CHAPTER 2

THEORITICAL FOUNDATION

2.1   Basic Terminology

Portable video game console is a lightweight, portable electronic device with a built-in screen, games controls and speakers [4]. They are entirely portable, self-contained, battery-operated devices with their own small screens The most popular portable video game console are iPod touch, NDS (Nintendo Dual Screen), and PSP (Play Station Portable).

In contrast to computer-based or game console-based games, handheld games are run on machines with small machine size. It allows people to carry along anywhere and play around with it at any time when they are free. Generally, such machines can be referred to dedicated handheld game consoles, personal digital assistants (PDAs) or mobile phones. Due to the hardware limitation, such game devices are often suffered from small in screen size and limited in processing power and storage space, as well as the problem of short battery life. These problems do not only impose difficulties to handheld game development, they also make some people reluctant to play handheld games. Fortunately, these shortcomings have been addressing or have ways to workaround during recent years.

The first handheld game console is *Tic Tac Toe*, which was made in 1972[5]. *Similar* to most of the early handheld game consoles, it came with one hard-coded game only. This limitation had been lasting until 1979, when the first handheld game console with changeable cartridges, *Microvision*, was developed. In general, as handheld game consoles at that period were suffered from the problems of small in screen size and limited in battery life, handheld games had not received a truly great success. Until the release of Game Boy in 1989, which came with a monochrome display with improved resolution, used re-chargeable batteries and had a long list of game cartridges for game players to pick and play, handheld games became to attract significant amount of game players. More importantly, Game Boy virtually set the

"design standard" for today's game consoles. In addition, 5 in 1998, the color display version of Game Boy was released to further improve the attractiveness of handheld game consoles.

Nevertheless, up till the release of Game Boy and its color display version, as the processing power of the handheld game consoles was still quite limited, most of the games developed for the handheld game consoles were still essentially 2D games. Starting from 2000, there is a dramatic development in handheld game consoles, particularly in terms of computation and graphics processing power. In light of this improvement, 3D games had been engaged to these devices, an example of this was in Game Boy Advance. On the other hand, useful accessories, such as network connections, external memory storages and new types of input devices were added to the game consoles. Regarding to the network capability, examples could be found in Nokia N-Gage and Nintendo DS. This made multiplayer online games be possibly supported. To extend the storage capacity, Sony had made use of UMD disks and Memory Stick Duo as a media to extend the amount of storage of its newest handheld game console, Sony PSP. For input device, Nintendo DS adopted a touch screen approach, where game players could use stylus or even the player's finger as an input method to control the games objects.

2.1.1   Male and Female Interest in Game

A recent study conducted by the Entertainment Software Association found that women constitute 40% of the total gamer population, and this number is sure to increase over time. [6]. Although there are numerous stereotypes regarding the typical female gamer, female gamers take interest in a wide variety of games ranging from the more "masculine" shooters to strategy games, casual games, and puzzles.

Overall, girls and boys play with different kinds of games in early childhood that provide different types of learning experiences. Most girls play games that emphasize relationships (i.e., playing house, playing with dolls) or creativity (i.e., drawing, painting). In contrast, boys play computer and video games or games that

emphasize building (i.e., LEGO®), both of which develop problem-solving, spatial-relationship and hands-on skills[7].

2.2 IPod Touch

2.2.1 History

The first time iPod is invented, it is a music player. In 2000, digital music players were either big and clunky or small and useless with equally terrible user interfaces. Apple, the developer of iPod, saw the opportunity and announced the release of the iPod, their first portable music player on October 23, 2001.

At first, the reactions were confused and hostile; critics lambasted the $400 price tag, the unconventional scroll wheel and the lack of Windows compatibility. Despite all this, the iPod sold beyond everyone's expectations, went on to revolutionize the entire music industry, and the rest is history.

In 2002, Apple launched the second generation of iPod. The iPod second generation used the same body style as the first generation, the hold switch was redesigned, a cover was added to the FireWire port, and the mechanical wheel was replaced with a touch-sensitive wheel. The front plate also had rounded corners and edges. The other improvement is also from the memory capacity, from 5-10 GB become 10-20 GB.

