



UNIVERSITY OF
BIRMINGHAM

Human Computer Interaction

Unified Sports Booking System

Rebecca Devney,
Aasima Pathan,
Josh Wainwright,
Andrew Walker

Group 5

Supervisor: Bob Hendley

Date: March 2014

Abstract

We propose a new, unified interface for finding a time, location and the cost for playing any of a number of sports, at any of the available locations within a given distance or relative to a different location, construct several first and a single second generation prototype and evaluate these against a set of user personas and other evaluation criteria.

Contents

1	Introduction	1
I	Pre-Prototype Preparation	1
2	Review of Related Work	1
2.1	User Input	1
2.1.1	Timetables	1
2.1.2	Date/Time Selection	2
2.1.3	Forms	3
2.2	Current Comparison/Booking Applications	3
2.2.1	Skyscanner	3
2.2.2	Trivago	5
2.2.3	thetrainline.com	6
2.2.4	What we can learn	7
2.3	Application Considerations	7
2.4	Current Sports Booking Applications	9
2.4.1	University Of Birmingham Sport	10
2.4.2	Aquaterra Leisure Centres	11
2.4.3	London Tennis	13
2.4.4	What we can learn	13
3	User Personas	15
3.1	Elderly Persona	16
3.2	Working Persona	17
3.3	Student Persona	18
3.4	Child Persona	19
II	First Generation Prototypes	19
4	Methods of Evaluation	20
4.1	Prototype 1	21
4.1.1	Presentation	21
4.1.2	Heuristic Evaluation	24
4.1.3	Persona Evaluation	25
4.2	Conclusion	26
4.3	Prototype 2	27
4.3.1	Presentation	27
4.3.2	Heuristic Evaluation	29
4.3.3	Persona Evaluation	30
4.3.4	Conclusion	31
4.4	Prototype 3	32
4.4.1	Presentation	32
4.4.2	Heuristic Evaluation	34
4.4.3	Persona Evaluation	35
4.5	Conclusion	36
5	First Generation Prototype Conclusion	37
5.1	Evaluation of Tools	38
5.1.1	Proto.io	38
5.1.2	Balsamiq	38
5.1.3	Possible Alternatives	38
5.1.4	Drawing Packages	38

5.1.5	Presentation Software	39
5.1.6	Animation Software	39
5.1.7	Conclusion	39
III	Second Generation Prototype	41
6	Presentation	41
7	Review	46
7.1	Evaluation Plan	46
7.2	Heuristic Evaluation	47
7.3	Persona Evaluation	48
8	Cognitive Walkthrough	50
8.1	Task 1	50
8.1.1	Walkthrough	50
8.2	Task 2	51
8.2.1	Walkthrough	51
8.3	Task 3	52
8.3.1	Walkthrough	53
8.4	Task 4	54
8.4.1	Walkthrough	54
9	System Usability Scale Questionnaire	55
9.1	Summary of Comments	56
IV	Conclusion & Recomendations	57
10	Recommendations	57
11	Summary	58
11.1	Team Analysis	58
V	Appendix	59
A	SUS Questionnaire	59
B	Questionnaire Results	61
C	Project Log	61

1 Introduction

If you currently want to book sports facilities, the only way to search is directly through the individual sports center's websites, or through direct communication. If someone is flexible in the location or choice of sport, they are required to search multiple locations to find the best compromise.

In addition to the difficulties of checking multiple websites, often each of these websites are unintuitive and difficult to use, requiring the user to know exactly when and where they want to use the facilities and often not giving clear information about other possible factors such as cost.

Here, we propose a new, unified interface for finding a time, location and the cost for playing any of a number of sports, at any of the available locations within a given distance or relative to a different location.

Part I

Pre-Prototype Preparation

2 Review of Related Work

2.1 User Input

In order to present a user with useful information, our application will have to accept data from them. This is done by means of forms, text input and buttons. To maintain a clean, intuitive user interface, a simplistic approach is often taken to reduce the thinking time required to process information on a single screen. If more information is required, multiple screens are often used.

2.1.1 Timetables

A common set of information presented to a user which represents a considerable challenge, particularly on small screens, is a timetable of available or appropriate times. From this, the user can then select which is most suitable for them. When too much information is displayed on a single screen, this can become confusing or impossible to read. For example, in figure 1 [1], despite a single hour being a common appointment length, the text for these slots is hidden entirely.

A common way to improve the readability of these complex structures, which often contain a large quantity of data, is to have graded selection of that data. In other words, where there is an option to refine a search to reduce the data needed to be displayed, only the immediately relevant information is displayed, with simple navigation to other relevant data.

This method can be seen clearly in the RedSpottedHanky.com application, figure 2 when a user is searching for tickets for a specific date and time. Although there may be many trains within a narrow time gap,



Figure 1: Google Calendar's cramped calendar.

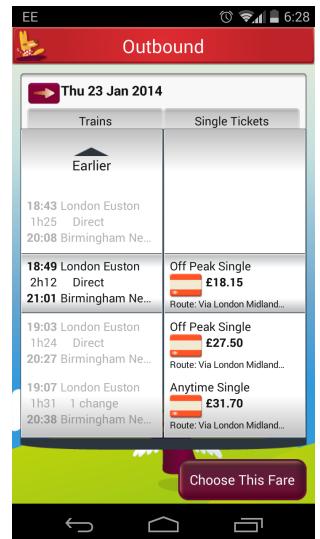


Figure 2: RedSpottedHanky displays dates more clearly.

the application shows a small number of tickets with the option to move either earlier or later. Each ticket time is also associated with a number of options relating to ticket price. These are shown only for the currently selected ticket time.

2.1.2 Date/Time Selection

In order to reduce the search range, often a date and/or time selection dialogue is used. Figure 3 shows two different implementations.

Figure 3a, on the right is an example, again, from RedSpottedHanky [2], which shows the time selection associated with booking a train ticket. This design fails since the method of changing time requires very close control when accuracy is required, and is time consuming when the desired time is far from the currently selected time. The movement is performed in single increments or decrements of the hours and minutes. This is despite the functionality described above which lets the user view and switch to other trains at nearby times.

Figures 3b, in the middle and 3c on the left are examples from Google Calendar which shows how the process can be made much more intuitive, simple and fast. Through the use of separate screens with large and clear selection, this selection is much easier to navigate than the scrolling method used above.

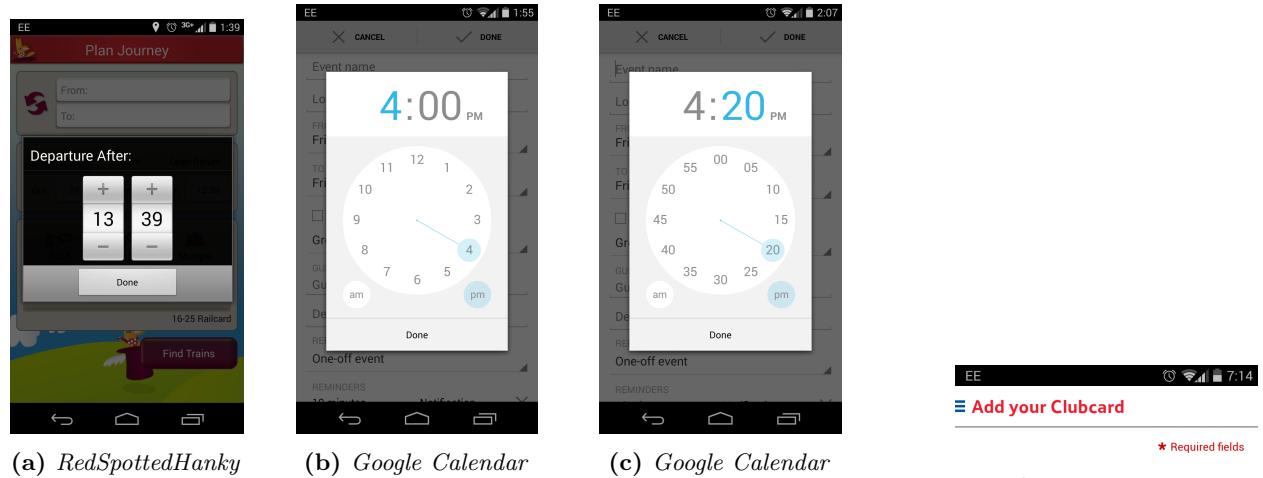


Figure 3: The time selection for RedSpottedHanky requires the user to spend too much time selecting the time when larger increments could be used to smoothen the process. Google Calendar, on the other hand, allows simple and fast selection of the hours and minutes through separate screens.

A combination of both of these is used in the stock iOS, shown in figure 4 [3] where a much easier to navigate scrolling mechanism is used. Though this can still cause the user to spend more time selecting the correct number, the fact that the user can “flick scroll” though the numbers means reaching a value that is far from the currently selected one is much quicker than the RedSpottedHanky.com application.

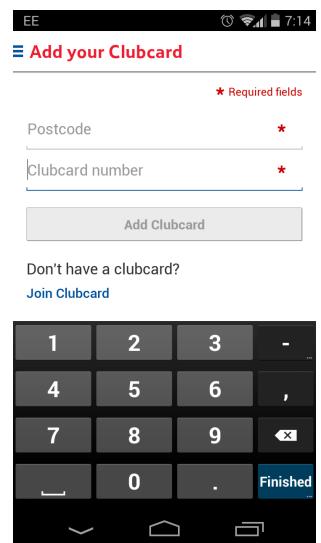


Figure 5: Large, easy to access text entry

12	October	2008
13	November	2009
14	December	2010
15	January	2011
16	February	2012

(a) RedSpottedHanky



(b) Google Calendar

Figure 4: Stock iOS date and time picker is easier to scroll through, but still requires more time than selecting the appropriate number.

2.1.3 Forms

When entering information that is not limited to a small set of possible values, such as a name, location or arbitrary number, a form must be used to accept the user input. Since touch screens rely on the user being able to navigate to the correct form section, the input must be of sufficient size to allow this movement easily.

Figure 5 shows a simple form with two input boxes. Each has a clear border around it so the target for interaction is easier to select.

An important consideration that has been made here is to specify that, for the second set of text input, the data is strictly limited to digits. For this reason, the keyboard switches from a general purpose “qwerty” keyboard to a purely numerical version. Again, this assists the user, both by indicating that only the provided digits are acceptable, and making the input of those digits easier (often the numbers on a touch screen keyboard are only accessible by switching modes).

By contrast, the interface in figure 6 is overly crowded with too many small buttons squashed together. This could cause the user to select the wrong input area, or not be able to navigate the application properly.

2.2 Current Comparison/Booking Applications

The idea of comparing various services to match your requirements at the best price is widely spread over the web, especially when it comes to booking flights, hotels, transport etc. We want to take this idea and apply it specifically to booking sports facilities across the county. Some applications compare results from different websites; others show available options from different companies on their own website.

2.2.1 Skyscanner

Skyscanner is a flight search application which compares flights and airlines. The application allows the user to search by airport, departure/return date, number of passengers and cabin class. They are then directed to search results matching their criteria. Once the user has chosen their desired flight, they are linked to the airline or travel agent to buy directly.

Strengths

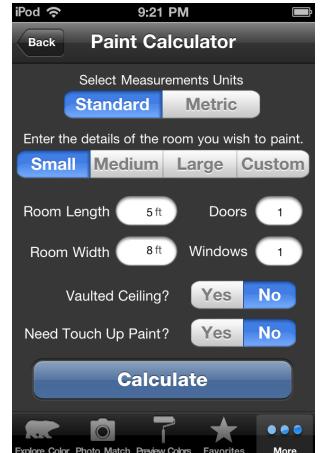


Figure 6: Crowded interfaces make entry more difficult.

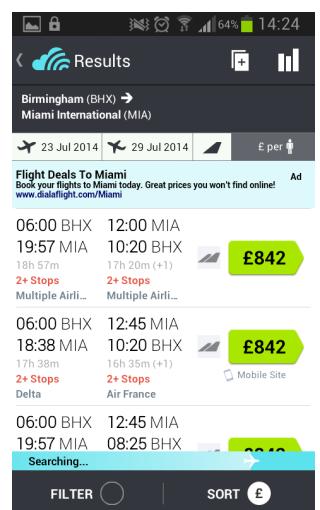


Figure 7: Skyscanner's search results

- The date selection page is simplistic and easy to use. The user is provided with a calendar where they can simply touch the date they would like to fly (figure 8a).
- Clear, concise information is shown on the results page. This allows the user to quickly scan the flights available and doesn't clutter the page with information which would not affect most customers' decisions (figure 7). Further details (destinations and times of any stops) can be viewed by clicking on the flight.
- If a return date is not specified, an extra screen is displayed which allows the user to see the prices of different departure dates and the return dates available. This gives the customer an opportunity to change their departure date based on the prices shown. (figure 8c)
- There is a filter option on the results page permitting users to be more specific. For example, particular airlines, direct flights only, flight times etc. (figure 8b)

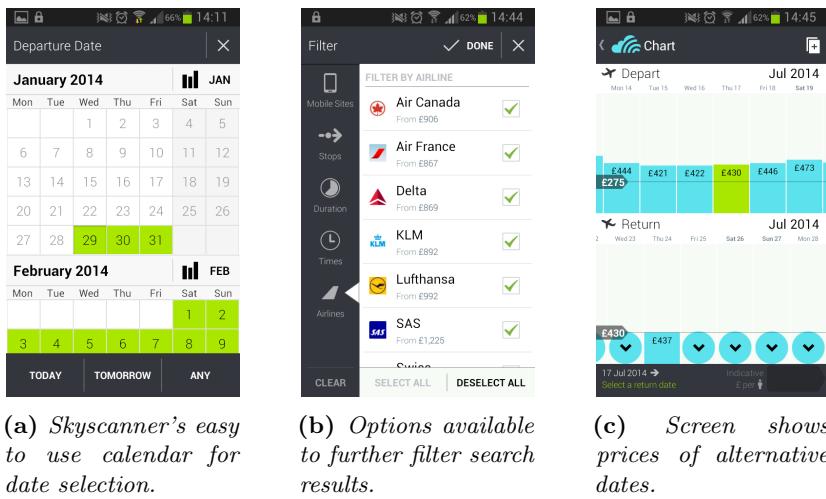


Figure 8

Weaknesses

- There is no flexibility in departure date (except for the option of "any" date). However the return date option allows flexibility of one day.
- The "Everywhere" option (figure 9) seems slightly pointless as it is unlikely someone would have no preference as to where they wish to go but have a particular date in mind. It is more likely they have a general idea of where they want to go, for example the country, but there is no option for this.
- When choosing a destination, the user is required to select a specific airport. This restricts the user to where they can fly. For example, they may wish to check prices to a variety of destinations within a particular area or group of Islands with various airports.

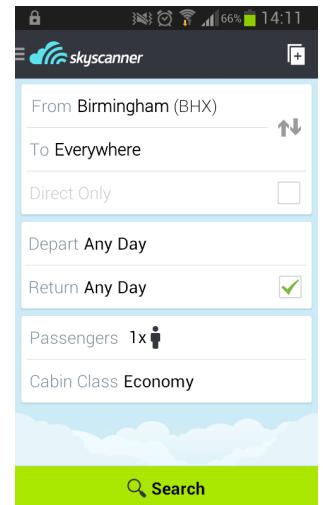


Figure 9: Skyscanner's home screen

2.2.2 Trivago

Trivago is a hotel comparison website comparing hotels from booking sites such as booking.com and Lastminute.com. The initial search screen boasts many options and filters. As well as the expected search criteria such as location and check in/out date, the user can also filter by rating, popularity, distance, price and whether the hotel has certain features such as WiFi and a pool etc. A maximum price and distance can also be set within a certain range using the sliding bars (figures 10 and 11). The results show the cheapest price for each hotel available and what booking website the customer can get this price. Once the customer has chosen their hotel, they will be directed to the booking website where they will make the payment.

Strengths

- As a location is typed, the number of available hotels is displayed in brackets next to suggested locations.
- Searching is very flexible, for example you can search by hotel name, region, points of interest and city.
- It is possible to search for hotels in the vicinity of a specific address, very useful if you want to find the nearest hotel to a specific location.
- Search results automatically load up at the side of the screen as search criteria is filled out. The user can swipe across to see them, for example once a location had been entered, it will load up available hotels whilst still maintaining the search screen.
- The search results are very clear and simple in that they show enough information without clogging up the screen. The hotel name, rating, stars, distance from the centre, price and a photo are all displayed in a concise manner (figure 12a). The user can then look into more detail by clicking on the hotel (figure 12b).

Hotel Name	Rating	Distance	Price (per night)
The Royal York	★★★☆	0.5 miles from centre	£142 (£97)
Holgate Bridge	★★★	0.9 miles from centre	£56 (£50)
Park Inn by Radiss...	★★★	0.2 miles from centre	£201 (£98)
Jorvik	★★★	0.4 miles from centre	£61 (£88)
Holiday Inn York	★★★	1.7 miles from centre	£78 (£88)
Hampton By Hilton...	★★★		£127 (£78)

(a) Trivago's search results screen

(b) The hotel in more detail

Figure 12

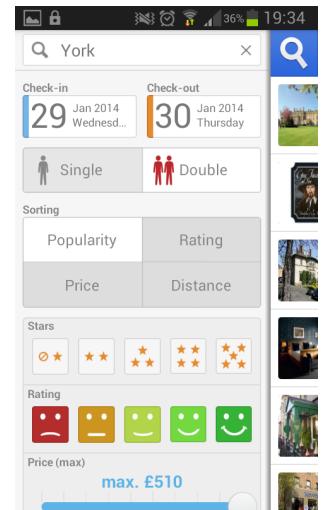


Figure 10: Top half

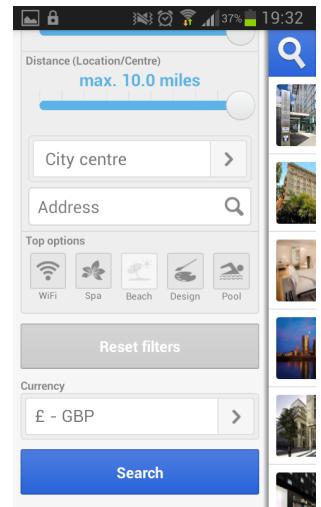


Figure 11: Bottom half

Weaknesses

- The ‘current location’ feature in the search box is useful if you need a hotel there and then, but in reality this is rarely the case. Customers would usually book a hotel at least a day in advance at which point their current location is unlikely to be near an area they would need a hotel.
- There is no option to select how many people and therefore no option for multiple rooms. The user may require multiple rooms if there is more than two of them. Therefore this application is useless for families and people travelling in large groups.
- There are no additional filters past the home screen. Customers may require extra filters such as free parking.

