



POLITECNICO
MILANO 1863

Elk River project

Digital Innovation Lab

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1 Introduction

1.1 The Elk River problem

The Elk is a river in central West Virginia, USA. Elk River watershed is a relatively big but low populated area with Charleston being the only big city. It is characterized by vast natural resources and less developed industry and infrastructure. In 2014, one of the biggest employers in the area was involved in a major ecological incident, namely a chemical spill, which led to closure of the plant, leaving many people jobless and making impact on the local flora and fauna. Since then, the area has not been able to resume economic development, but still it attracted a lot of tourists, especially fishers who like to enjoy many fishing spots that the river offers. After analyzing the current situation in the area and all groups of people living and visiting the area, it becomes evident that one of the things that is most probable to succeed in improving the well-being of all groups could be improving the tourist offering. The goal of this document is to further explain the platform using user-centered approach.

1.2 Stakeholders

Stakeholders are the locals, whose economy is struggling since the 2014 spills. Many of them will be able to establish a job position with a stable income thanks to our service, with the possibility of working part time as a second job. Our platform will also boost the economy of the area by attracting tourists, so many activities already in place will indirectly benefit from the service, and others will born.

1.3 Definitions, acronyms and abbreviations

What follows is the list of all the main terms and abbreviations used in the document.

1.3.1 Definitions

- **Reservation:** data referring to the wish of the user to have the specified service at that time for himself.
- **System:** All the software needed to deliver every functionality needed.

1.3.2 Acronyms

- **BPMN:** Business Process Model and Notation
- **SDK:** Software Development Kit
- **API:** Application Programming Interface
- **DB:** Database
- **DBMS:** Database Management System
- **UID:** Unique Identifier
- **URL:** Uniform Resource Locator
- **UI:** User Interface

1.3.3 Abbreviations

No other abbreviations aside from acronyms were used.

1.3.4 Revision History

- 29/05/2019 First draft of the basic structure

2 Overall Description

2.1 Proposed project solution

Elk River area resources

Project structure

The final system is going to be divided in two main components:

1. Mobile application version for phones and tablets.
2. Backend structure to support the functioning of the service.

While the backend structure is needed for the functioning of the service provided, the user will never interact with it but will ever only see and use the mobile application. A more detailed view will be explained in [8.1](#)

2.2 Product Functions

TO BE EXPANDED

1. Register to the system with email and password.
2. Logging to the service.
3. Manage the information of an account.
4. Create or delete a reservation.

2.3 User Characteristics

The users interested in using the system should be at least familiar with the concept of using a smartphone in the day to day routine without needing any technical competence regarding the topic, they must be aware of the laws regarding fishing, they should also know how to traverse the environment and have basic first aid knowledge if they wish to work as fishing experts.

2.4 Goals

The project is designed to satisfy the user needs, or (in other words) to achieve certain specific *Goals* stated in the following list.

TO BE EXPANDED

Goal.1: Allow anyone that owns a smartphone to become a registered user of the service.

Goal.2: Create and later manage reservations.

3 Target Group and Personas

3.1 Target Group - Fishing Enthusiasts

The main purpose of the application is to bring closer people living in the area, mainly those that are fishing pros and people who come to the area because of fishing and other similar activities in the nature, everything to the economic benefit of locals without damaging the already fragile environment. It is expected that it could also attract new people unaware of the region to visit the area. Therefore, the two groups in the focus are:

Locals: they need a new income system, possibly based on a clean use of the natural resources and environment

Others: they want a new and different place where to practice their passion and try different fishing techniques

Two personas representing each of the groups are given in the following section.

3.2 Personas

Bob The Fishing Enthusiast

Bob (40) is father of 2 young children (10 and 12) that has lived his entire life in the small town (700 people) of Webster Springs West Virginia. He used to work at Freedom Industries before the spill of 2014 when shortly after the company filed for bankruptcy and Bob was left without a job. Given that he never attended college and the little possibilities in his hometown, Bob now works at his wife's bakery while he is still searching for another job to help the family put aside some money for the children tuition and health care plan.

Interests: Fishing, camping, hiking, restoring classic cars and classical music.

3 reasons for me to engage with you:

1. I am looking for a new job.
2. I know the territory and believe it can be used for tourism and fishing enthusiasts like myself.
3. I have been fishing all my life and would love to teach people how to fish.

3 reasons for me not to engage with you:

1. I am not sure it would provide enough for my family
2. The water is still not completely clean
3. Too much tourists may destroy the natural environment of the area.

My skills:

Fishing expert, Great sense of direction, it's almost impossible for him to get lost in the local area he has been roaming since childhood, Good survival skills, basic medical training, can cook the best trout on the grill of the state

Typical day:

Bob wakes up with his wife every weekday at 4:40 AM and they both head up to the bakery in order to prepare everything the little community needs during the day. At around 7:00 AM he takes the little van they have for the activity and he starts the delivery for the other businesses of the area and once he is done he goes back home to work on his latest car project until he has to go and pick up the kids from school. Once home again, they eat all together and then he watches some baseball with the kids and then helps them with their homework until it's time for dinner. After the boys are in bed he likes to relax for

some time on his chair listening to some classical music before going to bed himself, always waiting for the next fishing trip during the weekend.

My personality:

Bob is a kind man that has always a smile on his face no matter the situation, he is an optimist at heart and always believes that everything will be alright and no problem can't be solved if people work together. He is always the first one to volunteer when work for the community has to be done and takes pride and joy in helping the others when they are in need, often refusing any form of compensation.

