Virtual Game Simulation

Implementation Guide

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Gaming Research Integration for Learning Laboratory™ (GRILL™)
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TABLE OF CONTENTS

1. CHALLENGE PROBLEMS

Modeling and Simulation professionals often utilize commercial off-the-shelf (COTS) games to provide a basis for the virtual environment training and simulation. Utilizing existing games reduces the economic investment required to provide a customized training environment and therefore moves the business or industry forward without a large investment in the development of the simulation. These challenge problems provide students with the opportunity to create virtual models similar to those used by industry professionals while using racing as the topic of interest.

2. IMPLEMENTATION GUIDE AND INSTRUCTIONAL RESOURCE

This implementation guide provides an overview of the tools and tutorials available for each challenge problem. Students developed the associated tutorials during summer internships at the GRILL™ at Wright-Patterson Air Force Base in Dayton, OH. Consistent with the philosophy of challenge problems, teachers should not give these resources and tutorials directly to students; this will help ensure students actively engage in the learning and problem-solving process. The resources and tutorials are a tool for teachers to help foster these processes and skills in students.

2.1. ENGINEERING LOGBOOKS

Engineering logbooks should be used by students as a personal reference about project learning and results. Logbooks are used to help monitor and control where students have invested their time, knowledge learned, resources, and problem solving. Logbooks can also be used as a resource for grades for educators.

Logbooks should have the following general expectations for entries:

- Date for each entry
- Log of personal activity, communications, and team activity
- Research and engineering analysis
- Reviewing of individual/team performance
- Include everything contributed towards the solution
- Sketches
- Class notes
- Meeting notes
- Math calculations

- Design process
- Project reflections
- Rationale for decisions
- Decision criteria
- Design alternatives
- Project requirements
- Links to helpful resources

Note: Include everything contributed towards the solution; the good, the bad, and the ugly.

2.2. HARDWARE AND SOFTWARE

Each challenge problem requires some combination of hardware and/or software. Table 1 illustrates possible application of various tools to solve each of the problems. Do not use this list as the sole solution to the challenge problem, but as an example of a solution students may implement.

Table 1: Hardware and Software Tool Options for each challenge problem

Challenge Problem	Tools
1- Create a Simple Game	Existing off-the-shelf games, game engines ranging in skill level from SCRATCH to Unity, and computer coding skills
2- Rapid 3D Modeling	Kinect, Skanect, SketchUp, Meshlab, Unity, and a 3D printer
3- Create a Virtual Environment	Kinect, Skanect, SketchUp, and Unity
4- Animate and Control a Character in Game	Kinect, Skanect, SketchUp, Blender, MeshLab, Mixamo Auto-Rigger, Unity, and coding
5- Virtual Control	biosensors, microcontrollers, Kinect, eye-tracking, virtual reality headsets, voice command, off-the-shelf simulations
6- The Big challenge	Unity, SketchUp, 3ds Max®, and coding, Exemplar: Driving with Sunny

Approximate costs and links to information regarding each of the potential tools are summarized in Table 2. We collected these estimates at the time we prepared this content.

Accordingly, teachers implementing this content should verify the costs with the makers of each tool for planning purposes.

Table 2: Tools and Associated Costs

Name	Type of Tool	Link	Cost
Kinect for Xbox 360	3D scanner	http://www.xbox.com/en-US/KINECT	$107
Kinect for Windows	3D scanner	http://www.cdwg.com/shop/products/Microsoft-Kinect-for-Windows-Acacdemic/2849923.aspx?enkwrd=ALLPROD%3a%7c2849923%7cAll%20Product%20Catalog/	$170
Skanect	Scanner software	http://skanect.manctl.com/download/	$129
Kinect SDK	Scanner software	http://www.microsoft.com/en-us/kinectforwindows/develop/developer-downloads.aspx	$0
Kinect Developer Toolkit	Scanner software	http://www.microsoft.com/en-us/kinectforwindows/develop/developer-downloads.aspx	$0
MeshLab	3D processing software	http://meshlab.sourceforge.net/	$0
Mixamo	Auto-rigger	http://www.mixamo.com/	$0
Unity 4.x	Game Engine	http://unity3d.com/unity/download/	$0
Blender	3D Graphics Software	http://www.blender.org	$0
3ds Max®	3D Graphics Software	http://www.autodesk.com/products/autodesk-3ds-max/overview	$0
CityEngine	Virtual Modeling Software	http://www.esri.com/software/cityengine	Free Trial or $500
Scratch	Game Programming	http://scratch.mit.edu/	$0
Stencyl	Game Programming	http://www.stencyl.com/	$0
Cube3D	3D printer	http://www.cubify.com	$1300
Ultimaker	3D Printer	http://www.ultimaker.com	$1560
Buccaneer	3D Printer	http://www.pirate3d.com	$400
Arduino	Microcontrollers	http://www.arduino.cc	$25
SparkFun	Electronics Distributor	http://www.sparkfun.com/	Varies

(sensors)

2.3. RESOURCES TO GUIDE AND SCAFFOLD INSTRUCTION

Users and participants have used the resources listed in this section to help solve the Full Throttle STEM™ Challenge problems. These resources are neither exhaustive nor comprehensive and *should not be treated as complete tutorials*. Teachers should use these resources to help familiarize themselves with the relevant tools and to guide and scaffold instruction.

