**PRJ400 GameHub**

**Literature Review**

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Figure 1 GameHub Logo (Anon., 2024)

Contents

[1 literature Review 4](#_Toc175084548)

[2 Introduction 4](#_Toc175084549)

[3 Databases 4](#_Toc175084550)

[3.1 Firebase Cloud Firestore 4](#_Toc175084551)

[3.2 MongoDB 6](#_Toc175084552)

[3.3 Conclusion 7](#_Toc175084553)

[4 Game Data and API Integration 8](#_Toc175084554)

[4.1 RAWG Video Game API 8](#_Toc175084555)

[4.2 IGDB (Internet Game Database) API 9](#_Toc175084556)

[4.3 Conclusion 9](#_Toc175084557)

[5 Cross-Platform Development 9](#_Toc175084558)

[5.1 Benefits and Challenges of Cross-Platform Development 9](#_Toc175084559)

[5.2 Frameworks for Cross-Platform Development 10](#_Toc175084560)

[5.3 Conclusion 12](#_Toc175084561)

[6 Authentication and Authorization 12](#_Toc175084562)

[6.1 Authentication 12](#_Toc175084563)

[6.2 Authorization 13](#_Toc175084564)

[6.3 Conclusion 13](#_Toc175084565)

[7 Ecommerce Integration 13](#_Toc175084566)

[7.1 PayPal API 13](#_Toc175084567)

[7.2 Stripe API 14](#_Toc175084568)

[7.3 Conclusion 15](#_Toc175084569)

[8 User Experience (UX) Design 15](#_Toc175084570)

[8.1 Importance of UX Design 15](#_Toc175084571)

[8.2 Key Principles of UX Design 16](#_Toc175084572)

[9 Conclusion 17](#_Toc175084573)

[Bibliography 18](#_Toc175084574)

[Figure 1 GameHub Logo (Anon., 2024) 1](#_Toc175084575)

[Figure 2 Database Table Comparison (Kot & Smołka, 2023) 5](#_Toc175084576)

[Figure 3 MongoDB Example Structure (Vishnurathan, 2023) 6](#_Toc175084577)

[Figure 4 MongoDB Comparison (Eyada, et al., 2020) 7](#_Toc175084578)

[Figure 5 Sample Ionic HTML (Lynch, 2019) 11](#_Toc175084579)

[Figure 6 React Native Code Example (Deshpande, 2024) 12](#_Toc175084580)

[Figure 7 PayPal Logo (PIXABAY, 2024) 14](#_Toc175084581)

[Figure 8 Stripe Logo (Postman, 2024) 14](#_Toc175084582)

[Figure 9 Stripe Checkout UI (Stripe, 2024) 15](#_Toc175084583)

[Figure 10 Gamer Demographics (Howarth, 2024) 16](#_Toc175084584)

[Figure 11 Gamer Proportions (Howarth, 2024) 16](#_Toc175084585)

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# 1 literature Review

## 2 Introduction

The purpose of this literature review is to display the various areas of research that was done for the creation of GameHub, an application developed for users to keep track of their gaming experience. The research gathered focuses primarily on concepts, methodology and various technologies that will be used in the development process of GameHub.

## 3 Databases

### 3.1 Firebase Cloud Firestore

Cloud Firestore is a NoSQL document database that stores data into collections. Firebase is owned by Google who are obviously one of the biggest companies in the world, which provide Firebase with many advantages. One of the main advantages being that Google provide analytics on Firebase completely free. That allows developers to monitor the analytic reports on their events which is great to monitor user behaviour. “Google Cloud Analytics for Firebase offers free, unlimited reporting’s on as many as 500 or more separate events. Statistics present content on user behavior in IOS and Android applications to enable best decision-making about improving an application performance and marketing”. (Chougale, et al., 2021). Firestore scales automatically based on the increasing traffic load as well as when the database increases in size. “So if there are recurring traffic spikes, the splits are maintained and more splits are introduced whenever required. These mechanisms help Cloud Firestore databases to autoscale under increasing traffic load or database size.” (Firebase, 2024). This is very useful as it is easy to manage autoscaling databases, it allows for high availability and is quite cost effective.

#### 3.1.1 Firestore Performance

In figure 2 below, a comparison of Firebase Realtime Database, Cloud Firestore and SQLite was completed. This comparison was performed in the journal “A performance analysis of a cloud database on mobile devices” by Kot, Sylwester and Smołka, Jakub. The comparison shows that Firestore cannot retrieve the records in any case above 2000 records. “Unfortunately, for record count above 2000 in case of Cloud Firestore and 10000 in case of Realtime Database there was an OutOfMemory exception thrown by the server side of database, which prevented getting the results for these conditions.” (Kot & Smołka, 2023). The figure actually shows that SQLite executes the retrieval time the fastest in all scenarios and does not throw the OutOfMemory exception in the results that were tested, with Firebase Realtime Database coming in second but it also threw the same error but only for records with 10000 entries or more.

