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The Effect of Interface Animations on the Usability of Accommodation Booking Applications

Bachelor's Thesis (9 ECTS)

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The Effect of Interface Animations on the Usability of Accommodation Booking Applications

Abstract:

The usage of animations in interface design is gaining more and more popularity. While the effect of interface animation on the usability of web sites is relatively studied, there is a significant gap in researching the effect of animation on the usability of mobile applications. The purpose of this thesis is to study the effect of animation on usability in accommodation booking applications. It investigates the general usability as well as two usability´s performance metrics effectiveness and efficiency separately.

Keywords:

Usability, interface animation, accommodation booking application, System Usability Scale, effectiveness, efficiency.

CERCS: P175 Informatics, systems theory

Kasutajaliidese animatsiooni mõju kasutajamugavusele majutusasutuste broneerimise mobiilirakendustes.

Lühikokkuvõte:

Animatsioonide kasutamine kasutajaliidese disainis kogub aina rohkem populaarsust. Kasutajaliidese animatsioonide mõju veebilehtede kasutajamugavusele on küll palju uuritud, kuid mõju mobiilirakendustele on teadmata. Selle bakalaureusetöö eesmärgiks on uurida kasutajaliidese animatsioonide mõju majusutasutuste broneerimise mobiilirakenduste kasutajamugavusele. Antud töö käigus uuritakse nii üldist kasutajamugavust kui ka tõhusust ja mõjusust.

Võtmesõnad:

Kasutajamugavus, kasutajaliidese animatsioon, majutusasutuste broneerimise mobiilirakendused, süsteemi kasutatavuse skaala, tõhusus, mõjusus.

CERCS: P175 Informaatika, süsteemiteooria

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1 Introduction

The first use of interface animations dates back as far as 1984 when Apple Macintosh used rudimentary animations when opening and closing icons (Bederson & Boltman, 1999). From this point onward the use of interface animation has increased from year to year. In years 2016 and 2017 interface animation was one of the most popular interface designs used (Yalanska, 2017).

Animation in interface design is not just a merely way to make the products fun, it has a more practical reason, they are there to make the experience easier (Thomas & Calder, 2001). Moreover, the effect of animation to user interface is both cognitive and affective. By enabling the user to understand and follow changes in the interface´s appearance, animation offloads some of the cognitive burden associated with deciphering what is happening in the interface from higher cognitive centres to the periphery of the nervous system (Chang & Ungar, 1993). A study on the benefits of animated scrolling showed that animated scrolling significantly improves average task time and also significantly decreases error rates for reading tasks as well as improving satisfaction (Klein & Bederson, 2005). Although the popularity of interface animation is growing, there is very little empirical evidence supporting the effectiveness of animation and certain principles how to use animation in user interfaces (Fry-Pierce & Layton, 2018; Shanmugasundaram & Irani, 2008).

Moreover, there is little research done to study the effect of animation on mobile applications usability, while the usage of mobile applications is growing over the usage of desktop. According to the report by Meeker (2017) the split between mobile and desktop is becoming more and more pronounced. Americans for example in 2016 were spending 3+ hours per day on mobile, which is 10 times more than in 2008, and only 2.2 hours per day on desktop, which is the same as in 2008 meaning no increase. Marcus (2005) has studied the effect of user interface design on investment and found that highly usable devices have a greater return on investment.

The hotel industry is one of the largest and most profitable industries in some countries and it helps to boost the economy of both developed and developing countries and stands as the

main supplier in these countries (McTavish & Sankaranarayanan, 2010). As customers travel both inside the nation and internationally the internet has been considered a competitive marketing channel in the hospitality and tourism industry removing any geographical and physical barrier (Doolin, Burgess, & Cooper, 2002). Due to that, the popularity of Online Travel Agencies (OTA) has emerged. In 2013 bookings via OTAs increased to 22% of all the bookings made (Hunold, Kesler, Laitenberger, & Schlütter, 2018).

Because of the increasing usage of phones and the increase of Online Travel Agencies there are also more and more OTAs providing their services through mobile applications. As the competition is tough, especially among smaller providers it is important to improve the usability, because as mentioned before highly usable devices have a greater return on investment. Interface animations could improve the usability of those applications, but their effect on the usability is not studied.

The main goal of this thesis is to investigate the effect of interface animation on usability in accommodation booking mobile applications. International Organization of Standardization (ISO) has defined the usability performance metrics as effectiveness (error rates), efficiency (completion time) and satisfaction (ISO, 1998). In order to investigate the usability in more detail the effect of interface animations on the efficiency and effectiveness in mobile applications is studied separately.

The research seeks to address the following questions:

RQ1: How does interface animations affect the general usability in accommodation booking mobile applications?

RQ2: How does interface animations affect the efficiency in accommodation booking mobile applications?

RQ3: How does interface animations affect the effectiveness in accommodation booking mobile applications?

To answer the questions an A/B testing will be conducted. There will be two groups participating who will both receive a prototype. The first group will perform given tasks on a prototype that does not have animations applied. The second group of participants will complete tasks on a prototype that has interface animations implemented. In order to know which animations to use, the theoretical overview must be given to research the background of interface animation and secondly the interface animations used in existing accommodation booking applications needs to be analysed.

The structure of the thesis is the following:

Introduction – Gives justification of the choice of topic and the purpose of the thesis. Gives an overview of the previously published researches. In addition, the problem statement is added, and the structure of the thesis is described.

Theoretical Background – Gives an overview on topics of usability, usability in mobile applications, System Usability Scale and the different types of animations used in interface design.

Animations used in accommodation booking applications – This chapter analyses the animations used in existing accommodation booking applications.

Research methodology – Gives an overview of the methodologies used in this thesis. Explains the reason why such methods were chosen.

Results – Introduces, describes and analyses the results from the study.

Summary – Gives a concluding overview of the thesis.

2 Terms and Notations

Usability – The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use (ISO, 1998).

Effectiveness – The ability to complete a certain task in the system combined with accuracy of these goals (Brooke, 1996; Frøkjær, Hertzum, & Hornbæk, 2000). It is usually measured quantitatively with error rate (Rubin, Chisnell, & Spool, 2008).

Efficiency – The amount of resource consumed when performing a task measured in completion time (Brooke, 1996).

System Usability Scale – Questionnaire used to measure the usability of a system (Brooke, 1996).

3 Theoretical background

The first part of this chapter discusses the possible definitions of usability and studies the performance metrics of usability (effectiveness, efficiency and satisfaction). In addition, it gives an overview how usability in mobile applications differs from the usability in desktops. System Usability Scale is described as it is used in this thesis to evaluate usability. The second part of the theoretical background studies the animations used in interface animations.

3.1 Usability

Usability in Human Computer Interaction field has various definitions. Rubin, Chisnell and Spool's (2008, p. 4) define the usability "when a product or service is truly usable, the user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or question.". Reiss (2012) explains that usability deals with the individual's ability to achieve broader goals or accomplish specific tasks while using a service or a product. He takes it further and states that usability does not have to involve a certain "thing" like a web page or product. What both Reiss (2012) and Nielsen (1993) agree is that usability is not a single, one-dimensional property of a user interface, it has certain components. These components are defined by International Organization for Standardization (ISO) as effectiveness, efficiency and satisfaction (ISO, 1998), which are taken as the main indicators of usability in this research.

Effectiveness

Effectiveness is the ability of users to complete a certain task in the system combined with accuracy of these goals (Brooke, 1996; Frøkjær et al, 2000). It is usually measured quantitatively with error rate (Rubin et al., 2008). According to Nielsen (1993) an error in this case means any action made that was not needed to accomplish the desired goal. A system error rate is measured by combining all of the errors made by user while performing some specific tasks. When using a computer system a user should make as little errors as possible (Nielsen, Usability Engineering, 1993).

Efficiency

Efficiency refers to the amount of resource consumed when performing a task (Brooke, 1996). Usually the amount refers to time, meaning that efficiency is the quickness with which the user can complete a desired goal completely and accurately (Rubin et al., 2008). It can also refer to the learning time (Frøkjær et al., 2000), but in this thesis I will use completion time as the primary indicator of efficiency.

Satisfaction

Satisfaction primarily consists of how pleasant it is to use the system (Nielsen, Usability Engineering, 1993). Combining perception, feelings and opinions, it shows the user's subjective reaction towards the product (Brooke, 1996; Rubin et al., 2008). Nielsen (1993) brings out that satisfaction, as an attribute of usability, can be especially important for systems that are used in a nonwork environment, for example games. Their entertainment value is greater than the efficiency in which tasks get done, because the idea is for users to want to spend long time having fun (Nielsen, Usability Engineering, 1993).

Usability in mobile applications

Usability in desktop and mobile devices differ in a few ways. Mendoza (2013) has written some of the main principles of how the user experience in mobile applications differ from desktop.

One of the main points that he says differ is the time a user spends on the device. Users take time using desktop, mostly they are at home, in a café, at work or somewhere where they are seated and taking time to open the computer and focus on the screen. When looking at user experience in mobile apps one must look at small increments of time (Mendoza, 2013).

Another major difference that Mendoza (2013) points out is the screen size. The typical web experience uses several columns of information and pages to organize its functionality and content. While web user experience design creates multiple layers, the mobile devices take

the layers away to create a linear story. Cramming through desktop screens is replaced by delivering only the essentials (Mendoza, 2013).

Mobile devices also take away the mouse. By replacing the pinpoint accuracy with touch gestures, it is important to rethink the user experience for imputing information (Mendoza, 2013).

System Usability Scale

In order to measure the usability of the system efficiently John Brooke (1996) developed a simple usability scale, which is called System Usability Scale (SUS). SUS is a simple ten-item scale giving a global view of subjective assessments of usability. The SUS is a *Likert* scale that consists of ten statements, each having a five-point scale ranging from *Strongly Disagree* to *Strongly Agree* (Bangor, Kortum, & Miller, 2009; Brooke, 1996). It is a mixed tone questionnaire, meaning that all odd-numbered questions have a positive tone and all even-numbered have a negative tone (Lewis & Sauro, 2008). SUS can be seen in figure 1.

	The System Usability Scale Standard Version	Strongly Disagree					Strongly Agree
			1	2	3	4	5
1	I think that I would like to use this system frequently.		o	o	o	o	o
2	I found the system unnecessarily complex.		o	o	o	o	o
3	I thought the system was easy to use.		o	o	o	o	o
4	I think that I would need the support of a technical person to be able to use this system.		o	o	o	o	o
5	I found the various functions in this system were well integrated.		o	o	o	o	o
6	I thought there was too much inconsistency in this system.		o	o	o	o	o
7	I would imagine that most people would learn to use this system very quickly.		o	o	o	o	o
8	I found the system very awkward to use.		o	o	o	o	o
9	I felt very confident using the system.		o	o	o	o	o
10	I needed to learn a lot of things before I could get going with this system.		o	o	o	o	o

Figure 1: The standard System Usability Scale. Note: item 8 shows “awkward” instead of “cumbersome”. (Lewis & Sauro, 2008)

3.2 Animation

Digital animation can be defined as a "simulated movement of objects using computer graphics" (England & Finney, 2002). Animations express a sense of continuity and process that is hard to convey through other techniques (Kurlander & Ling, 1995). There is a vast variety of animations starting from simple transitions to 3D animations. This thesis is going to concentrate on the interface animations.

Animation in user interface design

According to Fry-Pierce and Layton (2018) the importance of motion design in the context of user experience is being more and more acknowledged. Motion is not just a merely way to make the products fun, it has a more practical reason, they are there to make the experience easier. In the context of user interfaces, animation is still a quite new field and there is a significant gap in the research. For example there is not a lot about the principles of how to use animation in user interface (Fry-Pierce & Layton, 2018), but Head (2016) has suggested that one must study the traditional animations to imply them in interface design.

Traditional animation started in the 1920s when it grew from a novelty to an art form at the Walt Disney Studios. To study the natural way of movement Walt Disney set up drawing classes for his animators at the Chouinard Art Institute in Los Angeles. Analysing models in motion and live action films playing certain action over and over again allowed them to gain more knowledge of the natural models in motion. The animators applied the knowledge from these lessons to the production of animation. By trying to tell other animators what they learned in the lessons, the 12 principles of animation were shaped (Lasseter, 1987). They were defined first by Ollie Johnston and Frank Thomas in their 1981 book "Disney Animation: The Illusion of Life" (Thomas & Johnston, 1995).

These principles can be applied to user interface, but one has to keep in mind that user interfaces are not cartoons. Cartoon is a passive medium, but the user interface is an interactive one. The user must be in control and thus the final product must be responsive to the user's desires (Chang & Ungar, 1993; Bederson & Boltman, 1999).

12 principles of animation

The 12 principles of animation defined by Johnston and Thomas in 1981:

1. Arcs
2. Anticipation
3. Staging
4. Follow Through and Overlapping Action
5. Timing
6. Slow In and Slow Out
7. Squash and Stretch
8. Straight Ahead Action and Pose to Pose
9. Secondary Action
10. Exaggeration
11. Solid Drawing
12. Appeal

Only the first six principles are covered in detail, because they are used in this thesis.

Arcs

Arcs are the most natural and economical way of an object to move (Lasseter, 1987). When throwing a ball, it does not move straight, it follows an arched trajectory. The way the object moves usually tells which type the object is. Giving an object a straight movement will give it a more mechanical movement while arched movement gives a more natural variation (Thomas & Johnston, 1995).

Giving an animation a more technical or arced movement will add the object more character to display it as true to the brand's character (Fry-Pierce & Layton, 2018). An example of an arc animation can be seen in figure 2.

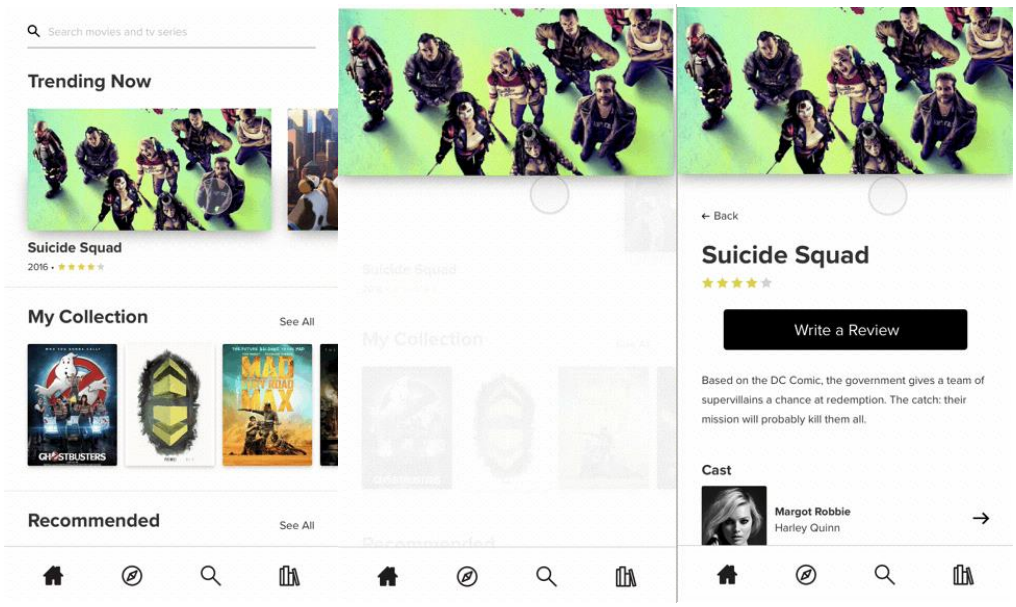

Figure 2: Straight line of motion make this app more clean and professional. (Fry-Pierce & Layton, 2018)

Anticipation

An action consists of three parts: a setup of action, the action and a follow through of the action. Anticipation is the setup of an action, which usually is the contrary movement to the action (Thomas & Johnston, 1995). In addition, anticipation is also used to catch the audience's eye, to prepare them for the next action and lead them to believe it is going to happen before it occurs. Anticipation is also used to help the user understand what is going to happen next (Lasseter, 1987).

