Functional Specification

BARBELL TRACKER

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FUNCTIONAL SPECIFICATION CONTENTS

1. INTRODUCTION

1.1 OVERVIEW

Our project will help with personal trainers and clients alike involved in strength sports such as Powerlifting/Olympic Lifting, field sports such as Rugby or GAA, and will also be useful for those who train using the gym as a hobby. We feel it will be useful especially for a coach or personal trainer who wants to understand more about the gym sessions their client has, as well as seeing what factors influence the session of the individual, e.g. Sleep, Nutrition, Hydration, Mood. Our Project is an app for tracking many factors that come into play when we decide to take the leap into the world of the gym, in particular weights. From bar speed, velocity and path, to other factors outside of the gym such as quality of sleep, nutrition and hydration on the day of/before training day.

Our project will be able to recognise the end of a barbell through either live video recording, or uploaded video. We are unsure of which method we will use, but at the minute our two options are to have 1. A circular piece of paper, a colour vastly different to the user's background that our system will know the size off, as the circular ends of the barbell are consistent across the world. From this, our system can determine the pixels per metre on the screen, and while tracking the movement of the barbell can determine data such as bar speed, bar path, velocity etc. and help to determine the RPE of a set.

Our project will also be able to determine the key point on the body that are factors in RPE becoming harder/easier than expected, i.e. back rounding making it harder, or weight shifting, making it easier, both of which however, are conducive to higher injury risk.

The term known commonly as RPE (Rate of Perceived Exhaustion) which essentially rates the difficulty/10 of the set just completed by an athlete (How many more reps could I have completed? etc.). Many sports, but, primarily in Powerlifting and Olympic Lifting, use these techniques in order to keep training at a certain intensity for the individual for the quickest and most efficient ways of gaining strength. This RPE is very individual, so, starting off with a default speed and velocity we will determine an RPE of a set for the individual. As time goes on however the app will take input from the individual, as a set may move as slow as an RPE 9/10 (Implying the athlete thinks they could only have completed 1 more rep), but in terms of how it felt for the athlete, they may have felt there was more 'in the tank' so perhaps it was an RPE 8 for them. By examining the trends in their lifts, and their own input on how the set felt, we can use this date to extract some customised RPE - speed mappings. By default an average athlete will have a bar speed of 0.7m/s when a set is an RPE 8, however thanks to inputs from the user, we know that generally the speed of the bar when they lift at RPE 8 is actually 0.6m/s. This allows for an individualised training approach which is becoming more and more necessary in the industry as there is no 'one size fits all' in terms of programming or RPE.

The path of the bar is another factor that we will take into account when considering RPE and form checking. Perhaps if an athlete's weight shifts forward and they begin to ascend while squatting, we can see as we draw the bar path for the individual to see where they are going wrong, as the bar in a squat should move in a straight line (however this differs from lift to lift) We can tell the athlete, perhaps this was an RPE 9 today, although you hit this weight 2 weeks ago at RPE 8, BUT HERES WHY. This can be extremely useful for both veterans of the sports and novices or people only pursuing them as a hobby.

Using factors such as sleep, nutrition and hydration will also be able to help the athlete and/or coach determine why on a particular day, a weight which normally would be easy for the athlete (RPE 6), becomes an RPE 8 for no apparent reason. We can encourage the athlete to enter a rating out of 10 for all of these factors and, determine if today is a good day for them to train, or should they perhaps eat or hydrate a bit more before they train, should they save it for another day as a bad nights sleep could potentially increase injury risk especially when prescribed a lift at RPE 9. Again, through learning about the individual and what levels of sleep, hydration and nutrition enables them to perform at their best. These however will only be recommendations, and we will include a disclaimer stating the user won't hold us responsible if they are injured.

1.2 BUSINESS CONTEXT

Although we do not have a business organisation sponsoring our project, we do hope that it would be useful for many sports teams that include gym routines as part of their training, or for individual use for those using the gym as a hobby. There are many powerlifting clubs in Ireland that use the RPE system or determining workout intensity and we feel that being able to track data for the athletes would be extremely beneficial for them to get the best out of their athletes in order to grow their own reputation.