A table of data

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Figure 2 Database Table Comparison (Kot & Smołka, 2023)

To continue on with the comparison between the three databases for mobile development, SQLite is only compatible with Android while Realtime Database and Firestore are compatible with IOS and Android. However, SQLite is free while all Firebase services are paid depending on the amount of activity within the database, e.g. the amount of read, writes and deletes. The amount of storage the database uses as well as the number of index entries used to satisfy a query. “When you use Cloud Firestore, you are charged for the following:

* The number of documents you read, write, and delete.
* The number of index entries read to satisfy a query.
* The amount of storage that your database uses, including overhead for metadata and indexes.
* The amount of network bandwidth that you use.” (Firebase, 2024).

Since Firestore stores its data into collections and it is an autoscaling database, it is very easy to work with. Whereas Realtime database stores its data as one file making it hard to scale especially when there is a lot of data withing the database “Realtime database stores data as one large JSON tree which makes it very easy to store simple data but Complex or hierarchical data is harder to organise at scale.” (Mehta, 2024). SQLite is also very complex to scale with a larger backend.

### 3.2 MongoDB

MongoDB is a non-relational document database that stores JSON data in documents, similar to Firestore. MongoDB is also seen as schemeless as it does not have a pre-defined schema. “As a NoSQL database, MongoDB is considered schemaless because it does not require a rigid, pre-defined schema like a relational database. The database management system (DBMS) enforces a partial schema as data is written, explicitly listing collections and indexes.” (MongoDB, 2024). MongoDB is horizontally scalable which is great for larger applications as it helps to balance the incoming demand very well. “Horizontal Scalability – MongoDB provides horizontal scalability as part of its core functionality. Sharding distributes data across a cluster of machines.” (Chauhan , 2019). If GameHub was to become immensely popular in the future and had a massive user base, MongoDB would be great in this instance because of its scalability. Sharding would allow MongoDB to distribute the data across multiple servers making sure that the database could handle the large amounts of traffic. As Seen in figure 3, the structure of MongoDB is incredibly simple and easy to manage.

A screenshot of a computer code

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Figure 3 MongoDB Example Structure (Vishnurathan, 2023)

#### 3.2.1 MongoDB Performance

A table with numbers and numbers

Description automatically generatedIn figure 4 a comparison was conducted between MongoDB and MySQL. The performance test increased the same workloads. “MySQL accepts from 4000 records; in the first insertion operation, to 48000 records; in the last insertion operations. On the other side, MongoDB accepts 4000 records in all cases from the first to the last operations. Table 5 shows the latency of these insertion operations in all cases.” (Eyada, et al., 2020). This performance test shows that MongoDB’s latency is way lower than MySQL’s meaning that MongoDB is retrieving the data much quicker. Although MySQL can accept way more records than MongoDB.

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Figure 4 MongoDB Comparison (Eyada, et al., 2020)

### 3.3 Conclusion

To conclude the Databases section of this literature review, the evaluation of Firestore and MongoDB highlights their different strengths and weaknesses. MongoDB is a strong contender for GameHub’s backend model with its flexible schema design, horizontal scalability as well as its low latency in retrieving records but ultimately Firestore will be the database of choice when it comes to GameHub although it does have limitations when it comes to large datasets. There are many factors in this decision such as Firestore’s easiness to use and its autoscaling capabilities. Connectivity is also a huge reason for this decision such as Authentication and Authorization. As mentioned in heading 6 of this literature review, Firebase Authentication is a great choice for GameHub especially if Firestore is used in unison with it.

## 4 Game Data and API Integration

### 4.1 RAWG Video Game API

RAWG API is an API that allows developers to connect to their own application to work with a massive library of game data having a game library of over 500000 games. “RAWG is the largest video game database and game discovery service. And we are gladly sharing our 500,000+ games, search, and machine learning recommendations with the world.” (RAWG, 2024).

#### 4.1.1 RAWG Features and Capabilities

Obviously, the main feature of RAWG is the extensive game library that they have created allowing developers to pull game information from their API. This includes many different platforms such as PC, consoles and even mobile games.

RAWG also collects the details of each game such as a detailed game description, the genre of each game, the associated tags attached to a game, screenshots of gameplay so the user can see what the game feels/ looks like before the buy it, RAWG also includes trailers for games if they are available, some older games do not have trailers as they were not a thing of the past. The trailers endpoint is only available to RAWG members who are on the business or enterprise plan which is costs a monthly fee. The API also includes the release date of each game as well as the game developers and the publishers.