2.2.3 thetrainline.com

thetrainline.com is a train ticket retailer application designed to let customers buy train tickets without the need to have a paper ticket. This application differs slightly in that it independently searches individual trains without searching external websites. Train journeys can be searched by location of departure and destination, departure/arrival time and number of passengers, as shown in figure 13. All available train journeys are then displayed with the cheapest price for each journey. Once the customer has confirmed their chosen journey they can pay for their ticket on thetrainline.com. The customer will be sent a barcode ticket to their mobile phone.

Strengths

- When typing the name of the station it suggests possible stations based on the first few letters. Useful if you’re unsure of the name of the station. For example, typing ‘Birmingham’ shows a list of all stations in Birmingham. In addition to this all recent searches are also displayed, so it is not necessary to type the name of the station each time.
- The application uses GPS to find the customer’s nearest station and it is also possible to set a home station to make it quicker and easier to plan a journey home every day (figure 15).
- There is no redirection to another website, the customer can pay directly on thetrainline.com which provides a quicker and smoother payment process.
- The results shown are not limited to the specific time chosen, figure 14. This gives the customer an opportunity to choose an earlier or later train if it happens to be a lot cheaper.

Weaknesses

- The time and date selection feature is very sensitive and therefore requires a steady hand when scrolling up and down. The time can also be selected to the nearest minute, which when it comes to planning a journey, isn’t particularly necessary considering multiple

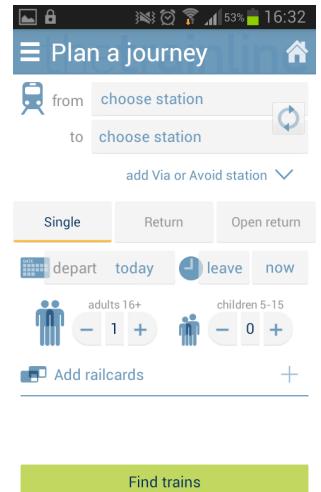


Figure 13: thetrainline search criteria screen

GROUPON deals with good taste SEE DEALS >	
Out	Departing Today
20:23 London Kings Cross	From £85.00
20:08 Birmingham New Street	Duration: 1h 45m Changes: 1
18:43 London Kings Cross	From £52.50
20:27 Birmingham New Street	Duration: 1h 44m Changes: 1
18:47 London Kings Cross	From £52.50
20:38 Birmingham New Street	Duration: 1h 51m Changes: 2
19:00 London Kings Cross	From £52.50
20:45 Birmingham New Street	Duration: 1h 45m Changes: 1

Figure 14: Search results from thetrainline

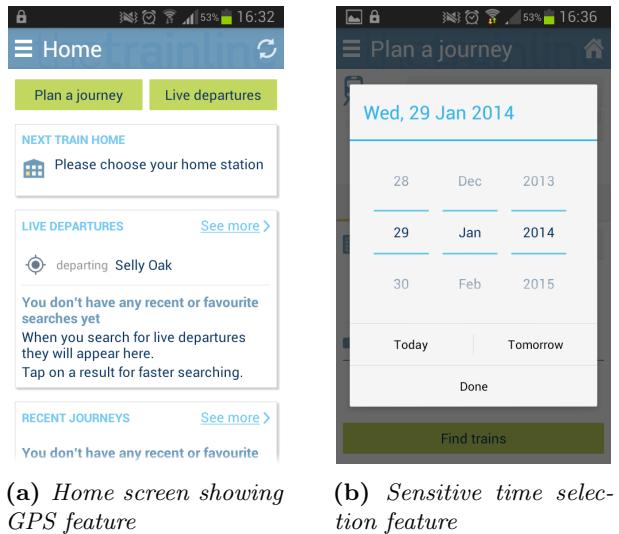


Figure 15

journeys are shown on the results page. Both these flaws contribute to time taken to find the desired journey.

2.2.4 What we can learn

- Our sports booking application would benefit from having a GPS feature as those looking to play a particular sport would usually prefer to play near their current location. For the same reason, when the results are displayed, a filter for distance to the sport venue could be beneficial to the user.
- It would be useful if a message was sent to the users phone to confirm the booking. This will allow the user to check the booking details they are likely to forget such as court number or price. If the user booked the court well in advance, there could also be an option for the user to request a reminder, say a day before they are due to play.
- When searching for a particular location, the user should have the option to search by either postcode, address, town or city. By entering the city, this gives the user flexibility on location. However if the user does not wish to travel far, the other options would be more constructive. Either way, there is no restriction on how to search for a venue.

2.3 Application Considerations

Depending on the operating system, each platform has its own specific guidelines on how to provide users with a good experience. Key issues include; page layout, navigation and interaction.

Apple recommends that the most important feature of an application should be displayed at the top-left of the page so that it will be the first thing a user sees [4]. Booking.com and the trainline.com both implement this well [5].

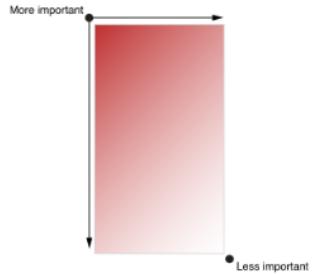


Figure 16: iOS page layout recommendation

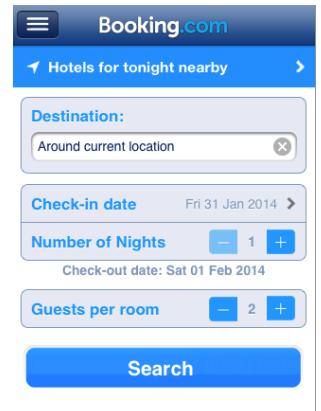


Figure 17: Booking page for thetrainline.com [6].

Users should be able to navigate their way through the application to achieve their goal of booking sports facilities.

There are 3 main styles of navigation;

Hierarchical navigation is where users make one choice on the first screen, another on the second screen and so on until they reach their final destination. To navigate to another destination, the user may have to retrace some steps or start over from the beginning. This could be very inconvenient for the user as they may have to go back several steps or start over.

Content or Experience-driven navigation depends on the content of the application. The navigation also plays an important part of the application experience. The Skyscanner application includes a globe, figure 18, which allows the user to explore the cost of travelling to particular locations. This feature provides a unique experience for the user.

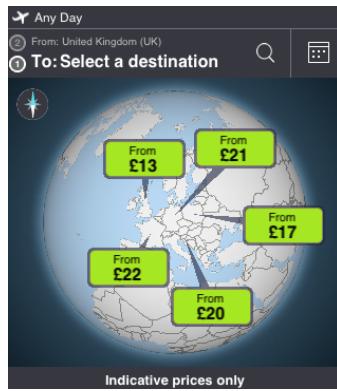


Figure 18: Skyscanner apps globe feature

Flat navigation allows users to move from one category to another, as all categories are available from the main screen. This style has been used by many of the applications studied including redspottedhanky.com, booking.com and thetrainline.com

In some cases, it may be better to combine more than one navigation style, but it could also run the risk of overcomplicating the design of the application and the user's experience.

Some applications like Trivago have a navigation bar, which manages the screen's contents. The user can select to change the search criteria or pinpoint hotels on a map. In the Zipcar application, figure 19, the options in the navigation bar allow the user to perform actions. E.g. 'Reserve' or 'Log in'. These options change depending on where the user is in terms of navigation



Figure 19: Zipcar navigation [7].

Some navigation styles have tab bars placed at the bottom of the screen; this allows the user to switch between different subtasks, views or modes. For example, redspottedhanky.com's application includes the options of

switching between finding trains, viewing tickets or account details or finding other information. This is a useful feature that helps a user navigate their way through an application, which thetrainline.com has chosen not to use in their design.

Apple and Microsoft both recommend 44×44 points and a maximum of 5 icons to avoid tab bars being over cluttered.

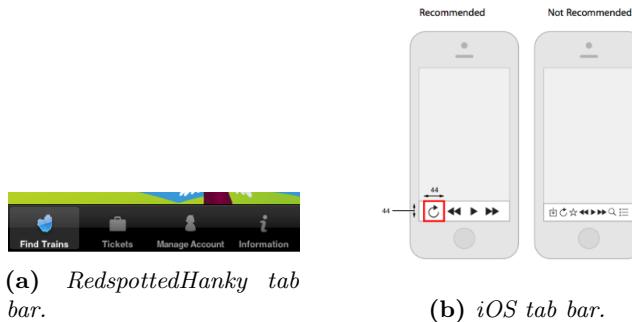


Figure 20: Tab bar icon sizes.

None of the applications studied take into account the orientation of the screen. Users have no option but to use the applications when the phone is in portrait. It would be best to provide users with the choice of holding their device in landscape too. As can be seen in figure 21, Trivago, in particular, contains a lot of details within its side menu; some users may prefer to see slightly bigger, which could be possible when the screen is tilted horizontally.

The way all of the applications function is through a touchscreen interface. Users may be used to certain functions such as ‘pinch to zoom’ and other interactions defined in figure 22 for iOS. It will be important to consider these interactions to make the application easy to use.

Other ways the user could provide input include using speech recognition. For example, the user could say the sport, date, time and location instead of having to input text or select options.

2.4 Current Sports Booking Applications

Our application will allow searching across multiple organisations, locations, times and sports to provide available bookings. There are currently no applications that allow searching across multiple organisations’ facilities for available sports bookings. There are, however, web applications for specific organisations which:

- have multiple locations, each with many available sports to play,
- have a single location with many sports to play,
- have multiple locations with a single sport to play.

There are also web applications which allow for searching of different facilities but offer no information on available bookings beyond providing contact information for each facility.

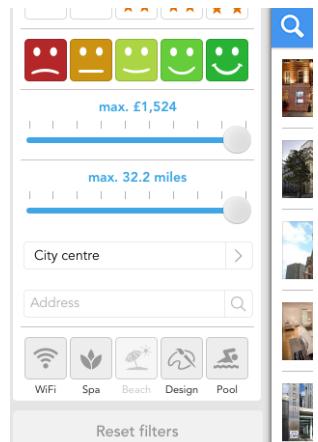


Figure 21: Trivago input [8].

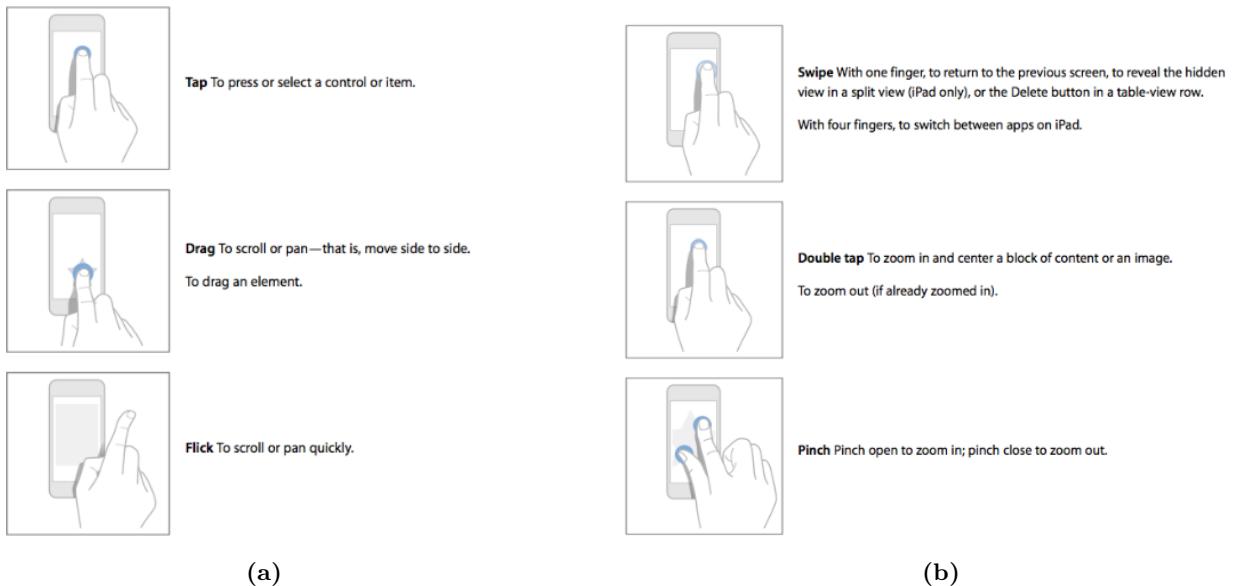


Figure 22: iOS touchscreen interactions

2.4.1 University Of Birmingham Sport

The University Of Birmingham has an online booking system for numerous sports available to play at facilities at its campus in Edgbaston [9]. This site allows search by location, type of activity and time. Once the user has entered their search criteria, a list of “activities” are returned. The user then selects an activity and is shown a timetable indicating at what time this activity is available. The activity can then be booked directly on the website.

Strengths

- The search form has tick boxes to filter out particular days of the week. A user may only know which days of the week they want to play a sport rather than exact dates. This feature gives the user a quick way to search for this.
- There are quick links on the form to change the date ranges to either today, tomorrow or 7 days time. When a group finishes playing a particular sport one week, they may want to quickly see what is available at the same time the following week; these quick links speed up the process of finding these available bookings.
- It is possible to search solely by time, leaving all sport and location fields blank. If the user knows they want to play a sport at a particular time, but would like to have options on sport and location, the search form in figure 23a allows them to search this way.

Weaknesses

- The option to filter by “activity type” in the search form is actually a filter for location and many of the locations host a variety of different sports. Furthermore, the names of these locations, such as “Sports Hall”, often offer no clear indication of which sports are

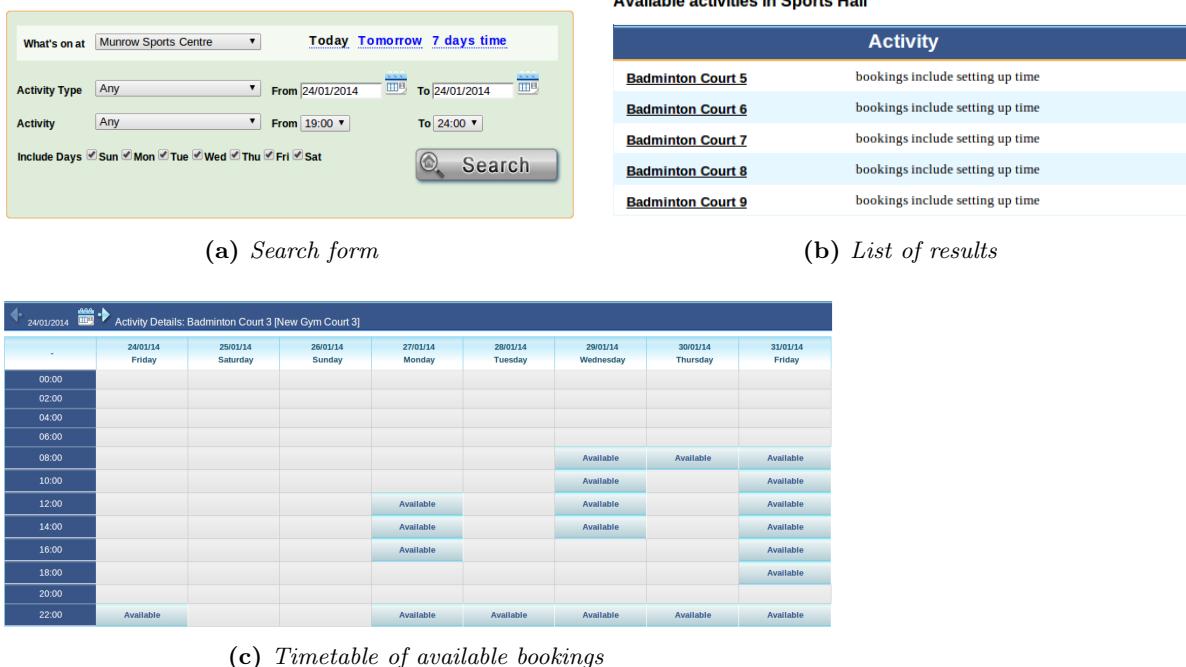


Figure 23: The booking interface for University of Birmingham Sport.

available at a particular location. If the user wants to know what sports are played at a particular venue, they have select that venue and then see which options then appear under the “Activity” drop down box of the search form. This is confusing and unintuitive for the user.

- For many sports, such as badminton where there are multiple courts available for badminton across several locations, there is no way to simply search by that sport. The user is required to go to each court individually to see what times are available for that court. The user is unlikely to have a court preference and most likely just wants to know at what times they can play badminton; this system offers no quick and easy way to do this.
- The timetable results groups times into two hour slots but often each booking slot is one hour long. It will show ‘available’ for a two hour slot when at least one of those two hours is available. Therefore it is impossible to know if the exact hour a user wants to play is available without selecting the containing two hour slot as shown in figure 24.
- There is no indication of price until you select a booking slot for a particular sport at a particular time.

2.4.2 Aquaterra Leisure Centres

Aquaterra is a charity funded by Islington Council who manage several leisure centres and other sports facilities in Islington, London. They maintain a website [10] where users are able to book at each of these facilities. The booking home page shown in figure 25 prompts a user to select which of the locations they would like to make a booking at.

