

RentIt

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1 Introduction

1.1 Vision

RentIt is a radio hosting service, that enables users to host online radio stations and for other users to listen to them. The creator of a channel can upload tracks to the channel, and based on how popular the tracks are among listeners, the system chooses which tracks to play next. It is a system intended to be used by the common user, without any special knowledge or training.

1.2 Glossary

Track: An audio file that the users can listen to via channels.

Channel: A collection of tracks that is played infinitely, and can be listened to by users. Managed by a channel host.

2 Specification

This section contains the functional and non-functional requirements, as well as the use cases that they are based on.

2.1 Use Cases

Create account: The user navigates to the "create account"/"register" page. He fills out required information and agrees on possible conditions.

Delete account: The user does not want to use the service any longer. He navigates to edit account and selects delete account. All data about the user is deleted accordingly.

Listen to channel: The user navigates to the channel, possibly by searching for it and selects "listen to channel".

Subscribe to channel: The user has selected a channel and selects "subscribe to channel". The subscription status changes accordingly.

Unsubscribe to channel: The user has selected a channel he is already subscribed to and selects unsubscribe to channel. The subscription status changes accordingly.

Comment channel: The user is on a channel and want to comment on it. He writes and submits the comment. The comment is saved and the page is refreshed

Create channel: The user navigates to "create channel" and fills out the required information as well as uploading tracks. When the user is done it is immediately accessible by other users.

Delete channel: The creator of the channel does not want the channel anymore and he decides to delete it. He navigates to edit channel and selects delete channel. All subscriptions to the channel are deleted, subscribers get notified, and the channel is removed.

Upload track: The user has a channel and wants to upload a song. He navigates to edit channel. He selects the song through a filebrowser and selects upload.

Delete track: The owner of a channel wants to remove a track from his channel. He navigates to edit channel. He browses the list of tracks and selects remove on the track he wants to remove.

Edit channel: The owner of the channel selects edit channel and edits the channel attributes he wants to change. Then he confirms the changes.

Upvote/downvote track: The listener of a channel selects up- or downvote on a list of the last tracks that has been played.

2.2 Functional requirements

The functional requirements describe the required functionality of the system and defines enumerations for reference.

R0: The system shall allow all users to create a channel, add attributes and edit the channel.

Domain concepts: The channel shall have its own collection of tracks that it plays. It is created and maintained by the channel host(the creator of the channel). The channel shall have genres, a description and comments posted by users. The channel must be visible to other users with proper search parameters.

Dependencies: The requirement is necessary for "upload track" and "listen to channel" because a track is associated with a channel.

Priority: It is of essential importance, since the functionality is prerequested for other fundamentally important requirements.

R1: The system shall allow users to listen to an online radio-channel that streams audio.

Domain concepts: A channel has a collection of tracks that can be listened to.

Priority: Highest as this is the primary service that the system provides.

Implementation notes: The system must be able to stream audio in a smooth and clutter-free manner. The system must have an intelligent way of selecting the next track to be played, meaning that it must consider up/downvotes and how much it has been played compared to other tracks of the channel. A radio-channel must be able to stream an endless stream of audio without pauses between audio tracks.

R2: The user shall be able to rate a track associated with a channel.

Domain concepts: The rating of a track must affect the frequency with which it is played within its associated channel. A higher rating giving a proportionally higher chance of being played.

Dependencies: The listen to channel requirement is dependant on this requirement because the track to be played is determined by its rating.

Priority: It is of essential importance, since the functionality is prerequisite for other fundamentally important requirements.

R3: It shall be possible for users with a channel to upload a track to it.

Domain concepts: A channel has tracks that are managed by the channel creator.

Dependencies: The listen to channel requirement is dependant on this requirement because the track can only be played to others if it has been uploaded to the server.

Priority: It is of essential importance, since the functionality is prerequisite for other fundamentally important requirements.

R4: It shall be possible for users to subscribe and unsubscribe to channels.

Domain concepts: A user has a collection of subscribed channels.

