CS4474

Final Report - Tanks

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Executive Summary

Tanks Overview

'Tanks' is a turn-based, multiplayer video game that pits up to 4 players against each other. It is based off an old flash game from addictingames.com that has been around for years. Our version of tanks improves on many of the systems that were around in the old game.

Upon starting the game, players will see the 'Start' screen where they will be asked to 'Press Any Key to Continue'

Each player is given a tank and using keyboard controls and their knowledge of physics and vectors, are rewarded points for shooting the other players. When players hit other players, they gain points and the enemy player loses health. When a player's health is fully depleted his tank explodes and he is out of the round. When there is only one player left the round ends. Matches in tanks are played in best of three rounds, five or seven rounds. The player with the most points at the end of the match wins.

At the end of each round, players are greeted with a results screen that shows how they stack up against each other in terms of points. Players then go to a shop screen where they can pick between a variety of different weapons and upgrades including:

- Large Missile
- Armor Piercing Missile
- Ball
- Explosion
- Frag
- Inflammatory
- Helicopter Strike
- Armor Upgrade
- Fuel Upgrade
- Repair

Each weapon has a distinct function that aids the player in their quest to destroy the other players, stay alive and ultimately, gain points to win the match. Before buying weapons, players can see a small description of what each weapon does and an animated preview of each weapon in action on the game screen. When they are done shopping, players will head back into the game screen to play the next round and will be able to pick their newly acquired weapons and items from the pullout inventory menu at the bottom left of the screen.

Goals of the System

We wanted to improve on many of the HCI elements of the original 'Tanks' game. This includes:

- Teaching the user concepts of physics such as gravity, vectors and wind resistance.
- Make an educational experience that will also be fun for the users who are of a young age (ages 8 - 13).
- Providing controls and an interface that is simple for the user to pick up and play without having to use unnecessary mental effort to understand the gameplay.
- Improving the visuals of the game to look more modern
- Making the feeling of hitting opponents more rewarding
- Removing bugs found in the predecessor
- Making this version more intuitive

