Cultiventura software architecture tool supporting the learning of the Moche culture

Videogames and augmented reality

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***Abstract*—This paper aims to describe the software architecture used for the development of Cultiventura, tool that provides technology resources to support the formation of cultural identity in the teaching-learning process through technology of videogame and augmented reality for students of fourth, fifth and sixth elementary school. The design method of architecture in the context of an agile software development process is described. The results indicate that applying the model based on architecture has allowed us to develop the application with better management from the conceptual vision to the software artifact, understanding more appropriately as the essential features are implemented in the organization of the elements Cultiventura taking advantage of the interactive features of the technology to insert cultural concepts that allow students to bring cultural identification through fun and learning.**

Keywords—Architecture, games, augmented reality, movile, software.

I. INTRODUCTION

The production of highly interactive tools software as a support to teaching-learning process of archeology requires a methodology for transformation, from the opportunity of making known the finds made by scientists about the cultures pre Inca, to provide an interactive, motivating and fun tool that causes learning and identification as a direct result of play and interact, both students and teachers.

This article will explain the software architecture used for the development Cultiventura, tool that provides technological and interactive resources such as video games and augmented reality to complement and strengthen cultural identity in the teaching-learning process of the Moche culture.

II. CULTURAL IDENTITY IN THE TEACHING-LEARNING PROCESS OF ARQUEOLOGY

The work with cultural identity, it constitutes a significant source of learning for understanding of History and Social Sciences [1]. In Peru on May 21st, it has been declared as the "National Day of cultural and linguistic diversity" [2] in order to facilitate the massive access of the population to the knowledge of the many manifestations that make up the heritage and cultural diversity. In the educational context, the Peruvian Ministry of Education has developed a series of documents called Learning Paths, in which emphasis is given to democratic school based on cultural and linguistic diversity of the student [3]. In the course of Social Personal since fourth grade of elementary, it is taught about the cultures Pre Inca with the aim that each child retain, reassess and learn to spread their culture, developing learning processes that allow them to live together in diversity [4] .

III. TECHNOLOGICAL RESOURCES FOR THE SUPPORT OF EDUCATION

Emerging technologies such as gamification, cloud computing, Internet of things and augmented reality are gaining strong momentum thanks to the reduction of equipment costs and the high penetration of mobile devices that have influenced on offshoring of technologies [5], these technological resources are being used to enhance the teaching-learning process; educational video games currently represent one of the most direct ways [6] so that children can learn about their culture and to improve the learning process in many ways. Among the benefits most cited of learning based on games, appears the increased motivation of students [6]. Augmented reality is being used by teachers to increase the theories developed in the classroom [7]; nowadays, it is available technological resources and / or digital that allow approaching the reality of students allowing the introduction of knowledge in the world where children are immersed most of the day.

I. SOFTWARE ARCHITECTURE

Software Architecture lets you see a software system from a point of view holistic [8], which comprises software elements, relationships between them and properties of both that enable

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reasoning about the system [9], each component affects the fundamental requirements, whether functional or nonfunctional; architecture addresses these rigorously requirements and ensures a good design of the final application, resulting in better quality, higher return on investment of the projects and ensures better maintainability of the systems built therefore can define Software Architecture as the science that deals with the design of an information system and the impact of their qualities such as (performance, security, modifiable among others) [10].

Cultiventura, has been developed with agile process based on SCRUM, where once the development of the system has been accepted and the work plan has been validated by the client, begins with activities related to requirements engineering [11] focusing on requirements which directly influence the architecture, such as functional requirements, quality attributes and constraints, this allows two activities important in architecture design: the definition of a base architecture during the first Sprint and constant refinement architecture if necessary, in the remaining sprint.