Priority: This requirement is of secondary importance because no essential requirements are dependent on this requirement. It is important because it helps classifying popular channels and helps the user navigate to his or her favorite channels.

R5: It shall be possible for user to comment on channels.

Domain concepts: A channel has comments that everyone can read and author.

R6: It shall be possible to create, delete and edit accounts. All attributes of an account shall be editable.

Domain concepts: All users of the system has an account.

Dependencies: As an account is required for the use of the system, all requirements are dependent on the creation of an account.

Priority: It is of essential importance to create an account, since the functionality is prerequested for other fundamentally important requirements. Delete and edit are of secondary priority.

2.3 Non-functional requirements

The non-functional requirements describes how the functionality shall work in multiple aspects, as well as defining success criteria for them. They are structured with FURPS+.

Functionality

Channels

Channel owners must be able to assign genre tags to the channels they control/own.

Two users listening to the same channel at the same time must hear the same song with same amount of elapsed time (Δ 1s), in other words, a channel is "playing" the same track for all listeners.

A function for searching for channels must be implemented.

A list of the most popular channels should be available to all users. Popularity must be based an attribute or a combination of attributes of channels and must me documented.

Tracks

The service must support tracks in .mp3 format.

Logging and Error Handling

All exceptional states must be logged.

All state changes must be logged.

Security

All usage requires authentication. (usage meaning the use of any services related to the program)

Usability

The website shall be intuitive to use for 90% of persons above the age of 12 to appeal to our target audience. Intuitive means that no use case may take more than 3 minutes to complete.

- listening to a channel
- maintaining one
- uploading songs
- voting
- subscribing

There must be help available for all functions in the form of text. This help must be accessible from within the client

Users must not be required to subscribe to a channel in order to listen to it.

Users must be required to be subscribed to a channel in order to vote on the channel.

If a user unsubscribes from a channel, all votes made by that user must be removed so as to not affect track ordering.

Users must be able to see all the songs contained in a channel.

Users must be able to upvote and downvote the last 5 songs that have been played on the channel while they were listening.

Users must not be required to download or install any third party software in order to listen to a channel.

Reliability

The server must not be affected by any errors clientside. All operations requires internet connection.

No system failure of any kind should affect any track in the persistence storage.

If a channel on the server crashes:

- all clients must be notified about the failure.
- the website must not be affected by the crash.
- the website must refresh the website with possiblity to listen to the channel greyed out until the channel have been fully recovered on the server side.
- on the server side, the channel stream must shut down.
- the error must be logged and reported automatically.
- the channel must be safe to use again when all track's identity have been confirmed(via hashing), and none of them are in use.

If upload of a track fails, everything about the track must be removed from the server and the user must be notified.

Supportability

The server architecture must not limit the ability to correct eventual errors. This means that no unnecessary coupling exists in the server. The server and website must be implemented modular so as to ease extendibility. This means that extensions such as video streaming or downloading of media must not require extensive changes in the system architecture.

The server will be running on Windows Server 2008 R2 Enterprise OS with support of .NET 4.0 Framework.

Implementaion

The server will be written in C# with the .NET 4.0 Framework and Windows Communication Foundation. The website will be written in ASP.NET and must work in all popular browsers.

2.4 Target Audience

The target audience of our RentIt Radio system is primarily users in the age 13-35. Since our system is not just a place to listen to music, but also a place to discuss music, older users might choose ordinary radiostations. Younger people are more used to social networks and the radio system is designed to be a social network combined with radio.

3 Analysis

This section contains considerations on how to implement the functional and non-functional requirements. This includes the possible solutions, the chosen solution and the reasoning for the choice.

3.1 Datamodel

The basic domain entities of the system consists of channel, user and track. The rest of the entities supports functionality that is required for the basic entities.

User and channel each represents a unique system entity, while track can represent the exact same data as another track, only separated by the id and the channel it belongs to. The decision to not let channels share tracks is because it would require analysis of the mp3 file to determine whether it is similar to another mp3 file, regardless of the name/artist combination. This design does not limit a possible extension of the system to measure similar mp3 files and update references to avoid redundant data in the file system, but such an extension will not remove redundant data in the database, as our datamodel does not support it. Track has an upvote and a downvote count, which vote entities have a functional dependency to, because each vote on a track causes upvote or downvote to increase. This duplication is made in order to speed up the algorithm, because it does not need to count vote entities when it has up- and down- vote counters.