My social environment:

Active member of the community in the small town of Webster Springs West Virginia he is well known and respected. He is usually more forward thinking than the older people that live in town and since he is more accepting of new ideas for the future he often can convince the others to back up new opportunities.

My dreams:

Have an independent job, spend more time with his kids, provide more for his family, buy a 1968 Mustang and then restore it with his children



Jack The Tourist Fisherman

Jack(36) is a father of a little girl (6 years) and lives with her and his wife in Columbus, Ohio. He is an IT technician in a medium size company where he has been working since 2007 and is a respected employee. He never obtained a degree but studies IT in high school and has always been tech savvy. Jack's father always brought him to do outdoors activities when he was younger, from rafting to camping, he always loved playing football until he got a knee injury, but his true passion has always been fishing, which he does to this day with his father and friend.

Interests: Fishing, camping, driving, football, rafting and bowling

3 reasons for me to engage with you:

1. Wants a new place to spend the weekend fishing.
2. He knows how to fish the "usual" way, but he never tried fly fishing.
3. He loves natural places and off the grid camping spots.

3 reasons for me not to engage with you:

1. He's never been to West Virginia.
2. He still doesn't trust the area after the spill.
3. It's a longer drive than usual.

My skills:

Fishing expert, tech enthusiast, problem solver, knows his way in the great outdoors.

Typical day:

Jack wakes up every weekday at 7:00 AM with the family, they all have breakfast together and then he brings his daughter to preschool and then goes to work which starts at 8:00 AM. Around 12:30 AM he heads back home for lunch, which he usually prepares when his wife arrives home with the little girl. After lunch he helps his daughter to bed for the afternoon nap and heads back to work for the afternoon shift. Once home again in the evening they have dinner and spend some more time together watching

some TV until it's bedtime for the kid, once she is asleep Jack usually catches up with the latest football updates until it's time for him too to go to sleep.

My personality:

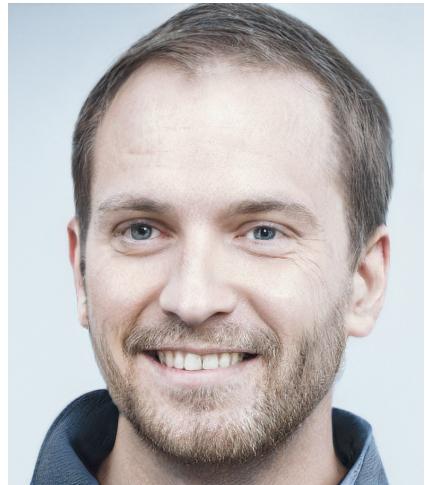
Jack is a loving father and husband, a great friend and he is known at work for his great work ethic. He rarely gets upset and is always glad to learn something new, from a simple fact, to a new tech that is going to change the market, up to a better way to do his job. He worked for what he has but does not like to remind people of this and is a great teacher, whether it is on the job, at the bowling alley or during a fishing trip with someone new joining the group.

My social environment:

One of the most experienced people in the company he works for and between the ones that have been there since the early years, Jack is well known and respected by his colleagues and loved by his friends. He is always present at every social event, from birthdays to a quite evening in the bar.

My dreams:

Become a manager of the company, teach his daughter to fish, buy a house with a pond.



4 Thinking Hats

 <p>Factual</p>	<p>Scarcely populated area, zone has been polluted in 2014, avoid eating too many fish, supposedly people lost their jobs after the spill, no economic growth, rich of natural places where it is possible to camp, raft, fish etc.</p> <p>River is not very deep (2m), road are present but not state of the art, no railroad nor public transportation.</p> <p>The only economic/social center is Charleston at one of the ends of the river. The area is already known as a fishing spot.</p>
 <p>Emotional</p>	<p>I feel sad about the situation in the zone and the people living there, it does not feel like a place where I would go to spend my time as it seems to be a shadow of its former self.</p> <p>I would work on the place using the extensive natural resources to bring value to the zone.</p>
 <p>Logical</p>	<p>The lack of jobs and the unemployed could easily start a new work environment based on a new system that we can propose.</p> <p>The area is already known as a fishing spot and we could use that to start a new flow of people as fishing tourists.</p> <p>Given that the river is quite long, the amount of people we can attract is as large as the area can afford to hold and manage.</p> <p>Giving new jobs to the people will surely improve the quality of life in the area.</p>
 <p>Cautious</p>	<p>The health care institution suggest not eating more than one fish per month because of the pollution, the river be a hazard if there is too much rain during a season, while if there is a drought there will not be enough water for fishing.</p> <p>The area is not easily reachable and there aren't many structures where people could spend time.</p> <p>Since the river is not very deep, it is unsuitable to use it with ferries or other boats. During winter there isn't much to do.</p>
 <p>Out of the box</p>	<p>The natural area is ideal for camping and cabins where people could live during the summer as a different type of vacation.</p> <p>Hunting is an option in the woods.</p> <p>Music festivals in the woods are a small but researched type of entertainment. Cryptocurrencies.</p>
 <p>Management</p>	<p>All ideas given can be put in place, probably the safest bet is correlated to fishing as it is the one that requires the least amount of change to the natural area and is already in place in non competitive and non commercial way.</p> <p>Hunting is already practised but it involves safety hazards, especially if we consider a larger number of people being involved.</p>

