WEB VIRTUAL BALL GAME "POK-TA-POK"

[1]M. C. MARCO ANTONIO, GONZÁLEZ, [2]M. C. MARTHA ROSA CORDERO,
[3]JORGE BENJAMÍN SILVA GONZÁLEZ

[1.2]Dorantes, Escuela Superior de Cómputo Instituto Politécnico Nacional
Av. Juan de Dios Bátiz s/n esquina Miguel Othón de Mendizabal. Unidad Profesional Adolfo López Mateos.
Col. Lindavista C.P. 07738, México, D. F.
57296000 ext. 46188

[3]Escuela Superior de Cómputo Instituto Politécnico Nacional
Av. Juan de Dios Bátiz s/n esquina Miguel Othón de Mendizabal. Unidad Profesional Adolfo López Mateos.
Col. Lindavista C.P. 07738, México, D. F.
57296000 ext. 46188

E-mail: marthac@mexico.com, magi98@mexico.com, jorge.ben.silva@gmail.com

ABSTRACT

The next pages describes the development of the web virtual ball game "Pok-Ta-Pok", the followed methods and the achieved results on the developing of a system capable to recreate the ballgame matches for two players in a local web, making use of actual techniques in game development such as 3D modeling, texturing, skeletal animation, artificial intelligence algorithms, programming techniques on GPU to effect addition and videogame controls.

Keywords: *Design Of Learning, Educational Systems, Video Game, Ball Game, Mayan Civilization, Culture, Learning System, Entertainment.*

1. INTRODUCTION:

The ball game (in original dialect "Pok-Ta-Pok", called that by the ball's noise at bounce on the walls and the players) beside to be the representative sport of the Mayan culture and all Mesoamérica, have to much of religious and spiritual.

The game's argument consists on the luminous team players hitting the ball with their hips, elbows and knees looking for plays that the opponent can't respond, and with this get the light triumph and the birth of the sun, meanwhile the other team is looking for the dark triumph.

Generally the match ended when one of the teams scored the first goal. In some ritual games the loser team's leader was decapitate and his skull was the center for a new ball.

The number of players (Pitziil) goes from 2 to 5 on each team, they used to wear head's protection, called Pix'om, hips protection (Tz'um) made from deer or jaguar leather and on the knees and elbows Kipachq'ab.

The ball was made from a mix of latex from rubber trees (Hevea Brasiliensis) and Guamol trees (Calonyction aculeatum) it size were between 22 and 25 cm of diameter with a 3 to 6 pounds weigh.

The field was "I" or double "T" formed, with 30 x 8 m dimensions. The goal was scored when the ball touched the target; the players could touch the ball only with the protected body parts. They were inclined walls on the field with plane targets at the center and the ball was always big. If one player touched the ball with their foot, the other team scored a goal y kept the control of the ball; there were arbitrators that made the rules accomplished.

2. OBJECTIVE

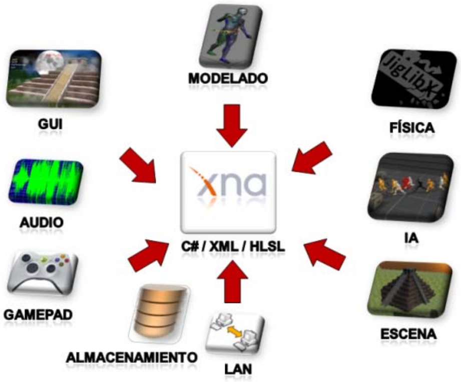
Develop a functional application, striking and entertaining that allows recreate the matches of the ball game in a 3D interface with local web support, using actual technologies and techniques in videogame development, such modeling, textured, rigging and artificial intelligence algorithms as well as programming principles on GPU using XNA and HLSL.

2.1. Specific Objectives

- To get historic information about the ball game, rules, game mode, field dimensions, playing civilizations and symbolism.
- To design and model characters about the thematic and design sceneries to play the matches of the ballgame.
- To analyze the different used tools in this kind of applications to implement it.
- Develop and implement the virtual ball game.

3. IMPLEMENTATION

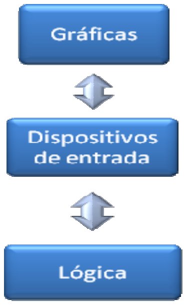
In order to develop the system, the basic necessary elements are indentified, these elements are typical in most of the actual videogames, and these elements are shown in the next diagram interacting to get the right game play with will be defined ahead.



General diagram of system elements.

3.1 System Architecture

On the searching for the independence between the diferent elements, we decide to use a layers set or blocks sets that interact between them. The main elements in these sets we found the game states manager, the time manager, the scores manager and the Artificial intelligence (AI). The network use a independent thread, this helps to unload the main process.



System architecture diagram

The server

Create the match, use the time manager and score manager, manage the physics engine (speed and position), recive the data from the client to update the game.

The client

It connects to the macth created in the host. Recive the game status and data for the agent’s reaction like the ball’s speed and position, recive the player’s actions and update player’s data (actions and movements).