1.3 GLOSSARY

RPE: Rate of Perceived Exhaustion - The RPE scale is used to measure the intensity of your exercise. The RPE scale runs from 0 – 10. The numbers below relate to phrases used to rate how easy or difficult you find an activity. For example, 0 (nothing at all) would be how you feel when sitting in a chair; 10 (very, very heavy) is how you feel at the end of an exercise stress test or after a very difficult activity. Source of definition.

2 GENERAL DESCRIPTION

2.1 SYSTEM FUNCTIONS

When a user downloads the app they will be prompted to create an account or login. Upon successfully logging in, the user will find themselves at the home page with links to the other pages consisting of **Track**, **Stats**, **Account**

Track - page where the user can upload or record a video, ensure the app has found the end of the barbell, and then proceed to do their set. After this the video will be show on the top of the page. With the stats shown underneath. There will be a button to either show or hide the bar path drawing on the video, and they can see all sorts of data including, average speed velocity, form check, and graphs potentially showing the progress made from the last videos they uploaded. There will be a save or discard button if they want to save the data or not, and also an input of what RPE they found the set to be

Stats - Here the user will be given options of the different lifts e.g. squat, bench or deadlift. When each is selected, they will be presented with the data from their previous attempts at these lifts. They will also be able to switch between form tracking data and bar tracking data, enabling them to see if they get less form breakdown warnings as time goes on, or if their set has sped up or become a lower RPE over time too.

Account - The account section will be where the user can see details about their account, change their information such as email, username etc, and see our customised rep charts for them, depending on how often the system is utilised by them.

2.2 USER CHARACTERISTICS AND OBJECTIVES

The intended users for our project will be gym goers, people participating in a weightlifting sport, people participating in other sports in which their training involves gym work, or coaches/Personal Trainers, who's clients are using the RPE method of training. The users will need no prior knowledge in computing etc. but may find prior knowledge on rep and other areas of the fitness industry in order to better understand the data given back to them.

2.3 OPERATIONAL SCENARIOS

For our operational scenarios we will use a **Given When Then** syntax, a Gherkin Reference, which we hope to use for our end to end tests using cucumber. It is basically a test file that is written in plain English so it is easy to see where the errors occur e.g. **Given,** a user wants to record a video **When,** they press record **Then,** the video records. Extra steps in the when section are joined with an '**And'.**

1. **Given** A user wants to login
   When they login using their correct credentials
   Then they are brought to the home page under the correct account name and info

2. **Given** A user want to record a video
   When they login with their correct credentials **and** navigate to track **and** press record video
   Then they see the video has started to record

3. **Given** A user want to see the barbell is being tracked before they start their set
   When they login with their correct credentials **and** navigate to track **and** select record video
   Then they will see confirmation the barbell has been found and is being tracked

4. **Given** A user wants to save a video to their account
   When they login with their correct credentials **and** navigate to track **and** record a video **and** click save
   Then the video and its data are saved to their account

5. **Given** The user wants to see the bar path of their uploaded video
   When they login with their correct credentials **and** navigate to track **and** upload a video **and** click see bar path
   Then the bar path is drawn for them on the video

6. **Given** A user wants to see the data for the video just uploaded
   When they login with their correct credentials **and** navigate to tracking **and** upload a video
   Then the data for the video can be seen underneath the video

7. **Given** A user wants to tell our system what rep they found the set to be
   When they login with their correct credentials **and** navigate to tracking **and** record a video
   Then they can type their proposed RPE value into the text box

8. **Given** A user wants to see the bar data for the deadlift recorded yesterday
   When they login with their correct credentials **and** navigate to stats **and** click deadlift **and** click the instance of the deadlift they want stats for
   Then they will see stats for the set in question

9. **Given** A user wants to see form stats for their squat recorded last week
   When they login with their correct credentials **and** navigate to stats **and** click squat **and** click on the instance of the squat they want stats for **and** click form stats
   Then they will see form stats for the set in question

10. **Given** A user wants to see their account information
    When they login with their correct credentials **and** navigate to account **and** click info
    Then they are presented with their account information

11. **Given** A user wants to change their username
    When they login with their correct credentials **and** navigate to account **and** click info **and** click change username
    Then they input their new username and the database is updated with this information

12. **Given** A user wants to see their own custom RPE chart.
    When they login with their correct credentials **and** navigate to account **and** click info **and** click RPE
    Then they can see their own customised rep chart

2.4 CONSTRAINTS

Time will be a major constraint for this project as the deadline is in the month of May. As the project grows we can only hope that we don't run into too many time consuming problems and our project will be fully functional before the due date. The more constraints we face in time, the higher the potential risks are, as the project will end up being rushed.

