UNIT 17 2D & 3D GRAPHICS

Assignment 1

Learning aim A

Investigate the purpose and characteristics of digital graphics that are an important part of visual communications.

Oliver Collins-Cope
2102775@rutc.ac.uk

Contents

Introduction

This report will aim to discuss all the available aspects of digital graphics listed below including, but not limited to, the impact on usability and accuracy of graphics, the evaluation of technical characteristics of digital graphics and how they impact their purpose, and discussing how different factors of technical characteristics can impact different aspects of successful products, such as quality, scalability, and many more.

Purpose of digital graphics

Digital graphics has grown throughout the 21st century, where previously the dominant graphic types were all handmade and there was minimal involvement of computers in making any kind of graphics. As such, the purpose of digital graphics has also evolved and there remains a few key points that must be included when discussing the purpose of digital graphics.

Digital graphics, just like any other kind of media, has the specific purpose to visually convey information, messages, and a meaning to an audience, through the use of computer-generated images, designs, or illustrations. These images have a number of uses, most notably the following, to educate, information, promotion, advertising, and entertainment.

Education

This refers to how graphics can be used to educate the consumers based on the scenario. This includes things like graphic instructions for building something, or graphics in books to help illustrate the purpose of the text to the consumer. Finally, graphics can also be used to help enhance the point of plain text when trying to educate a consumer, reinforcing the text.

Information

Informative graphics serve the purpose of conveying information to the consumer, whether that be essential or non-essential information. Some common examples of informative graphics include signs, and leaflets which help to get out lots of information through a minimal amount of graphic information. High quality graphics here can help to inform the consumers more effectively.

Promotion

Promotive graphics help to promote different products or services. This also stretches into fields like entertainment and business usually, and ties in closely with advertisement, being similar in nature. Contrary to advertisement, however, promotion involves dissemination of information about the specific item it is promoting, and this is included the graphic.

Advertisement

Advertisement graphics, as mentioned above, serve to communicate in a one-way manner about specific products or services and how to obtain them. These are usually for specific themes or events, such as products, and enable businesses the ability to promote the object of the advertisement.

Entertainment

Finally, entertainment graphics are designed to entertain and relieve the consumer of boredom. Some common examples of entertainment graphics are graphic novels, animated series, and games. Games are one of the most common forms of entertainment graphics and always heavily feature many different graphics in order to create the feeling of immersion and enjoyment.

Legal requirements of digital graphics

There are a number of legal nuances that digital graphics, or any kind of media, have to follow and keep in mind in order to make sure that they do not breach any of these. The most notable ones that must be considered include:

- Human Rights Act (1998) including
    - Protection of property
    - Freedom from torture & inhumane/degrade treatment
    - Freedom from slavery/forced labour
    - Right to liberty and security
    - Respect for your family and private life
    - Freedom of expression
    - Protection from discrimination
- Copyright, Designs and Patents Act 1988 (CDPA).
- Trade Marks Act 1994
- Patents Act 1977
- Defamation Act 2013
- Consumer Rights Act 2015

It is crucial to consider these laws governing digital graphics as they work to safeguard the rights of individuals and organizations and ensure that those who develop them do so in a legally and ethically correct manner.

For instance, privacy law helps to protect individuals to ensure that their personal information is not exploited and used against them, in a manner that could be detrimental to them. Defamation laws exist to shield the reputations of individuals and organisations by guaranteeing that false, misleading, or damaging statements are made regarding them. Additionally, consumer laws help to protect consumers and make sure that they are not misled or exploited by businesses.

To continue, copyright legislation ensures that authors and artists receive fair compensation for their work, thereby promoting the protection of their rights. Trademark law helps to prevent confusion among consumers by ensuring that trademarks are used properly and only by authorized parties. Patent law helps to protect the rights of inventors by ensuring that they are properly compensated for their inventions.

Through following these legislations and laws, digital graphics creators, alongside with consumers, can continue to produce and consume content guilt free with peace of mind.

Digital graphics

There are two primary versions of digital graphics that are used within 2D and 3D graphics. These are raster graphics and vector graphics which will both be discussed and compared below.

Raster

Raster graphics are digital images that are made up of a large number of pixels. Every pixel in a raster image has a value that represents its colour and all together these come to make a complete graphic.

Raster graphics, unlike vector graphics, are made using pixels and therefore resolution dependent. This means that if an image is scaled up or down, the quality of the image will decrease or increase respectively due to the number of pixels being used to display the image being stretched or shrunk. When enlarged, pixels often become clearly visible, and it is easy to tell and differentiate individual pixels.

There are a number of raster graphics principles and they each serve their own important purpose. These are;

- 2D arrays – This is where each pixel in the array is designated a colour value and serves to portray that colour.
- Resolution/Dimensions – This determines the number of pixels in an image, which in turn, determines the quality of the image.
- Sampling – This is the process of getting a number of specific values from a function, map, and image.
- Bit depth – This is where the number of bits are determined for each pixel and helps to determine how many colours are able to be used in the image.
- Colour modes – This determines how colours are represented in the image.

