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Point to Culture: a point to click framework for Serious Games in Cultural Heritage

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Abstract

In this paper we propose Point to Culture, a novel plugin for Unity3D game engine which allows the realisation of simple yet beautiful and historically rich Serious Games in the form of point-to-click adventures, a type of game that is well suited for Cultural Heritage dissemination and promotion. Given the ever growing demand for technologies which enhance Cultural Heritage Serious Games, we provided a complete and modular plugin for one of the most common game engine which allows the development of a game, like an escape room, with almost no line of code needed. Additionally, in order to test the proposed tool, we present a case-study game set in the Benedictine Monastery of Catania.

CCS Concepts

• Software and its engineering → Software creation and management; • Computing methodologies → Graphics systems and interfaces;

1. Introduction

The videogame industry has spread widely in recent years and the purpose of videogames has changed over time. The ever-increasing requests to bring the game closer to educational aspects led the emergence of Serious Game. Hence the videogame turned from an entertainment tool to a mean for cultural and educational purpose where the entertaining power of the videogame is not the primary goal but plays a support role.

Health care, military simulations, school education are just few examples of effective usage of the Serious Game. Lately we find an ever increasing use of Serious Games for Cultural Heritage as they promise a greater engagement and interests from players, providing a powerful mean for knowledge dissemination, as well as an effective means for digitisation and preservation of cultural sites [BBA*16, B*15, CMN13]. The interest for Serious Games applied to Cultural Heritage has grown with the introduction of newer technologies such as 3D scan, virtual and augmented reality [EV18] yet without abandoning the idea of developing simple story driven Serious Games without any other support device. Hence, this led the scientific community to improve both technologies and design for Serious Games applied in Cultural Heritage [MCB*14, TS18] providing guidelines for better understanding what the community needs, in terms of development tools and game design. In this paper we propose Point to Culture a novel tool embedded in Unity3D Game Engine that makes it simpler and more intuitive the development process of simple 2D point-to-click games. The tool implements smart algorithms that facilitate the realisation of common features in a point-to-click game, such as but not limited to:

- `items`: Use and combine pickable objects.
- `inventory`: Inventory system.
- `explorable scenes`: Switching between interactive scenes.
- `puzzles`: Create puzzles like numerical combinations or use the correct object over an interactive item.
- `dialogue system`: Create interactive narrative experience.
- `cutscenes`: Creating static cutscenes by combining two or more images.

To prove the validity of the proposed tool we present a case study of a custom Serious Game set in the famous Benedictine Monastery of Catania [HZ35, AGI*16]. The game resumes the well-known format of escape rooms. The player, gaining knowledge from the Monastery, has to use the information learned to escape and win the game. The contribution of this paper can be summarised in:

- A novel Unity plugin to support the development of point-to-click digital games.
- A case-study Serious Game set in the Benedictine Monastery of Catania, developed by using the proposed plugin.

The remainder of this paper is organised as follows: Section 2 describes all the previous works done for Serious Games development and the technology improvement for Cultural Heritage Serious Games; Section 3 details the framework and its components; in Section 4 we present a case study game developed with the pro-

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posed tool and by remarking its cultural relevance; Section 5 concludes the paper.

2. Related Works

The approach to Serious Game development has changed and evolved with technological changes. Virtual and augmented reality provided powerful tools for Serious Games, specially for Cultural Heritage. Augmented reality allows an effective in-site gamification and is extensively employed for Cultural Heritage study [AEB*12, GPA*19]. On the other hand, Virtual reality gives the opportunity to virtually visit any location from home. However, this does not make obsolete classical Serious Games, specially if they are story driven, have to teach something about the cultural site and need a player rather than a virtual visitor. Indeed, such games have been implemented and have proven their effectiveness as stated in [MD17].

Several studies have been conducted on best practices and models for better implementing efficient Serious Games [ACF*17, ALBA13, BBDG*13, MTG*16].There are many valid approaches proposed during the past years [SS13], but what the scientific community seems to agree on is the format for developing Serious Games for Cultural Heritage. To be effective they should be story driven and task based, like puzzle games or adventure games [VILK19, PS19, RBO*19]. Furthermore, there are many game engines on the market, even professional ones. However, Unity and Unreal turn out to be the most exploited [PFHB17, TGGQGQ*20]. Unity is appreciated for its ease of use compared to Unreal, which is more suitable for professional video games. Even though there are some adventure makers plugin in the Unity Asset Store they are designed for more complex games providing a harsh learning curve for Serious Games designers.

