International Journal of Advanced Science and Technology
Vol. 29, No. 7s, (2020), pp. 1821-1830

A REVIEW ON DEVELOPMENT OF 3D ADVENTUROUS SERIOUS GAME: THE SEASONAL RUN

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Abstract

Gaming industry is a boosting phenomenon and the focus of games has grown from entertainment to serious learning. Previously, tremendous amount of games were produced with the focus on adventure, action-adventure, role-play, racing, multiplayer, casual play and many more. However, current trend in gaming world has transformed the action or adventure game to an immersive educational game, which include pedagogical aspect to enable learning process during the play. This paper discusses on the development of three-dimensional (3D) adventurous serious game called Seasonal Run using Unity Game Engine by a group of students. The game was developed based on phases available on the traditional Game Development Life Cycle (GDLC) namely, initiation, pre-production, production, alpha testing and beta testing and finally to release but each development phases has been refined with detailed context to simplify the game production. This guideline method able to produce a wholesome game with interesting features of adventure game such as exciting storyline, fun and realism, unceasing challenge, immediate and useful rewards, target to achieve, re-playability and also include some serious game elements such as engaged learning, knowledge through experience and problem solving skills. After the deployment, a prototype framework was developed to differentiate educational and entertainment module.

Keywords— *Adventure game, Serious game, Game Development Life Cycle (GDLC).*

I. INTRODUCTION

Gaming industry is rapid growing field in 21st century (Krotoski, (2004). Game is vastly used in many applications because it enhance experiences (Luimula & Trygg, 2016) and provide high degree of re-playability (Medendorp & Semwal, 2018). Traditional games were took over by computer games (Connolly et al., 2012) as a leisure activity among teenagers (Aleem et al., 2016) within 40 years of period. Everyone plays game since computer games are played globally in various languages (Ahmad et al., 2014). Many reports specify that playing digital games promotes aggressive thoughts, physiological arousal (Anderson, 2010), inappropriate time management (Ogletree & Drake, 2007), addiction (Griffiths & Davies, 2002) loneliness and anti-social (Merhi et al., 2007) especially when playing violent entertainment. Conversely, (Subrahmanyam & Greenfield, 1994) state that digital games also can develop valuable skills and provides an attractive and beneficial approach on learning if it is emphasise in positive way (Connolly et al., 2012). Hence, it is crucial to focus on educational entertainment games rather than violence-based entertainment games. Nowadays, games assimilated into education to establish a pioneering educational prototype (Tan et al., 2007). The process of calibrating educational element in an entertainment construct a new term called edutainment game (Muda & Basiron, 2005) widely known as serious game (Perez-Colado et al., 2017).

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II. SERIOUS GAME CONCEPT AND APPROACH

Serious games are games that implanted pedagogical and entertainment aspects equally in digital games (Ahmad et al., 2014). A great extend emphasis on pedagogical element will lead to a course material which has very minimal engagement, whereas too little emphasis on pedagogy will lead to full entertainment with controlled learning (Perez-Colado et al., 2017). Thus, serious games should include both education and entertainment aspects to enhance the learning process through gaming (Ahmad et al., 2014). Therefore, development process of serious game is not only in the hands of developer and designers but also incorporate with educators, pedagogues, psychologist and also students (Ávila-Pesántez, 2017). A serious game design process must include a number of processes before it make up to be a complete game. The process includes storyboarding, analysis, design, animation refinement, video production, scenarios, sound, technological and functional requirement, programming, testing and evaluation (Aleem et al., 2016). Serious game convey the learning message efficiently since it provides immersive learning experiences through the game play (Avila-Pesántez et al., 2017). Educational games generally drives motivation (Papadimitriou & Virvou, 2018), (Amani & Yuly, 2019) of a player to learn and adapt with the message given in the game very easily. When serious game elements embedded in the adventurous game, the learning process becomes very fast and efficient.

III. INSIGHT TO ADVENTURE GAMES

Adventure game is a type of video game in the form of exploration or puzzle-solving to proceed to next level where the player plays the role of hero or leading character to complete the mission of the game (Papadimitriou & Virvou, 2018). Adventure games are the type of games that have powerful narration (Dickey, 2006), (Lin et al., 2018). Adventure games are designed for single player since the primary focus of the genre is the story and the character. Adventure game is very popular entertainment among all the children, youth and even adults. The evolution of adventure game starts in the year of 1970s to date from simple two dimensional (2D) to a challenging three dimensional (3D), afterwards to Augmented Reality and Virtual adventure games (Luimula & Trygg, 2016). Evolution of technology and the appealing game presentation are the prime factors for many youngsters to play the adventure games nowadays. Every day the release of adventure games in the google play or online platform keep rising (Muda & Basiron, 2005).

