CHAPTER II

LITERATURE REVIEW

2.1 Book Design

Books defined by Haslam & Andrew (2006, pg. 9), are the oldest media of documentation, storing records of knowledge, events, and ideas all around the world. The origins of the word book derived from the Saxons and Germans known as *'bok*' which means 'a board of writing'. The function of a book according to depends on the content and structure of the book itself, whether it could be educational, entertainment or academic purposes. No matter the function, all books rely on a set of rules and design principles to ensure the reader's comprehension and engagement.

2.1.1 Types of Books

According to Meleen (2024), books can be categorized into two which are nonfiction and fiction, each with their own varying genres.

1. Nonfiction

Books that are nonfiction according to Meleen (2024) work around information that relies on real and factual data. These books contain events that are either accurate or have happened in the past. Such book genre examples are biographies, history, architecture, business, cookbooks, crafts, journals, dictionaries, encyclopedias, science, philosophy, religion, true crime and others.

2. Fiction

Fiction books are made up stories written by the author. Most of the content written in fiction may have hints of non-fiction but have been manipulated, fabricated or changed to create a new narrative. Examples of fiction genres are adventure, action, comics, coming-of-age, fantasy, thriller, drama, fairytale, fantasy, horror, mystery, romance, satire, science fiction, western and many more Meleen (2024).

2.1.2 Book Anatomy

Several components make up a book, which are :

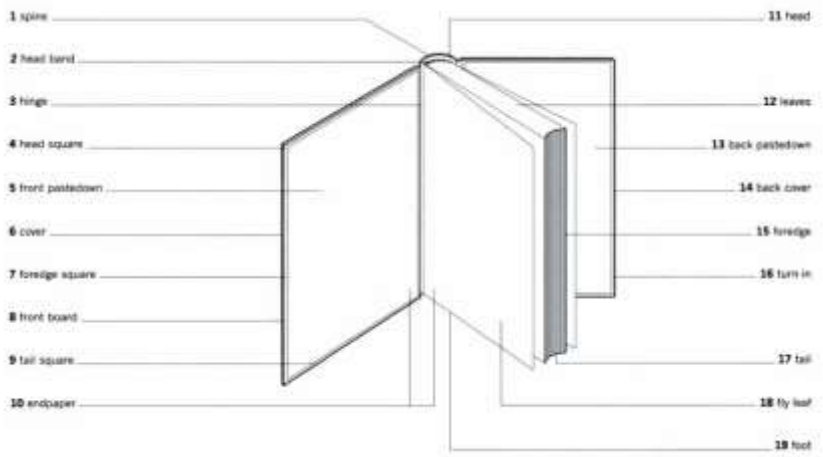

Figure 2.1 Anatomy of a Book
Source: https://parsonsdesign4.wordpress.com/wp...

1. Spine is the part of the book that covers the bound edge.
2. Head band is a thin band of thread attached to the book sections that is usually colored to match the cover of the book.
3. A hinge acts as a fold that binds the fly leaf with the pastedown.
4. Head square is a protecting flange on top of the book
5. Front pastedown is an endpaper glued on to the book's front board.
6. Cover is a thick piece of paper or board that protects the book.
7. Foredge square is the tiny flange at the foredge of the book.
8. Front board is the book's cover board.
9. Tail Square is created when the cover and back boards of the book are bigger than the leaves.
10. Endpaper is a thick paper that supports the hinge by binding the inside of the cover board.
11. The head is the top of the book.
12. Leaves are separate pieces of paper bound with two sides.
13. Back pastedown is the endpaper glued to the back board.
14. Back cover is the thick piece of paper or board that covers the board of the back.

15. Foredge is the edge of the book's front part.
16. Turn-in is a type of a paper or cloth that wraps the outside to the inside of the covers.
17. Tail is the bottom part of the book.
18. Fly leaf the other side of the endpaper.
19. Foot is the bottom part of the page.

2.1.3 Grid Systems in Books

According to Poulin (2018), grid systems play an essential role in organizing and arrangement of objects just like how typographers design their letterforms, how cartographers plot the map, how artists proportion their murals and the output of a printed page. A grid system is a compositional tool used to solve design problems such as the layout of newspapers, books, magazines, brochures, reports, sign systems or websites (pg. 74). The function of a grid system is to convey the right message and meaning through the arrangements of design elements within a layout (pg. 75). With this information, the writer can provide visual clarity for the readers by allocating the appropriate position of texts and QR. There are eight types of grids, which are:

1. Manuscript

Poulin stated that the simplest form of grid system is the manuscript (pg. 78). Originating from the early 14th century, it is mostly a simple block of rectangular text area that consists of long and continuous text. The grid may also consist of secondary elements such as headers, footers, or section titles.

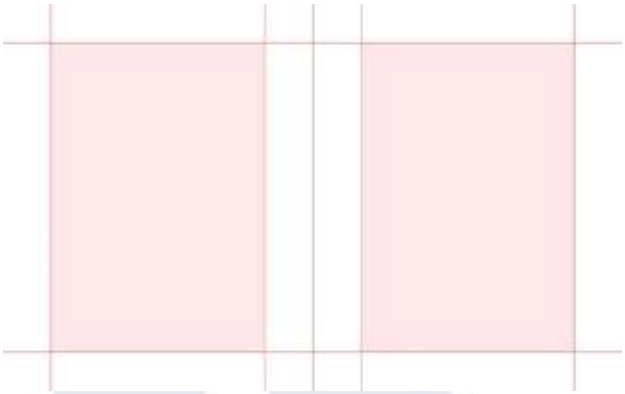

Figure 2.2 Manuscript Grid
Source: https://img.uxcel.com/practices/functional-grid....