5 Customer Journey

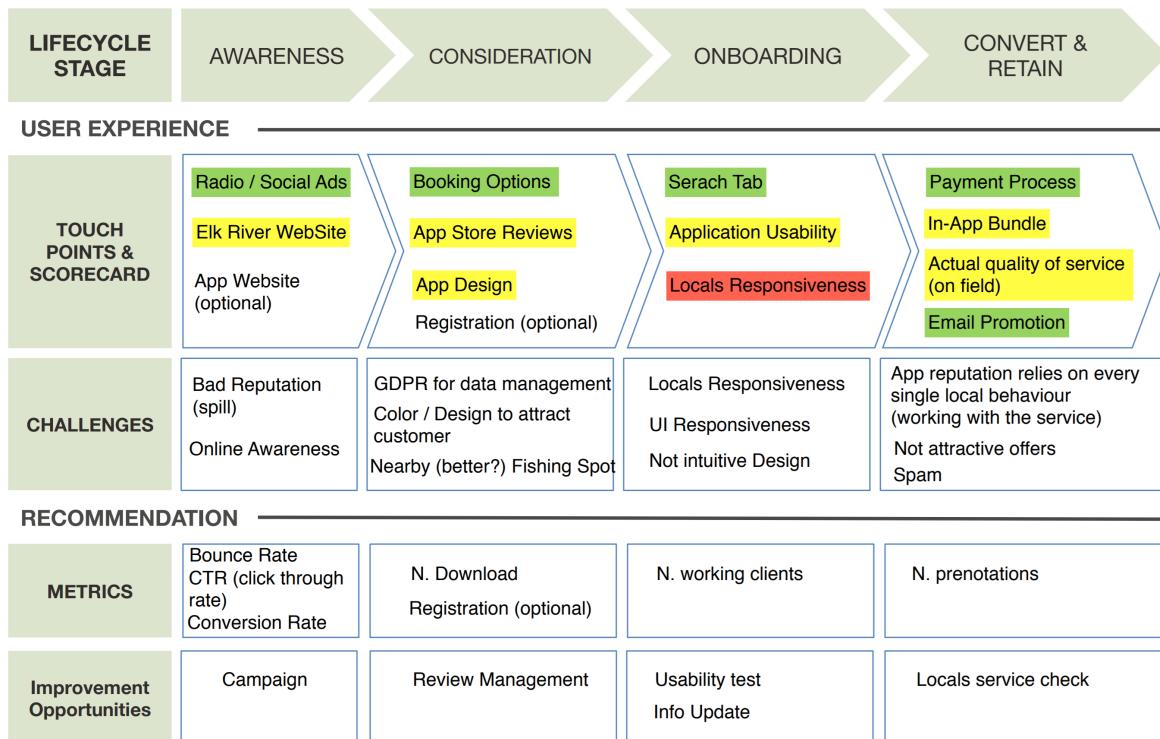


Figure 1: Customer journey map of a person who visits the area and uses services offered by locals

In the awareness phase, a potential customer becomes aware of the application existence. It is therefore important to find channels with biggest probability that a customer will notice the application. The easiest way to reach new customers is using social networks. Still, another channel very likely to succeed are radio stations in the area, since the majority of the persons traveling to the area will listen to some of these because, all of them being with excellent coverage. The Elk River website is a viable marketing channel as long as it is regularly updated with new information, inviting existing visitors to visit the website, and new visitors to search for information there. The spill of 2014 can be considered as the major challenge when bringing new visitors to the area but it is not something controllable.

Most users with option to download an application first take into consideration the reviews of the application. They will read the application description, reviews and look at the application screenshots because they want to see what the application offers exactly. This application, being an application used for booking activities and places should present them in a clear way what are their options. Special attention must be payed to fulfill customers' needs from the beginning as this will make them spread the word. Bad reputation will for sure reject people from trying the application. Following good practices such as private data management is very important in today's ever growing concern for privacy.

After a user downloads the application and after verifying that the application look as expected, they will be able to see who are the locals offering services in the area. Therefore, it is important to bring as many locals as possible to use the application so that the visitors can immediately see the value in using the application. On our side, we need to make sure that the platform works as expected and that it is simple to use for everyone.

After a user completes at least one booking using the application will they be able to give final verdict. Unfortunately, the quality of the service depend also on the real offer and so it is in the hands of the locals. Working with locals in the first period by giving them instruction how to improve could bring greater acquisition rate. Then, staying in touch with users by sending them promotional emails will

make sure that they keep using the application.

