CS 319 - Object-Oriented Software Engineering

Analysis Report – Revised

Bombplan

Group 1

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1. Introduction

Bombplan is a brand-new version of classical Bomberman game. The main aim in Bomberman is to reach to exit door without being killed by the monsters in the game. The main character has the power to plant the bombs in different locations on the map. The map is in form of a maze and there are some wall blocks that can be destroyed by the bombs and some others that can never be destroyed. The character starts from one end of the maze and by destroying the suitable walls and running away from the monsters, tries to reach to the exit door. The bombs are not only affective on the walls, if there is the main character or one of the monsters in the range of the bomb, they can also be destroyed.

In this report, the main analysis of the Bombplan will be discussed. We will provide Bombplan with an OOP implementation. The following sections will lead to discussions related to requirement analysis, and the analysis with object models and dynamic models. During the requirement analysis part we will examine functional and non-functional requirements, constraints, scenarios, use case models, and user interface of Bombplan. At the end, we will conclude with a general revision of the whole report.

2. Overview

Bombplan is a desktop application that will be created with Java. Game instructions will be as following;

- The main character (from now on, it will be referred as bomber) will have only the ability to plant a bomb.
- A bomb has a range of one wall block from 4 sides. The waiting time for the explosion of the bomb is 3 seconds, default. The bomb features can be changed by the taken bonuses that are

randomly distributed inside of the walls on the map. The features that can be changed are as following;

The bomb will be as the following:

Figure 1: Bomb image [1]

When bomb explode explosion will be as the following:

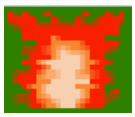


Figure 2: Fire image [1]

- Bomb explosion can be made up to the user. By the help of a taken special bonus, bombs do not explode themselves in 3 seconds; instead, they wait for the user to explode it.
- The range of the bomb is 1 wall block from 4 sides -default-, but it can be extended by a special bonus. After the bonus, the range increases 1 more wall block in depth from 4 sides. Since, user can take from that special bonus more than once, at some point, range can be 4 wall blocks in depth from 4 sides.
- Normally, user cannot plant one more bomb if there is already a planted bomb. However, by the help of another bonus, user can plant multiple bombs. Each bonus increases 1 the maximum number of the bomb that can be planted at once.
- There is a special bonus that different from the other three bonuses. After this special bonus is taken, it gives a random bonus to player.
- There is also a bonus that does not affect bomb. It resets the timer after player takes it.

- Bomber has 3 lives at starting. This can be increased with hearth shaped bonuses by one and of course, it decreases by dying.

  The bomber, hero, will be as the following:

Figure 3: Hero image [1]

- Bomber can die by being in the range of an exploding bomb, fail to kill all of the monsters and to reach the door in the given time or touching to one of the monsters.
- There are 2 types of monsters -slow and fast- in the game. The number of the monsters from these types changes according to the level. Total number of monsters also changes according to the level.

  The slow monster will be as the following:

Figure 4: Slow monster image [1]

  The fast monster will be as the following:

Figure 5: Fast monster image [1]

- There are 2 types of walls in the game. One of them can never be destroyed by bombs, the other can. Their design changes according to the type of the wall and of course all of the bonuses are in the walls that can be destroyed.

The destroyable wall will be as the following:

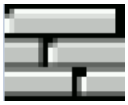


Figure 6: Destroyable wall image [1]

The non-destroyable wall will be as the following:

Figure 7: Non-destroyable wall image [1]

- Number of blocks will be definite for each level. However, the blocks will be distributed randomly on the map. Of course there will be some constraints for the distribution of the walls to provide a more homogenous map.
- To pass a level, bomber need to kill all of the monsters and find the secret door inside of one of the wall blocks in the given time.
- To finish the game, bomber should pass 3 levels of maps or spend all of his lives.
- During the game, user earns some points with destroying walls, killing monsters, taking bonuses or passing levels. At the end of the game, the collected point is put in high-score list if it is one of the highest 10 scores ever played on that computer.

3. Functional Requirements

Play Game

The game starts by locating the main character to the top left corner of the map to each level. The map is in form of a maze and its difficulty changes according to the level. The monsters in the field

distributed and move randomly. Speed of the monsters again changes according to the level and different type of monsters will be seen in high levels. Their only aim is to touch to the main character and kill him. The main character should kill all of the monsters in the map before losing all of his lives. By default, the main character will start to the game with 3 lives that will give him a chance to die 3 times before loosing the game. To kill a monster, bomber should plant a bomb to a location that possibly a monster will be in the range of it. With only one bomb, it is possible to kill multiple monsters if they are all in the range of the bomb. Additionally, bomber can be stuck in an area but there will be some walls that can be destroyed by bombs and some others that cannot. By destroying the walls, bomber can open a way for himself. In the same time, bonuses will be hidden in these destroyable walls randomly. To reach a bonus, bomber should first destroy the wall. A bomb can both destroy a wall and kill some monsters if there is any in the range of it in the same time. To finish a level of the game successfully, bomber should both find the secret door that is hidden in one of the destroyable walls and kill all of the monsters. The crucial point is that, he door is placed under one of the destroyable walls after the user kills all of the monsters. After passing from the door, the game will load the next level if there is one. If the user passes the last level, or die before succeeding in the game, he will see a menu if his score is one of the highest 10 and he will be able to save his score with a name.

Save Game

In any time of the game, user will be able to save the current state of the game with a name so that he can continue after a while if he needs to quit the game in that moment.

Load Game

The user will be able to see his saved games by choosing “Load Game” from the main menu and we will list his saved games. After he choses one of the saved games, we will load it to the game.

Pause Game

The user will be able to stop the game in anytime and do his urgent job if he should. The game will be paused if he pushes the button “Esc” from his keyboard or choose pause button from the screen of the game. He will see a push menu after pause there will be the list of Save Game, Continue Game, Help, Return to Main Menu, and Quit.

Help

For a user who is completely new to the game, help menu is crucial. Thus, it should be visible to him before starting to play a game. Additionally, it should be reachable while the user is playing the game since he might want to check what a bonus is or simply how to move the character.

In the help menu, we will provide the information on the main aim generally, abilities of the character, bonuses, how to use them, and how to move the character.

High Scores

The user will be able to see the high scores in the game by choosing High Scores from the main menu. High scores will be given in form of a table with their names. If there is no saved high score, it will give an appropriate message.

Options

Options menu will be reachable from both main menu and pause menu. Through the options menu, user will be able to set character type, music (on/off), and effect sounds (on/off).

Credits

Credits on the game will be presented in “Credits” that is available on the main menu. It will include developer information, library names and version number.

4. Nonfunctional Requirements

4.1 Performance Requirements

- Response time to input actions will be low enough so that it will never surpass 1 second.
- Highscores will be saved (written) to the txt file. Reading this data and creating high score table will be fast, it will not surpass 1 second.

4.2 Reliability Requirements

- The game will be robust. Empty high score list will not be a problem while displaying high score list.
- Option preferences, listed high scores and saved games will be stored in files.

4.3 Supportability Requirements

- The game will be executable for every platform that Java works on.
- The software will not require any installation process.

4.4 Usability Requirements

- The game rules will not be hard to understand, user shall be able to learn game rules within 2 minutes by reading help instructions.
- Game controls will be easy to understand such that user shall be able to learn game controls within 1 minute by reading help instructions.

4.5 Constraints

- Bombplan is going to be implemented using Java programming language.
- Game graphics will be drawn by Paint.Net.
- Game language will be English.
- It will be an open source software licensed.

5. System Models

5.1 Scenarios

Scenario 1: Play Game

Player Ilkay wants to play a game and starts the game. She chooses New Game option. Default level 1 is loaded and she starts to play the game. She destroys all the monster of the level 1 but she cannot find the door in the given time. Thus she loses the game. Then she returns to the Main Menu.