Navigational Map

Overall Navigation

Landing Page

Main Menu/Game Setup

Game Screen

Round Results

Shop
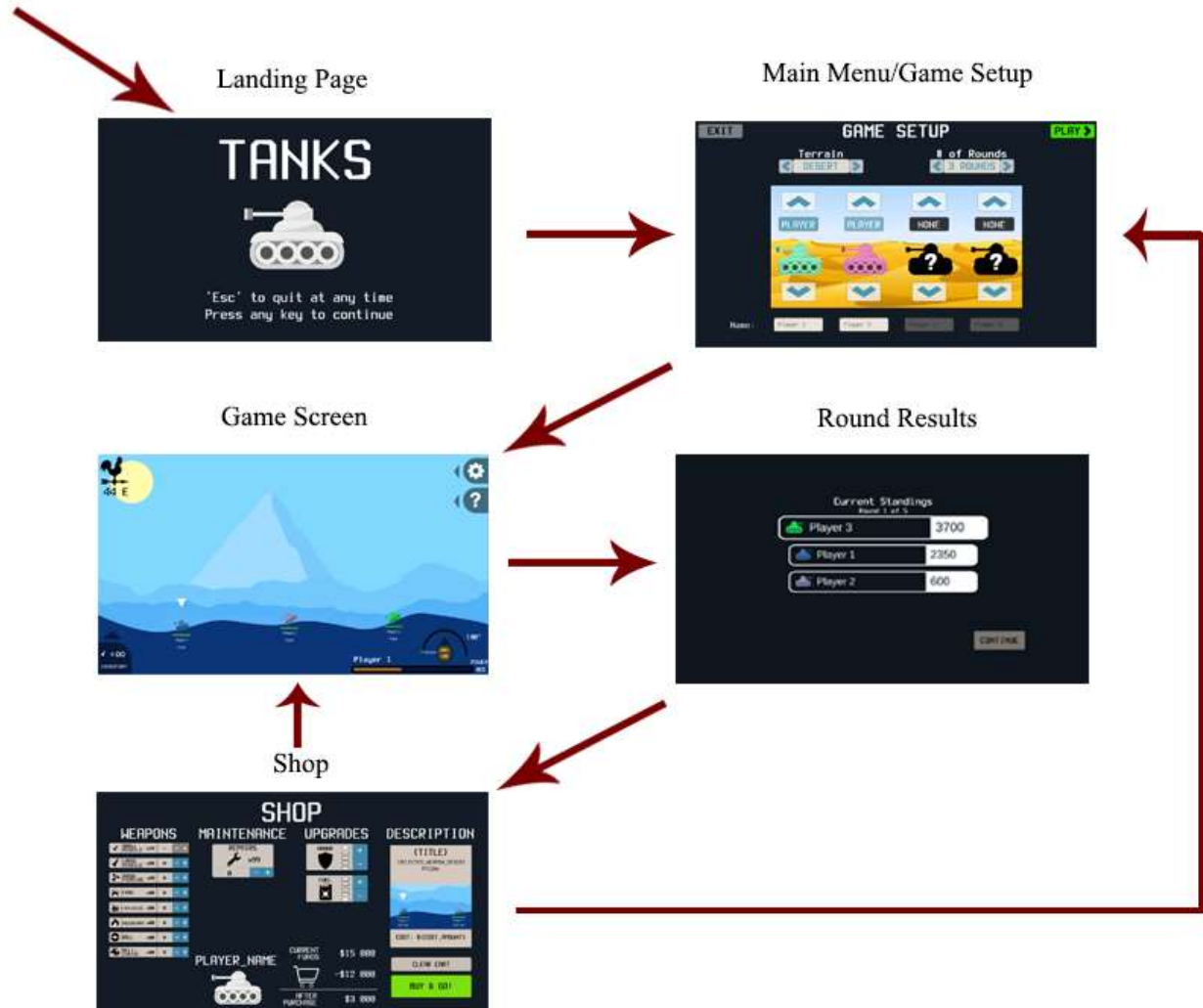
Landing Page

Press a key other than Esc to navigate to main menu

Press Esc to exit game

Main Menu/Game Setup

Game Setup

Click to view confirmation pop up

Click to exit game

Click to flip between mountain/desert terrain

Click to increase or decrease # of rounds

Click to activate tank and change its colour

Click to type a custom name

Game Confirmation Popup

Click to return to Game Setup

Click to start round (navigate to game screen)

