Chapter 7

Evaluation

7.1 Introduction

The system has been evaluated by creating a prototype to test the approach proposed by this thesis. Following aspects of the system were considered during the evaluation process.

1. Time taken to generate 3D environments
2. Customizability and Extendibility of the system
3. Adherence to industry standards
4. Portability
5. Cost Effectiveness

Following sections reports the evaluation of above specific aspects.

7.2 Time Taken to Generate 3D environments

Reducing the time taken to create a 3D game environment is one of the main advantages of the approach proposed in this thesis.

To evaluate this it was decided to come up with 2 control experiments.

7.2.1 Control Experiments

It was decided to compare the prototype based on the approach proposed in this thesis with following approaches.

1. Using a coding approach to design the 3D game environment
2. Using a world editor to manually design the 3D game environment

7.2.2 Selection of Participants

It was decided to select 3 users who have experiences with 3D game environments and with programming background in Java programming language as shown in Table 7.1.

User	Experience with Java	Experience with 3D game environments
User1	3+ years	4+ years
User2	2+ years	4+ years
User3	2+ years	3+ years

Table 7.1 : Selection of Participants for Evaluation

7.2.3 Preferred 3D Game Environment

Designing a 3D environment with following 3D models/ features has been selected for the evaluation as shown in Table 7.2.

3D Model	Number of Instances Required
Coconut tree	15
Lotus plant	10
Small house	15
2 Story house	10
Total	50

Table 7.2 : Preferred 3D Environment

In addition, there should be 4 residential areas connected by road network.

A height map was provided as an input to generate the terrain. Also the water level of the environment was provided as an input.

Following section reports the time taken to design this environment in above specified 2 approaches.

7.2.4 Approach 1: Using a Coding Approach to Design the 3D Game Environment

This is the default approach provided in jMonkeyEngine, since there are no visual world editors provided with jMonkeyEngine at the time of writing this thesis. To design the given 3D game environment using coding approach, following tasks needs to be completed with coding. The tasks are given to 3 users selected and captured the

time taken to complete tasks. Already available sample game code has been selected and modified the code to match the required environment.

The results of the evaluation are shown in Table 7.3.

Task	**User1**	**User2**	**User3**
Modify code to generate the terrain from height map	3min	5 min	6 min
Modify code to add water	5 min	10 min	12 min
Prepare a transparent image for roads texture and modify code to load road texture	10 min	8 min	10 min
Write code to load and place (using x,y,z coordinates and required rotation) 10 3D models. This involves taking decision to select proper places based on the terrain and road network. Also there should be no conflictions between 3D models.	30 min	45 min	40 min
Based on the time taken for above task, estimated time to load rest of the 3D models (40 3D models)	120 min	180 min	160 min
Total time taken to design the 3D game environment	168 min	248 min	228 min

Table 7.3 : Results of Evaluation of Approach 1

Average time taken to design

preferred 3D game environment with coding approach = (168 + 248 + 228)min / 3

= 215 min

7.2.5 Approach 2: Using a World Editor to Manually Design the 3D Game Environment

It was decided to create a simple world editor for evaluation purposes, since there are no visual world editors provided with jMonkeyEngine at the time of writing this thesis. To design the given 3D game environment using world editor approach, following tasks needs to be completed manually. The tasks are given to 3 users selected and captured the time taken to complete tasks.

The results of the evaluation are shown in Table 7.4.

Task	User1	User2	User3
Load the height map	1 min	1 min	1 min
Load water	2 min	2 min	2 min
Prepare a transparent image for roads texture and load road texture	8 min	6min	7 min
Selecting all required 3D models (50 3D models from 4 categories) from menus	2 min	1 min	1 min
Place 3D models using point and click method. This involves taking decision to select proper locations and orientations based on the terrain and road network. Also there should be no conflictions between 3D models.	23 min	29 min	27 min
Total time taken to design the 3D game environment	36 min	39 min	38 min

Table 7.4 : Results of Evaluation of Approach 2

Average time taken to design
preferred 3D game environment with world editor approach = (36 + 39 + 38) min / 3
= 28 min

7.2.6 Proposed Approach: Multi Agent based Approach to Assist Design of 3D Game Environments

This is the approach proposed by the thesis and a prototype is created to evaluate the approach. To design the given environment using prototype, following tasks needs to be completed. The tasks are given to 3 users selected and captured the time taken to complete tasks. The results of the evaluation are shown in Table 7.5.

Task	User1	User2	User3
Load the height map	1 min	1 min	1 min
Define environment parameters such as water level	2 min	2 min	3 min
Selecting all required 3D models (50 3D	2 min	1 min	1 min

models from 4 categories) from menus			
Generate the 3D environment	2 seconds	2 seconds	2 seconds
Total time taken to design the 3D game environment	5 min	4 min	5 min

Table 7.5 : Results of Evaluation of Proposed Approach

Average time taken to design
preferred 3D game environment with proposed Approach = (5 + 4 + 5) min / 3
= 5 min

7.3 Customizability and Extendibility of the System

It is possible to customize the system by modifying agent rule sets, define new agent rule set hierarchies and modifying the 3D model definitions. The agent classes and agent rule sets in the system are defined in a very extendable manner to for future use. Also the facilities are provided to introduce new 3D models, define new agent rule sets and associate agent rule sets with 3D models using configurations.

7.4 Adherence to Industry Standards

The use of height map for terrain generation is considered as a one standard practice in game development industry and the prototype developed for this project uses the same approach for terrain generation. As a result it is feasible to any height map used in industry, as an input for the system. The prototype supports loading of standard 3D model formats such as 3D Studio Max (.3DS) and LightWave 3D objects (.OBJ) which are widely used in game development industry. In addition, the system represents the 3D game environment as a scene graph which is a data structure commonly used in game engines.

7.5 Portability

The use of Java programming language, jMonkeyEngine, MASON and H2 embedded database improves the portability of system and simplify the deployment on any platform which is supported by Java.

7.6 Cost Effectiveness

The licences of products selected to develop the system are as shown in Table 7.6.

Product	**Licence**
Java	GNU General Public License (GPL)
jMonkeyEngine game engine	BSD
MASON agent development tool	Mostly Academic Free License [Partial] Artistic License [Partial] Sun Open Source License [Partial] BSD License
H2 embedded database	Mozilla Public License Eclipse Public License

Table 7.6 : Software Licences List

As a result the product is developed with a zero licensing cost. This reduces the cost of 3D game environment design drastically.

7.7 Summary

This chapter reported the evaluation process of the Multi Agent based Approach to Assist the Design of 3D Game Environments. The prototype developed is mainly used for the evaluation and time taken to generate 3D game environments using prototype is compared with 2 conventional approaches to design 3D game environments, with the help of 3 participants. In addition, Adherence to industry standards, portability, cost effectiveness, customizability and extendibility of the system have been evaluated. The next chapter concludes the results of evaluation and overall project.