System and Software Architecture Description (SSAD)

Newlette Coins

Team 06

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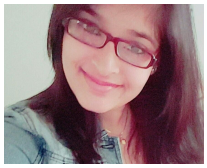	Santhoshi Priyanka Gooty Agraharam	gootyagr@usc.edu	Project Manager	Tester
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Version History

Date	Author	Version	Changes made	Rationale
10/8/16	TC	1.0	● Initial draft	● Initial draft for use with Instructional ICM-Sw v1.0
10/9/16	NS	1.1	● Updated artifacts and use-cases	● For better requirements coverage
11/28/16	TC	2.0	● Updated topics - Tehnical-Dependent Model - Architectural Styles	● Describe in-depth details of the system
12/3/16	TC	2.1	● Adjust layout ● Update table of contents, figures, tables	● For better reading

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1. Introduction

1.1. Purpose of the SSAD

This System and Software Architecture Description is created to describe the in-depth essential detail of the project that includes

- Software architecture
- Technology, tools and framework
- Software Lifecycle
- Security

1.2. Status of the SSAD

This is the first version of SSAD. It contains the System Analysis - context, artifact, behavior and Architectural styles, patterns & frameworks.

2. System Analysis

2.1. System Analysis Overview

The primary purpose of the Newlette Coins project is to provide the users with an easy to understand board game that can be played on both touch-based and pointer-based devices including phone, laptop, tablet & desktop. The system keeps track of all the games played by a user along with points win/lose. The system also maintains a leaderboard listing the top scorers in the game.

2.2. System Context

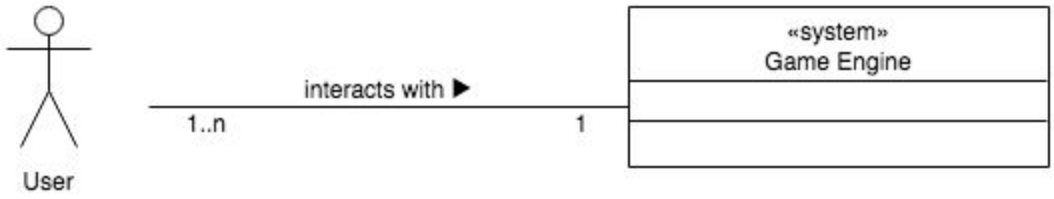

Figure 1 System Context Diagram

Table 1: Actors Summary

Actor	Description	Responsibilities
User	*General public including people of all ages.*	• *Register and login into the game* • *Plays the game by selecting a multiplier bid and placing bombs* • *Views his/her game history* • *View leaderboard*

2.2.1. Artifacts & Information

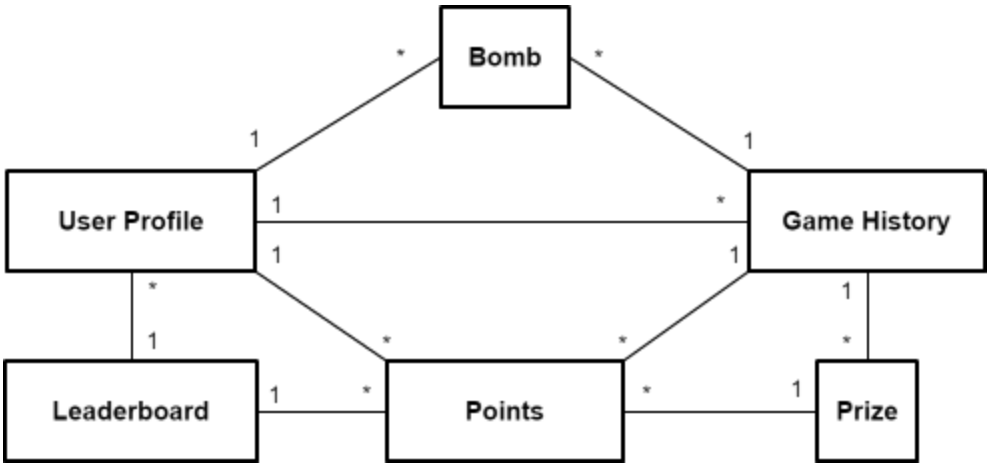

Figure 2: Artifact Diagram

Table 2: Artifacts and Information Summary

Artifact	Purpose
ATF-1: User Profile	Contains all profile information about the user including name, avatar(profile image), email, login credentials and earned points from playing games
ATF-2: Game History	Contains all historical data of played game by user including location of bombs, earned prizes and total points
ATF-3: Leaderboard	Contains the ranking information of users based on their points
ATF-4: Points	Contains all points of the user
ATF-5: Prize	Contains all prizes created by the system when a user clicks detonate button