IV. OBJECTIVE AND SCOPE

The objective of this study is to provide an expanded genre of Game Development Life Cycle (GDLC) model with detail description to ease the development of 3D adventurous game from the scratch. Thus, to provide a framework model of game prototype to differentiate learning and entertainment module in the game. Further, the new GDLC would help other game developers to follow as guideline to create or develop a game and also include a framework model to clearly see the edutainment approach to make the learning fun, alive and active. The framework model is design in assisting children learning season from five (5) years to twelve (12) years old in the communication medium is in English.

V. DEVELOPMENT METHODOLOGY

The development methodology for this research paper has been divided into four sections. First section discusses about the summary of Seasonal Run game. Generally, this section discusses on the background setting of the game, role-playing character, the mission of the game, intended user and the objective of the game. Second section talks about the conceptual model used to develop Seasonal Run game. This section gives a very brief detail about each phases in a modified GDLC and how it is used to develop Seasonal Run game. Third part is about a framework model which was developed to show the interconnections between menu, learning and knowledge modules of Seasonal Run game. The final section is speaking about prototype interface and design. This section discusses on the timeframe to complete Seasonal Run game, includes few examples of interface design and motivating factors for the re-playability of the game.

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A. Overview of Seasonal Run

Seasonal Run is an educational adventure game which is also considered as adventurous serious game created by students of Metro Polytechnic Kuala Lumpur, Malaysia. Seasonal Run focuses on the people who loves exploration. Basically, this game is about a boy, Rudy who explores four seasons on earth in his dream. The world season includes summer, winter, autumn and spring. He learns about four seasons on earth in his school. After coming back from school he brought his learning mind to bed and dreamt about four seasons he have learnt in school. He really wants to experience all the four seasons on earth and would like to enjoy his stay in all the four seasons. Hence this game is about Rudy's dream where he explore and have entertainment in all these four seasons as well as get knowledge all through his exploration.

So the player cast the role of Rudy in this game. The player needs to unlock all the levels in order to help Rudy to get out from his dream. There are four levels in this game from level 1 up to level 4. All the levels give various seasonal experiences with different obstacles at each level. Rudy's mission in this game is to complete his exploration in all the four seasons by collecting items along the path based on instructions. Once he complete each level, he will be awarded badges based on the finishing time. Besides that, this game has embedded educational values, where at the end of each level the player will get exposure about the suitable attires to wear during the particular seasons.

Basically this game is an educational game to give early exposure for the pre-school kids regarding four seasons and the suitable attires to wear throughout the four seasons. There are four levels or modules in this game. Module 1 is about spring, module 2 is about summer, module 3 is about autumn and the final module is about winter. After each mission the kids or the player will have a short quiz before proceed to next module. In each module the player need to collect the attires to wear during particular season. Once complete with the module, the player need to recall the attires during gameplay to answer a short quiz. If the player manage to pick all the related attire then the character will appeal to the player with the same attire he collected as in Figure 1. A selection on the right answer in the quiz will unlock their play for the next level.

Figure 1: Character appeal in various seasons

The objective of this game is to create an exploratory game that implement all the four seasons on earth to teach various seasons, to promote educational values in adventurous game for the children, to entertain the children with fun learning and to develop an adventurous game which is playable without boring feeling.

B. Conceptual Model

Seasonal Run was successfully implemented with the guidance of a conceptual model which arise from existing Game Development Life Cycle (GDLC) model. Some modifications has been done based on the need of edutainment digital game. In this model there are six phases namely, initiation, pre-production, production, alpha testing, beta testing, and final release (Ramadan & Widyani, 2013), (Amani & Yuly, 2019) as shown in Figure 2 to complete the production of game. Students of Metro Polytechnic Kuala Lumpur, Malaysia use this conceptual model to complete Seasonal Run game.