Experience and Prior Knowledge will be another constraint for us. Neither of us have worked with image processing before or object tracking, so this will be a new area for us to venture into. Jordan has some prior knowledge around RPE and how the data is relevant to our system, but Nathan has not done these kinds of things before, so learning this will also eat into our time constraint a little bit, however we are confident he will be able to understand only the necessary areas of this fairly quickly.

Database Memory may also be an issue, storing names, details, and lots of data for each lift may take a toll on our memory limits, so we will need to look into how much memory we can get for free and if we can use this, or if we need to upgrade our memory wherever we decide to store it.

3. FUNCTIONAL REQUIREMENTS

3.1 LOGIN

Description

The system must be able to identify the correct user login and redirect the user to the appropriate page. We will need to store all of the users' info in a database in order to determine a login.

Criticality

Medium

Technical Issues

Ensuring the user logs into the correct account when they log in

Dependencies

Must interact with he account management part of the app

3.2 TRACK BARBELL

Description

The system must be able to identify the barbell, size of it and track it gathering the speed, velocity and path of the bar along the way

Criticality

High

Technical Issues

Ensuring the system tracks the barbell accurately and only the barbell, we don't want it to track other things in the gym

Dependencies

Interacts with the stats section as without this data we will have no stats to show

3.3 TRACK BODY PARTS

Description

The system must recognise body parts within the video ankles, knees, shoulders etc

Criticality

High

Technical Issues

Ensuring it doesn't track other people who may be in the background and get calculations wrong from this

Dependencies

Interacts with the stats section as without this data we will have no stats to show

3.4 OBTAIN AND SHOW DATA

Description

Obtain data given from the barbell and form trackers and then display them in way that would be beneficial to the user.

Criticality

High

Technical Issues

Ensuring we get the right data from the right aspect of the system, e.g. speed from barbell tracker and form data from the form tracker

Dependencies

Dependent on the form tracker and barbell tracker to get the data and then show the data in way that will be useful for the user

3.5 USE USER INPUT WITH GATHERED DATA TO GENERATE CUSTOM VALUES

Description

Incorporate the data gathered from multiple videos to generate custom RPE with the data input by the user determining how they felt the set went (regression perhaps?)

Criticality

High

Technical Issues

Ensure the regression is correct, and not giving values that are impossible, eg moving at 10m/s for an RPE 7. We should have min and max values that the bar can travel at and be considered for each RPE

Dependencies

This will be dependent on the Barbell tracker getting us the correct information, and the user providing us with relatively accurate information on how the set felt to them.

3.6 ACCOUNT EDITING

Description

User must be able to change their name, email, password etc.

Criticality

Medium

Technical Issues

Ensuring there aren't more than one of the same email/username, deleting previous usernames passwords etc.

Dependencies

Dependent on the login screen working correctly and assigning the user the correct credentials when logged in so they don't change somebody else's username

4. SYSTEM ARCHITECTURE

Frontend User logs into the account and makes HTTP Requests to get information from the server side backend and through this retrieves from the database.