2.2.2. Behavior

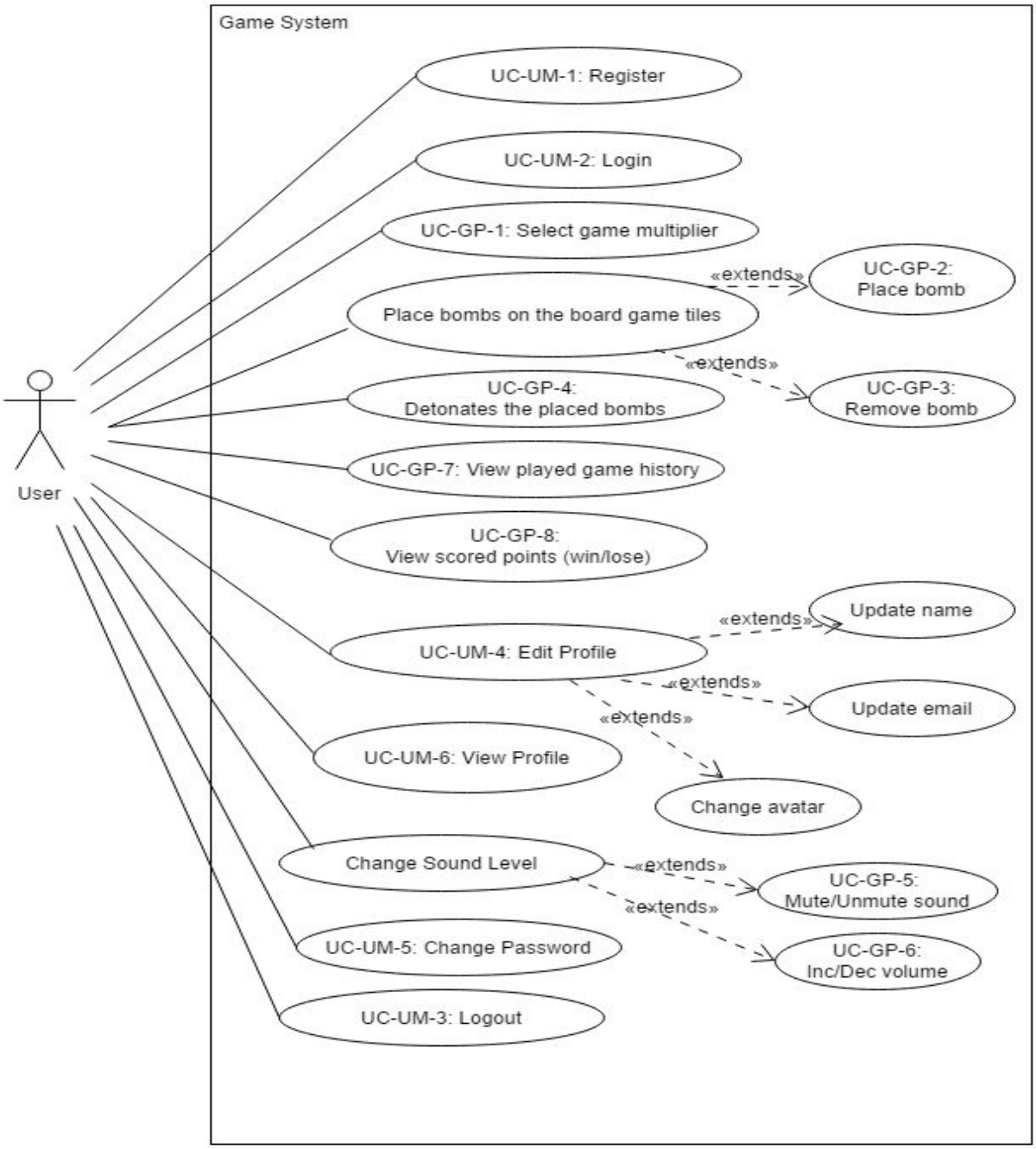

Figure 3: Use Case Diagram

2.2.2.1. User Management

2.2.2.1.1. Register a new account

Table 3: Register: Process Description

Identifier	UC-UM-1: Register

Purpose	To create a user login credentials to login to the game
Requirements	The user must use these information to create an account - Firstname - Lastname - Email - Password
Development Risks	Validate all the input to avoid query injections.
Pre-conditions	The email address must be unique and valid
Post-conditions	A new user account is created

Typical Course of Action

Table 4: Register: Successful

Seq#	Actor's Action	System's Response
1	Open game website in the web browser	The web browser shows Newlette Coins login page.
2	Click on 'New Account'	The web browser redirect to register page
3	Input Firstname, Lastname, Email, Password	
4	Click on 'Register'	System validates the email address and password combination, creates a new user account and login user into the game
		System redirects the user to game screen.

Alternate Course of Action
Table 5: Register: Failure

Seq#	Actor's Action	System's Response
1	Open game website in the web browser	The web browser shows Newlette Coins login page.
2	Click on 'Register'	The web browser redirect to register page
3	Input Firstname, Lastname, Duplicated Email, Password	
4	Click on 'Register'	System pop ups an error message indicates that the email is already existed

2.2.2.1.2. Login

Table 6: Login: Process Description

Identifier	UC-UM-2: Login
Purpose	To allow user to use their login credentials to login into the game
Requirements	The user must use these information to login - Username - Password
Development Risks	None
Pre-conditions	The user has already an account
Post-conditions	The game screen is displayed

Typical Course of Action

Table 7: Login: Successful

Seq#	Actor's Action	System's Response
1	Open game website in the web browser	The web browser shows Newlette Coins login page.
2	Input Username and Password	
3	Click on 'Login'	System validates the username and password and
		System redirects the user to the game screen.

Alternate Course of Action

Table 8: Login: Failure with invalid username or password

Seq#	Actor's Action	System's Response
1	Open game website in the web browser	The web browser shows Newlette Coins login page.
2	Input Username and invalid Password	
3	Click on 'Login'	System validates the username and password and pop ups error message indicates that his credentials is invalid

2.2.2.1.3. Logout

Table 9: Logout: Process Description

Identifier	UC-UM-3: Logout
Purpose	To allow user to logout from the game
Requirements	The user must click on Logout button
Development Risks	None

Pre-conditions	The user is logged in and he is in a game screen or board screen
Post-conditions	The login screen is displayed

Typical Course of Action

Table 10: Logout: Successful

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with Logout link will be visible
2	Click on 'Logout'	System invalidates this user's session
		System redirects the user to the login screen

2.2.2.1.4. Edit Profile

Table 11: Edit Profile: Process Description

Identifier	UC-UM-4: Edit Profile
Purpose	To allow user to change/update his information (Avatar, Name, Email)
Requirements	The user must click on Edit Profile button
Development Risks	None
Pre-conditions	The user is logged in and he is in a game screen or board screen
Post-conditions	The user's profile is updated

Typical Course of Action

Table 12: Edit Profile: Successful

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with Edit Profile link will be visible
2	Click on 'Edit Profile'	System redirects the user to edit profile page
3	Enter information required	
4	Click on 'Save'	Save updated user profile and display pop up message indicates that his user profile is saved