A good example in interfaces are buttons, which often grow bigger when one hovers on it to show the user that they are clickable (Fry-Pierce & Layton, 2018), an example can be seen in figure 3.

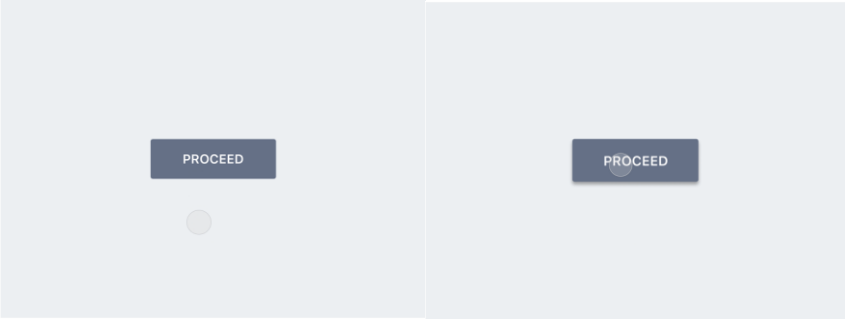

Figure 3: An example of anticipation. Animating the growing of a button when hovering over it usually informs that there is an action happening next. (Ruthi, 2018)

Staging

Staging is a presentation of an idea so that it is unmistakably clear. An action should be staged so that it is understood, an expression should be staged so that it is seen, a character should be staged in a way that it is recognizable, and a mood should be staged so that it affects the audience (Thomas & Johnston, 1995).

Most important in staging is to draw the attention of the audience to only one place, that means that only one idea should occur at a time or else the viewer can look at the wrong object. The idea in interest should be in contrast to the other ideas in the stage. For example, in a still scene a moving object will catch the eye and in contrast in a busy scene a still object will make itself noticeable. It should look as if the animator is saying, “Look at this, now look at this and now look here” (Thomas & Johnston, 1995).

In interface design staging draws the user's attention. Whether it is to bring focus to what should be addressed next of what king of potential interactions could be initialised, a good staging animation helps the user understand the hierarchy of an application and clarifies the action flow for the user (Fry-Pierce & Layton, 2018). An example of staging can be seen in figure 4.

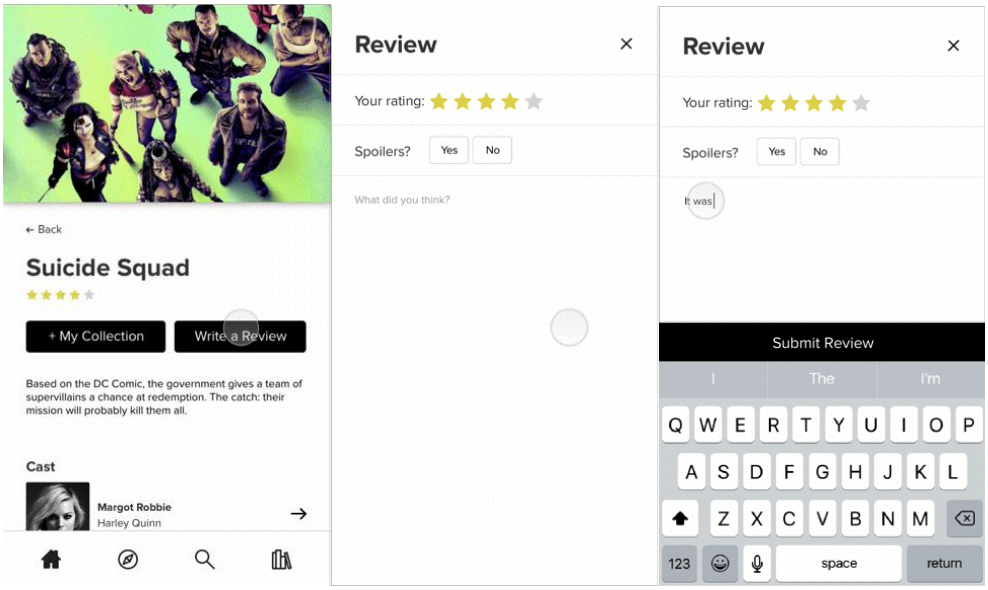

Figure 4: An example of staging. The submit button only appears after the user has started typing the review, it sets the stage for what action they should take next. (Fry-Pierce & Layton, 2018)

Follow Through and Overlapping Action

Just as anticipation was the setup of an action follow through is the termination of an action. An action rarely ends with a complete and sudden stop, but rather are they carried on after their termination point. For example, a hand throwing a ball does not stop after the ball is released, it continues past the actual release (Thomas & Johnston, 1995).

Often variations of speed and timing are added to the loose parts of an object in order to make them seem more interesting. This is called an overlapping action, which makes the object and movement seem more interesting (Thomas & Johnston, 1995). What is actually more important is that the overlapping action helps to convey the story. An action should never come to a complete stop before starting a next action, the second action should always overlap the first. Overlapping helps to maintain a continual flow between whole phases of action (Lasseter, 1987). Walt Disney has also described the overlapping of an action in animation that "When a character knows what he is going to do he doesn't have to stop before each individual action to think to do it. He has it planned in advance in his mind." (Thomas & Johnston, 1995). An example of an overlapping action can be seen in figure 5.

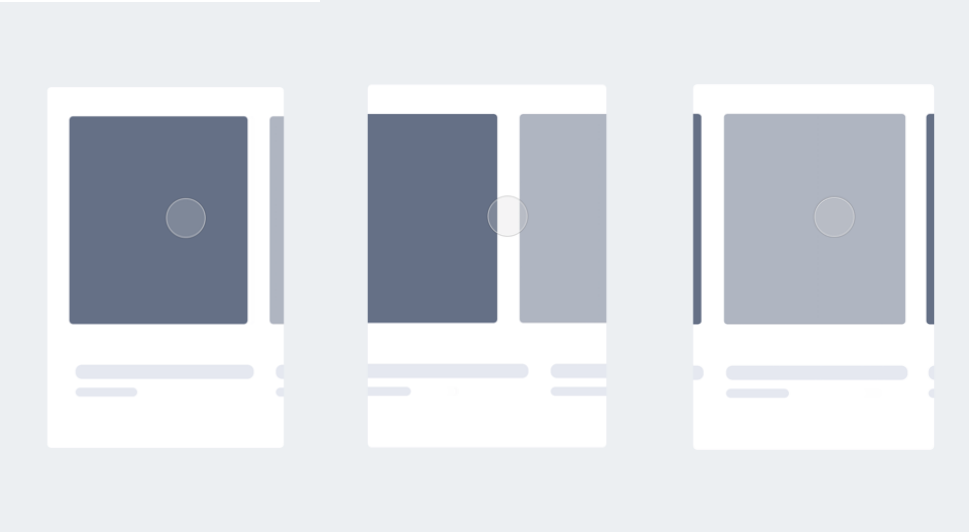

Figure 5: When scrolled, the image cards and the texts start at different rates exhibiting an overlapping action. (Ruthi, 2018)

Timing

Timing is the speed of an action; it is important because it gives meaning to movement. Is usually carries the weight and size of an object and can even carry emotional meaning (Thomas & Johnston, 1995).

Proper timing is crucial to making the idea readable. It is important to spend enough but not too much time to prepare the audience for an action, to participate in an action and the reaction to the action. If one spends too much time on an action the user's attention will wonder and if too little time is spent the audience may not notice the action at all, which wastes the idea of it (Lasseter, 1987).

In interaction design timing is probably the most important principle of all. The way a sequence, what are made primary and secondary actions, define the user’s perception and comprehension (Kitt, 2016).

Slow In and Slow Out

The movement of most object needs time to accelerate and slow down. Slow in and slow out deals with the in-between of drawings between extreme poses, which means that the animation looks more realistic when there are more drawings near the end and beginning of an action (Thomas & Johnston, 1995) (Lasseter, 1987). For example, when one looks at a car. Car mostly starts slowly, gaining speed and when hitting breaks, it takes time for the car to come to a full stop.

Slow in and slow out is also one of the fundamental tools to drive users' attention, while making the animation look authentic. Using it with timing and overlapping helps the animation create a comprehension hierarchy. In addition, people tend to pay more attention to the objects that slow down rather than the object that accelerate. So, it is useful to slow in ideas that the audience need to notice and let the unimportant objects leave at the top velocity (Kitt, 2016).

4 Animations used in accommodation booking applications

In order to apply animations to the prototype, a selection of accommodation booking applications was analysed beforehand. Due to the fact that the prototype was tested on a device that was operating on an iOS mobile operating system, the selection of applications was chosen from App Store (digital distribution platform for mobile apps on iOS operating system). Twelve applications were selected from the top travel apps list in Estonia that provided accommodation booking. The selected twelve apps were Agoda, Airbnb, Booking.com, Couchsurfing, Hopper, Hotels.com, Hotel Tonight, momondo, SkyScanner, TripAdvisor, trivago and Hostelworld. The applications were analysed to find which animations were used in the most common tasks performed. These tasks are searching for an accommodation, looking at the details of an accommodation, booking an accommodation (until the payment method selection) and saving the accommodation to book later (some apps called it saving or favouriting).

4.1 Searching for an accommodation

Users of booking accommodation application usually visit them primarily to search for available accommodation in certain place, time and guests. In the applications analysed, animation was mainly used when searching for an accommodation in displaying search results and sorting the accommodations.

Displaying search results

When the user hits “Search” button (or triggers the display of the results in some other way) it is the first time the person sees the list of accommodation that one possibly might be booking.

Using animation to bring off-screen elements info view helps to create a spatial relationship between the user and the interface (Head, 2016). To create the mental model Hotel Tonight application uses a non-arced slow in animation to display the hotels in the result. The hotels slide in from the bottom of the screen (see figure 6).

The slide in effect with results also confirms search action which the user has performed. It confirms to the user that the application understood that it must display the results. This is an example how animation can be used to show the immediate effect of an action, which also acts as a confirmation of that action (Head, 2016).

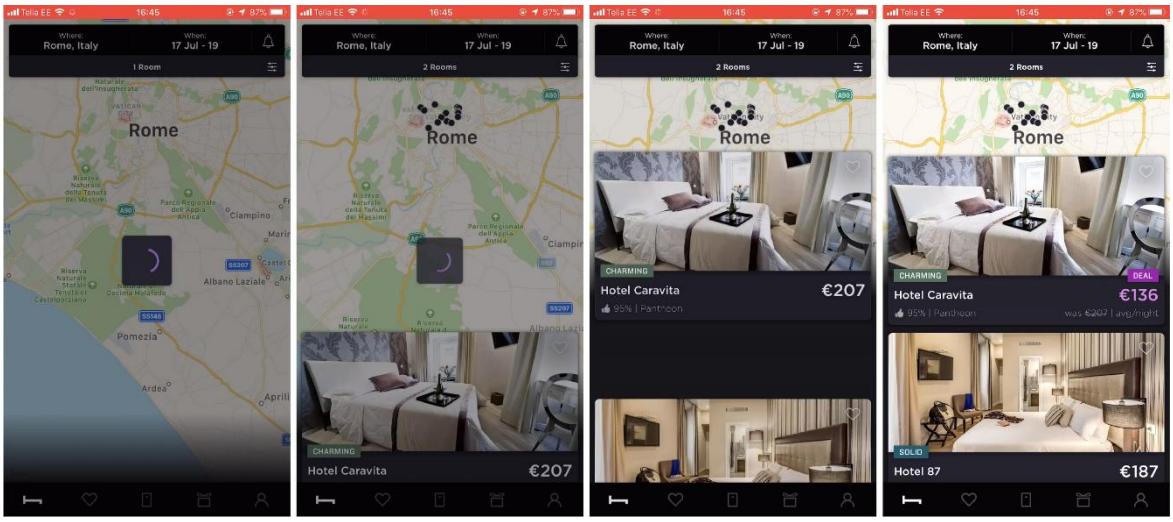

Figure 6: Hotel Tonight application using slide in to display results. Source: developed for this research.

Sorting the results

In Booking.com, when one searches for an accommodation for the 12-14th of June 2019 for two persons then they get 1687 properties (searched on the 10th of April 2019). In order to find the desired accommodation, one most certainly would like to sort the hotels in some way. Out of twelve application I analysed, all of them had the possibility to sort accommodation. Booking.com uses a button, which triggers a slow in overlay to give the opportunity to sort results (see figure 7).

The overlay is a hidden layer, which is brought to the user when one presses a button. Slow in animation helps to create the layer effect. The overlay is an additional layer on top of the search. This adds explanation to the navigation and additional value to create a mental model what is out of view. Staging is also used to grab the user's attention to one place.

Furthermore, the slide in overlay also acts as a confirmation to an action effect. Animating the overlay helps to explain the immediate response to the action, in this case clicking to a button.

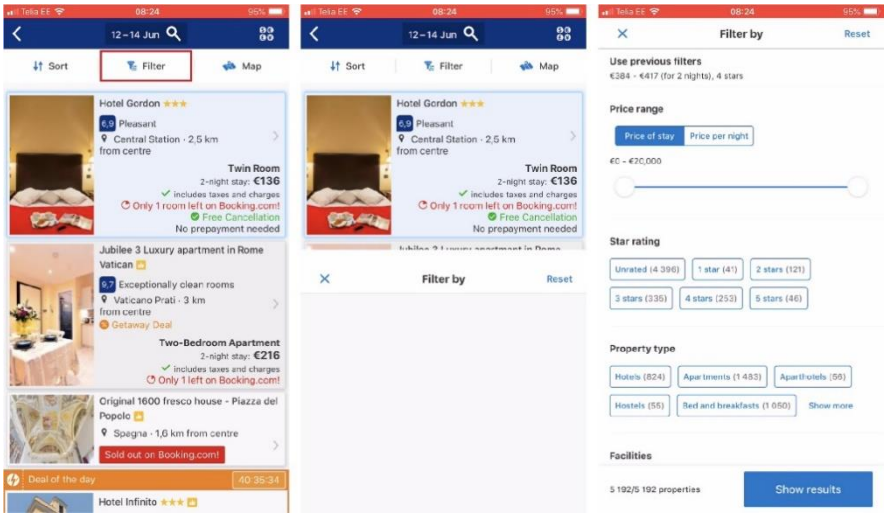

Figure 7: Booking.com application uses slide in animation to display filter options. Red box marks the area inside where the user clicks. Source: developed for this research.

4.2 Looking at the details of an accommodation

After seeing the results of the search criteria, the next step would be to gain additional information about the accommodation. The result page is kept simple and not overloaded with information. All the applications that were analysed use an extra layer to display hotel details. Both Hotels.com and Agoda applications used slow in layers to show extra details about the accommodations (see figures 8 and 9).

Orienting interface layers with animation, such as Hotels.com and Adoga used, serves to make the layer change more apparent and separate the hotel info layer as a distinct one. It is much like in the physical world, where also animation is needed to change the layer order of objects. Animating layers creates a shared understanding of space, even when layering gets complex and more than two layers are used (Head, 2016).