II. ARCHITECTURE SOFTWARE RESOURCES DEVELOPED IN CULTIVENTURA

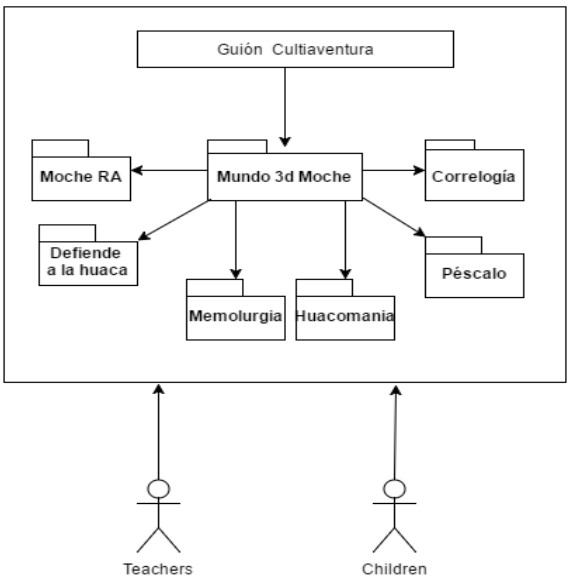
Software Architecture of Cultiventura is developed in two stages within the framework model of rapid development based on the SCRUM process. After prioritizing user stories, during the first sprint is defined the base architecture, then after the refinement of user stories, is done refining the architecture, all the following sprint.

The base architecture defines the context, functional requirements, the design of architecture; refinement of architecture follows the same steps for each interaction of software, this allows keeping agility of development without losing sight the overall structure of the product.

A. *The context of Cultiventura.*

- Those interested, elementary students of fourth grade to sixth grade and teachers of Personal Social course.
- The operating environment, Cultiventura will be used from web browsers such as Firefox, Internet Explorer from mobile devices such as Android 4.4 onwards and PC with Windows operating systems.

Fig. 1. The system context



B. *Requirements.*

1) *Functional requirements*

Described the functional requirements and the characteristics to covered by each of them.

TABLE I. REQUIREMENTS CULTIVENTURA

Video game	***Video game***	***Type***	***characteristics***
Moche culture	Memolurgia	Computer	The video game should be allowed to know the different ornaments of Señor de SIPAN
	Pescalo	Computer	The video game should be allowed to know the fishing method of the ancient Moche and tools used.
	Huacomania	Computer	The video game should allow identify Moche huacos or ceramics as a source material for the learning of history and archeology.
	Correlogía	Computer	The video game should allow identify the Moche deities.
	Augmented reality Niño moche	Tablet o smarphone	Interaction with the character of a child of the Moche culture as ethnic references of the Moche culture.
	Augmented reality Dios AiApaec	Tablet o smarphone	Interaction with the deity Ai Apaec to publicize the imposing form of cutthroat God.
	Augmented reality Señor de Sipan	Tablet o smarphone	Interaction with the character of Señor de Sipan to publicize their ornaments.
	Augmented reality Dios cangrejo	Tablet o smarphone	Interaction with Crab God to publicize his imposing form of cutthroat god.
	Defiende la huaca RA	Tablet o smarphone	The video game should allow identify the deities.
	Mundo 3D Moche	Computer	Environment where is located the Huaca Rajada containing all video games of the Moche culture.

2) *Quality attributes or nonfunctional requirements*

TABLE II. QUALITY ATTRIBUTES

Category	***Stage***
Performance	Source of encouragement: User Stimuli select the "play" and choose the level. Artifact: game screen Answer: the system processes the request and displays the initial screen for interaction. Answer: The system will process the request and displays the game screen. As Response: The burdens of resources not take more than 30 seconds, except for the first time. Internal access to different portals not take more than 4 seconds. Any change of scene (eg. When moving from the opening scene to scene mundo3D) the game should not take more than 3 seconds. When a user enters any mini game (games within the 3D world) the change should be instant, ie less than 1 second. The first time the application is run will be asked to install the plugin Unity Web Player to use, the installation should not take more than 1 minute under normal operating conditions is a minimum connection of 5 megabits per second (speed broadband

