

# DRDC PROJECT

## Mental Readiness FPS Game Development

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# 1 Executive Summery

Making a military themed serious first person shooting game that adheres to the purposes of the app which has creative and user-friendly design. The serious game primary implemented the ideas of tactical breathing, self-talk, goal setting, visualization, attention control and memory improvement which improve soldiers' mental healthiness and effectiveness of standby time. The game is interactive since user's heart rate will be monitored and shift to tactical breathing section to restore to the normal heart rate during the entire process of the game by connecting the heart rate monitor at the beginning of the game. Users can improve their visualization ability by answering questions of what they think of the environment would be when change to the unfamiliar environment. This task could make users more confident and well prepared using their mental imaginary. Memory improvement skill is also trained and practiced by finishing subtask called "bomb defusing" based on N-Back memory improvement methodology. Furthermore, goal setting, self talk and attention control skills improvement are also covered in the game which users will be trained in different section of skills when paying the serious first person shooting game.

## 2 Game Overview

- **2.1 Project Requirements**

DRDC Toronto research centre would like to develop the existing prototype of the mental readiness serious game for mobile application. The main purpose of the game is to improve mental resiliency and to provide self-regulation support. The team need to expand the game by improving graphic and usability of the serious game prototype. Meanwhile, the game should cover six following subtasks to train and improve users for the final purpose of practicing mental resiliency and providing self-regulation support.

- Attention control: Improve ability to focus and shift attention when required.
- Tactical breathing: Regulate breathing to stabilized mental state and heart rate.
- Goal setting: Learn strategies of how to obtain large goals, by focusing on smaller, more attainable goals.
- Visualization: Use mental imagery to improve confidence and performance.
- Self-talk: Learn to utilize positive words, bookmark positive events and challenge negative thoughts.
- Working memory skills: Improve fluid intelligence by training on validated working memory tasks.

- **2.2 Project Solution**

- Our team planed and conducted WeChat group, Google doc and Email for online internal communication. For external communication, we have DRDC weekly teleconference for exchanging idea and reporting to DRDC officers and team members face to face meeting every Wednesday.
- Timeline:
  - ✓ Jan/16: Final group members are confirmed and project starts.
  - ✓ April/19th: Hand in first version of game, presentation, test, receiving feedback and modification
  - ✓ End of July: Project deadline. Hand in final version after modifications, final project report as well as recommendation.

Week	Task
1.16-2.5	Get familiar with project materials, start learning Unity, generating timeline proposal, roles, skills and required assets.
2.6-2.12	Making design proposal, theme, key components, implement sub-game tasks, install distributed version control system(GitHub).
2.13-4.3	After modification to the proposal, start coding the game.
4.19	Presentation of phase 1 at DRDC
4.20-end of July	Modification of phase1, implementation of sub-task of games: tactical breathing, attention control, etc.

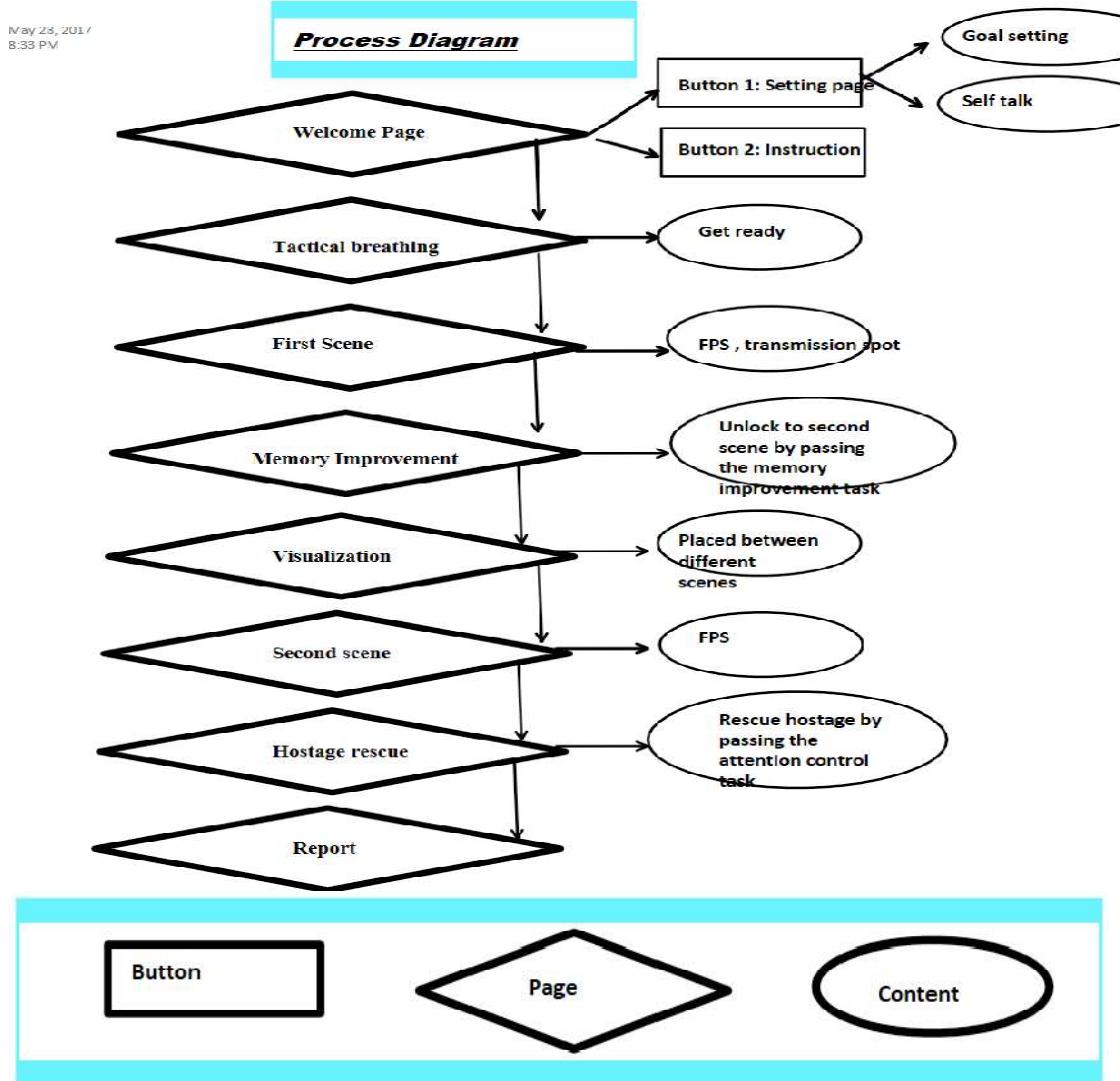
Implementation of heart rate monitor. Preparing final report.

**End of July** Presentation of final version.

○ **List of everyone's skills/roles**

Members:	Roles:	Skills:
Sida	Programmer, Project leader	Android development, C#, Unity 3D, repository manager, Project leader (Enemy system, Control system, Implementing Tasks)
Xiangling	Programmer	C#, Java, Android development, Unity 3D, repository contributor (Gun, Bomb system)
Linda	Programmer	C#, Android development, Unity 3D, repository contributor (Enemy system)
Haoran	UI designer,	UI design, Java, Unity 3D, proposal, final report preparing, repository contributor (scene building)

▪ **Game process diagram:**



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- **2.3 Game description**

We developed a military based first person shooting game which implemented different subtask helps to improve players' mental healthiness and memory skills. The game can also read player's important physical data by using heart rate monitor and suggest player to do necessary task to return to the normal heart rate. Player need to fight enemies like the way in the war and need to find the final task of defusing bomb to release the hostage in order to improve attention control and memory skills. When changing the scene from outside to indoor, player need to think of what the indoor situation, potential risk, dangerous, allocation will be using imaginary which will increase the chance to get hurt. Player will set their attainable goals at the beginning setting page for the goals they will try to success during the game. They will also be encouraged when they encounter difficulties or they successfully finish specific tasks. This game will finally practice players mental resiliency and provide self-regulation support.

