Game Design Document

SPACEWAR!

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Game Design

Elevator Pitch

Spacewar is a two-player competitive game playable on the DEC PDP-1. Each player controls a spaceship and attempts to destroy their opponent by hitting them with a torpedo. Piloting the ships is challenging as they move with actual physics; they take time to accelerate and once moving keep their momentum. To make matters worse a star sits in the middle of the battlefield gradually pulling both ships towards it with its own gravity.

Gameplay Description

This is the envisioned player experience for Spacewar. More specific information on game components and functions follows in their own sections.

In Spacewar each player is trying to destroy the other's spaceship. To accomplish this both ships are capable of firing torpedoes along a straight path in the direction the ship is facing. Each player is trying to use their ship to outmaneuver the other and land a hit with one of their torpedoes to win the game.

The ships move by rotating clockwise or counter-clockwise and can apply thrust to push themselves in the direction they are currently facing. Because the ships follow the laws of physics, namely acceleration and momentum, they can turn to face a completely different direction than they are travelling in. Learning how to change the trajectory of the ship and adjust aim to account for both their movement and their opponent's are key to victory. If they are desperate each player can also activate hyperspace, a risky move which makes their ship disappear from where it is and restart in a random location.

There are two complications to the fight. One is the star at the center of the battlefield, its gravity constantly pulling both ships in towards itself. This changes the paths of the travelling ships and if they make contact with the star that ship is restarted at the corner of the battlefield. The second is that the battlefield "wraps around" to connect to itself horizontally and vertically; a ship or torpedo going off the edge appears on the opposite side of the battlefield. It curves around to meet its opposite boundary.

Platform and Target Audience

Spacewar is only possible to play on the DEC PDP-1 computer system. The game is intended to be played by people much like its developers: technologically-inclined university students. Once it received some exposure, and the less computer-literate people were taught how to play, it would likely be popular among youths, teens and adults who enjoy direct competition and contests of skill. The game is straightforward and simple, with no objectionable content, making its only real limitation the technological hurdles of owning and operating a DEC PDP-1.

Level Design

This details the design and traits of the battlefield Spacewar takes place in.