Scenario 2: Change Settings

Osman plays the game without his earphones, and then he thinks that he can mute the sound since he already does not hear anything. In order to do that Osman stops the game by pressing “Esc” key. Then game pauses and a pause menu shows up. Osman changes sound and the music from on to off. Then he wants to continue, so he returns to the game.

Scenario 3: Load and Save Game

Player Cenk starts the game. After main menu appears, Cenk clicks “Load Game” button. He chooses last game from all saved games. Game initializes game board and settings according to the last game which Cenk saved. After playing a while, Cenk stops the game and clicks to “Save Game” button in the pause menu. Game saves last settings successfully and returns to pause menu again.

5.2 Use Case Model

Use Case Descriptions

Use Case 1

Name: Play Game

Participating Actors: Player

Main Flow of events:

- Player starts the game by selecting ‘start game’ option.
- The system loads the default Level 1 map and bonuses and monsters randomly through the destroyable walls in the map. The system gives 3 lives to the user and locates the character in top left corner of the map. Also the time counter starts to countdown.
- Player starts to play first level by using keyboard control buttons, he or she destroys all monsters on the map and find door and passes the level 1 within given time.
- Player passes all three levels of the game in the same way and finishes the game successfully.
- System asks player to enter his/her name since its score is among the top ten scores.
- Player enters his name and then high score list shows up.

Entry Condition: Player should start the application, and then press the start game button. The map is loaded with all monsters, walls and bonuses successfully.

Exit Condition: Player finishes all levels and he enters his name for high score list.

Alternative Flow of Events:

- Player finishes all levels successfully but since his score is not among the top ten scores game over message appears at the end of the game.
- Player has lost all of his lives and game over message is displayed on the screen.

- Player stops the game while he is playing and from the pause menu he decides to save game and exit from the game.

Use Case 2

Name: Load Game

Participating Actors: Player

Main Flow of events:

- Player chooses ‘load game’ choice from the main menu of the game.
- Saved games are listed on a table on the screen.
- The player chooses one of the pre-saved games from the table to start game.
- Game is started by the system successfully.

Entry Condition: Player chooses ‘load game’ choice from the main menu panel of the game.

Exit Condition: Saved game that is chosen is started by the system successfully.

Alternative Flow of Events:

- Player drops the idea of loading game and he backs to the main menu.
- There is no pre-saved game on the list, and then player backs to the main menu.

Use Case 3

Name: View Credits

Participating Actors: Player

Main Flow of events:

- Player chooses ‘view credits’ option from the main menu of the game.
- Credits panel is created by the system.
- Player views names, e-mails of developers and current version of the game.

- After player views the credits, he or she backs from this panel to the main menu.

Entry condition: Player chooses ‘view credits’ option from the main menu of the game.

Exit condition: Player backs from credits panel to the main menu.

Use Case 4

Name: Get Help

Participating Actors: Player

Main Flow of events:

- Player chooses ‘help’ option from the main menu to read instructions about the game.
- System shows information about the main aim, abilities of the character, bonuses, how to use them, and how to move the character.
- Player reads all instructions from this panel and backs to the main menu of the game.

Entry Condition: User should choose the ‘help’ option from the main menu.

Exit Condition: User should back from help menu to the main menu.

Use Case 5

Name: Change Options

Participating Actors: Player

Main Flow of Events:

- The game is started and from the main menu player selects the ‘options‘ choice.
- Options panel is displayed on the screen by the system.
- Player mutes the sound from this panel.
- Settings will be saved by the system.
- Player returns to the main menu.

Entry Condition: The game is started and from the main menu player selects the ‘options‘ choice.

Exit Condition: Player backs to the main menu from options panel.

Alternative Flow of Event:

- Player does not change any settings from this panel and returns to the main menu.
- Player mutes the music from this panel.
- Player unmutes the sound effects of the game. and returns to the main menu.
- Player unmutes the music of the game and returns back.

Use Case 6

Name: View High Scores List

Participating Actors: Player

Main Flow of Events:

- The game is started and from the main menu player selects the ’view high scores’ option.
- High Scores panel is displayed on the screen by the system.
- Player looks over the top ten scores that are previously played.
- Player returns to the main menu.

Entry Condition: The game is started and from the main menu player selects the ’view high scores’ option.

Exit Condition: Player returns to the main menu.

Alternative Flow of Event:

- High score list is empty, and player returns to the main menu.

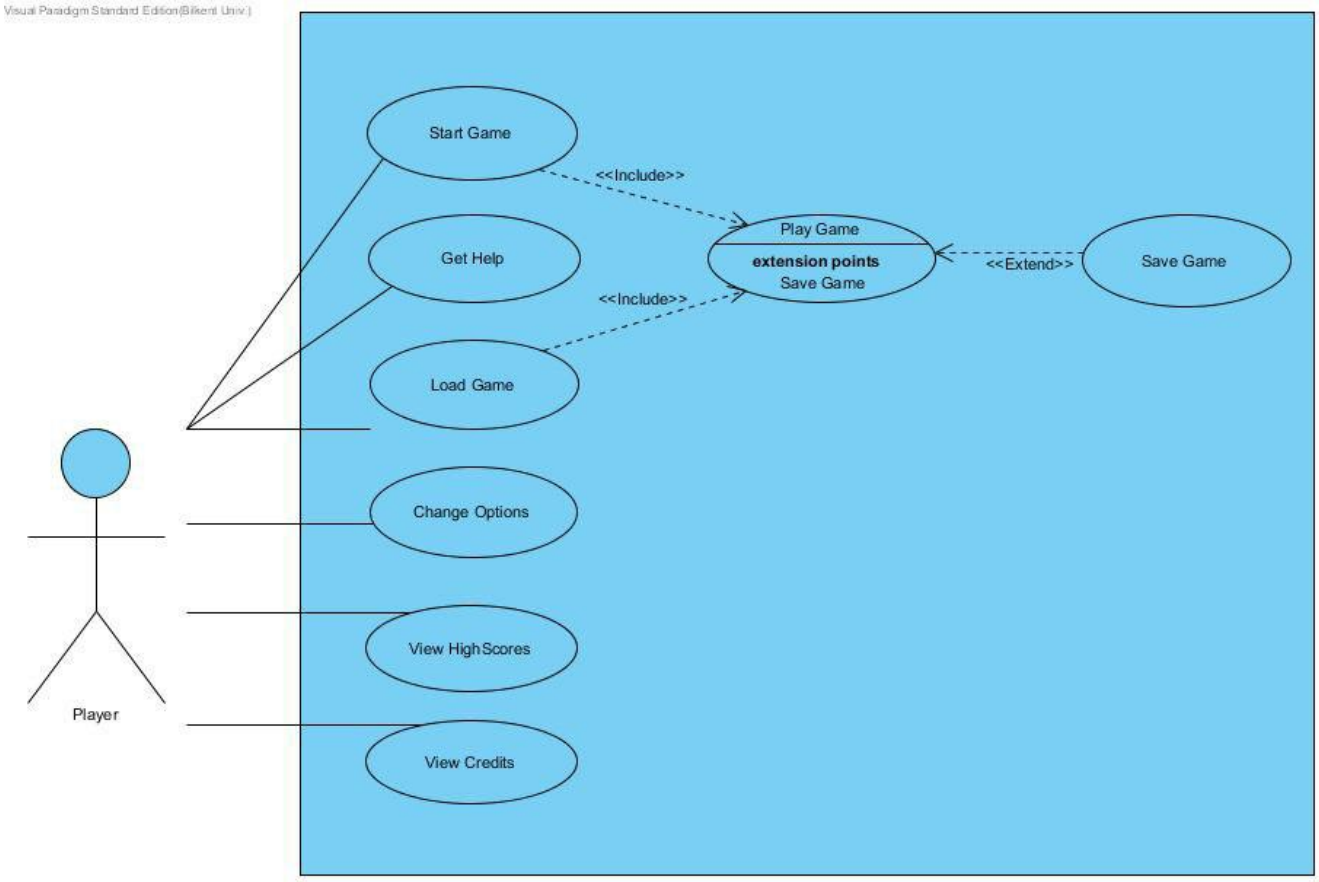


Figure 8: Use Case Diagram

5.3 Object Model

Data Dictionary

Player: Player is the main character of the game. He starts to the game with 3 lives and without extra abilities such as multiple bombing or control when to explode a bomb. The player class holds this information in itself. He is able to plant bombs, take bonuses to improve his abilities and kill the monsters with the help of his bombs. The class will also hold the location and icon information.

