

ID2216 Developing Mobile Applications

Project Report

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January 2, 2017

Abstract

During the course, we have worked in team to propose, build, and document a mobile app. We have developed a functional application that addresses an interesting and relevant area we have identified. This report describes step-by-step how we designed the mobile application.

Contents

Section 1

Concept

1.1 Brainstorming

At the very beginning, we started to think about general hypes and most current usages of mobile applications and tried to define some fields that were interesting to do a more detailed research. Some of these fields were mobility, travel, IoT, sharing, collaboration, big data, and digitalization. Of course, this is still too much to get any detailed results or to find a concrete idea for a mobile application.

So the next step was to think of problems that we faced on our own in daily life, that could be solved by a suitable application. Some outcomes of this are listed below:

- Since it is often very hard to find a decent present for someone's birthday or for Christmas, it would be very useful to have an app that suggests suitable presents. This could be done based on the presents or wishes someone has submitted, so that others can see what they could go for a gift.
- Another idea was to build a portal where people who have to stay home because they are too old, disabled, or injured, can place a groceries list so that others can buy those and deliver them for a small fee. Both parties would benefit from it since old, disabled, injured people get their groceries and students, for instance, who do the groceries could earn little money and do social work.
- Our third idea for a useful application was based on a personal experience of a team member. It is quite common in Stockholm to buy or sell SL cards for public transport from or to other people, and there are a lot of offers in Facebook groups or other websites on the Internet, but they are not standardized, and it is sometimes quite hard to find a suitable ticket. A solution for this could be a portal where people can offer and search for SL cards that is easy to use and standardized. All three of us agreed that this idea is worth to spend more time on a deeper research.

1.2 Observation-based field study

After we agreed on a rough idea for our application, we decided to research our application domain, travel, and mobility, in more depth. So we tried to observe if and how people use mobile applications while they are travelling by public transport.

We chose to observe this behaviour at both Kista and Stockholm Central station. Additionally, we also put focus on buying SL cards and how people use it at the station. Our observations are gathered below:

- Most of people use their smartphone a lot, while waiting for a train or walking to the correct line. Unfortunately, it is quite hard to see which exact kind of apps they are using, but many of them listened to music, seemed to play games or read the news.
- Many people also use their smartphone to check their route and the time schedule for the trains.
- Sometimes there are long queues at the counters if you want to buy a SL card or recharge it, while the vending machines are not used.
- Some people try to cheat. They do not buy a ticket and just go through the gate after someone who opened it by validating the SL card.
- Many people communicate with others through messaging apps or they are just calling someone.

After observing the public transport system live, we changed our focus to the Internet and how people try to sell and buy SL cards here. Of course you can buy tickets on the official website of the public transport system, but there are also other ways to buy tickets.

We also found a lot of Facebook groups where people were posting about SL cards. Each of these offers had a tentative price for the card given its expiration date. Other information, like where to pick the card up or if it is a special card for students, was often missing. Furthermore, there was no standardization for the offers and each had its own format.

We also found offers for SL cards on websites such as www.blocket.se. However, they were still not standardized as it happens in the Facebook groups. Moreover, from some of the posts you could not clearly recognize if someone was offering or searching for a card. On top of that, it took sometimes quite a while to find an offer for a SL card and looking for a specific period of validity was even much harder.

Then, we had found a problem that we wanted to solve with our mobile app, but we were still not sure what potential users could think about it as a good solution. So we conducted some interviews with friends and family members in order to get their opinion for our idea, get possible new features, and if this app could help them.

Therefore, we created a set of questions that we asked each participant. These questions started very general about the public transport system in Stockholm and then we narrowed it down to the trade of SL cards. The majority of our interview participants lives permanently in Stockholm, but we also questioned a tourist in order to also cover this potential user group. A description of our questions and a summary of the answers are gathered below:

- ***How often do you use the public transport system?*** Most of the people we questioned and who live in Stockholm use the public transport system almost daily. They use it to get to the university, to their work and also for leisure time activities. Mostly, they take the metro and commuter trains, but also buses and trams. On the contrary, the person who does not live permanently in Stockholm but is every four to five weeks in the city uses the public transport normally on the weekends or in the holidays.
- ***Do you have a 30-days or 90-days ticket?*** People who live regularly in Stockholm usually have a 90-days pass, unless they plan to be out of the city. Tourists don't usually buy such a ticket, they take a 3-day pass or, if their stay is longer, a 7-day pass instead.
- ***If you do not have a 30/90-days ticket, do you pay per ride?*** We found out that if someone has a 30/90-days ticket, he does not pay per ride of course, but some tourists who stay in Stockholm for maybe four or five days buy a 3-day pass, and on the other two days they pay per ride. If they foresee they need to travel often on those days, they just buy a 7-days pass instead, since this is cheaper than two 3-days passes and they just do not make the most of the last days of the 7-days period.
- ***What do you think about the prices for public transport in Stockholm?*** The general participants' perception of the prices was that it is quite high, especially if you are a student, even though you get a discount. In other European capitals you pay way less than in Stockholm. But some others answered that the reduced price is fair, since you can go anywhere in the city and take any means of transport. If you do not get a discount on the fares, it is really expensive, stated one of the participants. Since we can do nothing about the prices, our point is to solve the problematic of the fact that short period passes (3/7-days) are very expensive proportionally compared to 30-days tickets.
- ***Do you get any discount on the fares?*** Since we mainly questioned students, the majority got discounted fares for the tickets, but there were also people who had to pay the regular price.
- ***Have you ever searched for a SL card on the Internet? If yes, how did you find it? Was it easy or laborious?*** Some of the participants said that they have not searched specifically for a SL card, but they have seen offers in Facebook groups. If one had searched for a card, he said that it is really laborious to find a suitable ticket, since the offers are spread over different portals and groups, and if you found a suitable ticket, it is often really cumbersome to retrieve it from the seller and to communicate with the seller about the details.
- ***What do you think about our idea for a platform to trade SL cards? Do you have any suggestions or wishes or is there anything else you want to mention?*** Some said that it would be really useful for them if they can rent out their SL cards while they are on vacation. So they would get a little compensation for the time they are not in town, but still could purchase a 90-day pass. Additionally, all agreed that both the seller and the buyer would benefit from this app, the buyer by getting cheaper and more flexible public transport tickets and the seller by getting money back if he does not need the SL card anymore.

1.3 Project proposal

After all these findings, we decided to build an application that provides its users with the opportunity to offer and search for SL cards. These SL cards have to be, of course, not registered at the carrier in order to make them transferable.

This app will be as easy-to-use as possible with a very simple and clear user interface. Within a few steps each user should be able to find or post what he wants. The offers will be kept in a standardized format and users will find all relevant information about a given offer in the app. Furthermore, users should be able to get notified if someone has posted an offer for a SL card that fits to a desired pattern.