- **2.4 Characters& Enemy system**

This game is first person shooting game, players will think them as the main characters completing the mission. Main player has limit number of lives, one life in the most updated version, and limit amount of blood for each life during the game. Each life has 100 points of blood. Every Time when player is shot by enemy, 25 points of blood will be deducted. Our enemy is designed for making game more interesting and challengeable. Every enemy is designed to detect the player in its sighting range; if it cannot find the player, it will move in one direction randomly to wide the search range. If the enemy find the player, it has two ways to attack the player; if player is far away from the enemy, the gun attack will be chosen; if the player is next to the enemy, the enemy will use melee attack. The enemy is also able to interact with damage. If it is hurt by the player, when its health is lower than 25, it will run away. Player will also be wounded by an exploded bomb. The amount of blood will be deducted depends on the distance of player from the bomb with up to 20points. The closer the player is, more amount will be deducted. Player can also drop current weapon and pick up specific weapon from the ground.



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FPS: Main game view

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Player is under attack by an enemy

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- **2.5 Interface & control**

We need to make sure that users want to come back, implemented with human center design which human body inspection data (heart rate) are integrated. Heart rate will be monitored all time during the game. At the beginning, heart rate will be collected and due to the difference of each person's status, we will set a certain amount of percentage red line which will be an alert if the play's heart rate exceeds the red line. In this situation, the game will suggest and guide player to do tactical breathing and continue to play after back to normal acceptable heart rate.

In order to use our app, we design a UI for operating the character in game by touch screen. For moving system, we designed two joy-sticks. The right joy-stick can is used for changing angles (-30 degree - +30 degree); the left joy-stick is used to control moving direction. Besides, we also add some buttons on the screen. The heart rate button is for tactical breathing and displaying the heart rate data; the map button is for displaying the map; the operating button is used for interacting with the exploding barrel; the task information is used for noticing and recording information; the shoot button can control the gun to open fire; the jump button can let character jump in the game scene. At the bottom of the screen, the inventory is for opening the inventory system and choose different items. The pickup and throw buttons are used for picking up and throwing items.

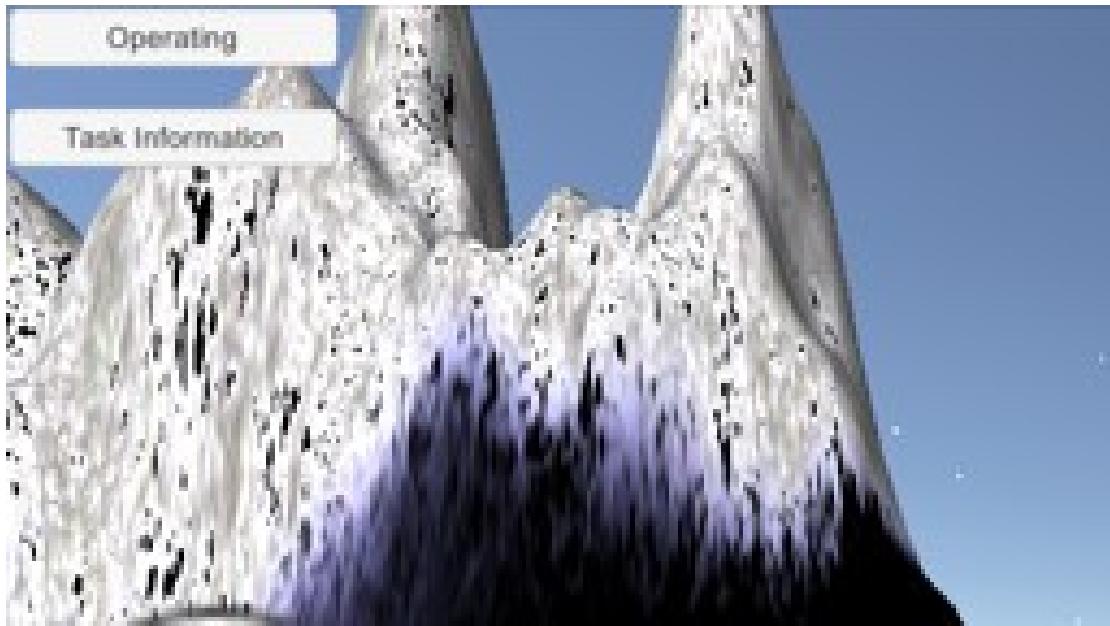
- **2.6 Environment**

Our team developed two different environments for the first person shooting game. One is outside environment of snow ground, which has forest, hills and rocks. Another is inside environment of storage warehouse with lobby, narrow and curly aisles. Players not only need to avoid attacks from enemies but also need to find suitable barriers to hide from fires. Two distinct types of scenes will practice players' imaginary skills for visualization. They need to get familiar with both indoor and outdoor enlivenment possible potential risk, components and allocations.

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*Outdoor Scene: Snow Ground*

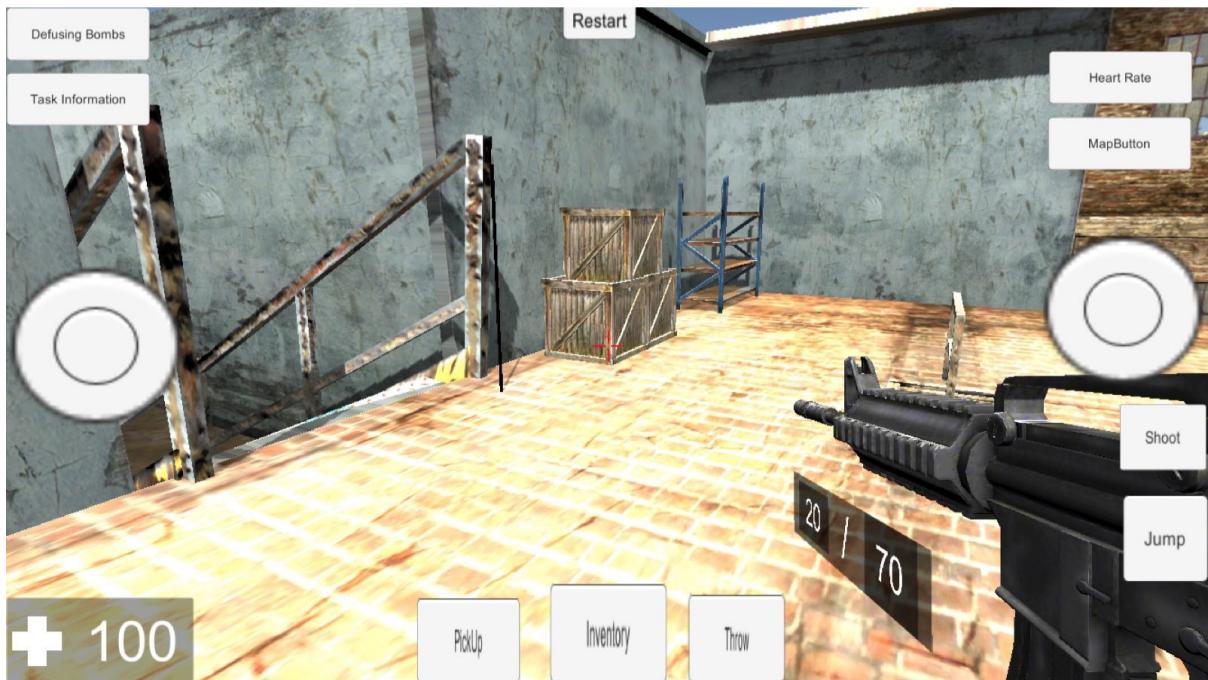
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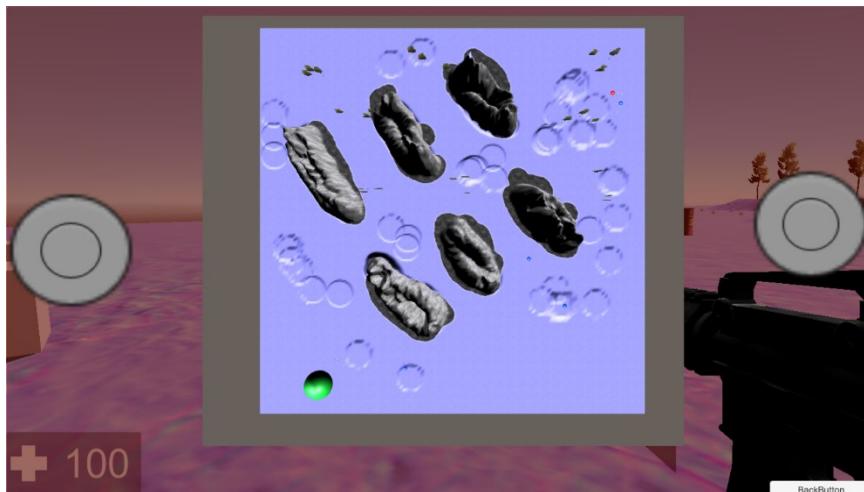
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*Indoor Scene: Warehouse*