The manuscript grid is used to create groundwork for the layout of the book. This allows allocation of space for the illustration, text and size for the elements within the page. The author will use the manuscript grid as a guideline for the contents that will be made for the book.

2.1.4 Typography in Books

Following the typography theory of (Crawley, 2010), the type chosen to be used in a book is a crucial step in creating the right atmosphere for the book. Designers have the option to choose various fonts that are suitable for creating the look and feel for the readers (pg. 36). The following are important notes on choosing the type for books.

1. **Alignment**

   Writing softwares allows the user to adjust their text alignment in four ways: justified, centered, flush left or right. Most books that are text heavy such as a novel or memoir have their text with the justified alignment as it forms even edges on the sides and an easy way to deliver the content. Flush left is mostly used when lines need to have some space or give the illusion of natural writing such as poetry. On the other hand, illustrated books are less strict in picking either of the alignments as it needs to fit best appropriately with the content of the illustrations (pg. 37).

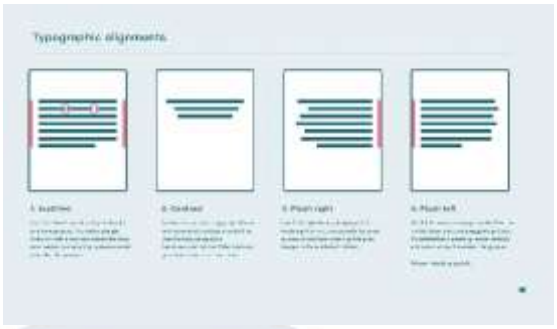

Figure 2.3 Text Alignments
Source: https://miro.medium.com/v2/resize:fit:4800/....

2. Historical Book Faces

Typefaces were originally created mostly for the use of books, these types are Garamond, Jenson and Caslon (Crawley, 2010, pg. 38). Their design reflects the environment of historic setting, creating the look and feel of historical readings. These faces can also use sans serif fonts such as Helvetica or Futura.

Figure 2.4 Historical Book Faces
Source: Crawley (2010, pg.39)

3. Contemporary Book Faces

In this modern era, new fonts are constantly being designed by graphic designers all around the world. It is distributed online and can be used by many users. Contemporary book faces have two typesets which are Dolly and Auto (Crawley, 2010, pg. 39). Dolly typesets are readable in small sizes because their thick and thin elements are low in contrast. Auto typesets are optimal for varying fonts as they are made using three different italics.

Figure 2.5 Contemporary Book Faces
Source: Crawley (2010, pg.39)

4. Display Faces

Aside from using different typesets for the body text, subheading, caption and others, a larger scale typeface can be added to enhance the level of priority and impact of texts (Crawley, 2010, pg. 40). Display faces, or also known as display fonts, are used separately intended only for the use of titles or headlines.

Figure 2.6 Display Faces
Source: Crawley (2010, pg.39)

From the written faces and rules above, the author will utilize display faces for the title, historical book faces for the main text, contemporary book faces for secondary texts and alignment rules to remain order with the book's layout. These following theories will guide the author in ensuring that the design choices are readable, consistent and clear for the readers.

2.1.5 Illustration in Books

According to Serafini (2020, pg. 10), book illustrations act as a semiotic language that creates narrative meaning alongside the text. The interplay of illustration and written text creates an experience that synergizes the reader's understanding of the story. The function of illustrations according to Zeegen (2020) is to evoke reader's emotions and establish a certain mood that strengthens the narrative experience and engagement in both fiction and non-fiction books. Concluding Serafini's definition and Zeegen's function, books act as a tool conveying images that evoke certain emotions to help readers understand the context of the narrative. To convey historical narratives, the writer needs to present the accuracy and authenticity of the story as close as possible to the source.

Based on Ghozalli (2020), there are three forms of illustrations which are:

1. **Spread**

   Spread illustrations fill in two pages of the book as it is expected that the reader will pay more attention to the details of the illustration (pg. 15). Spread illustrations are mostly used when showing a different environment or time period as the wide area allows a bigger immersion in the illustration's setting. Most spread illustrations need to fill in the bleed area for safety purposes during cutting and printing.

Figure 2.7 Spread Illustration
Source: http://www.richardjohnsonillustration.co.uk/....

2. Single spread

Single spread illustrations fill the whole space within one page (pg. 17). This can be done with bleeding or framed illustrations. This can be used when trying to tell two different or separate stories within one spread.

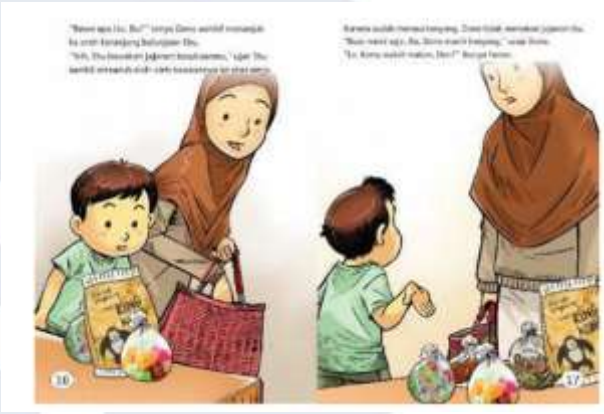

Figure 2.8 Single Spread Illustration
Source: Ghozalli (2020, pg.17)

3. Variation

The forms mentioned above can be combined and used several times to convey the right message with the illustration (Ghozalli, 2020, pg. 20). Adapting on the events, setting, activity and object becomes a decision maker in what form of illustration should be appropriate to deliver the message.

