

(Serious) Games Development: The State of the Art

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(Serious) Games Development: The State of the Art

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ABSTRACT

In this report, we give an overview of research and development of serious video games. Firstly, we briefly look at the history of (digital) video game. We discuss different types of video game and introduce the concept of serious game. In the following, we review the important aspects of technology development for general video games and serious games. We further discuss the critical elements of the game design. In the end, we summarize the components that form a successful serious game. This report can act as guideline for the development of a video (serious) game.

KEYWORDS: video game, game design, game development, quality, serious game

1. Introduction

Nowadays video game is known to most of the people. The potential of video games for entertainment has been demonstrated clearly and thoroughly by research and the acceptance of consumers in the commercial market place. Recently, the interest of applying video games to other purposes instead of entertainment starts to grow. Serious games are those that intend to provide an engaging, self-reinforcing context in which they motivate and educate the players towards non-game events or processes, including business operations, training, marketing, well-being and advertisement. However, there are many challenges in terms of designing, developing video games, including serious games [1]. In this paper, we review the important aspects of game design and development. In particular, we discuss the difficulties that are faced by researchers and engineers while designing and development a serious game.

2. (Serious) Video Games: two components

There are many different types of video games. Based on the platform it runs, a video game can belong to one of the following categories:

- **Personal computer (PC):** This kind of games can be run either in a stand alone mode or within a webpage; the number of involved player(s) can be one or many.
- **Game console:** A Game console is mainly designed for gaming purpose. Play station, xBox and Wii are three typical examples.
- **Arcade machine:** An arcade machine is a coin-operated entertainment system, usually founded in public businesses, such as restaurants, bars, and amusement parks. Most arcade games are video games, pinball machines, electro-mechanical games. From the late 1970s to the late 1980s was the golden age of arcade games. Arcade games continuously decline in popularity when home video game consoles are widely available.
- **Hand-held device:** The appearance of hand-held devices leads to the new development of video game. Various platforms include mobile phone, portable game console or tablet PC.

Games on these different platforms own different characteristics, such as device size, CPU speed, wireless connectivity, graphic rendering power, and interaction devices. These differences pose particular requirements while developing and designing a game on a particular platform. In addition, similar to most

other forms of media, we can categorize games into different genres based on factors like methods of game play, types of goals, art styles and etc. Common game genres include the follows:

1. Action
 - a. Shooter
 - b. Fighting
2. Action-adventure
3. Adventure
4. Role-playing
5. Strategy
6. Music
7. Vehicle
8. Sports

Some genres represent the combinations of others, such as massively multiplayer online role-playing games (MMORPGs). Very often higher level genre terms are collective in nature across all other genres, for example action, music/rhythm or adventure-themed games.

Advancing technology has fostered the creation of better life-like and complex games, pushed the boundaries of existing video gaming. In some cases, it adds new possibilities in play. A video game is a software product with art, audio, and gameplay. In fact, a truly successful or popular video game title must excel in many areas. To present video games that people will be eager to play, it is not only about appealing technology, but also about great content/story design. Game development can be regarded as a software development process [2, 3]. As a subset of game development, the activities of game design include designing the content and rules of a game in the pre-production stage, designing of gameplay, environment, storyline, and characters during production stage. Game design also includes documentation of related design activities. Despite of different platforms and genres, the development, production, or design of games shares three common phases: preproduction, production and postproduction [2].

2.1. Technology Developments

As an interactive application, any video games are developed upon certain technical components. In general, these technical aspects will include the following:

- **(3D) modeling:** A well-design game requires vivid characters and realistic models and environment. Modeling is responsible for creating all the characters and objects in a game. It is particularly important and demanding for complex 3D games.
- **Rendering:** Modern video games reply on various graphical rendering techniques or algorithms in order to reach the goal of presenting a player a more realistic scene. These techniques will cover every aspects ranging from lighting and shadow to materials, scene graph management [4].
- **Sound:** Interactivity is a distinguishing feature of video games, and sound plays an important role in this. A player's actions can trigger dialogue, (ambient) sound effects, music. Games on different platforms from penny arcades to the home game console pose different requirements on the sound quality, the formats of sound files.
- **Artificial intelligence (AI):** Games, for example first person shooter game, often involve activities that put the player against preprogrammed opponents or human like agent. These opponents or human like characters that are called non-player character (NPC). In video games, they are controlled by the computer through AI [5]. NPC's behavior is usually scripted and automatic, triggered by certain actions or dialogue with the player characters. Techniques in game AI are draw upon existing methods from the field of AI. Algorithms and techniques from control theory, robotics,

computer graphics and computer science in general are applied as well in games. AI in Games focuses on appearance of intelligence and good game play, workarounds and cheats are often used.