RAWG has a built-in search and filter functionality that allows users to search for a specific game by name, genre or platform. This is incredibly useful as from a developer standpoint it is simpler to use a built-in search system rather than creating a new one form scratch.

RAWG also includes user ratings and reviews of each game which can be used to enhance the overall user experience and by providing feedback on games.

Achievements and trophies are available as part of the RAWG API which provides information on all available trophies and achievements in every accessible game. All data can be pulled from the API.

Developer and publisher information is also available as well as which platform a game is available on.

### 4.2 IGDB (Internet Game Database) API

The IGDB API is another great option for GameHub as it requires extensive video game data in order to provide a plethora of information on over 99000 video games and constantly growing its database size. “To fill this gap, we propose PlayMyData, a curated videogame dataset of 99,864 games belonging to main gaming platforms (called platforms hereon) i.e., PlayStation, Xbox, Nintendo, and PC, stored on IGDB website.” (D'Angelo, et al., 2024). IGDB also contains a summary of the game and a more descriptive description of the game compared to RAWG. Similarly to RAWG IGDB also contains the platforms that a chosen game was released on. The genres of a game are also available for each game. “A game can belong to 23 different genres available on IGDB”. (D'Angelo, et al., 2024). Certain games also have game trailers and screenshots available withing the API allowing users to be able to see what a game they are looking at is like without leaving the website to watch gameplay on something like YouTube for example.

### 4.3 Conclusion

In conclusion of the game data integration section, IGDB and RAWG have a lot of similarities as they are both video game APIs but for the scope of this project, GameHub will use RAWG API to collect video game data. The reason for this is because RAWG has a larger game library as well as having more data on older games which will provide a wider audience.

## 5 Cross-Platform Development

### 5.1 Benefits and Challenges of Cross-Platform Development

Cross-Platform Development is the practice of developing an application that can be run on multiple operating systems such as web platforms or mobile platforms such as Android or IOS while using a single codebase. The advantages of cross platform development are:

Cost efficiency: by developing a single codebase application with the purpose of hosting it on multiple platforms, the cost is significantly less than if the developer were to make a native mobile application as well as a web application.

Consistent User Experience: cross-platform development allows users to have the same experience on any version of the product as the interfaces should be the same with a single codebase.

Wider Reach: by having an application across multiple platforms developers can reach a broader audience as the application is more accessible with the more platforms it is available. Some people may not have a laptop or PC but do have a mobile phone which enables them to access the application or younger people who may not have a phone could be the opposite.

However, there are also some challenges when it comes to cross-platform development such as:

Performance issues: cross-platform development may not perform as optimally as a native or web application especially with more complex features or platform specific features which can lead to slower or reduced responsiveness.

Limited access to features: certain native features or APIs cannot be accessed or will need a workaround to get access within cross-platform development. This therefore can complicate the development process by having to use plugins for certain features that would be easily accessible in a native framework.

UX Inconsistencies: Although a single codebase would be used and the UX should be similar because of this, there can be slight differences with how each platforms handles certain UI elements.

### 5.2 Frameworks for Cross-Platform Development

#### 5.2.1 Ionic Framework

Ionic Framework is a popular framework used for making multi-platform applications. It is built on top of Angular, the popular TypeScript language used for frontend applications. Since angular provides an array of pre-built components it allows for rapid development of web and mobile applications. Ionic is built with components and pages which make it very easy to manage as the component files, service files etc. cam be separated into folder. Components can also have sub-components which make it easy to manage as well. Ionic leverages Cordova or Capacitor to access native features, allowing developers to integrate features like camera access, geolocation and push notifications. “Ionic provides all the functionality which can be found in SDKs of native mobile environment. Ionic application enables inventor to build their applications and customize them according for different platforms such as for iOS, for Android, and deploy through Cordova.” (Chaudhary, 2018).

A screen shot of a computer program

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Figure 5 Sample Ionic HTML (Lynch, 2019)

Figure 5 shows the built in Ionic components utilized in HTML. This is extremely helpful to give users that responsiveness in the application and would be an excellent choice for GameHub to make use of.

