggage conveyor belt
23. takes too long
24. is blind
25. has vision difficulties
26. cannot hear
27. is physically challenged
28. has learning difficulties
29. can’t understand English language

30. can't understand the language options offered
31. child goes onto the conveyor belt
32. the belt breaks down
33. there's a queue of people
34. there's a power cut/security alert
35. lost their passport

Where the system cannot provide help, the Customer Services Agents are automatically called. A signal is sent from the system to the Customer Services Agents mobile phone/pager system with the name of the person, the screen they have had an issue with and the kiosk number. The Customer Services Agent may then arrive at the situation with some information already which may save time and provide a quality service to the user.

There is also an automated system to call a Customer Services Agent which times if a user is on a particular part of the check-in system for too long or if the system is in a state of 'no response' an offer of an automated call to Customer Services displays. The user may choose to revert back to the previous question. Each check-in screen has a different 'time out' period set, for example, entering passport details and credit card numbers and flight numbers may take a user a while to find their documents so the time out period will be longer than the screen that asks the user their security questions.

Clock

A 24-hour clock is shown. Although the design would have benefited from a simple clock face with hours and minutes displayed around the clock face and hands pointing to the hours and minutes, there could be an issue with anti-meridian, am and post-meridian, pm. Therefore the 24 hour digital clock was selected to address globalisation. The time display will be local time.

Animations

There are animations to show:

- the passport being opened and put into the scan reader
- placing baggage on belt
- how to pay for excess baggage
- removing overweight bags
- how to tie the RFID baggage tag around the handle of a suitcase
- retrieving the printed boarding pass

These animations will aid the user in understanding what actions need to be taken at that specific time within the system. These animations will display between the relevant screens and not overlay any of the interfaces. The animation will stop once the action has been taken. For example; when the system asks the user to insert their passport for scanning, the system will stop

the animation and proceed to the next stage of the process once it has scanned the passport.

Use of the tick symbol

On the Booking screen, when people are checked-in, ticks appear against their name. Also, once they are booked in the option buttons 'yes' and 'no' are removed, taking away any user decision of any option in the event a user is not comprehending fully.

Feedback is given to the user throughout the booking process, for example below their name it states 'you have already checked in' and the option buttons are removed. For those in the group that haven't checked in, there is no message under their name and the option buttons exist still to receive the data input of yes or no from the user *(see figure (ix)).*