Game

Battlefield

Game Settings Menu

Game Help Menu

Press to close help menu

Click a category to view information for that topic on the right hand side

Game Inventory Menu

Click items in white to select as the active weapon

Click to close inventory menu

Click to automatically repair tank
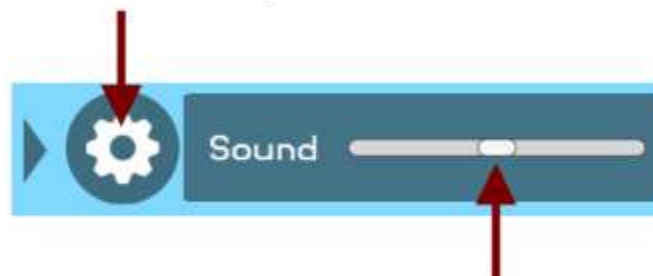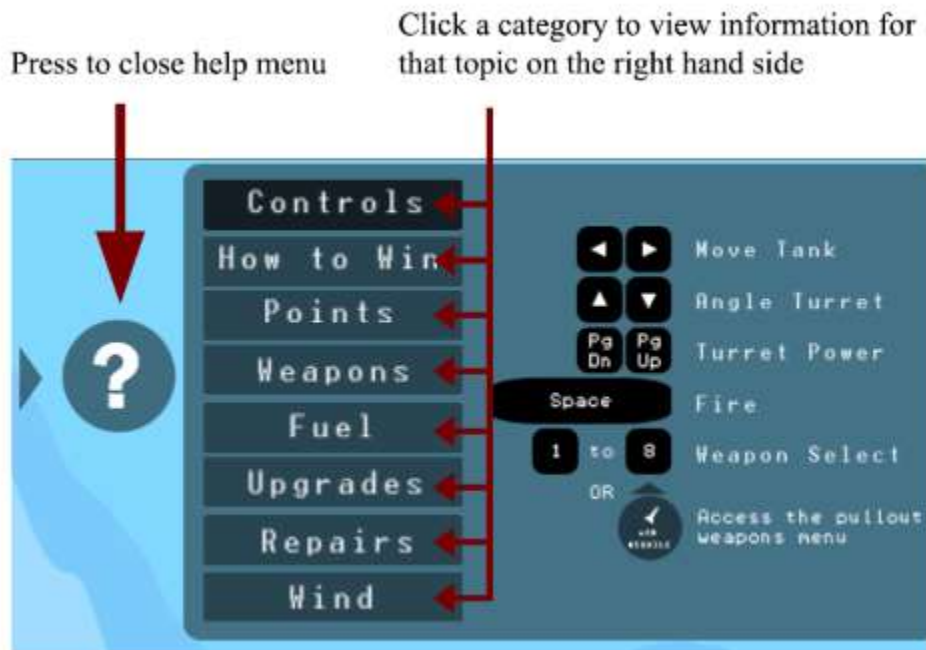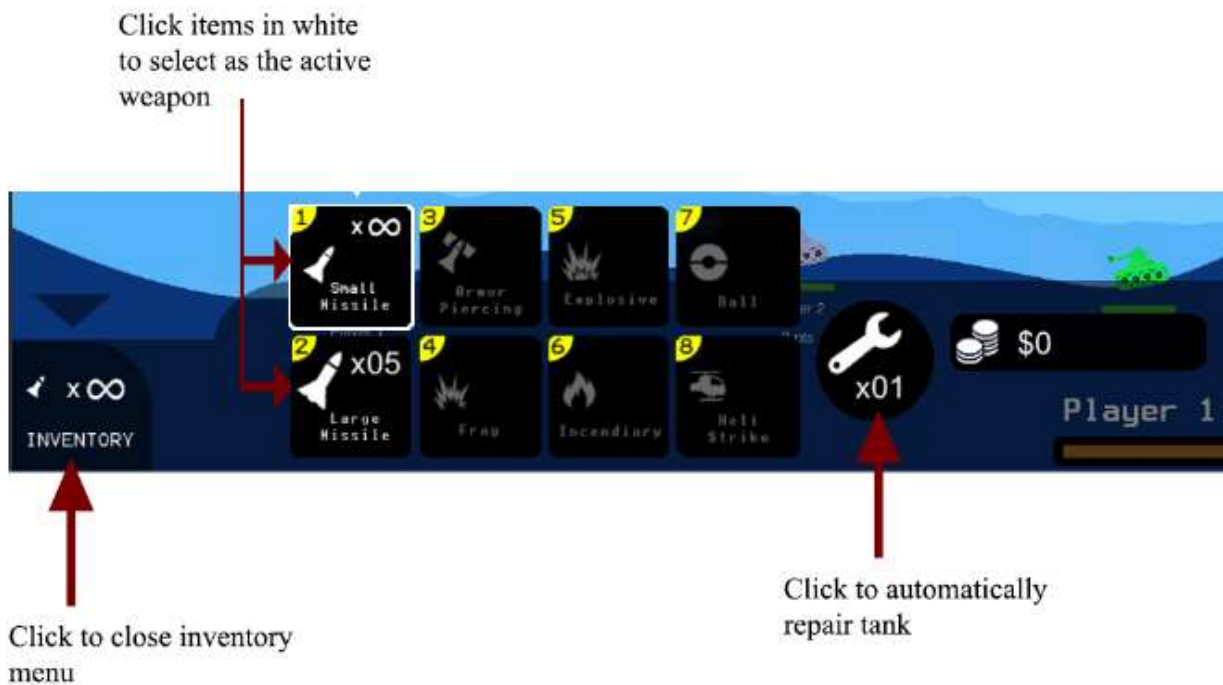
Round Results

Click to continue to Shop

Shop

Shop Edit

Click a weapon to see its description with an animation (highlighted)

Click to increase item amount to buy

Click to decrease item amount to buy

Clear Cart Confirmation

Click to return to Shop screen edit

Click to remove all items from cart

Purchase Confirmation

Click to return to Shop screen edit

Click to buy items (navigates to next player's shop turn OR to next game round)

Design Principles Used

5 Hat Racks

- Categorical organization: All items in the shop are organized by how they can be used by the tank
- Continuum organization: : tanks are displayed in order of decreasing score in the round results page