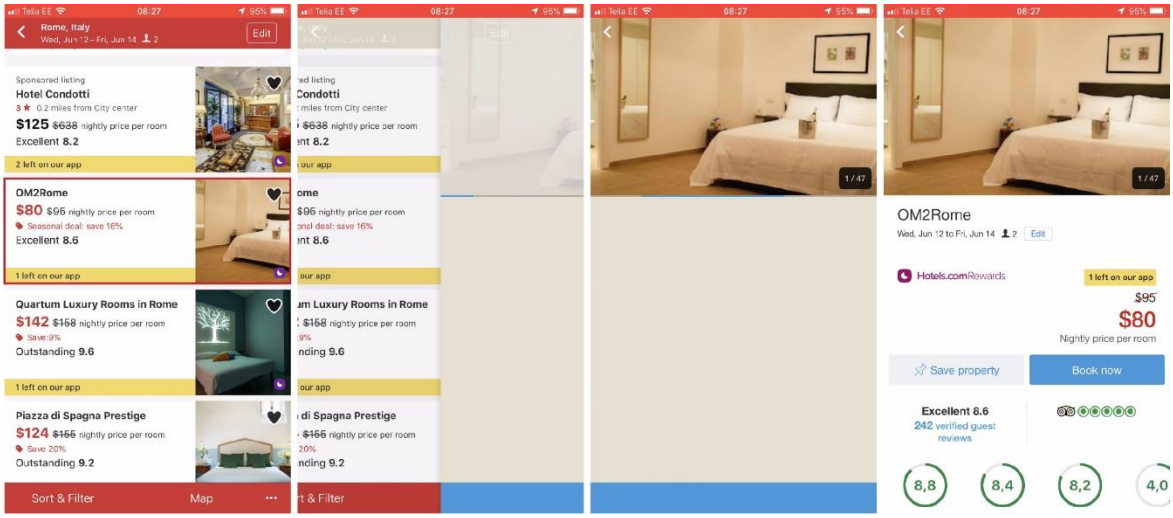

Figure 8: Hotels.com application using layers and slide in to display hotel details. Red boxes mark the area inside where the user clicks. Source: developed for this research.

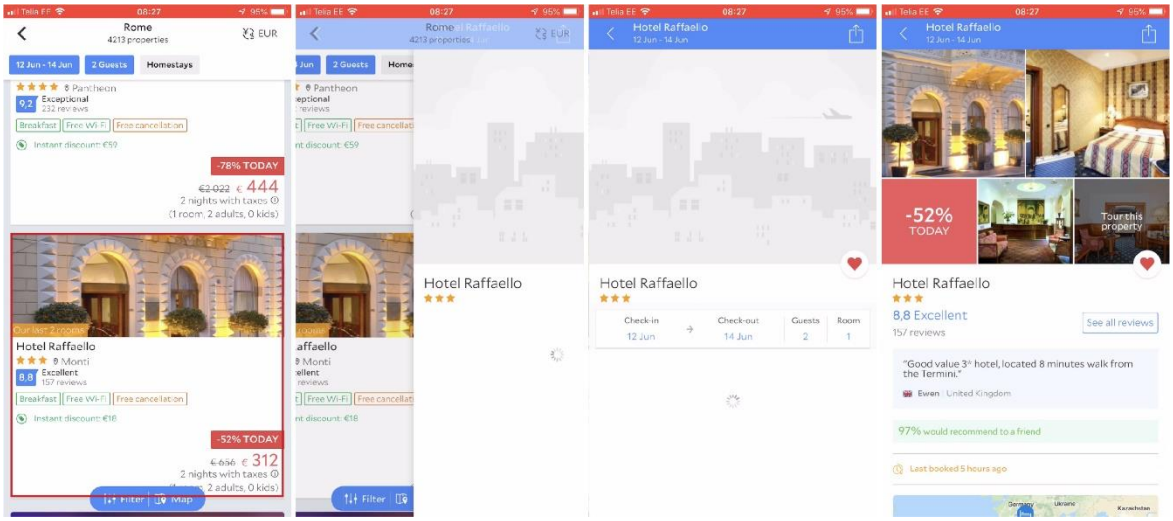

Figure 9: Agoda application using layers and slide in to display hotel details. Red boxes mark the area inside where the user clicks. Source: developed for this research.

4.3 Booking an accommodation

Please note that this user flow is analysed until the payment method must be chosen. The main purpose of accommodation booking sites is to attract the user to book a property. Because of that, it is important to keep the user on the right track. When opening hotel details, Hopper, a hotel booking application, uses a slow in popover in non-arced movement to bring attention to the “Book Now” button (see figure 10).

The popover slows in, meaning that it arrives later than the other content, which helps to reinforce its importance and makes sure it is noticed (Head, 2016). Making the booking link noticeable helps the user to keep in mind the most important tasks. Usually there are certain list of things that a user looks for in an application, so it is important to keep the essential parts noticeable.

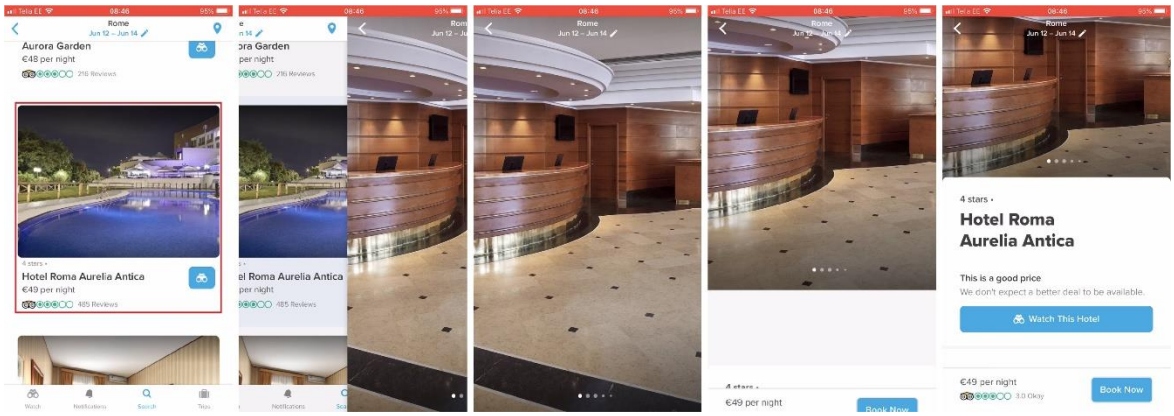

Figure 10: Hopper application using an ease in popover to bring attention to "Book now" button. Red boxes mark the area inside where the user clicks. Source: developed for this research.

4.4 Saving the accommodation to book later

A feature that eight out of twelve applications that were analysed used, was saving properties of interest for later. This feature welcomes the customer back to continue booking a hotel that was of interest before. A vacation rental application Airbnb uses firstly exaggeration while filling the heart next to the property to show the success of adding the rental to favourites (see figure 11). Secondly, it uses slow fading in animation next to the saved button in the navigation bar to indicate that this is the place where the user can find their saved rental.

Head (2016) indicates that directing the eye from one animation to another, like Airbnb does, helps to indicate where the user should look next. Motion graphics call the eye movement from one place to the next an eye flow. A logical eye flow can influence the user's gaze invisibly and make following the information seem almost effortless. But it is

important to not overuse it, as motion coming from all sorts of direction at different times causes tension and confusion (Head, 2016).

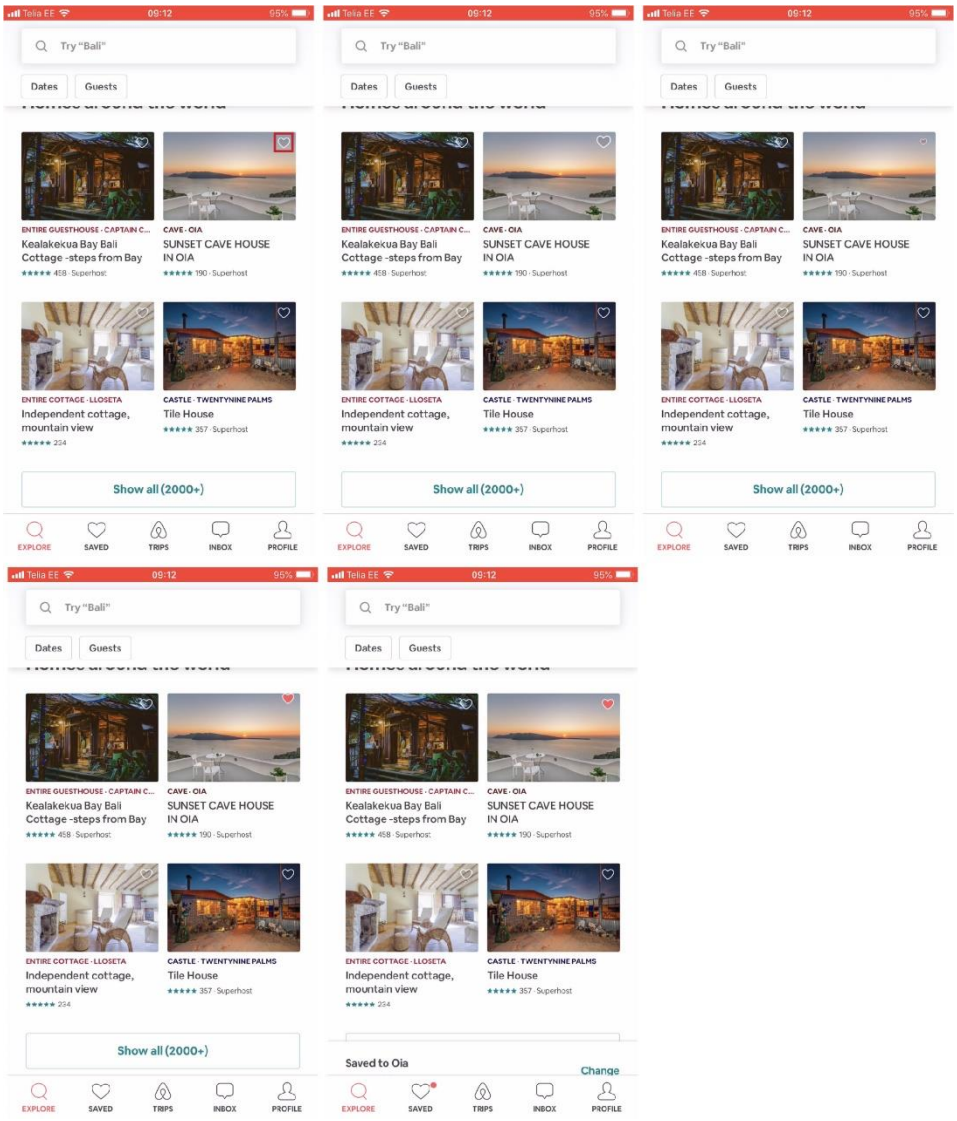

Figure 11: Airbnb application using animation to refer where favourited accommodation goes to. Red box marks the area inside where the user clicks. Source: developed for this research.

5 Research methodology

The purpose of this chapter is to describe the methods used to find the answers to the research questions.

RQ1: How does interface animations affect the general usability in accommodation booking mobile applications?

RQ2: How does interface animations affect the efficiency in accommodation booking mobile applications?

RQ3: How does interface animations affect the effectiveness in accommodation booking mobile applications?

5.1 Research methods

Measuring the usability of an application can be done in a laboratory or in field. A study by Kallio and Kaikkonen (2005) compared the difference between laboratory and field testing of mobile applications. Their results suggest that a field study is not the best way to test user interface as it is more time consuming than the lab test. Due to that, in this research a laboratory study was enforced.

The study was conducted in an A/B testing form in order to find out the effect interface animation has on usability. Both test subject groups received an accommodation application prototype with the difference, that the prototype B had interface animations implemented but prototype A did not use any animation.

iPhone 8 Plus was used in this research as it was the researcher's personal device. It allowed to test the prototype while designing and before the study.

Standard usability testing protocols dictate that a certain set of tasks need to be defined in order to observe the users performing these tasks (Kortum & Sorber, 2015). The set of tasks

was conducted based on the information gathered in analysing the existing accommodation booking application in previous chapter and are described in detail in the laboratory study script.

The typical performance metrics of usability, as described in the theoretical overview, are defined by International Organization for Standardization as effectiveness (error rates), efficiency (completion times) and satisfaction (ISO, 1998). To measure the general usability the researcher chose to use System Usability Scale. Details why it was chosen is described in the following chapter: System Usability Scale. To add more detail to the research, in addition to the general usability of the applications, the effectiveness and efficiency was measured separately. Details how it was measured is described in the chapters Effectiveness (error rates) and Efficiency (completion times). Eye tracker was used in order to collect additional information about the effect of every animation.

System Usability Scale

A System Usability Scale (SUS) was used in this study to measure the general usability of the prototypes. SUS was chosen because of the several characteristics brought out by Bangor et al. (2009) that make the SUS attractive. Firstly, it is composed of only ten statements, which makes it relatively quick and easy for the participants and for the researcher to score. Secondly, it is non-proprietary, so it is cost effective to use and can be scored quickly. Third, SUS is technology agnostic, which means that it can be used to assess a broad type of user interfaces. Lastly, the result of the scale is a single score from 0 to 100 making it easily understandable by a wide range of people.

Bangor et al. (2008) described the results of 2 324 SUS surveys from 206 usability tests collected over a ten-year period. They found that the SUS is highly reliable (alpha = 0.91) and useful over a large range of interface types. In addition, Tullis and Stetson (2004) measured the usability of two web sites using five different surveys and found that SUS provided the most reliable results across different sample sizes.

Scoring SUS

Brooke (1996) has described the calculation of the SUS score the following way: first the sum of the score distributions needs to be found. Each item's score contribution will range from 0 to 4. For items 1,3,5,7 and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Next the sum needs to be multiplied by 2.5 to get the overall value of the system usability. The score varies from 0 to 100.

Effectiveness (error rates)

The effectiveness of a system is measured in error rates. In this study error rates were measured with extra clicks the user made. Every task has the shortest user flow and number of clicks it can be finished. Every extra click increases the error rate. The extra clicks were counted from the video received from the eye tracking device.

The shortest way to complete task 1 is showed on figure 12 under the Task 1 scenario. When selecting a place, the number of clicks may vary by the number of characters typed on the onscreen keyboard and it was not measured as an extra click. The shortest way to complete task 2 is showed on figure 16 under the Task 2 scenario and task 3 on the figure 19 under Task 3 scenario.

Efficiency (completion times)

The efficiency of a system is measured in completion time. In this research the completion time was measured from the user clicking "Start Task" to user receiving the completion success message. As the success message in task 1 and 2 appeared one second after completing the task, then this second was deducted from the time, in order to receive the correct completion time. In addition, eye tracking was used to deduct the time a user spent to reread the task description while performing tasks in order to measure the task completion time, rather than the memory of the user to remember the details of the task.

5.2 Designing a prototype

The prototyping program that was used to create an accommodation application was Adobe XD. The researcher chose this program, because it allowed to create a fully functioning prototype without using any code. Furthermore, it allowed to create animated interface designs with Auto-animate function.

Two prototypes that were used in the study had the same layouts and design. The layout was inspired by the applications that were analysed in chapter four (Animations Used in Accommodation Booking Applications). The design was chosen by the author, but the effect of it is not relevant in this thesis as the goal was to compare the usability of animated and non-animated prototypes not to measure them separately. The animations selected to the prototype B was based on the analysis done previously in chapter four (Animations Used in Accommodation Booking Applications).

The prototype also consisted of popups indicating the end of a task and a button to start the task. It was needed to measure the time a person spent to complete a task. As the task descriptions were given to the participant on paper then there was no need to add the descriptions to the prototype.

5.3 Participants

The study was done in the University of Tartu library. The subjects to the study were chosen randomly from the group of people spending time in the library´s main area. All in all, 10 people were chosen to participate in the study. 5 persons per group was chosen, because a study by Nielsen has suggested that testing the usability with 5 persons lets one find almost as many usability problems as one would find using many more test participants (Nielsen, 2012).

Since eye-tracking glasses were used then persons using glasses for eyesight problems could not participate as the eye-tracker glasses were with regular glasses.