Besides simple selling or buying, users should also have the opportunity to rent and rent out their SL cards. Moreover, the user will see directly in the app where they can pick up the SL card, whether the prices and the period of time are negotiable and contact information will also be visible in the app.

This app will be improved step-by-step with a lot of feedback loops to make it as user-friendly as possible and to adapt to changed requirements from the users. We will start with a paper prototype for a rough understanding, moving onto a web app prototype and then to a native app prototype until we have a working solution.

Section 2

Go-to-market feasibility

2.1 Technical feasibility

2.2 Economic feasibility

2.3 Legal feasibility

2.4 Operational feasibility

2.5 Schedule feasibility

2.6 Resource feasibility

2.7 Financial feasibility

Section 3

WebApp prototype

Once we agreed to develop an application that helps users to find and offer SL cards, we focused on creating first prototypes and getting a preliminary structure for the application. Therefore, we created a paper-based prototype and collected feedback from potential users and friends.

Based on this, we aimed to create a site map of the different layouts of our application and how the user navigates through our app by creating a clickstream. Additionally, we developed a new digital "paper-based" prototype of our app by using the online tool Balsamiq.

3.1 Paper prototype

The very first step for creating the paper-based prototype was to think about which basic layouts and functionalities does our user need. So, we took a paper and a pencil and started drawing the main views. We discussed a lot about which features are really necessary for the first version of our app, since it must be as slim and lean as possible.

Furthermore, we tried to incorporate basic design principles of Android applications, so that the user will easily adapt to the usage of our application. This was carried out by using common design patterns of Android apps as well as a really clear structure.

The outcome was a paper prototype based on eight different views, all of which had a quite similar design and an easy usability from our point of view. See figures ?? and ?? on pages ?? and ?? respectively.

3.2 Site map

After finalizing the paper-based prototype, we showed it to friends and other potential users in order to gather their impression and feedback. All in all, they liked the first prototype quite much, since it was also very simple and good in their opinion. Nevertheless, some also showed us that we missed little things or could improve the prototype at certain points. Some of the major feedback points we discovered are listed below:

- It would be nice to have start screen with the logo of our app, before reaching the home screen.
- There should be a "Log out" button in the swipe menu on the left.
- It would be cool to have settings screen, where you can define the date/time format and the displayed currency.
- The offer details must definitely contain the user behind the offer and his contact details. Furthermore, it would be good to see how long he has been registered in the app.
- A support tab in the swipe menu would also be nice, in case there are any questions or feedback for us.
- As a matter of privacy, there should be an option if people searching for a SL card can see the mobile number of the seller or not. I think if someone sees the email address, this is fine, but the mobile number is quite sensitive.
- It would be cool to have, maybe in a later stage, also an integrated chat system to contact the seller of a card.
- It would be nice to see a suggested price for the given validity period.
- Be sure to implement the insertion of the date with the popup calendar.
- Why so much data at login? Would not it be enough with username and password to log in?
- It would be nice to change free text for extra information or comment or something more understandable.
- Credit is not very clear and could be confuse with Price. What about Saldo?
- It would be good to change Pick Up Place for Pick Up Station, if that is restricted to stations, we ensure that the buyer has a chance to check the validity of the card. In addition, it feels safer to meet that way.

Next, we discussed which of the feedback will be implemented in the next prototype and which not. For this new prototype we created the site map that displays all layouts of our app structuredly. See figure ?? on page ??.

3.3 Balsamiq prototype

With the existing site map, it was time to create a new prototype. This time not with a pen and paper, but with the online tool Balsamiq. This tool was also already used to draw the site map chart. Balsamiq is a quite handy and useful tool that allows you to develop prototypes for apps and other software in a very fast way by providing with drag-and-drop functionality.

So, we created for each screen at least one wireframe in order to make the prototype as real as possible. By using the framework of Balsamiq, we could insert a lot of real Android API components, such as the map functionality.

3.4 Clickstream

After finishing the Balsamiq prototype, we created additionally a clickstream of the current prototype that shows how the user later will navigate through the app. See figure ?? on page ??.

3.5 WebApp prototype

Based on the feedback we received for the previous prototypes, we created a WebApp prototype. For tracking changes in source files and coordinating work on those among us, we created a git repository. The desktop application we used is Sourcetree. We used NetBeans in order to implement the prototype and imported the Bootstrap framework in order to ease the development. Basically, we wrote a html file for every screen/view. Transitions between the corresponding views according to the site map were implemented. See figures from ?? to ?? in appendix ??.

After finalizing the WebApp prototype, we showed it to friends in order to gather their feedback. Some of the major feedback points we discovered are listed below:

- In search-overview menu, if I like an offer, should not I be able to click it?
- Put the calendar widget at the choice for the dates in offer
- Offer in home and new offer in top menu point to different outcomes, is it what we want?
- Why overview search returns the query and specify search requires the login?
- In specify search the top menu is not present, in the other choices it is.
- If you log out, you should return to home.
- Is not the top menu too much wide for a smartphone? Should not it be better a couple of big buttons to go home or back?

Section 4

Android prototype

Based on our WebApp prototype and its feedback we started to develop an Android prototype using Android Studio. The structure remained basically the same as in the WebApp prototype, and we tried to use Google's Material Design language in order to let the user work with our app from the very beginning comfortably.

To keep an overview of all the changes we used GitHub, as already done for the WebApp prototype, but this time with Android integrated functionality "VCS".

To increase the development efficiency, we assigned each team member a certain screen/view of the prototype that he/she had to develop, and later we cared about the transition and connection between them.

4.1 Developing tools

We chose to use Android Studio for several reasons:

- It is built purposely for Android, while for example Eclipse was built to all-purpose IDE that can be used with any language and platform.
- It has a really nice interface design perspective where one can view the interface one is working on and its related components.
- Compared to Eclipse it is a much smaller IDE, therefore it uses less RAM space and lower CPU speed, so we get a very stable performance with no crashing and unresponsiveness.

Screenshots are presented in appendix ??.

4.2 Feedback

After finalizing the mobile prototype, we showed it to some users in order to gather their feedback. Some of the major feedback points that were observed and received are listed below:

- Could the text on the buttons be larger, maybe in bold?
- The buttons almost disappear in bright light, mark them with a sharper colour.
- Search/offer buttons look similar to overview/specify search buttons which is a bit confusing.
- Good with the calendar so one does not have to type any date in.
- A home button on all screens would be convenient.

4.3 Outlook

After developing the prototype and analyzing the feedback we obtained, we came up with the following outlook:

- We plan to improve and implement the map information, so it is easier for users to find a card close to their preferred location.
- The logo for the app should be seen on all screens.
- Home or back button on the top menu should be implemented.
- We also need to decide on back-end tools for the database.

Section 5

App web service

After we received first feedback from testers for our initial draft of the Android app, we aimed to make it more useful and handy by integrating some web services. We decided to use therefore the Google Maps API, Facebook API, and SQLite relational database management system.