At best of our knowledge there are few references to frameworks dedicated to task based Serious Games like Sketch'ndo [MTG*16] which is not a plugin for a Game Engine. It is built on top of Blender Graphical engine and it works with Blender logic connections providing limited flexibility. Differently, our plugin provides a powerful tool for adventures and point-to-click games. Adventure Creator [Stu] is a plugin for Unity that allows the development of traditional adventure games. It is certainly a valid tool for the creation of point-to-click games, also taking advantage of a visual programming through the presence of a node editor. It is a very large framework that contains many functions, such as a dialogue system and a visual development tool and it is certainly the most suitable tool for large productions but its complexity and the large amount of documentation necessary for its use make it a tool not suitable for simpler games such as, for example, Serious games. In fact, the time that should be spent learning how to use the tool would be excessive compared to the minimum complexity required for a serious game.

3. Proposed framework

Unity3D engine is an environment which integrates a game engine provided by Unity Technologies. Unity is typically employed to produce digital games for different platform, such as PC, consoles, mobile devices and websites. The main feature of Unity is the convenient way to manage multimedia data, the user-friendly development GUI and the multi-platform builder [Xie12].

In this work we propose a novel tool called Point to Culture as plugin for Unity3D. Our framework provides all the necessary tools for easily develop 2D point-to-click video-games that are well suited as Cultural Heritage Serious Games. It can be used to easily address multiple common tasks which usually occur during the development of this type of games. Usually, the development process of a serious game can be summed up in three phases [BFVdO*15]:

- `Brainstorming`: The theoretical conception of the video-game with mechanics and dynamics.
- `Prototype development`: Multi-phase development of prototypes up to the realisation of the finished product.
- `Validation`: Validate the effectiveness of the game.

The proposed plugin fits into the prototype development phase, providing all the necessary tools for rapid prototyping, leaving developers the opportunity to focus more on the other phases thus reducing development times and costs. The plugin appears in the form of a toolbar element providing a drop down menu. Each menu item opens a dedicated section where it is possible to build almost every game element without a single line of code.

One of the most common aspects of 2D point-to-click games is the presence of multiple items and the need for the programmer to insert complex interactions such as the possibility of combining two or more objects and use them with each others or together with other scene elements. For example, the user could use a key to open a chest or a door or he could combine a hammer head with a handle to obtain a hammer to use against a wall. After selecting the relevant menu item, a window will open, as it is shown in Fig. 1 where the programmer can insert the sprite that provides the exterior appearance of the item and whether or not it is obtained by the union of other items. In this case, the programmer simply selects the items providing the combination, or the recipe, to get the composed item. To place them on the game scene, the programmer selects the dedicated menu element, selects the item to place, and puts it on the scene with just a click.

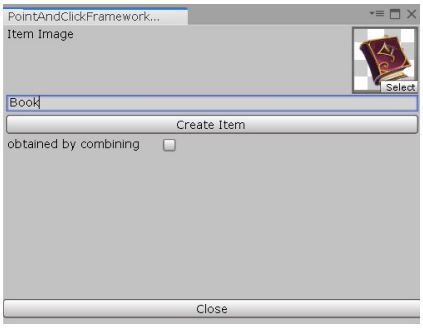


Figure 1: *Create item window*

3.1. Inventory

Another important aspect of 2D point-to-click games is the presence of the player inventory, a virtual storage where to insert items

picked during the game. To create it, as it is shown in Fig. 2, the programmer needs to select the sprites representing the frame for the items, the background of the inventory and the items already in the inventory at the beginning of the game, if any.