5.4 Laboratory study script

Setting up the study environment

Google Forms questionnaire about the System Usability Scale and background information is set up in the computer. Eye-tracking glasses are set up for a new participant and connection between the glasses and a control tablet is checked. An unfilled consent form is set on the table.

General introduction

The researcher gives a general overview of the study. The time frame in mentioned together with a fact that their eye movement will be recorded to video, that will only be used for research purpose.

Consent form

The participant is given a consent form which they must read through. It is also mentioned in the form that the participants could stop the study at any time and leave. If the participant agrees to the terms, then they could participate in the study.

Eye-tracking calibration

The step includes:

- Putting on the Tobii Pro Glasses.
- Finding a comfortable place on the chair.
- Calibrating the classes with Tobii Pro Glasses Controller Software. To do the calibration the participant is asked to look at a black dot at the back of a tablet which the researcher is holding.

- The participant is handed the device which has the prototype that will be tested (next referred to as a study device). The study device shows five black squares with white boxes. The participant is asked to look at certain dots to make sure the calibration is accurate enough.
- If the researcher decides that the eye tracking is not accurate enough the calibration is repeated. After that the accuracy is tested again.

Introduction to tasks

The researcher gives a short overview of the application that will be used. The participant is explained the limitations of a prototype. There will be altogether three tasks which will be presented to the participant one by one on paper. The paper with the task description will stay on the table while performing the task, so the subject has the possibility to check some details if they forget. Every task starts with a button click and ends with a success message. The researcher encourages the participant to hold the phone the way they are used to handle a phone.

Tasks scenarios

Next there is an overview of the scenario of every task.

Task 1

Task description:

"Task 1

After pressing "Start Task 1" you will see the Search screen. You want to search for hotels in Rome, Italy. Search for available hotels in **Rome, Italy** on **12-14th of June** for **2 adults.**"

Users start the task by pressing "Start Task 1". After they will see the "Search" screen where they can select where and when to go and who will need accommodation (see figure 12 to

see user flow). After clicking “Where?” they will have the possibility to type “Rome” or select it from the list. Selecting “Rome, Italy” will lead back to the “Search” page. Next users can choose the dates by clicking “When?”. After the right dates have been selected the “Continue” button transparency will decrease and it leads back to the “Search” page, where the user can select the last criteria, the number of guests. When the guests have been chosen the “Search” button’s transparency on the “Search” screen will decrease indicating it’s clickability. “Search” button will display the results and after one second a popup appears indicating that the task has been finished.

In task 1, the difference between animated and non-animated interface:

a) Non-animated interface –
    a. Transition between different pages in not animated.
    b. Pressing “Continue” leads back to the main page without animation.
    c. Search results appear to the screen without animation.
b) Animated interface –
    a. Transition to selecting where/when/who is animated with a slow in non-arced slide left animation. For example, “Choose dates” page slides in a slow in animation from right and the main search page slides away with slow out animation to left (see figure 13).
    b. In addition, after pressing “Continue” button the page dissolves to the main search page (see figure 14).
    c. Pressing search triggers an animation, where the results slide up from the bottom of the screen. Moreover, the selected dates, place and guests slide up to the top of the screen while the filter button slid down (see figure 15)

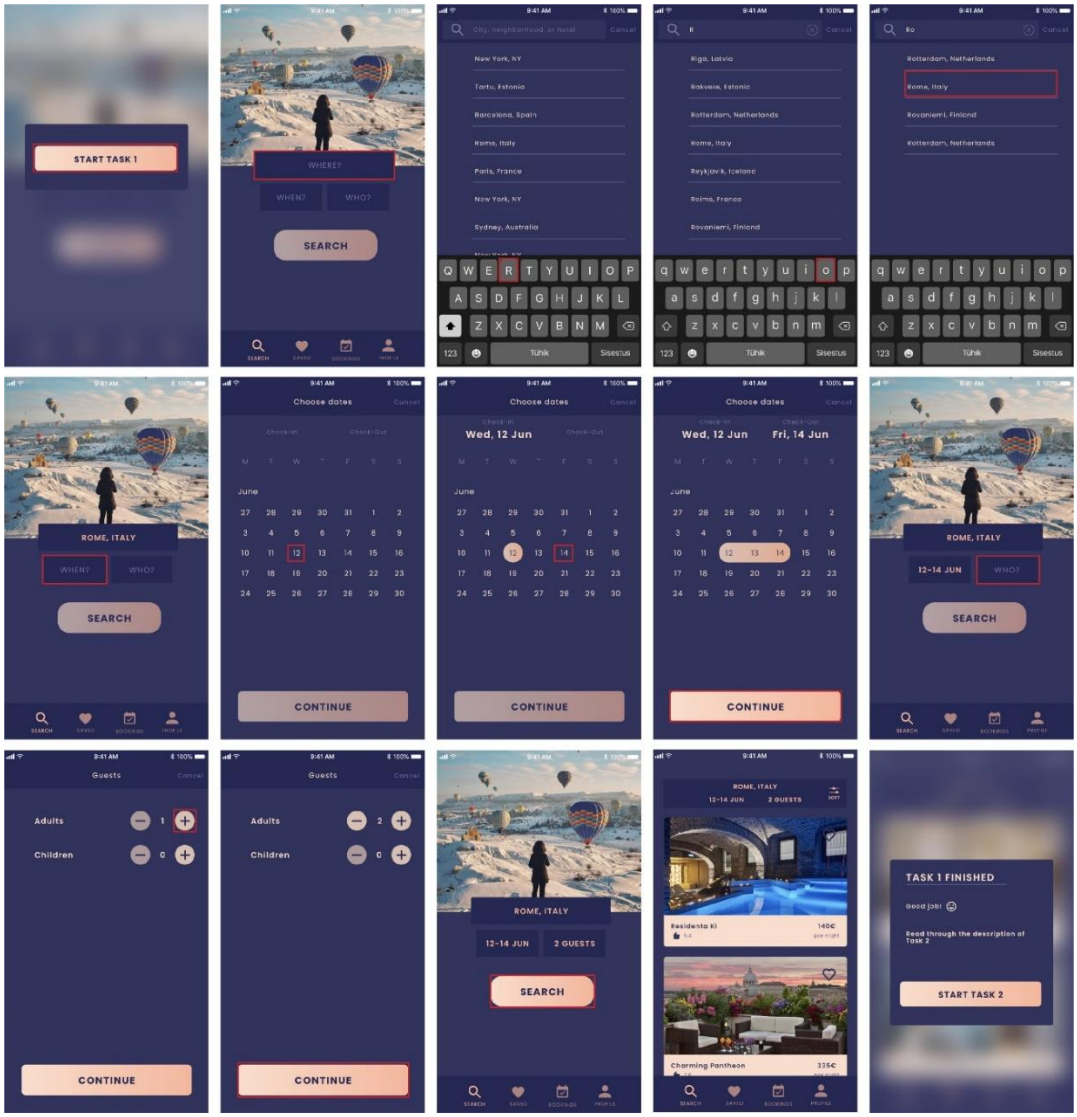

Figure 12: The user flow of the Task 1. Red boxes mark the area inside where the user clicks. Source: developed for this research.

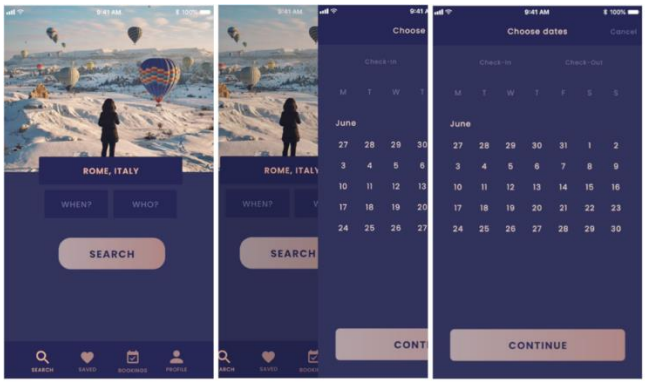

Figure 13: Slide left animation example when choosing the date. Source: developed for this research.

Figure 14: Example of dissolve animation when the user presses “Continue”. Source: developed for this research.

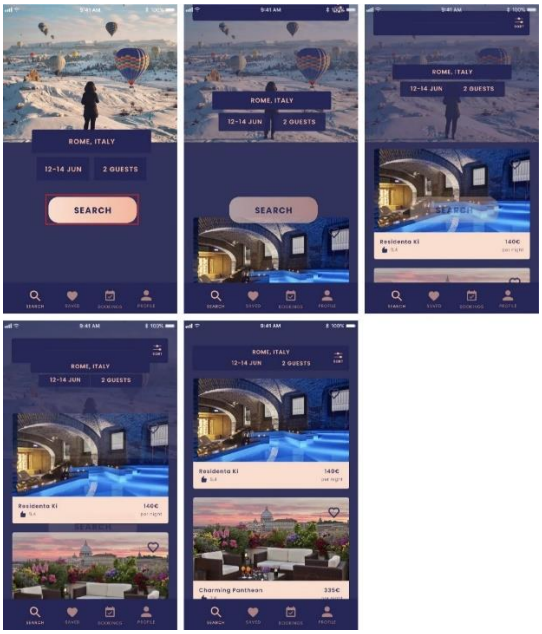

Figure 15: Example how pressing “Search” triggers an animation, where selected search criteria slide up and search results slide up from the bottom of the screen. Red boxes mark the area inside where the user clicks. Source: developed for this research.

Task 2

Task 2 description:

“After pressing “Start Task 2” you will see the results from the search you made in Task 1.

- **Sort** hotels in the result **by price from lowest to highest.**

- Mark **2** of the **cheapest** hotels as your **favourites**/in your saved trips"

Users start the task by clicking "Start Task 2". After that they will see the results of their previous search. To sort the hotels, they must click on a "Sort by" button in upper right corner and then "Price (lowest first)". After that the hotels will be sorted according to their selection. In order to add the two cheapest hotels (which are the B&B Casa Angelini and Starhotels Metropole) as favourites the user can tap on the hearts or open the hotels one by one by tapping on the picture or accommodation information and then click on the empty heart next to the hotel name. After the user reaches the search results page with both hotels marked as favourites the task success popup will appear after one second. The complete user flow can be seen from figure 16.

In task 2, the difference between animated and non-animated interface:

a) Non-animated interface –
    a. When the user clicks on the heart to favourite the hotel, it fills up using no animation.
    b. Sort by selection appears and disappears with no animation.
b) Animated interface –
    a. When the user clicks on a heart to add the hotel as favourite the heart fills up and at the same time a heart moves to the navigation bar in a non-arced movement indicating that the accommodation that was added as favourite can be found under the saved page (see figure 18 for explanation).
    b. Sort by button triggers an animation, where the selection slides in from the bottom part of the screen. After closing the selection, it slides away back to the bottom of the screen (see figure 17).

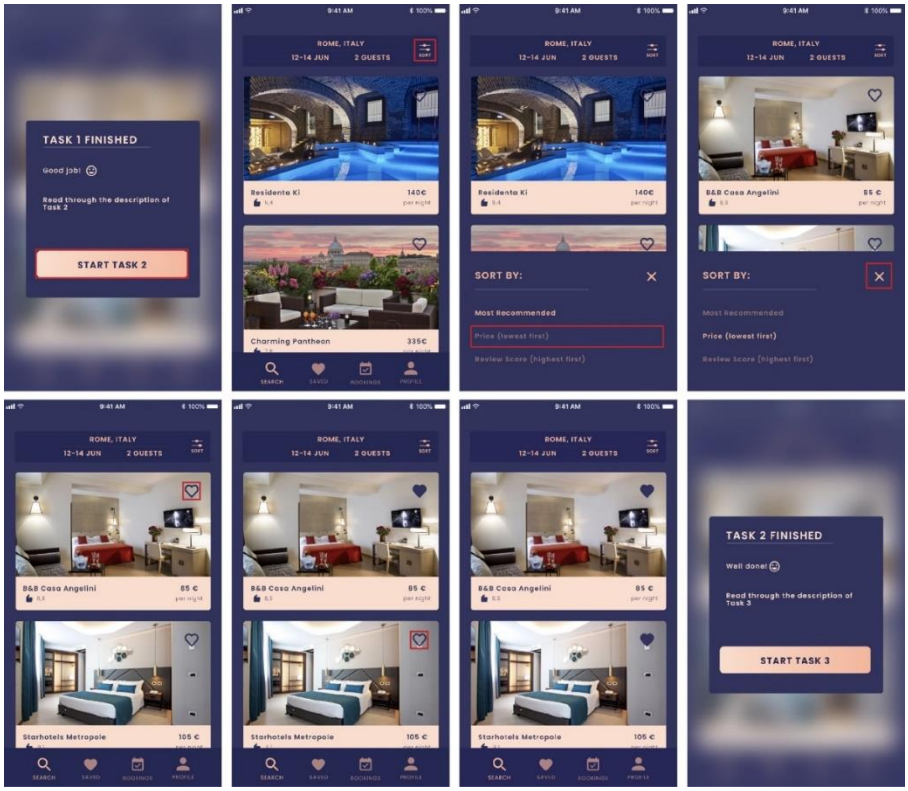

Figure 16: The user flow of the Task 2. Red boxes mark the area inside where the user clicks. Source: developed for this research.

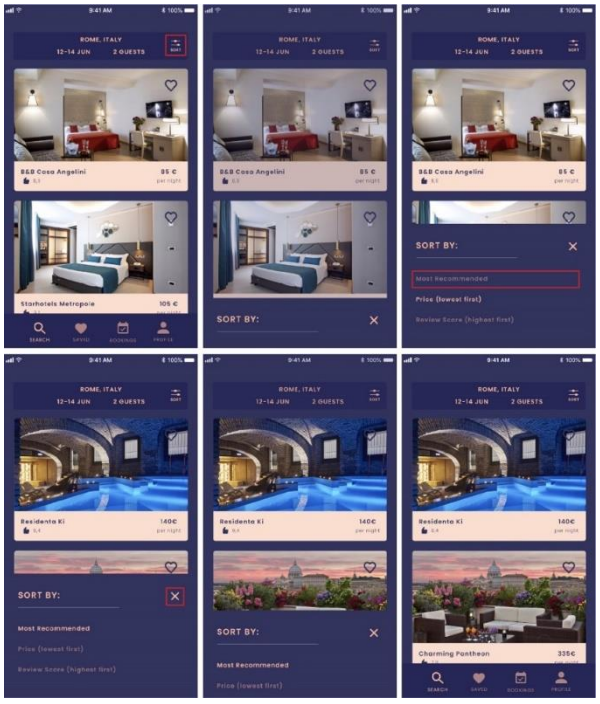

Figure 17: Slide in and slide down animation in the prototype when selecting sort variation. Red boxes mark the area inside where the user clicks. Source: developed for this research.