The author will be using both spread illustration forms when incorporating the story of Cut Nyak Dhien. From the explanation of single spread and spread illustrations, these encompass storytelling elements which fit the context of a focused narrative. These illustration forms ensure that the entire pages of the book are covered with illustrations and minimal text allocation.

2.1.6 Color Theory in Books

Color is an important design element according to Landa (2013, p. 23), who defined light to be a characteristic of light energy. Light allows people

to see color and the light that bounces off an object which then is reflected is seen by the human eye as color. Color through a digital screen is called digital color as it is made by the mix of light waves that create variations of colors. The elements of color can be separated into three categories which are hue, value and saturation.

1. Primary Colors and Subtractive Colors

Basic forms of color are known as primary colors (Landa, 2013, pg. 23). Screen-based media uses three primary colors which are red, green and blue (RGB). These lights are also known as additive colors as it creates white light when all are added together equally. Primary colors cannot be created from mixing other colors, but other colors can be mixed using primary colors.

Figure 2.9 Primary Colors
Source: https://www.1728.org/RGB-Prim.png

Mixed primary colors become secondary colors (Landa, 2013, pg. 24). Red mixed with green creates yellow, red mixed with blue creates magenta and green mixed with blue creates cyan. A computer can mix millions of colors that are impossible for the human eye to see. Hence the term subtractive color is used to define the reflection of a surface, such as the ink on printed paper. It is termed ‘subtractive’ because the surface subtracts all light waves except the color that is seen by the viewer.

2. Value

The value refers to the level of lightness or darkness of a color (Landa, 2013, pg. 26). Black and white are not considered as colors but are called achromatic or without hue. Black and white are mixed to create gray, which becomes an interval between the light and dark values. To adjust the value of a hue, values are added to control the shade or tint of the color.

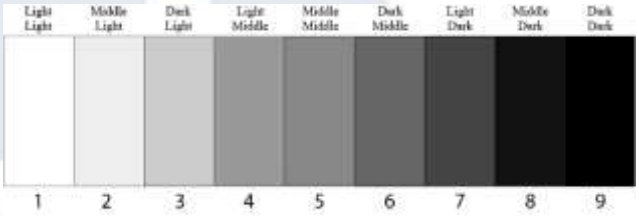

Figure 2.10 Values
Source: https://www.1728.org/RGB-Prim.png

Although achromatic values are pure, variations of hues can still be visible when mixed with colors (Landa, 2013, pg. 26). A black can appear warm when it is mixed with red or appear cool when mixed with blue or green. When handling composition, the contrast of values places an important role in differentiating the order of importance. Contrast in hues is not enough to differentiate one object to the other, hence the need to put contrast in values to put impact in the differentiation of one object to the other.

3. Saturation

Saturation controls how vivid or muted a color appears (Landa, 2013, pg. 27). A hue is considered purely saturated when it reaches the highest saturation, showing color without the influence of neutral colors. If mixed with neutral colors, the hue becomes diluted. The familiar term when a hue is mixed with gray is known as the tone of the color.

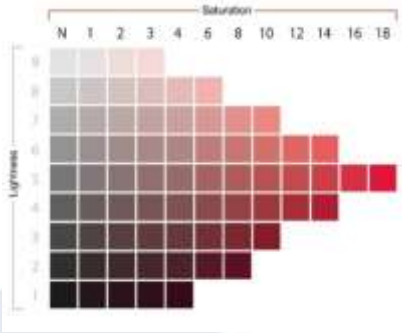

Figure 2.11 Saturation of Colors
Source: https://art-design-glossary.musabi.ac.jp/

According to Landa (2013, pg. 27) , when managing a composition, saturated colors have the ability in calling attention to themselves when surrounded by duller tones. The more saturated colors will stand out compared to less saturated colors. Managing saturation levels is key in maintaining the readability of the composition as it gives order to what the viewer will pay attention to first.

4. Color in Design

Landa (2013, pg. 27) states that colors can be used symbolically. This representation can evoke how people behave and feel about a situation, providing cultural and emotional associations. To provide context with historical themes, the choice of colors revolves around earth tones.

According to Cherry (2025), brown can be associated with strength, showing resilience and security. It can also be associated with devoid of life, showing the vast and empty. Wahidiyat (2021) also discusses that yellow symbolizes greatness, glory, nobility and tranquility. Orange has various representations, from fun and health to courage and strength.

From the theories written above, the author can utilize color choices to associate its symbol and meaning to the readers. With the theories of hue, values, saturation and color in design, his will guide the color palette of the book as select colors are stated to reinforce

certain meaning and values that help communicate the story of Cut Nyak Dhien. The author will utilize colors such as brown and yellow to present the story symbolically.