Activity Details: Badminton Court 3 [New Gym Court 3]	
-	
24/01/14 Friday	Available
25/01/14 Saturday	Available
26/01/14 Sunday	Available
27/01/14 Monday	Available
28/01/14 Tuesday	Available
29/01/14 Wednesday	Available
30/01/14 Thursday	Available
31/01/14 Friday	Available
00:00	
02:00	
04:00	
06:00	
08:00	
10:00	
12:00	Available
14:00	Available
16:00	Available
18:00	
20:00	
22:00	Available

Figure 24: Display when the 18:00 two hour slot is chosen. However, only one of two hours following 18:00 is available.

Online Bookings

You are here: Home > Online Bookings

Bath Sports & Leisure Centre
 Bath Sports And Leisure Centre Family Fun Swim
 Chew Valley Leisure Centre
 Culverhay Sports Centre
 Finsbury Leisure Centre
 Finsbury Park Tennis Courts
 Highbury Fields Tennis Court
 Islington Tennis Centre
 Keynsham Leisure Centre
 Sobell Leisure Centre
 South Wansdyke Sports Centre
 Three Corners Football Pitch
 Tufnell Park Tennis Courts

The interface for each of the locations varies slightly, but each will generally show a list of available activities at that location that can be selected to display a timetable of available booking slots within the following week for that particular activity. The price is displayed at this point and the booking can then be made directly on the website after choosing a preferred court.

Select Date & Time

Sobell - Badminton		Saturday 25 Jan	Sunday 26 Jan	Monday 27 Jan	Tuesday 28 Jan	Wednesday 29 Jan	Thursday 30 Jan	Time
9.00am	past							9.00am
9.30am		6 Left	14 Left	14 Left	6 Left		10 Left	9.30am
10.00am	past							10.00am
10.30am		sold	14 Left	14 Left	5 Left		10 Left	10.30am
11.00am	past							11.00am
11.30am		sold	10 Left	14 Left	5 Left		14 Left	11.30am
12.00pm	past							12.00pm

(a) Beginning of timetable showing available badminton slots

Select Court or Area

Full Name:	Non-member Guest	Member No:	
Centre:	Sobell	Activity:	Badminton
Date:	Sunday 26 Jan 2014	Time:	9.30am
Choose Court:	Any available	Price:	£14.00

[Book it Now!](#)

(b) Confirmation page for a booking slot showing price and choice of courts available

Figure 27: The booking interface for badminton at Sobell Leisure Centre

Strengths

- If a user knows the location they wish to play at and the sport they wish to play, then they can see on one page everything that is available to them in the next week. Rows being coloured alternately and having the time displayed at both sides of the timetable makes it easy for the user to navigate to a particular time slot at a glance.
- The timetable for badminton in figure 27a indicates how many courts are available within each slot. If very few courts are available in a preferred time slot, it could indicate to the user that they need to make a quick decision as those courts may soon be booked by someone else. Conversely, if there are many courts available it could indicate to the user that they could delay making a decision on which time to book a court. Providing the user with this information early in the search process could be very helpful.

Weaknesses

- When selecting a location from the page in figure 25, there is very little indication to the user what sports are available at which location. Therefore if they want to play a particular sport but have no location preference, they are required to go through each option on the homepage to compare what facilities are available for that sport at each location. Furthermore, as each location's page has a slightly different interface, the user has to make sense of each page separately, slowing down their ability to compare information provided for each location.
- There is no indication of price until you select a particular sport at a particular time.

Figure 25: Aquaterra booking homepage

Sobell

How to find us

- Badminton
- Squash
- 5-a-side : Weekend
- 5-a-side : Mon-Fri
- Early Morning Badminton
- Early Morning Squash

Figure 26: Facilities available at Sobell Leisure Centre.

2.4.3 London Tennis

London Tennis is a website designed to help tennis players in London find partners to play with, as well as tournaments to play in and courts to play at. The court search feature in figure 28 allows a user to search for a court anywhere in London including options to search by cost of playing, location and type of court.

The screenshot shows a search form with the following fields:

- Part of name or address: A text input field containing "Please select the area within which you would like to search."
- Full Search: A button to the right of the search bar.
- Within: A dropdown menu set to "1000 miles of postcode W1 (outcode only, e.g. SW19)".
- Park or club: A dropdown menu set to "Either".
- Free to play: A dropdown menu set to "Don't Mind".
- Court type: A dropdown menu set to "Don't Mind".

Figure 28: The search form for looking for a tennis court.

There is also the option to select courts from a map, as shown in figure 30. Users can filter out courts which are free or not free. However, there are no other interactive features on this map. Once a search is performed, the user is shown a list of courts matching their chosen criteria as seen in figure 31a. Once a court is chosen, the user is shown details about the court including exact location, type of court, price and weather predictions for the local area.

Strengths

- The user is able to show only free courts straight away without having to complete any other aspects of the search. This is in contrast to other sites we have seen so far and allows the user to immediately filter by something that is potentially a deciding factor in choosing a court.
- The weather predictions are a useful addition given tennis is very much dependent on good weather.

Weaknesses

- The size of the map for searching in figure 30 is too small for the number of courts shown on the map, particularly given there is no option to zoom in to more detail on the map. Though the map does give, at a glance, an idea of where courts are concentrated in London, it is difficult to actually select a court due to how close the buttons to select each court are to each other.
- There is no information about opening times for any of the courts. Although London Tennis is primarily a service to find court locations rather than provide details about available bookings it would be useful to inform the user of when the courts are even open.

2.4.4 What we can learn

- It could be useful to add options to filter by day of the week in addition to buttons that quickly allow searching by times relative to today such as tomorrow or one week from now as this is possibly be one of the main criterias of the users search.

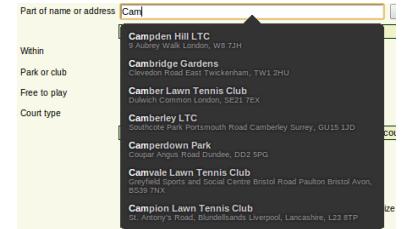


Figure 29: Drop down to predict input when typing a name of a court.

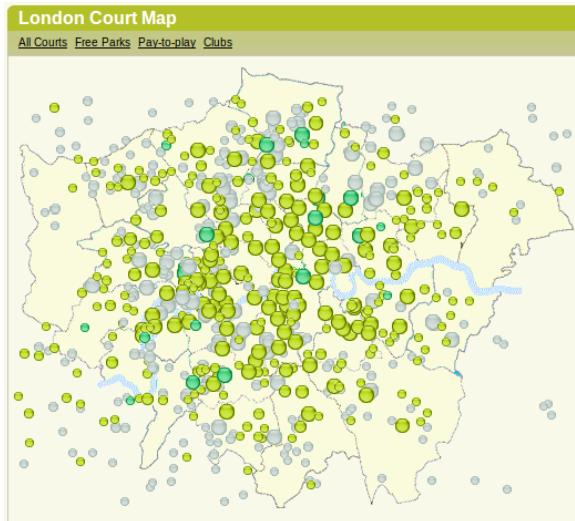
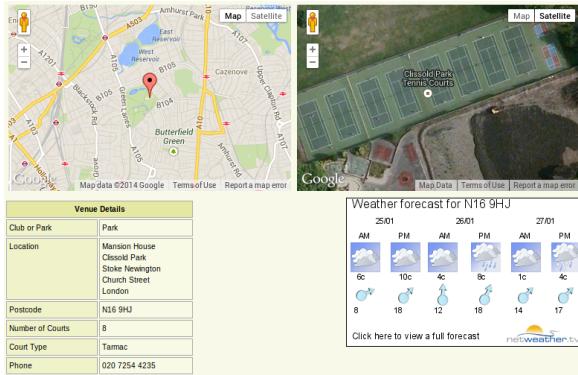


Figure 30: All courts by location on a map with the ability to filter between free and pay-to-play courts

- The naming of options to filter by when searching need to be intuitive and unambiguous otherwise it is difficult for the user to know how to actually search for what they want.
- Using a timetable layout similar to figure 23c could create difficulties in clearly displaying all available options after a search is done. There may be far more booking slots to display in our application given that our search will be conducted over a greater number of facilities. The screen space available will also be smaller than University of Birmingham has on their website. Therefore we need to think of a clearer way of showing the user the results of a search.
- Price is likely to be a factor in a user's decision of what sport to play and where, therefore our application needs to either provide a filter to search by price or clearly indicate the price of a booking option as early as possible when displaying results to a user.
- If we are to use a map to display results of a search, it will be difficult given the potentially large number of results to display every option individually on the map, particularly if the map covers a large area. Therefore it may be better to group options together, possibly by colour or different shapes or picture icons, in order to make it possible to read and navigate through the results.
- Weather could be an important factor when a user knows when they would like to play a sport but want to compare what sports are available at that time. When a user is looking at search results for outdoor bookings, it could be useful to display weather predictions for that time, particularly if the search is in the near future as predictions are likely to be more accurate for the near future.

Club	Address	Postcode	Club or Park	Courts
Cissold Park	Mansion House, Cissold Park, Stoke Newington, Church Street, London	N16 9HU	Park	8
Hackney Downs Park	Downs Park Road, London	E8 8NP	Park	3
Milfields Park	Milfields Road, Hackney	E8 0AR	Park	4
Spring Hill Park	Spring Hill, London	E5 9BL	Park	3
Springfield Park	Spring Hill	E5 9EF	Park	5

(a) List of courts matching a search.



(b) Details about a chosen court.

Figure 31: The displays for results of a search.

3 User Personas

In order to fully test and improve the prototypes that have been designed, a set of user personas have been developed. Together, they represent a very wide range of use cases, user abilities, and user preferences.

The four user personas that have been examined specifically are an elderly user, a professional working person, a student at university and a younger child.

Together, the profiles for these example users include several different requirements and restrictions, as well as demands on accessibility. They have been chosen as examples of real world user situations that would require certain aspects of the design to be carefully considered to maximise usability.

By using these personas as a limiting guide, emphasis can be placed on ensuring that all aspects of the final design are suitable for as wide a range of users as is appropriate, and allows, if necessary, the tailoring of this application to a particular subset of the population.

The table below demonstrates the wide range of use cases encompassed by these personas and allows the relative abilities and requirements to be compared (E — elderly, W — working, S — student and C — child).

	Not Important		Very Important		
	1	2	3	4	5
Time	E		S	C	W
Location	W		C	E	S
Sport	W	C	E		S
Price	W	E		C	S

Techincal Proficiency	Incompetent		Competent
	E	W	S/C

3.1 Elderly Persona

Description

Howard lives on the outskirts of York with his wife. Howard's wife works most days of the week as a supermarket shop assistant and their youngest son has now left home for university in London, leaving Howard with a lot of spare time on his hands. To help stay connected with his dad, Howard's son has bought him a smartphone in spite of Howard's inexperience and frustration with technology. For this reason he also prefers not to put any sensitive information in his phone, like credit card information.

Though Howard was very active in his working years, he has come to enjoy a more sedate life since retiring last year from his job as a construction manager. Recently diagnosed with osteoarthritis, Howard has been advised to exercise more regularly to help strengthen his muscles and joints. Howard has always been competitive, and would happily try his hand at any sport he could find. However, joint pain in his knees often restricts him from some high impact activities.

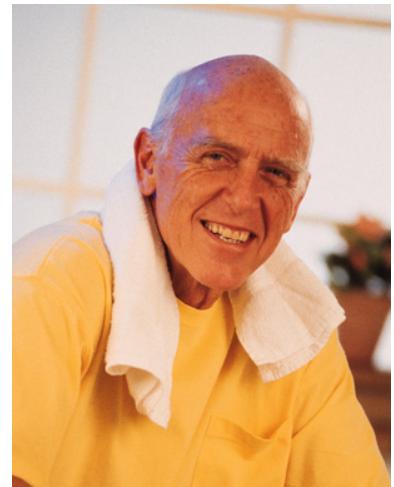
No longer able to drive, Howard relies on walking and public transport to get around during the week when his wife is not at home to drive him.

Scenarios

- Howard's doctor has just told him he needs to start participating in more activities. Howard has a lot of free time, but he doesn't know what sports he wants to play and doesn't know what facilities there are in York so he searches on his phone to see what his options are. When he finds a sport to book, he'd like to be able to inform his wife as she'll be giving him a lift, including information such as the time, location and the sport he's playing.
- Howard has gathered a group of 4 old friends to play sport with him this Friday when they are all free. They're happy to play anything involving a racquet. If it goes well, he wants to make it a regular, weekly activity.
- Howard has been having a lot of knee pain over the last few days so his doctor has suggested he try swimming. He doesn't think he can travel too far from his house and is worried he would need disabled access at the pool and doesn't want to feel rushed at the pool by younger and faster swimmers.

Pain Points

- Joint pain in his hands often causes Howard difficulty and discomfort when using his mobile phone.
- Howard has very little patience with technology.
- He would often prefer to play close to public transport facilities.
- Joint pain in his knees often makes walking up stairs very uncomfortable for him.



Name Howard Evans

Occupation Retired

Age 65

Main Goals

- Increase his overall physical activity.
- Maintain his independence from his wife.
- Limit his time using computers.
- Pay for the activity at the venue.

3.2 Working Persona

Description

Janet lives in a flat in Sheffield but must commute to Leeds during the week for work. Her job as an IT consultant can be stressful and very time consuming and often requires working late into the evenings. Due to her busy work schedule, Janet is restricted to playing sport on occasional evenings and at weekends. She doesn't have any children and currently lives on her own after recently coming out of a long term relationship. And for that reason, she wants to get out of the flat as much as possible and take her mind off things by staying busy and active.

Janet wants to play sport on her drive home from work as she does not have time to go home first. The fact she has a reasonably long commute gives Janet a large area in which she can play sport, and therefore a greater selection of sport centres to choose from. Due to her successful career, Janet has a decent income so is not restricted by budget and is willing to pay extra for playing at peak times. Her eagerness to stay active and keep busy means she is very much up for playing any sports, even if she has never played them before.

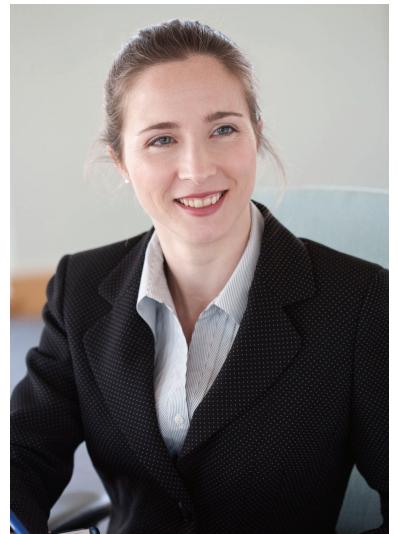
Although Janet works in the IT industry, her experience with using applications on a smart phone is limited.

Scenarios

- Janet feels like playing a team sport on Friday, she doesn't mind what sport but doesn't fancy doing something on her own. She has two friends who would like to get involved but would be willing to join other groups. The friends live far away and when they are organising the event, they would like to be able to share the same screen to make finding a suitable booking easier.
- It's a Tuesday evening and Janet has a table tennis session booked for 7pm. She has just been called in to an urgent meeting at work and doesn't think she can make the timeslot she has booked. She would like to see if she can push her timeslot back an hour, if not she must cancel.
- Janet has checked the weather forecast for next Saturday and it is looking to be a beautiful day. She has a coffee date at 2pm so can play any time before then and would like to play a sport outside.

Pain Points

- Unpredictable work schedule.
- Does not want to travel far from her usual commute route to get to a center to play sports.
- Can't plan for playing sports very far in advance.



Name Janet

Occupation IT Consultant

Age 33

Main Goals

- To play sport on her way home from work and at weekends
- To ease the stress of work and recent break-up
- Get involved in group sports to meet new people

3.3 Student Persona

Description

Jenny is a 20-year-old university student. She began playing tennis over the summer and would like to start playing regularly, she is not interested in any other sports.

Her university is situated in a large city. Jenny lives in a shared house close to the university's campus. As a student, she has a limited budget and would prefer to play somewhere close to the university. This would keep her travel costs down and she would be able to fit in a round of tennis in between attending lectures. She would also prefer places that would offer her a student discount or reduced price for multiple bookings.

Jenny organises her daily activities and social events on her mobile phone and would find it convenient to book sports facilities and keep track of her bookings through an application.

Scenarios

- This semester, Jenny has no lectures on Monday mornings, Wednesday afternoons and between 11am and 2pm on Thursdays. She would like to book a tennis court for one of these times.
- Jenny has a major assessment deadline next week and decides to spend her time during the day working. However, she would like to book for an evening session for any day during the week on a clay court in order to prepare for an upcoming tournament.
- She is practicing for a tournament with a friend and they have agreed to play together every week. In order to help remind her friend of this, Jenny would like to send the booking details when she has booked the court and have a weekly reminder of the time.

Pain Points

- Jenny is only interested in tennis, and sometimes finds it difficult to locate this amongst all the other sports on offer.
- She has a limited budget; she would prefer facilities that provide student discounts or other offers.
- She would like to use sports facilities within walking distance from university, to fit around her timetable and to keep travel costs down.



Name Jenny Stevens

Occupation Student

Age 20

Main Goals

- To fit tennis around her timetable on a regular basis
- To find cheap sports facilities locally

3.4 Child Persona

Description

Joe lives at home in a small town with his father, Pete. He is very active, playing many sports at school and outside and enjoys trying new sports whenever the opportunity is available. His father is keen to encourage him to participate in a wide range of activities so that he can make friends and stay fit.

Joe is at school every day but has afternoons after school and the weekends available. His father tries to find times when they can spend time together so sometimes take an afternoon off work to play sport with Joe.

Pete commutes just a short way to work by car, so doesn't mind traveling a bit to find some good facilities and has also been very active in the past so is always up for trying out new sports.

Joe is very adept with the latest technology, but occasionally has difficulty with words and colours since he has very mild dyslexia and red-green colorblindness.



Name Joe Wyatt
Occupation School student
Age 14

Scenarios

- With summer approaching, Joe wants to start a new sport outside and his dad wants him to have a professional coach. He's not too concerned what it is, but it needs to be close to home, as he'll need to get the bus there.
- It's the end of term and Joe wants to organise a squash tournament with a group of friends and his Dad. They want to book a couple of courts nearby for after school during the week, but they're not too concerned about the day.
- Pete and Joe want to play a game of tennis, but the court they sometimes go to is not of great quality. This time, they don't mind going further, and want to spend a bit more to get really good courts.