Shop categories: weapons, maintenance, upgrades
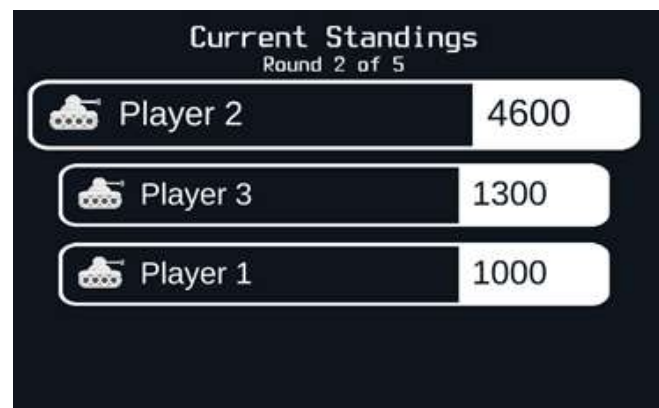
Round results ordered from top to bottom

Aesthetic Usability Effect

- The game achieves a flat design style that is more in line with today's design languages that are seen in Google, IBM and Apple interfaces. This increases the perceived usability

Affordance

- Static affordance is seen in the tank's structure
    - The tank's wheels and fuel indication afford tank movement across the terrain
    - The tank's turret indication and turret angle afford turret movement for firing
- Dynamic affordance is seen in the constraints of the tank's ability to fire
    - The ability to fire a weapon is further indicated by the ammo count that can be seen in the inventory menu
    - Pop up error messages also lets player know of their inability to fire


Static affordance: Tank before movement

Static affordance: tank after movement
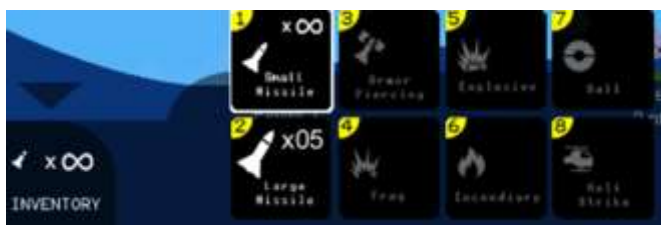
Dynamic affordance: ammo count

Dynamic affordance: errors

Alignment

- In the shop, the player can scan down a column easily because each item's name, current player's amount, cost, and amount in the shopping cart are aligned
- The buttons to increment and decrement the amount to purchase for items are also aligned

Calculations

- The shop calculates the cost of all items and the player's subtotal if they choose to purchase their items
- The score update and display to the players during score increases
- These minimize the strain on the payer's working memory when the system performs the calculations for the users

Shop calculations

Before Player 1 shoots Player 2 *After Player 1 shoots Player 2*

Color

- Colors are not used together that those with color blindness would have telling apart
  - Red and green are used but they are made to be very distinct, eliminating inability to differentiate
- The color of the active tank matches the color of the turret angle
- White arrow is used to denote an active tank

Player 3 is active by the white arrow

Player 3 is active by the green turret angle

Common Fate

- When a tank moves, the active arrow, the tank's points, the player's name and the tank's health bar moves in the same direction and speed as the tank itself
- This reinforces that the points and health are associated with that specific tank, since each tank has their own name, point and health display

Before Player 3 moves

After Player 3 moves

Conceptual Exclusivity
- All weapons are named differently because each weapon looks and performs differently
- Points and money are made sure to be distinct because it can be easy to confuse them since they are accumulated in the same way
    - Money decreases and can be used in the shop to purchase items. Money is displayed in the inventory menu
    - Points cannot decrease and are carried over after each round. Points are displayed by the player's tank

Weapons

Points
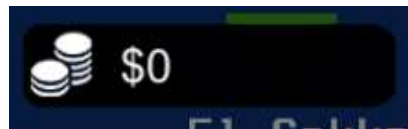
Money

Confirmation

- Before making a purchase, the shop has a confirmation pop up because players are unable to refund their items after making a purchase
- In the main menu, a confirmation is needed before starting the game. This ensures that the players have chosen the correct amount of tanks
- The confirmations only display during actions that are irreversible; this prevents habituation
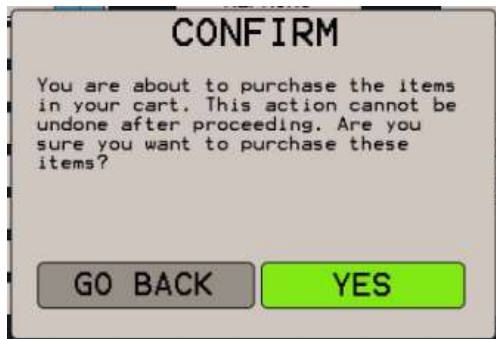
Shop confirmation