2.1.7 Augmented Reality Books

According to Roumba & Nicolaidou, (2022, pg. 60), Augmented Reality books are defined as a physical book built with extended interactive features that are supported by digital media. These digital media are virtual objects that are accessed by QR codes and a smartphone. AR books provide the same qualities of printed books but have extra features that can be utilized by its readers, providing a playful and interactive way of obtaining information. Theres has been a rise in popularity regarding technology-enabled reading as educational tools that are imposed with AR applications offer young readers exicitng experiences in compared to a normal textbook. Roumba & Nicolaidou also states that the use of AR in education is expected to increase learning attitudes of students for the next few years.

2.2 Augmented Reality

Augmented Reality defined by Milgram & Kishino (1994) is a real-time, interactive system that projects virtual elements into physical reality. The important elements of AR that make up its basic functionality are creating links, user interaction with the device, relationship of the physical world and information generated by the electronic device. These elements provide an experience that creates a digitally enhanced physical world.

2.2.1 Types of Augmented Reality

According to the studies of Prananta, Rohman, Agustin & Pranoto (2024), AR can be widely classified into four types :

1. **Marker-based AR**

   Also known as image recognition AR, marker-based AR relies on a camera to be able to identify the visual that is marked by the processor (pg. 47). This marker can be any visual object, it could

be an image, symbol, or QR code that is clear enough to be identified by the camera. Once the visual object is identified, the processor can calculate the orientation and position of the visual object.

Figure 2.12 Marker Based AR
Source: https://www.researchgate.net/profile/Krit-Salah-Ddine

Examples of the application of marker-based AR include AR restaurant menus, AR museums or AR books. The placement when using a marker-based AR is important as its recognition solely depends on the marker itself.

2. Markerless AR

A commonly used type of AR is the Markerless AR, where the device being used has a built in GPS technology that calculates the location, speed and position of the user (pg. 47). Available on most smartphones, this AR provides directional features and location-based applications that can help the user work around physical space.

Figure 2.13 Markerless AR
Source: https://www.iptec.id/wp-content/uploads/2024

Examples of markerless AR include Google AR live view; Pokémon Go or AR tourism. The whole process involves the user

moving around and navigating through the real space to see the AR, this is mostly used when the product involves real-life scale that is accurate to its physical size.

The author will use both markerless AR and marker-based AR for the book as it is suitable when scanning for image targets when opening a spread of a book. Using the illustrations as image targets as the marker for AR or symbols in case image recognition isn't detected by the AR application. This ensures that the user will not have to scan another object and will remain within the spread of the book.

2.2.2 Components of AR

Following the study of Masood & Egger (2020, pg. 5) , there are five main components that make up an AR:

1. Visualization Technology

Visualization technology refers to the hardware being used that displays virtual content to the user (pg. 5). The function of visualization technology is to visualize the content that is intended to be shown. These include smartphones, tablets, projectors or AR gadgets that specifically have the capability of processing AR features.

2. Sensor System

Sensors gather real world data from the environment that is then input to the processor for the data to be aligned with the AR content (pg. 5). Changes within the environment whether it be from the user or surroundings are input into the processor using sensors. Examples of sensors are cameras, stereo cameras, ultrasonic depth perception, gyroscope, accelerometers and infrared depth perception.

3. Tracking System

A tracking system ensures that the virtual object is aligned with the real-world objects (pg. 5). The data interchange between real world objects and the virtual objects must remain on track to provide accurate and real-time experience. There are two types of tracking systems which are marker-based tracking and markerless tracking.

4. Processing Unit

A processing unit is where all the data from the sensors, tracking and AR graphics are being processed. This component is the computational unit that inputs data processing, calculates feedback, renders the visuals of the virtual object and transfers data between one component to the other (pg. 5).

5. User Interface

The user interface presents an interface that allows users to interact with the AR content. This includes receiving input from the user and providing feedback to the user. Some technologies that are being used include audio feedback, haptic feedback, gesture recognition, gaze recognition, speech and hardware (pg. 5).

2.2.3 Applications of AR

There are several applications of AR in which different applications provide different outputs of AR functionality. The following are applications of AR according to Masood & Egger (2020):

1. Game Applications

The development of an HMD (Head Mounted Display) device allows users to use AR easily without carrying heavy weight like the Sword of Damocles, then AR systems eventually made its way to be built in smartphones (pg. 4). An example of a game application of AR is “Pokémon Go”, launched in 2016 that showed how AR presents its interactivity and features as a game. The

technology in AR uses cameras and sensors to map the surroundings environment and superimpose the virtual elements to the physical world, which is entertaining and simple to use for the users.

Figure 2.14 Pokémon Go
Source: https://lh3.googleusercontent.com/....

Pokémon Go is an example of AR applied into the game that allowed users to interact with virtual objects that use the data of real-world environments. Users collect various characters as they travel or go to different places, making AR an engaging and interactive experience. This uses the technology of markerless AR as it detects the user's location using the built in GPS from a smartphone.

2. Other Applications

Schools can now implement AR technologies to help students understand complex theories and concepts better. With most smartphones already equipped with basic AR features, students can see visualizations of the human body structure, the solar system or molecular structure in detail to further understand the topic (pg. 6). Other fields include the commercial sector and tourism sector, where users can view the product or service in 3D before purchasing.

2.2.4 Augmented Reality in Digital Era

In the 21st Century, emerging technologies are constantly being developed to improve the day-to-day experiences of people. AR has been described as the leading technology by numerous literatures discussing how AR can be implemented in various industrial sectors. However, despite the

booming of AR, there are still many limitations of AR that need to be improved and studied. AR technology depends on the computational resources available within an environment and the level of complexity can also contribute to its own limitation.