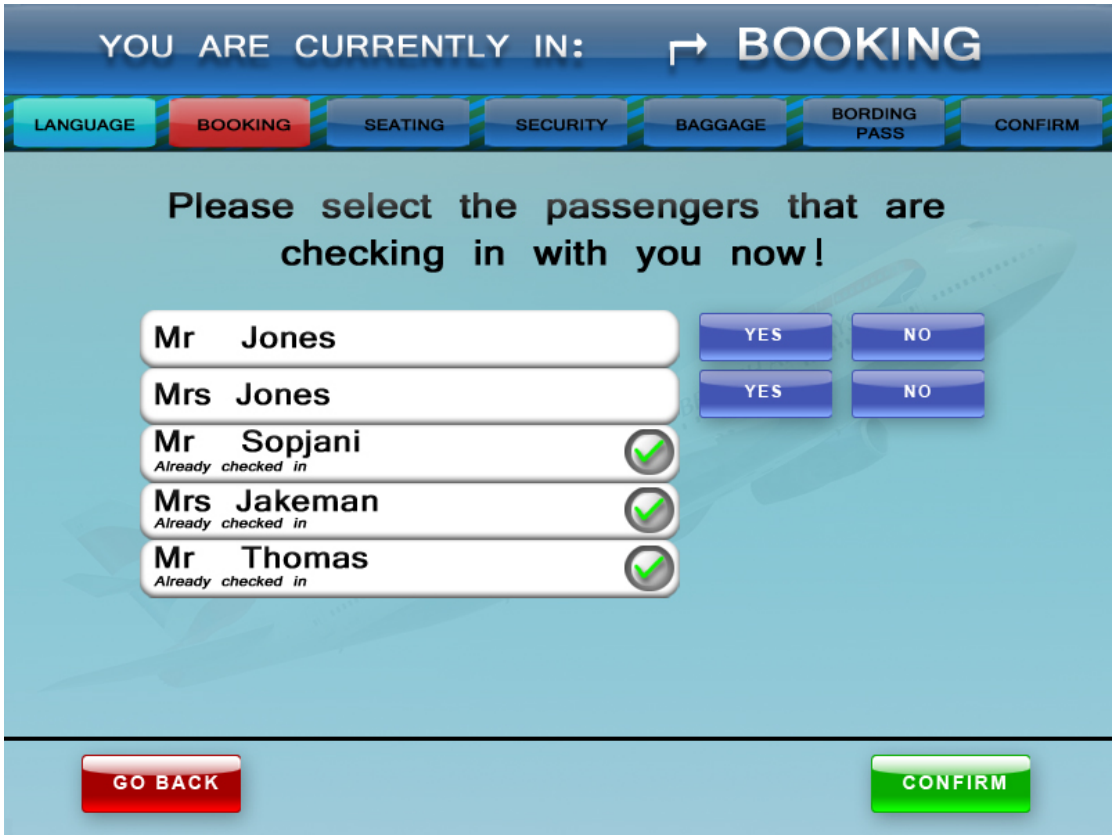

Figure (ix) Booking screen showing booking status of the group of passengers

Seating selection

Seating design has 4 states:

- red

  - shows the seat of the person in charge booking in

- dark blue/black
  - the travelling group (ie acquaintance, family, business partner, etc)

- medium blue
  - available seats

- virtually transparent blue
  - not available

The reason for the colouring is that red attracts the most attention and it is designated to the user's seat. Dark blue/black are quite deep colours which attract attention and the user can determine from the screen that those seats are booked by the user's travelling companions or group.