Main menu confirmation

Consistency

- Aesthetic consistency is achieved by having a flat simple design style across the game
- Functional consistency is achieved by using the left and right arrows to move the tank, and the spacebar to select or fire.
- Internal consistency is achieved in the error messages and shop item layout; they are consistent in size, location and image content
- External consistency is achieved with the game navigation that is similar to other games. The game begins with a landing page for introduction. Then it moves into the main menu, then to the game, then to the round results and finally to the shop.

Functional consistency

Internal consistency

Constraints

- The buttons in the shop are deactivated prevent a player from adding more or less to their cart based on what they can afford/ what is in their current cart
- If a player has reached the maximum of what their inventory is able to hold, or if they reached the maximum upgrade of an item, the buttons will also be deactivated

Shop: grey buttons are invalid

Contrast vs Brightness

- The terrain has contrast such that the ground level is a lot darker than the sky and background This lets the player know which area is the ground that the tank is able to move on
- The shop and round results have a dark simple background so that the items, buttons or round values are the focus

Terrain   *Shop*   *Round Results*

Control

- Experts are able to select their weapon using a shortcut
- Beginners are able to open the inventory menu to for a visual of their options and can select from there. A quick intro to gameplay is also displayed on the first round
- Beginners are able to learn the shortcuts using the shortcut indication on the top left of each weapon item in the inventory menu. This facilitates transition into becoming an expert

Yellow numbers are shortcuts, or click on the item

First round control information

Entry point

- The landing page is the entry point of the game
- The landing page has minimal barriers since any key can be pressed to continue
- The landing page gives the first impression that the game will be about a battle, based n the tank image and title of the game
- Progressive lures are used because minimal information is given on the landing page to entice players to navigate further to find out more about the game

Externalize

- The player does not need to remember gameplay controls or their inventory of weapons because the help menu and inventory menu provide this information on demand
- The player's tank information including health, score and point are also visible
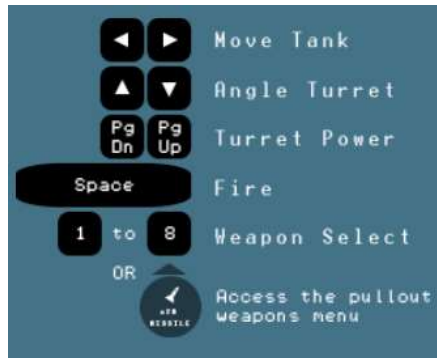
Control info
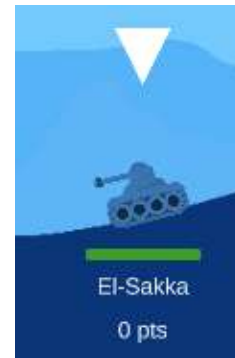
Points/health info

Inventory info

Figure and Ground

- The game screen is split into the ground which consists of the terrain, and the figure which consists of tanks
- The ground is static and the figures contain movement from weapon firing and tank movement
- If a pull menu is opened, it is translucent to allow for principles regarding 3D layering

Background: blue terrain, foreground: tanks

Translucent inventory menu

Fitt's Law

- All pull menus are placed at the corner or on the edge to allow for easy mouse navigation (infinite edge)
- All buttons in the rest of the game are large enough and far away enough from other buttons so players are less likely to click the wrong button
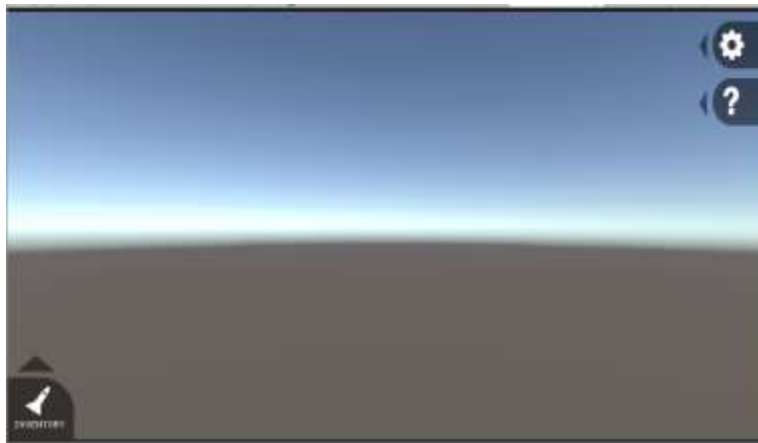
Pull menus (without gameplay view)

Clear cart is above 'Buy & GO!'