6 Business Process Model and Notation

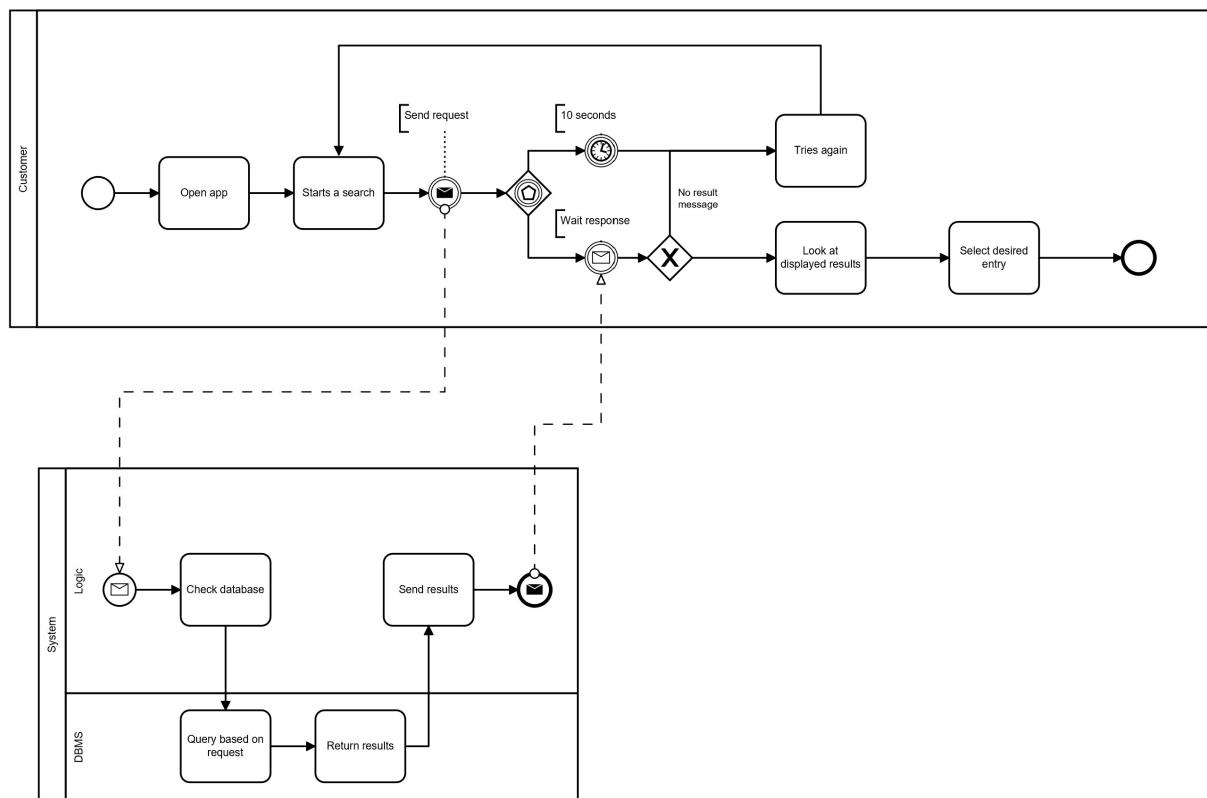


Figure 2: Ordinary application use diagram

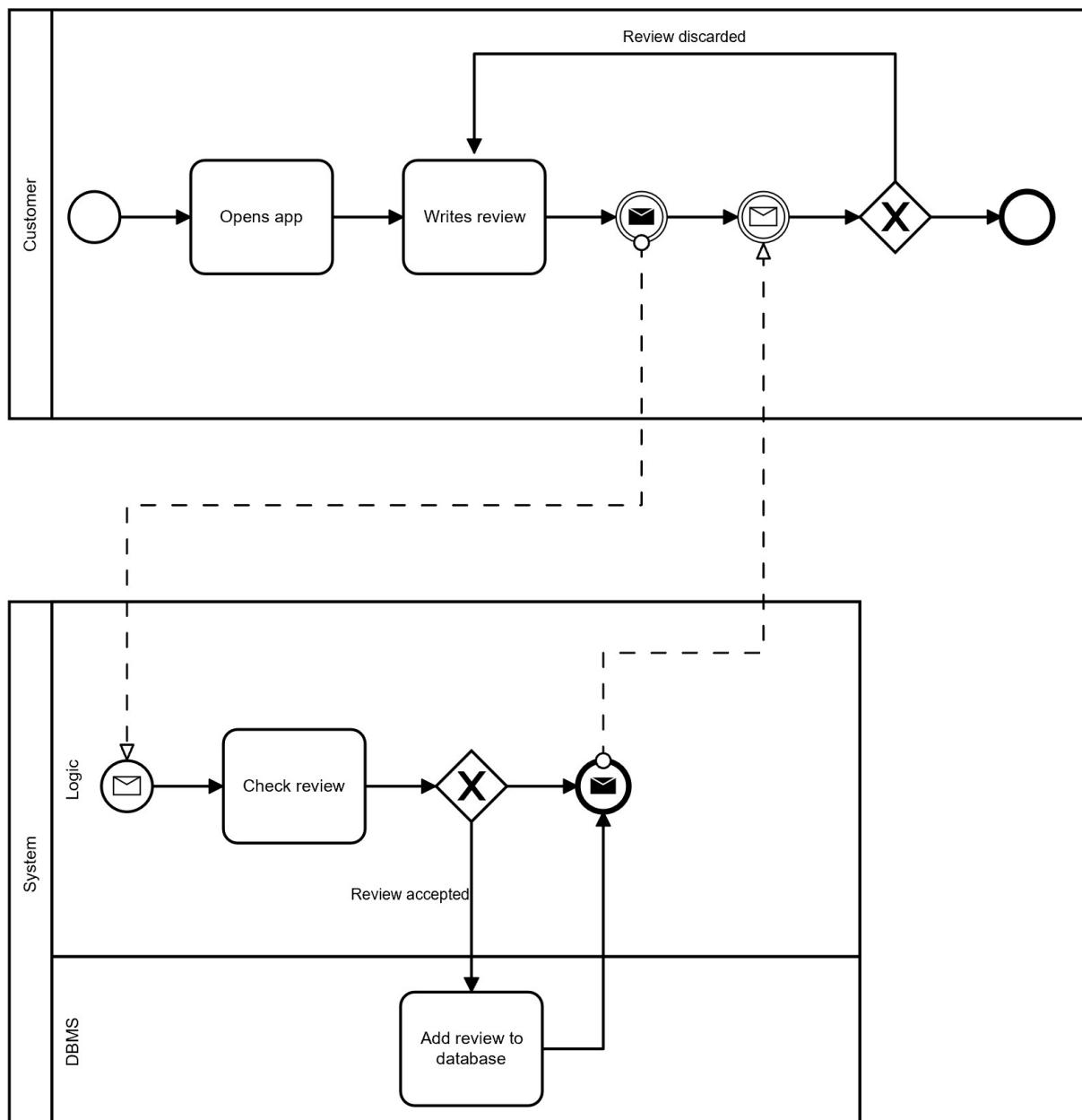


Figure 3: Review making diagram

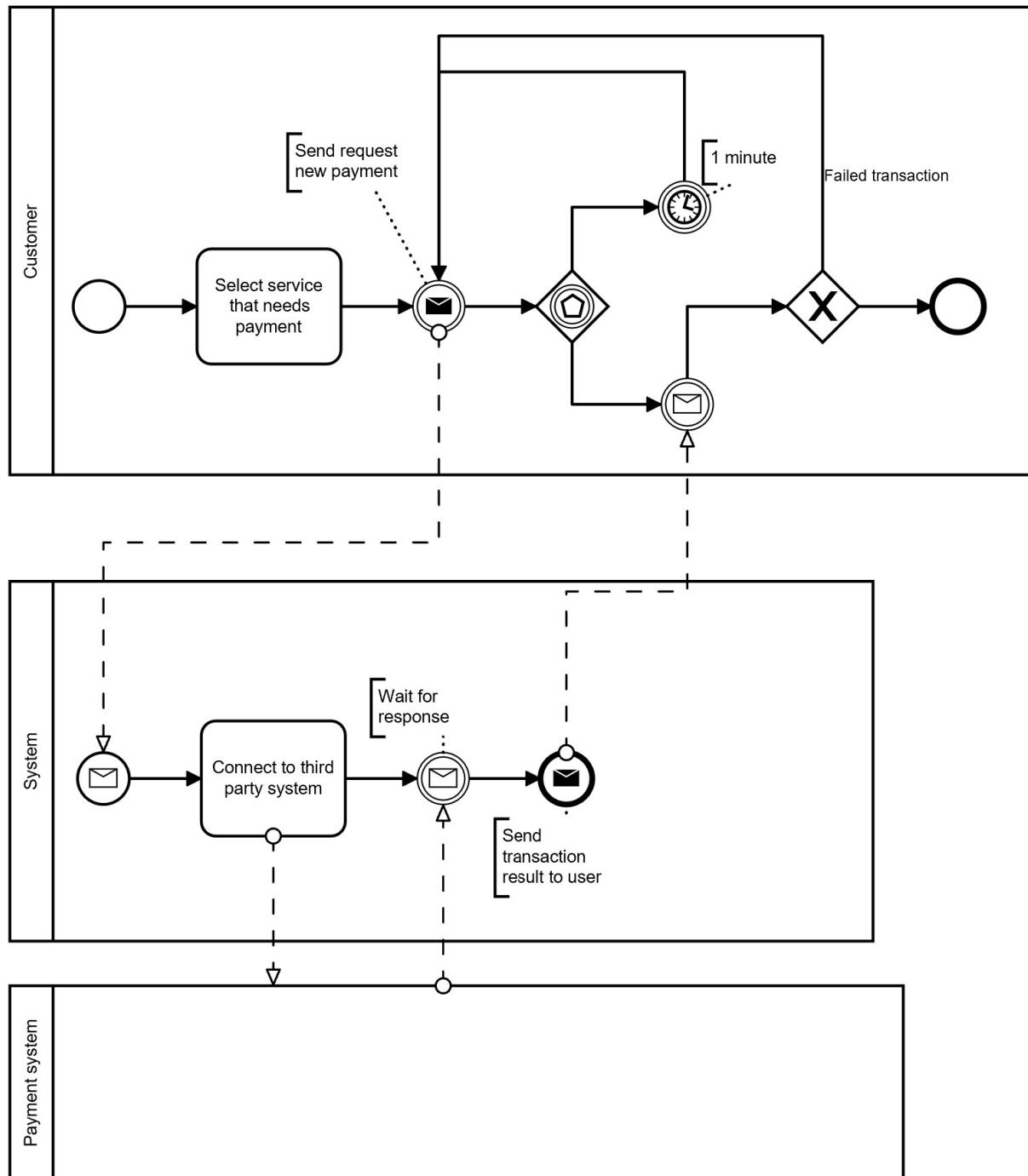


Figure 4: Payment execution diagram

7 Data Analysis

8 Prototype - Mobile Application

8.1 Structure

In this section we will describe how the prototype for the project has been realized, starting with an introduction to the technologies and services used, a description of the goals the app aims to achieve and details such as the structure of the database. Technical details of the implementation have been intentionally left out of this report given that it's not meant to be a design document or a how-to guide on how the application was built, since that would need a lengthy and appropriate document by itself. Instead, the aim of the following sections is to explain what the application does and the logic/reasoning behind the main choices that have been made during its development such as which services have been implemented and how data is handled.