Alternate Course of Action

Table 13: Edit Profile: Failure with invalid profile information

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with Edit Profile link will be visible

2	Click on 'Edit Profile'	System redirects the user to edit profile page
3	Enter information required with some invalid informations	
4	Click on 'Save'	Edited user profile is not saved and display pop up message indicates which field is invalid

2.2.2.1.5. Change Password

Table 14: Change Password: Process Description

Identifier	UC-UM-5: Change Password
Purpose	To allow user to change his/her login credentials
Requirements	The user must click on Change Password button
Development Risks	None
Pre-conditions	The user is logged in and he is in a game screen or board screen
Post-conditions	The user's password is updated

Typical Course of Action

Table 15: Change Password: Successful

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with 'Change Password' link will be visible
2	Click on 'Change Password'	System redirects the user to change password page
3	Input these information - New Password - Confirm Password - Current Password	
4	Click on 'Change'	Save new user password and display pop up message indicates that his user profile is updated

Alternate Course of Action

Table 16: Change Password: Failure with different new password and confirm password

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with 'Change Password' link will be visible
2	Click on 'Change Password'	System redirects the user to change password page
3	Input these information	

	- New Password - Confirm Password - Current Password	
4	Click on 'Change'	User password doesn't change and
		System display pop up message indicates that the new password and confirm password must match

Table 17: Change Password: Failure with invalid current password

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with 'Change Password' link will be visible
2	Click on 'Change Password'	System redirects the user to change password page
3	Input these information - New Password - Confirm Password - Current Password	
4	Click on 'Change'	User password doesn't change and
		System display pop up message indicates that the user inputted wrong password

2.2.2.1.6. View Profile

Table 18: View Profile: Process Description

Identifier	UC-UM-6: View Profile
Purpose	To allow user to view his personal information
Requirements	The user must click on My Profile link
Development Risks	None
Pre-conditions	The user is logged in and he is in a game screen or board screen
Post-conditions	The profile page is displayed

Typical Course of Action

Table 19: View Profile: Successful

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with My Profile link will be visible
2	Click on 'My Profile'	System redirects the user to the his profile page

2.2.2.2. Gameplay

2.2.2.2.1. Select multiplier

Table 20: Select Multiplier: Process Description

Identifier	UC-GP-1: Select multiplier
Purpose	Allow a user to choose multiplier factor which cause a user to spend more points in order to earn more prizes. (High risk high return)
Requirements	The user must click on predefined board images shown in the game screen
Development Risks	None
Pre-conditions	The user is logged in and currently in board screen The user have enough points for that multiplier factor
Post-conditions	The multiplier factor is selected

Typical Course of Action

Table 21: Select multiplier: Success

Seq#	Actor's Action	System's Response
1	Click on one of the multiplier factor button	System show some effects on that button

Alternate Course of Action

Table 22: Select multiplier: Failure with not enough points

Seq#	Actor's Action	System's Response
1	Click on one of the multiplier factor button which requires more point than the user's current point	The button is disabled and user is unable to click it

2.2.2.2.2. Place bombs on a board game tiles: Add a bomb

Table 23: Add Bomb: Process Description

Identifier	UC-GP-2: Add a bomb
Purpose	Allow a user to freely place a bomb on given grids
Requirements	The user must click on given grids
Development Risks	Finding attractive images and animations of a bomb

Pre-conditions	The user is logged in and currently in board screen The user cannot place more bombs than the current board limitation.
Post-conditions	A bomb is placed on a selected grid

Typical Course of Action

Table 24: Add Bomb: Successful

Seq#	Actor's Action	System's Response
1	Click on one of given grids	A bomb appears in the canvas of the web browser on a selected grid
		Number of user bombs is reduced

Alternate Course of Action

Table 25: Add Bomb: Try to place more than the game's bomb limit

Seq#	Actor's Action	System's Response
1	Click on one of given grids while the number of placed bombs are at limit	Nothing happens

2.2.2.2.3. Place bombs on a board game tiles: Remove a bomb

Table 26: Remove a bomb: Process Description

Identifier	UC-GP-3: Remove a bomb
Purpose	Allow a user to remove a placed bomb on given grids
Requirements	The user must click on given grids with a bomb
Development Risks	None
Pre-conditions	The user is logged in and currently in board screen There is a bomb on a selected grid
Post-conditions	A bomb is removed on a selected grid

Typical Course of Action

Table 27: Remove a bomb: Success

Seq#	Actor's Action	System's Response
1	Click on one of given grids with a bomb on	A bomb disappears in the canvas of the web browser on a selected grid
		Number of user bombs is increased

Alternate Course of Action

Table 28: Remove a bomb: Click on a grid with no bomb

Seq#	Actor's Action	System's Response

1	Click on one of given grids with no bomb	Nothing happen

2.2.2.2.4. Detonate all bombs

Table 29: Detonate: Process Description

Identifier	UC-GP-4: Detonate bombs
Purpose	Allow a user to detonate placed bombs to earned points and prizes
Requirements	The user must click on a detonate button
Development Risks	The sequence of animations to be shown The security issues in a connection between the game and backend server such as CORS
Pre-conditions	The user is logged in and currently in board screen There are bombs on a selected grid The user must select his desired multiplier factor The user must have enough points for selected multiplier factor
Post-conditions	The user gains/loses points (based on points they earned and points they spent) The earned prizes and points are recorded in the system

Typical Course of Action

Table 30: Detonate: Successful

Seq#	Actor's Action	System's Response
1	Click on one of multiplier factors button	The selected button shows an effect indicated that it has been selected
2	Click on a detonate button	Bombs' explosion animation are animated
		Prizes are shown on each grid.
		Number of point earned and number of point spent are shown on the screen
		Reset the board for new round - Remove all bombs - Fill user's bombs - Reset number of point earned and point spent