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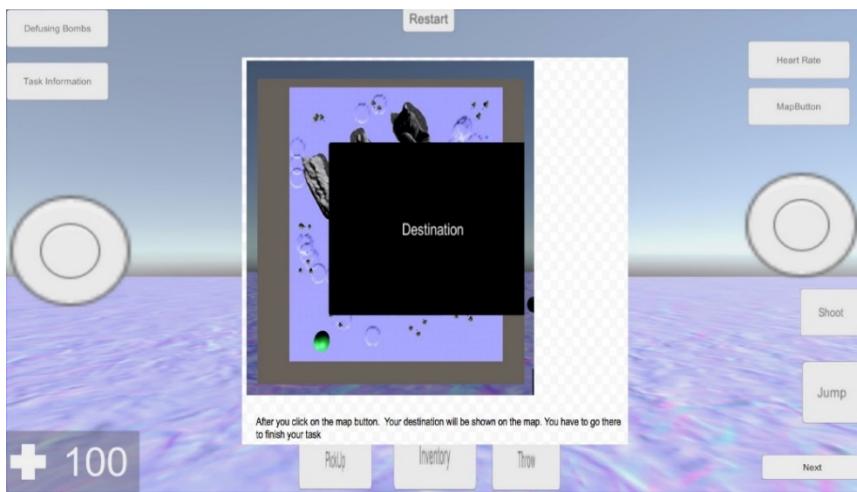
- **2.7 Game Map**



Player will be red point corresponding to the player's moving location. In contrast, enemies will be blue points. Player need to locate the bombs and try to defuse all the bomb to pass the game by moving towards the green bomb area showing on the map.



Map of indoor scene:  
Warehouse.



We also implemented the destination system which shows the task area range in the map. This will help player to identify the task are and they need to search for that area to finish the task.

## ➤ 2.8 External device implementation(MIO), Bomb mechanism, & Gun system

For connecting and transporting data from health kit, we need to connect the MIO device with iPhone through Bluetooth. Then open “Health” app, go to “Health data” and click “vitals”. After this process, we are able to access the data. For exploding barrel, we use blender to make animations like exploding to fragments. And harm of exploding increases as players get close to it when it explodes. In our scene, the exploding barrel is called bomb, of which has two types including “Bomb A” used for attention control and “Bomb B” used for Dual 2-back.

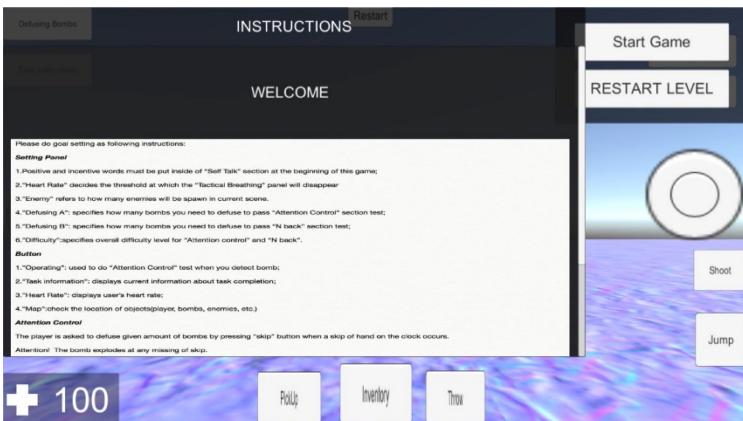
Gun system contains gun and ammo. Clip size of gun is set to be 30. When current bullets are used up, the gun can be reloaded automatically or you can press “R” to reload it before that with related animation, muzzle flash effect and sound. Dynamic crosshair is made for aiming. In details, the cross hair will be enlarged to increase the difficulty of aiming when the player speeds up. And the player can shoot as burst fire by keeping shooting button pressed down.



- **2.9 UserManual and Game Instruction**



When you open the game app “FPS GAME” on the iPhone, player will see the “Made with unity” page which shows the game is implemented on Unity 3D platform.



After that, welcome page will appear, player can either click Start Game button to start the game or Restart level to start again if he chooses to play from beginning. Players are also able to read the game instructions to have a better understanding how to play.



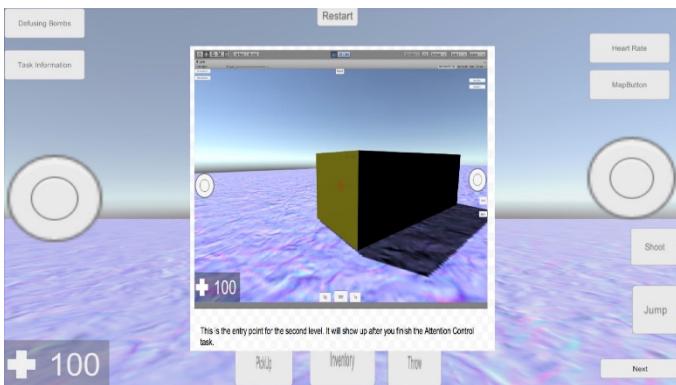
After entering self talk message and set proper number of bombs, enemies and difficulty level, game begins. Player will need to press “Throw” button to start the game.



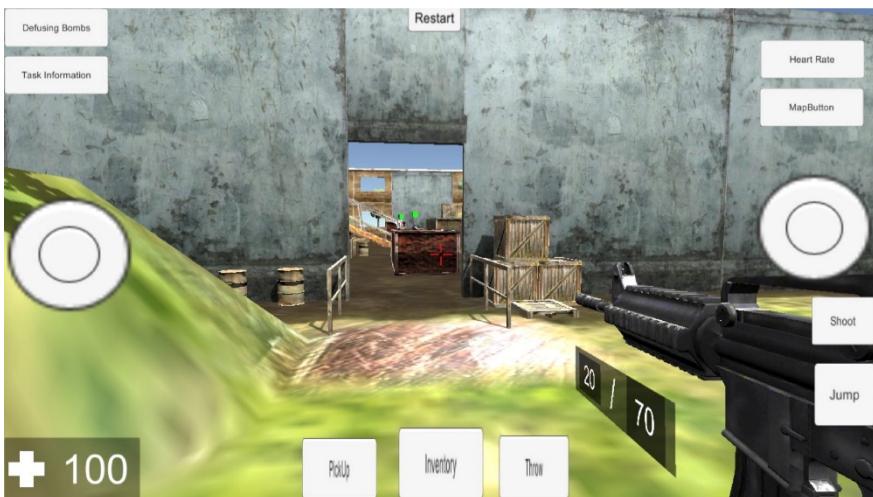
Player need to fight enemies and find the bombs to complete memory improvement task. Player can check the objective tasks from the top left corner “Task Information” button which will show what specific tasks player need to complete. Player’s blood is located at bottom left corner. Number of bullet is showed under the gun. Player can shoot, jump, throw the gun, pick up or check the inventory by pressing corresponding buttons.



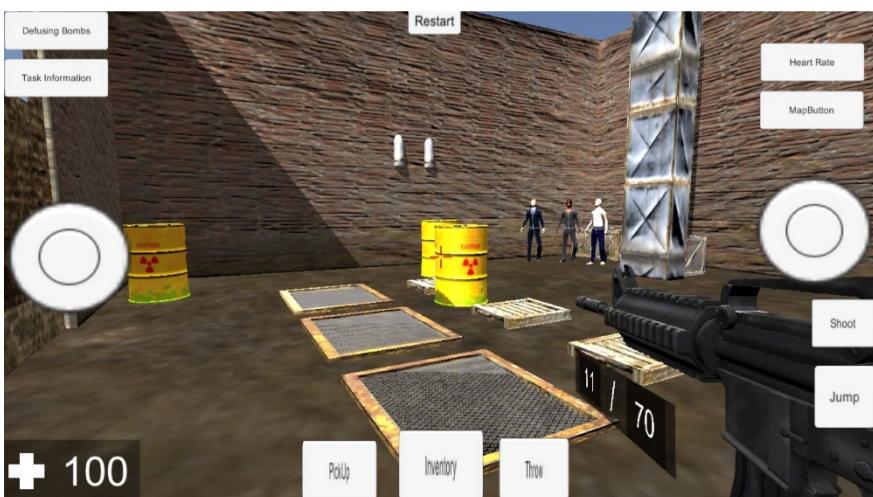
Player need to successfully defuse three bombs by finishing attention control task which player need to identify the skips in the clock. Player need to locate the bombs and press the “Operating” button on top left corner to enter the sub-task when “loading barrier” appears.