Bonus: There are 4 mainly different bonuses. We added one more that randomly selects one of the 4 bonuses and gives to the hero. Bonuses contain power-ups and timer reset. All of them increases the point user collected. Bonus class has a type variable indicating the bonus, location and icon information.

Monster: Two different monsters have two different speeds respectively. They move randomly through the map and they hold the speed information according to the type variable. The class also holds the icon information for itself.

Door: Door class has a location and a Boolean variable indicating if it is active or not. Since the door will be hidden under one of the destroyable walls, its activity will change according to the state of the wall. The class also holds the icon information for itself.

Wall: Wall class has location, icon, and destroyable data. Each wall is a square and they might be destroyed according to the location of the bomb. Walls hide bonuses and the door under themselves.

Destroyable wall: Has a destroy method, a specific icon and point.

Non-destroyable wall: Holds a specific icon. It does not have a destroy method.

Bomb: Bombs are planted by the hero to the specific locations and according to the bonuses the hero has, the effect and control system of them changes. They might be destroyed by a timer as well as a user. The class has location, icon and destroyable information.

Destroyable: Destroyable is an interface that should be implemented by all of the destroyable objects.

Movable: As an interface, implies for all movable objects that need the move method.

Map Object: Holds the location, icon and destroyable information and it is extended by all of the objects that will be in the map of the game.

Game Map: Game map holds the information on the objects existing in the map. It is responsible to do the changes demanded by the game engine on the objects. It manages collisions and handles the events happening after a request came from game engine. It holds a 2 dimensional map array

to see the current locations and relations of the objects. It also holds the remaining time information.

Collision Manager: Provides a chance for game engine to see the collisions through the method checkCollision.

Game Engine: Holds information on the current level and score. It is responsible from the general flow of the game. It manages the backend according to the user interactions.

Sound Manager: Responsible to play the game music.

Menu Panel: General flow of the menus and the functionalities are implemented in the menu panel.

Storage Manager: Handles to load and save actions through interacting with the game engine and fetching or writing the details of the variable and objects in the game.

Game Panel: General drawings of game screens and user inputs are handled by the game panel class.

Help panel: Help screen is drawn.

High Score panel: High score screen is drawn**.**

Load panel: The screen that will be used to load a game will be drawn in Load panel.

Settings panel: The screen that will provide user with the ability to change the settings will be drawn in this panel.

Credits panel: The screen that will be used to show the credits information of the game will be drawn.

Pause menu: Drawing of the pause menu will be done in this specific panel class.

Main menu: Drawing of the main menu will be done in this specific panel class.

Menu panel: 2 different type of menus will be managed and drawn in Menu panel.

Panels: Panels class is a generic screen class of the project. It contains all of the necessary panels in it and screen management happens by the help of this specific class.

Class Diagram

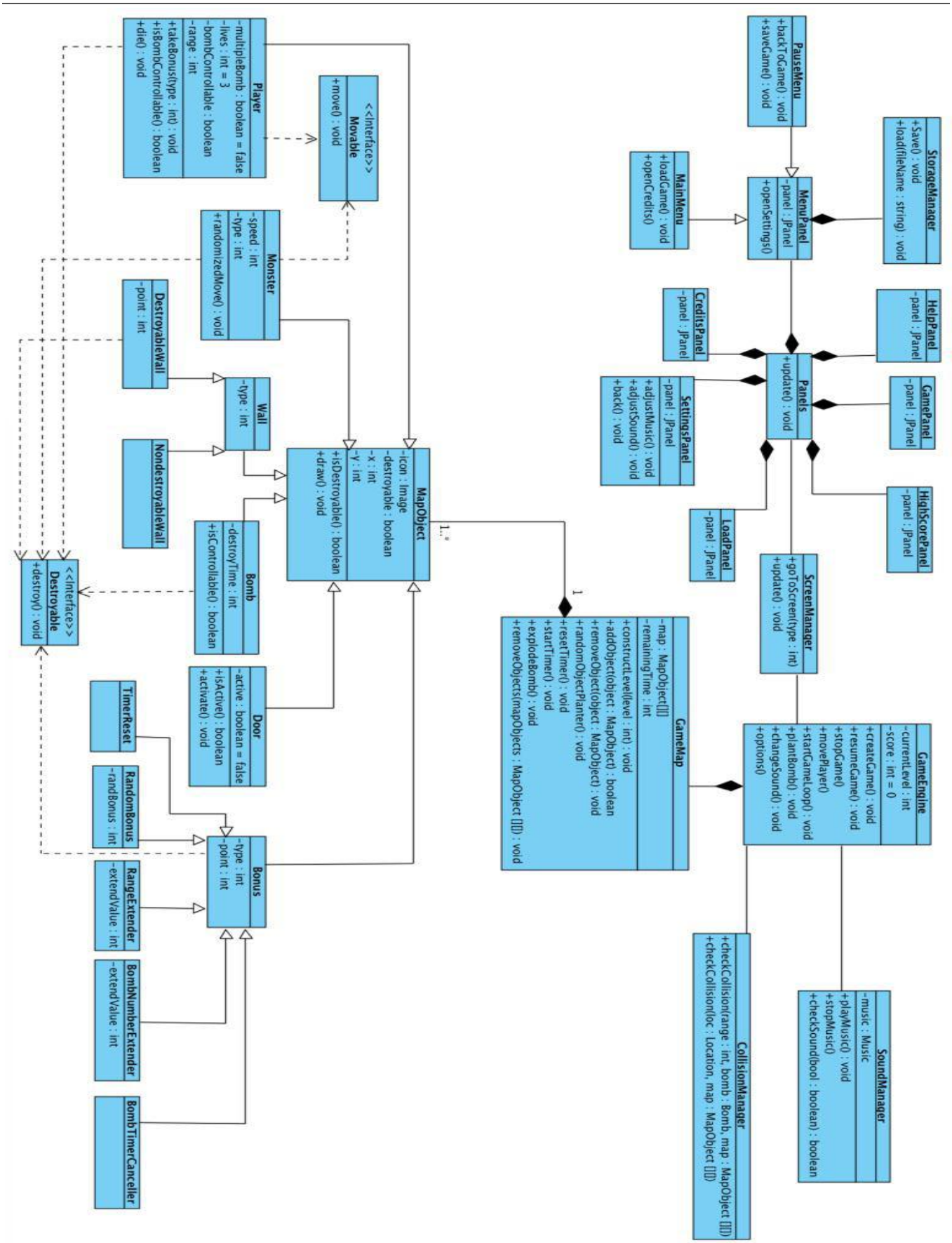


Figure 9: Class Diagram

GameEngine class is the core of the game. It holds 3 manager classes; SoundManager, CollisionManager, ScreenManager and controls them. It has also a relation with GameMap. GameEngine only access the entity objects through GameMap class. GameMap has a property of GameObject array. GameMap controls MapObjects according to this array. Class diagram is shown in above Figure 9.