2.3 3D Assets

3D models have improved since the earlier days since 3D game development (Terävä, 2017, pg. 4). To undergo the appropriate method in the production process, there are stages and workflows that need to be applied to create a functional 3D asset. There is one set workflow commonly used by 3D artists but also other deviating workflows that adapt from its traditional workflow. The terminologies and workflows will be discussed below.

2.3.1 3D Character Workflow

There are certain aspects to understand before creating 3D characters (Terävä, 2017, pg. 11). The output, technical limitations, style and functionality all decide on the entirety of the workflow in creating the asset. Whether the character will be animated, the quality of the model as well as the design of the model all depends on the designated output of the product. The production process in creating a 3D character depends on one studio to another, but the following is a set example that has been used as the basic stages in creating a 3D character (Terävä, 2017, pg.11).

1. **Concept Art**

   According to Terävä (2017, pg. 12), the first step in creating a 3D character usually involves the creation of a concept art of the character. This 2D concept art has detailed information about the character that acts as a visual guide for the 3D modeler to envision the character in 3D space. It is similarly described on how construction work needs an architect's blueprints to understand the foundation of the design.

Figure 2.15 Igor Sid's Diablo 4 Character Concept
Source: https://cdna.artstation.com/p/assets/images/images

There are limitations when delivering the accuracy of the 2D concept art to the 3D model, such as slight differences in looks either due to technical limitations or scale/shape translation in 3D. The concept art presents enough information regarding the character, the garments, color, shape, accessories and other important features.

2. Modelling

Different 3D modelling softwares have their own workflow and terminology (pg. 12). For softwares such as Autodesk Maya and Blender, 3D models are made up of polygons, which are geometric planes or surfaces made up of vertices. These vertices are units in 3D space, which hold information regarding the front or back end of the surface. Vertices connect to form edges, then edges combine to create faces. These can form into a rectangle, triangle which forms into a polygon. When several combinations of polygons are connected, it is eventually called a 3D mesh.

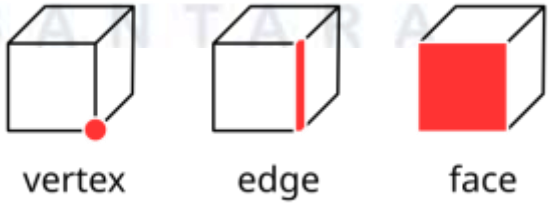

Figure 2.16 Vertex, Edge and Face
Source: https://upload.wikimedia.org/wikipedia/commons

There are various ways in which a 3D modeler can create a model, the most common ways are box modelling and edge modelling (Terävä, 2017, pg. 14). Another tool that is built in several 3D programs is modifiers, which are used to modify the model's property with various options and parameters that can be adjusted. These tools help the process of 3D modelling to be efficient as manual work would take up a lot more time.

3. Digital Sculpting

Another way in creating 3D meshes aside from 3D modelling is known as digital sculpting (pg. 69). 3D sculpting allows the 3D modeler to manipulate and carve the surface of the 3D model similar to sculpting clay. Different sculpting programs have brushes that carves and shapes the 3D mesh, examples of sculpting programs are Zbrush, 3D-Coat, Mudbox and Sculptris. Depending on the program, some allow dynamic tessellation that generates new geometry on top of the manipulated mesh which may be destructive to the overall geometry of the mesh.

Figure 2.17 3D Sculpting of a Head
Source: https://themotiontree.com/wp-content/uploads/20

The process of sculpting starts from creating simple blocking to construct the basic shape of the model or use premade meshes from other 3D programs (Terävä, 2017, pg. 71). The sculpting process begins. when the basic shape of the character is created. When manipulating the shape of the 3D character, the artist will have to keep in mind the character's proportion, shape, form and

gesture to represent the concept as accurately as possible. The primitive shapes define and proportions of the character, the further details and definitions refine the shapes and volumes of characters. The character's gesture, personality and sense of life need to be communicated throughout the process of 3D sculpting.

Figure 2.18 Building Forms in Digital Sculpting
Source: Workflows for Creating 3D Game Characters

The process in which simpler shapes are sculpted into more defined shapes is called building up forms (Terävä, 2017, pg. 73). The 3D artist should focus on the bigger shapes of the model before moving on to tiny details and smaller shapes of the model. From bigger primary forms, the model is ensured to have fair proportions and level of detail when bigger brushes are used first. Establishing the right form ensures the character has appropriate structure. Then, the artist can define certain parts of the forms such as smoother curves on muscles or fats and pronounced forms and angles when coming across the bones.

4. UV Unwrapping

The way in which a computer reads data on 3D faces needs to be mapped into 2D textures that are matched along the mesh (Terävä, 2017, pg. 19). The model's surface can be given texture data such as colors or materials, but it needs to be unwrapped to present its two-dimensional surface so that the visual information can be applied to the mesh. This process is called UV unwrapping, where edges are marked to be the borders of the selected faces.