Alternate Course of Action

Table 31: Detonate: Not enough points scenario

Seq#	Actor's Action	System's Response
1	Click on a detonate button while user doesn't has enough points	System pop ups an error message indicate that user has not enough points to play with selected multiplier

Exceptional Course of Action

Table 32: Detonate: Network issues scenario

Seq#	Actor's Action	System's Response
1	Click on a detonate button while there is no internet connection or some network issues	System pop ups an error message indicate that user has no internet connection
		No points will deducted from the user
		The user will be redirected to login page

2.2.2.2.5. Change Sound Level: Mute or Unmute sound

Table 33: Change Sound Level: Process Description

Identifier	UC-GP-5: Mute/Unmute sound
Purpose	Allow a user to mute or unmute sound
Requirements	The user must click on Mute/Unmute button
Development Risks	None
Pre-conditions	The user is logged in and currently in game screen or board screen
Post-conditions	The game sound is mute or unmute based on previous status

Typical Course of Action

Table 34: Change Sound Level: Mute sound

Seq#	Actor's Action	System's Response
1	Click on Mute button	The game sound is mute
		Mute button is changed to Unmute button

Table 35: Change Sound Level: Unmute sound

Seq#	Actor's Action	System's Response
1	Click on Unmute button	The game sound is unmute

		Unmute button is changed to Mute button

2.2.2.2.6. Change Sound Level: Adjust sound volume

Table 36: Adjust volume: Process Description

Identifier	UC-GP-6: Inc/Dec Volume
Purpose	Allow a user to adjust sound volume
Requirements	The user must click on Volume level slider
Development Risks	None
Pre-conditions	The user is logged in and currently in game screen or board screen The game sound is not muted
Post-conditions	The game sound volume is adjusted

Typical Course of Action

Table 37: Adjust volume: Increase volume

Seq#	Actor's Action	System's Response
1	Adjust volume level slider to the right	The game sound volume is increase

Table 38: Adjust volume: Decrease volume

Seq#	Actor's Action	System's Response
1	Adjust volume level slider to the left	The game sound volume is decreased

2.2.2.2.7. View played game history of the user

Table 39: View History: Process Description

Identifier	UC-GP-7: View played game history
Purpose	Allow a user to view his historical gameplay data such as earned points and locations of placed bombs
Requirements	The user must click on My History link
Development Risks	None
Pre-conditions	The user is logged in and currently in game screen or board screen
Post-conditions	The gameplay history page is shown

Typical Course of Action

Table 40 : View History: Successful

Seq#	Actor's Action	System's Response
1	Click on his avatar picture on right top of the window	A dropdown list with 'My History' link will be visible
2	Click on 'My History'	System redirects the user to gameplay history page

2.2.2.2.8. View scored points (win/lose)

Table 41: View Score: Process Description

Identifier	UC-GP-8: View scored points
Purpose	Allow a user to view his total points and his win/lose records
Requirements	None
Development Risks	None
Pre-conditions	The user is logged in and currently in game screen or board screen
Post-conditions	None

No Action is required

2.2.3. Modes of Operation

The system Newlette Coins as we envision it has only one mode of operation.

2.3. System Analysis Rationale

The primary purpose of Newlette Coins project is to provide a web-based game which will work on multiple devices including phones, tablets, laptops and desktops. The board game allows the user to place bombs in order to detonate tiles and find the treasure beneath. Points are awarded for different prize items. Game history for a player is maintained and the game includes a leaderboard showing users with maximum points.