The vote entity exists in order to prevent users from voting one track several times. TrackPlay is an entity that represents a play of a track. It is an entity and not an attribute of track, because we want to record the date that the track was played.

Genre is an entity and not an attribute of channel because we want to make a fixed set of genres to choose from when creating a channel.

3.2 Data storage

For storing information about our data classes. Microsoft SQL Server has been chosen because it is integrated with the server. The reason for choosing a DMBS¹ to store most of our data in is because it is fast and optimized for storing and retrieving data. However a research paper[reference] suggests that when it comes to an object with a size beyond 1 MB it is faster to store the object on the file system. Due to the knowledge acquired from the paper we chose to store our music files on the file system, because the average size of an mp3 file is around 3-4 MB. We have a table called track which have a path that indicates where the song is placed on the file system.

3.3 Webservice

The return types of most methods are intuitive. Methods which have at most one result will return the corresponding object, or a wrapper object in case it is an object which should reflect an object in the database, such as a channel or a user.

With methods which typically have more than one result, we have more options (methods like GetTrackIds and GetChannelIds). The first option is to return an array of the ids of the result. The second option is to return an array with all the objects associated with those ids. And the third option would be to return lazy objects, which were first completed (retrieved from the server) when the client called the object's methods. By returning an array of ids we allow the client to decide which objects they actually want to use time and bandwidth on retrieving completely. By returning all objects we force the instantiation of all objects in the server. And by using lazy objects we allow low bandwidth and only a single network transfer at first and wait until the objects are actually needed. The returning of ids give the clear advantage of giving complete control to the client. When the client retrieves an array of ids, it can decide for itself which objects it actually needs. The disadvantage for this is that our webservice api needs methods for retrieving single

¹Abbreviation for Database Management System

objects from id and the client have to call this method for each object it needs.

The advantage for sending all objects back in the first method call is that there will only be one method call and only one network-transfer. The disadvantages is that this could get really rough on the bandwidth and server load as some objects might contain images and other types of heavy properties and all objects would have to be completely instantiated. Another thing is that the client would have to handle this, possibly, huge load of objects even though it might not need to use most of them.

The advantage of lazy object instantiation is that it potentially loads fewer objects. The actual object instantiation and retrieval is done when it is needed the first time. A massive problem with this is, that the load times would be unstable even when the site is completely loaded. Simple clicks or hovers, which requires some new information, would have to make a new network transfer.

We have chosen to implement the solution which returns ids. This allows for several network transfers but the possibility of making the workload on the bandwidth and the server as low as possible for what is actually required. The problem with lazy objects is that we assume that users want a fully loaded website to actually be completely loaded and not have to wait for some objects, which is shown to be there, but isn't actually loaded.

In the method `GetChannelIds` (the method used for searching in all channels) we have chosen the input to be an instance of `SearchArgs`. The `SearchArgs` class contains properties for all the different arguments we allow to search on, this way we have one method which takes one argument, rather than a method which takes parameters for every single property we have in `SearchArgs`.

All objects we return, which is a representation of data from our database, will be returned as a customized wrapper object. This is in order for us to be in complete control of what we return to our clients and in order to keep our internal structure as hidden as possible. If we returned raw objects created by our entity framework, we would expose data which is not relevant for the user and which could be used for malicious purposes, for example filesystem paths.

3.4 GUI Technology

A major part of our web-client is the GUI(Graphical User Interface) and the choice of GUI technology and framework will have a great influence on our project. In the analysis phase, before we start the initial design of the GUI, we choose several different criteria for a great GUI framework:

- Familiarity - How familiar the programming team are with the technology or a related technology?
- Features - Does the technology have the features needed to support the features of our application?
- Support - Is the technology widely supported on different browsers and in different web environments?
- Extensibility/maintainability - Is the technology easy to maintain and extend and does it live up to common principles for good coding style, such as GRASP(General Responsibility Assignment Software Patterns)?