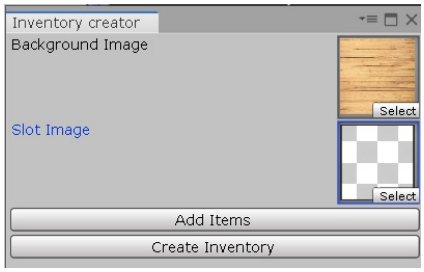


Figure 2: *Inventory window*

3.2. Combination Puzzle

The plugin permits to create a numerical combination by just selecting the relevant item on the menu. After selecting the background, up and down arrow sprite and the digit background, a screen with a single digit will be created. The programmer could then add more digits by selecting the relevant button. The screen created could be linked to any puzzles inside the game, either a chest with a numerical padlock or a door with a numeric keypad.

3.3. Background image and Cutscenes

By Selecting the relevant menu item, the programmer could create many static images providing the game scenarios which will be automatically connected through the presence of directional arrows that could be customized, also in appearance, and placed around the background. It is also possible to create simple cutscenes by just selecting a group of static images and the time lapse to change between them.

3.4. Conditions and reactions

To add complex interactions between game elements we provide a powerful tool easy to use. Interactive, Reaction collection and Condition collection represents three scripts providing complex interactions through the mechanism of action and reaction. The Interactive script provides interactivity to a game element. The Condition collection provides a list of allowed events for that specific element, linking each Condition to a specific Reaction. Interactive script allows an item in the game scene to be interactive. The programmer could add one or more behaviour to that specific item, in addition to a standard reaction which will be performed if no conditions are met. An interactive behaviour consists of the combination of a list of conditions and a list of reactions.

3.4.1. Conditions

The Condition collection script allows the programmer to add to a specific interactive item a list of scripted conditions that may or may not occur. It is also possible, for a programmer, to extend such script adding more conditions to expand the plugin. The conditions already included are the followings:

- **Combination condition** is the condition that allows the insertion of numerical puzzles, such as a numerical padlock to open a door or a chest. The Combination condition links a specific combination puzzle previously created to a specific interactive item. The Combination condition allows to insert the correct combination number for a specific combination puzzle. If the player inserts the right combination in the game, the condition is met and a reaction will be triggered.
- **Selected inventory item condition:** this is the condition that allows to add the interaction between a specific item in the inventory with an item in the game scene, for example a key for a chest or a key-card for a door.
- **State condition** is the condition that allows an item in the game scene to get a state, which is a boolean, which will trigger a reaction if the status is reached. For example a chest that gets open or a door unlocked.

3.4.2. Reactions

The reaction collection script allows the programmer to add several effects in response to any condition met. Following the reactions already scripted and their behaviour are explained:

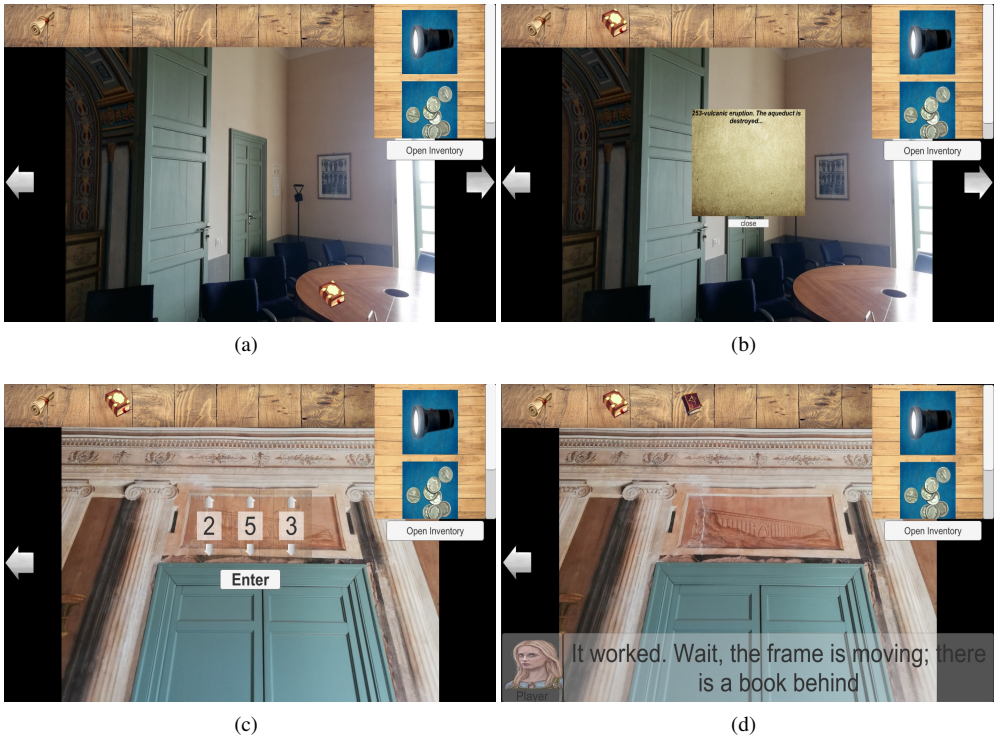
- **Active gameObject reaction:** when a condition is met activate a gameObject inside the scene.
- **Change scene reaction:** when a condition is met load another scene.
- **Change sprite reaction:** when a condition is met, change the sprite of an object inside the scene. This is used, for example, to change the appearance of a chest whether it gets opened.
- **Change state reaction:** when a condition is met, use it to change the state of an item in the scene, for example change the state of a door from closed to open.
- **Dialog reaction:** when a condition is met, triggers a dialog. It is used, for example, to trigger conversations with non playable characters.
- **Open combination reaction:** open the combination interface.
- **Take item reaction:** when a condition is met, puts an item in the player inventory.