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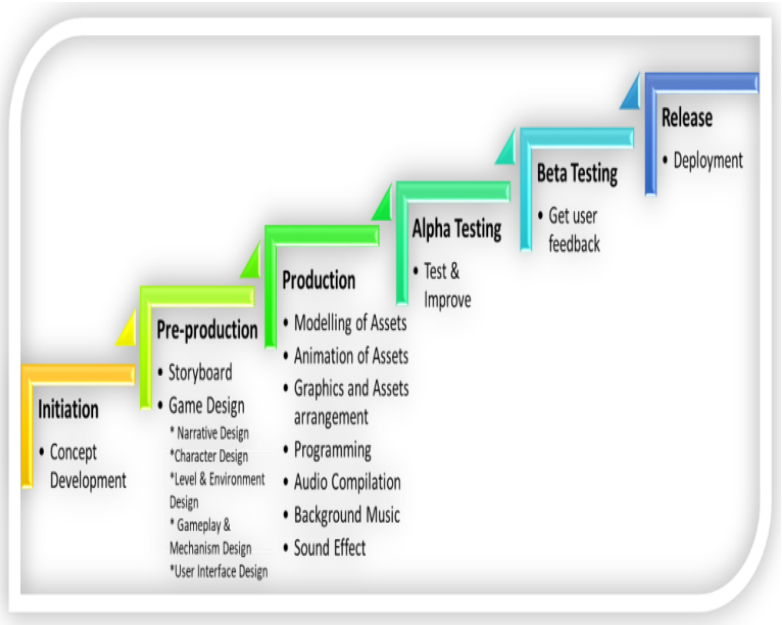

Figure 2: Modified Game Development Life Cycle (GDLC) model

1. Initiation

The production of Seasonal Run starts with the minute concept. Metro Polytechnic Kuala Lumpur, Malaysia students are still considered as freshman in exploring games. Creating 3D games from the scratch is not an easy task. After the brainstorming session, students come up with a concept of creating an adventurous game. Students' primary motive is to produce an exploratory adventurous game. Yet, a game for the solitary purpose of entertainment is not going to benefit the player or mankind. Thus, students implanted a concept of education in the adventurous game.

They picked a small topic from pre-school syllabus where kids learn different seasons on earth. Students of Polytechnic Metro Kuala Lumpur, Malaysia think of it as a good idea and took the challenge to create a concept to introduce seasons for the pre-school students in the form of game to give early exposure about four different seasons exists on earth since Malaysia only experience two monsoon seasons, namely Northeast Monsoon and Southwest Monsoon. Automatically, they have set their target players to pre-school students. Yet, this game do not restrict others from playing this game. While thinking of how to connect the idea of seasons they come up with an idea of introducing attires that links particular season, and thence organize their script to bring a beautiful game flow.

2. Pre-Production

Next step is, pre-production. This is an important stage in game development. Pre-production is the first and foremost step of production phase and the initial seed for the final output of a game. Pre-production works on defining production pipeline. During pre-production phase students identify and gather sufficient amount of information, tools and software required to develop a game. Then, jobs were segregated among members such as making storyboard and designing game. Storyboarding is a sequence of sketches of game scenes with appropriate camera view types and descriptions about every scene. Basically, the storyboard tells us the story of a game in the form of drawing. Figure 3 shows the storyboard of Seasonal Run.

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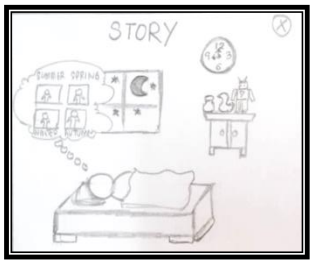
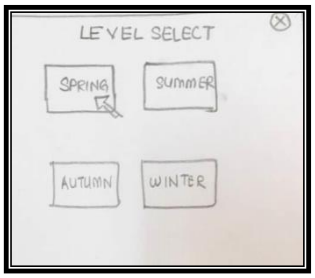
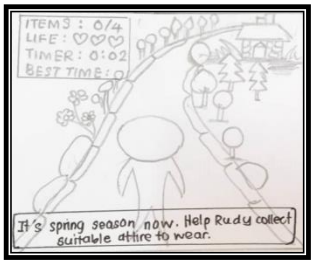
	
Scene: 1 **Camera type:** Fixed camera system **Description:** Interface of game to provide options to play or exit.	**Scene:** 2 **Camera type:** Fixed Camera System **Description**: Rudy is dreaming of exploring all the four seasons while sleeping on the bed in his room at night.
	