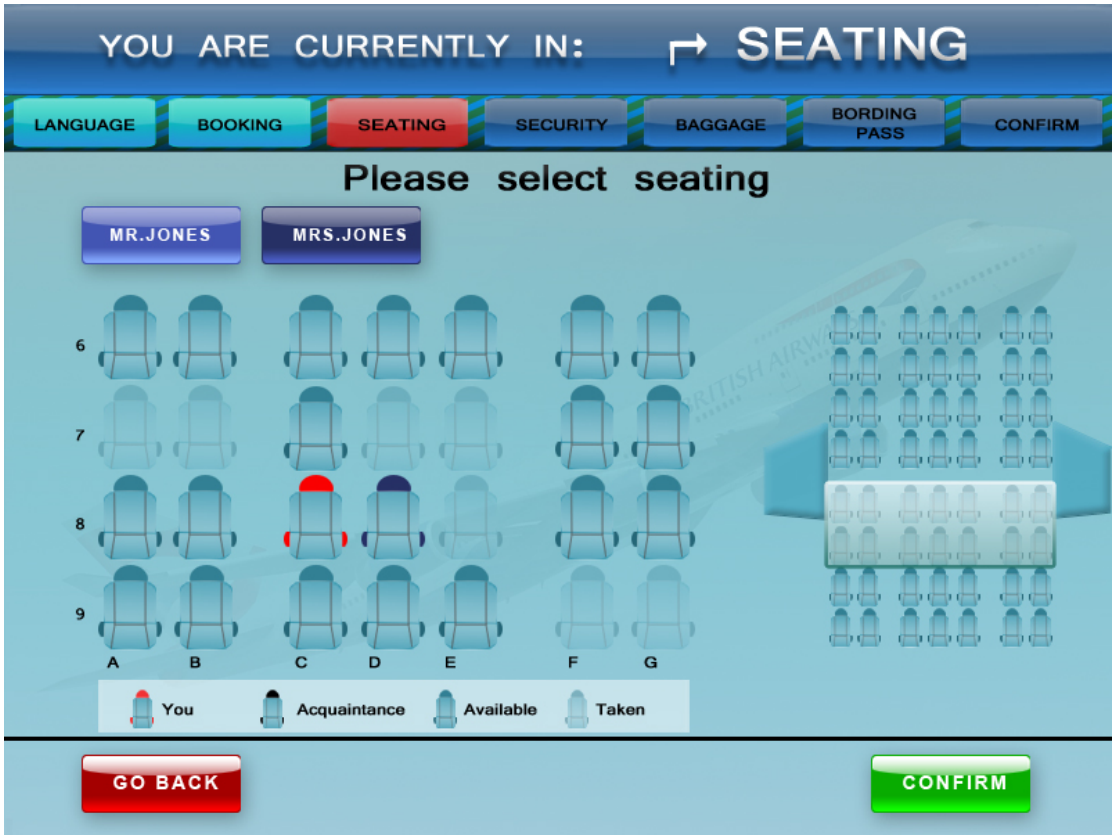

Figure (x) - Seat selection screen

The medium blue seats are available, are clear to see on this screen as the seating plan creates a large screen, so in this instance, blue is the best colour to use as the focus of the seating plan covers quite a large proportion of the screen. The medium blue seats are available, and this colouring is the third

colour that the user will see, so this will be the third option that the user looks at. The first is the users' own seat, the second is that, or those of their companions or group, the third is the available seats, this is ideal for the user, as they may then select those seats for the check-in process that they are currently in, ie they may be booking in their family.

The final colour, virtually transparent blue shows seats which are not available and are not related to the user in any way. They do not contain any of the user's group or companions and are of no interest to the user.

Therefore the shading of the seats has been constructed in a colour hierarchical style.

Also there is a diagram to the right of the seating choice area which gives a user a landmark, this is a different type of landmark to the progress bar which is a landmark that shows progress. The seating landmark shows where the seats are in relation to the structure of the seating in the actual aircraft *(see figure(x))*. It also has a scroll facility to create a two-way information exchange environment.

Security

Security is addressed according to the legal requirement and existing practice, there are two questions to be answered, and only two options of reply, yes or no. Again the same 'yes' or 'no' radio button with green colour for selected and an explanatory radio button display on the left hand lower side of the page out of the main range of the user's attention so as not to detract the user from the current task.

During the analysis period, it became apparent that security and baggage do go hand-in-hand and we have made a clear separation between the two, and placed the security process before the baggage process.

Accessibility

There is a legal requirement under the Disability Discrimination Act to take reasonable steps to provide for Accessibility. Part of the Act states that everyone of all ability should have the right to access goods, facilities and services.

Wheelchair user

A kiosk has been designed to accommodate a wheelchair user which is lower in height than a usual kiosk. The Accessibility kiosk creates room underneath the kiosk for the wheelchair. Buttons and keypad input onscreen are at the lower end of the screen layout and the design of the wheelchair user kiosk allows a user to get very close to the screen. A larger footprint or additional space for the kiosk will be required to provide a 'turning circle' for the

wheelchair user when they wish to place their bags on the scale/conveyor belt *(see figure (xi)).*