In 2003, the iPod third generation was invented and launched to the market. The model of this iPod was thinner than the previous model. The models replaced the fire wire port with a new Dock Connector and introduced the Touch Wheel, a completely non-mechanical interface with the four auxiliary buttons located in a row between the screen and the touch wheel. The front plate had rounded edges; the rear casing was slightly rounded as well. A new wired remote connector was introduced. Whereas first and second generation classics had an auxiliary ring around the headphone port for the remote, the third generation classic had a 4-pin jack adjacent to the headphone port. The memory capacity is 10-40GB and the battery life is 8 hours.

In 2004, Apple released iPod fourth generation, iPod photo, and iPod Mini First Generation. The fourth generation iPod classic replaced the touch wheel from the third generation with the Click Wheel from the iPod mini. The casing was also slightly slimmer. The battery life for audio is up to 12 hours.

The iPod photo featured a 220 x 176 pixel LCD capable of displaying up to 65,536 colors. The photo supported JPEG, BMP, GIF, TIFF, and PNG graphic file format and can be attached to a television or other external display for slide show. The capacity is 30-60GB with the audio life up to 15hours.

iPod mini first generation only has 4GB memory capacity with battery life for audio up to 8hours. This first generation was available in five colors: silver, gold, pink, blue, and green.

In 2005, iPod fifth generation, iPod Nano First Generation, iPod Mini second generation, and iPod Shuffle first generation were released. iPod fifth generation classic, known as the iPod video, featured a 2.5" 320x240 QVGA screen and smaller click wheel. The memory capacity is 30-80GB.

iPod Nano first generation only has memory capacity 1-4GB and battery life for audio 14hours. The development work on the design of the iPod nano started only nine months before its launched date.

The second generation of iPod mini no longer came with a FireWire cable or an AC Power adapter, which were left out to reduce the selling prices of the new iPod mini.

iPod shuffle first generation has smaller memory capacity than the other kind of iPods. The memory capacity is only 0.5 – 1GB. There is no screen. This first generation iPod shuffle was designed to be easily loaded with a selection of songs and to play them in random order.

In 2006, Apple launched iPod nano second generation and iPod shuffle second generation. This second-generation nano features scratch-resistant, anodized aluminum casing like the earlier mini's design. The battery life for audio is 24 hours.

The second generation model of iPod shuffle is less than half the size of the first generation model. Apple branded it as the "world's smallest MP3 player". This size includes the new built – in belt clip. The entire weight is only 15.5gr.

In 2007, iPod sixth generation, iPod nano third generation and iPod touch first generation was released. iPod sixth generation is the latest in the iPod range. It features a slightly thinner body and improved battery life. The sixth generation classic also introduced a completely overhauled user interface, incorporating more graphics and cover flow.

iPod nano third generation features a 2-inch QVGA (320x240) screen and a shorter, wider, heavier design, with new colors. New features include browsing via cover flow, a new user interface, video playback, and support for new iPod games.

iPod touch first generation was launches on September 5th, 2007. The iPod touch has the iPhone's multi-touch interface, with a physical home button off the touch screen. The home screen has a list of buttons for the available applications which include Music, Videos, Photos, Games, iTunes, Safari, YouTube, Mail, Maps, and widgets but it lacks of built in microphone.

In 2008, Apple released iPod touch second generation, iPod nano fourth generation, and iPod 6.5 generation. iPod touch second generation has the same model as the first generation but it features a thinner design. New additions include a volume button and inbuilt speaker.

iPod nano fourth generation is the thinnest iPod ever comes with rounded edges and 9 amazing colors. The new Nano integrates 'genius' playlist creation and includes accelerometer allowing you to turn the screen from vertical to horizontal. Shaking the new nano plays a random song.

In 2009, the products that Apple released are iPod touch 3rd generation, iPod shuffle third and fourth generation (launched in same year), and iPod nano fifth generation. The iPod touch third generation features a faster processor, optional higher capacity and support for

Open GL. This iPod touch is marketed as a gaming platform to rival the PSP and Nintendo DS. It released on September 10, 2009.

The third generation iPod shuffle controls are on the remote control in a similar way to the iPhone/iPod touch. One of the new features of the Shuffle is voice over, this makes it easier to navigate your shuffle as songs, artist and play list are read out through your headphones. Voice over is available in 14 different languages. iPod shuffle fourth generation is a little bit same with the third generation except some feature updated voice control, a clip and new colors.

iPod Nano fifth generation features slightly larger screen, a built in camera for taking photos and recording video, and integrated FM radio, a built pedometer (for Nike + iPod) and comes in 9 colors.