With these criteria defined, we consider several different GUI options:

3.4.1 Silverlight

Silverlight is a framework for creating rich web-applications and is especially known for its great streaming abilities(used by Netflix among others). A Silverlight application is declared in the Extensible Application Markup Language(XAML), the same language used for writing WPF applications. Silverlight is fully integrated with Visual Studio and C#, which is the language and IDE we are using to develop our web-service and the rest of our program. The developers in our team are very familiar with C# and the .NET framework and has previous experience with

Silverlight as well. The great streaming capabilities of Silverlight could also come in handy in our online radio-station application. Silverlight is not nearly as widely supported as other frameworks, such as ASP.NET or HTML5. It is often a necessity to download the Silverlight plug-in before you can use it. Recently, it has also been announced that Microsoft will stop to support Silverlight on future products, in favor of newer technologies.

3.4.2 HTML5

HTML is the common markup language used on the internet. Before HTML5, HTML was a reasonably promotive markup-language, that needed other languages and frameworks, such as JavaScript or Flash to implement more advanced features like video-streaming. With the introduction of HTML5, the language more advanced and now supports both video and audio-streaming, as well as SVG-graphics. HTML is the most widely used standard on the internet and even though HTML5 is not fully supported on every web platform yet, there can be no doubt that it will be soon. Because of its wide distribution, almost every other technology plugs well into it and there is a large amount of support to be found on the internet. The development team had no previous experience with HTML5 and would have to go through a learning process to be able to use it. Though HTML5 is much more advanced than the previous versions of HTML, it would still require another language, such as JavaScript, to use more advanced features, as well as a server side language for the code-behind operations.

3.4.3 ASP.NET

Asp.Net is a server-side framework developed by Microsoft and is used to dynamically create websites. It is a complete solution to creating a website with a build-in code-behind file written in C#. ASP.Net is very well integrated with Visual Studio, which is the IDE, that the development team is mostly familiar with. It creates a complete solution to the website, without need for supporting languages, such as JavaScript or PHP. It is widely supported on most browsers. Compared to Silverlight, it does not have the same streaming capabilities. The styling of components are not that pretty and might require some extra work.

3.4.4 Microsoft MVC

Microsoft MVC is a framework used to make ASP.NET websites structured in a model-view-controller pattern. It enables you to create very dynamic websites in a way that lives up to many of the GRASP [REFERENCE] principles for good and clean coding. With MVC you can create websites, that are easy to extend and maintain. Because the different components of the website are decoupled from one another, you can test these individually and utilize a lot of the unit testing tools available. It is a more advanced way to create a website, that requires some knowledge and experience to use. Our choice

We choose to use the MVC framework. Even though that it requires a learning period for the development team to master it, we find that the benefits that the framework gives outweigh it. It gives us the most possibilities for making a dynamic and well structured website. Some of the other GUI technologies are more simple, lightweight and easy to use, but they lack a lot of the structure and dynamic, that MVC has. For styling of the website, we use the Bootstrap layout, developed by Twitter. Bootstrap is not a framework, but simply consist of JavaScript files and CSS files, that styles the HTML elements. It is a simple and slick layout, that already has a lot of the styling we need.

4 Implementation

This section describes how the system is implemented by describing classes with a class diagram and functional dynamics with sequence diagrams.

4.1 Major classes

DatabaseDao

Communication with the database is done through a single data access object. This object functions as a bridge between the database and the server program, and it enables basic CRUD operations on the database for the server program.

FileSystemDao

Communication with the filesystem on the server is done through a single data access object. This object functions as a bridge between the filesystem and the program on the server. It enables the same basic operations on the filesystem as the DatabaseDao does on the database

RentItService

All communication between clients and the server, except the streaming of audio, go through this webservice class. It supports all the operations necessary to fulfill the requirements for the program.

TrackPrioritizer

This class selects tracks to be played based on the amount of times they have been played on the channel compared to other tracks, and the track rating.