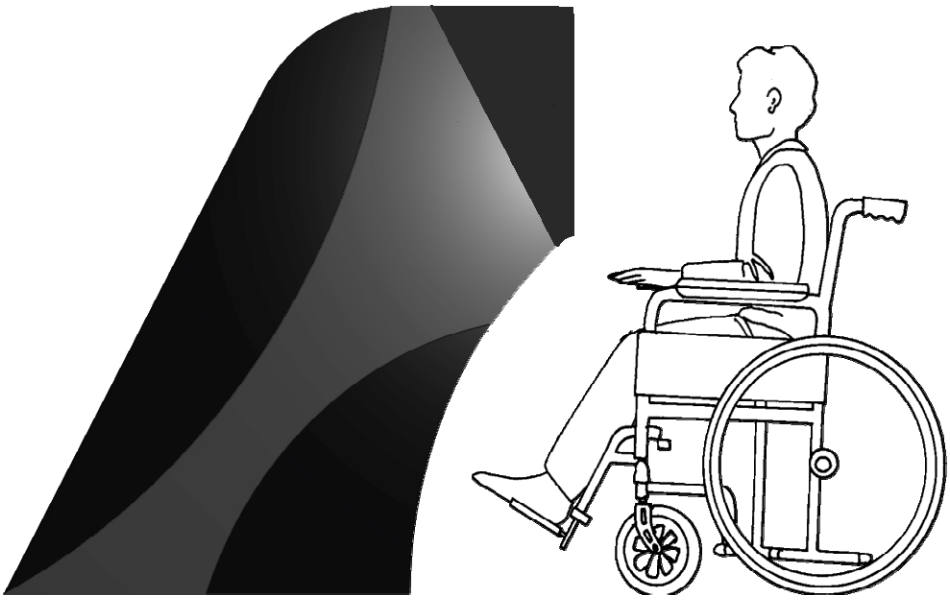

Figure xi: Initial proposed kiosk design accounting for accessibility

Blind user

A Refreshable Braille display *(see figure (xii))* will be provided which recognises text being sent to the screen of a pc. This is done with the use of a screen reader connected via either USB or Serial ports.

The Braille display also provides Braille pads for input, together with extra pads that provide functionality that can be married up to button controls onscreen. Therefore a Braille machine can provide all the functionality required for a blind person to check-in automatically.

Vision Impaired User

Clear fonts and large fonts have been used. Background and foreground colours have been selected carefully to avoid creating extra vision difficulties for vision impaired people to see the screen.

Another option within the system will be the use of a speech browser. This also works with a screen reader. Special consideration would need to be made when choosing this technology such as:

- the environment is noisy
    - an enclosed booth will be required
- security issues may occur, due to information being read out loud

- the environment would need to be secure

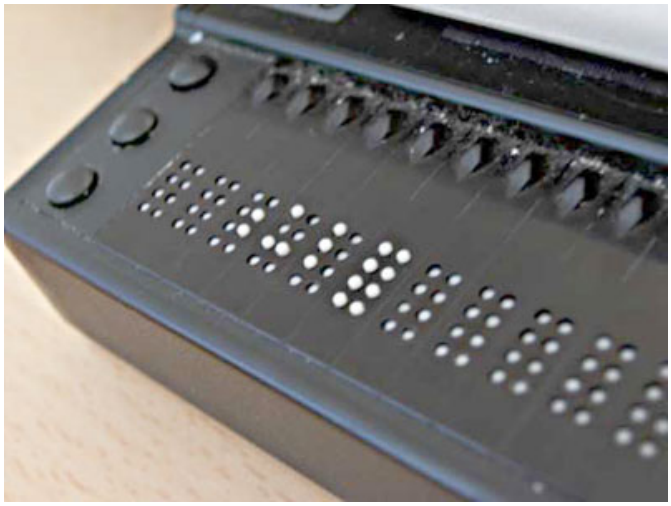

Figure (xii) refreshable Braille display

Hearing Impaired Person

The system does not use sound for any of its functions, therefore a hearing impaired person will be able to fully use this system with no added changes necessary.

Testing

Testing on a vision impaired person.

Some font was too small to read easily and was made larger.

Radio buttons when off, didn't look 'off' so they were changed to create an 'off' image by putting a smaller empty circle inside the outer circle.

Testing on a non-vision impaired person

Some words and phrases seemed to create a Gulf of Evaluation leading to a Gulf of Execution. For example, 'please could you state currently who you are booking in now' was changed to a simpler sentence which was easier to comprehend.