In 2010, Apple released iPod touch fourth generation and iPod nano sixth generation.. iPod touch fourth generation was launched to market on September 8, 2010. It featuring a retina display, face time video chat via wifi and HD video recording. The 4g iPod touch has a built in vibrating motor specifically for face time video chat alerts.

2.2.2 Specification

Technical aspects	iPod touch 1st Generation	iPod touch 2nd Generation	iPod touch 3rd Generation	iPod touch 4th Generation
Connectivity	Wi-Fi 802.11 b/g USB 2.0/Dock connector	Wi-Fi 802.11 b/g USB 2.0/Dock connector	Wi-Fi 802.11 b/g USB 2.0/Dock connector Bluetooth 2.1	Wi-Fi 802.11 b/g USB 2.0/Dock connector Bluetooth 2.1
Memory	128 MB DRAM	128 MB DRAM	256 MB DRAM	256 MB DRAM

Technical aspects	iPod touch 1st Generation	iPod touch 2nd Generation	iPod touch 3rd Generation	iPod touch 4th Generation
Power	3.7 V rechargeable Lithium-ion battery	2.92 Wh, 789 mAh; Audio - 36 hours, Video - 6 hours	2.92 Wh, 789 mAh;[1] Audio - 30 hours, Video - 6 hours	3.44 Wh, 930 mAh; Audio - 40 hours, Video - 7 hours
Operating system	3.1.3 (1.1 originally)	4.2.1 (2.1.1 originally)	4.3 (3.1.1 originally)	4.3 (4.1 originally)
Central Processing Unit	ARM11 620 MHz (under clocked to 400 MHz, then 412 MHz)	ARM11 620 MHz (underclocked to 533 MHz),[4] without internal ARM7 core for Jazelle acceleration	ARM Cortex-A8 833 MHz (underclocked to 600 MHz)	ARM Cortex-A8 Apple A41 GHz (underclocked to 800 MHz)
Graphics	PowerVR MBX Lite	PowerVR MBX Lite	PowerVR SGX	PowerVR SGX
Display	3.5 in (89 mm), 3:2 aspect ratio, 18-bit color depth LCD, 480×320 px at 163 ppi	3.5 in (89 mm), 3:2 aspect ratio, 18-bit color depth LCD, 480×320 px at 163 ppi	3.5 in (89 mm), 3:2 aspect ratio, 18-bit color depth LCD, 480×320 px at 163 ppi	3.5 in (89 mm), 3:2 aspect ratio, 24-bit color depth, aluminosilicate glass-covered LED-backlit LCD, 960×640 px at 326 ppi
Camera	not available	not available	not available	0.7MP fixed-focus camera with HD video

Technical aspects	iPod touch 1st Generation	iPod touch 2nd Generation	iPod touch 3rd Generation	iPod touch 4th Generation
				capture (720p at 30fps) with 960 x 720 resolution still images
Dimension	4.3 in (110 mm) × 2.4 in (61 mm) × 0.31 in (7.9 mm) (H×W×D)	4.3 in (110 mm) × 2.4 in (61 mm) × 0.33 in (8.4 mm) (H×W×D)	4.3 in (110 mm) × 2.4 in (61 mm) × 0.33 in (8.4 mm) (H×W×D)	4.4 in (110 mm) × 2.3 in (58 mm) × 0.28 in (7.1 mm) (H×W×D)
Weight	120 g (4.2 oz)	115 g (4.1 oz)	115 g (4.1 oz)	101 g (3.6 oz)

Table 2.1 iPod Touch specification

2.2.3 Technology

- Retina Displays

Everything you see and do on iPod touch looks amazing. That's because the Retina display's pixel density is so high your eye is unable to distinguish individual pixels. Which means images in games, movies, and photos pop off the screen. Text in books, web pages, and email is crisp at any size. And everything is sharper. No wonder it's called "cutting edge."

Behind the screen of iPod touch, there's some serious technology going on. By developing pixels a mere 78 micrometers wide, Apple engineers were able to pack four times the number of pixels into the same size screen found on earlier iPod touch models. This many pixels packed this close together — 326 per inch — make graphics and text look smooth and continuous at any size. Prepare to be glued to the screen.