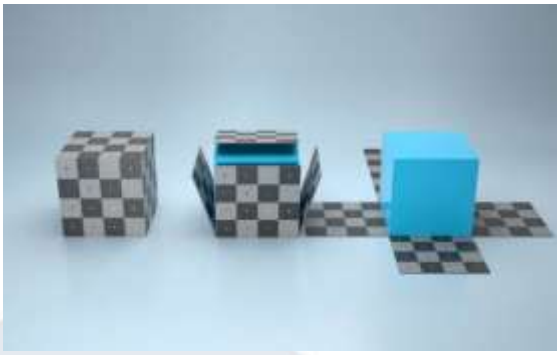

Figure 2.19 UV Unwrapping
Source: https://3dstudio.co/wp-content/uploads/2022/

There are several ways on how polygons are mapped into a UV map, using different ways of 3D projection (pg. 19). The polygons can be projected into the surface of a plane, sphere, cylinder or a cube. It is advisable when dealing with complex shapes and meshes to unwrap the surface of the 3D model so that the textures in UV align properly according to the shape of the mesh.

5. Texturing

After the UVs of the 3D model have been unwrapped, the mesh is eligible for texture (Terävä, 2017, pg. 23). Textures are images applied or projected into the surface of a 3D model, the process of creating a texture is called texturing. With the development of 3D programs, there are several ways in creating textures. They can be painted directly into the 3D model, hand-painted, procedural or even projecting existing photos into the UV.

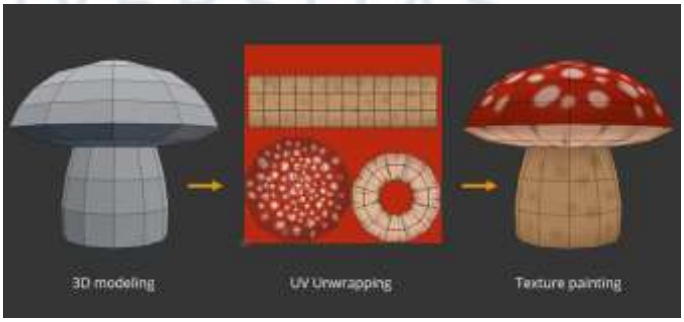

Figure 2.20 UV Unwrap to Texturing
Source: https://www.blendernation.com/wp-content

There are several layers on how 3D textures are rendered as a material, these includes albedo (base color), specularity, roughness, normal, displacement (bump) as well as transparency maps. These maps give data to the mesh' materials and provide information on how the 3D model is lit. Base color maps provide color to the mesh, bump maps give height definition to the mesh, transparency maps give data on which parts are transparent or not, roughness maps give data on how reflective the mesh is and many other physical based rendering data.

6. Rigging

Rigging is the process in which a character's mesh is given a skeleton which controls the 3D model (Terävä, 2017, pg. 30). Once a 3D character is rigged, the model can be animated and moved. The rig skeleton consists of joints, bones and bounds that mimic the human bone so that the rig moves similarly to humans. Animators will use this rig to create character animations, with different kinds of rigs used depending on the output target of the animation.

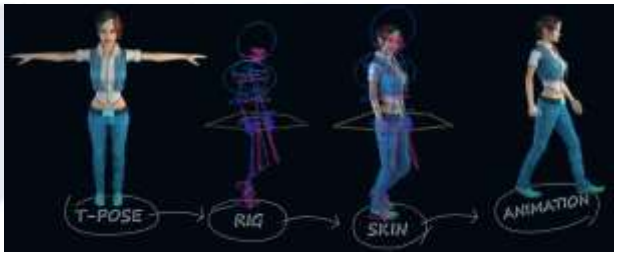

Figure 2.21 Rig to Animation
Source: https://dreamfarmstudios.com/wp-content/u

A 3D rig has a hierarchy of joints, where subsequent joints are parented to the main joint (Terävä, 2017, pg. 31). All the joints in a rig are connected to the root joint, and all the subsequent joints follow along the changes and position of the root joint. An example of a main joint and subsequent joint is the shoulder, if the shoulders are rotated then the whole arm follows along the changes of that joint.

2.4 Cut Nyak Dhien

Cut Nyak Dhien is an esteemed and well-respected Acehnese warrior that led the resistance against the Dutch in 1873-1904. Born in Lampadang, Aceh Kingdom around 1850, she was raised in an aristocratic family that carries strong Islamic teachings and a noble heritage (Kurniadi et al., 2023, pg. 2). Cut's mother carried the bloodline of a respected nobleman from Lam Pageu and her father was named Nanta Muda Setia. Her efforts in the Aceh War were highly praised and respected as it fortified Aceh's resistance against the Dutch colonial forces.

2.4.1 Aceh War

One of the most long-fought battles in Indonesian history was the Aceh War that lasted approximately four decades (1873 –1904). The conflict began since the signing of Sumatran treaty that involves the Netherlands and Britain, stating that the Dutch has the freedom to expand their territory and troops around Sumatra, which includes Aceh (Kurnia et al., 2023). The Dutch declared war on Aceh in 1873 in order to gain control over a vital commercial route in Sumatra that can profit them highly in natural resources. Despite the Sultan's efforts in rejecting the Dutch, the palace was taken over in the second Dutch military wave.

The first command was ordered by Dutch Government Commissioner named J. F. Nieuwenhuijzen from the warship of Citadel van Antwerpen (Kurniadi et al., 2023). As soon as the Dutch troops arrived in Ceureumen beach, they immediately attacked the Acehnese people using rifles and the Acehnese people fought with traditional weapons such as *rencong,* spears, javelins and *klewang*. The Acehnese did not stood feat easily but fought brutally against the Dutch as they considered the war a *jihad* (holy war) in the name of Allah. The Acehnese were strongly rooted in Islamic customs and vehemently opposed the Dutch's colonial control, this conflict is also known as the *Prang Sabil* with the spirit of "*jihad fisabillah"* which refers to a 'Fight in the Name of God'.