Forgiveness

- A player can clear their cart in the shop, or they can remove individual items
- This allows the player to change decisions before making a purchase

Hick's Law

- The number of shop upgrades are reduced from the original Tanks to prevent player's impatience when waiting for the active player to purchase items from the stop

Highlighting

- The currently selected item in the shop or in the inventory menu is highlighted with a light border

Small missile is active in inventory   *Frag is highlighted in shop*

Interference Effects

- The game avoids stroop interference by only associating red with negative actions, such as the quit confirmation

Layering

- 2D layering is used in the help menu as it organizing information into groups where only one layer is visible to the player at a time

Visible information on the right, layers depicted on the left

Mapping

- Layout mapping is achieved by having a tank move left and right using the left and right arrow keys
- Meaning mapping is achieved by having a tank's turret angle increase and decrease using the up and down arrow keys
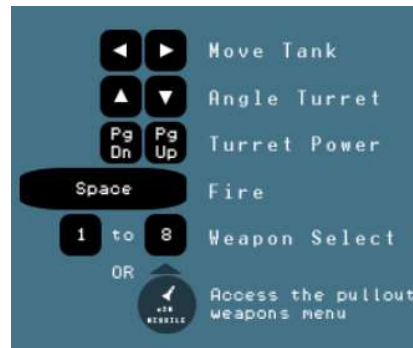
Metaphor

- The fuel is a metaphor for the tank's ability to move. It also let the player know that movement is constrained by the amount of fuel left
- The wind vane is a metaphor for the variability in which the weapons will be able to fire (based on wind strength)

Fuel metaphor   *Wind vane metaphor*

Mimicry

- Surface and behavioral mimicry is achieved by the turret angle. The visual of the angle resembles a protractor, and the turret's angle reflects the same angle that is displayed.

Protractor angle mimicry

Picture Superiority Effect

- Any display of a weapon is accompanied by its picture, to facilitate distinction of weapons
  - Displays are seen in the help menu, error messages and inventory menu
- This is important as there are 8 different weapons which can be hard for a player to differentiate

Help menu
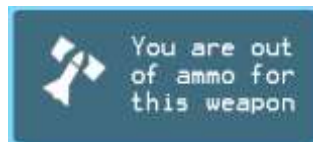
Error message

Inventory menu

Progressive Disclosure

- The pull menus are only available if they are requested to prevent an information overload
- When the help menu is opened, information is categorized so the plyer only sees information about what they need help on and nothing more
- This allows the player to focus on the gameplay

Settings and help pullout

Help menu opened

Proximity

- Items in the shop that are related to each other are closer together and are separated from non-relating items (weapons vs maintenance vs upgrades)

Shop items

Recognition over Recall

- Using symbols that convey what a weapon does helps the player to know about their function
  - Player can recall in shop where a text description is given about what a weapon does
- Displaying the terrain the player chose in the background during the menu selection allows player to recognize what each terrain looks like instead of having to recall it from a previous game

Weapon recognition

Weapon recall

Desert recongition

Mountain recognition

Responsiveness

- Every action is followed either by a visual or audio cue:
  - Any changes made to a tank's characteristic is displayed in the main menu (name and color)
  - Changing a weapon shows the symbol selected in the inventory menu button
  - Firing a weapon makes both a sound and an animation
  - Tank movement and weapon animations are smooth
  - Error messages will pop up for invalid actions (eg, no ammo, no fuel)

Menu display of tank characteristics

*Small missile is selected and highlighted*

Error message example

Restricting Controls

- In the main menu, players selected from a restricted set of colors
- In the main menu, inactive tanks cannot be edited
- In the gameplay, invalid shortcuts are handled by the system
- In the shop, player cannot make invalid purchases

Shop: grey buttons are invalid, blue are valid

First tank is valid, rest are invalid

Semiotics and Signs

- Each inventory item has a different sign which indicates how it performs
- Example of an iconic sign: small and large missile, explosive
- Example of an indexical sign: Incendiary, heli-strike
- Example of a symbolic sign: Repair