The Retina display includes LED backlighting and an ambient light sensor that automatically adjusts the brightness of the screen for

the best viewing and battery life possible. So you can focus on more important things.

- Apple A4 chip

The Apple A4 chip is behind, or rather underneath, all the fun you can have on iPod touch. Apple engineers designed the A4 chip to be a remarkably powerful yet remarkably power-efficient mobile processor. With it, iPod touch can easily perform complex jobs such as multitasking, editing video, and placing FaceTime calls. All while maximizing battery life. And fun.

- Gyro + Accelerometer. Smooth moves.

iPod touch just learned some new moves. It now includes a built-in three-axis gyroscope. When paired with the accelerometer, the gyro makes iPod touch capable of advanced motion sensing such as user acceleration, full 3D attitude, and rotation rate. Translation: More motion gestures and greater precision for an even better gaming experience.

- Two Cameras.

iPod touch captures video with two built-in cameras. It shoots amazing HD 720p video from the back camera. And with its advanced backside illumination sensor, it captures beautiful footage even in low-light settings. All while the built-in microphone records conversations, music, or any audio at the same time. And on the front of iPod touch, the built-in camera is perfect for making FaceTime calls and shooting self-portraits. It's surprising how much fun can fit into something so small.

2.2.4   Game Variety

This is some popular games that usually played on iPod touch:

- Angry Bird : a puzzle video game developed by Finland-based Rovio Mobile in which players use a slingshot to launch birds at pigs stationed on or within various structures, with the intent of destroying all the pigs on the playfield. Inspired primarily by a sketch of stylized wingless birds, the game was first released for Apple's iOS in December 2009

- Fruit Ninja : Player should swipe their finger across the screen to deliciously slash and splatter fruit like a true ninja warrior. But they need to be careful of the bombs, which are explosive to the touch and will put a swift end to your juicy adventure!

- Tap-tap revenge: Tap Tap Revenge throws a series of dots and arrows at you based on the beat of the song that you must tap or shake.

- Need for Speed : Need for Speed Shift from EA Sports brings the exciting world of NFS to your Apple handheld[8]. It is a racing game. They did a great job of encapsulating a 3D feel, combined with using accelerometer based controls to create the feeling that player are driving a car.

2.3   PSP (Portable Sony Playstation)

2.3.1   History

June 2003 A Sony PlayStation handheld is announced and described CEO Ken Kutaragi as the "Walkman of the 21st Century". There are no images, mock ups or models but the technical specifications are discussed.

November 2003 The first concept drawings of the device are discussed at a Sony meeting which include flat buttons and no analogue stick.

May 2004 The PlayStation Portable is unveiled at a press conference just before E3 and is the first handheld device to use optical disks - the UMD.

June 2004 The PSP is on show at E3 along with the games Metal Gear Acid and Wipeout Pure.

October 2004 The PSP is officially launched with the worldwide release dates.

December 2004 PSP launches in Japan on 17th October for ¥19,800 for the basic model and ¥24,800 for the value version. It sells 200,000 units on the first day.

March 2005 PSP launches in North America for $249, approximately $20 more than the Japanese price and $100 more than its recently launched competitor - the Nintendo DS. 500,000 PSPs are sold in the first two days but there are later suspicions that the first weeks do not reap quite the figures that Sony had hoped for.

June 2005 Hackers release the PSP code and distribute it online. As a result the ISO loader is created crammed full of pirated games and is thought to be responsible for the rise in sales of the PSP but the drop in retail of the games.

September 2005 PSP launched in the UK for £179 - at the time over $100 more than the US price. Sony say this is because of high VAT pushing it up in the UK and the need to compensate for local sales taxes in the US. All 185,000 units sell out in the first three hours doubling the DS's record on launch.

March 2007 The PSP totals 25.39 million units shipped worldwide.

June 2007 The next generation of Sony's gaming handheld is announced as the 33% lighter, 19% thinner PSP-2000 and is the first of the Slim and Light series. It supports USB charging, has a composite TV-out and twice the RAM taking the memory up to a healthy 64MB. The screen is brighter and the UMD speedier to load.

September 2007 PSP-2000 goes on sale worldwide.