Before Cut Nyak Dhien rose as the leader of the Aceh resistance, there were several Acehnese figures that fought against the Dutch colonial forced that defended Aceh grounds. These figures are considered as National Heroes of Indonesia, they are Sultan Mahmud Syah II, Sultan Alauddin Muhammad Daud Syah, Teuku Cik Tunong and Teuku Umar (pg. 2).. Some of the earliest resistance leaders were also the Ulama and Uleebalang that led the fighting spirit of the Achenese people. There were four periods of the Aceh war according to Purnamasari et al., (2024) that are explained below:

1. **First Aceh War (1873-1874)**

   The first battle against Dutch began on 26th of March in 1873 led by Johan Harmen Rudolf Köhler (pg. 154). There was a total of 18 days of attacks during the invasion and the Acehnese fought fiercely defending their lands. During this period, the Dutch destroyed Aceh's religious symbol and sacred place of worship, which was the Baiturrahman Grand Mosque. General Köhler retreated on 15th of April in 1873, forcing the Dutch to retreat their troops.

2. **Second Aceh War (1874-1880)**

   During this period, rose a new Dutch General named Jan van Swieten who successfully captured Banda Aceh in 1874 (Purnamasari et al., 2024, pg. 154). The death of Sultan Mahmud Syah II forced the Acehnese to retreat and reside in the countryside, operating guerrilla tactics under the commands of Sultan Alauddin Muhammad Daud Syah. The guerrilla tactics managed to slow down the Dutch operations and temporarily kept the people safe in Kraton.

3. **Third Aceh War (1881-1896)**

   In the third period, a rally of resistance led by Teuku Umar, Teuku Cik Ditiro, Panglima Polim and Cut Nyak Dhien fought back the Dutch with guerrilla tactics (pg. 154). Teuku Cik Ditiro died moments after the fake surrender of Teuku Umar, making the deceit

more impactful. The Dutch wanted to spy and get close with the Ulama through a translator named Christian Snouck Hurgronje.

4. Fourth Aceh War

The last period of the Aceh War was led by Cut Nyak Dhien, Pocut Baren and the Acehnese. Despite the efforts from the Dutch, the Acehnese people kept resisting and fought under the spirit of "*jihad fisabillah"* meaning to fight under the name of God. In 1899, Teuku Umar was ambushed and Cut Nyak Dhien was forced to lead the resistance alone.

2.4.2 Key Figures and Characters

There were other key figures that contributed in the resistance during the Aceh War :

1. Teuku Umar

Born in 1854, Teuku Umar was a descendant of a Uleebalang Melaboh (Purnamasari et al., 2024, pg. 156). He was a masterful military strategist that deceived the Dutch by gaining their trust in a fake surrender to launch a surprise attack. By 1880, he married Cut Nyak Dhien with the agreement to allow her to go to war with him. This marriage formed a strong military alliance against the Dutch colonial forces.

2. Teuku Cek Ibrahim Lamnga

Teuku Cek Ibrahim Lamnga was Cut Nyak Dhien's first husband when they married in 1862 (Kurniadi et al., 2023, pg. 2). His father was Uleebalang Lamnga XIII, carrying the title and nobility of a regional chief. He made several contributions in the earlier parts of the Aceh War and died in 1878 defending the Baiturrahman Grand Mosque against the Dutch troops.

3. Panglima Polim

Panglima Polim was a high-ranking nobleman who played a key role in smuggling resources and regrouping scattered troops (Kurnia et al., 2023, pg. 5). After the Dutch took over the Sultan's palace, Polim managed to unify and regroup the Uleebalang who were separated from the divide-and-conquer tactics of the Dutch. Polim's efforts strengthened the Acehnese spirit and prevent it from collapsing from internal conflict.

4. Sultan Mahmud Syah II (1870-1874)

Sultan Mahmud Syah II was the ruling sultan during the early parts of the Dutch invasion. He strongly declined the Dutch colonial forces, which made the Dutch declare war on Aceh on 26th of March 1873 (Purnamasari et al., 2024, pg. 154). Under his command, the Acehnese people managed to kill the Dutch's commander, General Köhler, in the Baiturrahman Grand Mosque attack.

5. Sultan Alauddin Muhammad Daud Syah (1875-1903)

The last ruling sultan of Aceh was Sultan Alauddin Muhammad Daud Syah II, who was instrumental inleading the Aceh's resistance against the Dutch (Daud, 2022). He was the son of Tuanku Cut Zainal Abidin bin Sultan Alaidin Ibrahim Mansyur Syah, and his mother was named Nyak Beulukeh. He was forced to surrender to the Dutch in 1903, but the Acehnese resistance continued.

6. General Joannes Benedictus van Heutsz

Van Heutsz was the appointed General of Aceh who led the Dutch troops in 1898 (Kurnia et al., 2023, pg. 4-5). Under his command, he created new policies that targeted the Acehnese people and Teuku Umar. Van Heutsz also implemented divide-and-conquer strategy to counter the guerrilla warfare of the Acehnese. He failed

several attempts in ambushing Teuku Umar but eventually caught him by sending a spy into Teuku Umar's troops.