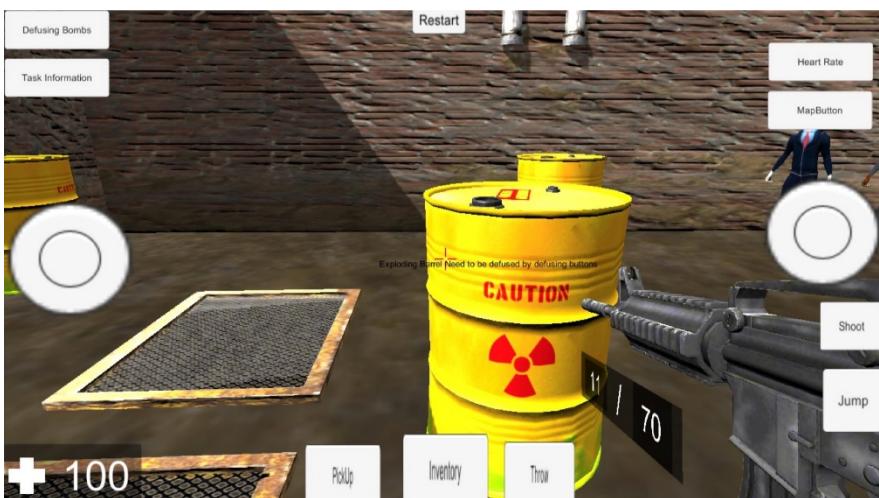
After successfully defused all the bombs, Player need to locate the trans-portal which will bring player to the second scene warehouse. Player will need to complete the sub-task of visualization to continue the game.



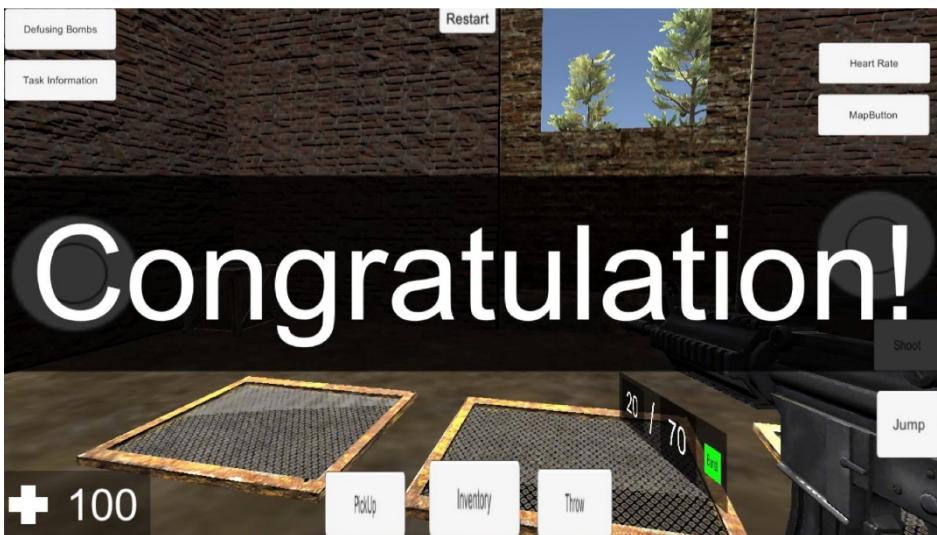
Going toward the trans-poral and after finishing the visualization subtask, player will enter to the second scene which is warehouse. The main goal is to rescue a hostage by defusing the bombs.



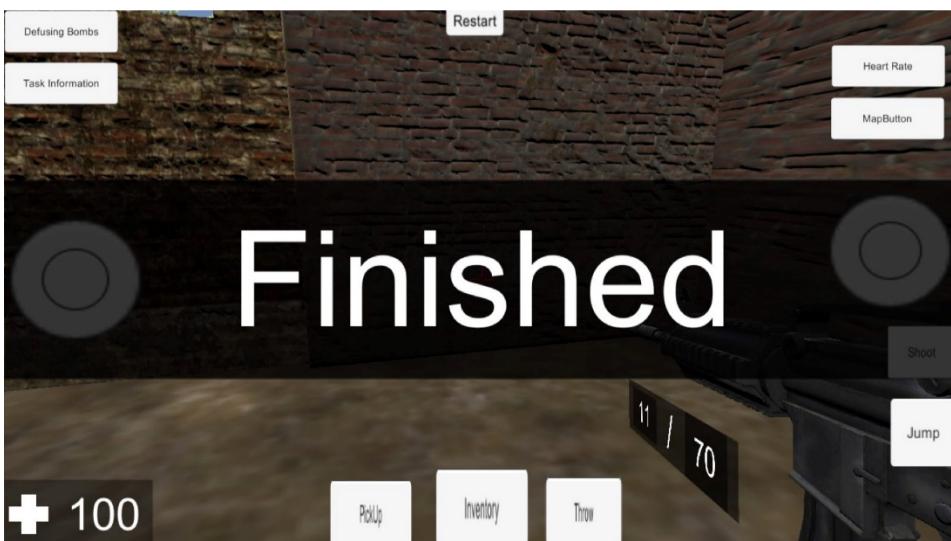
Player need to search the hostages and rescue them.



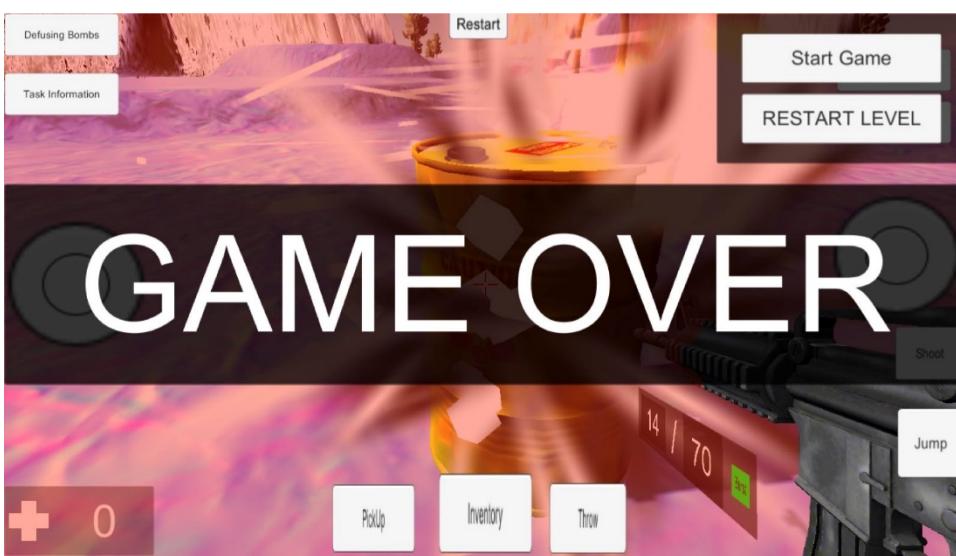
Distinct types of bombs from the bomb in the first outdoor scene. Player need to defuse them to rescue the hostage.



Screenshot of successfully finished all subtask.  
Congratulations on the achievement.



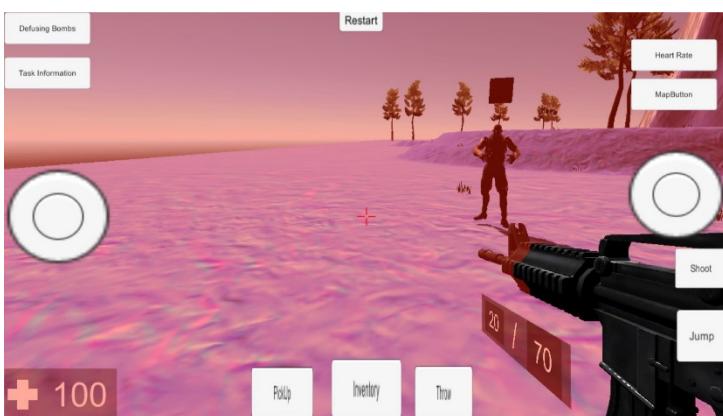
Game is finished and player can choose to restart the level by clicking the “Restart button”.



Screenshot of player has no blood when killing by enemies or exploding bombs.