Scene: 3 **Camera type:** Fixed Camera System **Description:** Displaying all four seasons as image type. First level is active and the rest are locked till mission is complete in first level.	**Scene:** 4 **Camera type:** Tracking camera system **Description:** Along this scene, character will run and collect the items along his path. Camera will follow the character's movement.

Figure 3: Some Storyboard design for Seasonal Run

However, game design is the mould for final output of a game. It has five primary elements to be measured before proceed to production phase. Game design elements involves narrative design, character design, level or environment design, gameplay and mechanic design and also user interface design (Ramadan & Widyani, 2013). During narrative design, the game plot and the mission of the game will be delineated. Once the plot is outlined, the next step is to design characters that play a role in the game. There are two types of characters when comes to gaming world, main character(s) and non-player character(s) or also known as computer-controlled character(s). The developer should sketch both player and non-player characters during character design. Once the plot is ready with characters, the subsequent step will be level and environment design. During this phase, the developer will decide suitable background for each scene, amount of lighting requires to create dynamic environment, perfect camera angle, appropriate weather for particular level and prop needed in each level. Next is the gameplay and mechanics design.

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While designing game mechanics, significant things such as challenge in the game, activity for the player, rewards for every successful attempt, game progression in level increment, game rules to be followed and the required skills to win the game will be outlined to make the gameplay durable. The last thing to consider in game design is user interface design. During interface design the developer has to take into consideration on the control of input keys. Input keys varies for different platforms, for instance, console uses controller, mobile uses touch, computer uses mouse or keyboard input and virtual reality applications uses headset. Apart from that, output devices to view the game should also have to define in the design phase. The last one is viewpoint. In user interface design it is important to state the game view whether it is perspective, side view or top view. All sort of designs mentioned above should be documented systematically in Game Development Document (GDD) at the end of pre-production phase for further revision.

Seasonal Run has undergone all these game designs before enters production phase. Game setting has been set to four different seasons with the mission of collecting suitable attire to wear during particular season. Main character in the game is Rudy, a small boy whereas there are some non-player characters which moves back-and-forth to restrict Rudy from moving forward along his path. The user interface of Seasonal Run is set with a perspective view and intent to deploy in personal computer which accepts keyboard and mouse input. This game also has rules to follow, challenges to move to next level, rewards after completion of a level and many more.

3. Production

Next step is production. Production phase uses the GDD which was developed during pre-production to transform the game designs to realism. Modelling of characters and assets, making animation of assets, graphics arrangements, physics simulation, scenes development, programming or implementation, audio-compilation, background music, sound effect and interactivity is done during this production phase.

Modelling of game objects for Seasonal Run was done in Autodesk Maya. Game objects are fundamental elements which create entire game (Raguman et al., 2019). The main character, Rudy was initially sketched and developed using Autodesk Maya. Then texturing has been done for the Rudy character using Adobe Photoshop as shown in Figure 4. Environment for each scene also developed using Autodesk Maya and Unity Game Engine was used to create some terrain functions like trees and hills as shown in Figure 5. The character and entire environment was developed using low poly model to reduce rendering time and to make the game less computational-intensive.

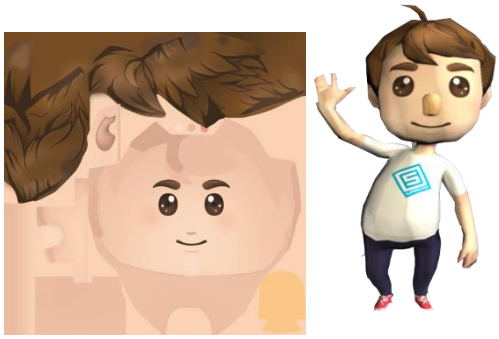

Figure 4: Texture and prototype of Rudy character

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Figure 5: Low poly assets and obstacles used in Seasonal Run scenes

Then, the arrangement of assets is done in Unity Game Engine according to the camera view. Barriers and colliders were applied to the environments to prevent the character passing through the assets. Then, the level design which involves various seasonal environment was set up. Separate scenes were developed for each season, spring has a greenery effect with many colourful flowers, summer is about sunny days, autumn season shows fall of flowers and the last phase is winter to show the cold weather. In each season, player will collect suitable attires for the particular season. Indication panel is given to show the number of items to collect in the particular scene, number of lives left to complete the level, player's completion time and the best time from total number of play. After exploring each level scene, the player have to take a quiz to answer and the achievement will be rewarded with stars. The stars visibility is based on the number of collectable items within a particular timing. Programming has been applied to activate the game mechanics and to make interaction between game assets as well as to combine all game assets according to game need. Finally, the individual scenes rendered with suitable background music. The production phase takes a long process to make as a complete game with all game mechanics working.

