Assignment 3 - Asteroids!

Authors

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Design philosophy

We designed our Asteroids game to behave similarly to the Atari 2600 version of the game.

We originally wrote the game using a procedural design methodology. We then rewrote the game from scratch using an object oriented design methodology. This document describes the procedural implementation of the game.

We spent a lot of time testing at each stage of implementation to ensure the software was robust and error free.

User interface

The graphical display of the game has a 3x4 aspect ratio which is the same as old school arcade consoles.

At the start of the game, your ship appears stationary at the centre of the display pointing up.

Four asteroids appear on-screen. The asteroids move at a fixed speed. They appear randomly in the left and right quadrants of the display moving close to an up or down direction. This ensures the ship won't be hit by an asteroid during the first part of the game. When an asteroid reaches the edge of the display, it wraps around so it appears diagonally opposite on the corresponding edge of the display.

The current score appears in the top left corner of the display.

The current level appears in the display under the score.

Controls

The keyboard is used to control game-play.

Key	Usage
Up arrow	Accelerate ship

Down arrow	Decelerate ship
Left arrow	Rotate ship left
Right arrow	Rotate ship right
Space bar	Fire laser bolt
Enter	Teleport ship

Ship movement

When the user uses the arrow keys to rotate and accelerate the ship, the ship moves with realistic physics around the display. When the ship reaches the edge of the display, it wraps around so it appears diagonally opposite on the corresponding edge of the display.

Ship exhaust

When the ship accelerates, a visible exhaust appears behind the ship. When the ship decelerates, a visible exhaust appears in front of the ship.

Ship lives

Icons representing the remaining lives appear in the display under the level. The user has four lives at the start of the game, so three icons appear to indicate the three spare lives. When a ship is destroyed, the number of lives decreases by one and fewer icons are displayed.

On a new life, the ship returns to the centre of the display and is stationary.

The ship doesn't re-spawn until the area around the centre of the display is free from aliens. If the wait is too long, the ship spawns anyway.

If there are no remaining lives, the game ends.

Alien visits

In level 2 and above, a alien randomly spawns. It approaches from either the left or right of the display randomly, then moves at a fixed speed across the display until it disappears off the side of the display. The alien ship randomly fires a laser bolt during it's visit.

If the alien laser bold hits the ship, the ship is destroyed. If a ship laser bolt hits the alien, the alien is destroyed. If the alien collides with the ship, the ship is destroyed.

Scoring

When the user presses the Space bar, the ship fires a laser bolt that moves at a fixed speed in the direction the ship was facing when it fired the bolt.

If a laser bolt hits an asteroid, the asteroid is destroyed and the score increases by an amount that depends on the size of the ship hit. You get more points for hitting a smaller asteroid.

If a laser bolt hits an alien, the alien is destroyed and the score increases by 200 points.

The laser bolt travels for a number of pixels equal to the display height. Many laser bolts can be in flight simultaneously. There's a slight pause after a laser bolt fires before the ship can fire another laser bolt.

Object Shot	Score
Large Asteroid	25
Medium Asteroid	50
Small Asteroid	100
Alien	200

Teleporting

When the user releases the Enter key, the ship teleports. It disappears and reappears at a random location on the display. The ship is stationary when it reappears. Any motion the ship had before teleporting is lost.

Explosions

When the ship collides with an asteroid, it is destroyed and an explosion animation plays at the location of the ship.

When a laser bolt collides with an asteroid, the asteroid is destroyed and an explosion animation plays at the location of the destroyed asteroid.

Spawning

When a large asteroid is destroyed, two medium asteroids are spawned in its place. Medium asteroids travel faster than large asteroids.

When a medium asteroid is destroyed, two small asteroids are spawned in its place. Small asteroids travel faster than medium asteroids.

When a small asteroid is destroyed, no asteroids are spawned.

The location of a spawned asteroid is the same as the asteroid destroyed, and the direction of a spawned asteroid is random.

Level up

When all of the asteroids are destroyed, the game goes to the next level.

The ship returns to the centre of the screen and is stationary.

The asteroids re-spawn the same as at the start of the game, except that the asteroids move faster than they did on the last level so the difficulty of the game increases.

More asteroids appear on each level up.

Game over

When all the ships lives are destroyed, the game is over.

A game over message displays and the user can press any key to restart the game.

If the user has a key pressed down when the game ends, a small pause causes the game not to start straight away so the user can see the game over message.

Game parameters

There's some game parameters that can be set in the Processing source code that affect game play.

Parameter	Value	Affect
laserSpeed	30	determines how fast the laser bolt moves
thrustConstant	0.2	pixels per frame per frame ship acceleration
asteroidStartSpeed	1	how fast large asteroids move on level 1
asteroidSpeedChange	0.25	how fast asteroid speed increases with difficulty increase
alienSpeedChange	0.5	how fast alien ship speed increases with difficulty increase
alienLaserSpeed	5	speed of alien laser bolt
lives	4	how many lives do you have
laserSize	10	diameter of a laser bolt
startAsteroidCount	4	how many asteroids does level 1 start with?
asteroidLevelUp	2	how many extra asteroids on new levels
shipSize	10	radius size on ship triangle
shipTurnSpeed	50	determines how quickly ship turns when left and right arrow pressed
centreRadius	100	detection radius for "is asteroid close to display centre"
laserFireFrames	5	how many frames must pass before laser fires again
endGameFrames	20	how many frames must pass before a new game can start
alienSpawnSeconds	10	stochastic delay before alien ship spawns
alienSize	25	size of alien ship
alienLevel	2	level that alien first appears on
alienLaserSpawnSeconds	10	stochastic delay before alien ship fires laser bolt
alienLaserSize	10	size of alien laser bolt
scoreAlien	200	points for shooting alien ship
scores	{25,50,100}	points for shooting {large, medium, small} asteroids
asteroidSizes	{75,50,25}	diameter for each asteroid circle: large=100, medium=50, small=25
spawnWaitLimit	300	how many frames must pass before a new ship is forced to spawn
laserFireFrames	5	how many frames must pass before laser fires again
endGameFrames	20	how many frames must pass before a new game can start
frameRate	30	frames per second
initialShipDirection	1.5*PI	initial ship direction is up: 1.5 pi radians is up

There's also some parameters that specify the explosion animations.

Parameter	Value	Affect
shipExplosions	{500,450,400,350,300,250,200,150,100,50}	ship explosion "frames"
asteroidExplosion	{250,225,200,175,150,125,100,75,50,25}	asteroid explosion "frames"
alienExplosions	{250,225,200,175,150,125,100,75,50,25}	alien explosion "frames"

Each element of each array specifies an explosion "frame" diameter. A frame is a circle of specified diameter. Explosion frames can be added/removed by simply growing or shrinking the fixed size arrays. The last element in the arrays is the first frame of the animation, and the first element in the arrays is the last frame of an animation. When one of these objects explodes, an explosion animation with the specified parameters starts at the location the object exploded.