7. General Johan Harmen Rudolf Köhler

General Köhler was the first Dutch general that led the first attack against Aceh in 1873 (pg. 3-4). The equipment brought by General Köhler were warships, naval ships, patrol ships with over 3000 troops, 168 officers and 1000 forced laborers. Despite all the equipment and power, General Köhler died in battle on 19th of April 1873.

8. Christiaan Snouck Hurgronje

Snouck was a Dutch affairs advisor that was an expert in Islamic studies and Arabic, he played a key role in influencing religious leaders and clerics to weaken their support of the Acehnese resistance (pg. 4).

2.4.3 Story of Cut Nyak Dhien

Cut Nyak Dhien was one of the most courageous female resistance leaders of Indonesia, showing a strong character with the love of the homeland, leadership, bravery and chivalry that had never given up in her fight against the Dutch (Kurniadi et al., 2023, pg. 16). She persisted in the face of treachery and know no fear, establishing a legacy of patriotism that continued to inspire generations. This section discusses her story into four parts, from her early life to her final years.

1. Early Life

Cut Nyak Dhien was born into a noble and aristocratic family in Lampadang, Aceh Kingdom in the year 1850 (Kurniadi et al., 2023, pg. 2). She carries the bloodline of a respected nobleman from Lam Pageu and her father was Nanta Muda Setia. Growing up in a religious and noble family, she was raised in an environment strongly influenced by Islamic teachings and Acehnese patriotism.

By the age of 12, she was married to Teuku Cek Ibrahim Lamnga who was a nobleman and military leader, which introduced her to the involvement in the Aceh War.

2. Aceh War

The Dutch declared war on Aceh in 1873 when the Sultan declined the Dutch Colonial Forces. Cut Nyak Dhien's husband. Teuku Cek Ibrahim Lamnga, was the leader during the first few battles of Aceh against the Dutch. When Cut Nyak Dhien reached 28 years old in 1878, her husband died in battle defending the Baiturrahman Grand Mosque. His death was devastating, making Cut Nyak Dhien vow to avenge his death and carry on the resistance (pg. 2).

3. Teuku Umar and Aceh Resistance

After the death of her husband, she was proposed by Teuku Umar, an Acehnese warrior that allowed her to join him on the battlefield (pg. 2). The marriage forged an alliance and united the spirit of resistance, strengthening the people's power and morale. Teuku Umar eventually died as he was ambushed by Van Heutzs' spy in 1899.

4. Final Resistance

The death of Teuku Umar forced Cut Nyak Dhien to lead the resistance alone, from gathering forces and unifying Acehnese people (Kurniadi et al., 2023). She was helped by Teuku Umar's follower named Pang Laot who helped her carried out guerrilla warfare against the Dutch troops. Her troops were outnumbered and low in resources compared to the Dutch but managed to disrupt the Dutch's colonial forces through her strategy and tactics.

5. Exile and Final Years

Despite her old age and myopic eyes, Cut Nyak Dhien's spirit bravely carried on the resistance and played her role in politics and war (pg. 13). She was exiled to Sumedang in 1907 because a member of her own troops sabotaged her hiding location. During her exile years, she continued the teachings of Islam until her death in 1908 due to old age.

2.5 Relevant Studies

To strengthen and reinforce the theories reviewed, the writer will have to study existing research and understand the output from that research. These studies must share similar topics and media to the design topic. The writer will have to identify its strengths and weaknesses to know what to avoid, what to implement and what to take note of, that can be used to further enhance the research. Below are the relevant studies that are used to help narrow the approach of this research.

Table 2.1 Relevant Studies

No	Research Title	Authors	Research Result	Novelty
1	Augmented Reality (AR) Application Recognition of Indonesian National Heroes with Image Tracking Method Based on Android	Yohanes Alfian Richiansyah, Julius Panda Putra Naibaho & Parma Hadi Rantelingg (2022)	The Augmented Reality Application that was created using Unity 3D Vuforia proved standard performance in the image tracking of Indonesian heroes.	The image tracking using Unity Vuforia on an android operating system, with the focus of accuracy and experience.
3	Increasing the Interest in Learning the History of Indonesian National Heroes through an	Karunia Dwi Novita, Media A. Ayu, Maria J.R.B. Wahyuni	The research shows how AR Illustration book is proven to be beneficial in learning as it provides more visual information than text-based. The research also mentions	Designing an AR illustration book about a national hero and presenting the story in a visual manner.

No	Research Title	Authors	Research Result	Novelty
	Augmented Reality Book		how a visual-driver story can increase the interest in learning and exposure of a topic.	
4	Augmented Reality Media Pembelajaran Pengenalan Gambar Tokoh Pahlawan Nasional Pada Uang Kertas Berbasis Android	Muhammad Gifario Matiinue Dyar (2024)	Marker-based Augmented Reality using android systems is practical, portable and lightweight. The writer discusses the use of Vuforia and its limitations.	To implement the virtual object to the book with render settings that looks clean and natural to the real-world environment.

From the studies written above, the research result and novelty can help guide the writer on what to pay attention to while making the design and application. The strengths and weaknesses of each study can be used to benchmark and narrate the direction for the production process of this research. This further enhances the idea that the media the writer chose, which is an augmented reality illustration book, is an applicable choice of medium that can be applied in the education field.