Game Programming Course – Creative Design and Development

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Abstract—**Rapid developments of the Electronic Entertainment - computer and video games, virtual environments, the "Games 3.0" revolution - influences also courses about Games and Virtual Environments. In the following is discussed the course "Games and Virtual Environments" presented in the fall 2007 term in Tallinn University of Technology; the main emphasis of the course was not on programming technology, but on understanding games as a special form of communication and exploring specific features of this form.**

Index Terms—**game programming, virtual worlds, game structure, communication.**

I. INTRODUCTION

Electronic entertainment (computer and console games, virtual environments) have obtained a serious commercial value. The Electronic Entertainment Index [1], the world's first equity index focused on the video game industry reported that the value of this industry has in last four years grown 2.5 times and e.g. in USA the gaming industry's growth exceeded four times the growth of the USA national economy in whole and thecommercial value of the video game industry in USA is $13 billion USD [2].

The influential business research magazine "Business Week" stated in oct. 2007: '…there is a revolution happening now in the games industry—one that many have labeled as "Games 3.0"…. The BIG idea around Games 3.0 is "Games as Media, NOT as product' [3].

Computers were invented for computing and the main applications of computers were for a long time (in the beginning of 80-ties) based on "number-crunching", i.e. computers modeled these aspects of reality which were easy to represent numerically. Soon computers started to handle the basic discrete communication mode - text. But with technological improvements become accesible also continuous media modes - sound and music, images, animation and video. Gradually computers become communication, media and gaming machines. Today's computers are ca 20 million times more powerful than the first mass-market games machines of the early 1980s [4] and computer has a huge advantage when compared with traditional media modes (printed/recorded, video/cinema) – it is interactive. The only way for a cinema visitor to express its attitude is to leave the cinema, but computer game player can influence the course of events. Human intelligence is based on communication, on social mind of community, which creates collectively models, understanding of our environment. Until now these models were static (text/recordins) or embodied one,

predefined course of events (video). But the "real" life is not static, we influence it with our actions and the course of events changes depending on our actions. It is impossible to make a video or cinema film which stores all these possible changes. There have been attempts to create interactive movies, which contain several different storylines that the user select by making choices during the viewing or (collectively) by voting of the cinema hall audience [5]. But these "branching" movies contain only these possibilities which authors considered possible, i.e. they are "canned" and finite. It is impossible to present using interactive video e.g. the simplest computer game – Pong: there are endless possibilities for ball to bounce.

Experiences which player gets in interactive computer games are much closer to "real" life and in several aspects even more real as the "real" life. Games are a way to investigate, to simulate and discover what will or can happen. Humans are all the time playing – this is the base to human creativity. Human intelligence is incremental: first we see/study what others have allready achieved, but then we invent new approaches, twist the situation.

Computer games are a new type of media, which present totally new possibilities for such exploration and this media can cover all areas of human activities: in Business Simulation Game gamers can manage their own corporations in a virtual economy [5], explore history of ancient civilizations or study the history of their home country or city [6], discover and explore laws of physics (car games); gamers can participate in the Olympic Games 2008 playing the MMORG (Massively Multi-player Online RolePlaying Game) "Beijing 2008"[7]. Computer game is a good environment to explain modern trends in software engineering, e.g. the 5-tier model of Systematic Software Process Improvement and SPICE [8]. Understanding and managing these possibilities is the most important and also the most difficult aspect of games and computer media.

Such a wide area of applications puts also high demands on courses which teach game creation. Game creation covers the whole pyramid of computer application creation – from low-level technical details of programming (especially graphics and 3D programming, sound and music reproduction), object-oriented design and complicated networking issues in MMORG-s to high-level conceptual and cognitional issues of game design.

II. WHAT IS A GAME

Games and gaming are (still) often considered a rather doubtful activity – "a pure waste of time!" (but those who claim this usually also do not have time to read books or

to visit theatre). Thus in spite of clear economical indications of rapidly growing value of gaming industry students should also understand, what is a game [9] and why the popularity of gaming is rapidly increasing: "To understand games and game design, we must first clearly establish our fundamental orientation. Games are a fundamental part of human existence" [10]. While in many analyzis gaming is considered as an activity necessary for humans because of the "fun" element [11], several other studies consider games as an art form [12], [13], [14] and as a new form/media of communication. "Gaming is much more than having fun - its core to being human." [15]. Johann Huizinga makes in his groundbreaking book "Homo Ludens" (Playing Man) [11] even stronger statement: "Play is older than culture".