Pain Points

- Sometimes has difficulty reading small text with bad colours.
- Pete is keen to get a good deal whenever possible, but not at the expense of good facilities at the right time.

Main Goals

- Stay active and have fun playing sports, with his father if possible.
- Try out new sports
- Make friends

Part II

First Generation Prototypes

4 Methods of Evaluation

The design process is aided by the generation and evaluation of a number of first and second generation prototypes. These will be assessed against several specific criteria as well as the user personas defined in Section 3. Using the results from these evaluations, the best aspects of the first prototypes will be used to inform the second generation.

When evaluating the initial designs, each of the potential scenarios are examined and the prototype tested to see if it provides the required or desired functionality. Where the functionality is not provided by a prototype, the impact of the implementation of that feature on the rest of the design will be analysed to see if it is possible to add this feature.

In addition to these real world situations, the designs are tested against a set of heuristics called Nielsen's heuristics [11] which allow individual elements of the user interface design to be evaluated in isolation against recognised principles. A description of each of the heuristics that are considered is given below.

Visibility of system status

The activity that is currently being performed should be clear to the user, and the status of that activity should be clear. For example, if a process is running, waiting, or completed.

Match between system and the real world

Using standard conventions for ordering items makes them easier to search through and select. Also the wording of buttons, labels and information should be familiar to the user. However, the computer system should not try to imitate a physical object directly, i.e. skeuomorphism.

User control and freedom

The user should be in control of the system. The system should work for them, but provide the ability to undo mistaken actions.

Consistency and standards

Any methods for interacting with the system should be uniform across different platforms so that users do not need to relearn to use the system.

Error prevention

Reducing the possibility of errors, and the ability for the user to provide data that could cause an error is better than recovering from errors. If an error does happen, then giving the user information is generally better than leaving them without knowing what happened.

Recognition rather than recall

Having navigational elements clearly visible and reachable means that the user does not need to remember how to use the application, instead the instructions are effectively on-screen.

Flexibility and efficiency of use

Catering to advanced users without distracting or confusing the novice allows the system to be used by a wider range of people.

Aesthetic and minimalist design

Including irrelevant data, or information that is only needed infrequently can be distracting. Reducing the number of visual stimuli presented to the user can increase speed and efficiency.

Help users recognize, diagnose, and recover from errors

Easy to read, simple error messages, briefly explaining what happened can help the user to not get into the same situation again.

Help and documentation

Providing documentation in a well structured way can help the tentative user to use the basic functionality and the advanced user find more.

4.1 Prototype 1

4.1.1 Presentation

Tools: proto.io

Rationale This prototype focuses on a content driven display showing users immediately what is available local to them with interactive tools for adjusting their search.

Home Map On opening the application, the user is immediately shown this map home screen with the date and time set to the current time and the location centred on the user's location.

1. The tab bar links to pages where the user can decide which sports and dates to filter into the search. The location tab will prompt the user to enter a new postcode to centre the map on or ask them if they would like to reset to their current location.
2. Icons represent locations to play sport. Where a single sport is available to play at a location, a picture for that sport is shown. Where more than one sport is available, a plus sign is shown to indicate that several sports are available at that location. When a user presses a sports icon, they are shown the 'Book Now' screen.
3. Colour shows, using a traffic light scale, either:
 - (a) availability of courts/facilities. Green indicates there is full availability at the location where red indicates there is only one booking left at this time.
 - (b) price of bookings at this location. Green indicates all bookings are free at this location and red indicates prices are expensive (in comparison to other activities in the area).
4. Settings button brings up a small drop down box to ask the user which of the two options they would like colour to indicate; availability or price.

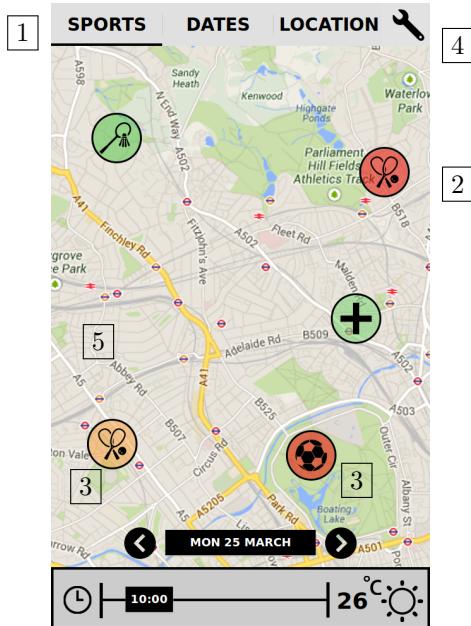


Figure 32: The home map screen

5. Map is navigable in the same way as the phone's native map application. The user can zoom in and out with finger gestures and pan left, right, up and down. As the user changes their location/zoom level, the sports icons update to cover the new area.
6. The current day being shown, with arrows to navigate through all days which are selected in the dates tab. By default, this is all dates, but the user can filter the dates via the dates tab.
7. A time slider which can be moved in hour increments. The icons shown on the map will change to accurately show what bookings are available for the hour following whatever time this slider is set to by the user.
8. A weather prediction for the date and time currently selected.

Sports filter A page to filter which sports are shown on the map home page.

1. Buttons for quickly selecting or deselecting all sports.
2. Checkboxes; when ticked, the chosen sports are included in the search.
3. A bar that can be either pressed or dragged up to close the sports selection tab and return to the map home page.
4. The tab bar remains so the user can navigate between sports, date and location selection without having to do so via the home screen.

Dates filter A page to filter which dates are included in the search. Dates which are highlighted are included in the date navigation on the map home page. (no 4 on the home screen)

1. Arrows to move between months of the year.
2. Days of the month. A user can press a number to highlight it, or swipe around the screen to highlight several dates in one swipe, e.g. swiping across a whole row to highlight an entire week.
3. Days of the week. A user can press one of these days, such as M for Monday, to highlight every occurrence of that day in the month.
4. A bar that can be either pressed or dragged up to close the dates selection tab and return to the map home page.
5. The tab bar remains so the user can navigate between sports, date and location selection without having to do so via the home screen.

Book now screen This screen appears when a user selects a sports icon on the home page. The screen does not cover the whole of the previous page, allowing the user to still see the date of the booking and the weather prediction for that time. The user can press the x to close this screen and return to the search.

1. The sport available at this location. If several sports are available at this location, a drop down arrow is shown next to the sport name to allow the user to select other sports at that location.

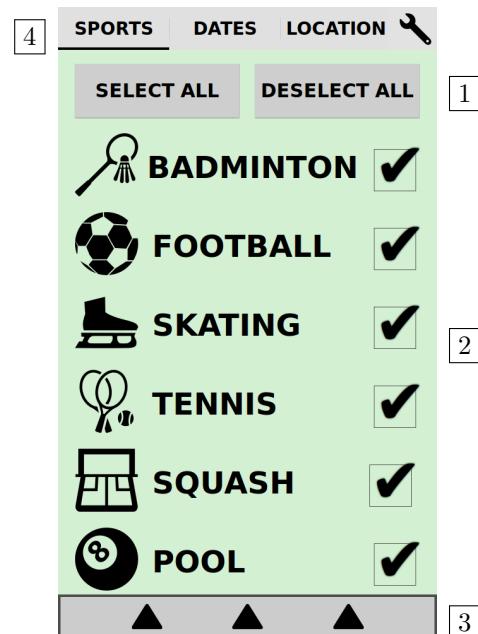


Figure 33: Sports filter screen

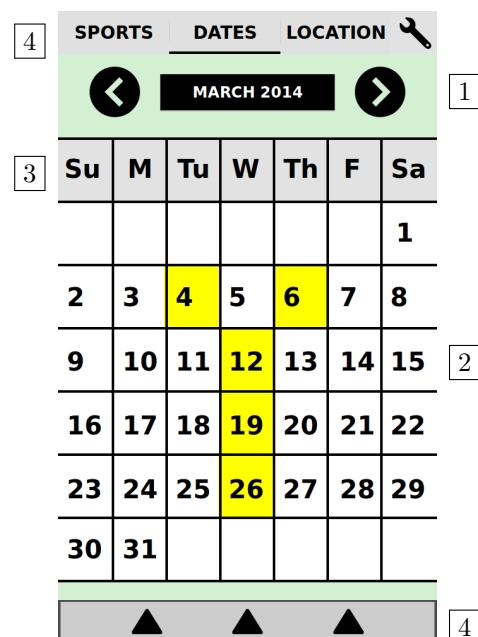


Figure 34: Dates filter screen

2. User can get directions through their phone's native map application, call the reception of the offices to get more information or navigate through pictures of the facilities.
3. The user can still attempt to change the time or date on the screen. If a booking slot is available at the newly selected time then details on the book now screen will change to reflect the change in time and price (if applicable). If a booking is not available then the text between the sport name and 'Location Details' will be replaced by a message telling the user no booking is available at this time.
4. The 'Book Now' button can be pressed to take the user to an external pay site or the website of that sports facility to pay for the booking.

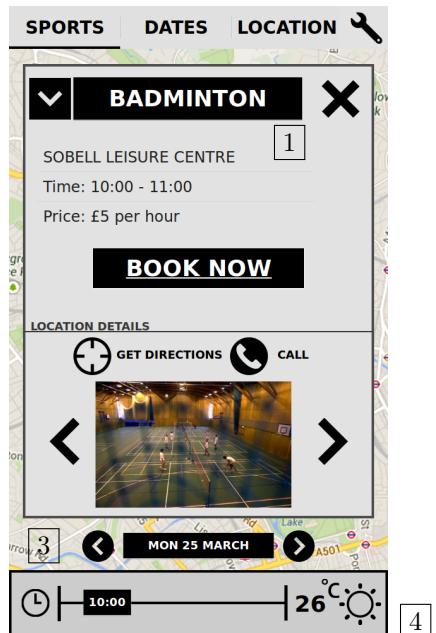


Figure 35: Book now screen

4.1.2 Heuristic Evaluation

Criteria	Rating	Comment
Visibility of system status	+	The time and date of the current results are always shown on the home screen.
Match between system and the real world	+	Map applications have become ubiquitous so use of the map should be intuitive.
User control and freedom	0	There are intuitive ways to return to previous screens and navigate between screens. However, an undo or return button could be added to return a user to a previous page they were on.
Consistency and standards	-	May not be clear that the dates on the map screen correspond to those in the dates filter tab.
Error prevention	0	Relatively few screens reduces the number of places an error can be made. Ensure there is a confirmation message before letting the user book facilities.
Recognition rather than recall	0	Clear icons are used to indicate each sport. No indication on map screen of which dates they can scroll through unless they go to the dates tab to see selected dates.
Flexibility and efficiency of use	0	Swiping on dates filter tab can speed up date selection. No bulk booking, if user knows they want to make several bookings, they have to search and process each individually.
Aesthetic and minimalist design	+	Keeping sports and date filters tabs separate from map results and grouping icons when several sports are available leaves map search results clear from clutter.
Help users recognize, diagnose, and recover from errors	-	If a user changes time or date on the booking screen they will be shown a message if a booking is not available at that time. However, there is no undo button to return to the original selection.
Help and documentation	-	Currently no descriptions or tutorials telling the user how to use the system. Could add a help icon which allows users to see what each page does or an initial tutorial on first use of the application.

4.1.3 Persona Evaluation

Scenario	Rating	Comment
Elderly		
Searching for new sports in the area and notifying his wife of the booking.	0	Howard is given an immediate visual representation of what sports are available near him when opening the application. However, with his lack of experience with technology, use of the map may not be intuitive to him and he may prefer options to read results as a list. There is no facility to send information about the booking to his wife.
Racquet sport with 4 friends on Friday	0	Howard could tick only racquet sports on the sports filter tab and Fridays on the dates tab. However, there is no way for him to bulk book if he wants to regularly play.
Swimming nearby with knee pain	-	There is no way to search for facilities with disabled access. This could be included in the description of the facility on the booking page but Howard would still have to look at each search result individually.
Working		
Team sport on Friday including screen sharing with friends	+	Janet can select the relevant sports and dates to show relevant results. Could have quick buttons on the sports tab screen to quick select all team sports to speed this up. There is no quick way to share a set of search parameters.
Change/cancel booking at late notice	-	As booking payments are held outside the application there is currently no way to cancel bookings or even see previous bookings. Could add a screen to add favourite booking slots to so users can potentially see previous bookings.
Outdoor sport early on Saturday	+	Janet can select the relevant sports and dates to show relevant results. Could have quick buttons on the sports tab screen to quick select all outdoor sports to speed this up. The weather prediction on the map screen also helps inform her search here.
Student		
Tennis court at specific times	+	Jenny can select tennis from the sports tab and all preferred dates from the dates tab and then quickly browse the options on the map across different times at the weekend.
Weekday evening session must be on clay	0	Jenny can select all days from the date tab then set the time to evening on the map and scroll through each day seeing which day suits her best. There is no way to specify the type of court or facility being booked.

Weekly practice with friend with reminders	–	Can navigate through different weeks but no option to bulk buy and no facility for reminders.
Child		
Outdoor sport close to home or on a bus route with coach	0	If Joe chooses his preferred outdoor sports from the sports tab, he will be shown those close to him straight away. However, there is no indication of bus routes on the map. An option could be added to overlay local bus routes on the map. There is no way to include coaching requirements in the search, but this information may be displayed in the information for individual centers on the book now screen.
Booking several squash courts for after school tournament	–	There is no way for Joe to book several courts at one time. Could add an option on the booking screen to book several courts at once or add a basket function so users can select all the bookings they want and then pay for them together. Could have some kind of rating system to search for highly rated locations.
Looking for high quality tennis court	–	There is currently little indication of the quality of each location. Could have some kind of rating system in the location description on the bookings page and some way to search for highly rated locations.

4.2 Conclusion

The evaluation of this prototype revealed a number of features that could be carried forward into the next prototype. The map itself gives the user a clear view of what is available near to them and should be intuitive to use given the ubiquity of map applications on phones. The use of icons to indicate sports allowed space to be saved on the screen and also helped allow recognition rather than recall when using the application.

However, there are also a number of issues with this prototype that would need to be fixed going forward. The heuristic analysis indicated that this design could be confusing to users and offers little help in guiding them through the application and through the booking search process. Furthermore, if a user mistakes a mistake there is no way of reversing the changes they made which could be particularly frustrating for inexperienced users.

The evaluation against scenarios also highlighted a number of missing features. Users are not able to cancel or change bookings, they are not able to book several different courts at once or make repeated bookings of the same facility.

4.3 Prototype 2

4.3.1 Presentation

Tools: Balsamiq

Rationale This prototype is a hierarchical design displaying each screen as a series of steps which the user must progress through before searching. This prototype also focuses on a very simple, easy to use interface.

Home Screen The home screen offers a choice of three menus

1. Make a booking; takes users to the hierarchy of search screens to enter their criteria
2. Change a booking; takes the user to a screen which allows them to change their criteria if alternative results permit it
3. Cancel booking; takes the user to a screen of their current bookings and the user can select which booking they would like to cancel. Whether a refund is possible would depend on the sports centre

Search screen 1 On selecting ‘Make a booking’, the user will be directed to the initial search screen which will be the first step in their search

The diagram shows a search interface with the following numbered elements:

- 1. A help button with a question mark icon.
- 2. A progress bar at the top.
- 3. A dropdown menu showing recent search results (Tennis, Squash) and a list of all available sports (Archery, Badminton, Basketball, Boxing).
- 4. A date selection calendar for February 2008, showing the 4th as the selected date.
- 5. A time selection dropdown showing 15:00.
- 6. A duration dropdown showing 1.5hrs.
- 7. A 'next' button at the bottom right.

Figure 37: First search screen.

1. The help button takes the user to a guide on how to complete the current page along with FAQ's.
2. The progress bar shows the user how far along they are in the search process.
3. The user can choose which sport they would like to play from a drop down menu. The drop down menu shows recent search results at the top, then lists all available sports in alphabetical order.
4. The user must press on the calendar icon which will present them with a calendar to select which date they would like to play.
5. The time is chosen by selecting the hour and minutes from drop down bars.

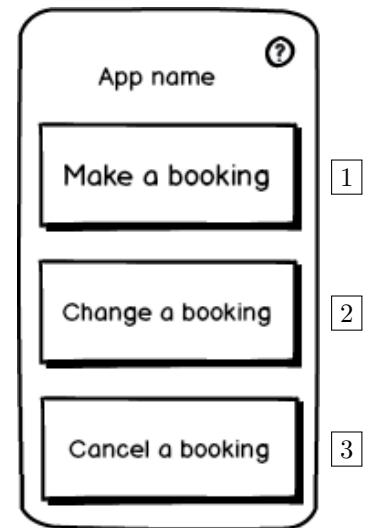


Figure 36: The home screen

6. The user can select how long they would like to play for, chosen from a drop down bar with half hour intervals.
7. The 'Next' button takes the user to the next step in the search process.

Search screen 2 The next screen focuses on location.

1. The search box allows the user to specify their location by either town, city or postcode. When the user begins to type a location, the system will suggest locations based on what they have already typed
2. The user can use a horizontal slider to specify how far they are willing to travel to play the sport
3. If the user requires disabled access they can tick the checkbox and the results will only show sports centres which are wheelchair accessible

Search Screen 3 The user is then brought to the final search screen where they may be able to get discounts

1. Numeric stepper to specify how many people the booking is for.
2. The user may be eligible for discounts if they are a child, student or pensioner. They can tick the suitable checkboxes if they fall into any of these categories.
3. If the user has a strict budget, they can choose to only see results which do not exceed a particular price.
4. Pressing the search button takes the user to a screen displaying the results of the search.