- The Facebook API was used in order to let users register with their Facebook account in our app, so that they do not need an extra account for our app. Furthermore, the Facebook API enables us to integrate in the future more and better customized services for the user.
- In order to display the location of the pick-up place in a more convenient way, we made use of Google Maps API, so that the user can see where on the map the pick-up place is located.
- To store our data in a manageable and clear manner, we aimed to use SQLite which is a database API optimized for Android applications.

5.1 Development

The great benefit from the Facebook API login functionality is that users are generally already logged into their Facebook account on their smartphones. Thus, a single button click in our application is sufficient to authenticate the user and give him access to the new offer screen. This reduces the effort for the user significantly and furthermore, he will stay logged in for the future, unless he does not explicitly log out.

To develop this feature, we had to register ourselves at the Facebook developer page first and our app then. Therefore, we needed to create a dedicated app hash key that is used by Facebook to identify our application. Then, if the user logs himself in to the app, we will receive an access token with which we can retrieve information from the user's profile, such as the name, email address, or profile picture in a JSON object. We made use of this information and displayed it in the navigation drawer menu in our MainActivity.

For the display of the pick-up place of SL cards, we made use of the Google Maps API. Luckily, Android Studio offers the possibility to create a Google Maps activity right away by

default. That is why we only needed to adapt this activity according to our needs and moreover, register our application at the Google developers web page. For both Facebook and Google APIs, there is a web dashboard that gives you the possibility to track the usage of the application (see the appendices for screenshots of the websites).

Since the users usually only gives us the alphabetical name of a location and not the exact coordinates, we had to use the class Geocoder which computes you the coordinates for a location. This data is then sent to the Google Maps API in order to display the location correctly on the map.

Regarding the database management system, we aimed to implement SQLite. We started implementing the creation of tables and insertion of new rows after the input data from the NewOfferActivity. Although the implementation was not fully tested, the written code was compiled and built without errors, so we assume that the input data from the NewOfferActivity was correctly saved at a local level on the phone.

5.2 Feedback

After integrating our Android application with the described APIs, we asked again some users for their opinion about the improved functionality. All in all, they really liked the improvements and found it quite handy. Nevertheless, they still gave us some valuable points to implement in the future, such as:

- Maybe you could use as the main activity the overview screen, so that I can start scrolling and searching for SL cards from the very beginning.
- It is definitely useful to see if a SL card is already sold, or if you can still buy it.
- Besides the Facebook login option, you could implement a Google login option as well.
- Implement country/region setting instead of date format. Then, date format and currency are bound to each other by such setting.
- Maybe the app should stay out from economic transactions at all, even from the publication or suggestion of the price for the SL card.
- To secure the purchase, the app could deliver some kind of digital certified receipt so that in the unlikely event that the seller reports the card from being stolen or lost, the buyer can claim that action.

5.3 Outlook

Through using the various APIs we highly increased the usability of our application for the end user. Nevertheless, there are still some open points to tackle, such as the feedback and improvements in the GUI to make our application even more convenient to use.

5.4 Further development

With regard to the database management system, we started researching alternatives for SQLite. For further development, we would definitely go for Firebase instead.

Firebase is a mobile and web application platform with tools and infrastructure made up of complementary features that can be mixed and matched to fit different needs, for instance, realtime database.

This platform provides a realtime database and backend as a service. The service provides an API that allows application data to be synchronized across clients and stored on Firebase's cloud. Client libraries that enable integration with Android, among other operating systems and programming languages, are provided.

Appendix A

Paper prototype figures

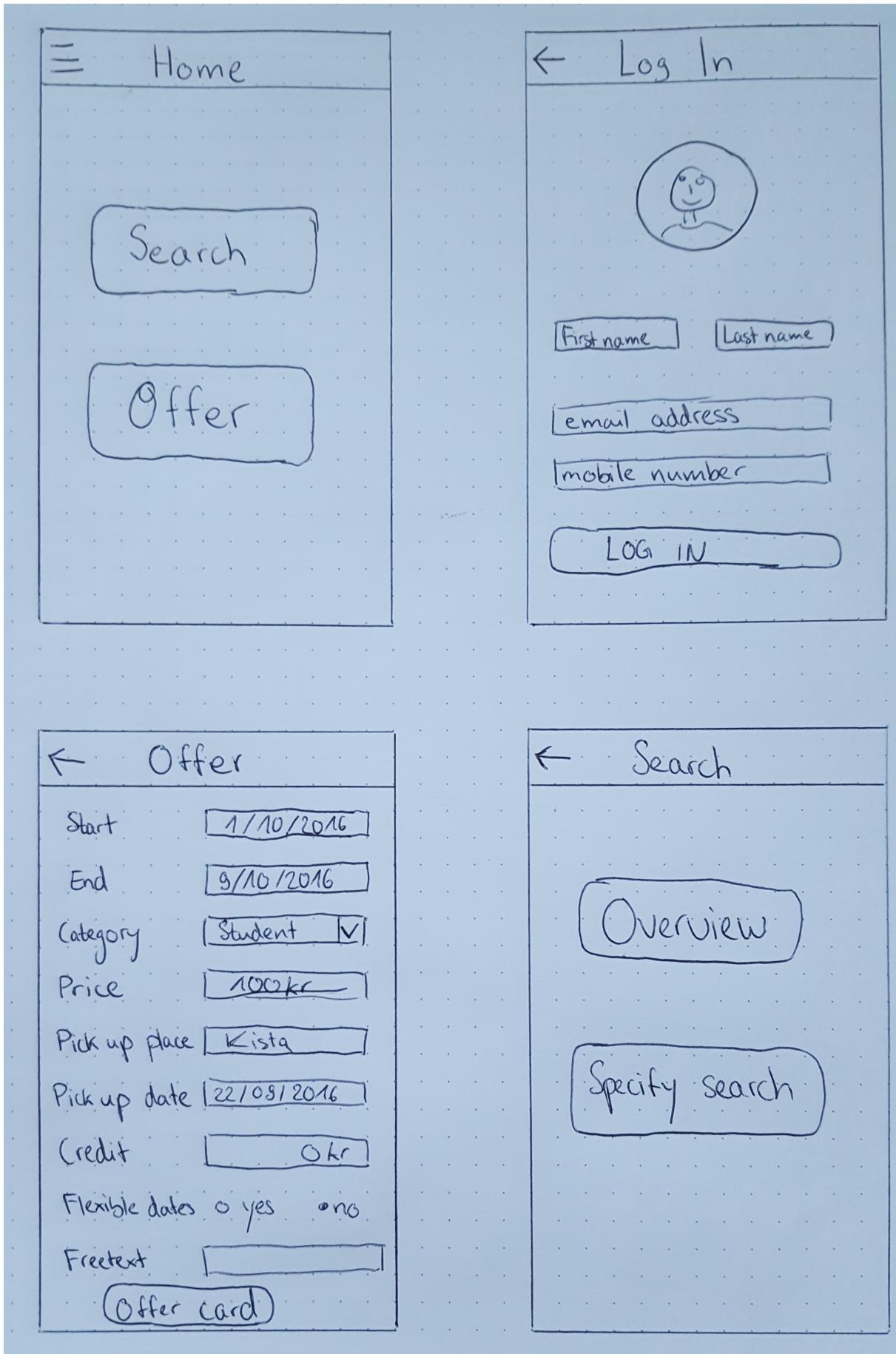


Figure A.1: Paper prototype figures

← Overview				
Start	End	Category	Price	PickUpPlace
1/1/17	3/1/17	Student	50kr	Täby
10/10/16	11/11/16	Normal	60kr	Kista
1/1/16	3/1/16	Normal	30kr	Husby
20/11/16	3/1/17	Student	400kr	T-Centralen
...
...
...