3. Technology-Dependent Model

3.1. Design Overview

3.1.1. System Structure

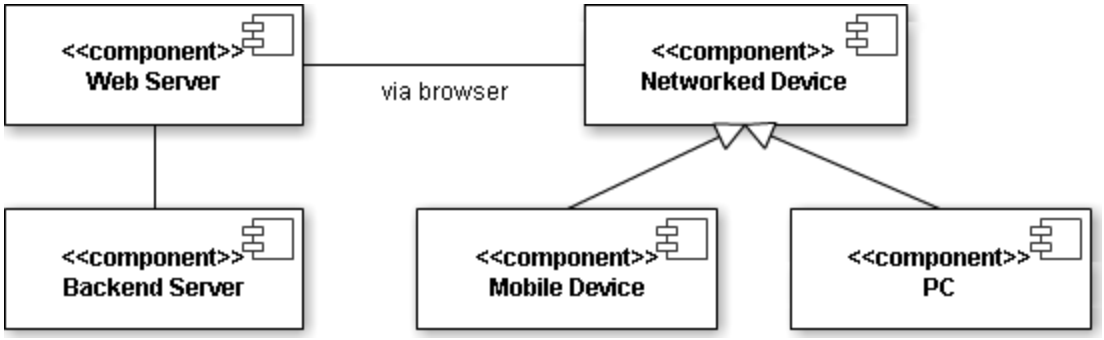

Figure 4: Hardware Component Class Diagram

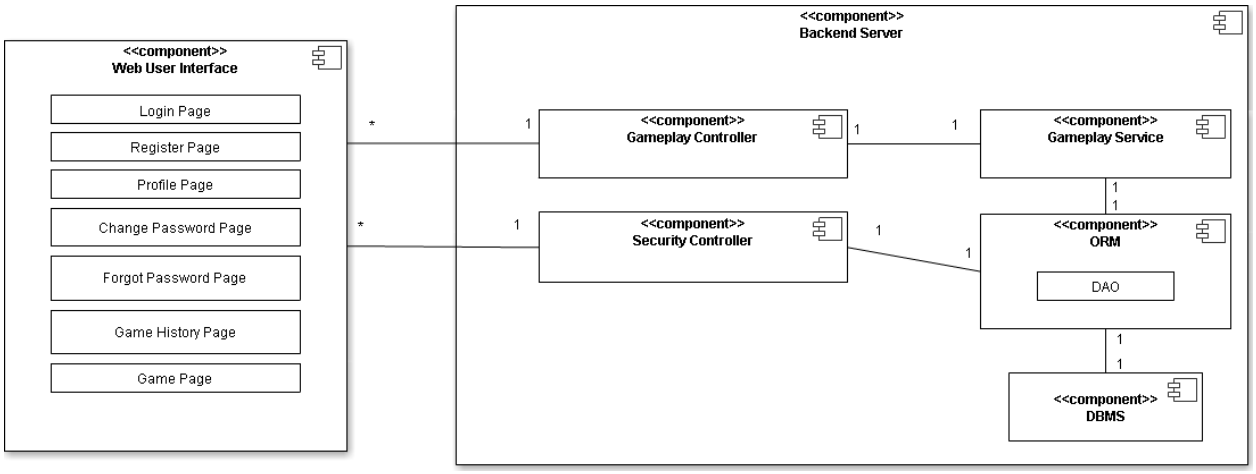

Figure 5: Software Component Class Diagram

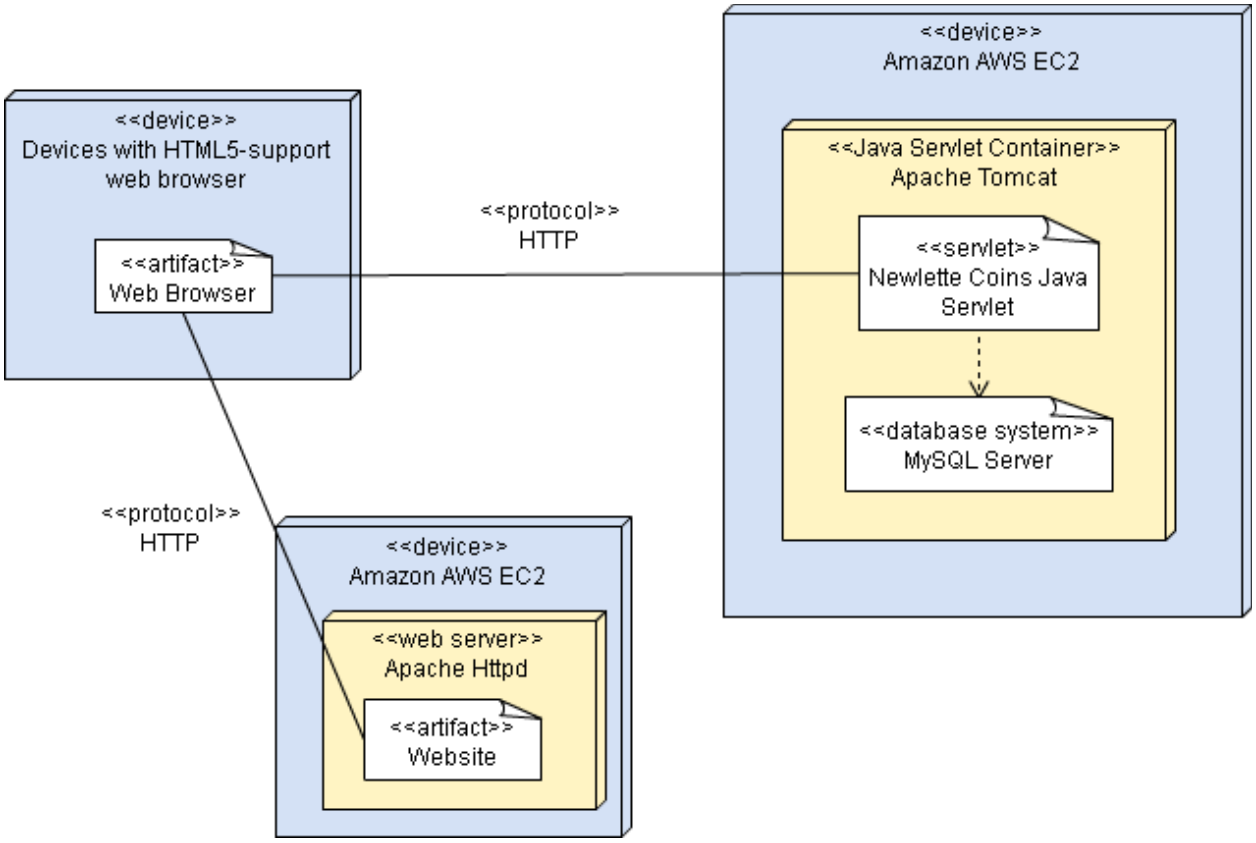

Figure 6: Deployment Diagram

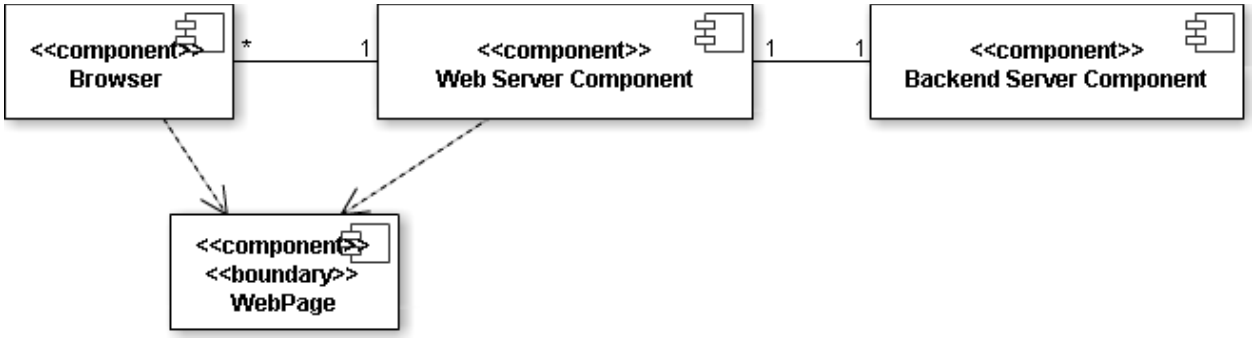

Figure 7: Supporting Software Component Class Diagram

Table 42: Hardware Component Description

Hardware Component	Description
Networked Device	Any device that is connected to internet. User can open a browser with that device and play Newlette Coins.
Mobile Device	One of the networked devices that user can play the game on.
PC	One of the networked devices that user can play the game on.
Web Server	The server that our frontend application will be running on it.
Backend Server	The server that our backend application and database of our system will be running on it.