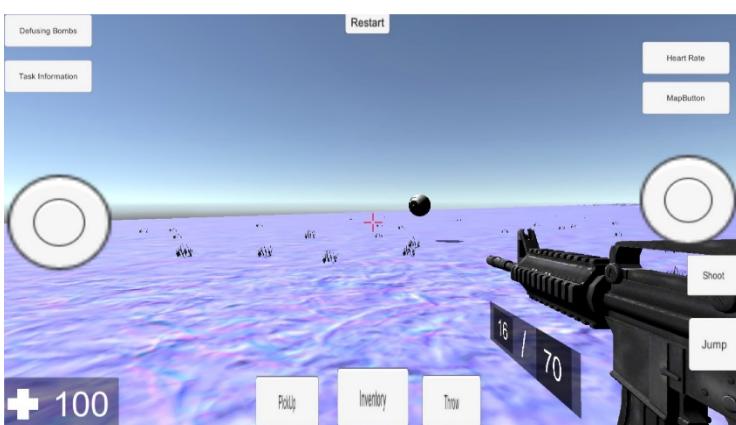
Task information page where player can check the progress and goal completing status during the game.



Player is under attack by an enemy and user interface will interactively change to red to show player his blood is deducting. This will also increase player's heart rate and make player more nervous.



Inventory page which shows what weapons player has and he can change different weapons to use.



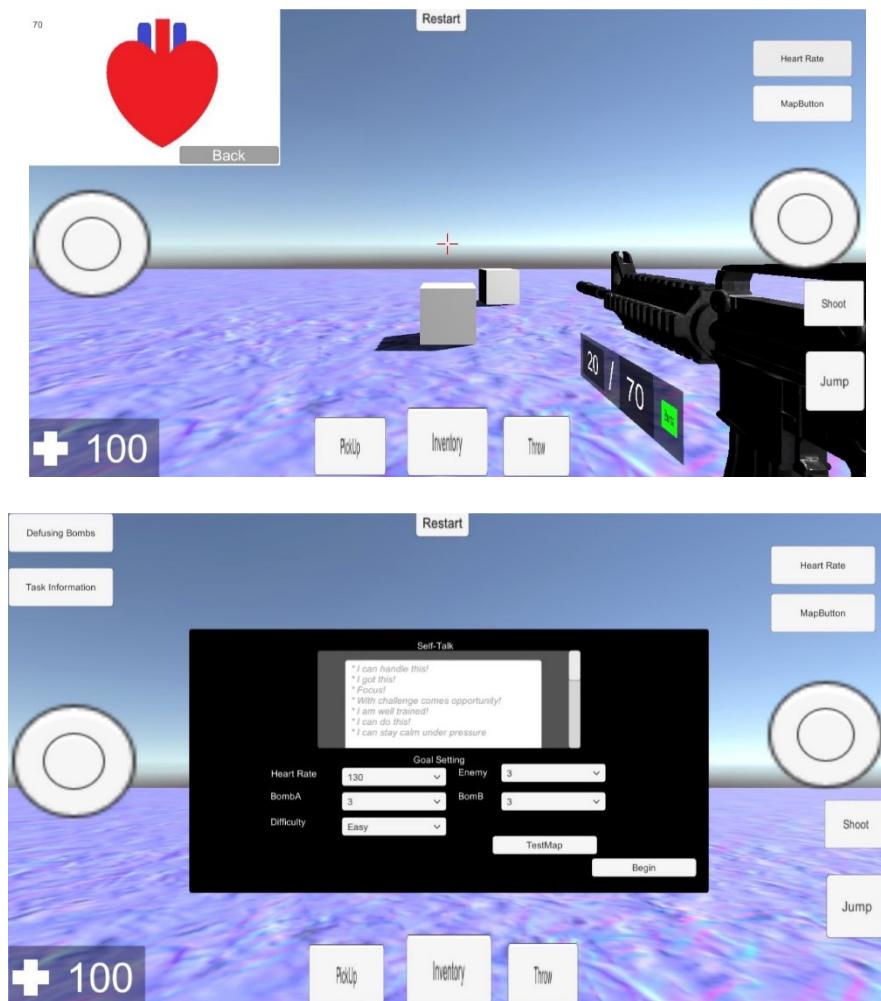
The sphere in the middle of the screen is ammo package which will increase player's ammo.

### 3 Game design

#### ➤ 3.1 Tactical Breathing

Tactical breathing section will be placed after the self talk section. we plan to record player's' heart rate before the game (normal rate), monitor the change during the game (rate when excited). The tactical breathing main page displays an animate lung, which has a changing speeding according to player's heart rate. Players will perform the tactical breathing practice and come back to the normal rate when his current rate during the game exceed the normal range of the heart rate. Meanwhile, players can set their target rate when he knows the rate before the game which also practices the goal setting and ability to keep calm under nervous circumstance.

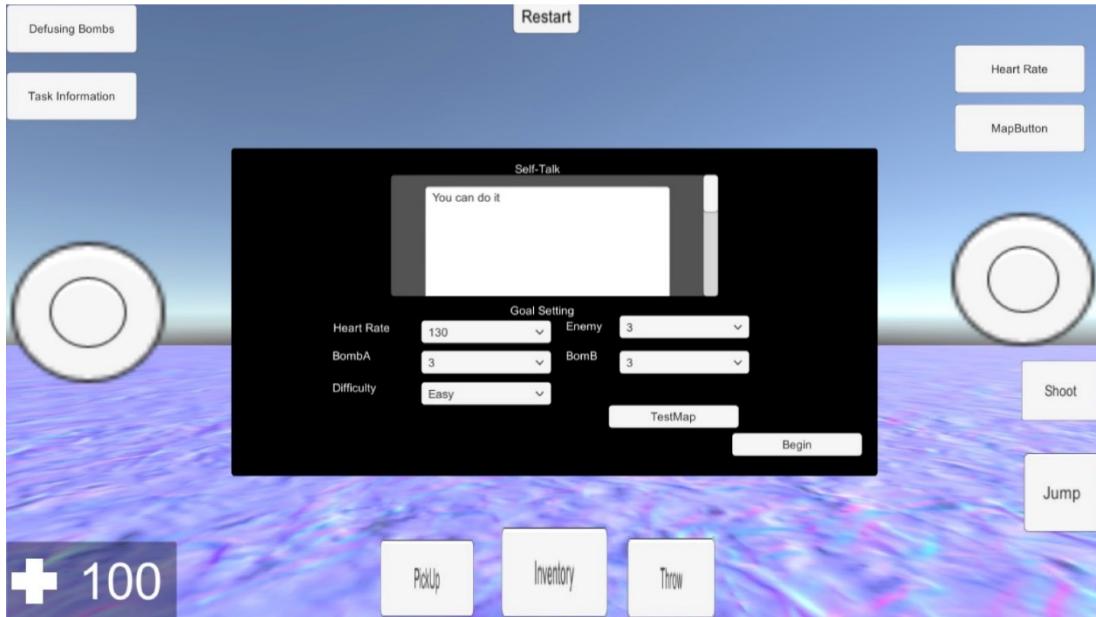
Users will be shocked during the game by different exciting and challenging sub games. For example, the section of bomb defusing and when multiple enemies are shooting the player. Players will be nervous and their heart rate will up. When it exceeds certain percentage of the acceptable level, the game will transfer automatically to the tactical breathing section. Player will be returned to the game when he performs the tactical berating task and cool down their heart rate to normal level. First step is to check the external heart rate monitor device connection. Number on the top left corner tells player his current heart rate and acceptable heart rate range under 120 bpm. Meanwhile, Players can change the acceptable heart rate range in the setting page.



### ➤ 3.2 Goal Setting

Goal setting section will be placed after the tactical breathing section. At the beginning of the game, we provide a checklist which includes some measurable standards (such as the time limit, the number of bombs defused) as well as the steps needed to complete the game.

The player can make choices according to the recommended checklist provided. Player could set minimum time to complete the mission, minimum life gets hurt and try to keep heart rate in the normal acceptable range. In this way, we avoid uncontrolled user input. After the goal is achieved. There will be a toast at the bottom of the screen to remind the player.