August 2008, An update of the PSP-2000 is shown off at a press conference in Leipzig. The PSP-3000 is ostensibly identical to its predecessor but features an improved LCD screen with a better contrast, color gamut, a faster response time and an anti-reflective coating.

October 2008 The PSP-3000 goes on sale worldwide.

January 2009 Built-in Skype service is added though a firmware update as Sony announces that 50 million PSPs have been sold to retailers worldwide

May 2009 After much internet speculation, the PSP Go is revealed in June's issue of Qore online

June 2009 PSP Go officially launched at E3 with Bluetooth, a smaller 3.8-inch screen and at 43% lighter than the original PSP. The UMB has vanished and instead is replaced by 16GB of internal flash memory for digital downloads plus a Memory Stick Mirco port. The release dates are revealed as the 1st October for North America and Europe, and 1st November for Japan. August 2009 56 million PSP units reported sold worldwide.

September 2009 PSP service called the PlayStation Room is announced where users will be able to host real time communications inviting people in to their "rooms" much like the PlayStation Home service on the PS3. A closed beta test is to take place in Japan only on 24th September - 5th October.

2.3.2 Specification

Technical aspects	PSP-1000	PSP-2000	PSP-3000	PSP go 1000
Connectivity	802.11b Wi-Fi, IRDA USB 2.0, UMD, Serial Port, Headphone Jack	802.11b Wi-Fi, IRDA USB 2.0, UMD, Video Out Mic Port Headphone Jack	802.11b Wi-Fi, IRDA USB 2.0, UMD, Video Out Microphone Headphone Jack	802.11b Wi-Fi Bluetooth 2.0 + EDR All in One Port Headphone Jack, Mic

Technical aspects	PSP-1000	PSP-2000	PSP-3000	PSP go 1000
	Memory Stick PRO Duo	Memory Stick PRO Duo	Memory Stick PRO Duo	Memory Stick Micro
Memory	32 MB	64 MB	64 MB	64 MB
Power	5v DC 1800 mAh, Upgradeable to 2200 mAh	5v DC 1200 mAh, Upgradeable to 2200 mAh	5v DC 1200 mAh, Upgradeable to 2200 mAh	5v DC Non Removable Battery
Operating system	1.00	3.60	4.20	5.70
Central Processing Unit	MIPS R4000 at 1~333 MHz	MIPS R4000 at 1~333 MHz	MIPS R4000 at 1~333 MHz	MIPS R4000 at 1~333 MHz
Display	480 × 272 pixels with 16.8 million colors, 16:9 widescreen TFT LCD, 3.8 in (97 mm) (PSP GO), 4.3 in (110 mm)	480 × 272 pixels with 16.8 million colors, 16:9 widescreen TFT LCD, 3.8 in (97 mm) (PSP GO), 4.3 in (110 mm)	480 × 272 pixels with 16.8 million colors, 16:9 widescreen TFT LCD, 3.8 in (97 mm) (PSP GO), 4.3 in (110 mm)	480 × 272 pixels with 16.8 million colors, 16:9 widescreen TFT LCD, 3.8 in (97 mm) (PSP GO), 4.3 in (110 mm)
Camera	not available	not available	not available	not available
Dimension	74 mm (2.9 in) (h)170 mm (6.7 in) (w)23 mm (0.91 in) (d)	71 mm (2.8 in) (h) 169 mm (6.7 in) (w) 19 mm (0.75 in) (d)	71 mm (2.8 in) (h) 169 mm (6.7 in) (w) 19 mm (0.75 in) (d)	69 mm (2.7 in) (h) 128 mm (5.0 in) (w)16.5 mm (0.65 in) (d)

Technical aspects	PSP-1000	PSP-2000	PSP-3000	PSP go 1000
Weight	280 grams (9.9 oz)	189 grams (6.7 oz)	189 grams (6.7 oz)	158 grams (5.6 oz)

Figure 2.2 PSP Specifications

Figure 2.1 Image Comparison of color reproduction of PSP LCD

2.3.3 Technology

- Wide Gamut RGB color space

Wide Gamut RGB color space is an RGB color space developed by Adobe Systems, that offers a large gamut by using pure spectral primary colors[10]. It is able to store a wider range of color values than sRGB or Adobe RGB color spaces. As a comparison, the Wide Gamut RGB color space encompasses 77.6% of the visible colors specified by the Lab color space, whilst the standard Adobe RGB color space covers just 50.6% and sRGB covers only 35.0%. It provides more natural and vibrant displays.