Table 43: Software Component Description

Software Component	Description
Backend Server	This component contains all endpoints for requests about gameplay. It provides a response for each incoming request from the web server created by user's events.
Gameplay Controller	A component that is responsible for calculate all the game's constraints, user's points, user's items. And, act as an endpoint to receive incoming requests about gameplay from users.
Security Controller	This component contains an endpoint for requests about user credentials and receive incoming requests for register user, login, change password, reset password.
Gameplay Service	A component to calculate all business logics about gameplay such as calculate user's points, items' location, points used and items earned based on designed ratio.
ORM	Data Access Objects classes that are used for connecting to database.
DBMS	Represents the database of our system.
Login Page	Page for user login
Register Page	Page for user register
Forgot Password Page	Page for user who forgot his password
Change Password Page	Page for user to change his password
Profile Page	Page for user profile
Game History Page	Page for user's played game history
Game Page	Page for user to play Newlette Coins

Table 44: Supporting Software Component Description

Support Software Component	Description
Browser	An internet browser that opens Newlette Coins web application. It is responsible for render all game pages and user interfaces.
Web Server Component	The server component that presents the web browser with all static files such as HTML and Javascript files.
Backend Server Component	The server component where all Newlette Coins' business logics are calculated.

3.1.2. Design Classes

3.1.2.1. Backend Project

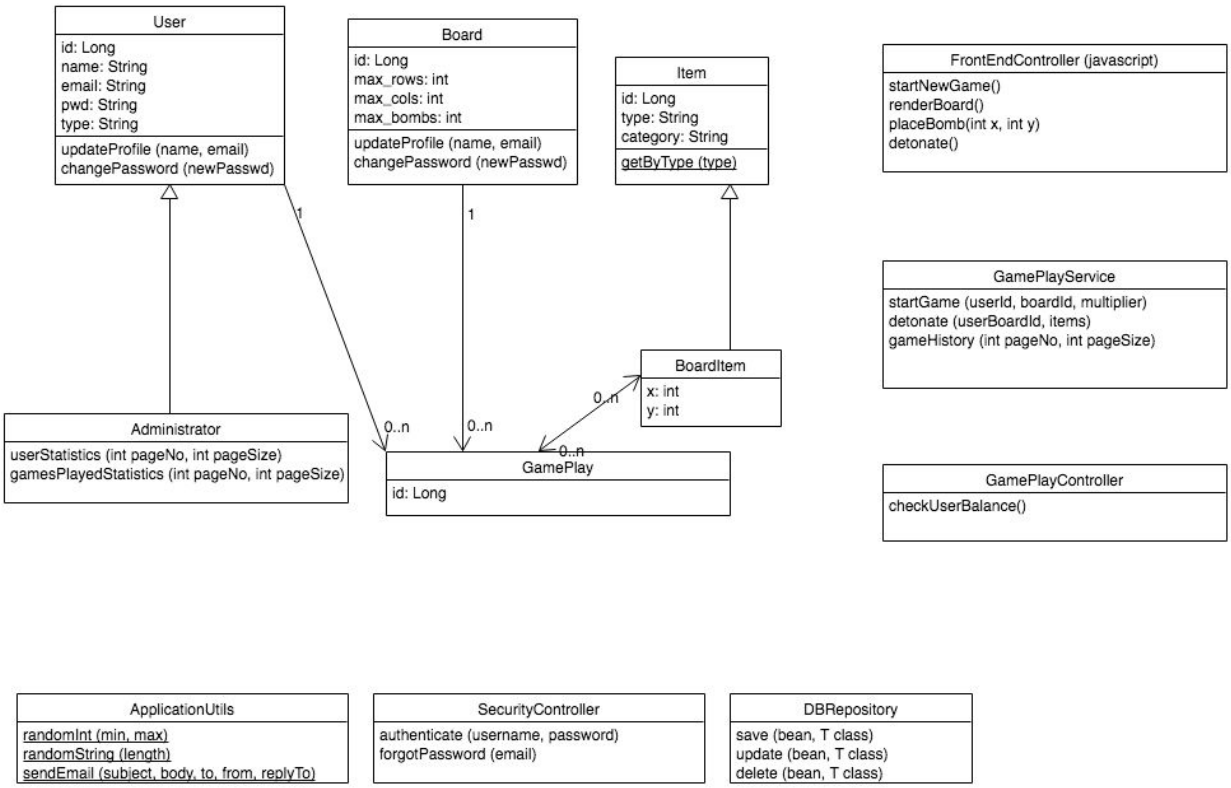

Figure 8: Backend Project Class Diagram

3.1.2.2. Frontend Project

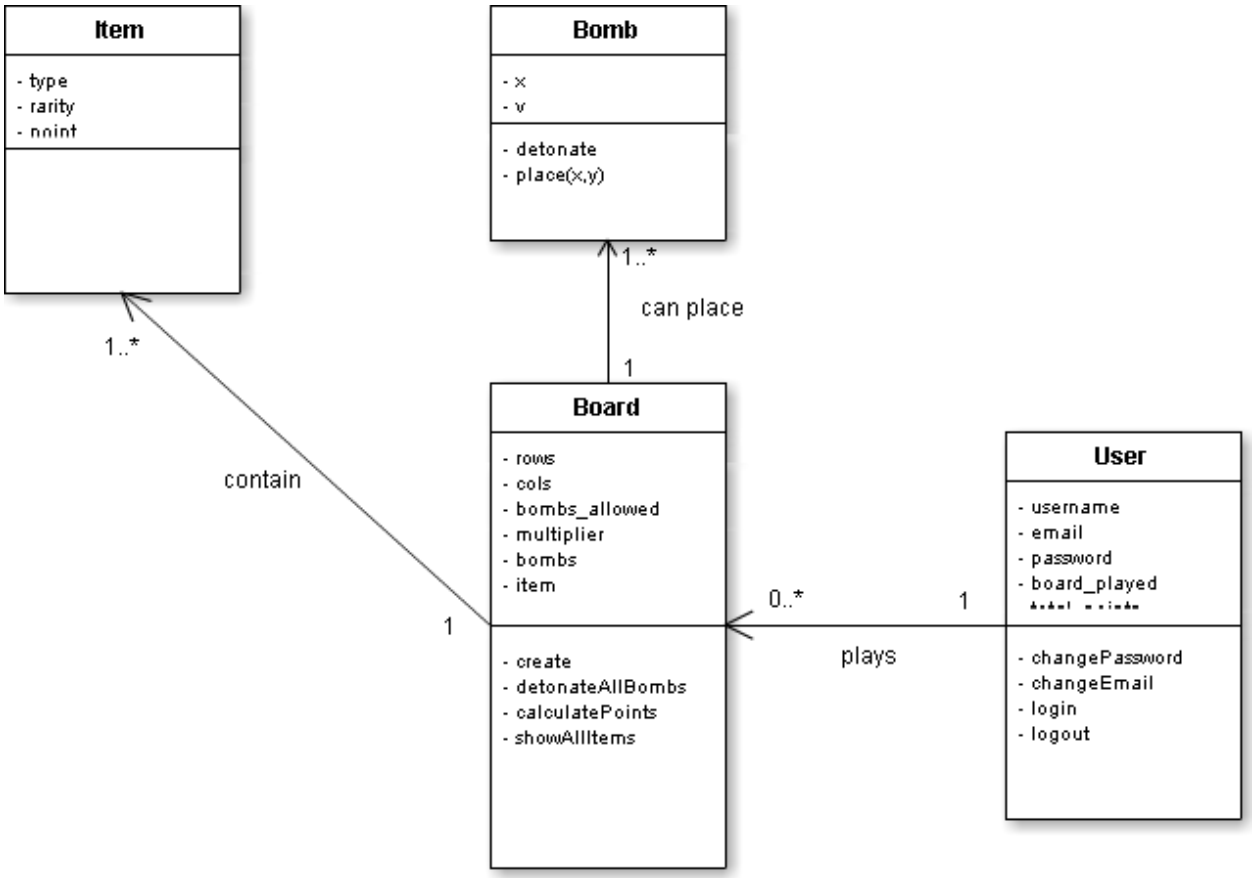

Figure 9: Frontend Project Class Diagram

3.1.3. Process Realization

For the main function of the game(User places and detonates bombs), we decided to create a sequence diagram to demonstrate its feature.