← Offer details				
Start	10/10/16			
End	15/10/16			
Category	Student			
Flexible dates	no			
Price	50 kr			
Credit	0 kr			
PickUp Date	8/10/16			
PickUp place	[Sketch of a city street with buildings and trees]			
Additional information:				
info info				

← Specify search				
Start	1/1/16			
End	5/11/16			
Category	Normal			
Max. price	100 kr			
Flexible dates	<input checked="" type="radio"/> yes <input type="radio"/> no			
Search				

← Profile				
First name	Last name			
email address				
mobile number				
Facebook account	Google account			
Save				

Figure A.2: Paper prototype

Appendix B

Site map and clickstream figures

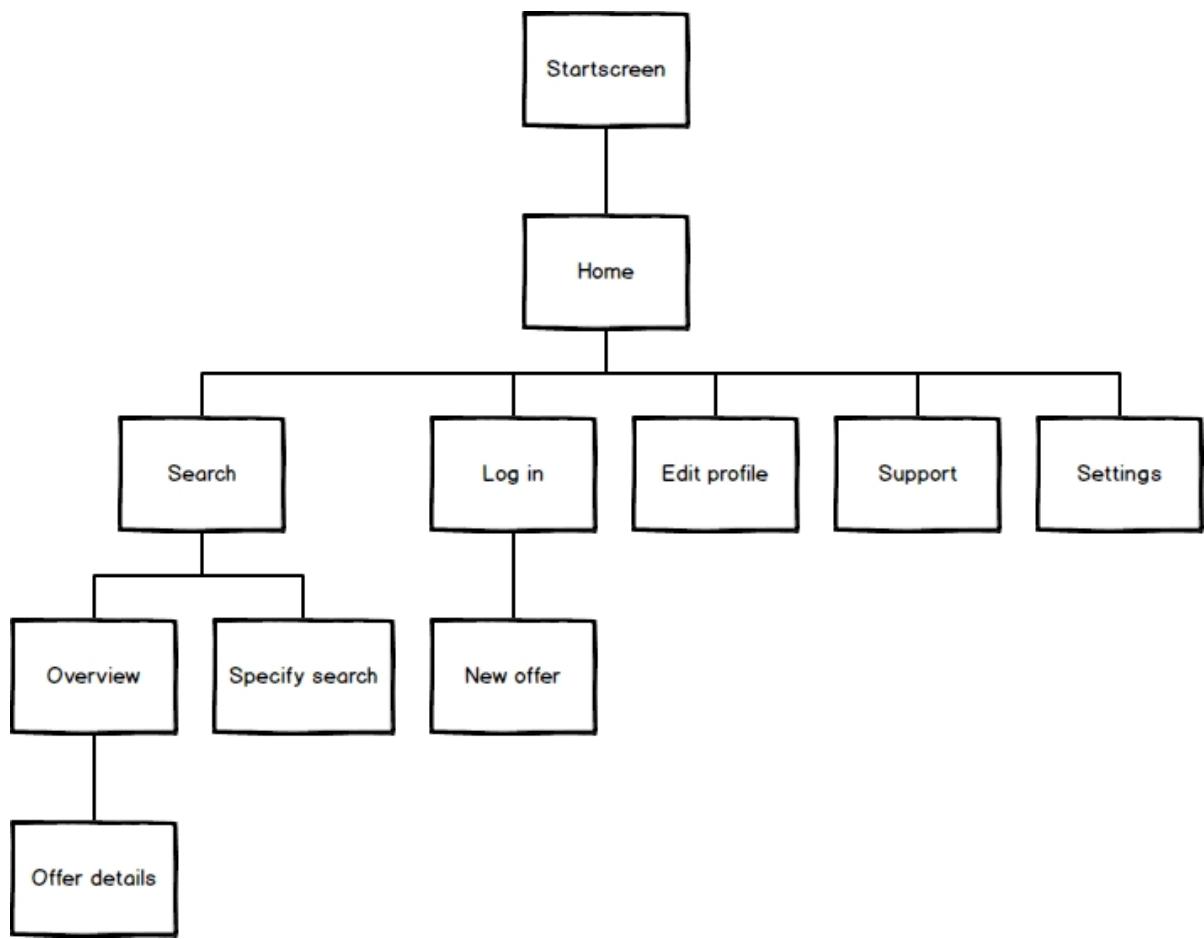


Figure B.1: Site map

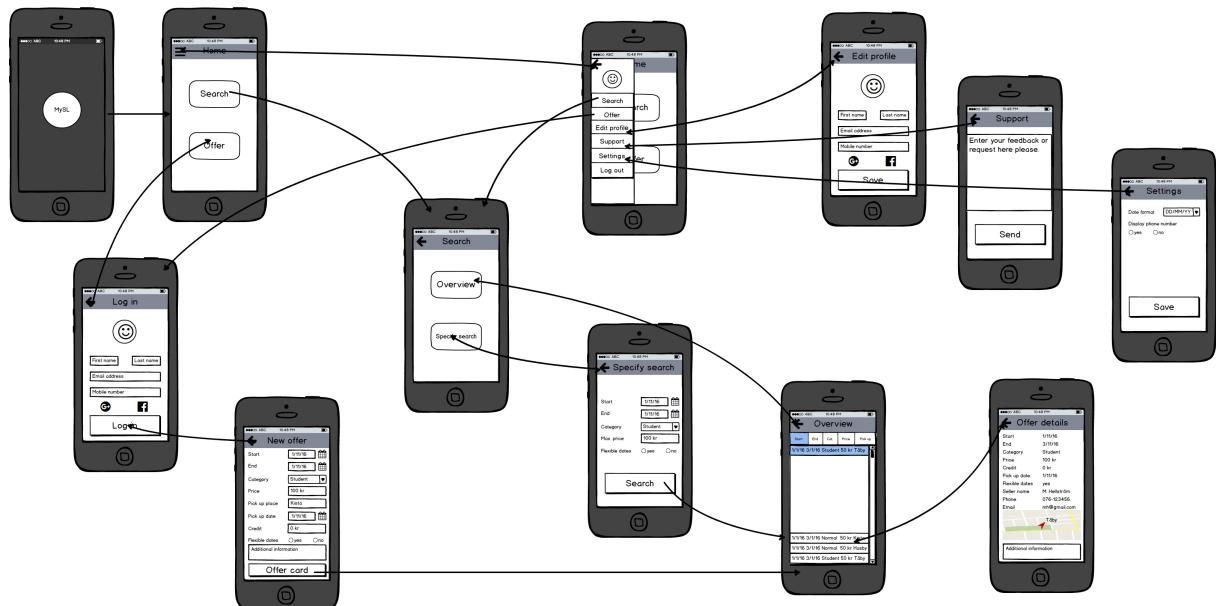


Figure B.2: Clickstream

Appendix C

WebApp prototype figures

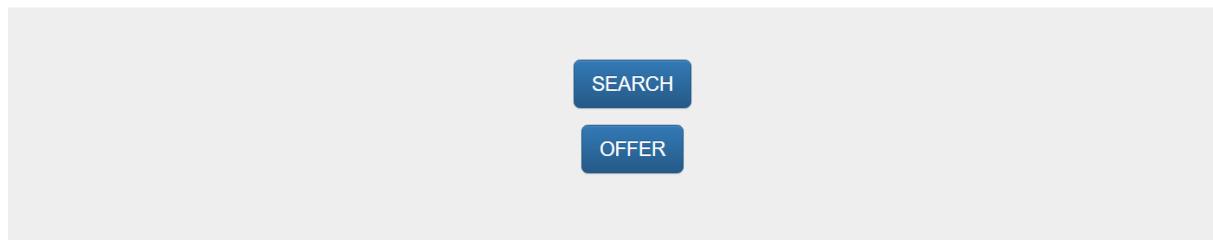


Figure C.1: Start page

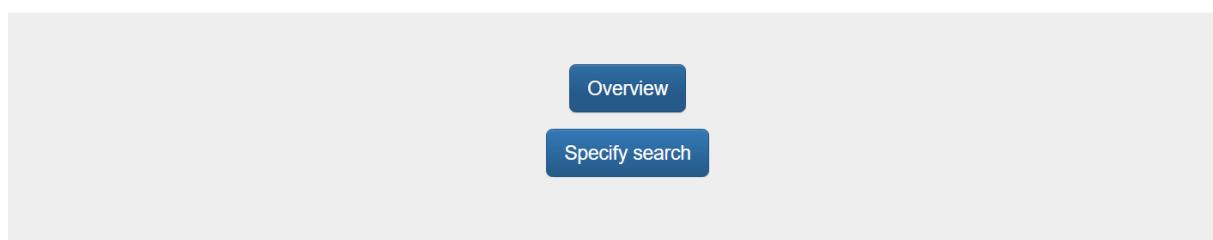


Figure C.2: Search page



Start	End	Cat.	Price	Pick up
2016-11-21	2016-12-05	Student	280 kr	Roslags Näsby
2016-11-23	2016-12-09	Student	320 kr	Universitetet