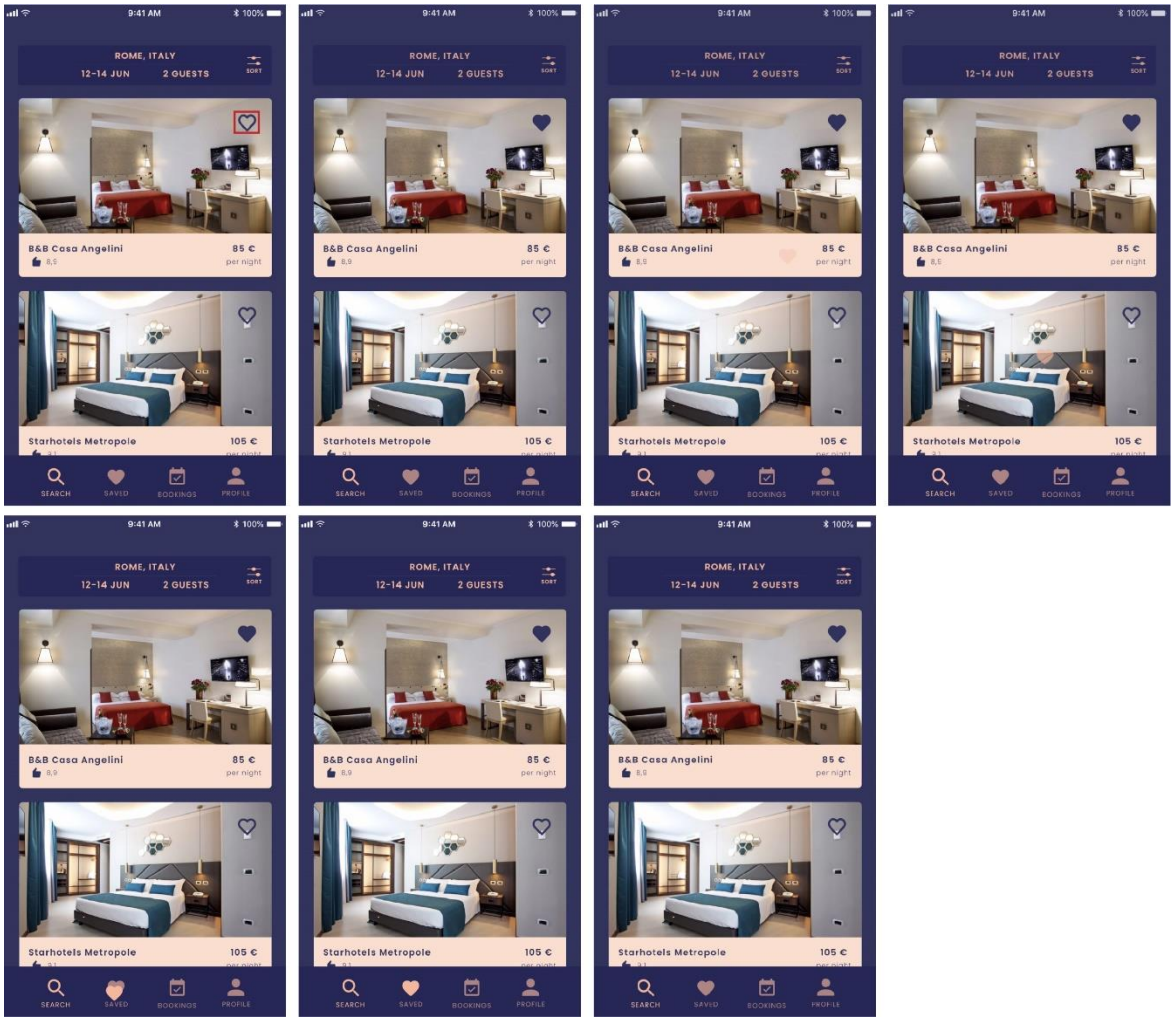

Figure 18: Favouriting a hotel triggers an animation, where the heart is filled and a pink heart slides on top of the saved button on the navigation bar.

Task 3

Task 3 description:

"After pressing "Start Task 3" you will see the results of the completed Task 2. Imagine that you have used the application before, and you have previously saved another hotel (Bed Guest House) as your favourites.

- From you **saved trips**
- find the trip **Rome, Italy** from **12th until 14th of June** for **2 guests**.
- Find the **Bed Guest House**.

- Book the hotel with **2 queen beds and 1 sofa bed**. “

Users start the task by clicking “Start Task 3”. They will see the same page where they finished Task 2. Users must click on “Saved” button on navigation bar to open the “Saved Trips” page. Next, they must click on the trip to Rome, Italy and then select Bed Guest House hotel. When the details of the Bed Guest House appear, users need to click on “Continue”. This leads to a page, where the users can select rooms. After selecting 2 Queens, 1 Sofa bed and pressing “Continue” the users immediately see the task finished popup. Full user flow can be seen in figure 19.

In task 3, the difference between animated and non-animated interface:

a) Non-animated interface –
    a. Transition between different pages is not animated.
    b. Transition to hotel information has no animation used.
b) Animated interface –
    a. Moving between pages is animated with slide animations, similar as in task 1. An example of sliding animations can be seen in figure 20.
    b. Furthermore, when the user clicks on a hotel to see the additional information, “Select rooms” button slides in from the bottom of the phone to make itself noticeable (see figure 21 as an example). Also, the paged change with dissolve animation.

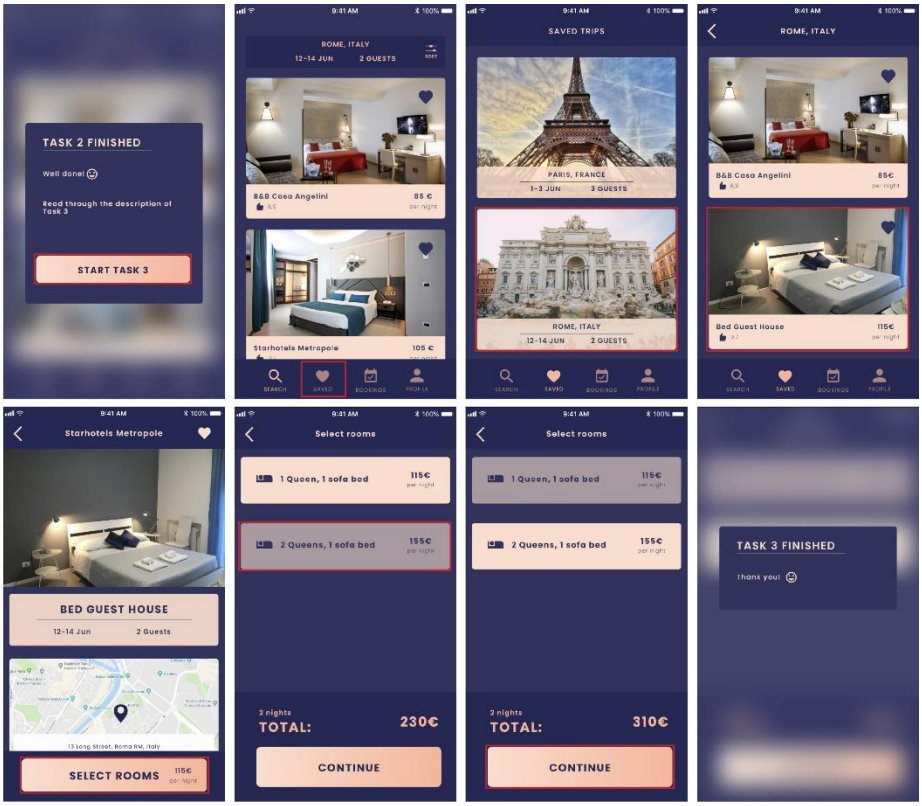

Figure 19: The user flow of task 3. Red boxes mark the area inside where the user clicks. Source: developed for this research.

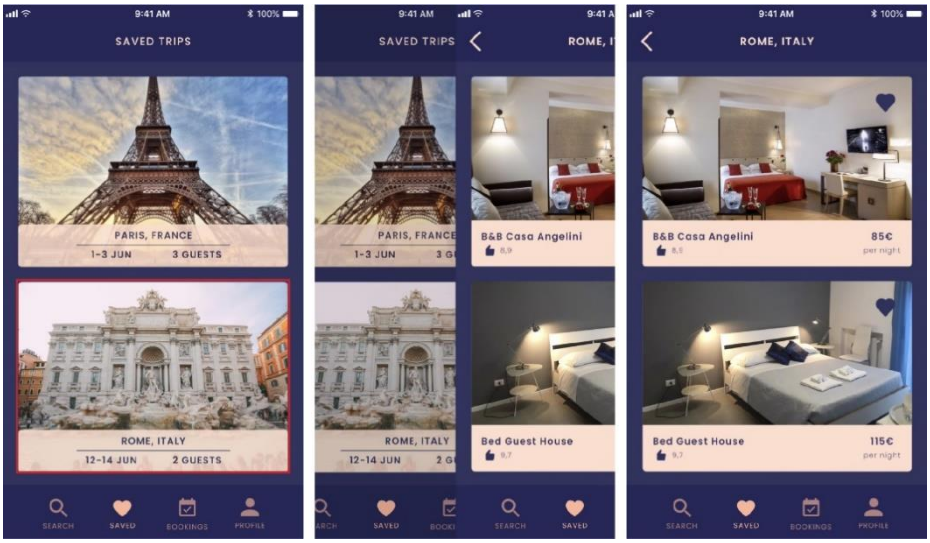

Figure 20: Example of slide animation, which is triggered by the user clicking on trip to Rome, Italy. Red box marks the area inside where the user clicks. Source: developed for this research.

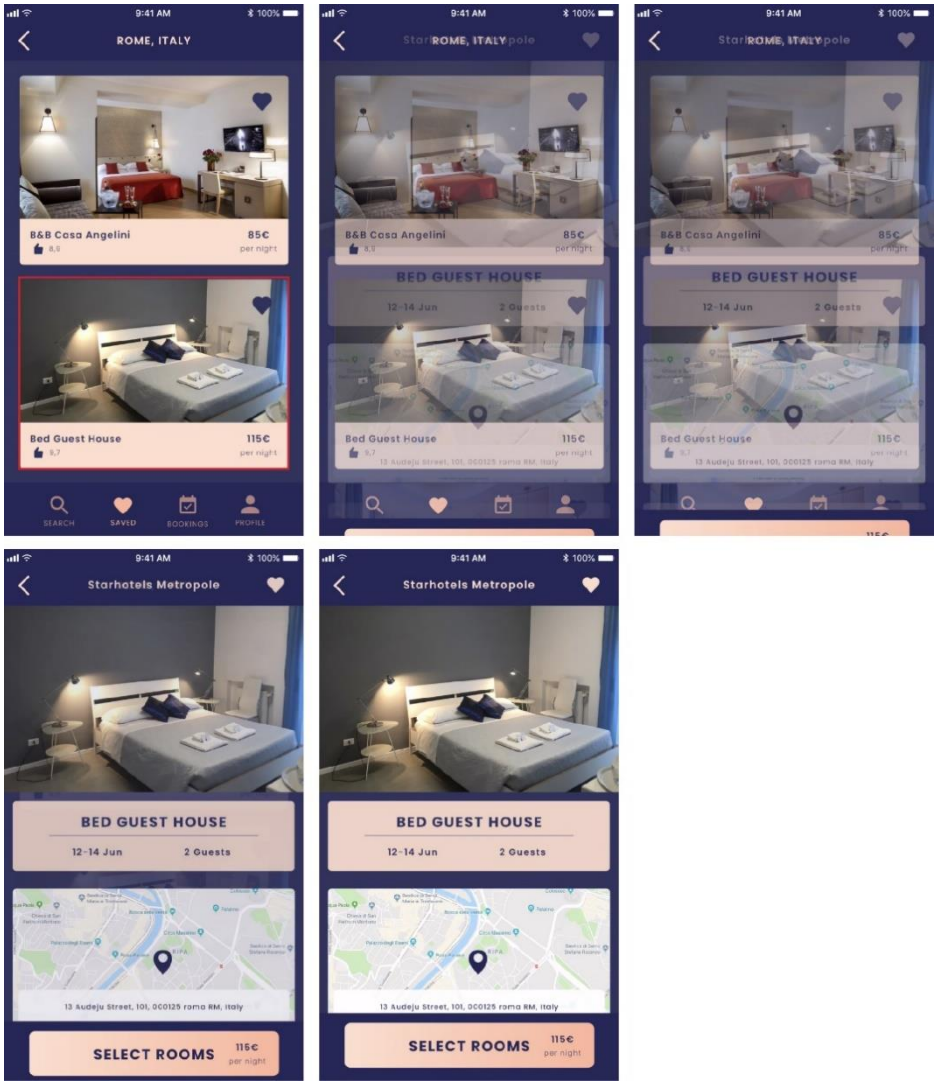

Figure 21: Clicking on the Bed Guest House to see the details triggers two animations: dissolving page content and “Select Rooms” slide in. Red box marks the area inside where the user clicks. Source: developed for this research.

Once the participants have finished the tasks the researcher will stop recording and take off the eye tracking glasses.

SUS scale

Next the participants are asked to fill in the System Usability Scale questionnaire about the used prototype. The questionnaire is filled in the researcher’s computer. The full questionnaire can be seen in appendix A – System Usability Scale questionnaire.

Background info

Lastly the participants must fill in the background info questionnaire in the same computer. It asks about their gender, age, smartphone usage and accommodation app usage. The full questionnaire can be seen in abstract B – background info questionnaire.

5.5 Pilot study

A pilot study was carried out with one participant. The aim of the pilot study was to improve the prototype and select the eye tacking device. Regarding the selection of eye tracking devices then in University of Tartu in the School of Economics and Business Administrator there are two devices that can be used to track the eye gaze on mobile phone. First is the Tobii X2-60 that would be used together with a mobile device stand and the second option is the Tobii Pro Glasses 2.

In the pilot study both devices were used to test the usability and the accuracy, user experience of the participant and researcher were considered when deciding which device to use. Although the technical specifications stated that the Tobii X2-60 is more specific in catching the gaze, the researcher decided to use the Tobii Pro Glasses 2 because they were a lot more convenient to the user. The researched wished that the participant would be in the most comfortable position when using the prototype to remove any unnecessary complications. The Tobii X2-60 together with the mobile device stand needed the user to be in one specific position in order to catch the gaze, which forced the user into a forced position. Moreover, the glasses gave the possibility to hold the phone in hand while the mobile stand placed the phone in a certain position.

The pilot study showed that the prototype has some minor mistakes in the interface that needed fixing before the main study. In addition to the pilot study the researcher tested both prototypes on two different persons to make sure that the interfaces were clear and to find out any other possible solutions to complete the task in order to add them in the prototype. The pilot study also helped the researcher to estimate how much time the full study could take.

6 Results

This chapter describes and analyses first the subjects' background info. Next it introduces the results gained from the System Usability Scale questionnaire and analyses them. In addition, the results of completion time and error rates are analysed task by task and a general conclusion is given to every research question. Lastly the analysed results are discussed in the final chapter.

6.1 Subjects' background info

In total there were 5 participants in group A and 5 participants in group B. In group A, two people were male (40% of group A participants) and three people were female (60% of group B participants). In group B, three people were male (60% of group B participants) and two people were female (40% of group B participants).

The average age of group A was 21,6 and standard deviation 2,408, while group B had the average age of 21,8 and the standard deviation 1,483. Meaning that the average of both groups was close, but group A participants' ages were more dispersed than group B participants' ages. See table 1 for the overview of ages and sex distribution.

	Total number of participants	Male	Male percentage	Female	Female percentage	Average age	Age standard deviation
A	5	2	40%	3	60%	21,6	2,408
B	5	3	60%	2	40%	21,8	1,483

Table 1: The age and sex statistics of both test groups.

All the participants from both groups owned a smartphone. Group A tends to spend more time on their smartphones daily than group B. More exact result can be seen in figure 21.