- **Networking:** Earlier games often have single-player, which lacks the flexibility and ingenuity of regular human thinking. In a multiplayer video game, more than one person can play in the same game environment at the same time. In a variety of different multiplayer game types, players can be in the form of partnership, competition or rivalry players. Multiplayer games provide the players with a form of social communication that is almost always missing in single-player oriented games. Multiplayer games typically require the players to share resources of a single game system through networking technologies. Multiplayer games allow players to play together over greater distances. Networking technologies are responsible for the scalability and security of a game, dealing with issues of network bandwidth and latency [6].
- **Physics:** Game physics involves the introduction of the laws of physics into a game, particularly in 3D games, for the purpose of making the effects appear more real to the players. Commonly used physics techniques include collision detection, particle system, soft body dynamics, fluid dynamics and etc.
- **Human Interaction Device:** As mentioned before, a distinguishing feature of video games is interactivity. Human interaction devices (HIDs) are important to help reaching such rich interaction. Typical HIDs include mouse, keyboard and joystick. More advanced tools include 3D tracking devices or even a BCI toolset.

As video games become increasingly complex and demand richer user interaction and experience, it is increasingly challenging to design a game from the beginning. That leads to the introduction of game engine. The process of game development is often economized, in large part, by reusing/adapting an available game engine to create target games [7].

2.2. Game (Content) Design

Game design is a critical process for a game to be successful. Artistic and technical competences as well as writing skills are required during game design [8]. Whether it is a first person shooting game, in which the player's only goal is to blow everything up on the screen, or a sophisticated war game, in which the player is equipped with sharp weapons and needs clever strategy, the first and foremost thing for a game must be fun. No matter how great the graphics are, how realistic the sound effects are, or how well designed the computer player's algorithms are, if a game does not bring any fun, it will certainly attract fewer players and get left in a closet to gather dust. Normally a success game can offer the players many things:

- A challenge
- To socialize
- To play on their own (sometimes)
- Bragging rights
- Emotional experience
- To fantasize

Many elements determine what makes a game enjoyable. The most important thing is the game's concept. Normally, a game's concept is based on some real-world event or circumstance. For instance, chess, as one of the most popular board games of all time, is actually a kind of war game. Monopoly, on the other hand, is a financial simulation in which players try to bankrupt their competition. Video games are often no separate from their real-world situations. They should have some logical goals for the player as well, and with rare exceptions they must be set in some sort of credible world. This world can be as simple as an onscreen maze such as Tetris or as complex as an entire planet with continents, countries, and big cities. No matter what

type of environment you conceive of for your game, it should have consistent rules that the player can master or follow [8]. For a game to be enjoyable, the player must be able to figure out how to surmount the various obstacles in his path. When a player loses a video game, it should be because he hasn't mastered the subtleties of the rules yet. Not only a game should be designed with consistent rules, but also needs a consistent game world. Every element in a game, graphics, sound, and story will contribute to this goal. Graphics, sound, interface design, computer algorithms, and more can make the difference between a fun game and just another common game.

For serious games, game design to focus on the story and idea become even more important since serious game is not mainly meant for entertainment, but for solving problems. For a long time, the biggest sectors that have the need for serious games have been military and defense, medicine and health care, but other domains including advertising, politics, art, religion, culture, education, government, general management, organizational behavior, and finance quickly gain interest. For these domains, understanding particular domain problems and creating relevant game story/concept will be desirable and challenging. In order to design effective, engaging serious games, theoretical understanding of learning, cognition, emotion, and play is required.

3. Discussion and Conclusion

There have been many publications and researches on video game design and development. However, there is no consensus on what determines the quality of a video game how to evaluate its. A good product can be judged by the measurement of whether it satisfies customers' needs, preferences and expectations [9]. Researchers have proposed three elements that are considered the key determinants of the quality of a game [10]:

- The context of the game;
- The required activities to win or complete the game;
- The difficulties of understanding what should be done, and how to actually accomplish it.

In particular, it is difficult to judge the quality of a serious game quantitatively and qualitatively due to the reason that serious games often domain specific.

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