2016-11-25	2016-12-13	Student	360 kr	Tekniska Högskolan
2016-11-27	2016-12-17	Student	400 kr	T-Centralen
2016-11-27	2016-12-15	Student	360 kr	Västra skogen
2016-11-27	2016-12-13	Student	320 kr	Kista

Figure C.3: Overview page

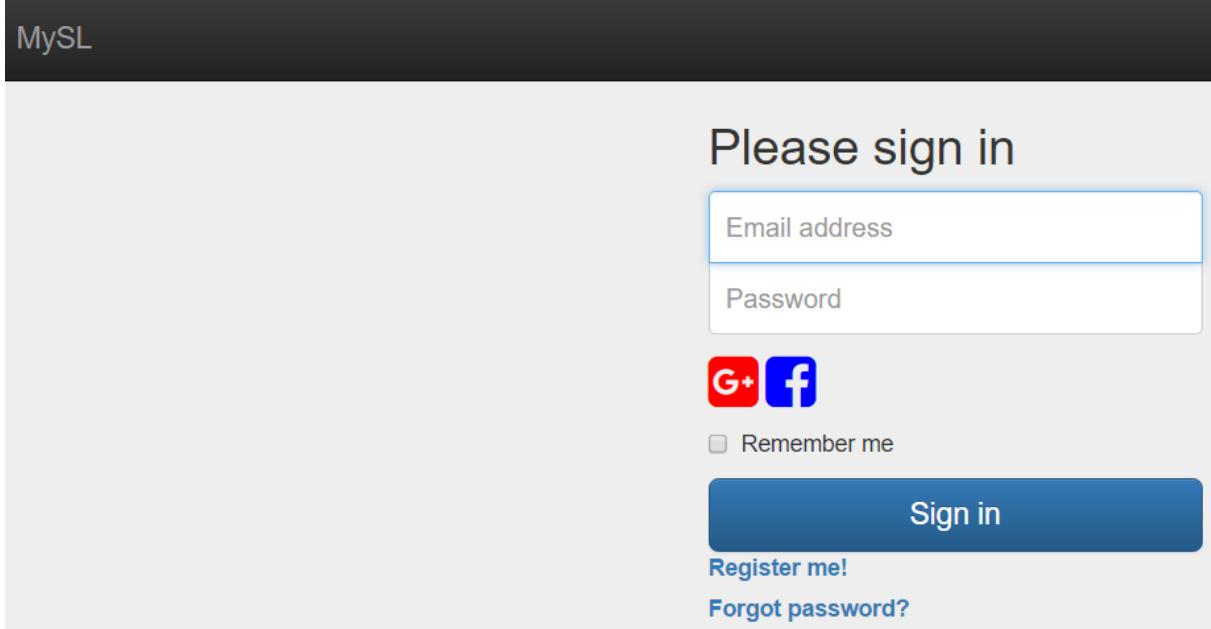


Figure C.4: Login page

The screenshot shows the "New offer" page. At the top, there's a dark navigation bar with several links: "New offer" (which is highlighted in red), "Home", "Search", "Edit profile", "Support", "Settings", and "Log out". To the right of these links are input fields for "Email" and "Password", followed by a green "Sign in" button. The main content area has a light gray background and contains several form fields: "Start" and "End" date inputs, a "Category" dropdown menu, a "Price" input field, a "Pick up place" input field, a "Pick up date" date input, a "Saldo on card" input field, and a "Flexible dates" section with "yes" and "no" radio buttons. Below these fields is a text area for "Additional information". At the bottom of the page is a large blue button with the text "Offer card" in white.