Controller

This class is the single point of entry to the server programs functionality.

4.2 Class diagram

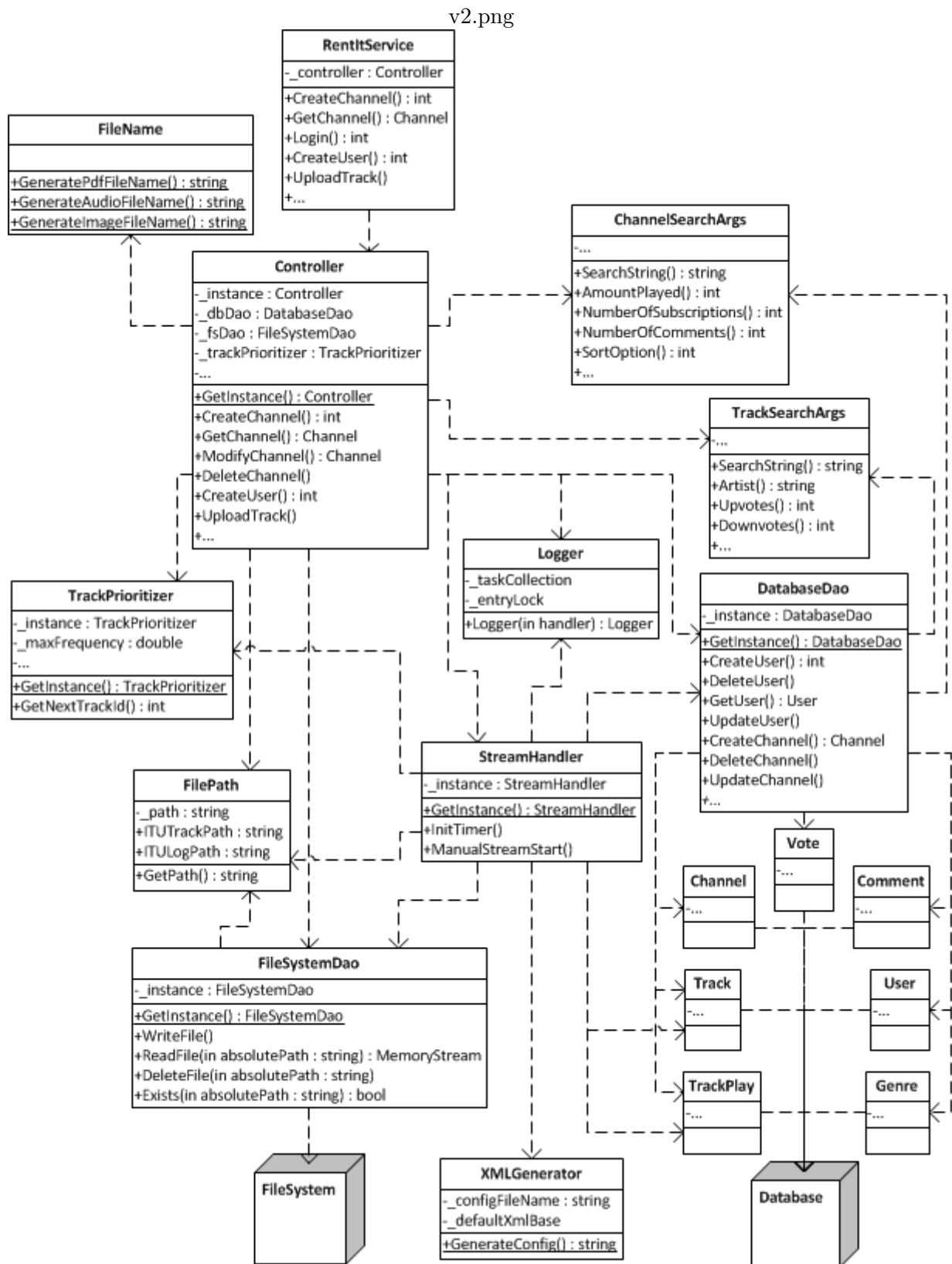
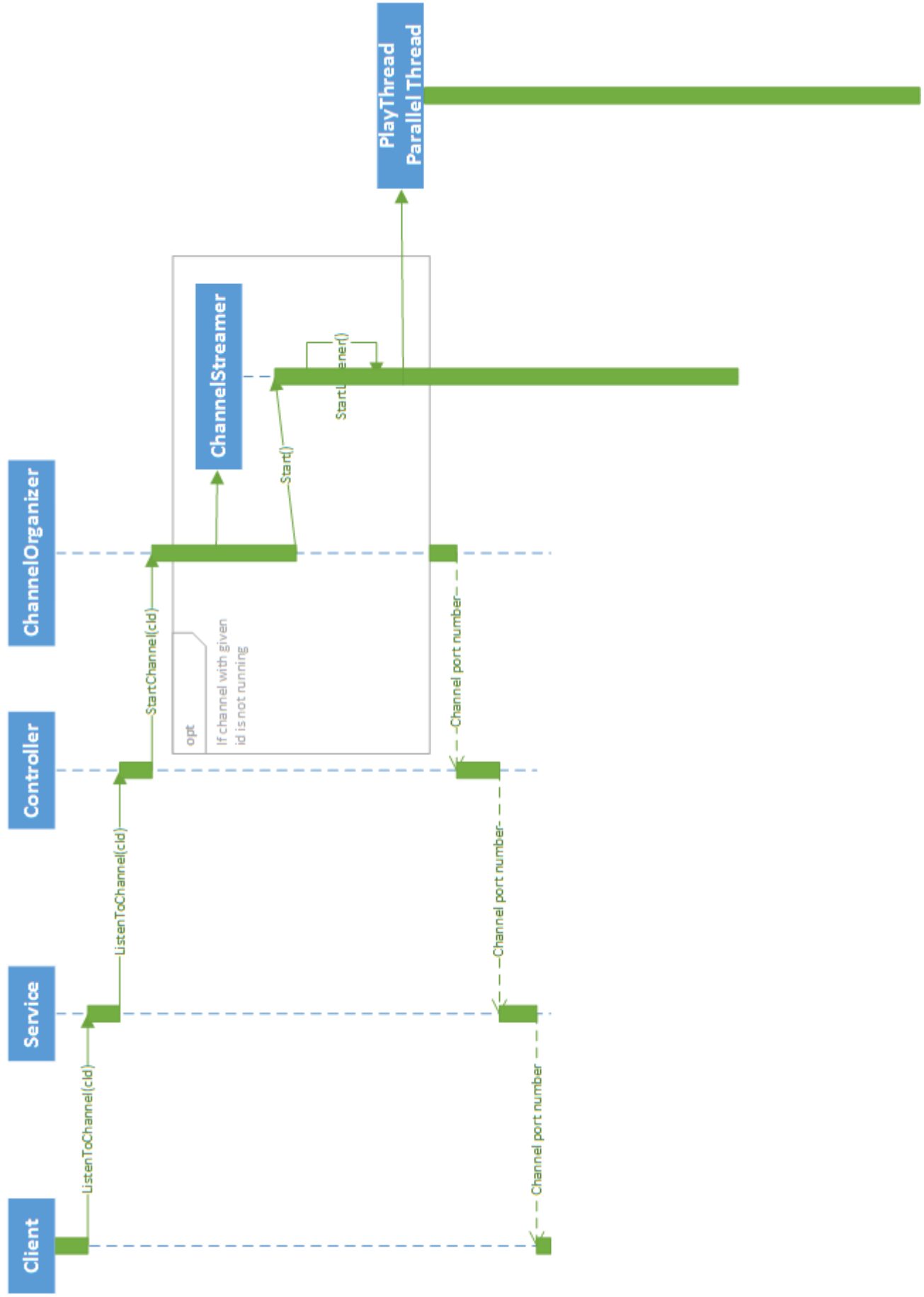


Figure 1: Class diagram of important methods and all classes

4.3 Sequence diagram



5 Testing Strategy

6 Collaboration with SMU

6.1 Interaction with the ITU system

As both the ITU system and the SMU system is an IS² and deployed on the same server, some of the classes have been reused in the SMU system and the ORM³ is in the same entity framework. The classes that have been reused are in the utilities namespace, and are FilePath, FileSystemDao and Logger. We have designed the classes in such a way, that a method call in one system can't affect the other system.

