Virtual Museum Exhibit: Artificial Intelligence and Non-Player Characters

Challenge Problems and Resources

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1. VIRTUAL HISTORY MUSEUM EXHIBIT: ARTIFICIAL INTELLIGENCE AND NON-PLAYER CHARACTERS

1.1. INTRODUCTION

Expanding on the Virtual History Museum Exhibit Project, students will develop Artificial Intelligence (AI) to control the actions of Non-Player Characters (NPCs). Using Unreal® Engine 4's Behavior Tree model, student levels will appear more authentic to traditional museum experiences as they become filled with characters acting as patrons and museum staff members throughout their virtual world. As student learning grows, virtual exhibits can become more interactive, where NPCs can become a part of the exhibits and assist in teaching players about the academic content.

By completing the attached tutorial, students will gain introductory experience in Unreal® Engine 4's Blueprints, Behavior Trees and Blackboard systems. They will become acquainted with additional resources aimed at increasing their confidence to expand upon what they learned within Unreal® Engine 4. Although this project is an extension to the Virtual History Museum Project, it can be used independently to teach students about basic Artificial Intelligence within game engines.

1.2. MATERIALS

Video Game Development Materials

- Student access to Unreal® Engine 4, or similar software installed on PC (recommended) computers
- A computer mouse for each computer used
- Introductory tutorials to learn video game creation technology skills

Assessment Materials

1. Virtual History Museum: Artificial Intelligence and Non-Player Characters Written Tutorial (14 pages)
2. Virtual History Museum: AI and NPC Tutorial Questions (3 pages)
3. Virtual History Museum: AI and NPC Rubric (1 page)
4. Student access to screen-recording software

1.3. OVERVIEW OF PLAN

Throughout this project, students will be motivated to learn about academic content and game design by answering the driving question: How can we use game design to encourage others to

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learn about history? Adding AI and NPCs to their virtual history museums will make their levels more interactive and similar to the learning that takes place in real museums. As the students continue to learn academic content and build confidence with the Unreal® Engine 4 game engine, they will be able to use inquiry and creativity skills to apply additional components to their video game level that allows players to interact within the virtual world in new ways.

1.3.1. ARTIFICAL INTELLIGENCE AND NON-PLAYER CHARACTERS WRITTEN TUTORIAL

By completing the step-by-step written tutorial titled, "Virtual History Museum: Artificial Intelligence and Non-Player Characters," students will apply basic AI to an NPC within their virtual history museum. This character will then appear to walk around the museum as a patron. Students will be able to program variances to a variety of NPCs to give the illusion of a crowded museum filled with different people participating in various activities, such as viewing artifacts within the museum, patrolling an area or chasing other characters.

1.3.2. AI AND NPC TUTORIAL QUESTIONS

In addition to their final museum level featuring characters, students will be assessed by completing the "Virtual History Museum: AI and NPC Tutorial Questions" supplemental handout. This handout will allow the teacher to formatively assess students with frequent "check-ins." It is meant to encourage critical thinking and problem-solving through collaboration among students. They will summarize the AI and NPC design process and explain how they will incorporate newly acquired skills to their final virtual history museum level.

1.3.3. SCREENCAST PRESENTATION

In order to share what they have learned, students will be required to screen-record themselves playing their video game level. As their playable character walks around the virtual history museum, students will narrate how they were able to design and program specific aspects of their product. They will also explain significances of academic content, such as the history that they learned throughout the course. Students will be able to, for example, explain the relevance of the Civil Rights Movement when focusing on an artifact related to bus boycotts while also explaining the visual scripting that was needed to make a security guard character stroll throughout their level.

1.3.4. OPTIONAL ADDITIONAL WRITTEN TUTORIALS

To differentiate instruction, two additional written tutorials may be used for students to expand upon their learning of programming AI to NPCs within the Unreal® Engine 4 game engine. The "Artificial Intelligence and Non-Player Characters: Additional Tutorials" handout

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walks students through the process of developing NPCs to populate their level. Students will be able to add characters that walk to a specific point within the virtual environment upon the player's command, as well as program an NPC to chase the playable character as soon as the NPC "sees" it. Due to time constraints, these tutorials may not be required for all students, but they will offer additional guidance to students who excel at adding AI to NPCs by incorporating Behavior Trees, Blackboards and Blueprints within their video game level. Including these tutorials within the project will allow students the opportunity to add different types of NPCs within their virtual history museum.