Missile   *Explosive*   *Incendiary*   *Heli-strike*   *Repair*

Steering Law

- Pull menus do not require a mouse to hover in the menu area. Instead it stays open until the player clicks the close button

Click settings circle symbol to close

Click help circle symbol to close

Inventory symbol

Supporting Reading

- Player only reads sentences in the help menu and in the item description in the shop
- Item descriptions are accompanied by an animation of how the weapon works
- In the help menu there are pictures to assist. For examples, there are contextual cues in the control section of the help menu
- The vocabulary and reading required are feasible for the target demographic (8 − 13yrs)

Shop description of Ball

Arrow key pictures indicate controls

Symmetry
- Symmetry in the main menu arrows for the player to know which control buttons correspond to which tank. (all buttons vertical of a tank belong to that tank)
- The buttons include the tank's color, and player name

Visibility
- The player is aware of whose turn it is based on the white arrow that hovers on top of the active tank, and the active player's name in the bottom right
  - o Reinforcement is given by the turret angle which is the same color as the active tank
  - o The active player can see their fuel level decrease while moving
- All tank's health and points are displayed around the tanks
- Wind direction and strength is displayed in the top right
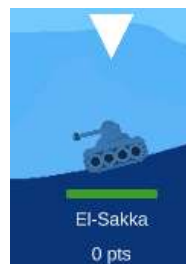
Health/points

Wind power

Name/turret angle color matches tank

Uniform Connectedness

- Uniform connectedness is achieved by using color in the terrain
    - o Only shades of blue are using for the mountain terrain to let the user know which part of the screen is the background
    - o The same occurs with shades of yellow in the desert terrain
    - o The sky is more similar in color than with the ground to separate the two

Mountain terrain
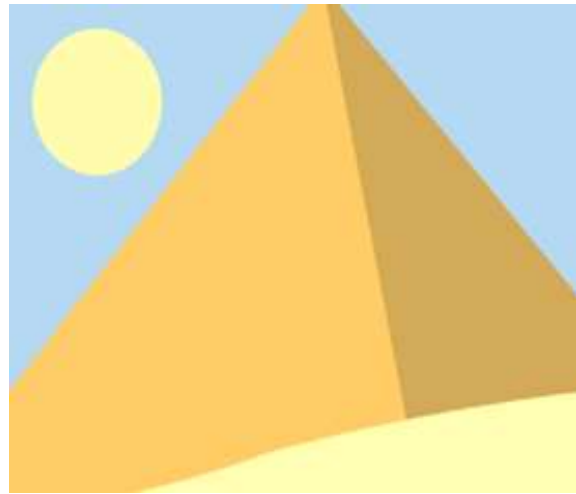
Desert terrain

Heuristic Evaluation

Evaluation of the System

We evaluated user experience based on heuristic evaluation of 8 students who played the game. Users were made to play the game against each other in groups of 2 and talk through their general thoughts on what they think is happening and what their goals are. Each step of the way, an evaluator took note of the users understanding of the game.

Interaction & User Activity

Visibility of system status: What's going on?

The students were aware of the system's status from start to finish of each round. Upon entering the Game setup screen, players could easily tell how to change colour, add players, change location, round settings and add a nickname. Every student knew how to navigate to the next relevant scene using the correct buttons.

Upon entering the Game screen is where a few players became confused. In an older version of the game, rather than having a tutorial screen, the help menu was pulled out by default at the start of the game. Some players were initially unable to discern that the help menu could be closed – eventually, they realized this was possible. Due to this feedback, we changed the tutorial screen to a more obvious overlay. After evaluation players could tell that the game was turn-based. Users understood that their tank corresponded to tank from the game setup screen.

One of the users' area of confusion was surrounding the points system of the game. Users did not initially understand the goal of the game was not necessarily to survive until the end, but to get have the highest number of points – both goals being somewhat aligned by the 2000-point bonus provided by being the last tank standing. Users were not always able to recall what weapon they had equipped before shooting. When increasing the shot power, many users expressed dissatisfaction with how slowly the power gauge filled up. Incorporating this feedback, we increased the rate at which the power gauge filled up.

Does the system follow the 80/20 rule?