Results Screen Screen showing the results of the search

1. The user can sort the results by distance, price or time.
2. If the results are not suitable, the user may wish to change their search criteria, the 'amend search' button will take them back to the first search screen where they can alter their original preferences.
3. Each result informs the user of the time, date, venue name, distance from the venue and the price. The price shows the total price for all people. The user can scroll down the page to view all matching results.
4. Pressing the buttons displaying the price will take the user to a more detailed description of the booking and a link to an external pay site or the website of that sports facility to pay for the booking.

Screen Title ?

Please enter a town, city or postcode:

Max Distance:
4 miles

Wheelchair accessible

back **next**

Figure 38: Second search screen

Screen Title ?

How many people **3**

Child **0**

Student **2**

Concession **0**

Max price: **£8**

back **Search**

Figure 39: Third search screen

1

2

3

4

Results ?	
Sort by...	
amend search	
Badminton 02/04/2013 11.00-13.00	
Venue1 3.2 miles	£5.50
Venue2 2.9 miles	£5.50
Venue3 1.7 miles	£7.20
Venue4 4.0 miles	£10.00

Figure 40: Results screen

4.3.2 Heuristic Evaluation

Criteria	Rating	Comment
Visibility of system status	+	Each screen shows the user their progress in the search process
Match between system and the real world	+	Each field is self explanatory and is clear what is asked of the user.
User control and freedom	-	The hierarchical nature of the system prevents the user from switching screens easily. If they choose to go back they will lose the information they have already typed on the screen they left. Freedom is also restricted as the user is required to fill all fields. For example they must pick a particular sport at a particular time.
Consistency and standards	-	The way users specify their criteria varies throughout the search, for example horizontal sliders and steppers to achieve numerical values. Although this would not reduce the clarity of what is asked of the user.
Error prevention	+	Due to the large buttons and very simple interface, there is very little chance of user error. Although the drop down menus could get a little fiddly. If the user does accidentally book the wrong option, they may have the opportunity to change or cancel this booking.
Recognition rather than recall	+	Information required on the current search screen does not depend on information on the previous screen.
Flexibility and efficiency use	0	Lacks efficiency due to the fact that the user must progress through all search screens filling in all fields before they can search.
Aesthetic and minimalist design	+	The design is very simple so as not to cause any confusion to the user. The home screen, for example, displays only 3 large buttons to allow the user to chose which path they would like to take
Help users recognize, diagnose, and recover from errors	+	If the user tries to move to the next screen having not filled a field or filled it incorrectly, they will be shown a descriptive error message in red above that field
Help and documentation	+	The help button displayed on every screen takes the user to a guide on how to complete the current page along with FAQ's

4.3.3 Persona Evaluation

Scenario	Rating	Comment
Elderly		
Searching for new sports in the area and notifying his wife of the booking.	-	Howard may find using the drop down menus difficult with his osteoarthritis. There is no feature to notify people of the booking
Racquet sport with 4 friends on Friday	0	Can select four people to play using drop down menu. Would have to specify which racquet sport he wishes to play. No bulk book feature.
Swimming nearby with knee pain	+	If Howard does not wish to travel far he can either filter the results by distance or specify a maximum distance he is willing to travel. If Howard's knee pain is particularly bad he may wish to swim somewhere which doesn't require climbing any stairs. He can do this by ticking the checkbox for wheelchair accessible locations.
Working		
Team sport on Friday including screen sharing with friends	-	The application would not support this scenario as there is no option to search for just team sports. There is also no current feature to support screen sharing but this could be incorporated into the final design.
Change/cancel booking at late notice	0	Janet has this option on the home screen. Although the application cannot guarantee the venue allows cancellations, she can chose to change her booking, or cancel if she is unable to rearrange. However, the application cannot guarantee the venue allows cancellations.
Outdoor sport early on Saturday	0	Useful as Janet can specify a time. But again, there is no flexibility in choosing a sport.
Student		
Tennis court at specific time	+	This scenario is tailored to this prototype's design. Jenny can specify that she would like to play tennis at a particular time on a particular day and how long she would like to play for
Weekday evening session must be on clay	0	This could be something that could be incorporated on the screen showing the booking in more detail, along with other information such as the court number.
Weekly practice with friend with reminders	-	There is no notification feature available with this prototype. The regular weekly booking feature could also be something that is incorporated in to the screen showing more detail about the booking.

Child

- | | | |
|---|---|--|
| Outdoor sport close to home or on a bus route with coach | – | No feature showing any transport routes. Joe would also have to specify which outdoor sport he is interested in playing |
| Booking several squash courts for after school tournament | – | With the current design, Joe would have to use the number of players field (4 people = 1 court) to portray how many courts he needs. He can specify how long they need the courts based on how long they think the tournament will last. However he would need to choose a particular day. |
| Looking for high quality tennis court | – | There is currently no way of finding the quality of the sport facilities. Pete can however, use the sliders to increase the maximum distance and price they are willing to pay. |
-

4.3.4 Conclusion

Based on the heuristic evaluation we can conclude that the hierarchical nature of this prototype would not suit our application as it lacks efficiency and freedom due to the fact that the user must progress through all search screens filling in all fields before they can search. It also prevents the user from switching screens easily. For a more flexible and efficient experience, a flat design may be more appropriate.

We can however say that this prototype is very clear and structured, and with its simplistic interface it reduces the chance of user error.

Playing out various user scenarios has highlighted some important drawbacks with this prototype. The main issue being there is no leeway in which sport they wish to play. A more relaxed approach where the user can select a variety of sports would be beneficial to the user.

4.4 Prototype 3

4.4.1 Presentation

Tools: proto.io

Rationale This prototype is based on the ‘flat’ design of other booking apps. The search criteria is spread across a number of pages and results are displayed as a list.

Home Screen The home screen is also a search page. Users are able to search by sport, location, distance, date and time or a combination of these options; all of these have the default value of ‘Any’ if the user decides not to enter a specific value or range.

By selecting a search option, such as ‘sport’, the user will be directed to another page where they can specify a sport or combination of sports using a checklist interface similar to the previous prototypes. The ‘date’ section would allow the user to select a specific date, a variety of dates or between two dates using a calendar interface. The user can select a time-frame. E.g. after 5pm, before 12pm or between 4pm and 8pm using the ‘time page’. Distance can also be selected by range (e.g. up to 5 miles). Location can be selected from a drop-down list of cities, the user can also type their location or use GPS for their current location.

Once the user has selected their options they can use the ‘Search’ button to see their results.

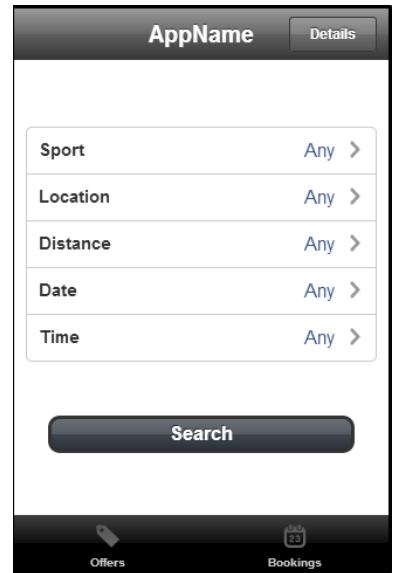


Figure 41: Home screen is also the search page

Details The ‘Details’ button in the navigation bar can store information about the user such as their age, which can help them to find offers that are relevant to them or discounts can be applied to the price during the search.

Basic information about the user can be stored locally to apply discounts and include relevant offers.

Results The results page allows the user to see their search criteria as well as a list of available facilities. These can be sorted by price or distance.

The user can go back to change the search criteria using the ‘Back’ button on the navigation bar or select one of the results in the list for more information.

Once the user chooses an available result, they can see further information on the facilities selected such as pricing, address, location and contact information. The user can choose to ‘share’ this information with others or ‘book’ the facilities using the buttons at the bottom of the screen.

The user can find out more about their current bookings by selecting them from the main ‘bookings’ page. For previous bookings, the ‘cancel’ button could change to ‘book again’.

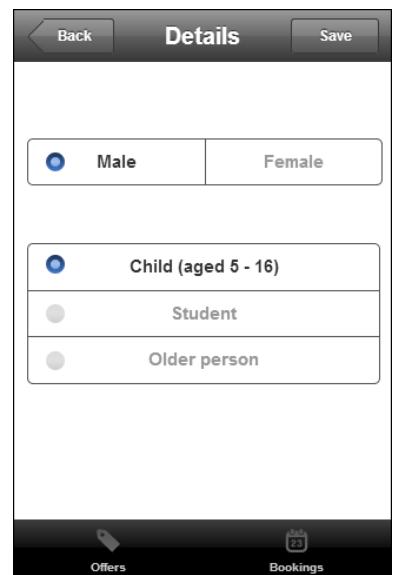


Figure 42: Details screen

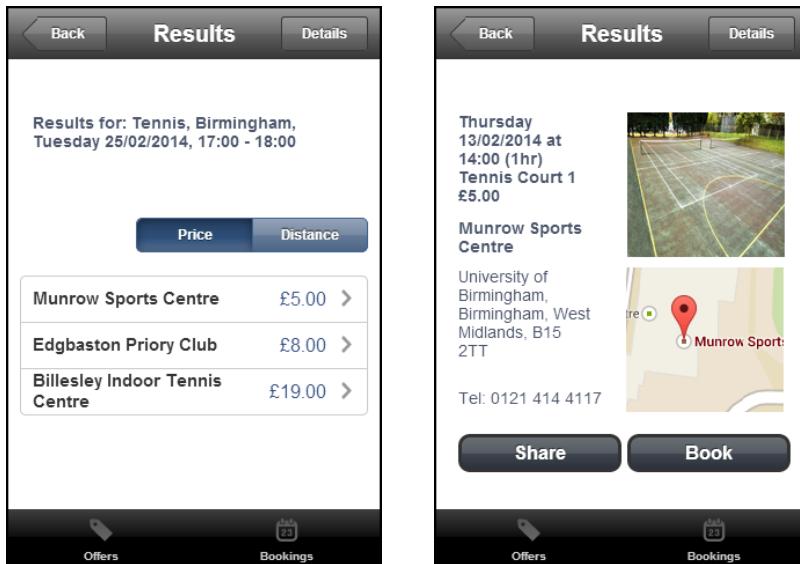


Figure 43

Tab bar There are two tabs on the bar at the bottom of the screen;

- ‘Offers’ tab, shows available offers. A user could choose to use this to search for facilities by available offers.
- ‘Bookings’ tab, users can keep track of their current and previous bookings.

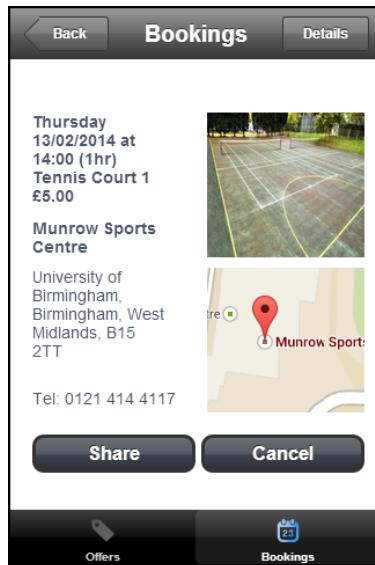


Figure 45: Further information is available

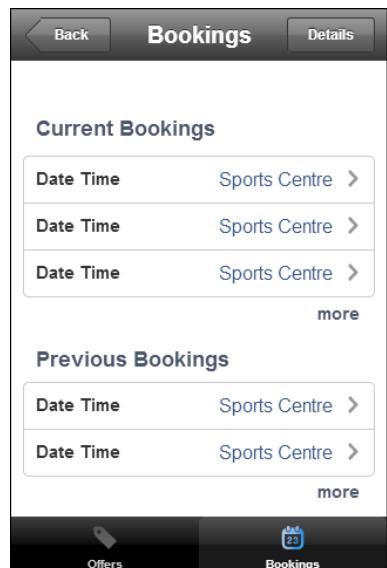


Figure 44: The bookings tab

4.4.2 Heuristic Evaluation

Criteria	Rating	Comment
Visibility of system status	+	There are only two states in this application, the search screen and the results page.
Match between system and the real world	+	Most other booking applications have a similar layout of a search page followed by a list of results (E.g. trainline, redspottedhanky). It should be easy for a user who is familiar with this format to use this design.
User control and freedom	+	'Back' button in the navigation bar allows the user to change elements of the search criteria.
Consistency and standards	+	Information is displayed in a similar way throughout the application, e.g. Bookings and Results both use lists and selecting a particular item in the list leads to a page with more specific information.
Error prevention	-	There is no way for a user to tell if they have made a mistake or where the errors are. A pop-up notification could supply this information when the user presses the 'search' button.
Recognition rather than recall	+	Search criteria is displayed on the main page and in the results section.
Flexibility and efficiency of use	0	Novice users may not find this format easy-to-use without instructions. Experienced users could also search for offers, or their current/previous bookings using the tab bar in addition to using the home screen.
Aesthetic and minimalist design	0	Keeping the search options on different pages prevents the home screen from becoming cluttered. However, presenting the results as a list may not be helpful for users who do not select a specific sport, date, time or location.
Help users recognize, diagnose, and recover from errors	-	There is no way for a user to tell if they have made an error. The only option available is to go 'back' and change the search criteria.
Help and documentation	-	Currently there are no instructions available on how to use the application.

4.4.3 Persona Evaluation

Scenario	Rating	Comment
Elderly		
Searching for new sports in the area and notifying his wife of the booking.	+	Howard can search using the location and distance criteria for searching for sports facilities locally. He can also send the details of his bookings to his wife by using the 'share' button.
Racquet sport with 4 friends on Friday	0	Howard can select the individual sports from a list, there is no option at the moment for racquet sports. He can also choose a Friday, but wouldn't be able to bulk book for a regular session in-app.
Swimming nearby with knee pain	-	It isn't possible to search for facilities that have disabled access, this could be something to include in the 'details' section and in the information pages of individual sports centres.
Working		
Team sport on Friday including screen sharing with friends	-	Janet can select individual sports like netball, football, etc. as there is no option for 'team sports' and dates. She wouldn't be able to share all the results with her friends but could share individual bookings she selects.
Change/cancel booking at late notice	0	Using the 'Bookings' tab, Janet could find her booking and cancel it using the 'cancel' button, or use the information to contact the sports facility to change her booking.
Outdoor sport early on Saturday	+	Currently no quick filters for 'outdoor' sports, Janet would have to go through the list of all possible sports and select those that she knows are outdoors. Or it could be easier for Janet to select Saturday and mornings using the date and time sections and see what sports are available.
Student		
Tennis court at specific times	0	Jenny can select tennis only but may have to search a few times to find suitable slots for the different times she is free.
Weekday evening session must be on clay	0	Jenny can select the whole week and hours in the evenings in the 'date' and 'time' sections. She would have to check individual sports facilities to see the types of courts available.
Weekly practice with friend with reminders	0	There isn't a way for Jenny to book weekly sessions but she could book one session a week and share the information with her friend using the provided 'share' button.

Child

Outdoor sport close to home or on a bus route with coach	0	It currently isn't possible to select 'outdoor' sports but he could choose a variety of sports in the sports section and can sort by distance. It wouldn't be possible to know if the facilities are close to a bus route but could check with the facilities by contacting them.
Booking several squash courts for after school tournament	0	It isn't possible for Joe to book several courts at one time. Could have some kind of rating system to the location description on the bookings page and some way to search for highly rated locations.
Looking for high quality tennis court	0	It could be possible to include other users ratings of each facility and sort results by these ratings.

4.5 Conclusion

The design of the flat prototype is based on many other booking applications, simply consisting of a 'search' screen and a 'results' screen, which should make it easy to use for most people. This design allows users to input some basic details which can help apply relevant offers to results. It also allows users to keep track of their current and previous bookings.

Based on the results from the evaluation against heuristics, the design needs to include error prevention and recovery, as well as help and documentation for users who may not be familiar with mobile booking applications. The results from the personas and scenarios show that although this design allows for search criteria to not be specified by using the default selection of 'any', there is little flexibility in terms of sports selection, it wouldn't be possible to search on broader terms such as 'outdoor', 'racquet' or 'team'.

Multiple bookings and group bookings also aren't possible with this prototype, though the 'share' button makes it possible to share booking information with others.

5 First Generation Prototype Conclusion

Following the evaluation of the first prototypes, there are a number of features we plan to include in our second prototype.

Prototype	Feature	Comment
1	Map	Intuitive to use due to ubiquitous use in most other applications.
1	Sports icons	Removes clutter from the page; important for a small screen.
1	Date selection & swiping to select	Allows quick and easy input of date selection.
1	Weather indication	Provides relevant further information for user scenarios where an outdoor sport was preferred.
1	Location details	Provides space to inform user on wheelchair access, parking information and weather predictions.
2	Home screen	Clear options help the user quickly identify what part of the application they intend to use.
2	Booking cancellation	Satisfies user scenarios in cancelling booking. Will add a message to inform the user of particular venue rules on cancellation.
2	Wheelchair accessible search	Satisfies user scenarios where disabled access to location was required.
2	Error messages	Helps users understand how to use the applications and gives guidance where they've made errors.
2	Help button	Provides instructions for users
3	User details	Allows the user to personalise the application to their preferences, speeding up their searches.
3	Current/previous bookings	Aids the user in both cancelling and sharing bookings, both common user scenarios.
3	Share button	Satisfies user scenarios that requires sharing information about a booking with friends/relatives.
3	Search options non-exhaustive	Matches real world situations and user scenarios where the user does not have specific criteria for each individual search option.
3	Back buttons	To an extent, allowed the user to undo some errors in navigating through the application.

The evaluations, particularly those against the user scenarios, highlighted a number of features which are missing from all of the initial prototypes:

- The ability to make several bookings at once.

- Confirmation messages when performing certain actions, such as making a booking.
- Grouping sports, such as team or outdoor sports, when searching for a sport.
- Clarification on booking cancellations as some venues may not allow cancellations at all or at least not without a certain amount of notice.
- Including public transport options in the location search.
- An indication of location quality, such as through user reviews.