Applications

Common applications of raster graphics are things like web graphics, digital paintings, game assets, print advertising, packaging, textures and patterns, and finally logos and icons. The main reason that raster graphics is due to their ability to accurately represent complex and detailed images. This allows them to be used to situations where there is a high level of detail involved, which could be considered contrary to their limitations of being resolution dependent.

Furthermore, raster graphics are also highly compatible with a large variety of software and hardware, making it readily accessible to a larger audience and therefore increasing its consumption/usage. Many devices and programs are designed to interact with raster images and therefore raster graphics are commonly used in several scenarios, ranging from the previously mentioned fields such as web graphics and game design.

Finally, they are also commonly used in scenarios where the images are unlikely to be resized as this is one of the biggest limitations of raster graphics. If there is a situation where it is highly unlikely that the raster graphics will need to be resized then it is more likely that they will be used in this situation as they will be highly compatible.

Vector

Vector graphics are digital graphics that are created using mathematical equations and are notorious for being completely opposite to the basic idea of raster graphics. This means that, while raster graphics rely on pixels and can be scaled into lower quality, the nature of vector graphics using mathematical equations to make graphics means that it is able to scale up without the loss of any quality. These are created using geometric shapes such as points, lines, curves, and polygons. The secret to the scalability lies in the fact that the mathematical equations designed to create the images will simply be recalculated based on the new design, allowing for scalability.

Some of the core vector principles include:

- Geometrical primitives – This refers to the aforementioned points, lines, curves, and polygons and can be manipulated in order to create complex shapes and designs.
- Nodes – This is the point where lines and curves of an image meet, and nodes are commonly used to adjust the shape of an image.
- Paths – Paths are made up of lines and curves and are used to connect different nodes together, just like the name mentions, creating a path between the two nodes.
- Voxel – A voxel in 3D vector graphics is a term used to refer to a point being represented in space.

Applications

Some core applications of vector graphics is often in many different fields including, but not limited to, graphic design, engineering, web design, fashion, and architecture.

Contrary to raster graphics, the reason that these fields commonly use vector graphics is due to the innate ability to scale up or down without the compromise of losing quality. This ability is key in some fields, like engineering or architecture, and therefore is a crucial application of vector graphics.

Additionally, the fine and precise control over vector graphics, through the use of nodes, paths, geometric primitives, and voxels, means that vector graphics allow an intimate control over design elements that allow the designers to create and adjust complex graphics with much ease, unlike raster graphics.

This large flexibility and fine control ability has led to vector graphics being essential in many different industries in the modern world, and it continues to be at the forefront of graphics alongside raster graphics.

Principles of 3D images

There are three main principles involved in 3D images. These are discussed below.

Geometric theory is the use of mathematics, similar to vector graphics in that regard, in order to define and utilise 3D objects inside of a digital image/space. Geometric theory provides the equipment in order to create 3D objects through different mathematical aspects such as positions, orientation, and shape. Geometric theory is essential for creating

realistic and accurate digital models that can be further manipulated using the other key principles in order to produce a final finished product.

Mesh construction is the creation of a 3D mesh which, in very simple terms, is a collection of different vertices, faces and edges. These 3 different aspects define the structure and shape of a 3D object and are critical. Construction of a mesh is usually done using a 3D modelling software, such as blender, however it can also be achieved manually, and similarly to before, is essential in creating accurate 3D models.

Finally, rendering is the process of converting a 3D model into a 3D image, which involves the other different aspects of the 3D model including, but not limited to, lighting, shadows, and textures. Rendering is what truly allows a realistic image to be created and can be done either in real time, such as during playing games, or beforehand such as during film and video production as in these scenarios it is often a time intensive process. For example, when creating a 3D model, the textures for the 3D model will have to be rendered separately and often times, the texture will have to be reapplied afterwards onto the model. This is often done by "baking" the 3D texture onto a 2D texture map.

These three different principles combined allow for high quality 3D models to be created and used in modern environment, such as video games or film and animation.

Applications of 3D images

3D images have a wide variety of applications amongst the many various industries out there. They are commonly used to create realistic – and sometimes interactive – models of landscapes that serve a variety of purposes, such as planning and entertainment. Additionally, 3D graphics are used extensively in video games in order to enhance the user experience while playing the game, by providing realistic game features in order to further immerse the player into the game and allow them the sensation of feeling like they are truly there or involved. To further expand computer games, 3D graphics are used heavily in the production and usage of virtual reality environments that can be made immersive and interactive with the right 3D graphics/models.

Furthermore, 3D graphics are also used in the entertainment industry, such as animation for films and TV, allowing for 3D characters and environments to be introduced into the chosen media. To add on this, 3D graphics are essential for the production of realistic and detailed effects for special effects such as explosions or other video effects.