III. THE COURSE

Often "Game Programming" courses cover only the low-level programming (C++) and other technical issues. This kind of courses look like "The Emperor's New Clothes" – they were created renaming an old content into attire of modern buzzwords. Reducing game creation to dull C++ programming takes out the fun and exitement of game creation. Besides, nice games can be created without tedious low-level programming. There are many so-called casual games – games, which can be finished in 5-10 minutes on a work breake and this category of "everyman-games" is rapidly growing. According to Casual Games Association's Casual Games Market Report 2007 [16] are casual games (in USA) worth $2.25B USD and in the last year their growth was estimated at a 20%. Students participating in their first game programming course are able to create (and finish!) this kind of games.

There are many theoretical topics of Informatics which should be considered in a games programming course. Games are finite state machines, their design and development is conducted according to Object-Oriented paradigm, there are many patterns which occur in design and development [17], many interesting and deep issues of 2D and 3D mathematics etc.

But games are also a new type of media and should be considered as such. If "The message of the movie medium is that of transition from linear connections to configurations" [18], then the message of computer games is transition from "pre-canned" (assumed by authors) configurations to more-or-less arbitrary sequences of configurations, which are defined not using their syntax, visual appearance (videoclip), but by semantics, the underlying game/world structure which causes this appearance, these configurations and thus gives rise to much greater user engagement and immersion.

To understand the essence of games as a new type of media and to distribute this understanding to students is a challenging task, but this new media needs creators who can employ the next-generation of tools to tell stories in new ways. "We need the Alfred Hitchcock and the Orson Welles of gaming to step forward and lead the industry into a new era. At the moment we have plenty of Buster Keatons and Harold Lloyds. Video Game Design and Development is the industry which needs artistic figures who can employ the next-generation of tools to tell stories in new ways… "[19].

A. The first individual project

The main focus in this course was not on low-level programming, but on game structure, idea/story, balance, playability and other notions which have emerged from game research [20], [21], [22]. These notions were introduced in the very beginning of the course. To get grip with these notions students had to prepare a review of some game, using the following questionaire:

Game Information: authors (idee, implementation), year, intended audience, genre, description of the game (with pictures), similar games

Role of the story: (if the game has any), how essential (natural, non-artificial) is the story

Visual and acoustic "sugar": quality of graphics (visual decor), sounds, music, videoclips; how essential are these elements

Game play:

- flow, playability, fun, long-lasting appeal, strategy, decision making, patterns, similarity with other games
- balance between the different features
- how well is control implemented, who is in control
- *Implementation:* programming environment (language/system), resource management, extensibility, possibility for mashups

Game AI: (if any)

- behavior of the opponents and/or units, non-gaming actors
- quality of motion planning
- game complexity: how many states/rooms (estimate), how complex is the game control

User interface: how well is presented the current state of the game, do the menus (popup windows etc) interfere gaming, is the game control logical and natural (no need for help!)

Documentation and learning curve

Possible improvements: what could have been left out without hurting the game, what could be added to improve the game.

This first task produced several very interesting and deep analyses and prepared students for better understanding of their second task – designing and implementation of their own game.

B. The Second (Main) Individual Project

The second (main) task was design and implementation of their own, original game.

Implementation tools: Most of participants were first-second year students and not yet skilled programmers. But there appeared also some senior students who were quite skilled (had full-time programming jobs), therefore selection of tools used in the course was problematic. The main tools used were Gamemaker and Flash, but students could choose whatever environment they liked, e.g. one very good game was made using the Ragnarok RPG Maker[18] and one – using Adobe Air. Use of programming languages (C, Java, Visual Basic) was discouraged – it is very unlikely that they could finish such a project. The course resulted in many nice and original games which demonstrated creative abilities of their authors.