A success criteria for our systems is that an error or change in one system should not affect the other if not intended. Two different web services have been used to avoid that an erroneous method affects the other system. The drawback to this decision is that the clients cannot share web service methods without adding the other web service. However, none of the clients need the web service of the other system.

6.2 SMU webservice api

The following api is the api the group from Singapore requested.

- int SignUp(string email, string name, string password, bool isAdmin)
- int Login(string email, string password)
- User GetUserInfo(int userId)
- User UpdateUserInfo(int userId, string email, string username, string password, bool? isAdmin)
- void DeleteAccount(int userId)
- Book[] GetAllBooks()
- Book[] GetPopularBooks()
- Book[] GetNewBooks()
- Book[] SearchBooks(String searchString)
- Book[] GetBooksByGenre(String genre)
- Book GetBookInfo(int bookId)
- int HasRental(int userId, int bookId)
- Rental[] GetRental(int userId, int bookId)
- int RentBook(int userId, int bookId, int mediaType)
- MemoryStream DownloadPdf(int bookId)
- MemoryStream DownloadAudio(int bookId)
- MemoryStream DownloadImage(int bookId)
- Rental[] GetActiveUserRentals(int userId)

²Abbreviation for Information System

³Abbreviation for Object Relation Mapping

- Rental[] GetAllUserRentals(int userId)
- void DeleteBook(int bookId)
- int UploadBook(string title, string author, string description, string genre, double price, MemoryStream image)
- Book UpdateBook(int bookId, string title, string author, string description, string genre, double? price, MemoryStream image)
- void UploadAudio(int bookId, MemoryStream mp3, string narrator)
- void UploadPdf(int bookId, MemoryStream pdf)

6.3 Collaboration Considerations

One of the main focuses of the RentIt project was our collaboration with another development team at Singapore university(SMU)[reference]. There are many risk factors and challenges associated with international collaboration, especially when the collaborators do not come from the same cultural background. Simple communication tasks, that we take for granted when communication within our own team, can easily become an issue when collaboration with a foreign team and the differences in work routines, traditions and culture often leads to frustrations and project setbacks.

In this section, we will not cover any of the technical details about the program we developed with the SMU. We will focus on how the communication went and how well we worked together as part of an international collaboration. We will first analyse the potential faultlines[reference] between our development team and the team at SMU. Then we will discuss what we can do as team to avoid that these faultlines evolves into problems. Last, we will conclude on how successful our collaboration with the SMU team were and suggest changes we would make in an potential future collaboration.

Data on SMU team This is the data initial data we get from the SMU wiki. The SMU team consists of 3 members.

- Waritta: Girl from Thailand
- Umair: Boy from Pakistan
- Safouan: Boy from Qatar

6.3.1 Fault lines

A faultline is defined as a difference between two subgroups, that can potentially lead to a conflict. A faultline does not necessarily have to lead to a problem, but like the continental lines of the earth they can suddenly erupt and become one. A faultline enhances the notion of us and them, also known as ethnocentrism[reference]. We have analysed and identified the potential faultlines we see between the SMU team and us:

Geographical location The most obvious fault line is the difference in geographical location. The fact that all live in the same city and meet face to face on a regular basis is hugely different from our relationship with the SMUs, who we only see on a computer screen and communicate with through email and video chat. The difference in geographical is the fault line we measure all other fault lines against.

Gender diversity Our team is made up of only men, while the SMUs has one girl in their team. This makes their team a gender diverse team as opposed to ours.