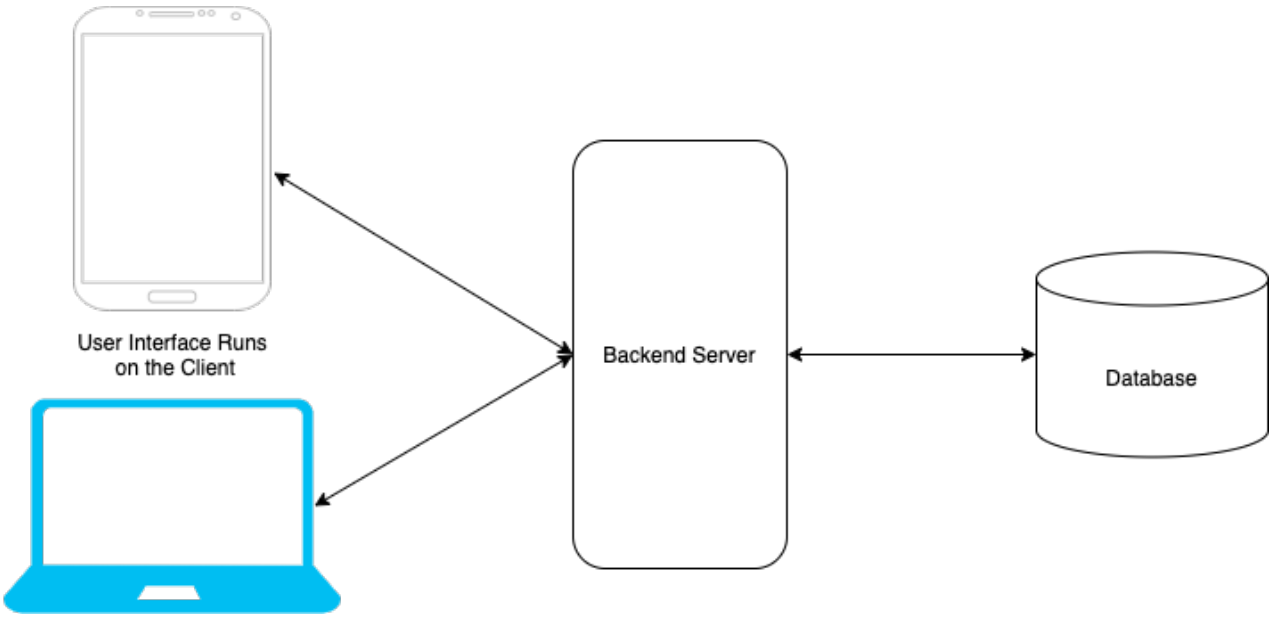
Server The server will hold our back end and database, so the UI is the only thing installed on the client side. If we get as far as making it possible to install on a phone, this will make it easier, as we had issues with getting things like bumpy onto a phone in last year's project, because this will just be accessed by HTTP requests instead of needing to be installed on a phone.

Database We will need to build a database for storing all relevant data, we can use a popular database such as MongoDB

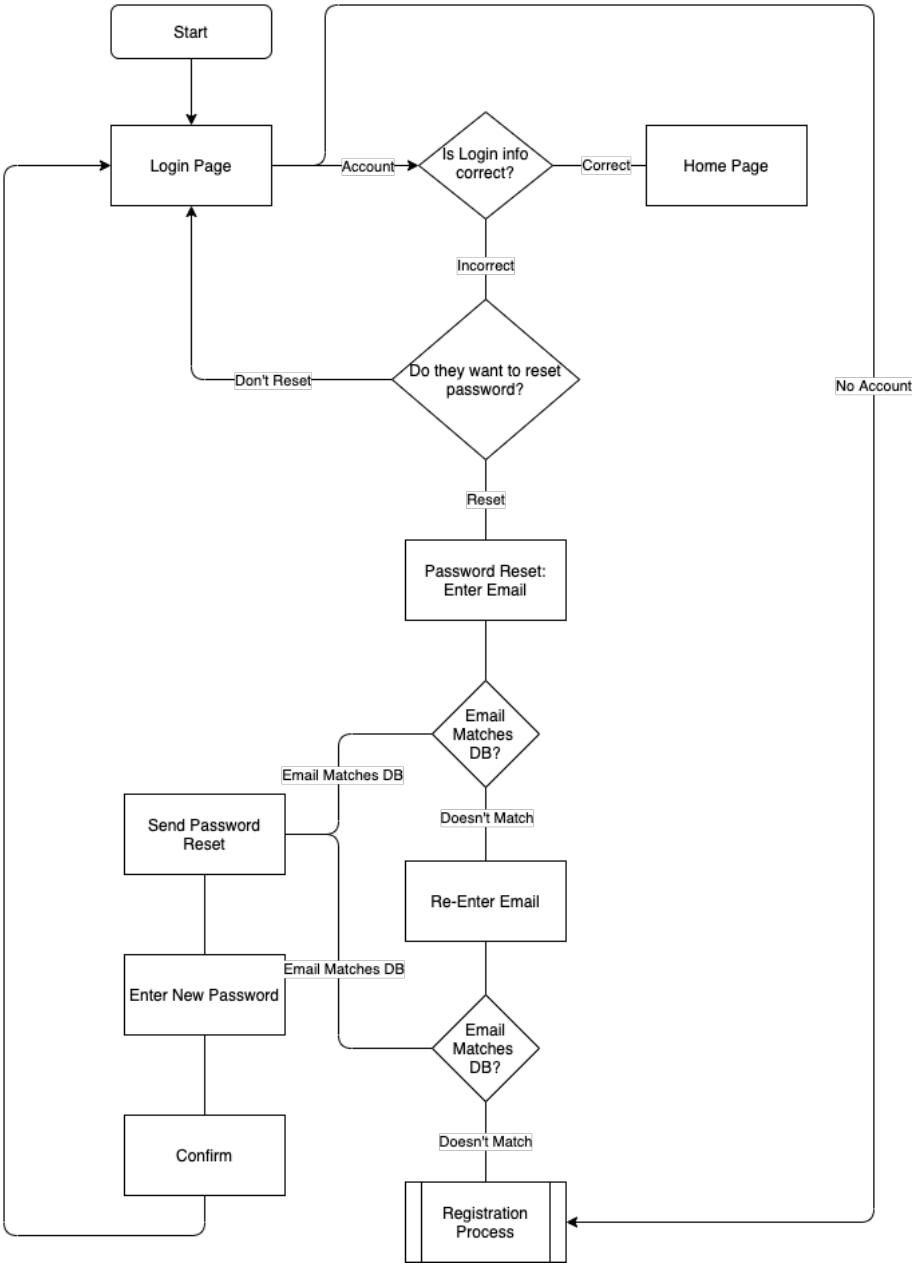
You can see a diagram for our system architecture in the next section.