-Anti Reflection

Anti- reflection technology enables you to see the screen more clearly in well-lit places, even when used outdoors. This technology decreases the reflection from sun light that cause the picture hardly to be captured by eyes.

-UMD

UMD stands for Universal Media Disc. UMD is an optical disc format developed by Sony for its portable game console, PSP (as in Play Station Portable) that was released in 2004[11]. UMD discs hold appx. 1.8GB of data and currently are used only for PSP games, applications and movies although Sony has announced plans to open up the format for third party companies as well.

-12 tone analysis technology

There is a growing need for high-quality musical metadata (data characteristics) to support new ways of enjoying music, including advanced music search and recommendation [12] . Conventional manual metadata assignment is costly and can lead to other problems, such as data inconsistency.

Sony has developed a unique 12 Tone Analysis system that automatically extracts a variety of metadata, including beat, chord progression, song structure, genre, instruments and mood, by using signal processing and statistical processing to analyze musical waveforms.

2.3.4   Game Variety

(Grand Theft Auto: Chinatown Wars, Tactics Ogre: Let Us Cling Together, Silent Hill: Shattered Memories, Resistance: Retribution, God of War: Ghost of Sparta)

- Grand Theft Auto: Chinatown Wars

Chinatown Wars casts player as a no-good loner named Huang Lee. With revenge on his mind, the player is launched into a tale of murder, betrayal, drugs, guns, and so much more. There's no behind the back third-person perspective, no voice acting in the cut scenes, and no strive for the most realistic looking game possible. Chinatown Wars is played from an angled top-down perspective, told through some moving art cut scenes[13].

- Tactics Ogre: Let Us Cling Together

Developed by acclaimed Japanese studio Square Enix, Tactics Ogre is a remake of a 1995 fantasy themed turn-based combat strategy game of the same name [14]. Fundamentally, it is not hugely different from chess – put in charge of a band of warriors who each boast distinct defensive, offensive and magical talents, the player must outwit and defeat various squads of rivals.

- Silent Hill: Shattered Memories

The game was first released for PlayStation Portable versions in North America on January 19, 2010[15]. The player is observed and evaluated by the game as they play and their actions will have an effect on multiple aspects of play, including its attendant monsters and characters' attitudes, gender and clothing changing according to the player's choices.

- Resistance: Retribution

Resistance: Retribution follows the story of former British Marine James Grayson. After a personal tragedy -- he is forced to kill his own brother inside a Chimeran conversion center – Grayson goes on a vendetta to destroy every conversion center he can find. Eventually Grayson learns that his efforts have been futile ... in Western Europe the Chimera has evolved a new method of converting humans to aliens. The European resistance -- the Maquis -- enlists Grayson's help, and he joins Cartwright and Parker in Operation Overstrike. The war to retake the European continent has begun.

- God of War: Ghost of Sparta

Set in the realm of Greek mythology, God of War: Ghost of Sparta is a single-player game that allows players to take on the powerful role of Spartan warrior Kratos. This new adventure picks up after God of War concludes, telling the story of Kratos' ascension to power as the God of War. In his quest to rid himself of the nightmares that haunt him, Kratos must embark on a journey that will reveal the origins of lost worlds, and finally answer long-awaited questions about his dark past. Armed with the deadly chained Blades of Chaos, he will have to overcome armies of mythological monsters, legions of undead soldiers, and amazingly dangerous and brutal landscapes throughout his merciless quest.

2.4 NDS (Nintendo Dual Screen)

2.4.1 History

NDS was developed and manufactured by Nintendo Co ltd. It was released in 2005 in North America and 2004 in Japan[16]. The console features a clamshell design, similar to the Game Boy Advance SP, with two LCD screens inside with the bottom one being a touch screen.

The Nintendo DS also features a built-in microphone and supports wireless IEEE 802.11 (Wi-Fi) standards, allowing players to interact with each other within short range (10–30 m, depending on conditions) or online with the Nintendo Wi-Fi Connection service, which launched later in the console's lifespan. The Nintendo DS is the first Nintendo console to be released in North America before Japan.