1.4. RUBRIC

Category	Components	Points Earned	Comments
AI and NPC Tutorial Questions Handout	The red text questions from the "Artificial Intelligence and Non-Player Characters" tutorial packet steps are provided on this handout. Your answers should be written on this handout.	/30 total	
	Finished AI and NPC example level	/5	
	Step 9	/4	
	Step 13	/2	
	Step 33	/3	
	Step 37	/2	
	Step 42	/2	
	Step 55 Description Question	/2	
	Step 55 Summary Paragraph	/5	
	Step 55 Behavior Trees and NPCs in your museum explanation paragraph	/5	
AI and NPCs addition to final Virtual History Museum level	Once you complete the "Artificial Intelligence and Non-Player Characters" tutorial packet, you will add AI and NPCs to your museum.	/60 total	
	At least one museum "customer" in each of the three historical exhibits. This can include NPCs looking at exhibits, children chasing each other, etc.	/30	
	"Security guard" character patrolling at least one museum exhibit.	/10	
	At least one "curator" and/or museum	/10	

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	"volunteer" available to assist customers.		
	Screencast presentation of the addition of your AI and NPCs to your museum level. While using your playable character to walk around your museum, you should narrate the purpose of the characters and how you programmed them in Unreal®.	/10	
Total Assessment	Completion of the tutorial packet, tutorial questions handout, inclusion of AI and NPCs into your museum level and screencast recording of final virtual history museum product.	/90 total	
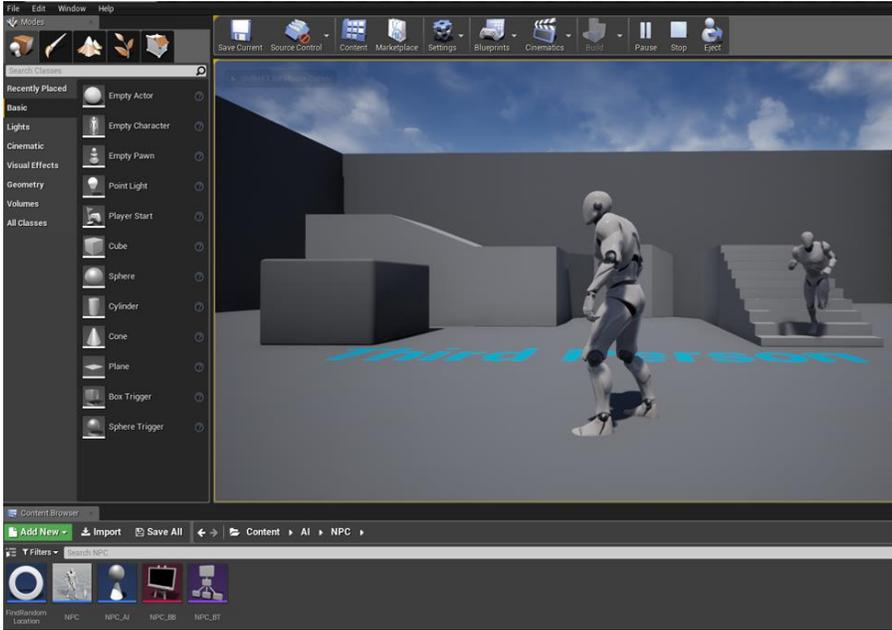
Figure 1: Sample NPC Moving in Level © Unreal® Engine 4 2019. Screenshot by Author.

Students will demonstrate learning by displaying the movement of Non-Player Characters within the level they create using the Unreal® Engine 4 software (see Figure 1).

1.5. RESOURCES

Examples of resources used in this project may be found below. Any content-specific material can be used. The goal is for students to be motivated to learn the content while answering the

driving question. They will be assessed by displaying their knowledge of academic content and game design skills within their virtual museum exhibit.

Attached Files

1. Virtual History Museum: Artificial Intelligence and Non-Player Characters Written Tutorial (14 pages)
2. Virtual History Museum: AI and NPC Tutorial Questions (3 pages)
3. Virtual History Museum: AI and NPC Rubric (1 page)
4. Artificial Intelligence and Non-Player Characters: Additional Tutorials (12 pages)

Video Game Development Resources

5. An introduction to the video game development process – Unreal® Engine 4 Level Designer Quick Start Tutorial: https://docs.unrealengine.com/latest/INT/Engine/QuickStart/index.html?utm_source=launcher&utm_medium=ue&utm_campaign=uelearn
6. An introduction to visual scripting, known as Blueprints: https://docs.unrealengine.com/en-US/Engine/Blueprints/GettingStarted/index.html
7. Behavior Trees User Guide: https://docs.unrealengine.com/en-US/Engine/ArtificialIntelligence/BehaviorTrees/BehaviorTreeUserGuide/index.html

Project Resource

8. Screen recording software, such as OBS Studio or Screencast-o-matic:
   https://obsproject.com/
   https://screencast-o-matic.com/

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