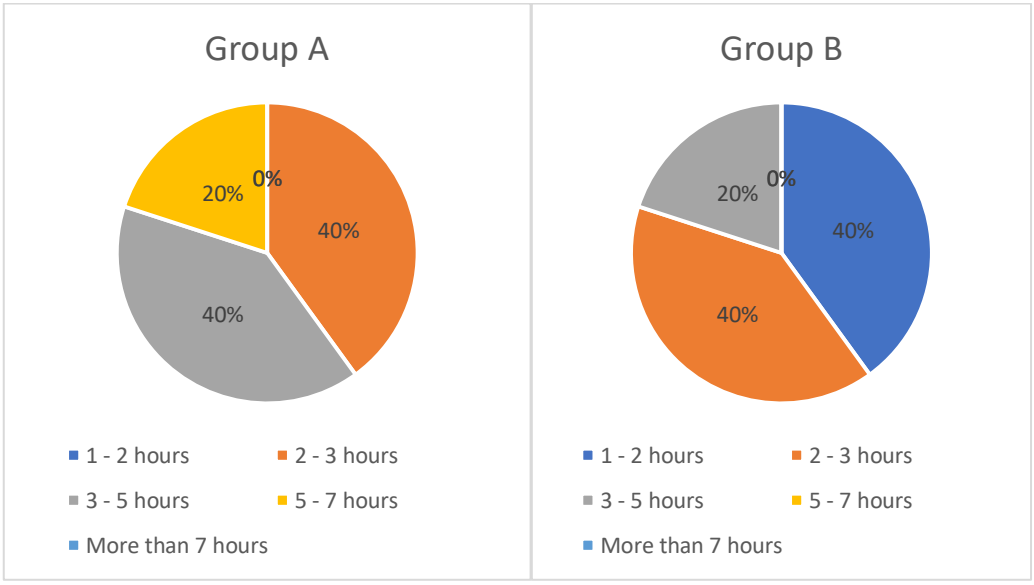

Figure 21: Pie charts about how much time the participants spend on their phone daily.

All participants from group A had used an accommodation booking mobile application before. Four people out of five had used an accommodation booking mobile application before in group B. The researcher also asked the participants which applications they have used before to book an accommodation. The most popular among both groups was Booking.com. The second most popular among group A was Airbnb and TripAdvisor and among group B was Airbnb. The participants also had the opportunity to add additional applications, but none of them suggested any other app that was not in the list. The results of all applications of both groups can be seen in figure 22.

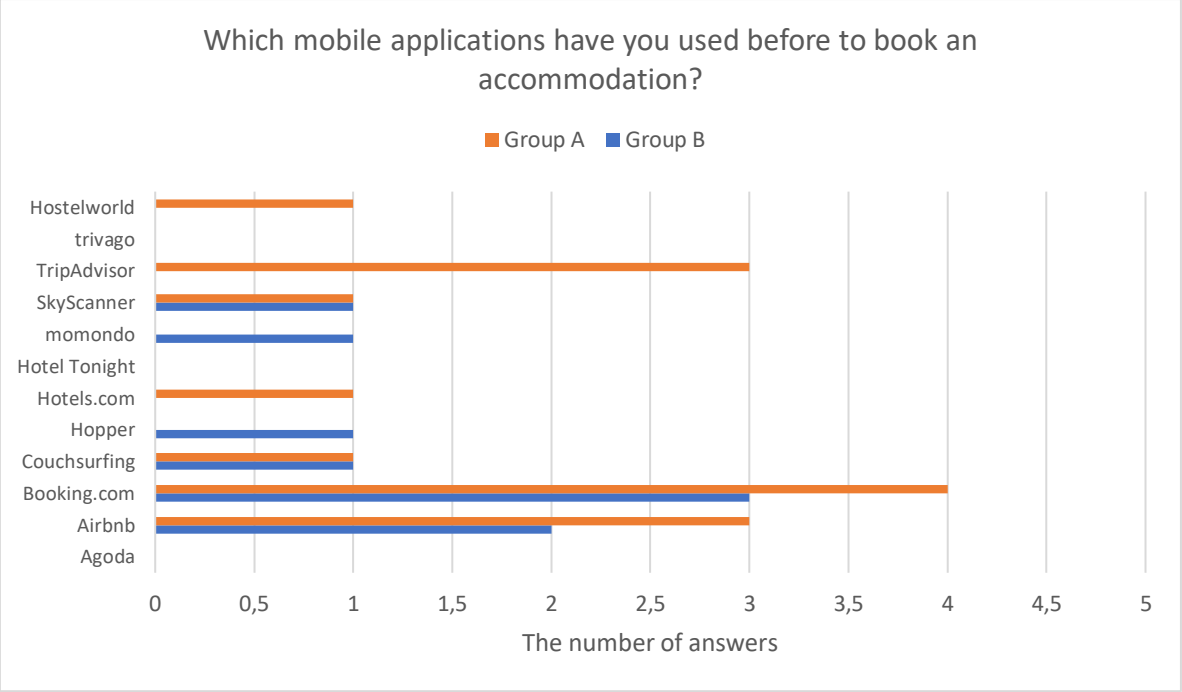

Figure 22: Bar chart displaying the previous usage of accommodation booking mobile applications.

6.2 System Usability Scale

Surprisingly the average System Usability Scale (SUS) score for group A (without animation) was higher than group B (with animation). The average SUS score for group A was 93,5 and there were in total two users whose questionnaire result scored the maximum (100) and the lowest score was 85. The average SUS score for group B was 90, while the highest score was 97,5 and lowest 85 (the same as group A). See table 2 for the detailed results and figure 22 for the comparison of average results.

The average scores imply that the use of interface animation decreased the usability as the scores were lower with the group that used the animated prototype.

	SUS score	
Participant number	Group A	Group B
1	85	85
2	100	97,5
3	87,5	92,5
4	100	87,5
5	95	87,5
Average	**93,5**	**90**

Table 2: SUS scores of every participant and the average score of both groups.

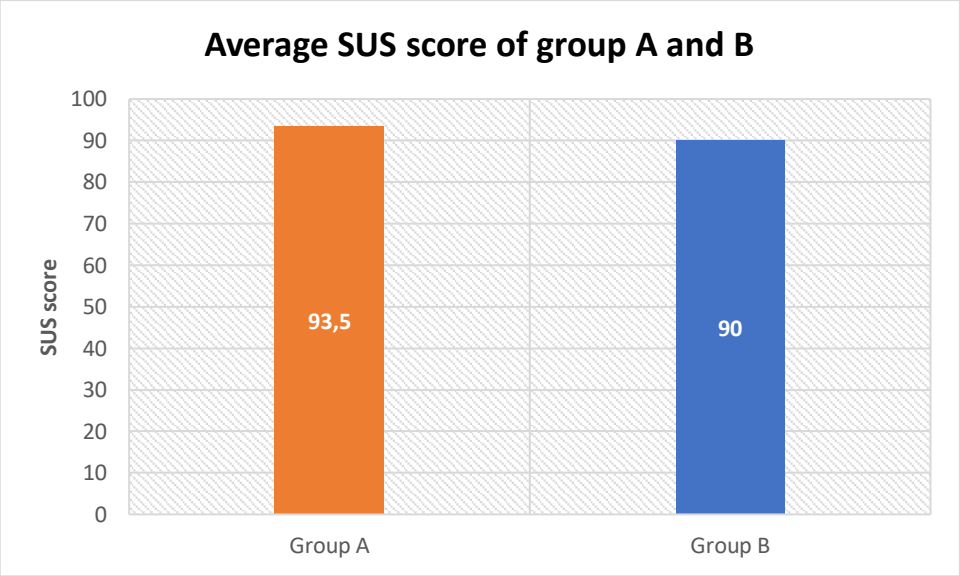

Figure 22: The average SUS scores of group A and B.

6.3 Completion time and error rates

As mentioned previously the study participants had overall three (3) tasks to complete. Group A used a prototype without animation and group B with animation. Every task was analysed separately to get more exact results. In addition, interface animations can have both negative and positive effects so analysing task by task can get more insight into the effect of certain animations. Together with the videos from the eye tracking device, the results can be explained in more detail. As the base of both prototypes was very similar in design it must be noted that comparing the two prototypes is significantly difficult. It needs the

background provided in the literature overview and the users´ behaviour together with gaze to provide meaningful comparison.

Task 1

In task 1 the user had to choose where, when and to whom they would like to book an accommodation. On average group A completed the task in 21,78 seconds, while group B completed the same task in an animated interface 1,42 seconds faster. The average amount of extra clicks made in a prototype without animation was 1,4 clicks and in a protype with animation 0,6. From table 3 it can be seen that only one person from group B did extra clicks. Completion time is somewhat correlated with extra clicks as the person who needed the most time to complete task 1 also did the most extra clicks in both groups. In contrast, the users with the least extra clicks were not the fastest ones to finish the task.

Analysing the videos of the studies it is seen that all extra clicks were made in choosing dates. Two of the four users, who made extra clicks when choosing dates, wanted to slide months although the correct month was in front of them, the confusion may become, because by default a lot of applications open the current date when selecting dates. The two other users with extra clicks wanted to select dates by sliding them, not with just clicks. As all extra clicks were not directly related to interface animation implementation, then we can conclude that in task 1 interface animation did not have effect on efficiency.

As the completion time in group B was lower than in group A then the evidence suggest that effectiveness grew in task 1 with the implementation of interface animation. This may be due to the implementation of a slide animation (shown in figure 13 in chapter five) that helped the user to understand the navigation better and due to that complete the task faster.

	Group A		Group B	
Participant number	Number of extra clicks	Completion time (s)	Number of extra clicks	Completion time (s)
1	5	33,72	0	18,16
2	0	17,72	0	16,2
3	1	15,72	0	16,44
4	1	21,28	0	18,00
5	0	20,48	3	33,04
Average	**1,40**	**21,78**	**0,60**	**20,37**

Table 3: Detailed results of extra clicks and completion times of group A and B.

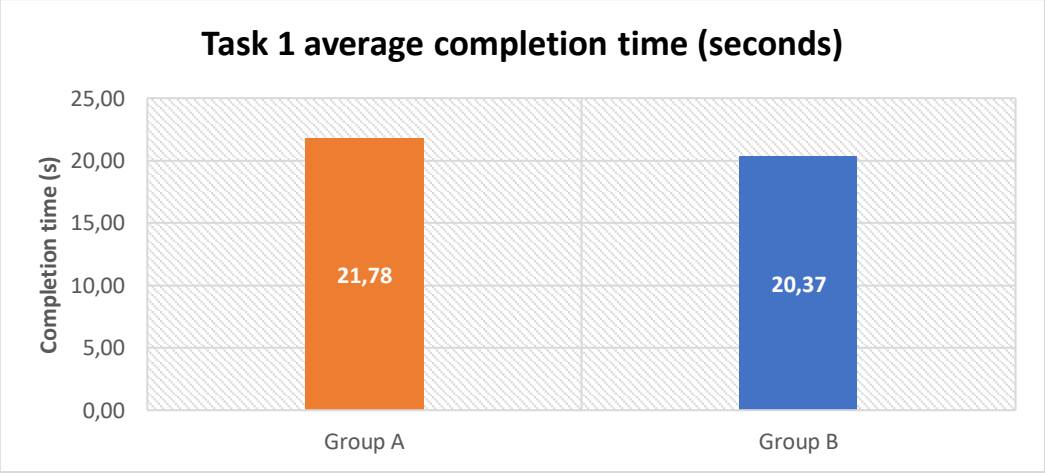

Figure 23: Comparing the average completion time of both groups in task 1.

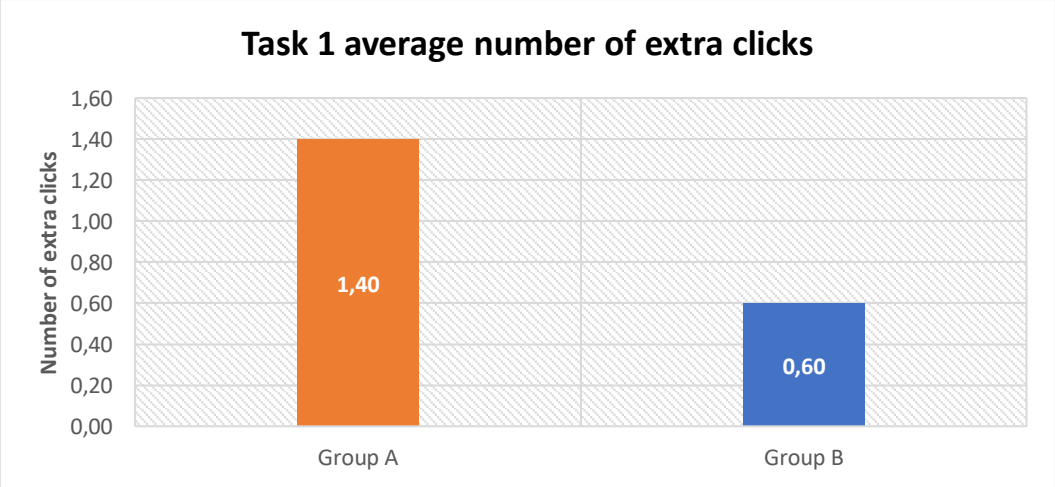

Figure 24: Comparing the average number of extra clicks of both groups in task 1.

Task 2

In task 2 the participants had to mark the two of the cheapest hotels as favourites. On average group A spent 22,30 seconds to do the task and group B on average completed the task 5,93 seconds faster. The standard derivation for group A times was 9 and for group B three (3), which makes the group A´s results more spread than group B´s. Group A made on average 0,8 extra clicks while group B made on average 0,4 extra clicks. See table 4 for the detailed results.

The results from both error rate and completion time suggests that interface animation affected efficiency and effectiveness positively. As the filter by selection slid from the bottom, then it attracted the user´s attention and they could notice it sooner.

	Group A		Group B	
Participant number	Number of extra clicks	Completion time (s)	Number of extra clicks	Completion time (s)
1	0	15,08	2	20,32
2	2	21,16	0	12,92
3	0	17,24	0	17,92
4	2	20,2	0	16,2
5	0	37,84	0	14,48
Average	**0,80**	**22,30**	**0,40**	**16,37**

Table 4: The results of Task 1. The number of extra clicks and completion times of every participant.

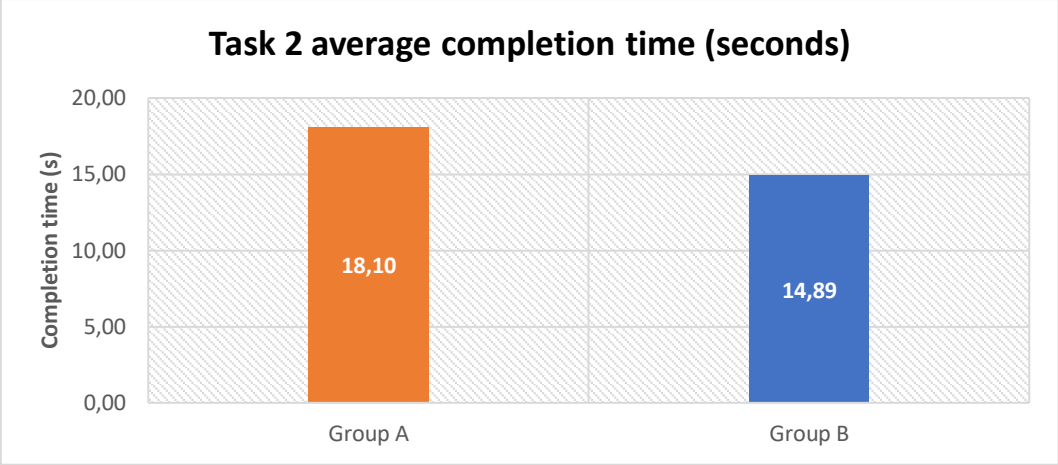

Figure 25: Comparing the average completion time of both groups in task 2.