Figure C.5: New offer page

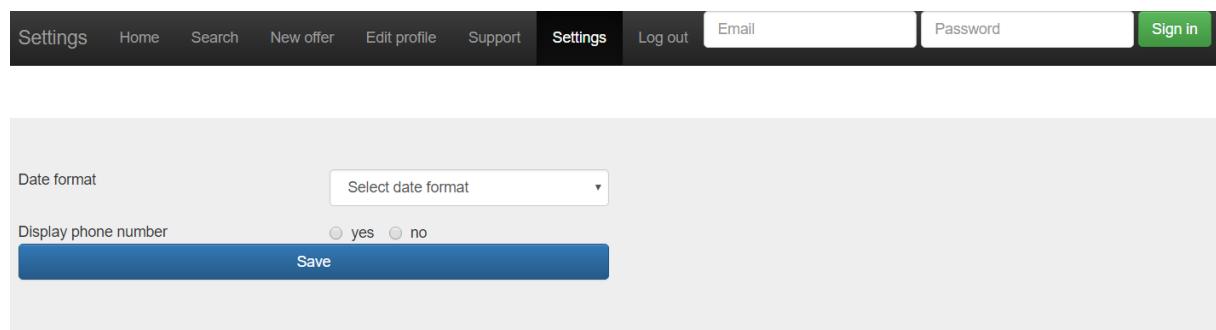


Figure C.6: Settings page

Appendix D

Android prototype figures



Figure D.1: Start view

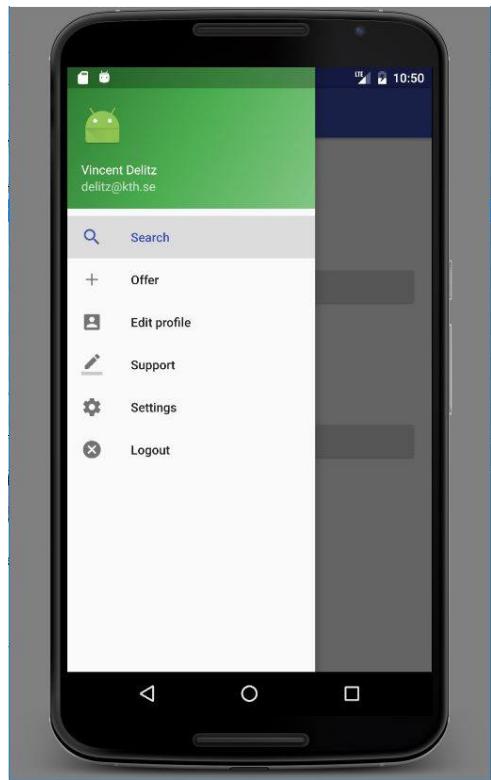


Figure D.2: Navigation drawer in start view

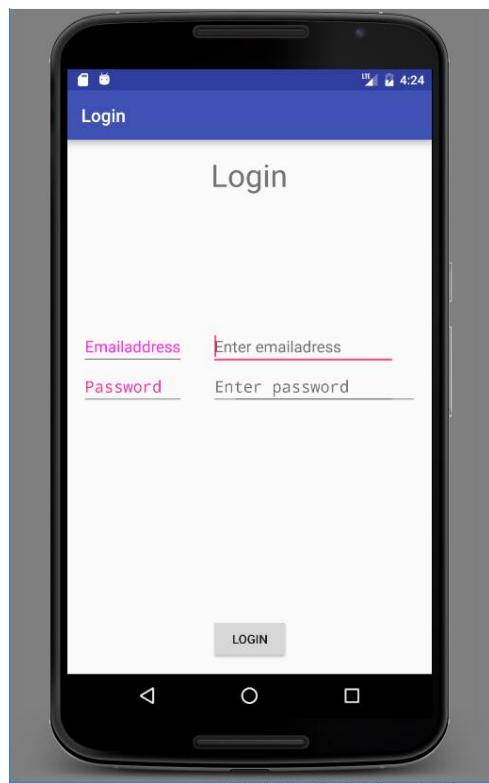


Figure D.3: Login view



Figure D.4: Search view

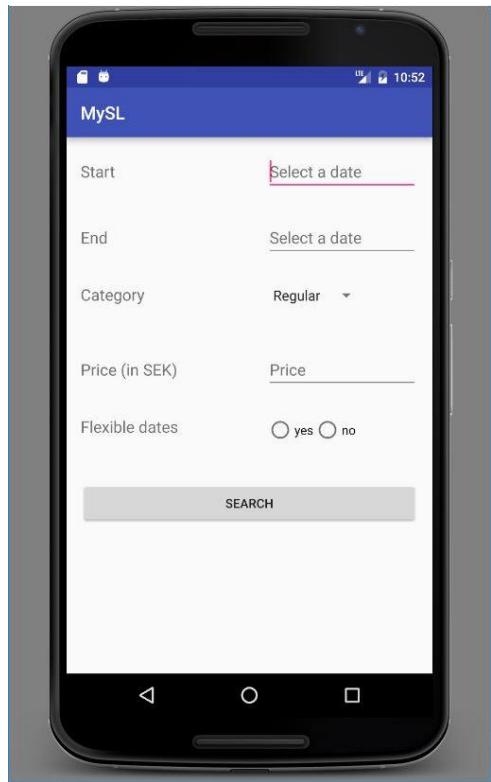


Figure D.5: Specify search view

A screenshot of the 'MySL' application showing an 'Overview' list. The screen has a blue header with a back arrow and the word 'Overview'. Below the header is a table with six columns: Start, End, Category, Price, and Pick up. The data in the table is as follows:

Start	End	Category	Price	Pick up
2016-11-21	2016-12-05	Student	280 kr	Roslags Näsby
2016-11-23	2016-12-09	Student	320 kr	Universitetet
2016-11-25	2016-12-13	Student	360 kr	Tekniska Högsk
2016-11-27	2016-12-17	Student	400 kr	T-Centralen
2016-11-27	2016-12-15	Student	360 kr	Västra skogen
2016-11-27	2016-12-13	Student	320 kr	Kista