8.2 Introduction

8.2.1 Operating System: Android

Given previous experience with it, we decided to build the prototype on Android (with minimum sdk 23 and compiled on skd 28), since the popular open source operative system is free to develop on by anyone without needing any particular machine or license (unlike for example iOS), and is instead sufficient to use Android Studio¹ that comes also with the proper emulator software for testing purposes without the need to connect a physical device (which is still possible to do by simply installing the USB drivers).

8.2.2 Development Platform: Firebase

Firebase² is Google's platform to develop web and mobile applications, which offers a number of services free to use on a small scale (but more than enough for our project purposes). Specifically we took advantage of:

- Authentication: handles in a standard way the registration and login of the users by allowing them to access with different methods by using a normal email address and password or connecting via popular verified systems such as Gmail, Facebook, Twitter and others, assigning them a UID to each identity.
- Database: as we will discuss more in detail in [subsection 8.4](#) we used both database systems:
 - Realtime database: fast and reliable, worse web interface and poor query capability as it doesn't allow chaining commands.
 - Cloud Firestore: just released from beta, it has an easier to read web interface and it allows more powerful queries with chaining and indexing.
- Storage: since neither of the database systems allow to store files but only Objects (strings, numbers, maps, arrays, etc...) a storage system has been used to store the users' profile images.
- Cloud Functions: used to perform server side actions when a given trigger is fired, a more in depth description can be found in [subsection 8.5](#).
- Cloud Messaging: used together the cloud function *SendNotification* ([subsubsection 8.5.2](#)) it was used to send users notifications for new reservations and incoming chat messages.

¹<https://developer.android.com/studio/>

²<https://firebase.google.com/>

8.3 Goals

We wanted to build a single tool for the entire target group ([subsection 3.1](#)) and after some considerations we came up with the following goals for our platform:

- Allow locals to create a profile to offer fishing services with working hours.
- Allow customers to create a profile with basic information to make reservations.
- Allow local fishermen to be found by customers that need fishing lessons.
- Allow locals to be found by customers that need fishing equipment.
- Allow local expert fishermen to add fishing spots to a public list.
- Allow customers to search for fishing lessons, renting equipment and fishing spots in the Elk River area.
- Allow customers to contact the employees using a simple chat system and vice versa.
- Allow customers to leave a review for any service offered.

8.4 Database Structure

As said in [subsubsection 8.2.2](#) Firebase was used among other things to store data.

Contrary to what it's commonly used, Firebase doesn't offer a relational database and it's instead a NoSQL JSON system, where the use of duplicate data is actually encouraged by the creators to avoid a higher number of reads in order to search for the related entry.

What follows is the representation of the online database structure of both the *Cloud Firestore* and the *Realtime* (used only for storing chats) by using some examples to fill the fields and definitions instead of some of those that are not meant to be read by humans, such as UIDs (Unique Identifiers) or URLs.

Chats [section 8.4](#) are stored in a different way, in the Cloud Firestore database the main collection *chats* contains for each user that started at least one chat a document with that user UID, inside of this document a structure Map-like is present where the key is the *other* user with whom the chat is started and the value is an object with the necessary data, meaning that for each chat two different entries are made in the Cloud Firestore database.

In other words if Kevin Smith starts a chat with Bob Simmons there will be two structures as follows:

- chats -> Kevin Smith's UID -> Bob Simmons' UID -> data
- chats -> Bob Simmons' UID -> Kevin Smith's UID -> data

This is done because each user needs to access all their conversations when opening the chat homepage, and retrieving a single document (using their UID) is much faster than doing a query and filtering it.

The single conversations are instead stored in the Realtime database, where each one can be found by their UID created as *smallUID_bigUID* (where the comparison of the two is simply the result of the *Java String.compareTo* method) and each message is stored under that with an auto-generated UID as key while as values only the message text and the sending user name are saved.

Notifications ([section 8.4](#)) are stored only temporarily, once the Cloud Function *sendNotification* ([subsubsection 8.5.2](#)) is triggered and it sends the notification, the entry is deleted from the database.

Further comments needed are written besides each field in *green colour*.

Customer :

```
{
  "uid": "Firebase generated ID",
  "name": "Kevin",
  "surname": "Smith",
  "phone": "3343200266",
  "mail": "kevin.smith@gmail.com",
  "profilePicUrl": "URL to Firebase storage" File storage is a different service
}
```

Fishing Spot :

```
{
  "uid": "Firebase generated ID",
  "name": "Spot Fly Fishing",
  "nameLowercase": "spot fly fishing",
  "latitude": 38.53497378591452,
  "longitude": -81.71645309776068,
  "averageReviews": 0,
  "numReviews": 0
}
```

Reservation :

```
{
  "time": "2019-08-10 17:00:00 UTC+2",
  "type": "expert_instructor",
  "employeeUid": "UID of employee reserved", null if spot reservation
  "spotUid": "UID of spot reserved", null if employee reservation
  "customerUid": "UID of customer reserving",
  "customerName": "Kevin Smith",
  "customerPic": "URL profile pic customer",
  "employeePic": "URL profile pic employee" null if spot reservation
}
```

Chat : From Bob Simmons' database part

```
{
  "thisName": "Bob Simmons",
  "otherName": "Kevin Smith",
  "otherUid": "Kevin Smith's UID",
  "lastText": "See you there!",
  "otherProfilePic": "Kevin Smith's profile pic URL",
  "isRead": true,
  "lastMsgDate": "2019-08-10 13:11:17 UTC+2"
}
```