#### 5.2.2 React Native

React native is an open-source framework which is created by Meta. React native can be used as a cross-platform tool but in a different way to Ionic as react native can develop applications for both Android and IOS simultaneously by rendering the JavaScript code to specific platform languages. The most common way of rendering the JavaScript code in react native is through C++. React is quite simple to use as the syntax used in React Native is called JSX (JavaScript XML). The component renders data by returning JSX. JSX is very suited towards UI development as it includes HTML, so when an element is being rendered it is very easy to describe what the UI is supposed to look like. “React components don’t require executing steps in an imperative way to render content. This is why JSX is so central to React components. The XML-style syntax makes it easy to describe what the UI should look like. That is, what are the HTML elements that this component is going to render? This is called ![A screen shot of a cell phone

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generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDuRXhpZgAATU0AKgAAAAgABAE7AAIAAAAMAAAISodpAAQAAAABAAAIVpydAAEAAAAYAAAQzuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEVzaG5hIFZlcm1hAAAFkAMAAgAAABQAABCkkAQAAgAAABQAABC4kpEAAgAAAAMxOQAAkpIAAgAAAAMxOQAA6hwABwAACAwAAAiYAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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ahdOWL3UzOAScsxYA8fUA/rW9bwaGNNtzczwMxeNmwArAFjuBxz0x1/Cqep6jLava/YLmGORYSkn2Q4UfvCwHH4Gjmu7JB7NpXbMr7Zdqjx/aZwrNudPMYAt6ketNnnubja91LNLxhWlYt+AJpnzSScnLMepPc1omWFdSjiLRm2t08ttw3Bh/ER7k5x+FXYybMynvNI8xlZ28w/wAWcGiYxmZ/IDCPPyhzkge9MpiCiiigAooooAKKKKACiiigAooooAKKKKAPef2X/wDkJeI/+uMH83r6Ir53/Zf/AOQl4j/64wfzevoigAooooAKKKKACiiigAooooA8Z+M//I06T/1xH/o0VH+zJ/yJuv8A/Yak/wDRaVJ8Z/8AkadJ/wCuI/8ARoqP9mT/AJE3X/8AsNSf+i0oA9qooooAKKKKACiiigAooooAKKKKACiiigAooooA8V/am/5JVZf9heL/ANFS1xHgf/kOaN/1zj/9Eiu3/am/5JVZf9heL/0VLXEeB/8AkOaN/wBc4/8A0SKY2fTlt/x7R/7oqWorb/j2j/3RUtIQUUUUAFfn9X6A1+f1AEi/8ez/AO8v9ajqRf8Aj2f/AHl/rUdABT2/1Mf1NMp7f6mP6mgBlFFFAFi0sLm9kVbaMsWbaCTgZxnGT7ClTTruWKKSG3klEpYII13E7cZ4HPcVasdXFtNYvNCX+xyBlCNt3LnJB9/etOTxVbXEkb3Gnksg6q467gc4Ix91QP1p6HPUnVjL3I3X/D/8AxDpV8NPF8bWX7NuK+ZsOBjr+HPWnwaPfXBYLbSqwiMyq0bAyKCB8vHPUVautaiukn327qWu2uogGBUbsfKwxyOB0pJdZi+23t1BHOr3kbq4eQHYWYHggdOCMUhc1a2xlOjRyMkisjqcMrDBB9MVYfS9QjMQksbpDMcRBoWHmH0Xjn8KXU70ahqc12EKeawO0nOOAOv4Vut4uhnvHlvbKSeJpxKI2lztAh8vA49cH04xVxUWndmnNOydjEXRtUZnVdNvC0Z2uBbvlT6HjioJLO6htkuJbaaOCQ4SVoyFb6Hoa7KL4hRwSqYbCVY12jaJQucCMdAMf8sz+dZ114wMsduYLVUeLyt8Tqpjfy1IByAG7+vc1UowS913FGVRvVGFYWP2+RlFxBBtAOZn2g5IH9aJNPmitop2Me2YExqJBucbiuQvXqDU+tazJrd0k81vb25RNu2AMAffkmnNrMhtLC2C4itR8y8fOd5bOcZHXFYa3Olctncht9JvJ7xLd4ZIC6lg0sbAADv0ziq6207wvMkMjRIcNIqEqv1NacGun+2ftl558sayvKkQccFuvJFJFrSQaYbSGN0K+YqPhCSr4yDke3aleRTUOjKBsLxXjQ2k4aTOxTE2Xx1xxzUt1pN5a3M8LQPIYADK0aEhMjPPHH41pN4kSVbhJ4JClxJIxIk+ZQyqMDI/2fypkuvW80l2ZrV5Ip8FYGYEKwTaG3YzkdeMUrz7D5adtypfQXKafBJNqCXEbY2QiYuUyoPTtjOKp28DXMwjQgHBJJ6AAZJNRVYgnSG1nUA+bKAgPYL1P58VaVjJu5E8UkaIzoQsgypI4YUyrLXn/EvFpGmFLb3ZuSW9vQfzqtTEFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQB7z+y//wAhLxH/ANcYP5vX0RXzv+y//wAhLxH/ANcYP5vX0RQAUUUUAFFFFABRRRQAUUUUAeM/Gf8A5GnSf+uI/wDRoqP9mT/kTdf/AOw1J/6LSpPjP/yNOk/9cR/6NFR/syf8ibr/AP2GpP8A0WlMD2qiiikAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQB4r+1N/ySqy/7C0X/AKKlriPA/wDyHNG/65x/+iRXb/tTf8kqsv8AsLxf+ipa4jwP/wAhzRv+ucf/AKJFMb6H05bf8e0f+6KlqK2/49o/90VLSEFFFFABX5/V+gNfn9QBIv8Ax7P/ALy/1qOpF/49n/3l/rUdABT2/wBTH9TTKczAxovcZzQAsMMlxOkMK75HOFUdzVqOzj+2yRvKHihUtI6jHTsM+/GapA4ORwasSX00sciyEMZdu98fMcdOaANCbRoYrVro3DLbtBE8Tlc5djgqcemH6elTv4ba61q4tdO4hhSNi7bpPvAY6LnnPpxWUdSuTYw2bOGt4JDIkbICAT/Mex4qd9cvZJ3lcwkyIEdfITa4HTK4wSMdarQ5eSv0f9af8Emn8NX9vuMgTYiO7uDlUK7sqT6/IaoXVm9sscgYSQzDMcgGA3qMdiKnGt34s2tBMBAyshQIAMMckdOKqTTyXEm+Zixxgew9B6VJrT9pr7S3yI6KKKDUKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigD3n9l//kJeI/8ArjB/N6+iK+d/2X/+Ql4j/wCuMH83r6IoAKKKKACiiigAooooAKKKKAPGfjP/AMjTpP8A1xH/AKNFcB8Hfi/4a+Huj6zpniBb3z59SedDbwh12lVXuw5yprvvjS4XxVo4PVoRj/v6K+TNR/5Cl1/12b+dA1oz66/4ac8A/wB3Vf8AwGX/AOLpP+GnfAP9zVf/AAGX/wCLr49opFcy7fn/AJn2D/w094C/556t/wCAyf8AxdIf2n/AX/PLVz/27J/8XXx/RQPmj/Kvx/zPsD/hqDwH/wA8dY/8Bk/+LoH7T/gM/wDLHVx/27J/8XXx/RQHPH+Vfj/mfYQ/ad8Anquqj62y/wDxdI37T3gJTxHqze4tk/8Ai6+QQqhcuTnsBVjybWdQLaR0lx9yXGG+hqhcy/lX4/5n1r/w0/4D/wCeOr/+Ayf/ABdH/DT/AID/AOeOr/8AgMn/AMXXx+Rg80Uh88f5V+P+Z9gf8NP+A/8Anjq//gMn/wAXR/w0/wCA/wDnjq//AIDJ/wDF18f0UBzx/lX4/wCZ9gf8NP8AgP8A546v/wCAyf8AxdH/AA0/4D/546v/AOAyf/F18f0UBzx/lX4/5nvXxt+Mvhj4g+B7fSdCS+W5iv0uGNzCqrtCOp5DHnLCrHgf/kOaN/1zj/8ARIr59r6A8DOv/CQaMn8XlRnHt5Ipkyd+h9PW3/HtH/uipaitv+PaP/dFS0iQooooAK/P6v0Br8/qAJF/49n/AN5f61HUi/8AHs/+8v8AWo6ACtrQI0urTVba4VTEtm9wHI5jdPukHtnO3HfNZt3Y3Fi0YuUC+bGJEKsGDKe4IJHY0kd5PFZzWsb7YZypkAAy23oM9cc9OlHcCxdWRh0ewu/sc0SzmQfaGkDJMVP8I6rjIBzVCppru4uY4o7ieSRIV2xqzZCD0A7VDQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHvP7L//ACEvEf8A1xg/m9fRFfO/7L//ACEvEf8A1xg/m9fRFABRRRQAUUUUAFFFFABRRRQB458bYNusaNdsvyrGwB9CHQn9M18na5AbbXr6FuCk7j9a+5PiZ4ck8Q+E3+yR+ZdWjedGvdxjDKPqCfxxXxv420uSPUTeKpO8fOcfexxu+vqOxpgcpRRRSAKKKKACpbWH7ReQwlgokdV3HoMnFRUA4OR1oAmvIHtb2aCX78blD9QcVCOtad5eW+qqJrgmG9CgO4GVmwMAn0b19aq2ksNpdLNIi3GzlUP3Se2fb2oAn1uJIdVdI0EfyoWUdmKjI/Os+nzzyXNw80zFpJGLMx7k0ygAooooAKKKKAFQbnVR1JxX0L4Htv8AiqtOQL80UYBPsqKv8zXifhnS5L/VYn2bo423YPQkf09TX0r8KdAludQGoSqShAEbEYyuclvxPP0xTA9wtxi3Qf7IqSkAwoHpS0gCiiigAr8/q/QGvz+oAkX/AI9n/wB5f61HV7SLJNT1OKxedoPPO1GVNw3dsjI49+fpVGgDc1seRo2jWs0e25S3Z2JOCqtIxVSP1z15rDo6dKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAPef2X/8AkJeI/wDrjB/N6+iK+d/2X/8AkJeI/wDrjB/N6+iKACiiigAooooAKKKKACiiigA615j48+Etlr7S3mmhIZ5DulhZN0cjeuOoPuK9OooA+OtX+DF5a3TKdKvUGfvW7B1/XBrN/wCFR3X/AD66p/36X/GvtN4IpPvop+opn2K2/wCeKflTA+L/APhUd1/z66p/36X/ABo/4VFdf8+uqf8Aflf8a+0PsVt/zxT8qPsVt/zxT8qAPi//AIVFdf8APrqf/fpf8aP+FR3X/Prqn/fpf8a+0PsVt/zxT8qPsVt/zxT8qAPi/wD4VFd/8+mqf9+l/wAaP+FRXf8Az6ap/wB+k/xr7Q+xW/8AzxT8qPsVv/zxT8qQHxf/AMKiu/8An11P/v0v+NH/AAqK6/59dT/79L/jX2h9itv+eKflR9itv+eKflTA+L/+FRXX/Prqf/fpf8aP+FRXX/Prqn/flf8AGvtD7Fbf88U/Kj7Fbf8APFPyoA+L/wDhUd1/z66p/wB+l/xqa2+Elx5wDabqMn/XTai/pzX2V9itv+eKflQLK3HSFfyoA8F8IfCKTEYuIFhgGMwopAP+8Ty38q9v0bRoNItBHEozjk4rQVFT7oA+lOpAFFFFABRRRQAV+f1foDX5/UAaWgS21trVvc3zFYbdvMIWPeXI6Lj3PeqUzz3EzzTs8ksh3O7clj6mmD/Vt+FNyaAHbG/un8qNjf3T+VNyaMmgB2xv7p/KjY390/lTcmjJoAdsb+6fyo2N/dP5U3JoyaAHbG/un8qNjf3T+VNyaMmgB2xv7p/KjY390/lTcmjJoAdsb+6fyo2N/dP5U3JoyaAHbG/un8qNjf3T+VNyaMmgB2xv7p/KjY390/lTcmjJoAdsb+6fyo2N/dP5U3JoyaAHbG/un8qNjf3T+VNyaMmgB2xv7p/KjY390/lTcmjJoAdsb+6fyo2N/dP5U3JoyaAHbG/un8qNjf3T+VNyaMmgB2xv7p/KjY390/lTcmjJoAdsb+6fyo2N/dP5U3JoyaAHbG/un8qNjf3T+VNyaMmgB2xv7p/KjY390/lTcmjJoAdsb+6fyo2N/dP5U3JoyaAHbG/un8qNjf3T+VNyaMmgD3r9mBSNS8RZGP3MH83r6Hr53/Zf/wCQl4j/AOuMH83r6IoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAK/P6v0BooA+AFICkHPPpR8no1ff9FAHwB8no1HyejV9/0UAfAHyejUfJ6NX3/RQB8AfJ6NR8no1ff9FAHwB8no1HyejV9/0UAfAHyejUfJ6NX3/RQB8AfJ6NR8no1ff9FAHwB8no1HyejV9/0UAfAHyejUfJ6NX3/RQB8AfJ6NR8no1ff9FAHwB8no1HyejV9/0UAfAHyejUfJ6NX3/RQB8AfJ6NR8no1ff9FAHwB8no1HyejV9/0UAfAHyejUfJ6NX3/RQB8AfJ6NR8no1ff9FAHwB8no1HyejV9/0UAfAHyejUfJ6NX3/RQB8AfJ6NR8no1ff9FAHwB8no1HyejV9/0UAfPH7MGP7S8R4z/qYOv1evoeiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigD//2Q==)declarative programming and is very well suited for UI development.” (Boduch, 2017)