Use of free (open-source) or low-cost (shareware) tools. Many students worked primarily at home using not-so-good computers (and often under Linux). Thus making students aware of programs which are either free (open-source) or cheap (shareware) and could be used also under Linux was quite important. Fortunately there are free or cheap alternatives to many expensive commercial programs, often aggressively developed by fans:

- *bitmap editors*: it is common belief that "Photoshop is the king" – it may be so, but Photoshop is first of all for professionals (and therefore quite expensive). There are several free alternatives: GIMP (also for Linux and Macintosh), Pixia - very suitable for creating game sprites, besides of original Japanese edition there are editions for many other languages: Hungarian, Chinese, French, Polish, German, Spanish, Italian etc; Satori; animated sprite (gif) editor GraphicsGale etc;

- *sound editing*: many free alternatives, e.g. Audacity which is available for all major OS-es;

- *game engines*: our main tool was Gamemaker, which has a free version; licence for the pro version is also rather cheap, but besides these were breafly presented also e.g. programming languages Phrogram, Alice, the Clean Game Library, Platform Studio etc.

Another game creation tool (mainly for more advanced students) was Flash. The latest version AS3 of the Flash programming language Actionscript was quite a revolution and many students who had previously used earlier versions were rather dissapointed – AS3 is rather different. But since AS3 is much quicker, more systematic Object-Oriented language, the use of AS1/AS2 was not accepted. The Adobe's Flash is rather expensive for a student's budjet, but fortunately there is also free open-source compiler and editing environment OpenFlash which can be used without Flash IDE and several students used this at home. For AS3 have been developed several open-source libraries (often hosted by Google's Code project): Papervision3D, Sandy (for 3D-modelling), Tweener etc. Advanced students explored also these and e.g. one of presented games used the open-source APE (Actionscript Physics Engine) extension to implement a nice three-wheel trick cycle.
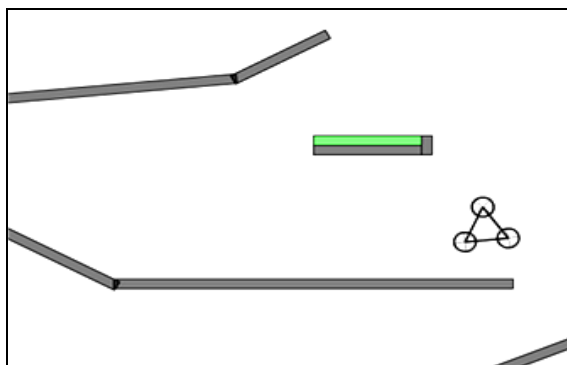

Figure 1.   A funny three-wheel trick cycle implemented using the open-source AS3 Physics Engine APE. Player has to ride this very elastic apparatus to the goal, using acceleration and bounces from walls.

Game genres: The genre of the final product (student-implemented game) depended first of all on the selected implementation environment. With Gamemaker the final result was usually a traditional Mario-type scroller, labyrinth-passing or Sokoban clone with some interesting novel elements, e.g. in a labyrinth the hero could turn itself horizontal to pass some narrow passage, in Sokoban the boxes could not only pushed, but also pulled etc. Some of student games were rather extensive with more than 15 levels. Several of them had also a strong story element, based e.g. on a fairy tale or on some contemporary development (e.g. current inflation in Estonia).
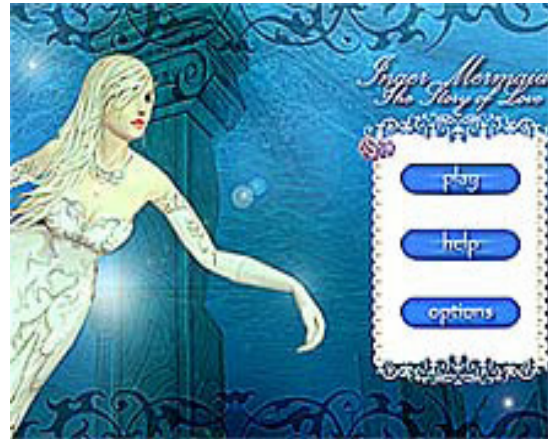

Figure 2.   An underwater game based on fairy tale about love between mermaid Ingeri and smith Ilmarine.

Figure 3.   A game based on Russian fairy tale – Ivan has to collect all magic apples in order to free the beautifull princess, captured by the evil witch Yaga.

Figure 4.   A very original, dark and syrreal bitting combat game (author's original artwork).

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