5.4 Dynamic Models

Activity Diagram

The diagram in Figure 10 shows the general game flow of the game. Player can initialize the game in two different ways; Starting a new game or loading a previously saved game. After initializing it, general game loop starts. During the game flow, in each time unit, it is checked if there is any monster left. If there are some monsters and the user is dead -game is over-, we know that the game is lost. After this step, according to the score the user collected, either he goes to the high score panel and save his score or directly continues to the main menu. If there are some monsters left and the game is not over yet, he continues to try to kill the monsters, destroy the walls, or collecting bonuses. These events are all decided with check collision step. According to the collision, maybe there is no, game map is updated and monster number check happens and game loops back to the collision check step. After killing all of the monsters, the loop breaks and the door is placed in one of the available places randomly. After the hero reaches to the door successfully, game loops back to initialize game step. If he cannot reach to the door successfully in the given time period, the game is over and again high score check happens. In any stage, if the hero loses all of his lives, we loop back to high score check stage.

Activity diagram for the game flow is as the following:

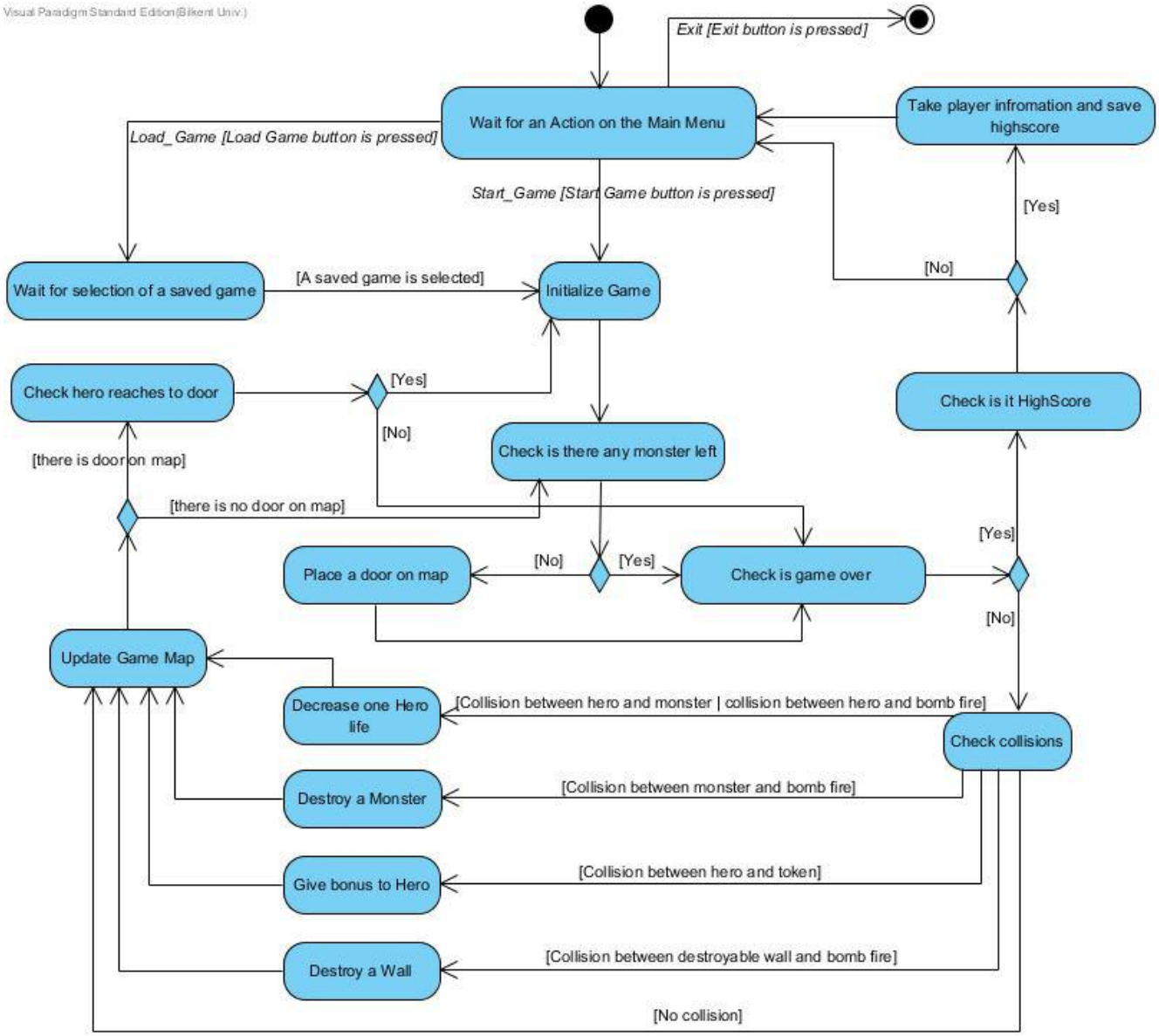


Figure 10: Activity Diagram for the Game Flow

Sequence Diagrams

Diagram 1: Start Game

This diagram in Figure 11 explains a scenario which the player starts a game. Player Ahmet chooses the Start Game option from the main menu and his action activates game panel to create a new game. Game engine creates screen manager, collision manager and a game map as instances. Game map constructs level one. Finally, game enters a loop.