Figure 6 React Native Code Example (Deshpande, 2024)

Figure 6 shows a simple code sample of React Native. The figure shows how components and props work in React Native.

### 5.3 Conclusion

In conclusion to the cross-platform development section, GameHub will be developed with a cross-platform framework using a single codebase. The framework that will be used is Ionic as it fits the needs of GameHub very well. A single codebase will be incredibly useful for GameHub as time is a big constraint in this application and GameHub aims to be hosted on multiple platforms.

## 6 Authentication and Authorization

### 6.1 Authentication

Authentication is the process of verifying the identity of a user attempting to access the application. It is the first line of defence in against unauthorized users and plays an integral role in maintaining the security of the application. Firebase Authentication is a great choice for authenticating uses as it processes everything in the background and has a plethora of choices for users to chose from when signing up. These options include email and password, multi -actor authentication (MFA) through mobile devices as well as social logins like: Google, Facebook, X (formerly Twitter) and GitHub. “It serves as an all-in-one identity solution, supporting various authentication methods such as email/password authentication, phone authentication, and social logins like Google, Facebook, GitHub, and Twitter.” (Milojković, et al., 2024). Firebase also provides third-party authentication through these social logins through OAuth.

### 6.2 Authorization

Authorization is the process of determining what an authenticated user is allowed to do or has access to within the application. A good example of this is admin privileges, if a user is not an admin, they should only be able to access certain parts of the application meanwhile an admin would be able to access everything available in the application such as access to user tables as well as permissions to write things to the backend. Firebase has a great way to handle authorization by having security rules on Firestore and Realtime Database. By having this in place the developer can specify what a regular user should have access to and what actions they can perform on the application.

### 6.3 Conclusion

To conclude this section on authentication and authorization GameHub will utilise Firebase authentication, more specifically through the email and password verification method. Firestore security rules will be used in unison of Firebase Auth to provide security for GameHub.

## 7 Ecommerce Integration

### 7.1 PayPal API

PayPal is widely recognized and a trusted payment system which would make it a great choice for implementing a payment system into GameHub. The PayPal API is fairly easy to implement into applications which is a great advantage. On the other hand there is a small transaction fee with PayPal which is a downside but that alone does not make PayPal’s API a bad choice by any means. PayPal is also widely known as being one of the safest ways to process payments online which makes it a great choice. “This study proposing PayPal is the best and recommended online payment method. PayPal has a reputation for security, protecting the interests of both merchants and customers. It is also a convenient option for patrons and merchants. Consumers spend less time entering their information; merchants can set up a payment system quickly, with no upfront payment necessary.” (M, 2014). PayPal also offers a seamless checkout experience by letting users’ complete purchases quickly and efficiently. The API supports express checkout which allows users to to pay with just a few clicks.

A blue and white logo

Description automatically generated

Figure 7 PayPal Logo (PIXABAY, 2024)

### 7.2 Stripe API

A white letter on a blue background

Description automatically generatedStripe is an API that allows developers to integrate payment systems into their applications. This is especially useful for creating ecommerce websites as payment intent is an integral part of that service.

Figure 8 Stripe Logo (Postman, 2024)

An advantage of using Stripe is that it is completely free to use for both developers and users. Developers do not have to pay a fee/monthly cost to integrate Stripe as well as users are not charged a transaction fee on a purchase when processing their payments. It is also very easy to set up a Stripe account allowing extremely fast access for developers to implement it into their setup. Stripe is also quite easy to integrate into projects as it is so easily accessible. “The Stripe Checkout is easy to integrate to any existing web application through many programming languages such as: NodeJS, Ruby, Python, PHP, Java, cURL, Go, .NET. The Checkout UI features 14 available languages, and it is updated to support Strong Customer Authentication (SCA) for European payments to reduce fraud since 14.9.2019.” (Ho, 2019). Stripe also has its very own checkout UI (as seen in figure 9) so developers can use the built in UI for ease of access or they can create their own custom checkout if they wish to match the layout of their application.