Group Testing

Punctuation was reduced to a minimum.

Words and phrases were re-evaluated and adjusted to create a much clearer communication.

Evaluation

It is very difficult to cater for all people, in all situations, all of the time. However it is not unreasonable to make every effort to cater for as many different people as possible. This user interface sits in an aesthetically pleasing environment, in an exciting and busy airport surrounded by travellers, staff, security, and airport officials, with fast changing scenery. People will see other people booking in and learn quickly by observation that the screens are touch screen. Notices and screen displays around the airport and the interface will aid the user as well as Customer Service Agents. The interface itself is streamlined, applying HCI principles as a matter of course.

There are issues with the interface and globalization, in particular with language selection.

One solution to this would be for passport control throughout the world to request users spoken language as part of the passport information held on database. Then, when a passport is inserted to an automated system in the future, the actual spoken language of the person could appear and this would resolve language issues with systems such as this design.

Also it is possible that work could begin on providing more languages and a facility to 'look up' a language and use it, however, balancing this against the whole design it was felt that it would impinge on the simplicity and seamlessness of the design and it requires a wide, far-reaching solution such as 'passport control' mentioned above.

Particularly pleasing are some of the Accessibility issues addressed, a simple wheelchair-user kiosk and Braille display for any blind person.

Sound has not been used in the mainstream user design because the airport is a lively, noisy environment and it cannot be relied upon to work. However, consideration has been given to creating a 'booth' to contain a kiosk where sound will work. This may assist vision impaired users and people with learning difficulties.

Consideration was given to creating an Accessibility area, but the preferred option was to integrate Accessibility equipment as much as possible with non-Accessibility equipment.

What was not done so well was address the issues of a physically impaired person who cannot use a keyboard who may benefit from:

- an adaptable kiosk with voice recognition which may be something for the future

The other issue that the team felt needed further addressing is the issue of Security. It is quite clear that any person may press the appropriate 'yes' or 'no' whether it is true or not and consider there are many options that could address Security in a more thorough way. One particular example is lie detection, although it is in its infancy at the moment.

Security is dealt with in person by staff further along in the process and therefore not considered of utmost importance in this design other than complying with the relevant legislation.

Conclusion

The design applies HCI techniques throughout and creates a logical and seamless process through which a majority of travellers will be able to navigate themselves through the system seamlessly and unaided. It caters for more than one item of travelling baggage which is an improvement on the existing system. It also creates a payment facility to continue this improvement to create a one-stop check-in interface for users.

Reference

Images Used

Figure i = Draft of baggage handling concept designed in Microsoft Visio
Figure ii = 2nd design of baggage handling concept designed in Adobe Photoshop
Figure iii = 2nd concept of kiosk designed in 3D Studio max
Figure iv = Progress bar designed in Adobe Photoshop
Figure v = Go back / confirm buttons Designed in Adobe Photoshop
Figure vi = Language selection screen designed in Adobe Photoshop
Figure vii = Qwerty keyboard Designed in Adobe Photoshop
Figure viii = Booking screen designed in Adobe Photoshop
Figure ix = Seat selection screen designed in Adobe Photoshop
Figure x = First side design of kiosk, Designed in Adobe Flash.
Figure xi = wheelchair-user kiosk designed in 3D Studio max
Figure xii = sourced from tp://2.bp.blogspot.com/_ GqGEPRWOfVA/R6U5t5oLy4I/ AAAAAAAAAys/88SGmigBjiI/s400/Braille_Display.jpg on 22 April 2009

Disability Discrimination Act
Accessed: (Owner: http://www.direct.gov.uk, The Disability Discrimination Act (DDA), http://www.direct.gov.uk/en/DisabledPeople/RightsAndObligations/DisabilityRights/DG_4001068, accessed: 03/04/09.