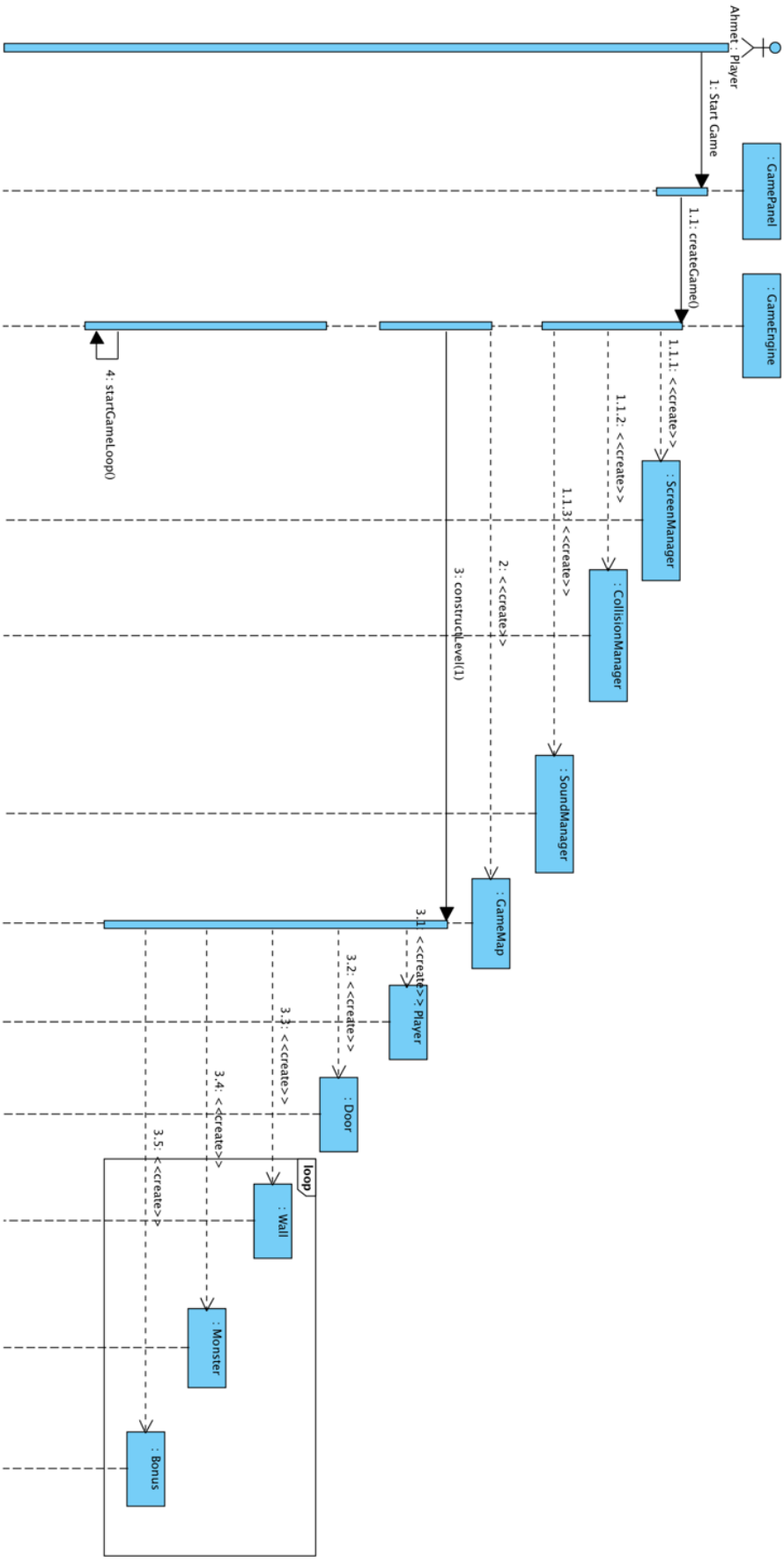


Figure 11: Sequence diagram of starting a game scenario

Diagram 2: Bomb Explosion

This diagram in Figure 12 explains a scenario which a bomb explodes and destroys a monster. Player plants a bomb by pressing a specific button from the keyboard. Then game engine gets the location of player, hero, from the game map and plants a bomb in that location. Then game engine adds this bomb to the game map. After adding a bomb to the map, game engine checks whether this bomb is controllable or not. In our scenario it starts timer since planted bomb is an uncontrollable one. After timer reaches the zero, bomb is exploded. Game map checks all of the possible collisions in the range of the bomb and collision manager finds all of the objects that should be exploded. Then these objects are going to be removed from the game map. In this scenario the possible movements of the monsters and the hero during the time between the creation and explosion of the bomb are excluded.

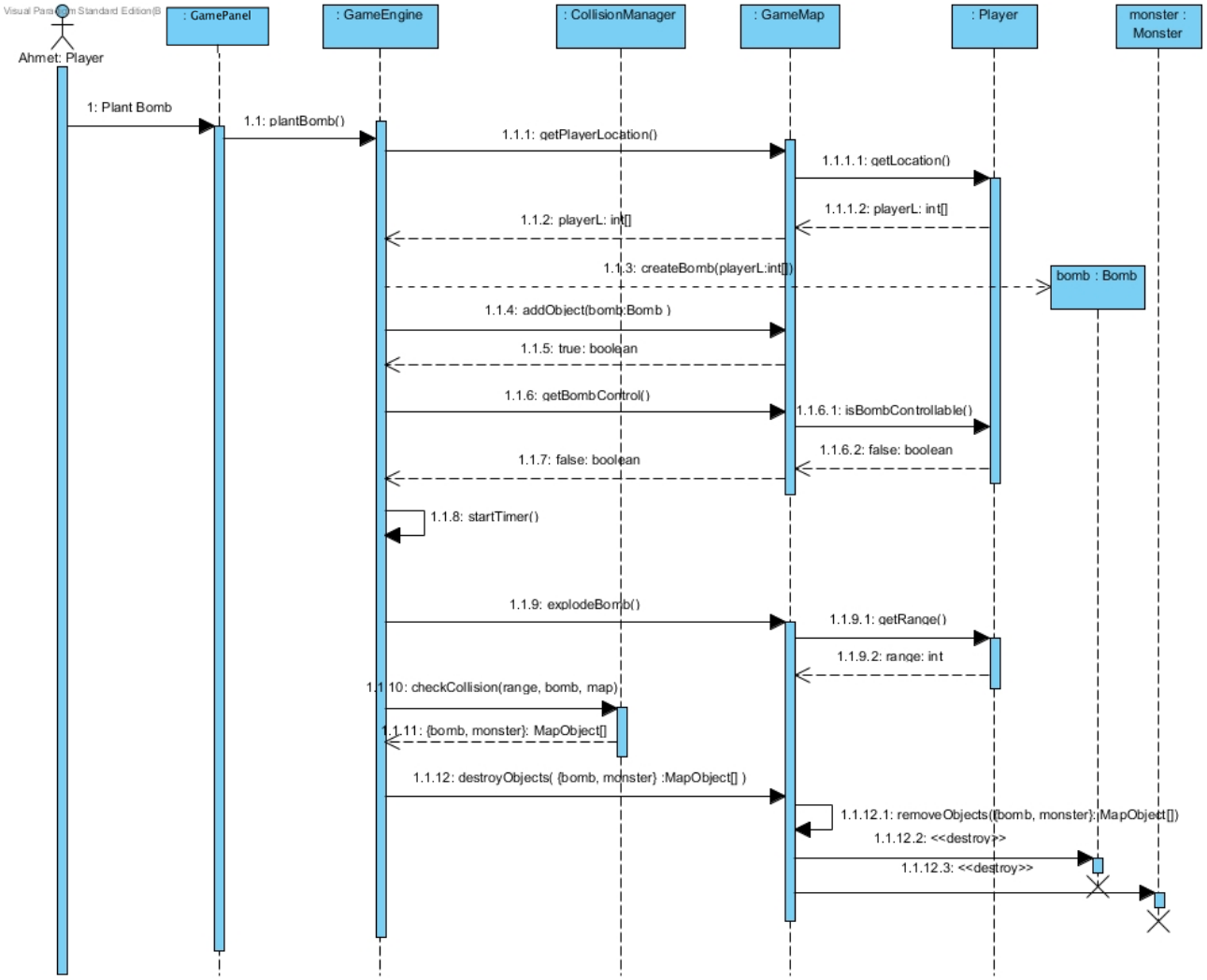


Figure 12: Sequence diagram of bomb explosion scenario

Diagram 3: Take Bonus

Diagram 3 does not show the scenario of bomb explosion since it is shown at the previous scenario. It assumes bomb is exploded and a wall is destroyed previously. Then a bonus which type is bomb number extender appears on the map under the destroyed wall. Player Bob moves hero, player, to right in order to take this bonus. Then game engine sets location of the player according to keyboard input. Game map is going to be updated accordingly. Then player takes the bonus as it is collided with bonus. Thus player has this bonus skill which makes possible to plant one more bomb in a time, and bonus is removed from the map.