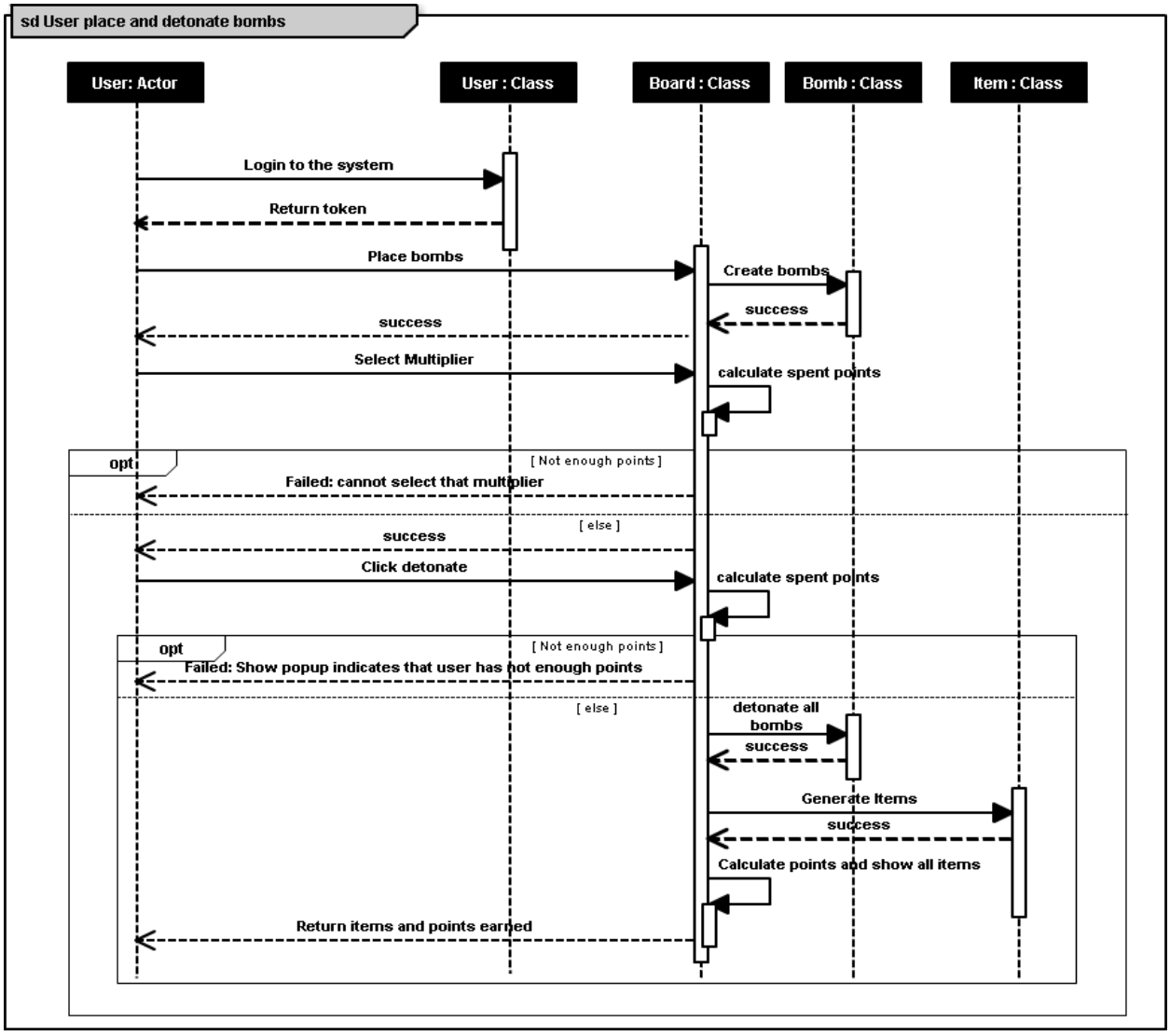

Figure 10: Sequence Diagram - User places and detonates bombs

3.1.4. State Diagram

The game process flows have been controlled using states. In order to make sure that we can understand the flow of our game's main function, we decided to create a state diagram.

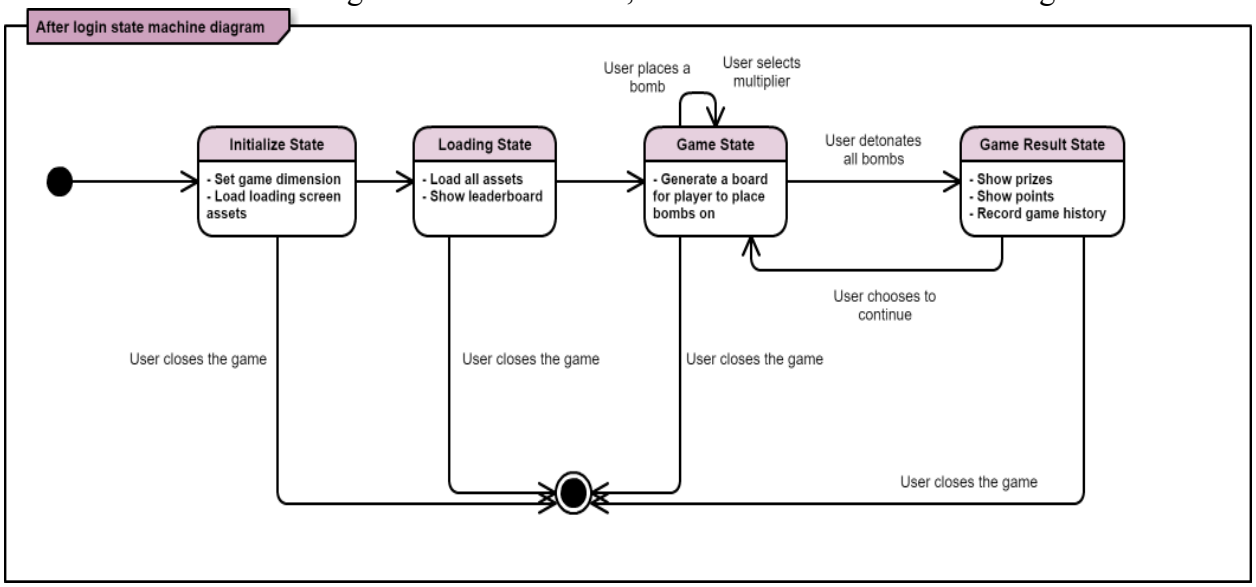

Figure 11: In-game State Diagram

3.2. Design Rationale

By decided to develop a mobile game, Newlette Coins, we have chosen HTML5 language, a programming language that is fully supported across multiple devices, as a primary language to develop the game. Thus, to develop a complexed game using only HTML5 language is not an appropriate way to do. So, we use Phaser.JS (Desktop and mobile HTML5 game framework) to develop Newlette Coins because it provides many functionalities to develop a HTML5 game. Moreover, the client, Crazy Cool Apps Co. Ltd, has many experience using this framework.

On the backend side, we decided to use Spring Framework for an implementation. This framework is an application framework that facilitates a developer to develop Java application with ease. Furthermore, the source code can be easily maintained by the maintainers because of its architecture that enforces separation of concerns by separate the business logic via many artefacts such as controller, service and repository.

We separate the frontend part and the backend part into different servers to improve security measures and scalability potential. This provide the maintainer ability to track which server will consume more resources and then they can increase the resource of that device. Moreover, they can create a load balancer on both frontend and backend server because both of them are stateless application.