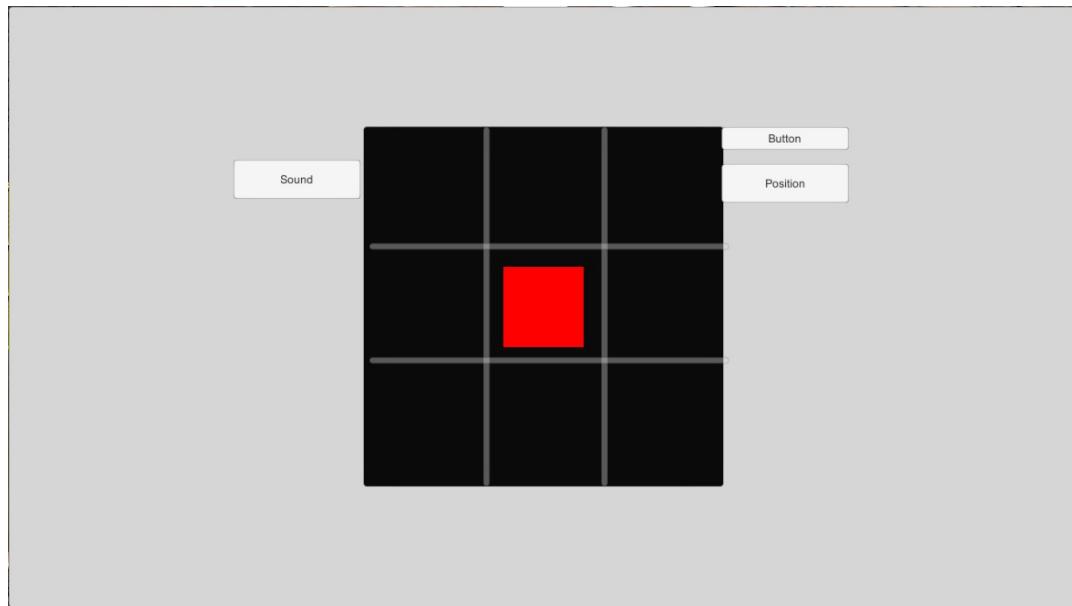
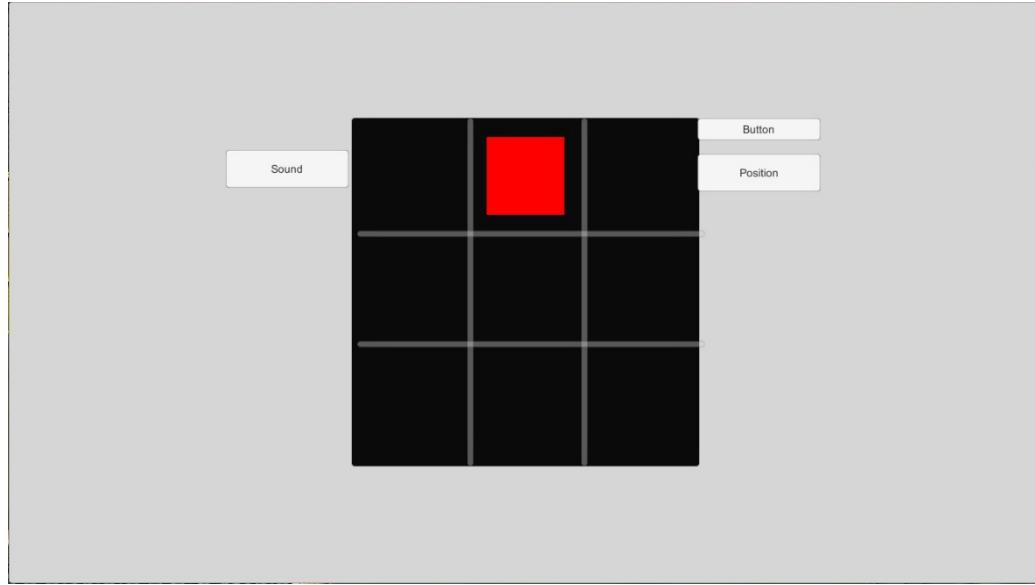


### ➤ 3.3 Memory Improvement

Dual N-back memory improvement task is implementing by memorizing and identifying the correct repeat of combinations of both position and sounds which appears two combinations previously. Player can choose the number of bombs that need to be defused in the goal setting page. There are three different level.

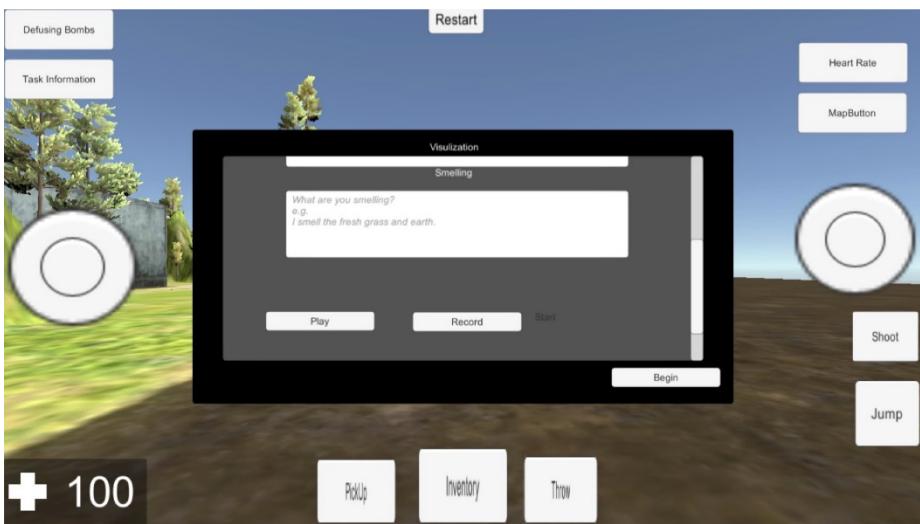
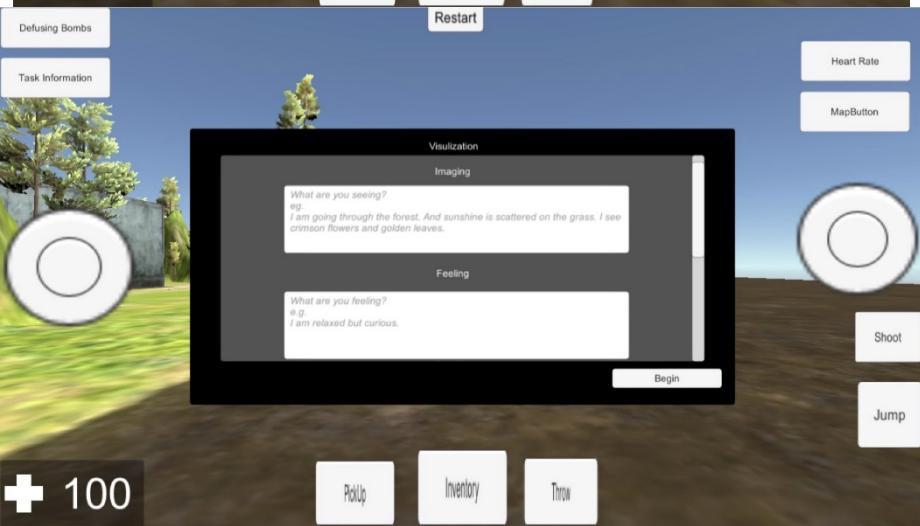
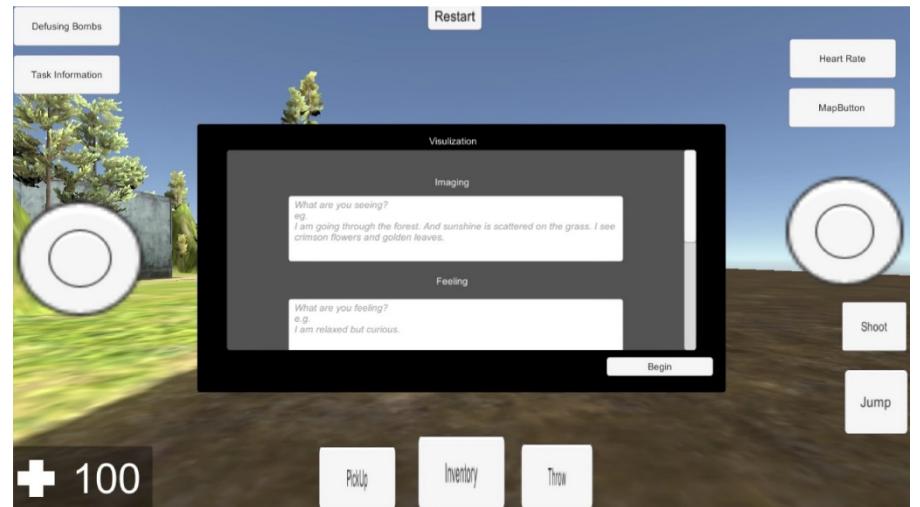
- ~Easy: successfully defuse a bomb when answering 5/10 correct. (50% accuracy)
- ~Medium: successfully defuse a bomb when answering 8/10 correct. (80% accuracy)
- ~Hard: successfully defuse a bomb when answering 10/10 correct. (100% accuracy)

Using N-back for improving memory. Cubes will appear in different position and different sequence. There will also be an unique sound playing with the appearance of the cube. Users need to focus on and remember the sequence of both position and unique sound of cubes. If the player fails to remember the position during the bomb defusing, the bomb will explode with a large sound, this would-be a in game shock for user to test their reaction under stress situation. Heart rate will be monitored during the section.