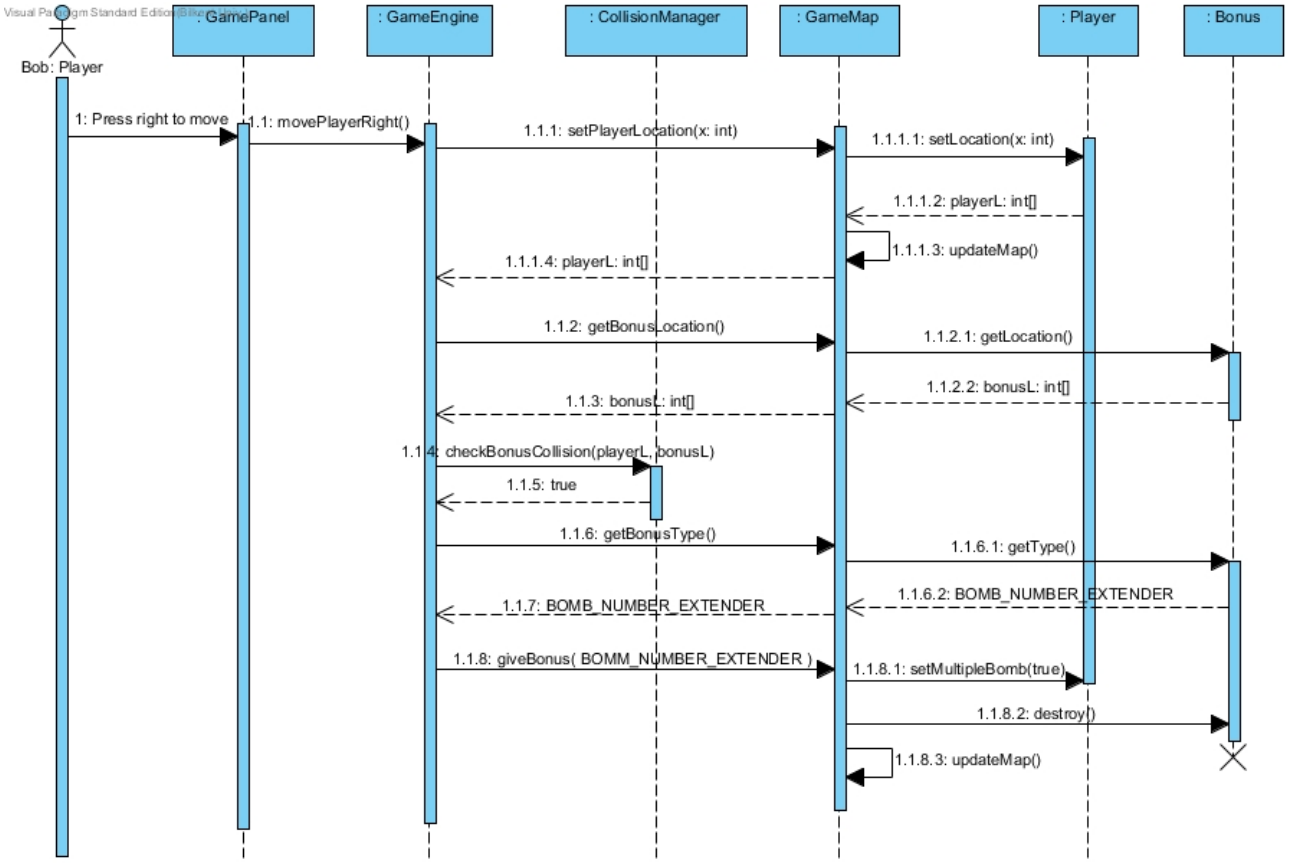


Figure 13: Sequence diagram of take bonus scenario

5.5 User Interface

In this part, user interfaces of the Bombplan game will be examined.

Main Menu

When player starts the game Main Menu shows up as the first screen of the game. Main Menu has Start Game, Help, Load Game, Options, HighScores, Credits and Exit options. Player can move any of these panels by pressing related button.

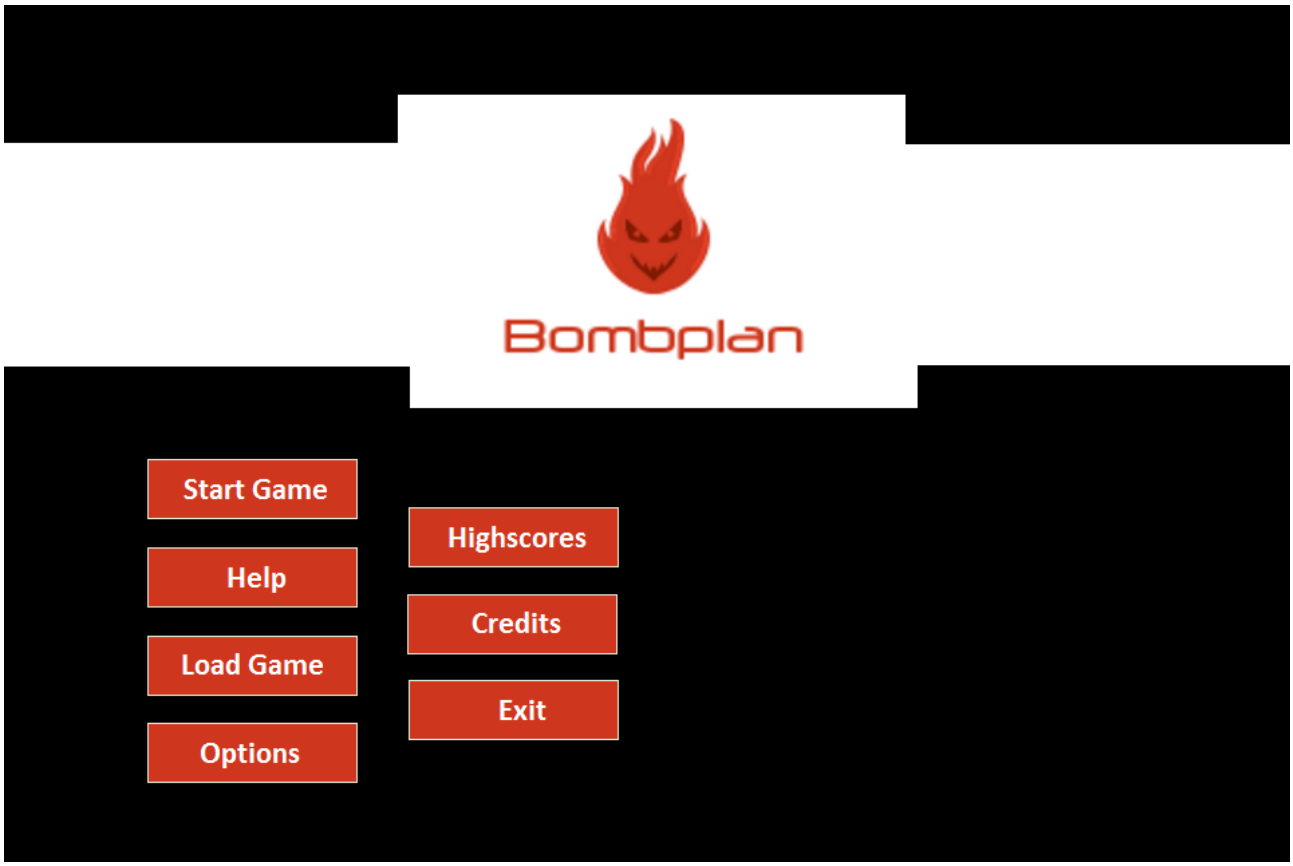


Figure 14: Main menu panel

Help

If player selects the Help option from the Main Menu, screen that has game rules and instructions will be shown. In the Help panel, player shall be able to read the game rules and instructions. In addition to that player can learn keyboard controllers. After player reads the information that he/she needs it can return to the Main Menu.

Figure 15: Help panel

Load Game

Player can load a game from this screen. If there is any saved game, these saves are going to be list in a table. If there is no saved game, then table will be empty. Saved games are stored with their user name, date, level and score information and this information is available in the table for player to find and continue a saved game easily. Player can return to the Main Menu by pressing Back button.