5. HIGH LEVEL DESIGN

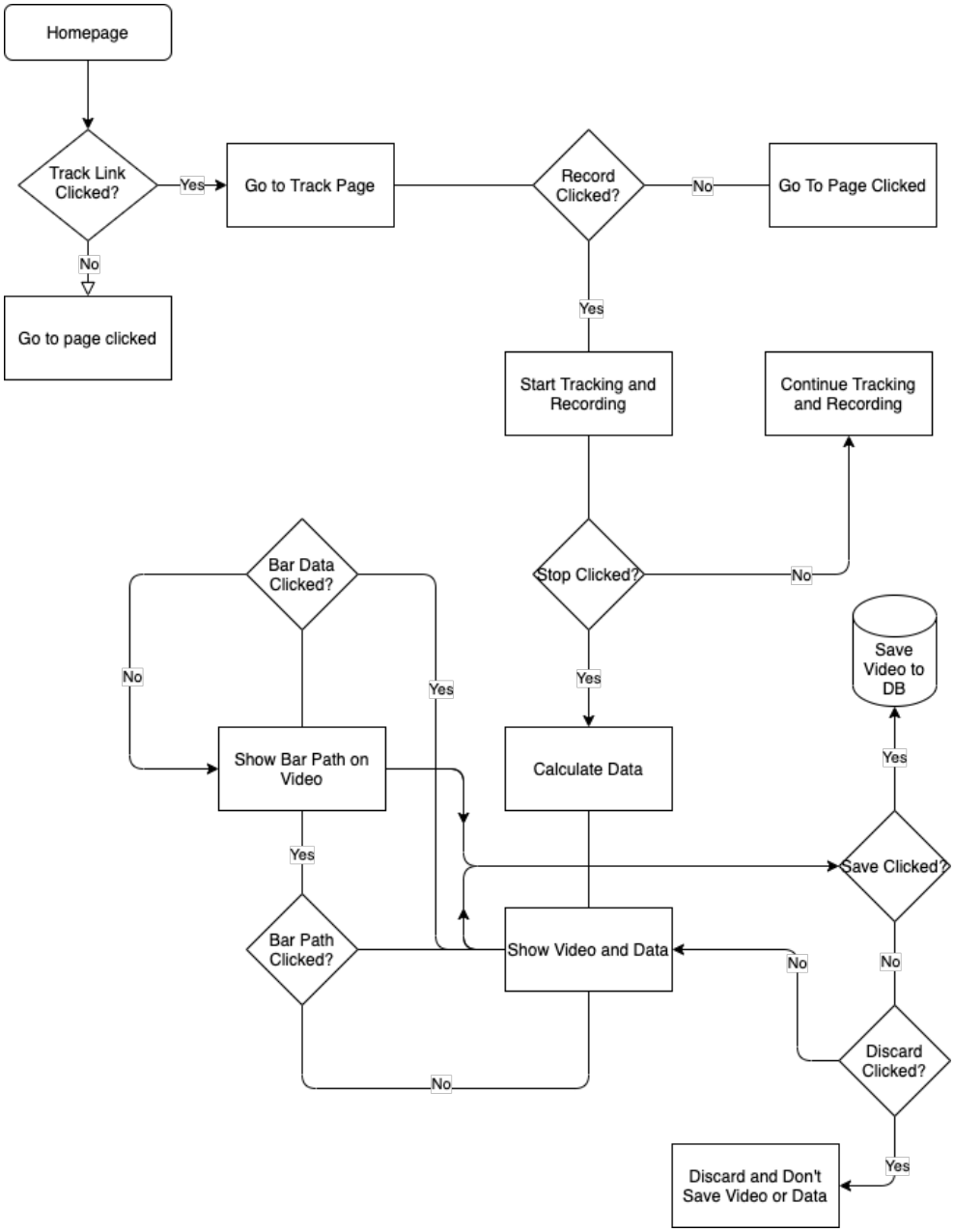
5.1 WEB APP ARCHITECTURE



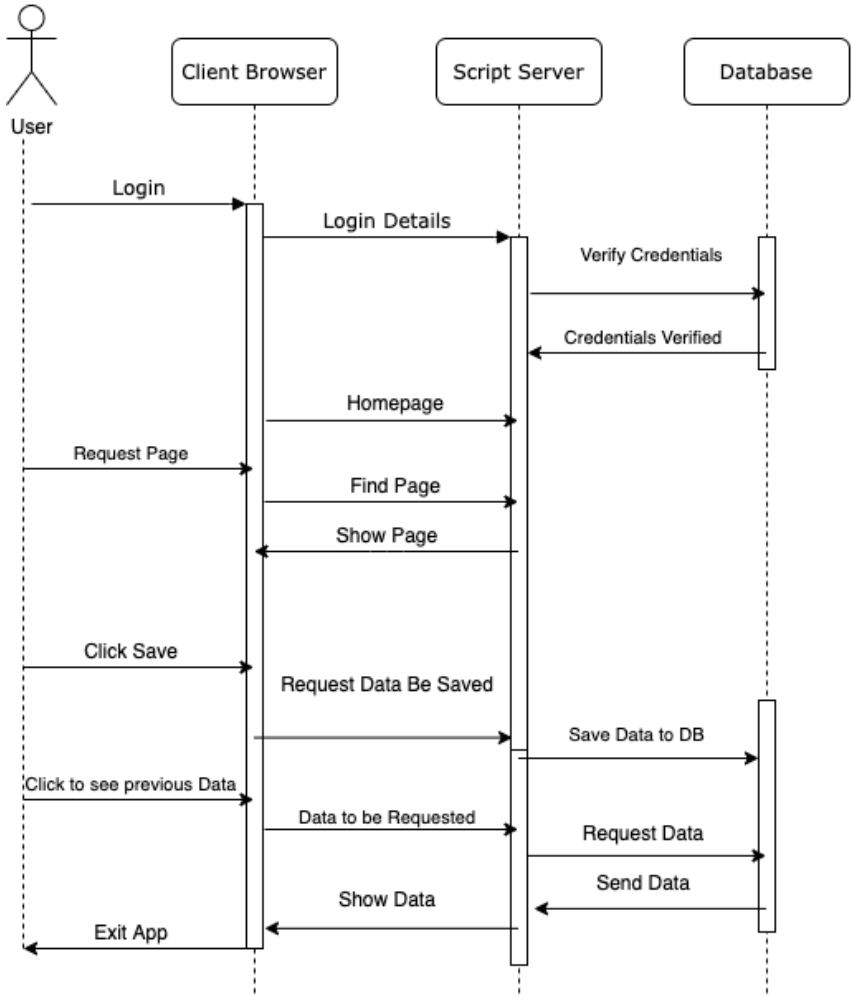
5.2 USER FLOW DIAGRAM FOR LOGIN



5.3 USER FLOW DIAGRAM FOR SEEING DATA FROM VIDEO RECORDED ON APP



5.4 SEQUENCE DIAGRAM HOW DIFFERENT ASPECTS INTERACT



6. PRELIMINARY SCHEDULE