4. Architectural Styles, Patterns and Frameworks

4.1. Frameworks

In the table below, you can see list of architectural styles, patterns and frameworks that we used in the implementation of Newlette Coins.

Table 45: Architectural Styles, Patterns, and Frameworks

Name	Description	Benefits, Costs, and Limitations
3-Tier Architecture	Modular code design with services, controllers, repositories and models.	Easy maintenance and loosely coupled code
Spring	Java library to provide dependency injection support	Provides ability to inject objects without worrying about the hassle of initialization. Ensures fast development Free & open source
Spring Data	Java framework	Provides an extensible and pre-defined framework for common database operations. The framework is time-tested and stable, thereby no bugs and large community support Faster development Free & open source
Hibernate	Java object relational mapping framework	Highly popular ORM framework provides ability to treat db objects as core java objects, thereby saving time to marshall/un-marshall between db tables and java entities Free & open source
TestNG	Java testing framework	Easy test setup and configuration through annotations with hooks at class & method levels Free & open source
Mockito	Java mock framework	Provides ability to mock un-necessary objects during unit-testing with pre-defined invocation results Free & open source
PhaserJS	Javascript framework	Desktop and mobile HTML5 game framework. Free & open source
MySQL	Relation Database Management System	An open-source relational database management system (RDBMS).

State Design Pattern	Design Pattern	Easy to manage the scene, the data and the status of the game.