Table 3: Supplemental Resources

Title	URL	Brief Description
Design Thinking for Educators Toolkit	http://designthinkingforeducators.com/	This toolkit has been adapted by IDEO to meet the context of K-12 education. These processes, methods, and tools help tackle complex challenges.
A Primer of Modeling and Simulation	http://www.corporatepress.com/clientfiles/ntsa/	Primer includes definitions, history, applications, value, and future of modeling and simulation.

Table 4: Modeling Resources

Title	URL	Brief Description
Sketchup Tutorials	http://www.sketchup.com/learn	Various self-paced tutorials in a variety of formats including reference cards, videos, and documents to guide users step by step on concepts of modeling.
SketchUp STL Exporter	http://helioslabs.blogspot.com/2013/02/sketchup-8-stl-files-for-3d-printing.html	Instructions for installing STL plugin to SketchUp for 3D printing.
SketchUp STL Importer	https://sites.google.com/site/jimfoltz/my-sketchup-plugins/stl-importer	Plugin necessary to import .stl files. Download into .rb file into SketchUp Plugin file folder.

Table 5: Skanect Resources

Title	Link	Brief Description
Skanect Tutorials	http://skanect.manctl.com/support/	These video tutorials answer frequently asked questions, with one tutorial focusing on how to complete a self scan.
Skanect Forum	http://skanect.manctl.com/forum/	This community forum provides comments and questions from users as well as bug reports.

Table 6: MeshLab Resources

Title	URL	Brief Description
MeshLab Tutorials	http://www.youtube.com/user/MrPMeshLabTutorials	These tutorials provide a variety of skill techniques ranging from novice to advanced.

Table 7: Coding Resources

Title	URL	Brief Description
Blue Pelican	http://www.bluepelicanjava.com	Free high school computer science textbook available for download or on-line use, complete with exercises and programming projects.
Code Academy	http://www.codeacademy.com	Provides online tutorials for learning various languages including JavaScript, HTML, CSS, Ruby, Python, and APIs.
Lynda Tutorials	http://www.lynda.com	Online video-training library with more than 1,400 software and training titles allowing anyone to learn software, design and business skills. Membership is required.
Greenfoot	http://www.greenfoot.org/	Visual and interactive tool to teach object orientation with Java.

Table 8: Unity Resources

Title	URL	Brief Description

Get Started in Games & Simulations	http://www.youtube.com/watch?v=ry4ie_O4Bqc	An introduction to Unity including use in creating simulations and games. 2:25 is where introduction begins.
Unity Tutorial Modules	http://unity3d.com/learn/tutorials/modules	Unity's modules on various topics and difficult level. Users can sort through content to meet specific needs or complete modules step by step to create an example game.
Unity Documentation	http://unity3d.com/learn/documentation	Access to manuals and references.
Unity Reference Manual	http://docs.unity3d.com/Documentation/Components/index.html	Reference Manual for components for specific platforms including OSX, iOS, Windows, and Android.
Unity Asset Store	http://unity3d.com/asset-store/	Storehouse of assets such as 3D models, textures, scripts, etc. Some free and some for purchase.
Car Tutorial	http://u3d.as/content/unity-technologies/car-tutorial/1qU	Provides guidance through all the necessary steps to create a fun arcade style race car simulation.
Unity Gems	http://unitygems.com/	Lots of helpful tips and suggestions.
Unity Scripting	http://unity3d.com/unity/workflow/scripting	The tools needed for scripting in Unity.
Mecanim Tutorial	http://video.unity3d.com/video/7362044/unity-40-mecanim-animation-tutorial	Mecanim video tutorial shows how to animate imported characters in Unity.
Arduinity	https://github.com/uclagamelab/Arduinity	Arduinity is a flexible, lightweight set of Unity scripts and Arduino code meant to allow Arduino and Unity to speak between applications.
Basic Arduino to Unity Tutorial	http://www.youtube.com/watch?v=of_oLAvWfSI	Tutorial created to demonstrate sending input from an Arduino board to Unity3D.
Distance Tool	http://the3dninja.com/blog/?p=1104	The distance tool provides the ability to measure objects in the scene and has the option to show a ratio between object scale in pixels and can help define proper texture resolution.

Table 9: Other Resources

Title	URL	Brief Description
Zorro2 Plugin	http://rhin.crai.archi.fr/rld/plugin	SketchUp plug-in to cut models or 3D

	details.php?id=623	shapes by drawing cut lines. Slice model at section option
Ball & Socket Joint	http://www.thingiverse.com/thing:70371	Model for a ball & socket joint for 3D printing.