

Sun Escape

An educational video game

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DANGER: STAR TOO CLOSE! RONAL MAGNETIC LOOP! YOU CAN'T ESCAP INT THE PROW TO THE STARS AND PRESS REQUIRE HALF OF THE ENERGY!

- The project aims at introducing young generations to the physics of stellar interiors.
- We initially focused on the Sun, the best known star. In our game, real physical processes, such as solar <u>flares and coronal loops</u>, are simulated. Besides stellar physics, we want to <u>trigger the curiosity of young people on fundamental physics</u>, by letting our starship <u>interact with magnetic fields</u>. The latter are present everywhere in the Universe, from galaxies to planets (Earth included): therefore, each learning experiment (included games) able to increase the interest on these phenomena has to be pursued.

Introduction

Educational Videogame

The game, in general, is an activity to which a human being dedicates himself with no other purpose than recreation and leisure. Through gratification, many abilities are developed that can be both physical and intellectual.

By definition, a game is something difficult, that can only be made easy through learning and perseverance to the point of personal or group gratification. For these reasons, it is a powerful teaching tool.

Educational Videogame

Video games (all of them) lead the player to the knowledge of a virtual reality and, very often, to the correlation between virtual and real reality. They always require active participation because they force you to decide, choose, assign priorities and therefore learn to make the right decisions. Within the game there are always problems to solve or obstacles to overcome and this develops problem solving and multi-tasking skills, clearly useful in everyday life.

What a player is going to learn with this videogame?

What is the Sun? What is the gravity? What is the friction? What is a coronal loop? What is a flare?

Unity's real-time 3D development engine

Why unity?

Visual effect graph

Visual effect shader

Coronal Loop Visual Effect

- Started from a slash tutorial effect: www.youtube.com/watch?v=Er99e0OOBgc
- Based on a visual effect graph which enables visual effects using Node-based visual logic that simulates particle behaviour on the GPU





Coronal Loop - Visual effect graph

• Composed by 3 main nodes:

- <u>Spawn</u> module responsible for controlling the rate at which new particles are created (only one for the loop)
- <u>Initialize</u> module which processes a Spawn Event and initializes new elements for a Particle. In specific 32 elements each with a lifetime as input and speed on Z.
- Output particle mesh module which takes the 32 elements and draw 32 mesh (torus) according to a certain shader (software that calculates the appropriate levels of light, darkness, and color during the rendering)



Coronal Loop Shader

 Made with Shader Graph which is a tool that enables building shaders visually (create and connect nodes in a graph framework. Shader)



Coronal Loop Shader

- Started from a noise (Voronoi function) that can be easily personalized
- Added a circular mask to show only the tip of the noise (the part visible to the user)
- Added animation as function of time
- And color with alpha channel



Explosion visual effect

- Started from a fireball tutorial effect: https://www.youtube.com/watch?app=deskto p&v=iq_ICwHQNWQ&t=0s
- Developed with visual effect graph (around 500 particles spawn)

Smoke visual effect

- Variant of the explosion
- Developed with visual effect graph (around 8 particles spawn per second)



Other visual effects

ENGINE FIRE

• Another variant of the explosion



FIREBALL – TAKEN FROM UNITY STORE

 <u>https://assetstore.unity.com/packages/vfx/</u> <u>particles/fire-explosions/free-asset-vfx-</u> <u>particles-fireball-pack-263814</u>



Model - Sun

- Modelled as a sphere
- Unlit texture taken from solarsystemscope.com
- Particle system for the atmosphere (100 images per seconds)
- Random fireballs spawn from it



Model - Spaceship

 Free asset from asset store <u>https://assetstore.unity.com/p</u> <u>ackages/3d/vehicles/space/hi-</u> <u>rez-spaceships-creator-free-</u> <u>sample-153363</u>



3D Scene and Animation

3D SCENE

- Main: where the game happens, composed by the Sun and the spaceship!
- Settings: where parameters of the physics engine can be set
- Win: when the player escapes the sun
- Intro: information and credits

ANIMATIONS

- Based on the unity physics engine
- Gravity force acts on the spaceship
- Spaceship engine applies a forward force to it
- Depending on the angle of the spaceship a friction force can be applied

Phisics



Interactions

• User interactions:

- Arrows keys to change the angle of the spaceship
- Space key «start the engine» === apply the forward force
- B key applies a boost force to the spaceship «thanks to the coronal loop» so that we can escape the star.

• Escape Star

- Coronal loop interaction
- Fireball/Flare interaction
- Sun interaction (end game)

Coronal Loop interaction

• When the spaceship hits a coronal loop it gets trapped into it and can't move. The engine recharges thanks to the magnetic field (it can be also a negative)



Fireball/flare interaction



Sun interaction (end game)

• When the spaceship hits the Star



Escape interaction

• When the distance between the Spaceship and the Sun is greater than a certain value.



Settings UI





Summary

The passion of video games for young generation can be a key in order to trigger the curiosity of young people on fundamental physics. Letting them play with coronal loops will create the best context for an astronomer to explain the fundamental physics.

Thank You

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