5.1 Evaluation of Tools

5.1.1 Proto.io

Proto.io [12] is a useful tool as it's specifically for creating mobile prototypes. It has a library of different devices and each has default UI components, such as buttons and lists built-in. Once a number of screens have been designed, they can be linked together. For example, a button could link to the next screen, which helps to visualise how the application could work. However, a free account only lasts 2 weeks, which means that it isn't possible to keep a prototype and preview its functions after 14 days.

Overall, it has a very easy to use 'drag-and-drop' interface, and the gridlines are helpful in positioning different components.

5.1.2 Balsamiq

Based on the simplicity of the prototypes, Balsamiq [13] was a useful mock-up tool to use as it allowed the prototype to be completed with a hand drawn effect. The selection of pre-drawn widgets were enough to design everything required of the prototype with the exception of a home page icon.

A major drawback of the tool was the inability to custom design a widget that was not already available. This meant there was no way of personalizing our design.

5.1.3 Possible Alternatives

There are a large number of other tools which we could use to develop the second prototype. These include applications not primarily designed for creating prototypes in addition to dedicated prototyping applications. There are drawing packages such as Adobe Photoshop, presentation software such as Microsoft PowerPoint and also software allowing sophisticated animation and interactivity such as Adobe Flash. These could be used together or individually to create a prototype.

5.1.4 Drawing Packages

The drawing package would allow a very high quality appearance for each screen. We could draw each screen exactly as we wanted it to look like. However, this would come at a cost of time and effort, particularly for someone without experience in the particular drawing package being used. Furthermore, a drawing package would have to be used in conjunction with other software as we would like to include interactivity. Interactivity is vital for our second prototype as it will allow us to better evaluate the design.

5.1.5 Presentation Software

Presentation software would facilitate most basic interaction options between screens but would likely need to be used in conjunction with a drawing package to allow higher quality appearance. However, these interactions are somewhat limited, particularly if we want to replicate sometimes complicated gestures that are available on modern mobile phones.

5.1.6 Animation Software

More sophisticated animation software would allow greater interactivity options, but at a significant cost as these tools often require a lot of prior experience to use effectively and quickly. As none of us have much previous experience with these types of packages, the prototyping would take a long time. It is important that we create the prototype quickly so we can spend more time evaluating the design.

5.1.7 Conclusion

We will use proto.io as our tool for developing the second prototype. Of all the options we considered, this tool will allow the highest level of functionality to be included in the prototype in the least amount of time and with the least amount of effort. Furthermore, many of the other possible tools have a learning curve that can increase the time taken to develop the prototype. The experience gathered from using proto.io in our initial prototyping will help us avoid this problem. One possible drawback is that this tool is only free for a limited time through a trial membership.

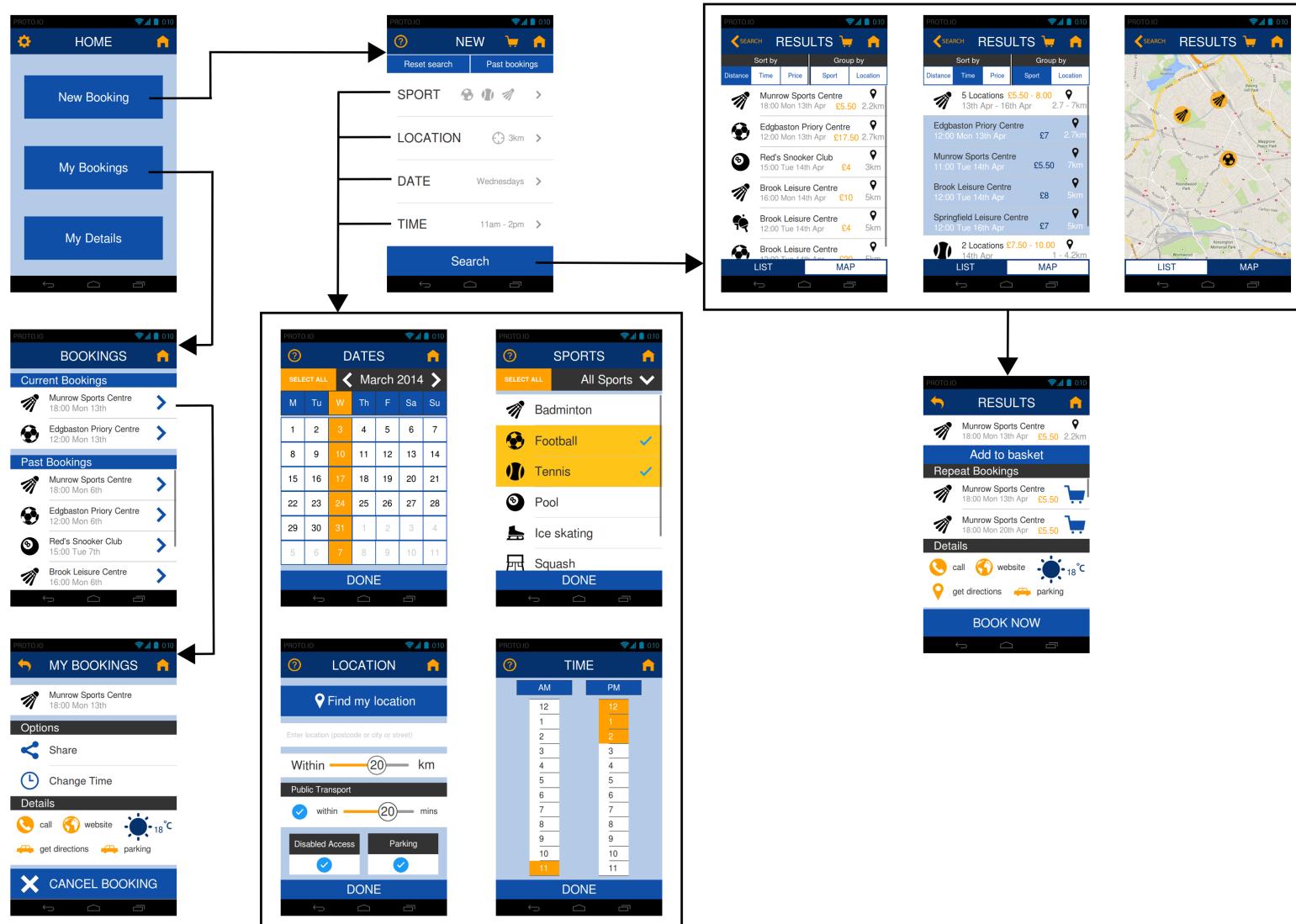


Figure 46: Outline diagram showing navigation paths between screens. Navigation starts, when the user opens the application, at the home screen, shown in the top left.

Part III

Second Generation Prototype

We have developed a second prototype based on what we have learnt from the evaluation of our first prototypes. This prototype has more functionality than any of the first prototypes to allow us to better evaluate the design against heuristics and scenarios and through usability testing. The basic navigation between screens is shown in figure 46, while each screen is explained in more detail below in Section 6.

6 Presentation

Home (Figure 47)

When the application is first started, the user is at first presented with three main options to choose from.

1. Make a new booking; this button takes the user to a page to input their search criteria (figure 50).
2. View their bookings; this button allows the user to see past and present bookings (figure 48).
3. Input their details; this page allows the user to specify a number of details about themselves:
 - (a) Their concession status so potential offers and discounts can be highlighted in the search results.
 - (b) Default search preferences if they regularly search for the same sport, location or time when looking to make a booking.
4. The home button is repeated on every page and provides the user with a quick way to return to this home screen.

My Bookings (Figure 48)

This page shows scrollable lists of current and past bookings the user has made. This allows the user to find details about past bookings if they want to repeat a search or contact the location. The user may also be able to cancel a current booking if the particular location they have booked allows them to.

Individual Current Booking Page (Figure 49)

This page displays information for a current booking.

1. A share button; this will display the phone's default share options. Typically this will allow the user to share information about the booking through other applications on the phone such as email or other messaging services.
2. If the location of this booking allows customers to change booking times, this will bring up a search results page, similar to figure 54a, showing available booking slots at similar times at this location.

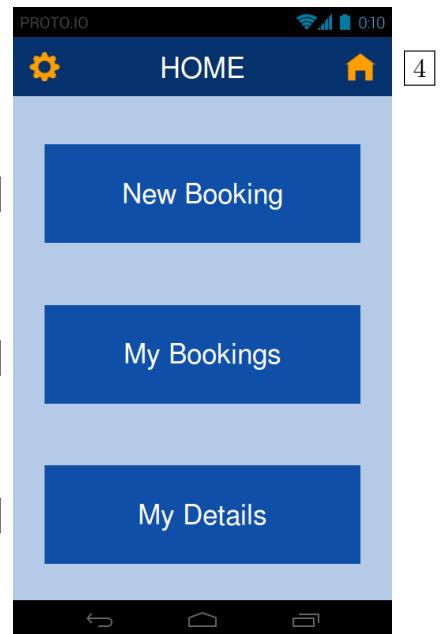


Figure 47: The Home screen

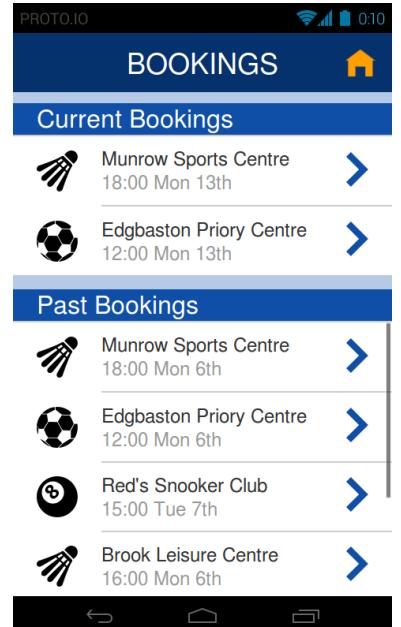


Figure 48: Current and past bookings screen

3. The details tab has buttons to call the location, visit their website, get directions to the location and also highlights if the location has parking facilities. In addition to this, the weather prediction for this location at the time of the booking is displayed.
4. A button to cancel the booking; a prompt will be displayed asking the user to confirm that they definitely wish to cancel the booking. If the location does not allow booking cancellations, this button will be greyed out and attempts to press the button will result in a message explaining the reason a cancellation cannot be made.

Search (Figure 50)

This is the main search screen which displays the current criteria in the search and allows the user to change this criteria viewing the results that match this criteria. The user can choose to search after defining any number of the four criteria.

1. Help button; displays hovering annotations describing what each part of the page is for.
2. Reset search button; this resets the search criteria to the default settings chosen on the My Details page. If the user has not entered these details before then the sport selection will be default to all, location to 5km within the user's current location, date to today and time to all.
3. Past booking button; this brings up a drop down list of previous bookings. If one of these bookings is chosen, all the search criteria will change to match that booking apart from the date which will remain unchanged.
4. Sport selection button with icons that show what is currently selected. Pressing this leads to figure 51.
5. Location button leading to figure 52.
6. Date button leading to figure 53a.
7. Time button leading to figure 53b.
8. Search button leading to figure 54a to display results matching the current search criteria.
9. A basket icon which leads to the basket page which displays all booking slots a user currently has added to their basket but have yet to confirm and pay for.

Sport Selection (Figure 51)

The user can choose to search for as many sports at once as they wish, individually, or from a list of groups of sports.

1. Drop down to choose to display different groups of sport such as outdoor sports, indoor sports, teams sports and favourites which are defined on the My Details page.
2. Select all button; this will check all sports currently displayed on the page. If all sports are selected, this button changes to clear all instead.

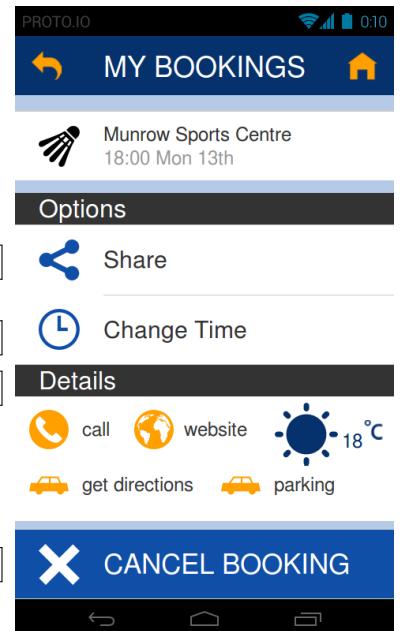


Figure 49: Current booking details screen

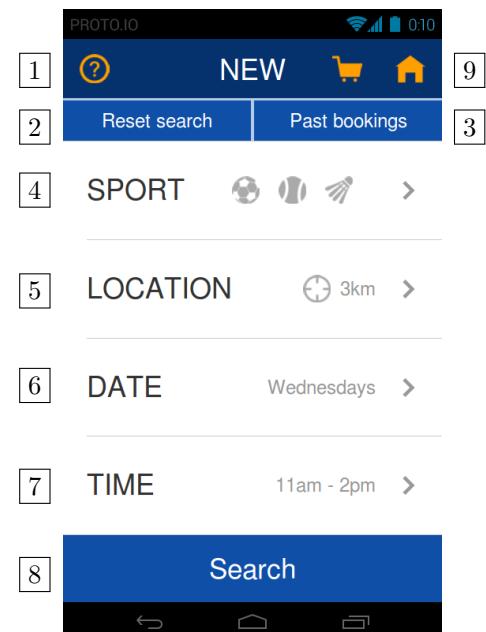


Figure 50: The main search screen

3. Each sport toggles between selected and unselected when pressed.
4. Done button; this returns the user to the search page. This is the same for all specific search criteria pages (figure 50).
5. Help button; displays hovering annotations describing what each part of the page is for.

Location Selection (Figure 52)

The user can choose to search within a distance from their current location or specify a particular location via its postcode or area name.

1. Find location; a button which sets the location using the user's current location.
2. Location input text field; when the user chooses the first button, this is automatically changed to the postcode of their current location. The user can also type in this field. As they are typing, suggestions will appear in a drop down box to help speed up their search.
3. A slider bar to determine how far from the chosen location the user would like to search.
4. Public transport; if the checkbox is ticked, the user can choose to search for locations which are within a specified journey time on public transport such as local buses and trains.
5. Checkboxes for including in the search only those locations which have disabled access and parking facilities.
6. Help button; displays hovering annotations describing what each part of the page is for.

Date Selection (Figure 53a)

All dates which are highlighted on this page will be included in the search.

1. Select all; highlights all dates in the shown month. This button changes to clear all when all dates are already selected.
2. Day headings; when a day is pressed, all the dates on the page for that day are highlighted.
3. The user can either touch a date to highlight it or swipe across multiple dates to highlight many dates in one go.
4. Help button; displays hovering annotations describing what each part of the page is for including instructions on using swiping gestures to select multiple dates.

Time Selection (Figure 53b)

All hours which are highlighted on this page will be included in the search.

1. AM and PM buttons; when the AM is pressed all morning hours are toggled on or off, likewise for pm.

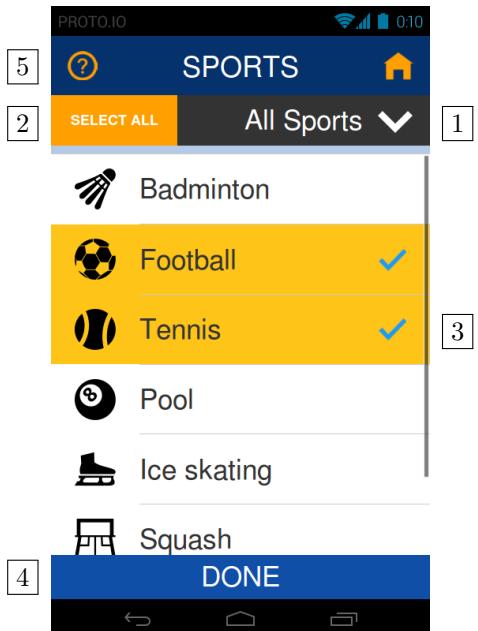


Figure 51: The sport selection screen

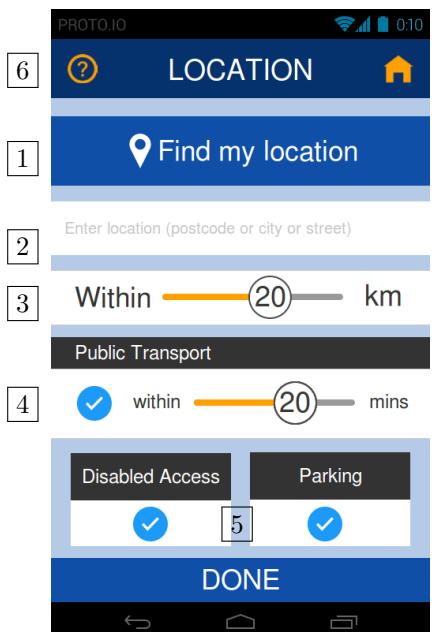
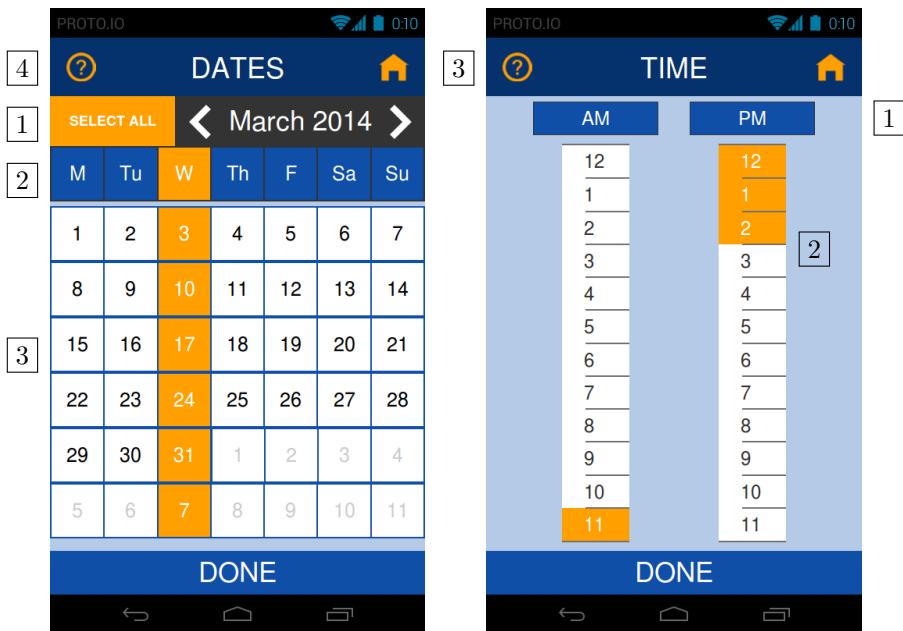


Figure 52: The location selection screen



(a) The date selection screen

(b) The time selection screen

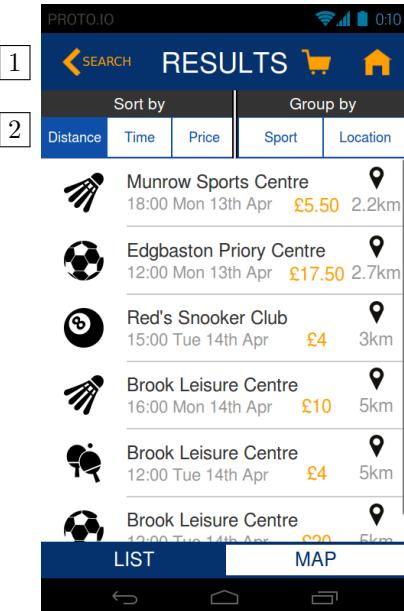
Figure 53

2. The user can either touch an hour to highlight it or swipe across multiple times to highlight them all at once.
3. Help button; displays hovering annotations describing what each part of the page is for including instructions on using swiping gestures to select multiple times.