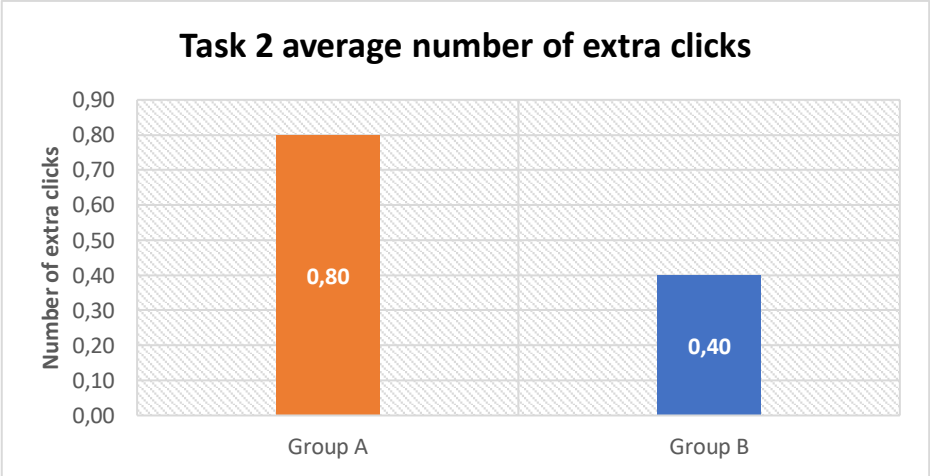

Figure 26: Comparing the average number of extra clicks of both groups in task 2.

Animation used in task 1 affecting the efficiency in task 2

In task 1 there was an animation that also affected task 2. The animation was when pressing search the results slid in from the bottom while the search criteria slid up and the filter button slid down (figure explaining the animation can be seen in chapter results in 5.4 laboratory study script under task 1 called figure 17). Due to the animation the user could have noticed the filter button and as a result when starting task 2 one could navigate to the filter button faster.

To analyse the impact of that animation the videos were studied to see if the participants noticed the filter bar in task 1 and the time to first fixation of the filter button was found.

Time to fist fixation was taken from the time a user first clicked “Start Task 2” button to the time their gaze was first fixed at the “Filter By” button.

The results can be seen in table 5. None of the persons in group A (non-animated prototype) noticed the filter button, while two of them noticed the top bar. In group B (animated prototype) two persons out of five noticed the filter by button, two persons noticed the top bar and one did not notice anything as the user was already putting the phone down and waiting for the next task. As there were more persons who noticed the filter bar in group B than in group A then it can be concluded that the animation worked as the attention was drawn.

The average time to first fixation in group A was 1100 milliseconds, while in group B it was 990 milliseconds. As persons in group B who used the animated prototype on average noticed the filter by button 110 milliseconds faster than it suggests that the animation improved to efficiency of the prototype.

	Did the user notice the “Filter By” button?	Time to the first fixation of the “Filter By” button (ms)
A1	No, only top bar	1317
A2	No, only top bar	1633
A3	No, only top bar	717
A4	No	633
A5	No	1200
Average		**1100**
B1	No, the person already put the phone down when results appeared.	917
B2	No, only top bar	917
B3	Yes	717
B4	No, only top bar	1567
B5	Yes	833
Average		**990**

Table 5: The detailed results of the analysis of the affect the slid up and slid down animation had on task 2.

Task 3

In task 3 the users had to find a hotel from their saved trips and book a hotel with 2 queen beds and 1 sofa bed. Although this was a task with the longest description and the biggest number of new pages in the interface, it was fastest task performed by both groups. Correspondingly it was the task with no extra clicks made by any participant. These results could be attributed to the fact that it was the last task executed by users. The participants had the possibility to get use to the interface and in the third task they were the most familiar with the prototype so they could complete the tasks more effectively and efficiently. The detailed results can be seen in table 6.

As the number of extra clicks was equal for both clicks then it shows that interface animation did not have any effect on effectiveness in task 3. The average completion time of group B was 3,22 seconds faster than group A suggesting that the interface animation decreased the completion time in task 3. This shows that the interface animation increased efficiency in task 3.

	Group A		Group B	
Participant number	Number of extra clicks	Completion time (s)	Number of extra clicks	Completion time (s)
1	0	16,68	0	14,44
2	0	11,68	0	18,72
3	0	15,12	0	12,96
4	0	18,8	0	13,08
5	0	28,24	0	15,24
Average	**0,00**	**18,10**	**0,00**	**14,89**

Table 6: The results of Task 2. The number of extra clicks and completion times of every participant.

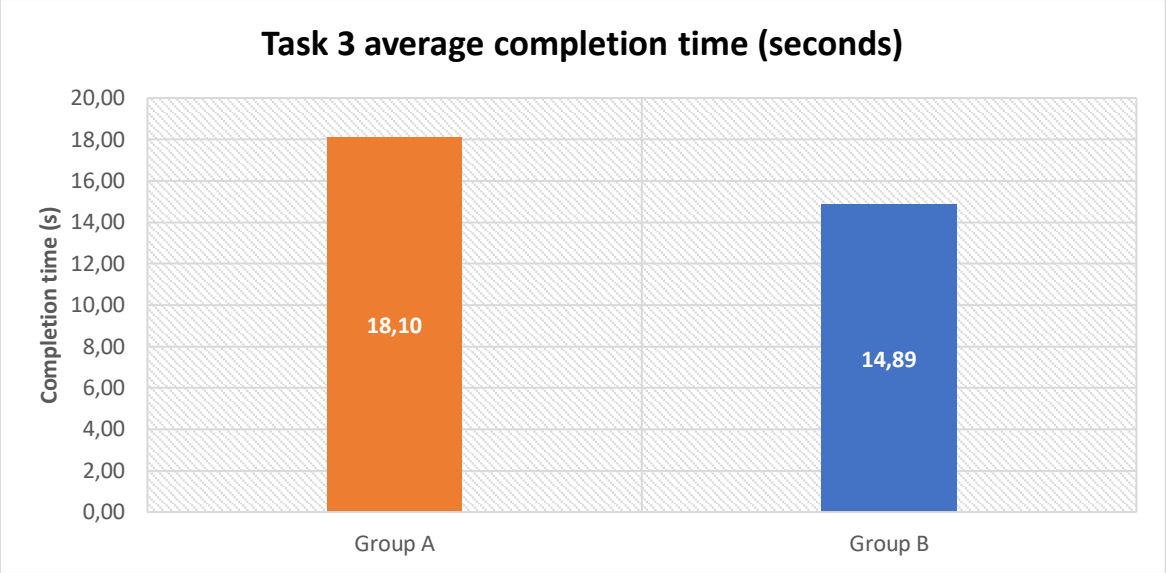

Figure 27: Comparing the average completion time of both groups in task 3.

Animation used in task 2 affecting the efficiency in task 3

One animation in task 2 could have also affected the performance of task 3. It is the animation where the user clicks on the heart to add the hotel as favourites, it fills up and at the same time a second heart moves to the navigation bar indicating that the favourited hotel can be found under the saved page. The figure explaining the animation can be found in chapter results under the laboratory study script of task 2 on figure 18.

To analyse the impact of this animation the videos were studied to see if the persons in group A noticed the "Saved" button on navigation bar and the persons in group B noticed the "Saved" button after both animations (first when clicking on the first heart and then on the second). In addition, the time to first fixation to the "Saved" button on the navigation bar in task 3 was found. The time to first fixation was taken from the time clicked to "Start Task 3" to the point where the user sees "Saved" button.

The results can be seen in table 7. Only one person from group A noticed the "Saved" button in task 2. From group B only one person out of five noticed the "Saved" button after clicking on the first heart, three persons were looking straight at the next heart they were going to click next and one person´s gaze was lost. After clicking on the second heart four people out of five noticed the "Saved" button. One person looked straight at the task description. It

could be suggested that it was because the person was checking whether the task was completed correctly. As the number of persons, who noticed the "Saved" button was greater in group B where animation was used than in group A where animation was not used it can be suggested that the animation was successful in drawing attention to the wished place.

The average time to first fixation in group A was 2797 milliseconds while in group B the average was more than twice faster 1307 milliseconds. Group A had one person (participant A5) who needed 7200 milliseconds to fix the gaze on the right place, so it brought the average up for group A, but the other participants in group A on average still spent more time to fix the "Saved" button. The results suggest that this animation improved the efficiency in task 3.

	Did the user notice "Saved" button during task 1?		Time to first fixation (ms)
A1	Yes		967
A2	No		1367
A3	No		2517
A4	No		1933
A5	No		7200
Average			**2797**
	Did the user notice "Saved" button after clinking on the first heart?	**Did the user notice "Saved" button after clinking on the second heart?**	**Time to first fixation (ms)**
B1	Yes	Yes	850
B2	No, looked at next heart	Yes	1083
B3	No, looked at next heart	Yes	1050
B4	Gaze was lost	Yes	1350
B5	No, looked at next heart	No, looked at the paper with task description	2200
Average			**1307**

Table 7: The detailed results of the analysis of the affect the heart animation had on task 3.

6.4 Concluding results

To conclude the results the results of all three tasks are combined in order to answer the research questions.

RQ1: How does interface animations affect the general usability in accommodation booking mobile applications?

To answer this question the results from the System Usability Scale questionnaire must be considered. Figure 22 shows that the average SUS score of group B was 3.5 lower than the average score of group A. While the prototype with animation received a lower SUS score than the prototype without animation the difference between the two scores (3.5) is not that significant.

Although as discussed previously in the SUS score results, the average results still decreased with the use of animation which indicates that interface animation had a negative effect on the general usability in accommodation booking mobile applications.

RQ2: How does interface animations affect the efficiency in accommodation booking mobile applications?

From the figures 23, 25 and 27 it can be seen that the completion time was lower for group B than for group A in all three tasks. This indicates that the usage of animation decreased completion time. These results indicate that interface animation increases the efficiency in accommodation booking mobile applications.

RQ3: How does interface animations affect the effectiveness in accommodation booking mobile applications?

As can be seen in figure 24 and 26, the average number of extra clicks made by group B (with animation) compared to the extra clicks made by group A (without animation) is smaller in task 1 and 2. In task 3 no extra clicks were made by any of the participants. In

this thesis the extra clicks were taken as an implication of error rate, so it can be concluded that animations decrease the error rate in applications. Meaning that the results show that interface animation affects the effectiveness in accommodation booking applications positively.

6.5 Discussion

It is somewhat surprising to see that the general usability decreased with the use of animation while the efficiency and effectiveness, which are the two performance metrics of usability, increased. It could be explained with the choice of methodology, because the System Usability Scale was a questionnaire meaning that the answers by participants could have been affected by outer environment or mood. In addition, the questionnaire and the application together with task description was in English which was not the first language of all the participants suggesting that the participants could have struggled with understanding. Although it was strongly advised to the participants in the beginning of the study to ask questions if something is unclear.

Moreover, the participant´s experience with different applications could differ and due to that the standards of the usability could also differentiate. For example, the term “easy” used in the statement “I found the system easy to use” could have a different meaning to the users depending if they have come across very complex applications or not.

In addition, it was interesting to see that the interface animation increased efficiency. It was surprising because efficiency was measured in completion time, but displaying animations take time and as a result adding animations increase the completion time. So, it was impressive to see that the animations managed to make up the used time and improve the completion time even more.

To further investigate the general usability the average score of each question in the System Usability Scale could be analysed. It could give more insight to see why animated prototype seemed as less usable to the participant.

The analysis of animations used in accommodation booking applications showed that the current applications do not have a lot of animations implemented. It was difficult to choose the animations, because most of the applications had similar animations integrated. Due to that animations that are currently used in various apps could be studied while studying more special and specific animations would have been intriguing.

In future studies, it might be possible to engage more participants in assessing the general usability of the application, as the results of five persons could be too dependent on the outer environment. In addition, using a real application instead of a prototype could give more insight into the effect of animation on usability as the prototype limits the user's accessibility in the application.

7 Summary

The purpose of the current study was to investigate the effect of interface animation on usability in accommodation booking applications. In order to a give more detailed approach the effectiveness and efficiency was also studied. This thesis reached the desired goal and provided somewhat a meaningful contribution to the research done previously in this field.

From the theoretical background it was revealed that classical principles of animations can be used to define the principles of how to use animation. Both their positive and negative effects were studied. In addition, an overview of the different approached to usability and the three main components (effectiveness, efficiency and satisfaction) of usability was given.

In the analysis of the animations in existing accommodation booking applications, twelve different applications were studied. Overall the animations used in the analysed applications were quite similar. Four most common tasks that were investigated were searching of an accommodation, looking at the details of an accommodation, booking an accommodation and saving the accommodation for later. Altogether 5 different animations were analysed in detail and later implemented in the prototype.

The study was conducted on two different study groups: group A that used a prototype without animation and group B that used a prototype with animation. The two prototypes were developed for this research in a prototype designing tool Adobe XD. A pilot study done prior to the main study showed some weak spots of the prototypes that were fixed. In addition, the pilot study helped on choosing the most suitable eye tracking device for this thesis.

The experimental study was performed on 10 participants, which were divided into two equal groups. The participants had to complete three tasks in the prototype during the study. To get insight into the background of the participants they had to fill in a background questionnaire. System Usability Scale was used to measure the general usability of both prototypes. The number of extra clicks (clicks that were not necessary for the completion of

the tasks) was measured in order to find the effectiveness of the prototypes and task completion time was taken as the reference for efficiency. Eye tracking device was used in order to collect additional information about the effect of different animations and to provide videos where the efficiency and effectiveness could be measured.

The results of the System Usability Scale showed that the general usability of accommodation booking applications decreases when animations are used. On the contrary the results of the extra clicks and completion time suggested that efficiency and effectiveness of accommodation booking applications increases when animations are used. As efficiency and effectiveness are performance metrics of usability then the results do not support each other.

Furthermore, the results indicated that using a non-arced slow out animation to show were the saved accommodations can be found later helps to improve the efficiency of the product. Moreover, using slow in slide in animation to display the top information bar with buttons also helps to improve the efficiency.

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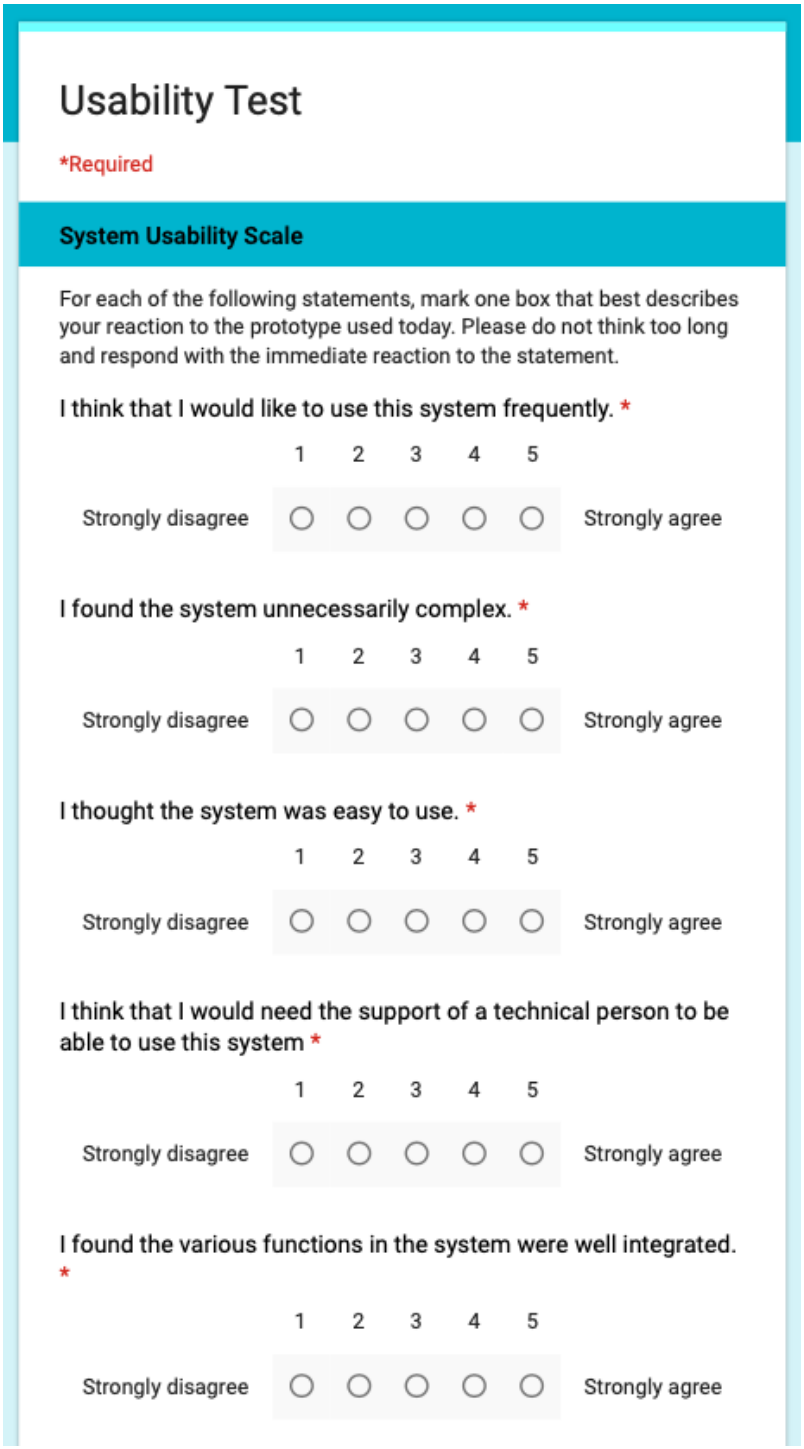
9 Appendix

9.1 Appendix A – System Usability Scale questionnaire



Usability Test

*Required

System Usability Scale

For each of the following statements, mark one box that best describes your reaction to the prototype used today. Please do not think too long and respond with the immediate reaction to the statement.