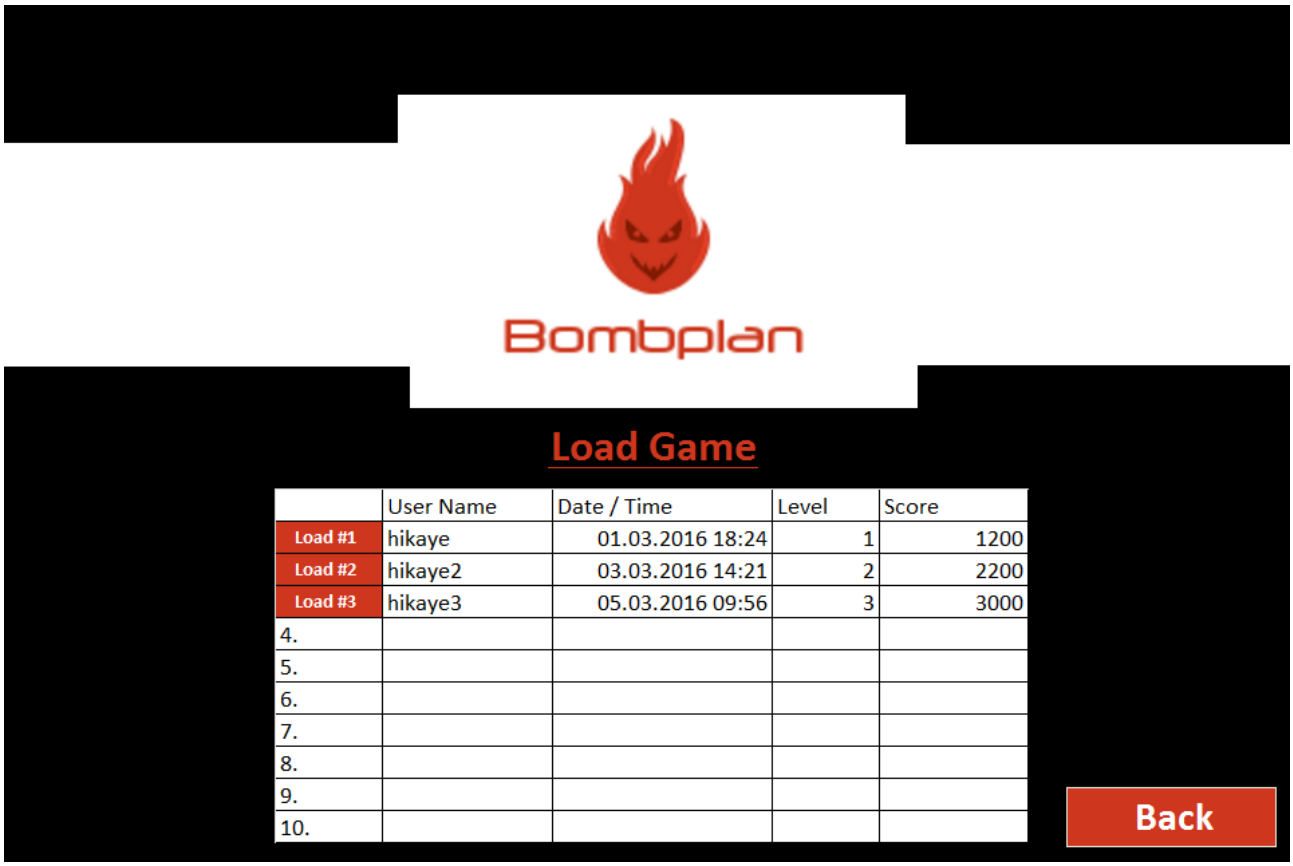


Figure 16: Load game panel

Options

There is 'Options' choice on the Main Menu, if player clicks it this panel will be shown. Options panel will be a mini configuration management screen of the Bombplan game. Player shall be able to change the volume of the sound effects and the music of the game via this panel. When player finishes his/her changes, he or she can return to the Main Menu and changes of the settings are going to be saved by the system.

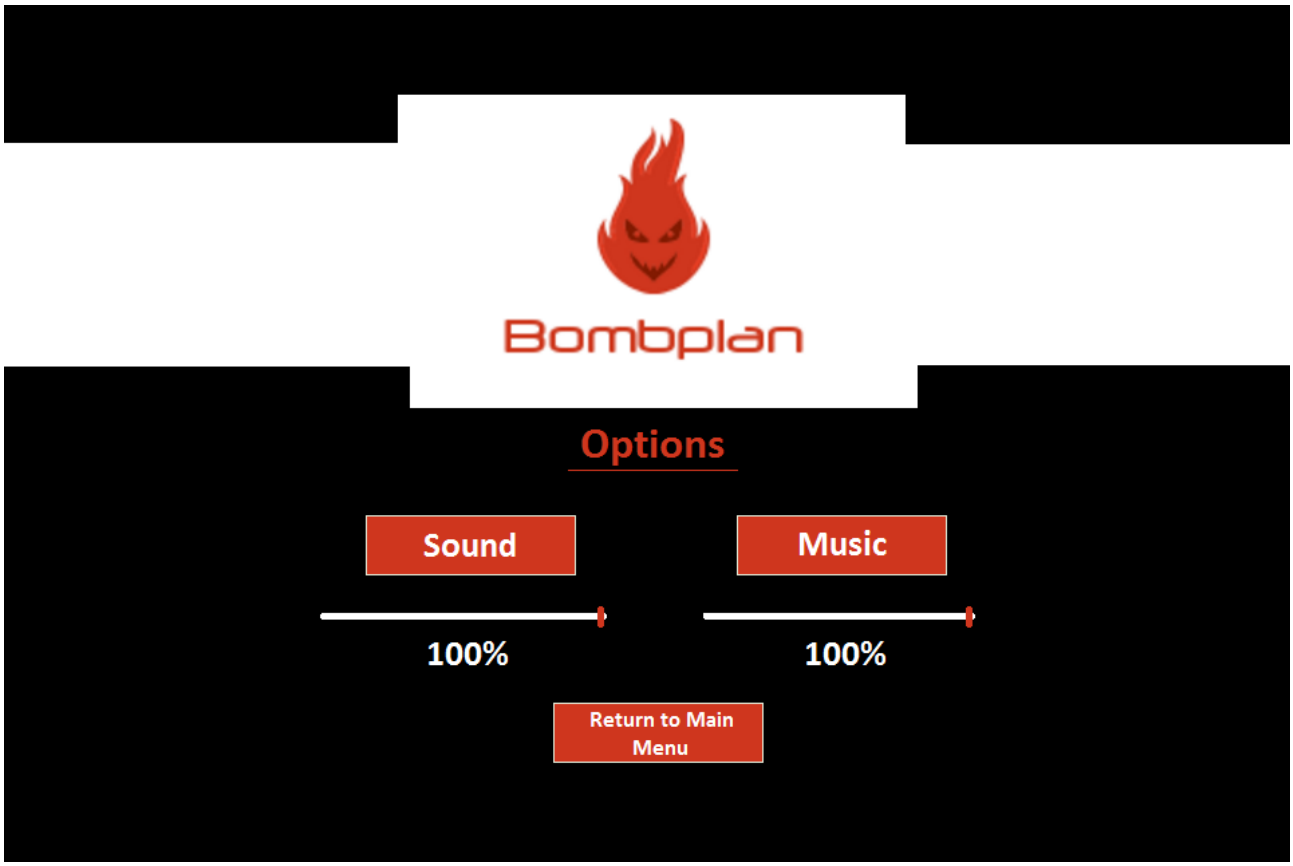
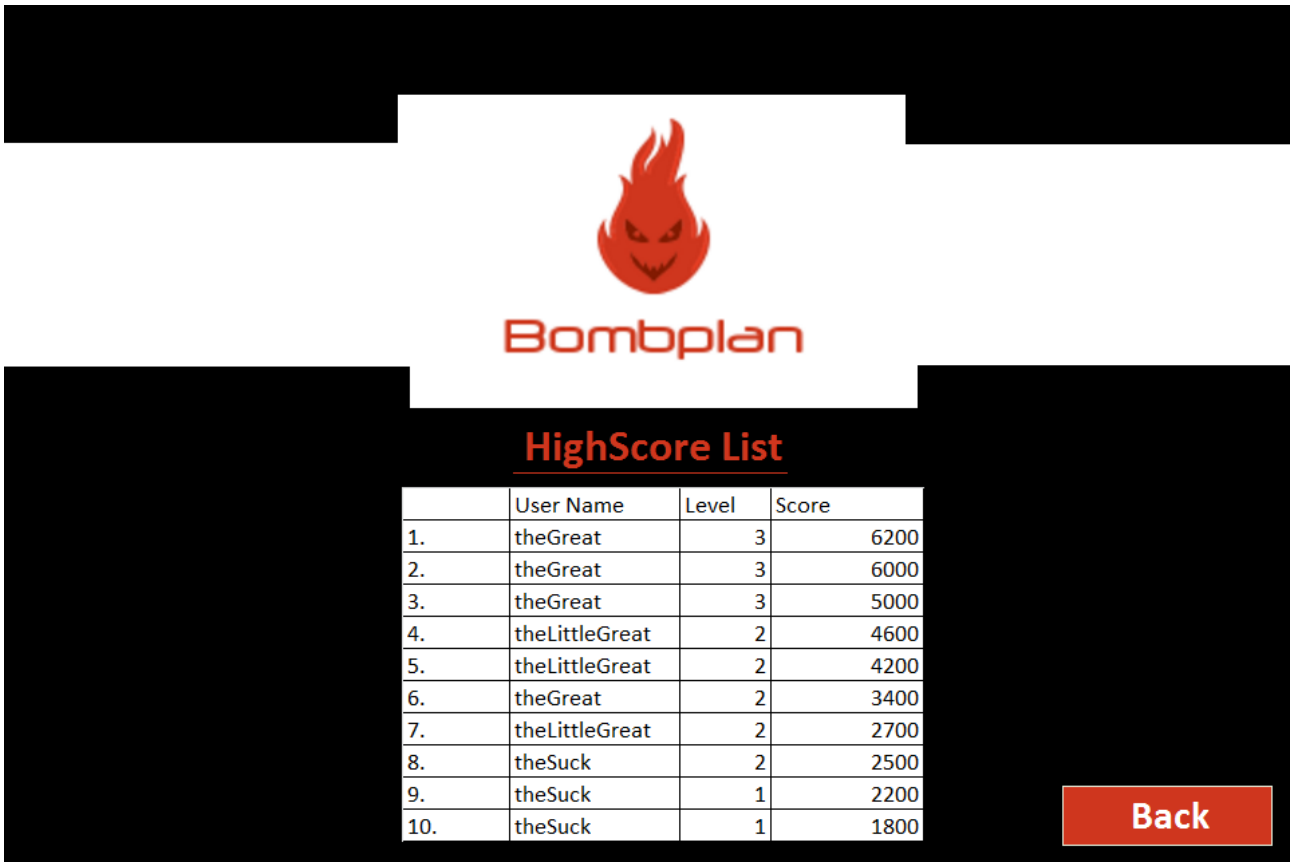