4. Escape the Benedictine Monastery

As a case-study it was chosen to develop an escape room game set in the former abbot's room in Benedictine Monastery of Catania. The choice of the Monastery as a game environment was led by the enormous importance of the Monastery and the Historical relevance of its environments. Furthermore, its structure is well suited to be brought back to a game like the escape room.

4.1. Case-study game

The player can independently visit the abbot's room and look for clues to leave the room. To win the game, the player will become aware of some historical facts related to various cultural elements that can be found in the room. In this case, as it is shown in Fig. 3, a short sequence taken from the demo, the player will find objects



(a) (b)

(c) (d)

Figure 3: *(a) Book item; (b) Book informations; (c) Knowledge verification; (d) Reward;*

scattered around the room containing important historical facts to end the game.

In the sequence mentioned above, in Fig. 3(a) and Fig. 3(b) the player, clicking on a book on the table will have access to historical information concerning the year of destruction of the Catania aqueduct.

In Fig. 3(c) the player is facing the representation of the Catania aqueduct. An interact script attached to the aqueduct representation will trigger a message window. At the end of the dialogue, the player will be informed of the presence of a numeric keypad. The player will need not only to remember what information concerning the aqueduct he was able to find but, above all, to understand what is the correct information to use in this situation.

In Fig. 3(d) after entering the date of the destruction of the aqueduct, another dialog will be triggered. The player will be informed that he has entered the correct solution and will get the reward. In the present case he will find a book, appeared in the upper area of the inventory, containing other historical facts about the monastery with which he has to solve other puzzles to win the game. The purpose of a serious game is to entertain the user, improving his specific knowledge of the topic covered in the game. Indeed, the player will be required to explore the history of the monastery as the knowledge of many historical details will prove essential to win the game, mixing, hence, the playful details of a video game, for example puzzles and riddles, with the historical details necessary for the educational purpose, according to the design principles of serious games [RBO*19].

5. Conclusions

The proposed plugin represents a valid tool for simple 2D point-to-click games oriented to Cultural Heritage. Its ease of use and the vastness of standard functions provided makes it one of the ideal tools to easily develop Cultural Heritage Serious Games in a short time. Furthermore, its modularity makes it easily extendable by a programmer, making it adaptable to any needs. As future works, we are planning to massively employ the proposed tool for developing a set of complete Serious Games to support Cultural Heritage dissemination and education. The simplicity of use of the plugin allows the creation of point-to-click video games, with any setting, photorealistic or drawn, in a short time, leaving the developer the possibility to focus more on the educational and narrative aspects rather than programming and development. With this plugin, indeed, we want to provide a development standard where it is possible to produce point-to-click serious games with any setting by changing only the graphics by interacting directly with the plugin interface. Furthermore we are organizing tests with selected group to evaluate both the plugin with more or less experienced developer groups, and the game with groups of players.

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