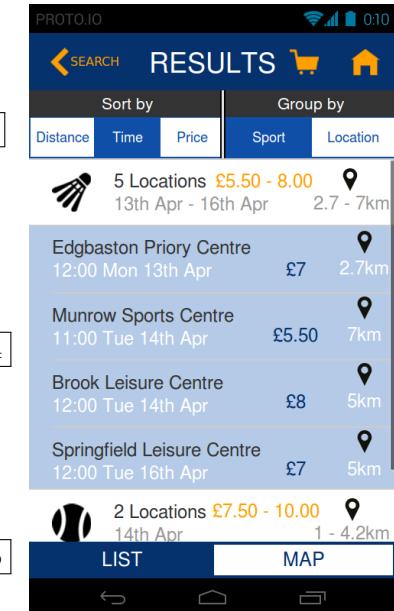
List Results (Figure 54a)

This is the default view for search results. Results can be sorted by distance, time or price and grouped by sport or location. The user can change the default sort and grouping options on their ‘My Details’ page.

1. Button to return to the search page and amend the search criteria.
2. Toggle buttons to change how the results are sorted.
3. Toggle buttons to change how the results are grouped. By default, the results are not grouped. An example is shown in figure 54b of results grouped by sport. When grouped, a user can expand a chosen sport to see all results for that particular sport. These items will be also be sorted by the chosen sort option.
4. Scrollable list of results. The user is shown an icon for the sport, the name of the location, the time and date of the booking, the price and the distance of the location from their chosen search location. Selecting a particular booking slot takes the user to the page in figure 56.
5. Toggle bar for switching between list and map search view (figure 55).



(a) The list results screen



(b) The grouped list results screen

Figure 54

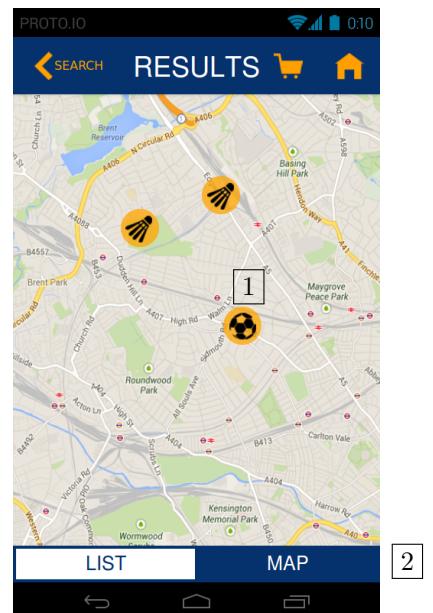


Figure 55: The map results screen

Map Results (Figure 55)

Results can also be viewed on a map which is navigable in the same way as the phone's native map application.

1. Icons on the map represent a specific venue. If only one sport is available at that venue then the picture icon will represent that sport. If more than one sport is available, then there will be a plus sign to show that multiple sports are available. When pressed, a scrollable list is displayed on the screen similar to that in figure 54b.
2. Toggle bar to navigate back to the list view in figure 54a.

Individual Result (Figure 56)

1. Button to add the displayed booking to the user's basket so they can continue searching before paying.
2. Scrollable list of bookings for the same sport and location at the same time in future weeks so the user can purchase several weeks at once if they know they want to play weekly. The basket icon adds the booking to the basket.
3. Details about the location and a weather prediction for the time of the chosen booking.
4. Book now button; takes the user to an external pay application to pay for booking before returning them to this page. The book now button will then change to a link to the page for this current booking as in figure 49 so they can make amendments to their booking or share details to their friends.

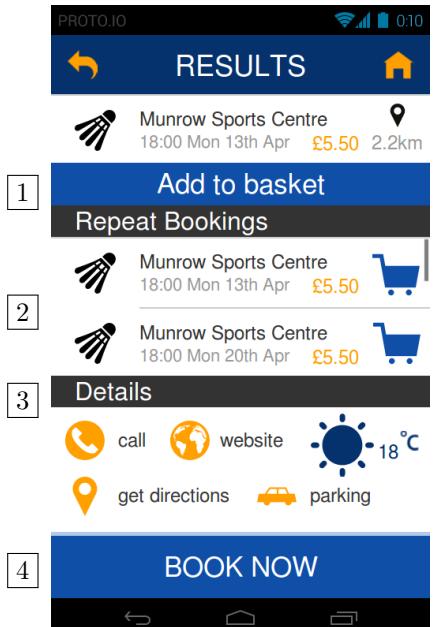


Figure 56: Screen for a booking slot

7 Review

7.1 Evaluation Plan

Having incorporated aspects of the first generation prototypes based on our evaluation of them, we will now evaluate our final design using the same methods as well as using a cognitive walkthrough and a usability questionnaire.

We will begin the evaluation of our second generation prototype by testing it against Neilsen's heuristics. The main goal of heuristic evaluations is to identify any problems associated with the design of user interface by means of a systematic inspection. We would hope to see a reduction in usability problems compared to the first generation prototypes.

Next will be an examination of the potential scenarios proposed by each persona. With a more detailed and robust design, we can examine each scenario in more depth and again hope to see an improvement in the way this prototype deals with them. We will then apply an inspection method called a cognitive walkthrough. This is a more formal approach to imagining people's thoughts and actions when they use an interface for the first time. This allows us to put ourselves in the shoes of a user while they aim to carry out a particular task with a certain goal in mind. We will select one task for each persona that the design is intended to support and then step through each action in that task. This method should help us find any obstacles a user may face when using the application having had no experience with it. We must motivate the actions based on the user's general knowledge and on feedback provided by the interface.

There are four questions to consider in a cognitive walkthrough [14]:

1. Will the customer realistically be trying to do this action?

Does the interface make unrealistic assumptions about the level of knowledge or experience that users have?

2. Is the control for the action visible?

Highlights issues with context-sensitive menus or controls buried too deep within a navigation system and identifies non-standard and unintuitive icons/buttons.

3. Is there a strong link between the control and the action?

Identifies problems with ambiguous or jargon terms.

4. If the correct action is performed, will the user see that progress is being made?

Helps to find problems when feedback is unclear, ambiguous or missing entirely.

We must decide if each of these questions is a pass or a fail for every action within the tasks.

Finally we will construct a questionnaire to test usability. Usability testing is a technique which will allow us to evaluate our design by testing it on members of the public. By doing this it allows us to gain a subject assessment. This is important as having designed the application ourselves, we as designers know exactly how it works and can make the error of assuming to understand the user.

We will take an informal approach with our questionnaire by sitting the user down with the system and letting them use it as they like. Their feedback will be recorded on the questionnaire and we will use the system usability scale test to analyse our results and draw any conclusions.

If time restriction was not an issue, there are other inspection methods we could have applied. For example, using the consistency inspection method we could have asked designers who represent multiple other projects to inspect our interface to see whether it does things in the same way as their own designs. However, finding designers who represent multiple projects in our time frame is not plausible.

The feature inspection lists sequences of features used to accomplish typical tasks, checks for long sequences, unnatural and complicated steps, and steps that require extensive knowledge and experience in order to assess a proposed feature set. This method of evaluation would not be beneficial to us as it is very similar to the cognitive walkthrough and our application does not require extensive knowledge or experience.

7.2 Heuristic Evaluation

Criteria	Rating	Comment
Visibility of system status	+	Clear headings show where in the booking process the user is. A simple structure to the pages means that returning to the home screen is easy and allows the user to view prior bookings.
Match between system and the real world	0	Simple, clear, short instructions and pieces of information are used to minimise the reading onscreen, whilst making the purpose of each selection object clear. The sports selection drop down menu is not immediately self explanatory.
User control and freedom	0	All stages of the booking allow the user to move backwards to a previous state. Since the final booking is handled by the independent sports centers, it is up to them to implement some verification with the user that the booking details are correct.
Consistency and standards	+	Well recognised icons are used throughout which correspond to the same functionality in other applications.
Error prevention	0	The settings for the search criteria can all be changed before finally selecting 'search'. It is not obvious that the time of a booking can be changed easily from the bookings screen, and the other details of the booking cannot be changed. To do this, the user has to enter a new set of search criteria.
Recognition rather than recall	0	All icons are chosen to represent the function to which they apply to reduce recall.
Flexibility and efficiency of use	-	The user can make repeated bookings for similar searches, but bulk bookings where more than the date changes are not possible.
Aesthetic and minimalist design	+	The design is clean and simple with bold colours to differentiate sections, headers and icons. There are a lot of different icons on the results pages which could make them look confusing when the user is not familiar with the structure and layout of the page.
Help users recognize, diagnose, and recover from errors	-	There is no undo button or selection to revert back to a previous state, the user must instead select a new set of search criteria.
Help and documentation	0	There is a help button to display information about the features available on the current screen.

7.3 Persona Evaluation

Scenario	Rating	Comment
Elderly		
Searching for new sports in the area and notifying his wife of the booking.	+	If Howard wishes to search only by location he has the option to leave the sports criteria blank or 'select all' sports. Under the location criteria he can then either enter a postcode or use GPS and specify the maximum amount of kilometres he is willing to travel. Once the results are displayed he can sort them by distance to see which sports are available nearest to him. If Howard prefers a visual representation of what sports are available locally, he can press the map button. He can also send the details of his bookings to his wife by using the 'share' button.
Racquet sport with 4 friends on Friday	0	Using the 'All Sports' tab, Howard can select racquet sports. There is no option to specify how many players, or how many courts he would like to book. Under the date criteria, he can select 'F' which will highlight all Fridays. After Howard clicks on his chosen booking, the following screen displays his booking along with 'Repeated bookings' which he can also add to his basket.
Swimming nearby with knee pain	+	Howard can specify swimming as his chosen sport and use his current location courtesy of GPS. He may choose to set the maximum distance he is willing to travel so he does not see results too far for him to physically travel. Or he can filter the results by distance and simply look at the first few options. If Howard's knee pain is particularly bad he may wish to swim somewhere which doesn't require climbing any stairs. He can do this by ticking the 'disabled access' option under location.
Working		
Team sport on Friday including screen sharing with friends	0	Janet can select the Team option from the drop down menu in the sports criteria section. She may wish to group the sports when looking at the results for better clarity. Screen sharing is not available but she can send the booking details to her friends using the 'share' option.
Change/cancel booking at late notice	+	By going into 'My Bookings' Janet can choose 'Change time'. If she is unable to rearrange she can also cancel the booking. Whether she is eligible for a refund depends on the sports centre's policy.

Outdoor sport early on Saturday	+	Similar to the team sports scenario, Janet can choose to see only outdoor sports. Under the time criteria, she can select the 'AM' button which will select all times between 12am and 11am. The weather prediction may also influence her decision of when to play.
---------------------------------	---	--

Student

Tennis court at specific times	+	Jenny can specify tennis as the sport she would like to play. She can also select a variety of specific time slots on the time criteria page.
Weekday evening session must be on clay	0	Jenny can choose not to select a date and click 'PM' under the time criteria to see only evening sessions. She would have to contact the sports centre to find out the surface of the tennis court.
Weekly practice with friend with reminders	0	Jenny can book weekly sessions using the 'Repeated bookings' option. She can share the booking information with her friend using the 'share' icon button, however there is no notification feature.

Child

Outdoor sport close to home or on a bus route with coach	0	Just like Janet, Joe can select the outdoor option to display a variety of outdoor sports. He can specify a maximum distance from home or sort the results by distance to find venues close to him. Under the location criteria, he can choose to display results where the venue is reachable using public transport within a certain time. This feature does not specify what form of transport would take him to the venue. Joe would have to perform two separate searches for venues within walkable distance and those offering public transport.
Booking several squash courts for after school tournament	-	There is no feature to choose how many courts are required. Joe would have to add the booking to his basket, search again, then add another booking several times. There is also no option for Joe to specify the duration, which could be important if the tournament was predicted to last several hours.
Looking for high quality tennis court	-	There is no way of accessing user reviews and ratings of the sport venues. Nor is there an indication of the quality of any of the facilities.

8 Cognitive Walkthrough

8.1 Task 1

Booking a nearby swimming lane with disabled access tomorrow at midday.

User: Elderly

1. Press ‘New Booking’.
2. Press ‘Sport’ on the search screen.
3. Ensure only ‘Swimming’ is ticked in the list of sports and press ‘Done’.
4. Press ‘Location’ on the search screen.
5. Ensure ‘Disabled Access’ is ticked and press ‘Done’.
6. Press ‘Date’ on the search screen.
7. Ensure only tomorrow’s date is highlighted on the calendar and press ‘Done’.
8. Press ‘Time’ on the search screen and press ‘Done’.
9. Ensure only ‘12 pm’ is selected.
10. Press ‘Search’ on the search screen and press ‘Done’.
11. Press the top result in the list.
12. Press ‘Book Now’.

8.1.1 Walkthrough

Choosing new booking Howard knows he wants to make a new booking and sees this option clearly on the screen. He hesitates slightly after seeing ‘My Details’ and wondered if this is where he needs to go to say he has disability requirements.

Selecting swimming Howard sees the list of search options on the main search screen and notices that next to ‘Sport’ it says ‘any’. He knows he wants to swim only so he presses the arrow which shows him a list of sports. On this screen, he is not sure what he is supposed to do as he cannot see swimming. Eventually, he presses the middle of the screen and realises the list moves up and down. He scrolls until he finds swimming and presses it, noticing that a blue tick appears after pressing it. He sees the done button and is returned to the previous screen with ‘any’ now replaced by a small icon depicting a person swimming.

Selecting disabled access Howard is not sure where he could look for disabled facilities. On the location screen, he notices a box labeled ‘Disabled Access’ and presses it noticing that a tick appears.

Selecting date and time Next to date and time in the search screen Howard sees ‘Today’ and ‘any’ respectively. He presses each of these in turn knowing that he wants to search for midday tomorrow. On the date screen he presses the date he wants on the calendar and sees that it changes colour. However, today’s date is also the same colour and he tries to press today’s date to change it. The buttons are quite close to each other so it takes some time for Howard to correctly press the right one. He does the same thing on time screen for midday and notices that the main search screen says ‘Tomorrow’ and ‘Midday’.

Completing the search and choosing the booking The main search screen informs Howard that each criteria is as he wishes. At first Howard doesn’t realise that the word ‘Search’ at the bottom of the screen is a button he can press to see the results. Eventually, he presses it and sees a list of bookings with different times and locations and presses the first one on

the screen. Howard is shown more details about this booking and is satisfied with it and eventually sees ‘Book Now’ on the screens and presses that button.

Step	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Success?
1	y	y	y	y	Success
2	y	y	y	y	Success
3	n	y	y	y	Success
4	n	n	y	y	Fail
5	n	n	y	y	Fail
6	y	y	y	y	Success
7	y	y	y	n	Success
8	y	y	y	y	Success
9	y	y	y	y	Success
10	y	n	y	y	Success
11	y	y	y	y	Success
12	y	y	y	y	Success

8.2 Task 2

Change the time slot of an already booked table tennis session (7pm). Cancel the booking if it is not possible to rearrange

User: Working

1. Press ‘My Bookings’
2. Click on the current booking to be rearranged
3. Press ‘Change Time’
4. Browse alternative results
5. Go Back
6. Press ‘Cancel Booking’
7. Confirm cancellation

8.2.1 Walkthrough

Choosing new booking Janet does not initially see an option to amend a booking on the home screen, she does not want to make a new booking so she knows she must select ‘My Details’ or ‘My Bookings’. She is unsure but clicks ‘My Bookings’ as it is one of her bookings which she would like to change.

Selecting swimming Janet is presented with a list of her current and past bookings. She clicks the table tennis session at 7pm which then shows this booking on a separate screen with a selection of different options.

Selecting disabled access There is an option ‘Change Time’ which Janet clicks. The location of this booking permits customers to change booking times, so a search results page is displayed showing available booking slots at similar times with all other search criteria remaining the same. Unfortunately after browsing through all the results she sees there are no available table tennis sessions after 7pm, so Janet must cancel.

Completing the search and choosing the booking After realising she cannot rearrange her booking, Janet returns to the previous page to look at other options. She knows she must cancel the session so she presses ‘Cancel Booking’ which is clearly visible at the bottom of the screen. A prompt is displayed asking her to confirm that she definitely wishes to cancel the booking, she is sure so she confirms the cancellation. Refunds?