Figure 17: Options panel

HighScores

There will be 'HighScores' option on the Main Menu. When player chooses this option on the Main Menu, high score list panel is going to show up accordingly. On the HighScores panel there will be a list of top ten scores. User name and level information is available for each line of score. Player can returns to the Main Menu after he or she views the high score list. If there is no recorded score, high score list table is going to be empty in that panel.



	User Name	Level	Score
1.	theGreat	3	6200
2.	theGreat	3	6000
3.	theGreat	3	5000
4.	theLittleGreat	2	4600
5.	theLittleGreat	2	4200
6.	theGreat	2	3400
7.	theLittleGreat	2	2700
8.	theSuck	2	2500
9.	theSuck	1	2200
10.	theSuck	1	1800

Figure 18: HighScores list panel

Credits

There is also Credits option on the Main Menu. Player can see the credits information of the Bombplan game using this option. In this panel there will be a text box which holds necessary information related credits and also a back button for player to return to the Main Menu. Credits panel will be as in the Figure 18:

Game Panel

On the Game panel there will be a timer on the left up corner of the screen. And number of the lives of the hero will be displayed on the right up corner of the screen. Game screen of the Bombplan will be as in the Figure 19:

Figure 19: Credits panel

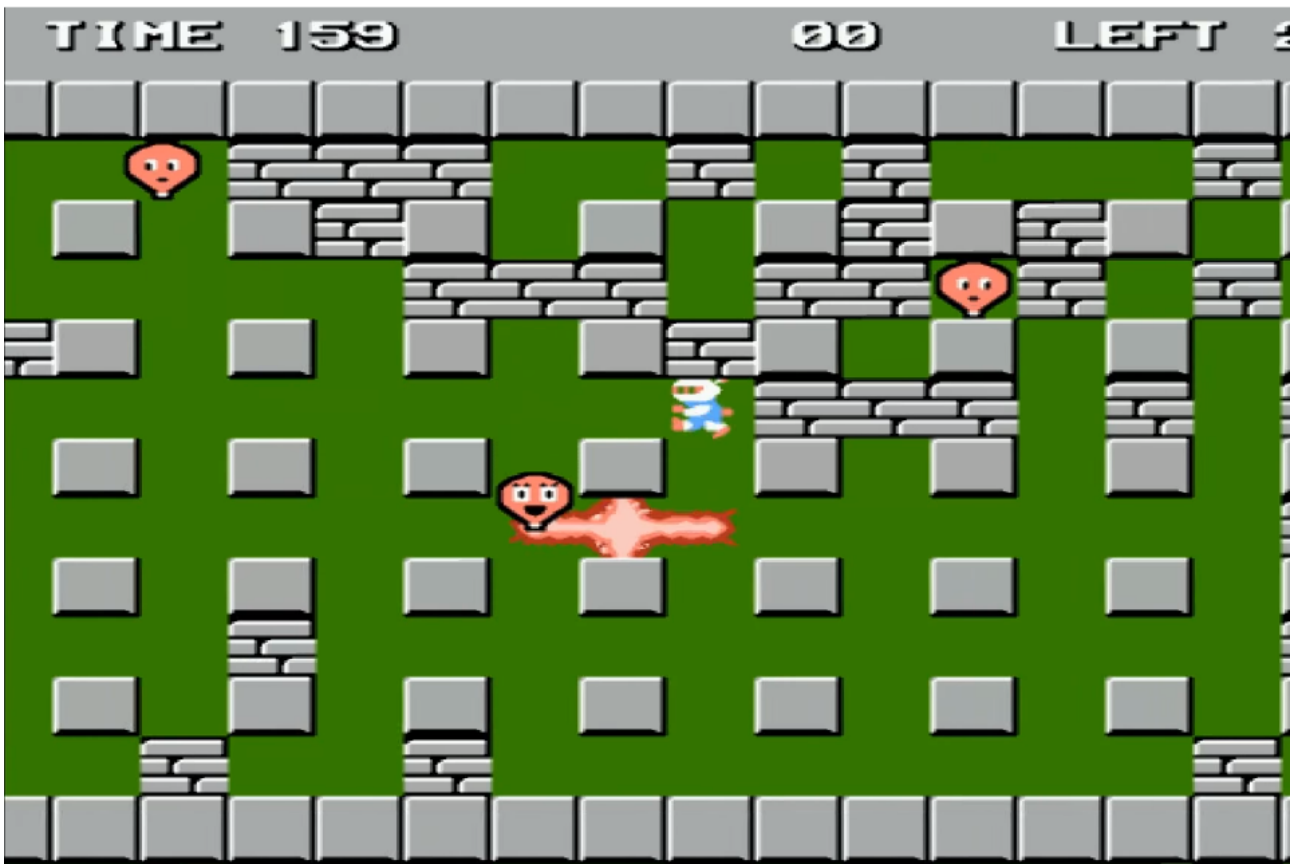


Figure 20: Game panel [2]

References

[1] Game hero, bomb, fire, monster types, and wall types images, accessed on 02 March 2016, http://eski.nintendocu.com/en-iyiler.php?subaction=showfull&id=1234094933&archive=&start_from=&ucat=20&

[2] Game panel, accessed on 03 March 2016, https://www.youtube.com/watch?v=EsIyPoKh0LM