Spacewar has only one level, the space battlefield where the two ships try to destroy one another. The game doesn't even delay the players with a title screen but immediately starts with the level loaded and running.
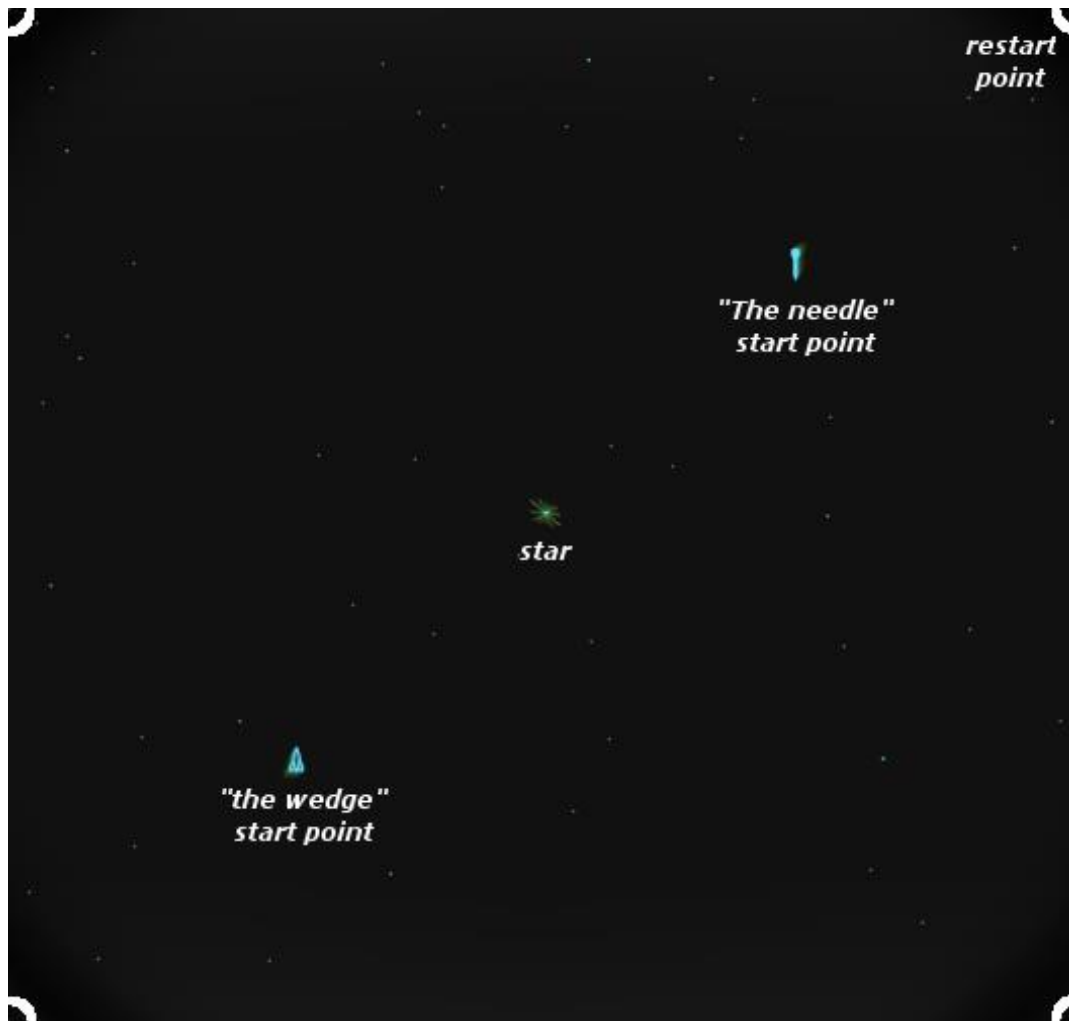
The battlefield is a completely open space with a twinkling star field in the background. The boundaries wrap around and connect to each other so players can go off one edge to reach the other side of the arena. The star sits in the middle of the arena and its gravity constantly accelerates both ships towards it. The pull of gravity is stronger the closer a ship gets. If a ship comes in contact with the star it is restarted at the shown point, the corner, which due to the wrap-around nature of the arena is connected to all other corners.

The two ships maneuver and try to hit one another until one, or both, are destroyed. A ship is destroyed if it is hit with a torpedo or if it collides with the other ship (which destroys both). After a ship is destroyed the game continues for five more seconds before resetting back to its starting configuration to allow another game.

Gameflow

This details the general options available to the players, the flow of a match and what results player actions can cause.
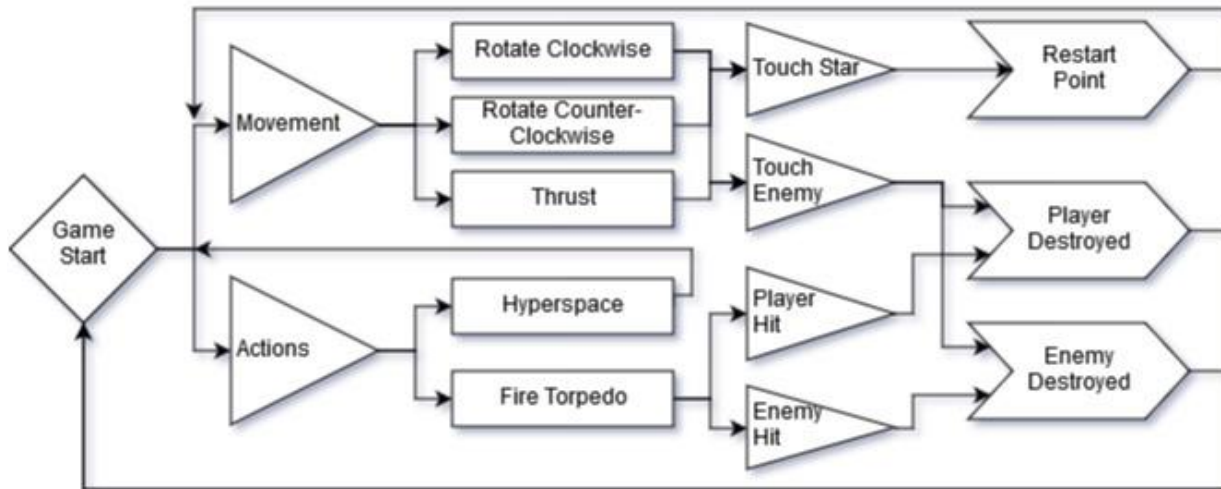
When the game starts each player is immediately put in control of their ship and the star's gravity begins pulling them towards it. Although the two ships appear different this is only to make them recognizable -- their capabilities are the same. The star's pull and the physics-based maneuvering of their own ship are the most important aspects of the gameplay. A player that learns how to use both together, like using the star's gravity to accelerate past it, will have a better chance of outmaneuvering their opponent and scoring a hit.