Category	*Stage*
	connection recommended). The number of concurrent users is being handled by Facebook.
Availability	The system is always available for download. The application can be viewed and executed from browsers Firefox 32 onwards, Explorer 7 onwards, and Safari 8 onwards On the web, if the server is inoperative at some time, for the user should be transparent. The data shown must correspond to the theoretical base foundation of the tool
Usability	If the user loses the illation of interactions at a given time, the system displays the help for that instruction. The names of the objects must be written and spoken. The colors used in the interfaces must correspond to a palette related to the Moche culture and educational psychology. Must be highly interactive to capture the child's attention. Must maintain the standard of using keys and mouse. Every interaction should have defined the corresponding sound.
Interoperability	The user can interact with the social network Facebook to spread achievements and results. Since the application is on the Google Drive and is executed on the server of Facebook.

3) Restrictions

The restrictions are identified in two categories, user restrictions and restrictions of the development team.

TABLE III. RESTRICTIONS

Restriction Type	*Description*
Customer	Delivery milestones, budget established
Development team	The development team is familiar with the game engine UNITY and Vuforia for augmented reality. Using web browsers, mobile devices, Facebook

C. Design

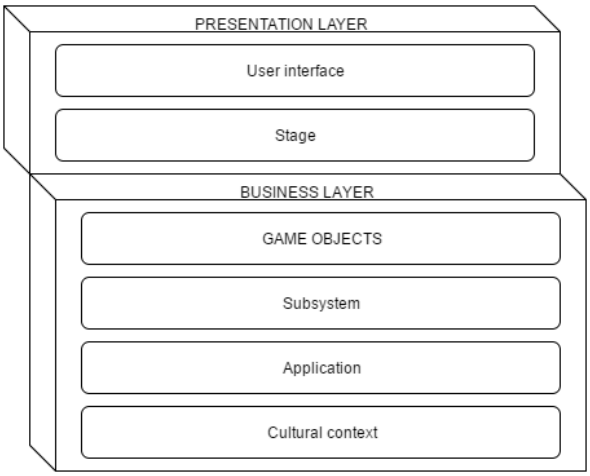
Break down element: Cultiventura

Design Concepts: Chosen the architectural pattern of layers and game engine UNITY with Vuforia.

1) Vista logica

Composed of two layers, the presentation layer and the business layer

Fig. 1. Diagram layers Cultiventura



The presentation layer has two responsibilities

User interface

- Responsibility, user interface, showing all the different scenarios, video game objects with which the user will interact.
- Properties, Language C #, Unity Game Engine

Stage

- Responsibility, responsible for integrating objects, multimedia and interaction rules for proper internal functioning of the game.
- Properties, Language C #, Unity Game Engine

Fig. 2. Level Huacomania user interface

Fig. 3. Level huacomania Scene

The business layer, has four responsibilities

Objects game

- Responsibility, in this layer is integrated modules and objects responsible for providing characteristics of the game, managing logical resources and views, between components and packages the game.
- Properties, Language C #, Unity Game Engine

Subsystem

- Responsibility, compose of the decoration responsible for updating the states of the elements, observing user interaction using design patterns. The event system is responsible for communication between objects and scripting system that is responsible for the game logic.
- Properties, Language C #, Unity Game Engine