4. Testing

After the production, the game will go for alpha testing for quality assurance. During this phase, the game will be tested at developer's site where it involves in-house developers, quality assurance team and customers. Alpha testing is done to check for defects, bugs, deficiencies, errors and incompatibilities. If the primary customer is unsatisfied with the product, the product will undergo the pre-production stage again to revamp the unsatisfactory elements in the game. Then, the game will reiterate production phase to make it complete and perfect for beta testing and thereafter to release to the public. Seasonal Run was tested among few pre-school teachers and also development team. Some improvement were made such as changing background music for the game and reconnecting the finishing storyline with initial storyline. Changes were made at the end of the alpha testing.

5. Beta

Second revision or known as beta testing is conducted by the group of real end users after the alpha testing to get end user's feedback and ensure readiness of product for the release. During this phase ideas will be thrown to enhance usability, compatibility and functionality.

6. Release

After undergoing all the testing phases, now it is time to release the game. A complete game is sent to the publisher to launch and sell in the market to get revenue. Presently, gaming is used in classrooms to convey contents (Kafai et al., 2016) to students in an effective way to improve their intellectuality (Muda, 2006). Seasonal Run was sold to the pre-school teachers as their teaching-kit to demonstrate the season topic at school.

C. Framework Model

After Seasonal Run has been deployed, a framework model was designed to show overall flow of Seasonal Run game as shown in Figure 6. The framework model has been categorized into three major components (Muda et al., 2004) called Human Computer Interaction (HCI), Learning Module and Knowledge-Based. HCI represented by menu component, Learning Module as learning and Knowledge-Based as record. Menu module contains the functional keys to play, game information

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and exit. Learning module starts with the story of the Seasonal Run. Later, the story leads to game scenes and quizzes after every gameplay scene and finally to end story. Record module holds the score of the player, achievement and best time for the each scene in the game. All the modules are interrelated to one another.

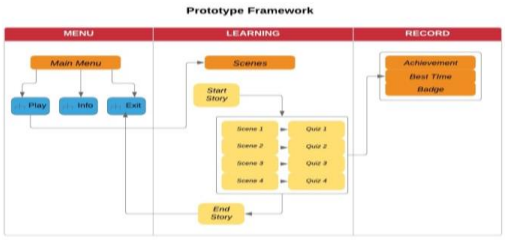

Figure 6: Framework Model of Seasonal Run

Figure 7: Sample of interface designs of Seasonal Run game

D. Prototype interface and design

The prototype design of Seasonal Run approximately devour a month to complete. Fig 7 shows the examples of Seasonal Run interface design in various seasons. All scenes are installed with lively 3D assets and vibrant graphics, catchy audios and fantastic animations. Various triggering functions with suitable sound effect also applied to handle interactivity when the character hit with obstacles and pick up the collectable items. Clear display of total lives, indication of items collected for the entire scene, well-noticeable text, simple key usage to move the character along the scene, coherent flow of story, refreshing quiz after every gameplay are truly some motivating factors for the player to drive their interest to play the game repeatedly.

VI. CONCLUSION AND RECOMMENDATION

In conclusion, this paper gives a review on the production of adventurous serious game, Seasonal Run from the scratch by using a conceptual model which is derived from GDLC model with six phases called initiation, pre-production, production, alpha-testing, beta-testing and release. The designed conceptual model is believed to produce a beneficial end products to the end users. Successful implementation of Seasonal Run game using the conceptual model verifies this statement. We recommend the usage of this conceptual model in the future as a reference to produce more adventurous serious games to produce valuable end product to the mankind. A recommendation is also given to deploy the end product, Seasonal Run game in Virtual Reality platform to give real time experience in various seasons. In addition, Seasonal Run can outspread the scope to learn the countries experiencing particular season by bringing alive the real environment to give real-time experience for the end users.

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