#### ➤ 3.4 Visualization

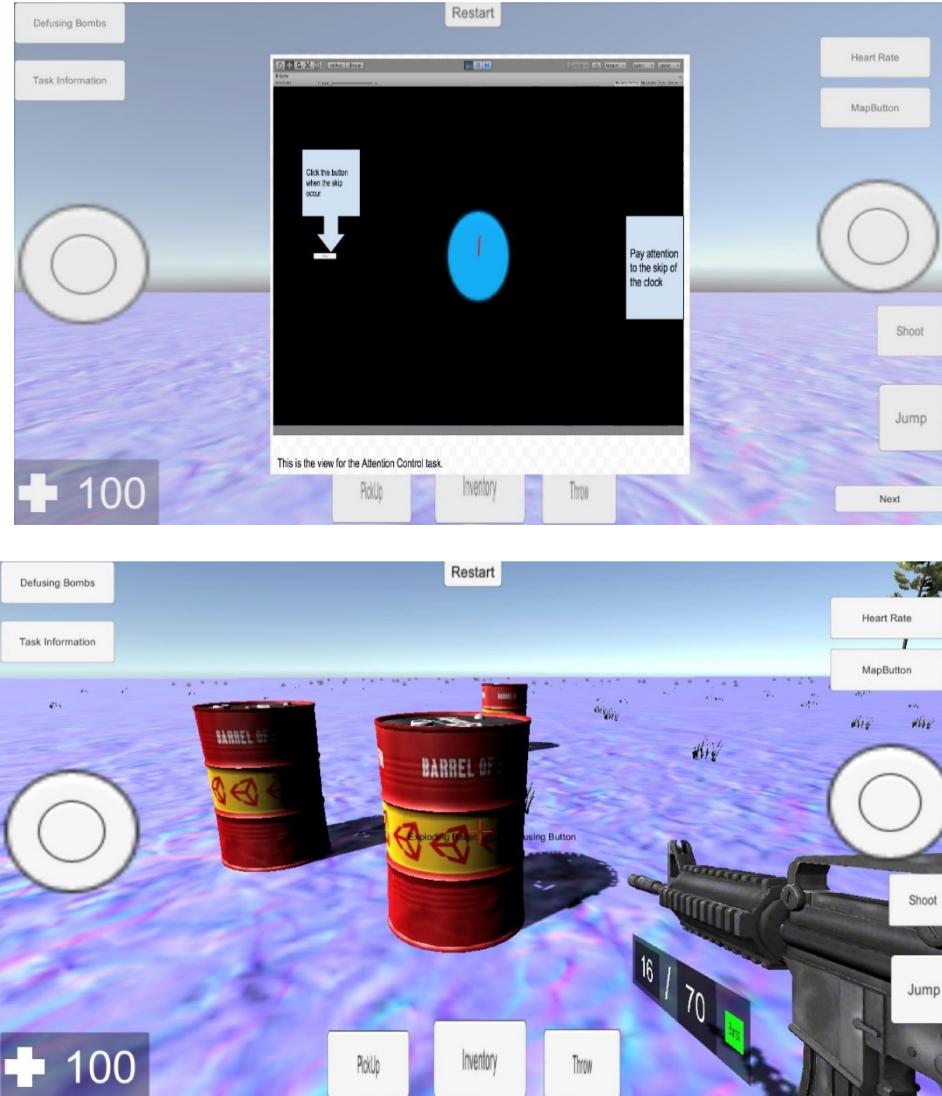
Visualization will be placed between transport from first scene to second scene. There will be two different scenes which environments are: snow ground and warehouse. Before player enter each of these rooms, game will ask player to use visualization to think of what will the situation and environment he will face and what he need to do to be successful. What player will see, feel, smell after he enter the next scene. This practice will make player be ready and prepare before actually see what is like in the room. This will increase the percentage of success during the mission.

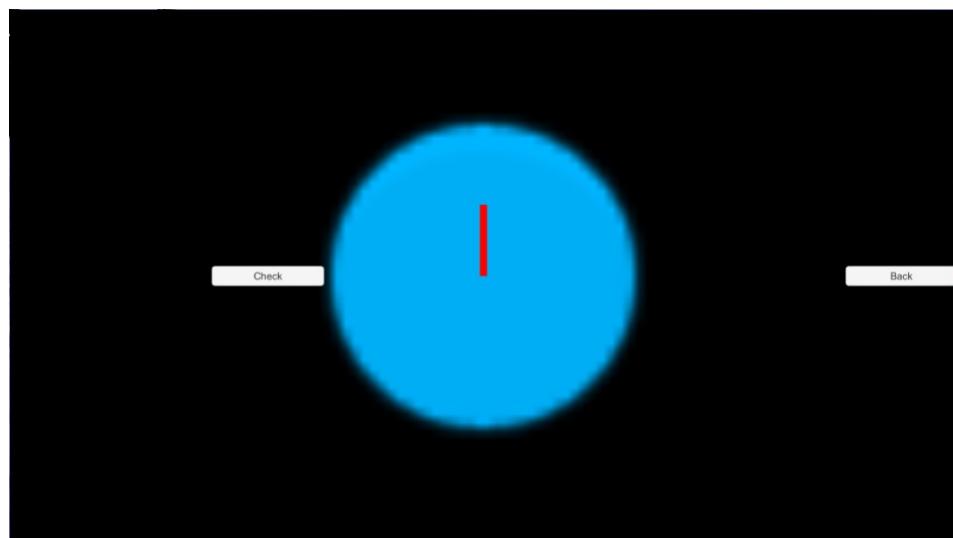
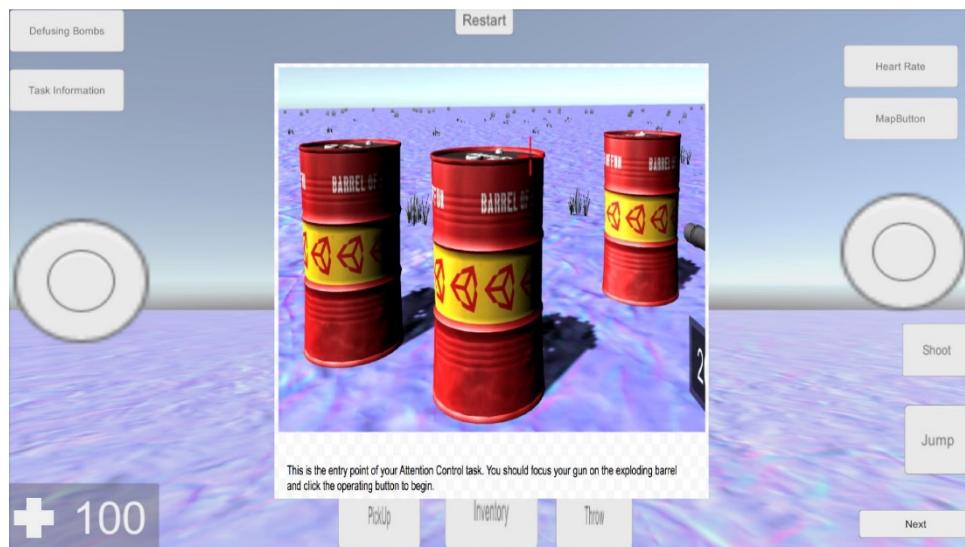


### ➤ 3.5 Attention Control

During the first person shooting game, player need to finish a task which stops bombs by focusing and touching the clock at the right time random required. Heart rate will be monitored during the game and if player's rate exceeds acceptable range, the game will guide player to tactical breathing section to calm down and be prepared again.