Employee :

```
{
  "uid": "Firebase generated ID",
  "name": "Bob Simmons",
  "mail": "bob.simmons@gmail.com",
  "address1": "Daniel St",
  "address2": "51",
  "city": "Webster Springs WV",
  "zip": "26288",
  "phone": "332655953",
  "averageReviews": 5,
  "numReviews": 1,
  "profilePicUrl": "URL to Firebase storage", File storage is a different service
  "tags": [ ArrayList<String>
    "expert_instructor"
  ],
  "hours": [ Map<String, List<String>
    {
      "Monday": [
        "Closed",
        "Closed",
        "13:00",
        "20:00"
      ],
      "Tuesday": [
        "Closed",
        "Closed",
        "13:00",
        "20:00"
      ],
      "Wednesday": [
        "Closed",
        "Closed",
        "13:00",
        "20:00"
      ],
      "Thursday": [
        "Closed",
        "Closed",
        "13:00",
        "20:00"
      ]
    }
  ]  
]Cut for page length purposes
}
```

Review :

```
{
  "reviewScore": 4,
  "serviceUid": "UID of employee / spot",
  "customerUid": "UID customer making the review",
  "type": "review type" spot, rental or expert_instructor
}
```

Notification :

Title and Body depend on the type (new reservation or chat message), but there is no need to store it.

```
{
  "recipientUid": "UID receiving user",
  "title": "notification title",
  "body": "notification message"
}
```

8.5 Cloud Functions

Written in JavaScript (NodeJs) When the specified trigger is fired server side actions can be executed in order to relieve the clients from doing numerous actions that would slow down their device.

8.5.1 New Review

Every time a new review is added to the database, it takes the given score and going into the employee entry it computes back the total score by multiplication between the average and the number of reviews, then it adds the new score and increments by one the total and the new average is computed and stored. If the new score is a modification of an older review, then the average is updated instead by subtracting the old score from the sum before adding the new one and the total number of reviews is not incremented.

8.5.2 Send Notification

When a new notification is stored in the database it takes sends the content to all the users subscribed to the topic specified, since the topic is the UID of a user and each one is subscribed to its UID topic after the login process, only one user will receive the notification.

8.6 User Interface

In this section the main UI screens are shown, note that the chat screen has the same interface for both kinds of users.