Fig. 4. Game objects and script

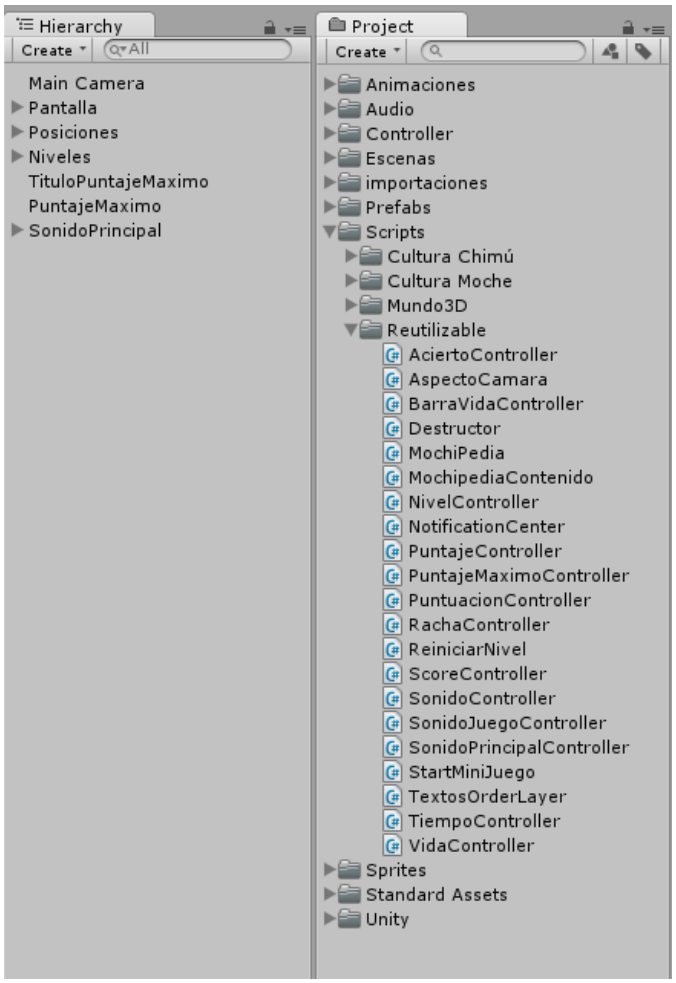
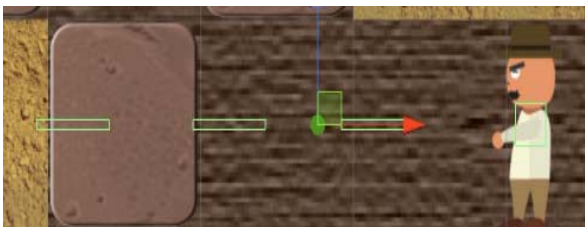


Fig. 1. Event System



In Figure 6, green rectangles is observed, these act as event listener. It contains a component called collider box which allows to recognize when touch something or enter something inside and run some instruction. This recognition is performed when the property Is Trigger is activated, changing from state to On trigger, which detects when an object enters the field domino box.

Fig. 2. Graphical interface of the green rectangle method

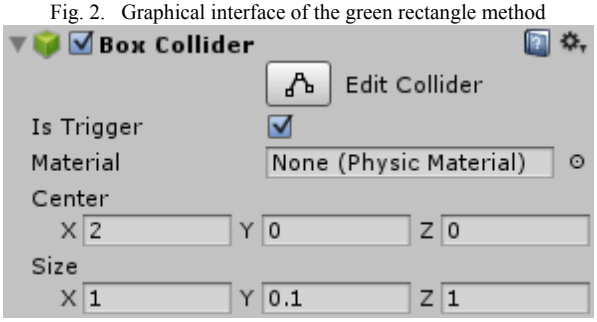


Fig. 3. On Trigger Code green rectangle

```
void OnTriggerStay (Collider other)
{
    if (other.tag == "Player")
    {
        estadoVision = 2;
        huaqueroPadre.GetComponent<EnemigoController>().estadoInicial = false;
    }
    else if (other.transform.tag == "Muro" || other.transform.tag == "MuroResbaladiso"
        || other.transform.tag == "Orejera1" || other.transform.tag == "Orejera2" ||
        other.transform.tag == "Arcilla" || other.transform.tag == "Huaco")
    {
        estadoVision = 1;
    }
}
```

Application

- Responsibility, specifies the generic elements of the video game, based on logic and available resources, responding and providing an interface for managing events and user feedback
- Properties, Language C #, Unity Game Engine