Although some did, many users did not add nicknames or change colours when they played the game. Also, very few users went through all the instructions in the help menu. No user upgraded their fuel or their health. Most users spent their money on new weapons.

Metaphor, Semiotics, Representation

Were users aware of the function of the fuel mechanic?

Users quickly understood that the fuel gauge indicated the amount of fuel that they had because of the colour and texture of the gauge.

Were users aware of the function of each weapon?

Users were mostly aware of the functions of each weapon from the display name and icon. The weapons that caused confusion were helicopter strike and ball. Users were confused by having to shoot at the location where they wanted the helicopter to strike. Users also were mystified by the function of the ball and did not know what to expect upon firing. To fix this, we added visual animations depicting what exactly the weapons did.

Did the repair button convey the meaning of repair to the users?

Users did not appear surprised by the effect of the button after having clicked it. Users clicked the button to replenish their health which is the function of the button.

Did the users understand that the '?' indicated help screen?

When users needed help they pressed the '?' button indicating that they understood where to look for help.

Did the gear indicate options to the user?

Users rarely clicked on this icon but that seemed to be an indication that they understood its use and had no need to click it throughout their experience with the game.

Design Perception

Are error messages expressed in plain languages that precisely indicate the problem?

When users ran out of ammo, they were aware that they could not shoot anymore due to the error message that appeared on screen when they attempted to press the shoot button. In the Shop scene, users were not always aware that they did not have enough money to buy a certain weapon, even though the buttons were greyed out.

Does the system have natural mappings?

Users that were used to the controls of computer games could use the natural movement key bindings (w, a, s, d) that are common in other games. The same was done thoughtlessly with the number key binding for changing weapons.

Learning to Use the System

Do users understand the language that was used to communicate with them?

When attempting to use a weapon with no ammo, users understood because of the dialogue box that appeared.

The gifs that we used in the shop screen provided a good demonstration for what the user was buying in the shop screen.

Does the system provide help and documentation where it is necessary to users?

The game scene has a 'help' pullout menu. When users needed help during evaluation, they clicked the pullout menu to find the information that they were looking for. The help menu included all of the necessary information for the users when clicked.

Pullout menus can be hidden by clicking the button again, so it's only available when requested.

General Usability

Does the system prioritize recognition over recall?

The weapon that a user equipped is displayed in the button for the inventory screen so that they do not have to recall which weapon they are using. Also, the weapon that they were using on their last turn is automatically equipped in their next turn so that they don't have to go back into their inventory and remember which weapon they used last turn.

Players also did not have to remember the amount of health they had or the amount of points they had as they were displayed under the tank they were using. Between turns the power gauge stays at the shot power they used last turn as well.

The system however does not display the round information during the game scene. Sometimes users forgot what round it was when playing which is an area where it can be improved.

Flexibility, and Efficiency of Use. Does it matter if you're an expert or a beginner?

Users who were more familiar with video games could choose a weapon without going into the inventory screen via keyboard shortcuts while users that did not have a background playing video games could choose weapons from the inventory screen with little trouble. Users understood that certain types of weapon had limited ammo and could tell when they did not have ammo due to error messages that appeared on screen when they tried to shoot.

Does the system consider Fitt's Law?

The 'settings' button and the 'help' button are connected to the walls of the screen. The inventory button is connected to the corner of the screen. This makes it so that if a user rapidly moves their cursor to the maximum distance of the screen, they will still press the button when they click.

Future Improvements

1. **Alter the interface on main menu that sets up tank characteristics**

   - the arrows that change colours on the game setup screen can be mistaken for arrows that add players
   - Make one button for player type (active tank or inactive tank) and have another set of buttons to change colors

2. **Make visibility of tanks in battlefield clearer**

   - With the large terrain space, the tanks could be made larger so it is easier to see without compromising the aesthetic of any other component

3. **Allow players to connect into the game with their own devices**

   - It would eliminate the need to swap an individual device amongst each player and would improve physical comfort
   - This would require setting up a server that hosts the game with clients that connect into it

4. **Add the ability for tanks to be bots**

   - This would require incorporation of artificial intelligence
   - This would allow for a single player, as the current version requires at least 2 human players

5. **Give players the ability to change the mode of their game. For example:**

   - Players can choose to play rounds without being affected by wind strength
   - Beginners can view a projectile angle of how their weapons would fire. This would resemble a dashed line that displays the trajectory of a weapon fire.