The Gameplay

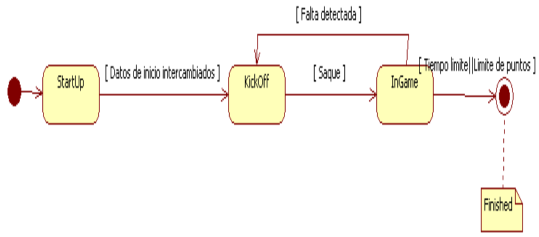
The Gameplay refers to the player’s experience and his interaction with the game system. The gameplay is also related with the game’s type. This is a real-time multiplayer sports game.
We use the keyboard, mouse and a XBOX 360 controller.

Game’s states

These are the game’s states that we use for the gameplay development:

- StartUp
  - Data exchange: Name, picture and opponent’s team models.
- KickOff
  - Waits until a player free the ball, throw it to somewhere.
- InGame
  - All the players try to win the match.
- Finished
  - Update for the players, score, wins and losses data.

This picture shows the game's states interaction.


[Falta detectada]
StartUp
[Datos de inicio intercambiados]
KickOff
[Saque]
InGame
[Tiempo limite||Limite de puntos]
Finished

System states diagram

Information Storage

The information stored is the changeable information in our system.

- Settings
- Profile
- Images
- Characters

We use XML and XSD to verify the XML files, to assign a verification schema to a each file.

Server-Client Communication

The communication achieved into a local area network, we define serial classes. This classes are sent and rebuilder in the final destination. We use the UDP protocol with the unrealizable send option, not in order.

Game's physics

The Applied physics to the game elements are:

- Ball
  - Mass and material
- Walls and floor
  - Unmovable
- Environment
  - Gravity
- Characters
  - Bounding boxes over the model

The ball's movement its defined by the next equation:

.

3.2. Artificial Intelligence

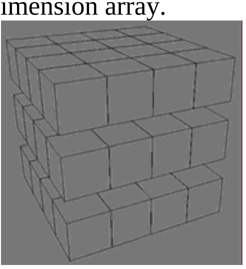
$$y = V_{0y}\,t - \frac{gt^2}{2} +$$

For the realization of our artificial intelligence, we use BDI intelligent agents. The Artificial intelligence is strong linked with the ball's movement.

We use a average process for the field to define the movement's space for the agents. Each agent have a independent thread from the game main process.

World's Average Process

We define cubes called spaceCells and these are stored in a 3 dimension array.



SpaceCells representation

We also define cells and these are stored in a 2 dimension array.

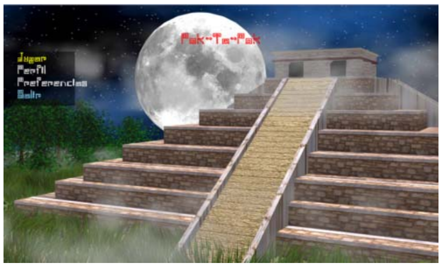
We use the spaceCells to decide the hit type over the ball. In other way, we use the cells to keep the agents movement.

3.3. Graphical User Interface

With the commitment to offer a pleasant experience, we looking for a easy interface's management that uses in a total way the uses cases presented in the documentation.

3.3.1. Menu screens

- **Allow the access to the different settings options and the match creation.**
- **Transition effects between screens**
- **Use of a attractive bottom screen to enhance the appearance**



Main menu, GUI example

3.3.2. Gameplay screens

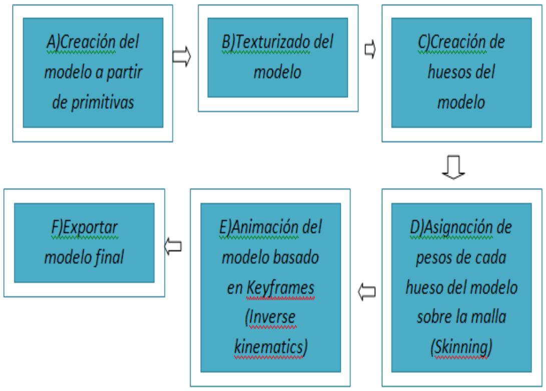
- Pause:
  - o Keyboard and XBOX 360 controller controllable, used to pause the game without stopping the match, also allow to exit and over the session.

- Match players information
  - o Show players login/logout
  - o Show the team's name and picture (local and remote)
  - o Shows time and scores

3.3.3. Characters and stages modeling

For the characters and stages modeling we use 3D Studio Max 2009 because it got the appropriate exporting tools for the use of XNA 3.0 models.

The characters modeling follow the next action sets:


A)Creación del modelo a partir de primitivas
B)Texturizado del modelo
C)Creación de huesos del modelo
D)Asignación de pesos de cada hueso del modelo sobre la malla (Skinning)
E)Animación del modelo basado en Keyframes (Inverse kinematics)
F)Exportar modelo final

Animated characters creation process

With a XML file, the animation is breaking apart into parts for change it for the animation linked to a pressed botton. The next code shows the definition of the players movement.