Step	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Success?
1	y	n	y	n	Success
2	y	y	y	y	Success
3	y	y	y	y	Success
4	y	y	y	y	Success
5	y	y	y	y	Success
6	y	y	y	y	Success
7	y	y	y	y	Success

8.3 Task 3

Weekly tennis sessions with a friend with reminders.

User: Student

1. Select ‘New Booking’
2. Press ‘Sport’
3. Select ‘Tennis’ and press ‘Done’
4. Press ‘Location’
5. Press ‘Find my location’
6. Slide the distance option down to ‘within 1km’ and press ‘Done’
7. Press ‘Date’
8. Press ‘W’ to highlight all Wednesdays and press ‘Done’
9. Press ‘Time’
10. Press ‘PM’ for afternoons and press ‘Done’
11. Press ‘Search’
12. Press ‘Price’
13. Select a listing
14. Add a number of bookings to the basket
15. Press ‘Book now’
16. Press ‘Home’ in the navigation bar
17. Press ‘My bookings’
18. Select a current booking
19. Press ‘Share’

8.3.1 Walkthrough

Creating a new booking Jenny immediately presses the ‘new booking’ button and selects tennis from the list of sports. She also fills the location section with ease. Knowing that both, she and her friend are free on Wednesday afternoons, she selects Wednesdays from the calendar. Jenny does this by pressing each Wednesday individually as she isn’t aware that pressing ‘W’ would highlight all Wednesdays this month. She presses the PM button on the ‘Time’ page to select afternoons before pressing the ‘Search’ button.

Making multiple bookings Jenny is aware that multiple bookings could cost her a lot and decides to sort the available results by price. She selects the cheapest result and sees that multiple bookings are available in the ‘repeated bookings’ section. She adds a number of these by pressing the basket icon and presses the ‘Book now’ button.

Sharing booking details with a friend Once she has made her payment, Jenny checks to see if her multiple bookings have been successful. She presses the ‘home’ icon in the navigation bar and presses ‘my bookings’ from the home-screen. She sees that all of the bookings she made in the ‘current bookings’ section. She selects the first booking for this Wednesday, and presses the ‘share’ button to send the details of the booking to her friend.

Step	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Success?
1	y	y	y	y	Success
2	y	y	y	y	Success
3	y	y	y	y	Success
4	y	y	y	y	Success
5	y	y	y	y	Success
6	y	y	y	y	Success
7	y	y	y	y	Success
8	y	n	n	y	Success
9	y	y	y	y	Success
10	y	y	y	y	Success
11	y	y	y	y	Success
12	y	y	y	y	Success
13	y	y	y	y	Success
14	y	y	y	y	Success
15	y	y	y	y	Success
16	y	y	y	y	Success
17	y	y	y	y	Success
18	y	y	y	y	Success
19	y	y	y	y	Success

Additional Notes Although the user was able to achieve the steps, it isn’t possible for Jenny to set up weekly reminders for her friend, she must either share the bookings with her each week, or remind them herself.

It also isn’t possible for Jenny to share the details of available bookings with her friend before making a booking, which could result in having to make multiple cancellations or rearrangements if the date or time becomes unsuitable for her friend.

8.4 Task 4

Book an outdoor sport, with a professional coach, close to home.

User: Child

1. Press ‘New Booking’.
2. Press ‘Sport’ on the search screen.
3. Select the ‘Outdoors’ selection option.
4. Press ‘Location’ on the search screen.
5. Select a maximum distance using the distance slider.
6. Ensure the ‘Public transport’ option is selected and choose a preferred travel time.
7. Press ‘Done’ to return to the previous screen, and then ‘Search’.
8. Select ‘Distance’ in the ‘Sort by’ options and ‘Sport’ in ‘Group by’.
9. Browse the list of sports offered at the locations found.
10. Select a result and select weekly times to book.
11. Press ‘Book Now’.

8.4.1 Walkthrough

Selecting sports to book Joe does not know exactly which sport it is he would like to book, so he is hesitant about entering the ‘Sport’ menu as he thinks he might be required to select one from a list. Once finding that there is a more relaxed selection menu, so that he can specify just outdoor sports, he is confident he will find something he likes.

Specifying distance and travel method When choosing the distance he is prepared to travel, Joe is unsure about the distances he is used to going so doesn’t know what value to give. He knows how long it takes to get to school, so enters a value slightly higher than this for the public transport slider and doesn’t move the radius slider.

Sorting and grouping results Joe has to wait for the results for a few seconds because the search criteria are quite broad. During this time, there is little notification that progress is being made. When the results are shown, he quickly sorts by the distance, as he isn’t interested in the price (Pete will pay) or the time (during the summer holidays). Joe has to experiment a couple of times with the ‘Group by’ options as he doesn’t quite understand their purpose as he misunderstands it to mean a bulk purchase.

Making repeated bookings Joe is pleased that he can book several sessions easily at once as he quickly recognises that the ‘Repeat Bookings’ section shows the same sport at the same time, but on different days. However, after selecting the bookings for the next few weeks, he realises he has added one week too many to the list of bookings to be made. He is not sure that clicking ‘Book Now’ will allow him to remove these mistaken bookings.

Step	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Success?
1	y	y	y	y	Success
2	y	n	y	y	Success
3	y	n	y	y	Success
4	y	y	y	y	Success
5	y	y	n	n	Success

6	y	y	y	y	y	Success
7	y	y	y	y	n	Success
8	y	n	n	n	y	Fail
9	y	y	y	y	y	Success
10	y	n	n	n	y	Fail
11	y	y	y	y	y	Success

9 System Usability Scale Questionnaire

In order to gather information about how real users interact with the system, a System Usability Scale (SUS) Questionnaire is used. This asks users to give a mark for each of ten questions relating to their experience with the application. They are first given the opportunity to use the system, to interact in any way they like and to play with the functionality that has so far been implemented. They are then presented the questions. The questionnaire that was used can be seen in Appendix A.

This questionnaire was given to 9 people who had first familiarised themselves with the system. The set of questions are all scored from 1 to 5. In order to be able to compare them correctly, these are normalised from 1 to 4. The graph in figure 57 shows the average score for each question. Highlighted in red are the two questions that received the lowest scores and in green, the highest.

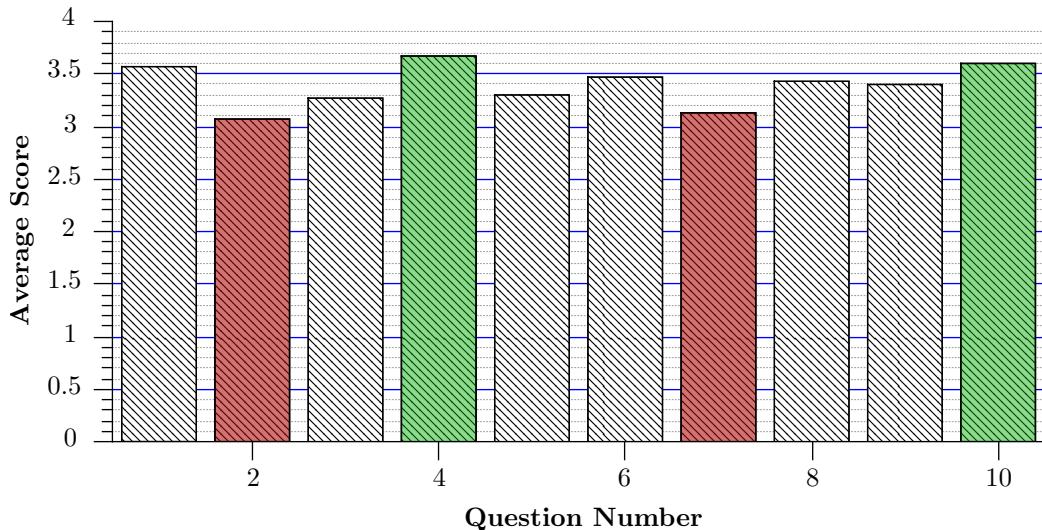


Figure 57

The graph shows clearly that the second generation prototype scored extremely highly in all areas. The lowest scoring questions were “I found the system unnecessarily complex” and “I would imagine that most people would learn to use this system very quickly”. These two suggest that the appearance of the application looks slightly too complicated to a new user and that an improvement might be to move some of the functionality so that new users are not overwhelmed, but that experienced users are still able to perform complex actions.

A possible explanation for the consistently high scores is that the participants in the questionnaire were almost all of the same age range and were all students. Also the participants were all friends with the researchers thus skewing their response.

9.1 Summary of Comments

As well as the ten questions, each user was asked to comment on the good aspects of the design, and on parts of the implementation that could be improved.

Some of the positive comments included:

- Good clean layout, nice use of colours.
- Clear “Home” screen and menus for sport location, data etc.
- Clear, easy to read display that allowed various ways to book a sporting activity.
- Simple flow from home screen → booking. Very few clicks needed to achieve desired task.

These show that the overall design of the application was clear and easy to use, whilst still displaying all the required information, and being easy to navigate.

From the ‘improvements’ comments:

- On “My Bookings”, wasn’t sure what sport it was.
- “My Bookings”, what is temperature (is it today’s temperature)?
- “Select Sports” screen, “OK” would have been more intuitive than “DONE”.
- Fewer sort options.
- The public transport section was unclear over what it meant, therefore i was wary to use it.
- The “AM/PM” selection in “Time” wasn’t quite clear if I had selected times between selected or just selected the times.

Part IV

Conclusion & Recommendations

As with the first prototypes, the second prototype was assessed against Nielsen's heuristics. The application achieves a neutral or positive result against most of the principles but needs improvement in the following areas:

- error recognition, and correction,
- flexibility and efficiency of use.

The application was also tested against user personas and their scenarios. The new prototype combines elements of the previous designs, which means it is possible for the user to achieve their goal in most cases. For Joe, however, it is likely that booking multiple courts is a rare case and would have to contact a sports centre for information on duration and multiple court bookings.

Other possible features the application could have include additional details such as 'court surface' and something that would help the user to determine the quality of the facilities such as a user-ratings system

The findings from the cognitive walkthroughs show that most of the steps needed to complete a task were possible and the personas would be able to complete the task. In some cases, the application would need the extra features mentioned above for a user to fully achieve their goal. It also highlighted features that may be difficult for the user to understand like the 'group by' selection.

The prototype was tested by 9 people who were asked to use the prototype system and then complete a questionnaire (see Appendix A). The results from the questionnaire show that, in general, the users had very few difficulties when using the system. Some considerations that could improve the design included simplifying the sorting and grouping options, and the repeated bookings screen which needs to be more intuitive.

Overall, the second prototype improves the functionality of the three previous designs but there are still features that need further development, and functions, such as error prevention, that should be added.

10 Recommendations

To take this design forward we would require further prototyping to implement the changes suggested in Section 11. There are a number of additional features that we would add and several changes we would make. The main aspects we would focus on are:

- Ratings system for each location.
- Easier search options for booking multiple courts at once.
- Search options for length of booking.
- Notifications/reminders.
- Simplified sorting and grouping options.
- Improved error prevention.

As some of these changes are brand new features, it would be important to prototype them before implementing them in the final design so that we could evaluate whether they actually work in the way a user would want and expect them to.

In addition to changing the mobile design, it could be possible to design a similar system for the web so that users can make bookings online on a desktop computer or laptop. This could be particularly useful for an elderly or physically impaired user who finds a mobile phone difficult to use or a user without a smartphone. However, this was beyond the scope of this project.

If we were to actually implement the mobile design, there are feasibility problems which we would need to overcome. We would need to get the data for the available sports at each location and the data for the individual booking slots at each location and whether the booking slots were already booked or not. This would be possible through two methods:

1. Direct involvement of the sports facilities. They would provide the data directly to us and would allow a connection to their own systems in order to actually make, cancel and change the bookings.
2. Scraping the data from the websites of each facilities, or get access to the data through APIs provided by these websites. In order to make a booking, the user would be redirected to the website of that particular facility.

The first option is preferable as it would allow the user to make and amend bookings directly through the application. The prototypes that we have made in this project would require the involvement of the sports facilities. If, going forward, this were to be revealed as unfeasible, we could possibly use the second method above. This would require a lot of changes in the design and therefore numerous more prototypes.

11 Summary

Our aim was to design a mobile booking system for sports centres that would allow users to search multiple facilities at the same time and compare results. This is something that can be done with many booking applications for other services.

Through our research into mobile booking apps and sports facilities websites, we identified key design features for our application. We also found that the interface may have to present a large amount of data. Readability and filtering results would have to be considered as well as an easy-to-use, clean interface. We then used these findings to design our first generation prototypes. These were based on the three navigation styles outlined by Apple Inc; hierarchical, flat, and content-driven.

We evaluated the first generation prototypes using Nielsen's heuristics and user personas. We found that each design had features that were useful and satisfied specific scenarios. These were then incorporated into the design of the second prototype.

The second prototype was able to achieve more than the previous designs but the cognitive walk-throughs and questionnaire results show there are some areas that would need further development if this application were to be taken forward.

11.1 Team Analysis

Our approach to the project was well structured in that we researched related existing systems and work that addresses similar principles and techniques, this helped us better prepare when designing our system. We were also very cautious in assuming to understand the user which can be a common mistake to make being the designer of the system. The user personas and scenarios were created to avoid this problem. We ensured that we used a variety of inspection and empirical evaluation methods on our final design to expose any issues which users may face when interacting with the interface. In terms of changing and improving our approach we could have spent more time incorporating other features such as showing the rating and have the user request a notification nearer to the time of their booking. The lack of such features came up in our evaluation but were

discarded from the final design. We could have increased the reliability and validity of our SUS results by having more participants from a more varied and wider demographic.

As a group, we met weekly and worked well in distributing our work fairly and evenly. Each week we each had our own task and every member of the group worked hard to meet the deadlines. Our work was kept well organized on Google Drive so any member of the group could view and make changes on all the documents created.

Part V

Appendix

Sports Booking Application

System Usability

Rebecca Devney
Aasima Pathan
Josh Wainwright
Andrew Walker

	Disagree	2	3	4	Agree
1. I think that I would like to use this system frequently....	<input type="checkbox"/>				
2. I found the system unnecessarily complex.....	<input type="checkbox"/>				
3. I thought the system was easy to use	<input type="checkbox"/>				
4. I think that I would need the support of a technical person to be able to use this system.....	<input type="checkbox"/>				
5. I found the various functions in this system were well integrated	<input type="checkbox"/>				
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>				
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>				
8. I found the system very cumbersome to use	<input type="checkbox"/>				
9. I felt very confident using the system.....	<input type="checkbox"/>				
10. I needed to learn a lot of things before I could get going with this system.....	<input type="checkbox"/>				

What was good?

What could be made better?

Gender:

Age:

B Questionnaire Results

The list of individual results from the SUS questionnaire is shown below.

	Score	Percentage
	32	80.0
	33	82.5
	30	80.0
	36	90.0
	37	92.5
	33	82.5
	39	97.5
	34	85.0
	36	90.0
Average	34.6	86.7%

C Project Log

Date	Time	Length (hours)	Room	Apologies	Plan
17/01	1100	1	UG04	N	Brainstorm project possibilities
23/01	1400	1	UG04	N	Finalise draft proposal. Discuss review of related work + decide who is researching which section
31/01	1100	2	UG04	N	Finalise review of related work. Discuss analysis of user requirements + decide who is researching each section
07/02	1100	2	UG04	N	Finalise personas and discuss prototypes
14/02	1100	2	UG04	N	Finalise first prototypes and discuss second prototype
21/02	1100	2	UG04	N	Discuss progress on second prototype
28/02	1200	1	UG04	N	Finalise second prototype and discuss evaluation results
07/03	1100	1	UG04	N	Discuss summary and analysis of project
11/03	1400	1	UG04	N	Review report, everyone to read through and check for errors.

References

- [1] Google Inc. (2014). Google Calendar. Retrieved from <https://play.google.com/store/apps/details?id=com.google.android.calendar>. Version 201308023 [Mobile application software].
- [2] RedSpottedHanky.com (2014). redspottedhanky (Android). Retrieved from <https://play.google.com/store/apps/details?id=com.redspottedhanky>. Version 1.72.00 [Mobile application software].
- [3] Apple Inc. (2013). iOS 7 Date Picker. Retrieved from <https://developer.apple.com> 24-01-2014.
- [4] Apple Inc. (2013). Apple Inc. Retrieved from <https://developer.apple.com/library/ios/documentation/>. Last Accessed 01/02/2014.
- [5] Apple Inc. (2013). Apple Inc. Retrieved from <https://itunes.apple.com/gb/app/booking.com-hotel-reservations/id367003839>. Version 6.1 (2014) [Mobile application software].
- [6] thetrainline.com (2014). thetrainline.com (iOS). Retrieved from <https://itunes.apple.com/gb/app/thetrainline/id334235181>. Version 3.1 (2014) [Mobile application software].
- [7] Zipcar (2014). Zipcar (iOS). Retrieved from <https://itunes.apple.com/gb/app/zipcar/id329384702>. Version 3.4.1 (2013) [Mobile application software].
- [8] Trivago (2013). Trivago (iOS). Retrieved from <https://itunes.apple.com/gb/app/trivago-the-hotel-search/id376888389>. Version 1.8.6 (2013) [Mobile application software].
- [9] University of Birmingham (2014). Munrow Sports Centre Bookings. Retrieved from <https://www.usbonline.bham.ac.uk/>.
- [10] Aquaterra Leisure (2013). Aquaterra Online Bookings. Retrieved from <http://www.onlinebookings.aquaterra.org/>.
- [11] Jakob Nielson. *Usability Engineering*. Academic Press, San Diego, 1994.
- [12] PROTOIO Inc. proto.io. <http://proto.io>. Accessed: 2014-03-02.
- [13] Balsamiq Studios LLC. balsamiq. <http://balsamiq.com/>. Accessed: 2014-03-02.
- [14] David Travis. The 4 questions to ask in a cognitive walkthrough. *User Focus*, Aug 2010.