8.6.1 Customer UI

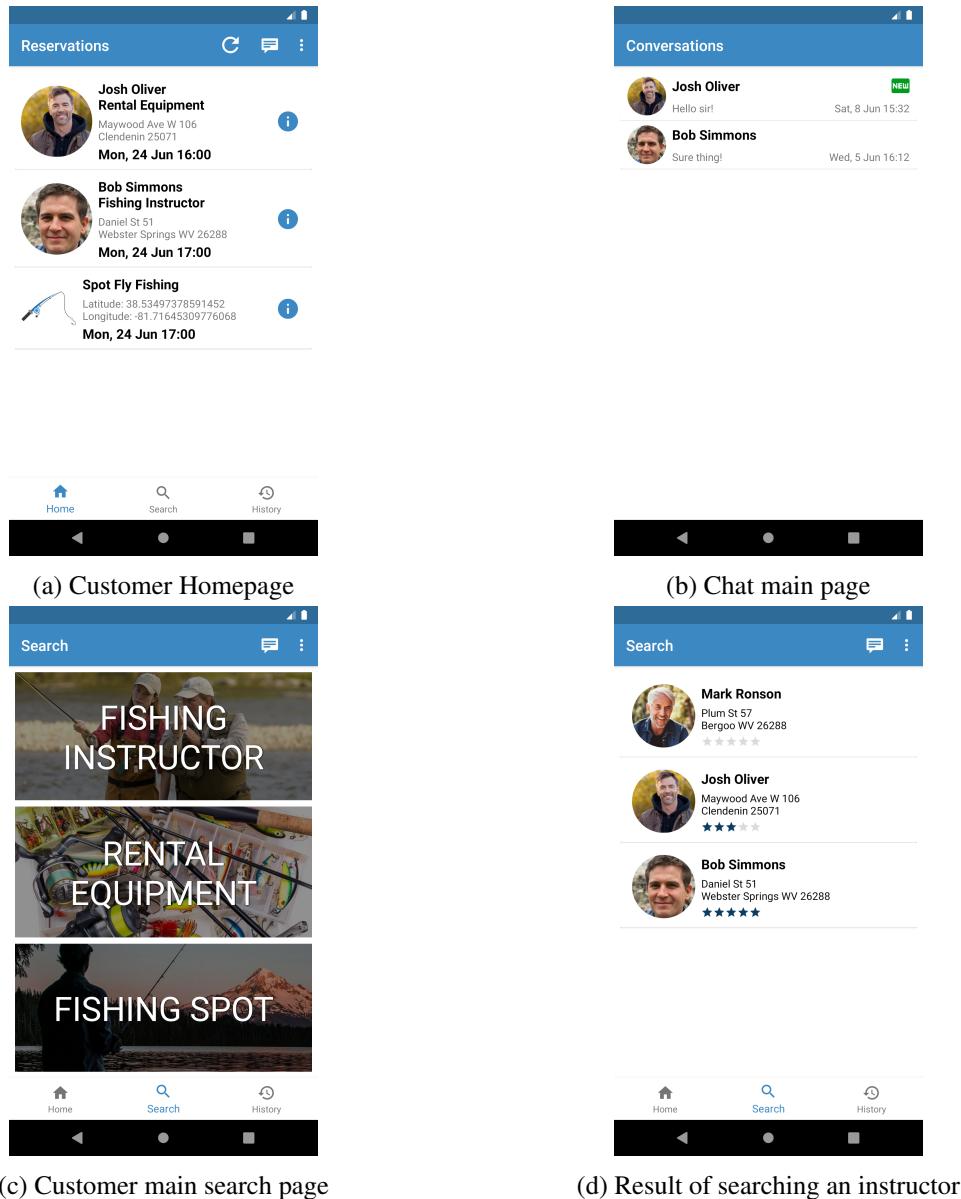


Figure 5: Customer Homepage (a), search pages (c)(d) and chat mainpage (b)

8.6.2 Employee UI

It should be noted that in **Figure 6b** the employee will have the option of dragging on the map (which displays all the already registered spots) to move the center cursor which will update the latitude and longitude values in real time, or he/she will be able to manually insert the values in the text-boxes, using then the "check on map" button to put the map in the specified position (only if the values correspond to a valid coordinates, otherwise an error will be shown asking the user to insert correct values). The name of the fishing spot **must** be unique to avoid confusion to the customers and since Firebase doesn't allow queries where a string parameters ignores upper and lower cases differences as shown in **subsection 8.4** fishing spots also store the name in lowercase. If no name is inserted or it's already in use an error is displayed to the user asking for a new one.

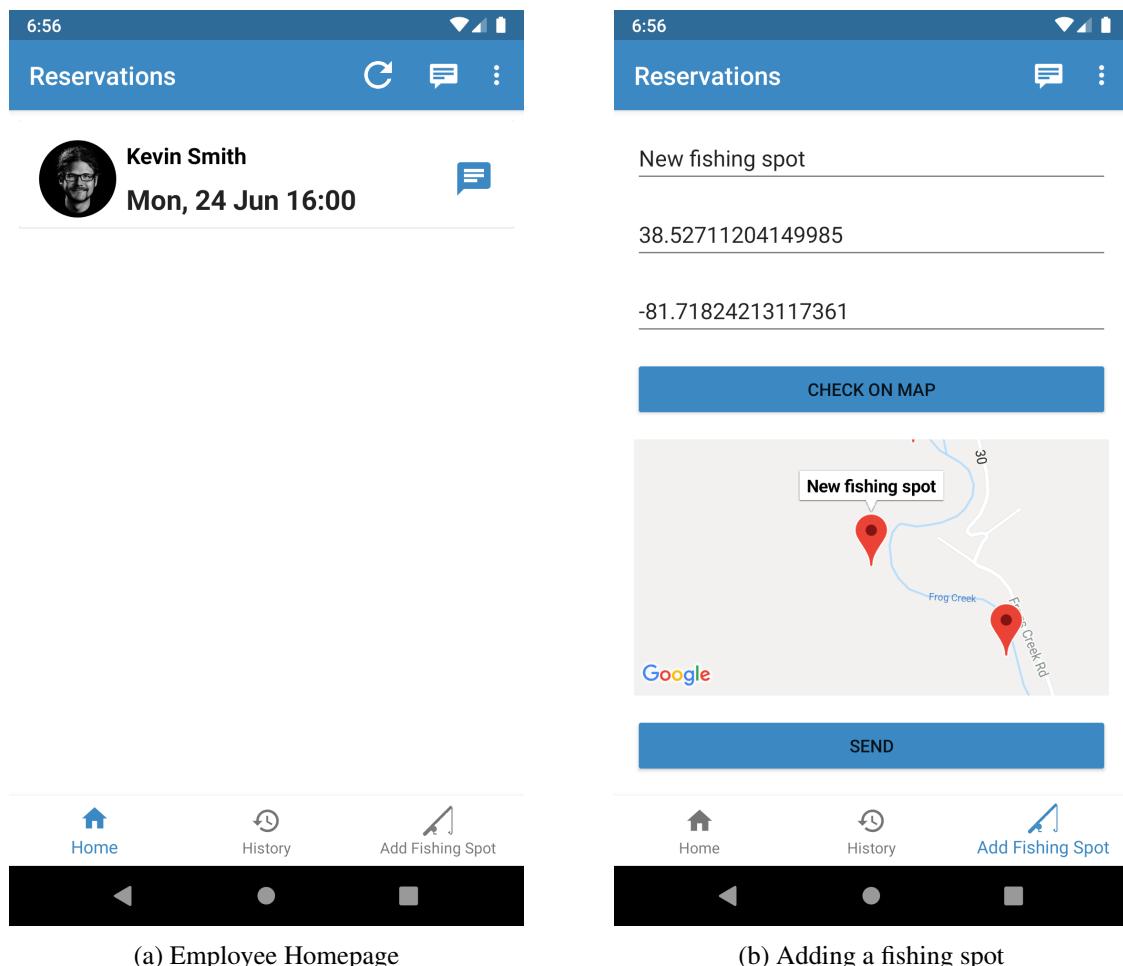


Figure 6: Employee Homepage (a) and new fishing spot insertion page (b)

9 Appendix

9.1 Software & Services Used

1. Texmaker as an editor for L^AT_EX.
2. Git & GitKraken
3. Android Studio
4. Firebase