Hyperspace offers a dangerous but effective escape from a doomed situation. When activated it causes the player's ship to disappear for two seconds and then reappear at a random location. This is a powerful tool to reset the flow of the game but has a chance of destroying the ship instead.

With no scoring system in the game itself each battle can be considered a deciding win or loss for the players. The speed at which the game resets, and the lack of any results screen, allows immediate rematches. The lack of a score and the fast reset time also encourages groups of players to change out after each match making it a more social experience and allowing for player-created contests or tournaments.

Art Design

Art Style

The visual style for Spacewar is very minimalist and easy to understand. The two ships, the star and all other effects are simple vector images in a bright blue against the naturally black background. The use of vectors allows the smooth rotation of the ships through a full 360 degrees without distorting the visuals. Twinkling lights fill the empty space of the background to more clearly show the boundaries of the battlefield and to add aesthetic appeal.
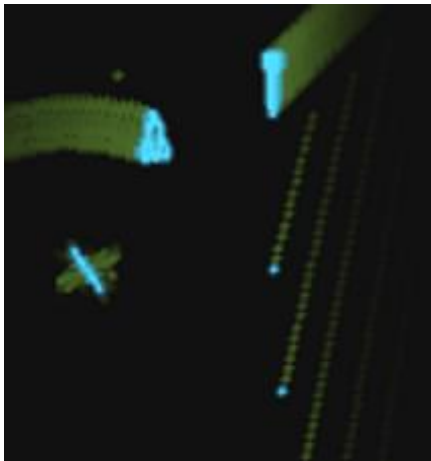
The visual style also takes advantage of one of the DEC PDP-1's graphical display quirks. Because of how the display works there are fading after-images left behind when a pixel is lit and then turns off. The ships and torpedoes seem to leave trails or a sort of wake as they travel. The resulting visual effect gives Spacewar a very dynamic look and it even allows players to better judge a ship's trajectory or the path of a torpedo.

Asset List

Background

The background of the game is a light seemingly-random scattering of twinkling stars. Each is a single pixel which is only lit every other cycle to give it the twinkling effect. It serves to gameplay function but is meant to be an attractive aesthetic component.

Entities

These are assets which have a gameplay-affecting function or are the result of gameplay itself. They are also designed to add visual appeal to the game. As with all visual assets in Spacewar they are a light blue in colour and leave behind darkening green after-images.
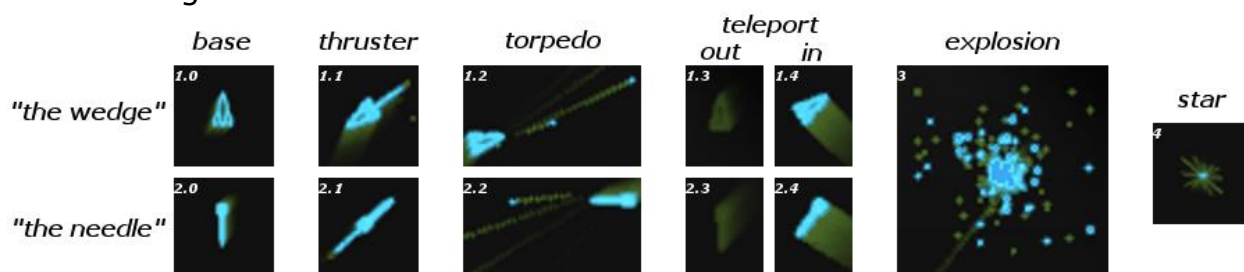
Ship Designs