The system's code name was Nitro, which can be seen in the model number that appears on the unit (NTR-001)[17]. The console's name officially refers to "Developers' System", in reference to developers of new game designs the system was meant to inspire, and "Dual Screen", the system's most obvious and distinct feature [18]

On March 2, 2006, Nintendo released the Nintendo DS Lite, a redesign of the Nintendo DS, in Japan. It was later released in North America, Europe, and Australia in June 2006. The DS Lite is a slimmer, smaller, and lighter version of the Nintendo DS; it also has brighter screens. Nintendo of America refers to the older model as the "original style" Nintendo DS. It is often affectionately referred to by fans as the "DS Phat." [19]

On October 2, 2008, Nintendo announced the Nintendo DSi, another redesign of the Nintendo DS, at the Nintendo Fall Media Summit. It was released in Japan on November 1, 2008. It was later released in North America, Europe, and Australia in April 2009. The DSi's codename has been changed to "TWL" due to it being a substantial hardware upgrade including a faster CPU and more RAM, and requiring new development kits.

As of December 31, 2010, the various models of the Nintendo DS had sold 144.59 million units, making it the best selling handheld game console to date, and second best selling video game console overall, behind the PlayStation 2.

2.4.2 Specification

Technical aspects	Nintendo DS	Nintendo DS lite
Connectivity	802.11b Wi-Fi	802.11b Wi-Fi
Memory	4 MB of RAM	4 MB of RAM
Power	850 mAh (battery capacity), 10 to 14 hours(battery life)	Lithium ion battery delivering from 15 to 19 hours of play on a three-hour charge; power-saving sleep mode; AC adapter.
Central	One 67.028 MHz	Two ARM

Technical aspects	Nintendo DS	Nintendo DS lite
Processing Unit	ARM946E-S and one 33.514 MHz ARM7TDMI	processors, an ARM946E-S main CPU and ARM7TDMI coprocessor at clock speeds of 67 MHz and 33 MHz respectively
Screen Size	3 inches (76 mm)	3 inches (76 mm)
Camera	Not available	Not available
Dimension	148.7×84.7×28.9 mm (5.85×3.33×1.14 in)	133×73.9×21.87 mm (5.2×2.91×0.861 in)
Weight	300 grams (11 oz)	218 grams (7.7 oz)
Stylus	75.0 mm × 4.0 mm	87.5 mm × 4.9 mm

Table 2.3 NDS specification

2.4.3 Technology

- Touch Screen Technology

The lower screen offers something never before provided by any dedicated game device: touch-screen capabilities. You no longer have to rely on just buttons to move your character or shift perspectives. Navigate menus or access inventory items simply by touching the screen with a stylus or fingertip. The possibilities are limited only by developers' imaginations. The touch screen features a tougher film cover for durability, and the included stylus is stored in the back of the unit.

2.3.4 Game Variety

- Pokémon Platinum

Pokémon Platinum starts off by allowing players to select both their gender and name. After a brief introduction, players are asked to

select their starter Pokémon, which in this game are Turtwig, Piplup, and Chimchar. Each of these three Pokémon have their advantages and disadvantages, so regardless of which one you select, you'll still be completing the same basic quest[20].

- Super Mario Kart DS

Mario Kart DS features a number of single-player grand prix competitions that comprise four races each. Mario Kart DS includes a total of eight grand prix competitions for a total of 32 different races, many of which aren't available until you beat those that you can select from the outset [21].

- Broken Sword

Broken Sword is an adventure game series created by game designer Charles Cecil of Revolution Software. The game series revolves around the adventures of Idaho-born George Stobbart and the French Nico Collard in several fictitious stories based on history and mythology. [22]

- Shadow of the Templar

The Shadow of the Templars, known as Circle of Blood in the US, was developed by Charles Cecil of Revolution Software and released for Windows, PlayStation, and Game Boy Advance. This is the first in a series of Broken Sword games, spanning from 1996 to the latest one released in 2006. The Shadow of the Templars is a point-and-click adventure game where the player interacts with the environment to find clues in order to solve puzzles. The game features pre-rendered, animated sequences and a full voice acting cast, with the option of toggling text transcription of game dialogue on and off. A simple mouse interface is used in the Windows version, with context-sensitive cursor changes enabling multiple actions to be performed with a single click. It has also been ported to the Palm OS by Astraware, and to the Wii and Nintendo DS. It was followed by Broken Sword II: The Smoking Mirror. [23]