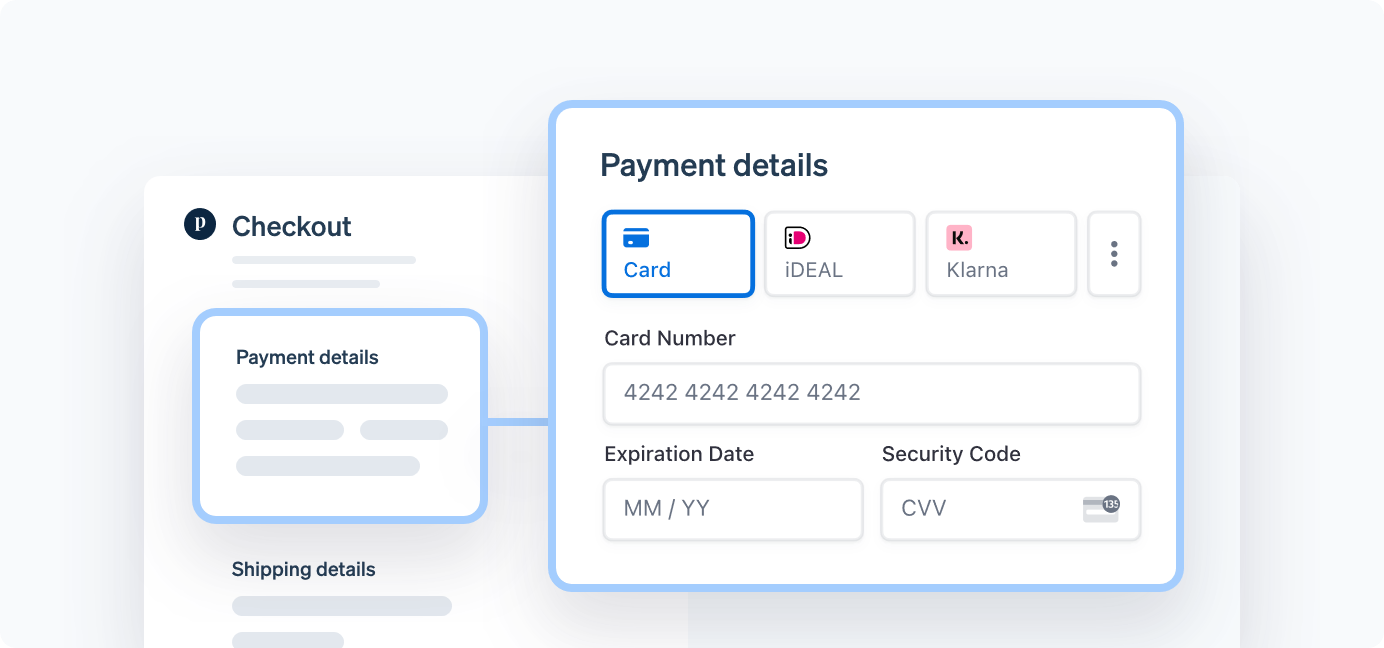


Figure 9 Stripe Checkout UI (Stripe, 2024)

### 7.3 Conclusion

In conclusion, integrating an ecommerce payment system to GameHub is essential if GameHub decides to make a storefront in the future along with the game tracking system. Both PayPal and Stripe are great options for this. They both have great security features and ease of integration which makes them both really reliable payment systems. However, if GameHub does make a storefront in the future, it will use Stripe. The main reason for this is because Stripe does not have a transaction fee on checkout while PayPal does. Otherwise, the decision would simply be down to preference.

## 8 User Experience (UX) Design

### 8.1 Importance of UX Design

The main goal of UX design is to ensure that the application is user-friendly and that users can easily navigate through the application and access the features easily. A good UX design should make complex tasks be executed simply and reduces the chance of users not knowing what to do. For the instance of GameHub this means creating an interface that allows users to track their gaming activities, discover new games and engage in the application without the frustration or confusion.

### 8.2 Key Principles of UX Design

The main principles of UX Design that GameHub will consider are:

User-Centred Design: The target audience should be the main priority of GameHub with the consideration of the design of the application. With the main demographic of gamers being males under the age of 34 (as seen in figures 10 and 11) they should be who the application is targeted towards as they take up 58% of the population of people who play games.

A graph of blue and white lines

Description automatically generated with medium confidence

## 

A screenshot of a graph

Description automatically generatedFigure 10 Gamer Demographics (Howarth, 2024)

Figure 11 Gamer Proportions (Howarth, 2024)

Consistency: especially in design elements including buttons, icons and colour schemes. This will help users learn how to interact with the application. Considering GameHub will be developed using Ionic, a cross-platform framework makes consistency even more important as the application should look the same across all platforms and not seem like a different application on mobile devices compared to the web version.

Responsiveness: again, considering GameHub will be using Ionic to be developed it is integral for it to be responsive across all platforms available. Meaning that the application should adapt to screen sizes, screen orientation so that users have the same experience no matter what platform they use.

## 9 Conclusion

This literature review has provided a comprehensive analysis of they key components that GameHub will utilize in its development process covering different fields such as databases, API integrations, development language, authentication and authorization, UX design and the possibility of an ecommerce element in the future.

Firestore was identified as the database of choice for GameHub which will work in conjunction with Firebase Authentication to provide a seamless user experience by interacting with each other.

The frontend will be developed with Ionic to make GameHub available on multiple platforms. A single codebase will be used and across the board and will help provide users with the same experience on all platforms.

Game data will be provided by the RAWG API. GameHub will utilise this API to populate data instantly for all users so they can manage what they are up to in their favourite games.

User Experience is also a main priority focusing on creating a thoroughly enjoyable and easy to manage experience. Responsiveness is also key in GameHub so that all users have the same experience on all platforms.

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