The base designs of the two ships, "the wedge" and "the needle", can be found in images 1.0 and 2.0, respectively. Each is a distinct but simple vector line design which can rotate 360 degrees with minimal distortion.

Thruster

When the player applies thrust by pressing the appropriate switch a flickering line appears out of the back of the ship (images 1.1 and 2.1) to give feedback to the player that the thrust is working. This is important as the gradual acceleration of the game's physics might be difficult to notice right away.

Torpedo

Torpedoes are a single pixel which travels along a straight path, unaffected by gravity, out to a certain distance. The trail of afterimages behind the pixel give players a clear idea of its path while the simplicity of the single pixel allows many torpedoes to be on screen at once with no slowing down of the game (images 1.2 and 2.2).

Teleport

The teleport, or hyperspace, function has a simple visual
effect of hiding the player's ship for a couple seconds
while moving it to a random location. When it comes back
into the game it drifts in a random direction, easily
notable by the after-image trail (images 1.3, 1.4, 2.3 and
2.4)

Explosion

A scattered grouping of pixels which occurs when a ship is
destroyed. As can be seen with the after-images in image 3
the explosion is actually a few different groupings which
quickly appear one after another, centered on the destroyed
ship, to clearly show it has been destroyed.

Star

The star is represented by a line being drawn through the
middle point of the battlefield every cycle, its length and
direction randomized within a short range. This gives it a
sort of twinkling effect while implying something larger
and closer than the background stars. The line's after-
images give the star a roughly circular appearance.

Technical Design

Here is a detailed listing of how every entity and function of
the game should behave. For specific coordinates, values or code
please see the TDD.

Ship

- When created a ship has zero momentum and can be given a
  direction to be facing.
- Ships rotate a full 360 degrees, either clockwise or
  counter-clockwise depending on switch pressed, at a rate of
  approximately one rotation a second if the button continues
  to be held.
- Pressing the switch for thrust applies acceleration to the
  ship in the direction it is currently facing at a gradual

rate – enough to escape the gravity of the star after a few seconds if used when the game starts. It also displays the thruster effect.
- Pressing the switch for torpedoes creates a torpedo entity at the tip of the ship which travels in the direction the ship is facing at that moment.
- Pressing the switch for hyperspace causes the ship to be removed from the game for two seconds and then appear at a random location halfway between the star and the battlefield edge. The ship's momentum is reset to a low amount in a random direction. A random number is generated and, if lower than threshold, the ship is destroyed. Threshold increases with each use of hyperspace.
- A ship in contact with the star is moved to (0,0) with its momentum reduced to zero.
- A ship in contact with a torpedo is destroyed.
- A ship in contact with another ship is destroyed.
- When a ship is destroyed it is removed from the game and an explosion entity is placed at its location with its momentum. The game resets 5 seconds later.

Torpedo
- When created a torpedo entity must be given a direction in addition to a location. It travels from its location in that direction for 5 seconds and is then removed from the game.
- A torpedo in contact with a ship is removed from the game.

Star
- The star applies acceleration towards itself to every ship at a rate which increases the closer the ship is to it.

Game Generation
- When the game is started it creates the background, creates a star in the middle of the battlefield, creates "the wedge" halfway between the star and the bottom-left corner facing up and "the needle" halfway between the star and the upper-right corner facing down.
- When the game is reset it removes all entities and is then started.

Additional Suggestion

As the switches on the DEC PDP-1 are not meant to be used
constantly it might help if we also developed an additional
input device with the switches and/or buttons needed to play
Spacewar.