Figure D.6: Overview

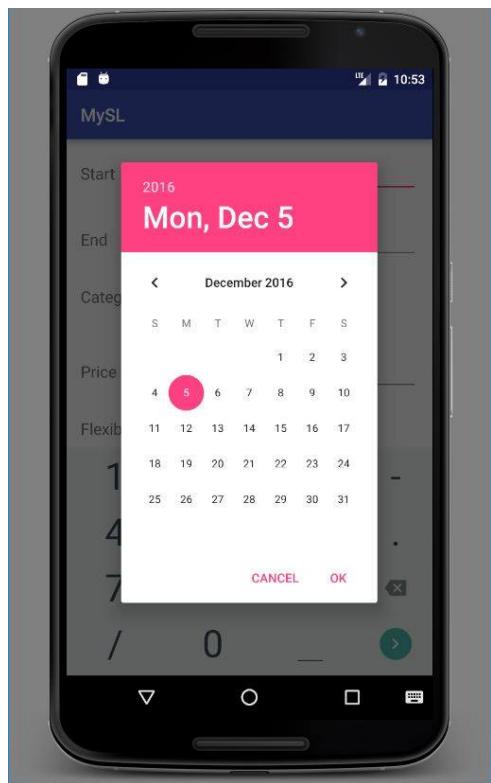


Figure D.7: Calendar view

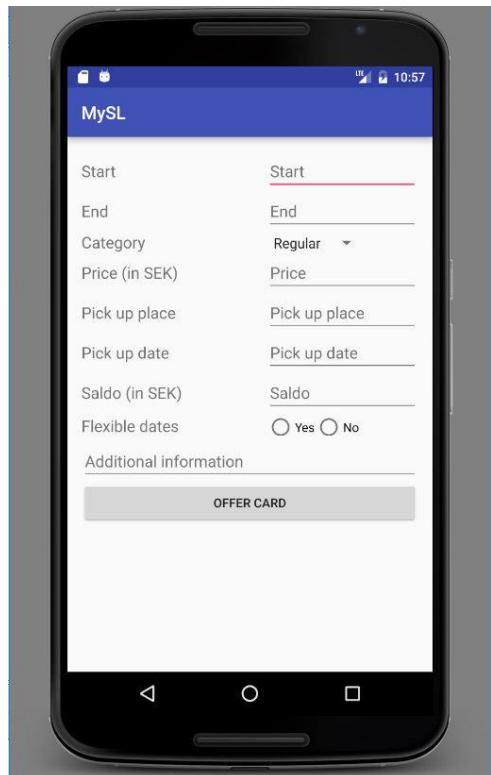


Figure D.8: Offer view

Appendix E

App web service figures

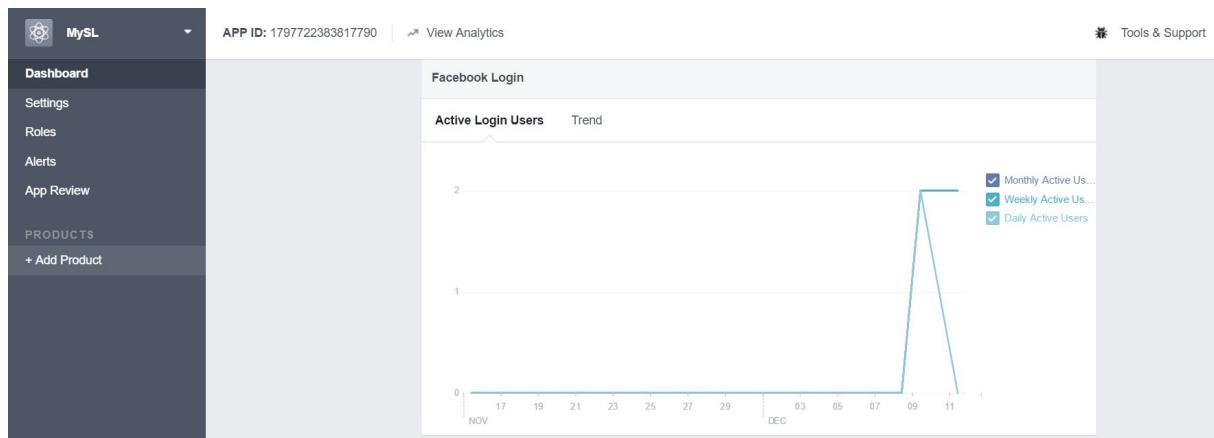


Figure E.1: Facebook developers dashboard website

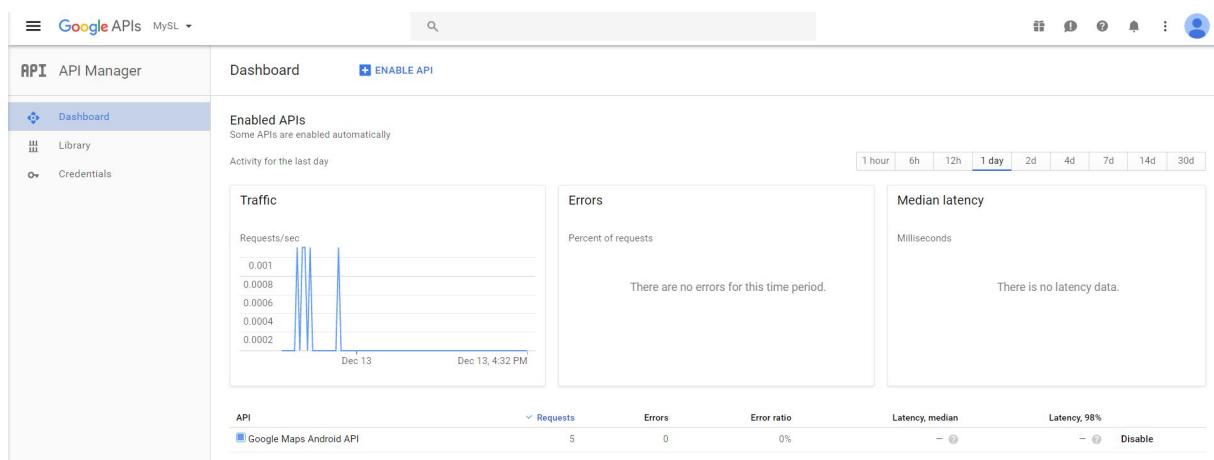


Figure E.2: Google developers dashboard website

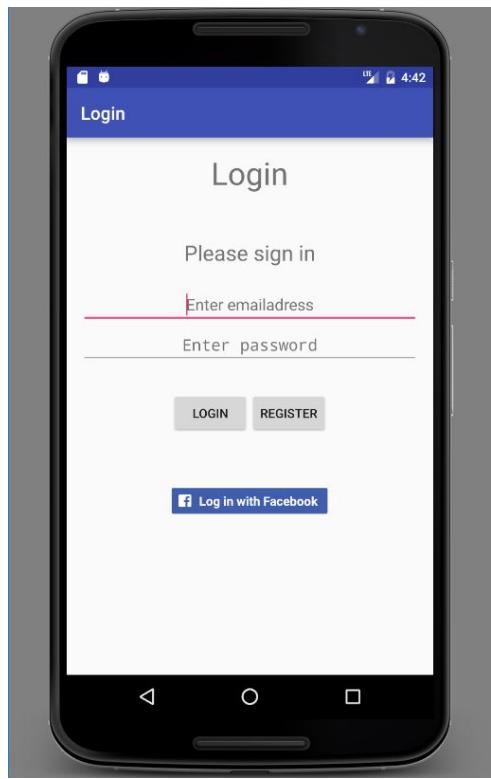


Figure E.3: Login view with Facebook login button

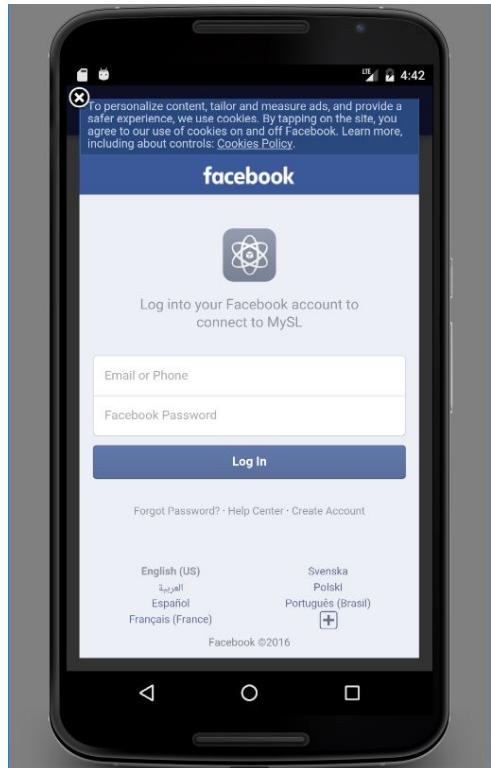


Figure E.4: Integrated facebook login view

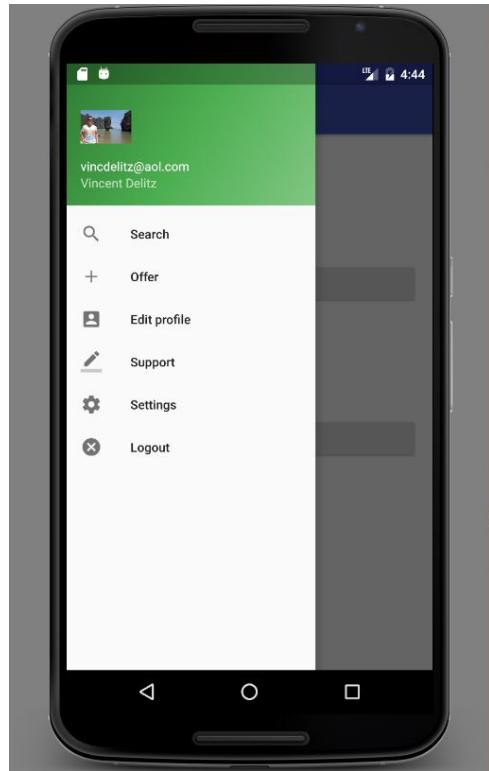


Figure E.5: Pulled Facebook data and profile picture in the navigation drawer

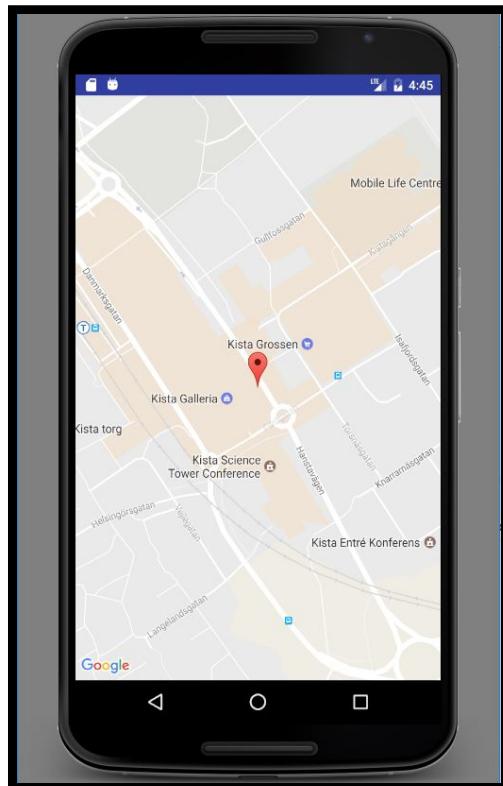


Figure E.6: Integrated Google Maps for the pick-up place

Appendix F

Opposition report

Opposition Report - MySL App by Group 5

Ni Chen, Vitali Reif, Ali El Tom, Razvan Ursachi

Group 6

General information

Group 5 developed a mobile application that is aiming to help holders of SL public transport cards to sell their cards to those who need such used SL cards. The application is implemented as native Android app with a very simple and clear functionality: users can see the offerings and add their own offers.

Critical notes

We have a few notes on the interface that are mostly related to user experience but we have not found anything really "critical" in the app.

Web Prototype & Android choice and testing

- The web prototype is shown on the desktop screen and not on a mobile screen. It is not clear how it looks on a mobile. How was it tested on test users?
- The choice of platform (Android) is not explained. A web app perhaps could be a more appropriate solution: there is no obvious reason why it should mostly be used with the mobile device.

First screen and UI suggestions

- The first screen with two buttons looks empty and not "inviting". Citing a suggestion from the class during the presentation we would also suggest to show a map with offerings (or simply show the offers as a list) on the first screen, with a

visible button "Add" and another button "Search". The same can be said about the Search screen: there is no need to have an additional step "Overview". The result can be shown in the first screen, with the "Specify Search" button.

Settings

- In the Settings, the current setting for "Display phone number" is not indicated.
- The Save button in the Settings screen could be omitted, with the settings saved when the user taps the back arrow button.