I think that I would like to use this system frequently. *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

I found the system unnecessarily complex. *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

I thought the system was easy to use. *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

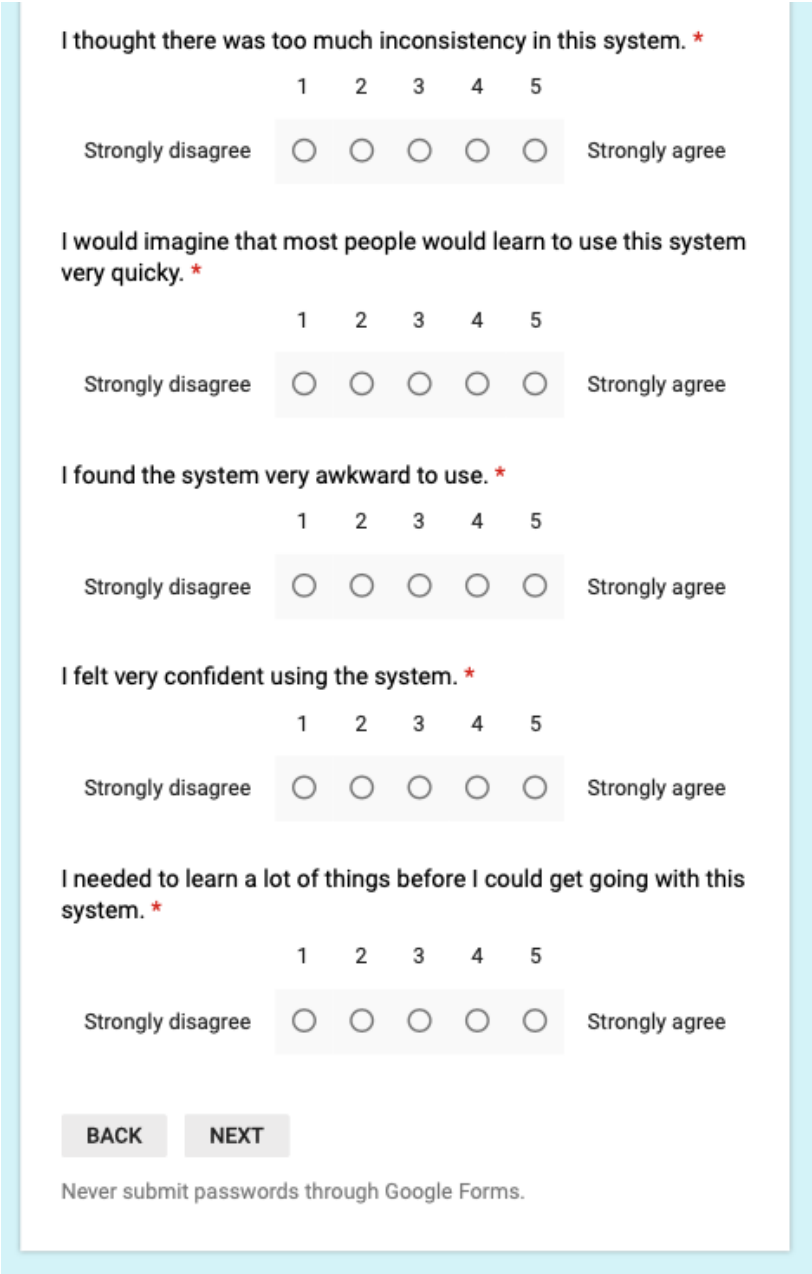
I think that I would need the support of a technical person to be able to use this system *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

I found the various functions in the system were well integrated. *

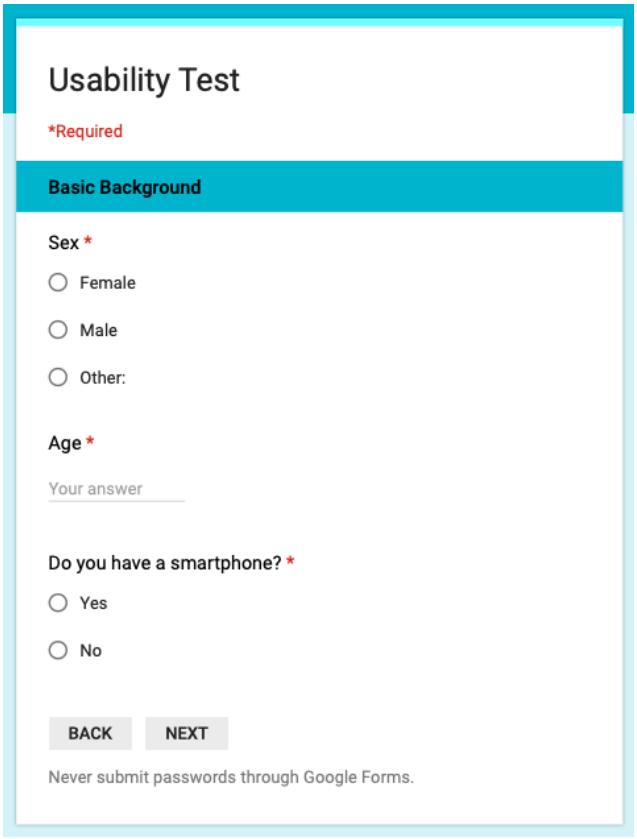
	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

Page 1 of the System Usability Scale questionnaire

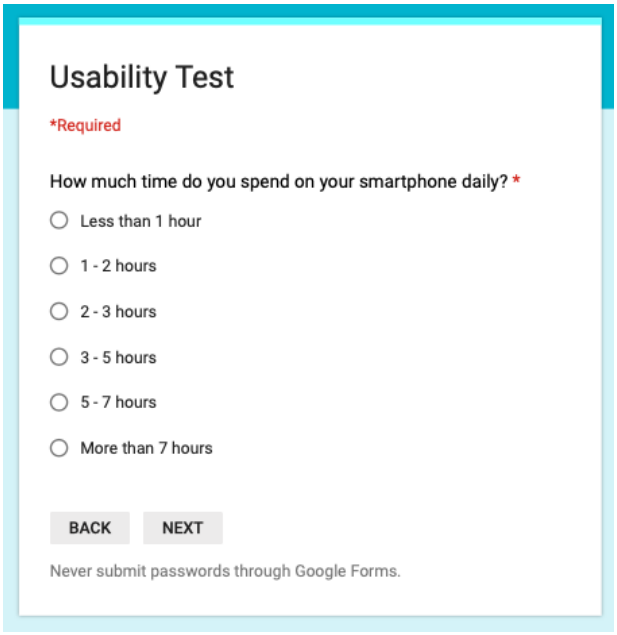


Page 2 of the System Usability Scale questionnaire

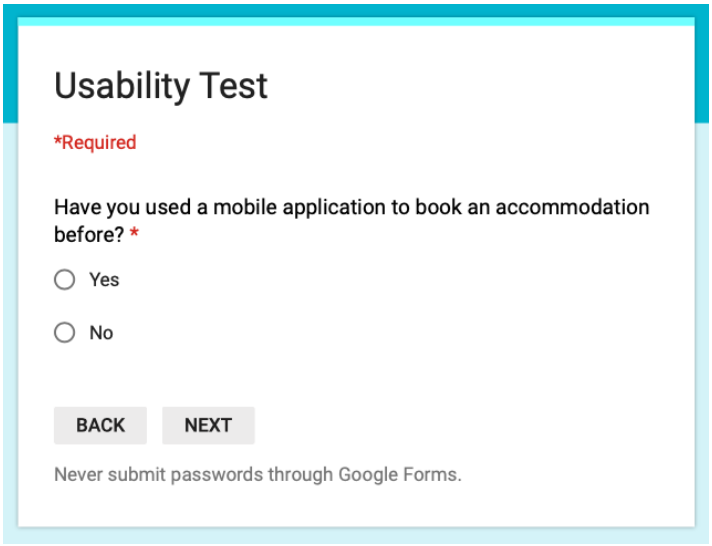
9.2 Appendix B – Background Info Questionnaire



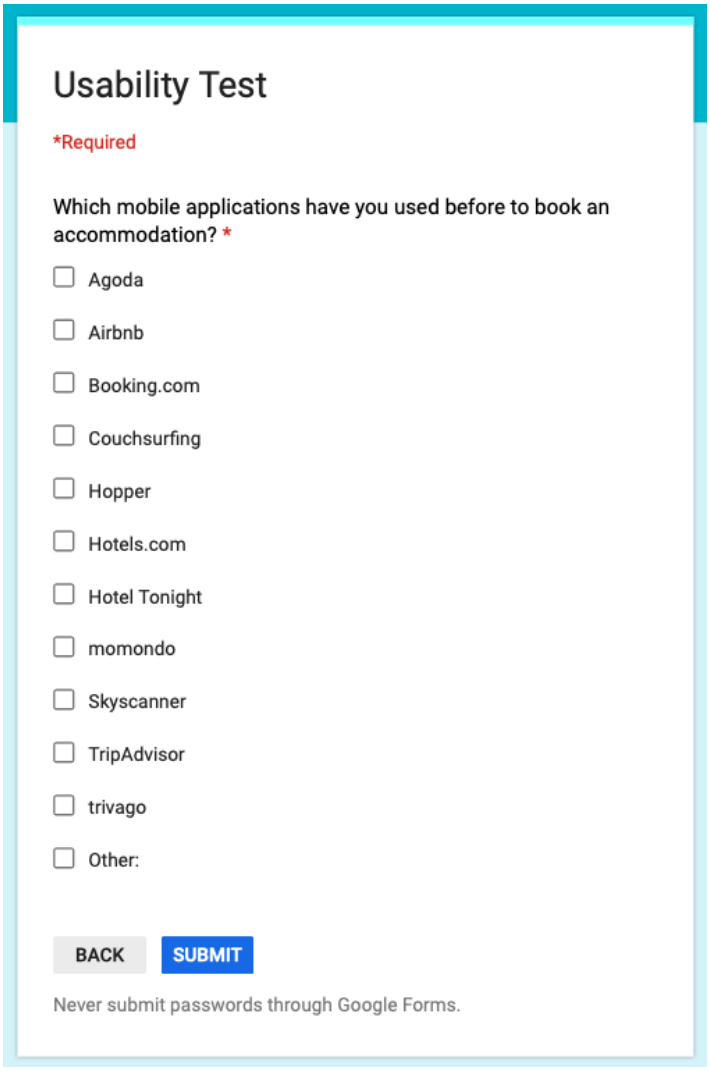
Part 1 of the background info questionnaire



Part 2 of the background info questionnaire. Can be seen if the previous question was answered positively



Part 3 of the background info questionnaire



Part 4 of the background info questionnaire. Can be seen if previous question was answered positively

9.3 Appendix C – Collected data

Participant code	Sex	Do you have a smartphone?	Age	How much time do you spend on your smartphone daily?	Have you used a mobile application to book an accommodation before?	Which mobile applications have you used before to book an accommodation?
A1	Female	Yes	21	3 - 5 hours	Yes	Booking.com
A2	Male	Yes	25	2 - 3 hours	Yes	Airbnb, Booking.com, Couchsurfing, TripAdvisor, Hostelworld
A3	Female	Yes	20	2 - 3 hours	Yes	Airbnb, Booking.com, Skyscanner, TripAdvisor
A4	Male	Yes	23	5 - 7 hours	Yes	Airbnb
A5	Female	Yes	19	3 - 5 hours	Yes	Booking.com, Hotels.com, TripAdvisor
B1	Male	Yes	21	2 - 3 hours	Yes	Airbnb, Booking.com, Couchsurfing, Hopper, momondo, Skyscanner
B2	Female	Yes	22	1 - 2 hours	Yes	Booking.com
B3	Female	Yes	24	1 - 2 hours	Yes	Airbnb
B4	Male	Yes	22	2 - 3 hours	No	
B5	Male	Yes	20	3 - 5 hours	Yes	Booking.com

Appendix C1: Answers to the background info questionnaire.

Participant code	*I think that I would like to use this system frequently.*	*I found the system unnecessarily complex.*	*I thought the system was easy to use.*	*I think that I would need the support of a technical person to be able to use this system*	*I found the various functions in the system were well integrated.*	*I thought there was too much inconsistency in this system.*	*I would imagine that most people would learn to use this system very quickly.*	*I found the system very awkward to use.*	*I felt very confident using the system.*	*I needed to learn a lot of things before I could get going with this system.*
A1	3	1	4	1	4	1	4	1	4	1
A2	5	1	5	1	5	1	5	1	5	1
A3	2	1	5	1	5	2	4	1	5	1
A4	5	1	5	1	5	1	5	1	5	1
A5	5	2	5	1	5	2	5	1	5	2
B1	4	1	4	2	4	1	5	2	5	1
B2	4	1	5	1	5	1	5	1	5	1
B3	4	1	5	1	4	1	5	1	4	1
B4	3	1	5	1	3	1	5	1	4	1
B5	4	2	5	1	4	1	5	2	5	1

Appendix C2: Answers to the System Usability Scale questionnaire.

Column1	Task 1 completion time (s)	Task 2 completion time (s)	Task 3 completion time (s)
A1	33,72	15,08	16,68
A2	17,72	21,16	11,68
A3	15,72	17,24	15,12
A4	21,28	20,2	18,8
A5	20,48	37,84	28,24
Average	21,78	22,30	18,10
B1	18,16	20,32	14,44
B2	16,2	12,92	18,72
B3	16,44	17,92	12,96
B4	18	16,2	13,08
B5	33,04	14,48	15,24
Average	20,37	16,37	14,89

Appendix C3: Completion times.

Participant code	Task 1 number of extra clicks	Task 2 number of extra clicks	Task 3 number of extra clicks
A2	5	0	0
A3	0	2	0
A4	1	0	0
A6	1	2	0
A7	0	0	0
Average	1,40	0,80	0,00
B1	0	2	0
B3	0	0	0
B4	0	0	0
B5	0	0	0
B6	3	0	0
Average	0,60	0,40	0,00

Appendix C4: The number of extra clicks every participant made.

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