Additional, we got statics elements inside the game. The sky simulation works through a skydome and have a grass like effect called billboarding that use a direct HLSL programing over GPU.

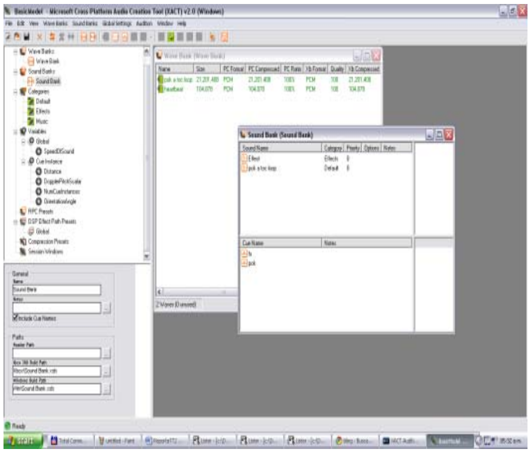
3.4. Audio

Considering that the game is a multimedia elements mix, the inclusion of audio effects, sound tracking and continuous clips allows create a believable and involving atmosphere.

We got a sound bank where we can to play a particular track in a specific moment, for intance, in the collision event for the ball against a wall or the floor.

Also we got a soundtrack playing into a loop with a audio effects like wind waving and 3D sound.

For the edition of the sound bank we use a tools owned by XNA called XACT "audio creation tool" that support exclusive WAV files.



Name	Size	PC Format	PC Compressed	PC Ratio	Xb Format	Quality	Xb Compressed
pok a toc loop	21,201,408	PCM	21,201,408	100%	PCM	100	21,201,408
heartbeat	104,070	PCM	104,070	100%	PCM	100	104,070

Sound Name	Category	Priority	Options	Notes
Effect	Effects	0		
pok a toc loop	Default	0		

Fig. 8. XACT, audio manipulation tool provided by XNA

4. TESTS

4. 1. Sound card tests

To get the maximum performance at the moment of execute the project, it were realized video card tests, beside it were created two system versions, one of this with more graphic detail while the other is visually simpler.
The main difference between these are:

- Billboarding
- Scattering and Skydome

These do not exists on simple version because the direct GPU management is a non-compatible characteristic with all the graphic cards (mainly on these with integrated graphic chips).

The results are shown on the next comparative table.

Video card	SM version	FPS (fog, tiling, basic illumination)	FPS (All the effects)
Intel GMA 950	2	20	N/A
Nvidia fx 6200	3	25-35	9-15
Nvidia 8600gt	4	30-40	54
Nvidia 9600	4	40-50	50-60

"All effects" include: Scattering, billboarding, skydome, fog, lights, shadows
FPS: Frames per second
SM: Shaded Model

4. 2. Web tests

To the send and reception of web packages, it was proved the four different send options offered by XNA, witch are:

- None
- Reliable
- InOrder
- ReliableInOrder

Observed results
None

- The send and reception presents some inconsistencies in the ball position witch are not a decisive factor for game performance.
- The delay is small and not always noticeable.
- Occasional lost packages does not alter the system performance neither.

Reliable

- Considerable delay because the forwarding of failed packages.
- The incoming order is not guaranteed, so can be a position inconsistence.

InOrder

- The incoming order is guaranteed, there is not position inconsistency.

ReliableInOrder

- Guarantee the correct package reception order, forwarding the failed ones.
- Considerable delay, turns the system not playable.

It was selected the None option, as the difference between this and InOrder was very small and the second achieve more fluidity.

4.3. Tests with Artificial Intelligence

For the AI part, it were defined two sizes of the spaceCells, with form a fundamental part for the agent's choice making. It was created a three dimensions array.

On test it was took a 160 X 80 units plane, on length and width, the SpaceCells were distributed on all this plane.

SpaceCell dimensions	Number of created SpaceCells	Conclusions
10, 10, 3.5	16*8*3=384	quickness more precision
5, 5, 3.5	32*16*3=1536	quickness more precision

Despite the number 1536 seems big, this does not demerits too much the system performance.

5. CONCLUSIONS

- It was realized on three phases: research, development and tests.
- The system allows to recreate the ball game matches in mayan style.
- It is possible use the system with two players on the web, using the respective profile.
- Several actual techniques were used on the game's development.
- It is possible to improve the graphic aspect and gameplay but this are proposed.

REFERENCES

[1]. Mexicana Arqueología. El Juego De Pelota. s.l. : Editorial Raices.

[2]. Arquitectura BDI de un Agente Jugador de Fútbol. Grupo de Sistemas Inteligentes . [En línea] Escuela Técnica Superior de Ingenieros de Telecomunicación,España. http://www.gsi.dit.upm.es/~gfer/ssii/trabajos2006/ag4-MFdez-ANavas.pdf.

[3]. Buckland, Mat. Programming Game AI By Example. s.l. : WordWare Publishing.

[4]. Fernando, Randima. GPU Gems. s.l. : Addison-Wesley Professional (April 1, 2004).

[5]. Grootjans, Riemer. XNA 2.0 Game Programming Recipes. s.l. : Apress.