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I.0: Requirements Documentation

I.1: Description of the Problem

**Name:** Cloth Physics

**Problem Statement:** Implement spring physic to simulate realistic cloth simulation.

**Problem Specification:** The application should simulate cloth using springs and physical forces such as gravity and wind.

I.2: Input Information

Description: Runtime interaction with the cloth

Type: N/A

Range of Acceptable Values: Mouse position and mouse buttons

I.3: Output Information

The program will simulate cloth based on input given before, and during runtime of the application.

I.4: User Interface Information

N/A

II.0: Design Documentation

II.1: System Architecture Description

The program is split into 3 different classes and 2 utilities. The main class of the simulation is Cloth.cs. This will create a grid of nodes, link the nodes with springs, and store apply post generation modifiers to specific variables. Node.cs stores unique values for each node in the system that will be used to move the node in space. Spring.cs links 2 game objects together and applies opposing forces to said game objects. The 2 utilities are CameraMove.cs and UI.cs. UI. cs is only used for exiting the program. CameraMove.cs is used to move the camera during runtime.

II.2: Information about the scripts

**File: Node.cs**

Class: Node

Data Members

Name: acl

Description: the current acceleration of this node in space

Name: vel

Description: the current velocity of this node in space

Name: frc

Description: the current force being applied to this node

Name: isLocked

Description: true or false if this node’s position is locked in spcae

Name: held

Description: true or false if the node is currently being manipulated by the user

Function: Awake

Parameters: none

Description: sets all initial values associated with this node to zero

Return: none

Function: FixedUpdate

Parameters: none

Description: checks for interaction by the user for dragging and locking nodes

Return: none

**File: Spring**

Class: Spring

Data Menbers

Name: springStrength

Description: the strength coefficent of the spring

Name: springLength

Description: the length of the spring at rest

Name: springDamp

Description: the damper coefficent of the spring

Name: node\_a

Description: a refrence to one of the object connect by the spring

Name: node\_b

Description: a refrence to one of the object connect by the spring

Name: a

Description: a refrence to the node component on node\_a

Name: b

Description: a refrence to the node component on node\_b

Name: Fs

Description: the force of the spring

Name: Fd

Description: the force of the spring damper

Name: e

Description: the direction the spring is facing to connent the 2 nodes

Name: Fg

Description: the force of gravity

Name: Ftotal

Description: the sum of all the forces

Name: strMod

Description: modifyable value to affect the spring's strength

Name: dmpMod

Description: modifyable value to affect the spring's damper strength

Name: grvMod

Description: modifyable value to affect the strength of gravity

Function: Build

Parameters: none

Description: creates a spring object between 2 pre-determined objects

Return: none

Function: FixedUpdate

Parameters: none

Description: runs all calculation functions and applies all forces to all connected nodes

Return: none

Function: CalculateSpringForce

Parameters: none

Description: calculates the spring force

Return: none

Function: CalculateSpringDamper

Parameters: none

Description: calculates the spring damper

Return: none

Function: CalculateNodeAceleration

Parameters: n(node)

Description: calculates the aceleration of a given node

Return: none

Function: CalculateNodeVelocity

Parameters: n(node)

Description: calculates the velocity of a given node

Return: none

**File: Cloth.cs**

Class: Cloth

Data Members

Name: node

Description: refrence to a prefabed node object

Name: spring

Description: refrence to a prefabed spring object

Name: strengthMod

Description: refrence to a UI slider for changing the spring strength at run time

Name: damperMod

Description: refrence to a UI slider for changing the spring damper strength at run time

Name: gravityMod

Description: refrence to a UI slider for changing the force of gravity at run time

Name: windForce

Description: the force of wind to be applied to the cloth

Name: rows

Description: the number of rows of nodes in the cloth

Name: columns

Description: the number of columns of nodes in the cloth

Name: offset

Description: the spacing between nodes in the cloth

Name: nodes

Description: a list of all the nodes in the cloth

Name: springs

Description: a list of all the springs in the cloth

Name: triangles

Description: a list of all the triangles in the cloth

Function: Start

Parameters: none

Description: calls the MakeCloth function at the start of the program

Return: none

Function: MakeCloth

Parameters: none

Description: creates a grid of nodes and connects them with springs to create triangles

Return: node

**File: CameraMove.cs**

Class: CameraMove

Data Members

Name: speed

Description: the speed the camera moves, zooms, and rotates at

Name: resetKey

Description: the key the user can press to retes the camera to its original position

Name: originPos

Description: the original position of the camera

Name: originRoe

Description: the original rotation of the camera

Name: originScl

Description: the original scale of the camera

Function: Awake

Parameter: none

Description: sets the original position of the camera

Return: none

Function: Update

Parameter: none

Description: keeps track of mouse buttons and movement for moving the camera in space

**File UI.cs**

Class: UI

Data Members

Function: Exit

Parametr: none

Description: closes the application

Return: none

Function: Restart

Parameter: none

Description: reloads the current scene

Return: none

III.0: Implementation Documentation

III.1 Program Code

Source Code: <https://github.com/Mouledoux/Physics>

IV.0: Verification and Validation Documentation

IV.1: Test Plan

IV.2: Operating Directions

To run this program navigate to the "Physics" folder and run Physics.exe

Hold MMB to pan the camera

Hold RMB to rotate the camera

Hold LMB to drag sections of the cloth

Tap "L" to lock or unlock cloth segments

Hold space to make wind