- Settings - Date: Since the app is specifically for SL cards, the majority of the users of the app will be residing in Sweden (very few tourists). Therefore, the Swedish date format could simply be used. Changing the format in the settings is not necessary.
- Settings - Phone Numbers: Other apps for selling used products, such as Blocket have the option for showing or hiding phone number in each offer add page. Did you consider that option instead?
- Settings: Settings has very few things to change (Date Format and Phone Show/hide) which feels Settings might be unnecessary. If you set the date in according to the Swedish standard and add the "Phone number show/hide" option on the "Add offer page", then you the Settings are not needed any more.

SL card offers

- Integrating Maps through Google Maps api is very wise and nice.
- Search results or Overview: the current date representation takes too much space and could be shortened as, for example, "21.11.16 - 12.12.16" (again we suggest using the common format in Sweden). Consider omitting the year from the date if both dates are within the current year.
- It is not clear whether the search results can be sorted by those columns, for example by category or price; this option could be useful.
- In the Specify search screen, the current date could be set by the default as the start date.

Log in/out

- The button "Log out with Facebook" looks confusing on the Login screen: is it a mistype? The Logout option is also located on the side menu.
- The meaning and the origin (how it was called) of the splashscreen "Logged in as" is unclear.

Other suggestions

- Reminder about expiring validity of the SL card in an offer.
- Based on our own experience and understanding, most people who buy 30-day or 1 year SL cards keep the receipts: if they lose the card they can go to SL and show the receipt, and the old card will be then canceled a new card will be issued. A possible fraud can occur if the original owner of the card claims that the card was lost and shows the receipt. A suggestion for preventing potential fraud: integrate an option for allowing sellers to add a picture of the receipt or indicate in a checkbox that the receipt is available. Such sellers in the mySL app could have a star or sign telling potential buyers that these sellers/cards are "trusted" or so. In such case when the seller sells the SL card he should give the receipt to the buyer. This is important even if mySL is not actually "in the transaction" between the buyer and seller, since it could prevent misuse and thereby adds trust to the app.