Fig. 4. Event eating clay and character movement

Fig. 5. Earmuff move event and character movement

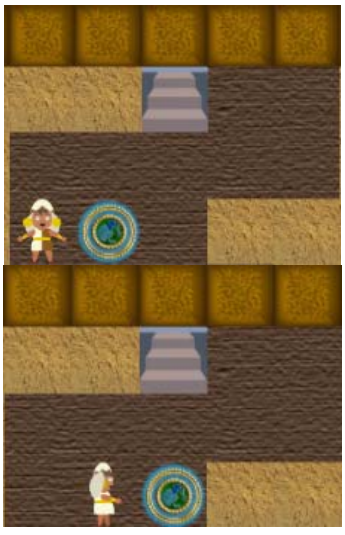
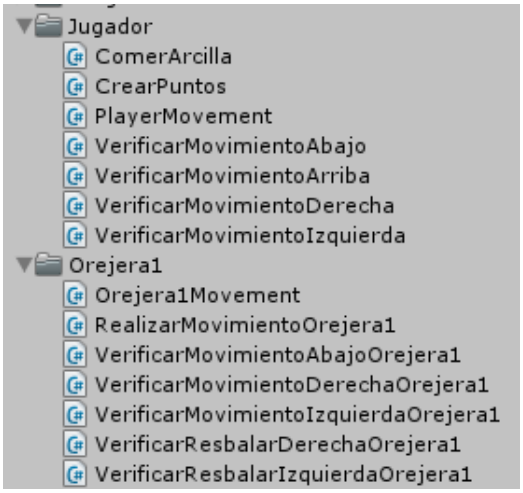


Fig. 6. Script used for those events



Cultural context

- Responsibility, found all the information that will be used in the game, as user information, language, multimedia for different scenarios, files sources of information cultures to develop.
- Properties, Language C #, Unity Game Engine.

2) Physical View

The physical view consists of the user's computer, mobile devices, and cloud.

Pc User:

- Responsibility, Personal computer through which users access the game.
- Properties, Internet Explorer, Firefox

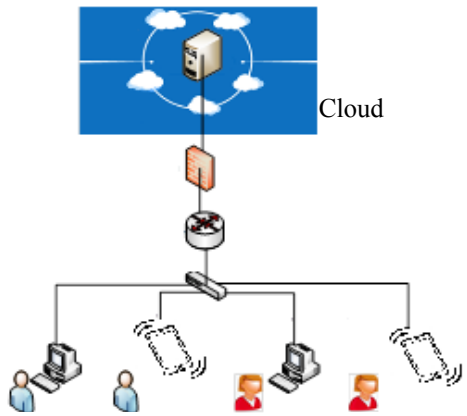
Mobile device:

- Responsibility, personal devices through which access to augmented reality game users.
- Android 4.4 operating system

Cloud:

- Responsibility, store games for download.
- Properties, Azure

Fig. 7. Diagram hardware



III. CONCLUSIONS

The proposal presented shows the architecture of software used for the development of Cultiventura, considering the characteristics required by the agile model of software development and users.

Design the architecture in two phases within an agile Process had allowed for a comprehensive approach, starting from a design perspective and global core production, which has been readjusted at each increment, without cluttering management product from the conceptual vision to the artifact software.

The architecture presented, provide the essential features for the organization of the elements Cultiventura, where take advantage the characteristics of video games, augmented reality and cultural information to create a group of interactive technological resources that enable to reach students various cultural themes with features fun and learning.

The architecture allows the systematic development of Cultiventura organizing its development, managing constituent elements, visualizing how these elements communicate with each other and how they affect the functional and non-functional requirements, as well as determine the requirements to reduce risks and increase quality, allowing include theories that reinforce cultural heritage identity and learning different topics related to the Moche culture. In addition, it allowed that the development team to work in parallel in the various components comprising Cultiventura, its structure has direct impact on their ability to achieve the requirements, quality attributes, restrictions and business rules proposed [11].

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