Engineers/Designers The team at SMU university is responsible for the webclient, while we are responsible for the web-service. This division of work area creates a natural fault line between them and us. Us, as engineers who are handling data and logic, and them as designers working with windows and styling. The fact that our team has not had very much experience with web-design and the SMU teams smaller knowledge of web-services and backend programming, can lead to many misunderstanding and an ethnocentric view of our own subgroup. It can be tempting to blame the designers for not using the web service right, instead of putting an effort into understanding their website and modulating the web service to suit that as best as possible.

Social etiquette There is a large difference social norms in Denmark compared to those in Singapore. In Denmark we have a very casual tone in a work environment. We have a very homogenous society, where the difference between people are very little. We dislike hierarchies and talk to our superiors in the almost the same way, that we would talk to our colleges. In Singapore and many asiatic countries they have a much more strict social etiquette, where you behave a lot different when you are in an official environment compared to when you are in a casual, private environment. This difference can create a faultline between us and the SMUs. They might see us as rude and unprofessional, whereas we might see them as stiff and strict.

6.3.2 Solutions

The fault lines we have identified in the previous chapter are all risk factors, that can create conflict between us and the SMU development team. It is important to address and prepare so that the risk of conflict is minimized as much as possible.

The situation we want to avoid is a situation of ethnocentrism. Ethnocentrism is when a subgroup sees itself as superior to the other group as acts in a hostile and competitive way against it. The more faultlines we have that aligns with the geographical separation of the two groups, the more strong the ethnocentric situation will be. The situation we want is a situation of ethnorelativism[Reference]. Ethnorelativism is a situation where a subgroup takes the perspective of the other group and tries to understand their situation. Each subgroup adapts to the context other subgroup and the notion that both development teams are part of one overarching subgroup is enhanced. What steps can we take to achieve this?

A good way to increase the ethno relativistic situation is to find the lines where our development team and the SMUs have something in common.

Students Both our development team and the SMU team consists of students. This gives us a lot of things in common. We all have to deal with exams, with the educational system, with deadlines and work. The fact that we have to deal with these things draws a faultline between us and them and the rest of the world, and thereby increases our sense of belonging to the same subgroup. This subgroup is further strengthened by the fact, that our educations are very much alike.

Age Both our team and the SMU team between 20 and 30 years old. Even though that the age in itself does not mean we have anything in common, it makes it likely that our general life situations are alike. We are more likely to have an outgoing lifestyle, to not have kids and to be somewhat unsettled in our lives so far. We will likely have many of the same pop-culture references and be interested in many of the same subjects.

Language Both us and the SMUs have the english language in common. In both Singapore and in Denmark a reasonably high level of english is taught and spoken by the students. This gives us a good common ground for expressing ourselves and potentially enhances the feeling that we belong to the same subgroup.

In our communication with the SMUs, we must remember these commonalities and share them with the SMUs. Information sharing[Reference] is a way to build a more moderate and accurate picture of another subgroup. Often, fault lines are build on prejudice and these can be removed by the sharing of information across the subgroups. We must share information about our background, our lives as students and ask them about theirs. Multural Positive Distinctiveness(MPD)[reference] is also a point we must address. If we define in our subgroup what we are good at, it is easier for us to accept another subgroup and respect their field of expertise. In our communication with the SMUs we must also give them credit for their field of expertise.

6.3.3 Conclusion of the SMU collaboration

We have analysed the Fault Lines and identified the ways to avoid them. How did the collaboration actually go?

In our first video session with the SMUs, the communication was very formal. It was a timeboxed meeting and we both had a teacher present outside the meeting room. In the next meetings the tone became more relaxed and casual. It turned out that none of the members of the SMU team came from Singapore, but from Thailand, Qatar and Pakistan, and it most likely had a big impact on the collaboration. Because they were not from the same country, they did not see themselves as a part of the same cultural group and therefore the fault line between us and them was weakened. At their suggestion, we utilized a chat application called WhatsApp[Reference] which gave us direct communication with each individual member of the SMU team. In between meetings we used this to engage in formation sharing, both related to the project, but also casual talk. In this way we could learn about the members in the SMU team on a more personal level and helped to understand things from their perspective. Some of the members has even kept contact since we finished the project.