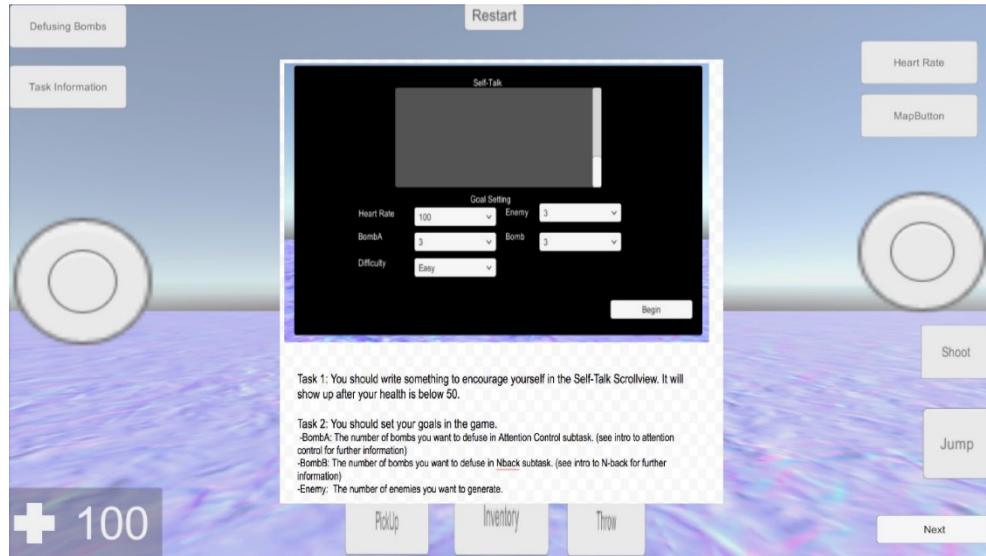
This game comes from the original mobile app and we integrate it in the part of defusing bombs. The game provides three levels for users and they should choose different level at the beginning of the game. For different level, there are six skips in a period of time. The higher the level chosen, the longer the game lasts.





### ➤ 3.6 Self Talk

Self-talk section will be placed at the beginning of the game which is an interactive training guide helps player to be better and encouraged during the negative situation. Players will enter his most favorite encouraging phrase during the most difficult time in the setting page. There will be a very positive and happy smiling face show on the screen which will increase the positive emotion to the player. At the same time, the game will let player know his response will help other people so that player will be more serious and responsible for his input. The game will save and keep all input of each player so that it is easier for future evaluation for the individual player. The positive phrase will pop up to encourage the player when player's blood is below 50%. This would encourage and improve player's emotion which would result in a better performance.



## 4. Testing

Our group conduct testing with two students in professor Chignell's lab. From this test, we got some advice and suggestions from testers which we have tried our best to make improvement by implementing all feasible parts in our latest version game within limited amount of time.

Feedback was as following:

1. Pop up window (instruction) will be helpful before the player is asked to do the task;
2. Triangle showing which direction you are facing is preferred over sphere;
3. The instruction page should be bigger;
4. A process bar on the top of the screen is expected;
5. the location of restart button should be adjusted;
6. Exchange the walking and aiming button;
7. Make all buttons and image bigger;
8. Final result should be clearer [fail, succeed, finish...].

Generally, testers felt that this game was fun and excited with abundant functionalities. And most importantly, all subtasks as required by client are achieved and work well without crash and satisfactory performance. And also, from testing by random selected testers' suggestions, some error was tested out and fixed.

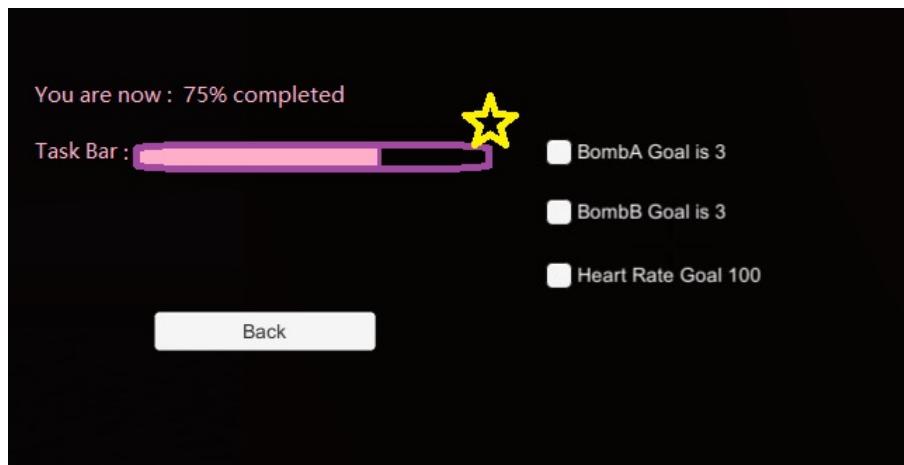
## 5 Suggestion for future.

Our team has some suggestion to develop a more interactive and challenge game which would be helpful for next stage of the game project development. First of all, design and implement virtual reality (VR) module to the game would be a huge improvement in the level of interactivity and effectiveness. Players would be able to play the game wearing special VR headsets and have better view and sense in the game.

For the Android Device, the connection problem is that we cannot get data through Bluetooth. We have tried three ways to get heart rate data by MIO. The first way is to get the data by basic Android Bluetooth service. The MIO is designed to transfer data only with some apps which are accepted by MIO company. This means we cannot get data through Android basic Bluetooth services. For the second way, if there is an official MIO API/SDK for developers, we could still get the data by them. Unfortunately, the MIO heart rate monitor does not provide an API or SDK for developers too. Finally, like iOS devices, we tried to use a third-party service to collect data. We used Google fit and we find it could receive the data from the heart rate monitor, but it didn't include the information of heart rate. Therefore, we think it is impossible for us to implement the function of collecting heart rate data by Bluetooth in Android devices. Our suggestion for the future team is to connect the MIO company to ask for an access to the MIO heart rate monitor hardware directly, that might be could solve this problem.

Adding the function of multiplayer mode is also an improvement in the usability level. Players can either play together as a team to complete a mission to practice team-work ability or compete the result with others, such as a ranking list. However, this would require solving the problem of internet security and potential technical breach risk. It is also a good idea to implement more scenes in addition to existing scenes of snow ground and warehouse to the first person shooting game such as garage, airport, and urban city. Visualization ability will be improvement more effective by implementing more scenes. In the future, we suggest implementing more types of weapons for player to use since we implemented the inventory system which allowed player to pick up, change manage weapons.

Implementing a task bar system for player to check the status of mission completed would be also be an innovative idea. It is more clear and straightforward for player to know how many present of mission they have completed during the game by pressing the “Task information” button rather than only reading the check list of the goals.



A specialized helping system which can pop up automatically would be important for the future version. It is friendlier to the players who play the game at the first time. Players will get the suggestion and hint to know what operations need to be finished and results they will get based on different performance. For example, when players try to defuse a bomb in the scene, a window including a brief introduction of associated instructions and game rules should be popped up before the defusing operation is began. However, this system should only appear when players want to learn how to play the game. Therefore, an option should be provided at the landing page to ask if players want to know how to play game.

A more reasonable UI design would be an improvement to the game. For the current version, there are twelve buttons on the screen. In case of pressing other buttons when using one button, the size of button have to be limited to a small size. This leads to players find it is a bit difficult for them to press the right button sometimes. Therefore, if follow-up developers want to solve this problem, re-designing the UI would be a good idea.

## 6 Conclusion

The first person shooting game is designed and implemented based on the guideline provided from DRDC. The Guideline mainly focus on improving player's mental resiliency and provide self-regulation support from practicing memory improvement, attention control, goal setting, visualization, tactical breathing and self talk. Each subtask is specifically designed to coalesce to first person shooting game of hostage rescue theme. The game will offer a new and interesting experience during their free time and life. Players are able to improve their skills and mental resiliency in efficient and effective way. The game offers a user-friendly interface with plenty of functions including shooting, jumping, picking up weapons, viewing map, setting difficulty levels, setting individual encourage words and tactical breathing threshold. The game also offers beautiful indoor snow ground and outdoor warehouse environment. Player's heart rate will be monitored during the game. The heart rate is an important and reflective personal data which shows player's mental tension level. Player will be direct to tactical breathing section to practice and recover to normal rate when exceed to certain pre-specified threshold level. In conclusion, this game will be a useful and interactive game to play and practice skills.