Impact of 2D and 3D Digital graphic representation principles

The principles of 2D and 3D graphic representation and the impact on their usability and accuracy varies greatly when depending on the scenario involved. For example, when discussing factors such as dimensions, context is also heavily involved as if the graphics involved are vector graphics then it is likely that dimensions will not impact the representation of the graphics, however in raster graphics it will play a much more significant role when considering pixelization of the graphic. It is vital to understand these key principles and how they impact digital graphics in order to effectively create high quality graphics that are both visually appealing and accurate.

Dimensions

As previously mentioned, dimensions play an important role in digital graphics. In 2D graphics they are measured using pixels most of the time, whereas in 3D graphics it depends on the context of the scenario. For example, in one situation someone might be working in miles or kilometres, and others in centimetres. The accuracy of the dimensions greatly impacts the usability of these graphics, due to the fact that if the dimensions are inaccurate then there will likely be numerous issues in the future, for example in fields like architecture and engineering where there could be devastating consequences for inaccurate dimensions. This means that dimensions limit the usability of 2D and 3D graphics if the accuracy is not good enough.

Scalability

Scalability is used in both 2D and 3D graphics and provides the options of increasing or decreasing the size of the image/model. Due to the nature of scalability, for 2D graphics this will typically be vector graphics as raster graphics will lose quality when scaled up. In 3D graphics scalability gives the option to increase and decrease the size of the model however it is always as simples as that, and this is because of the fact that different items in the model, i.e., a path or point, might scale differently from other aspects of the model and therefore lead to a warped model. This means that scalability much be done accurately in order to be used widely, otherwise the 2D and 3D graphics will be of low quality, inaccurate and therefore unusable.

Colour management

Colour management is the representation of colour in 2D and 3D graphics, and this remains crucial no matter what type of graphic is being worked with. While this does not differ much between 2D and 3D graphics, the core principles behind ensuring that the colours are accurate is vital and therefore remains an important principle. If the colour accuracy of a 2D or 3D graphic is limited then that means the usability of it is likely to be limited. Furthermore, while colour management as a whole has importance, it can also be mitigated by creating graphics in 2D or 3D and therefore can be argued that it does not greatly impact usability and accuracy as significantly as other principles.

Rasterising

Rasterising is the process of creating an image in raster graphics (pixel) rather than something like vector graphics which works by using mathematical equations and therefore is not limited by pixels. Often, raster graphics are generated from vector graphics by rasterising the vector graphics onto 2D texture map. In fields like game design, these textures are then reapplied onto the objects they were intended for in the game engines. This process can greatly affect the accuracy of graphics, especially for scenarios where certainty is crucial.

Quantisation

Quantisation is where the number of bits, that represent a digital signal, in a digital graphic is reduced. In turn, the reduces the number of distinct colour in the image, with the

intention that the image should still remain the same as before or as close as possible. In regard to 2D and 3D graphics, quantisation can great effect the representation of the digital graphic by reducing key areas like shading and texture of an image, therefore impacting the accuracy and usability of the graphics.

Anti-aliasing

Anti-aliasing is a way to smooth out jagged edges in graphics, which is commonly used all over digital graphics, such as digital painting or game design. Within 2D graphics, anti-aliasing can be used effectively to increase quality of elements like text which greatly helps the recipient enjoy the graphic, whether it be a game, art, or purely text. Within 3D graphics, anti-aliasing is crucial to help increase the realism of a model and therefore is highly valuable for this. Finally, anti-aliasing can greatly impact the accuracy of 2D and 3D graphics as determining whether or not anti-aliasing is enabled will significantly increase or decrease the realism and quality of the 2D or 3D graphic.

Evaluation

These factors each play their own separate role in affecting the representation of 2D and 3D graphics through their principles, however while there are some that have a large impact on the representation of 2D and 3D graphics through usability and accuracy, there are others that are less impactful and can be mitigated even.

One example of a principle that is less impactful than the others is quantisation. This is due to the fact that quantisation only works to reduce the amount of colours in an image while also maintaining the same colours for the image to the human eye. This also ties in heavily with colour management which works to represent colours in 2D and 3D graphics. These two remains less impactful for two important reasons, and these are:

- It works specifically to maintain the quality of the image through sacrificing accuracy, however the ability to notice the difference between something with more or less colour accuracy is often unnoticed and will likely not even be acknowledged. It is even more so unlikely when using quantisation in professional situations like marketing and design graphics where the image must be of high quality, and therefore an extra effort must be made to ensure that if there is any colour management done, it must be as unnoticeable as possible.
- Additionally, a principle like colour management is unique in that it will only apply when there are images with colour in them. This means that if someone were to create a graphic with only black or white, or only one specific colour, the issue or colour accuracy would not exist, and therefore the issue of colour management would not present itself.

It is due to these factors that I believe colour management is less impactful on the representation of 2D and 3D graphics, and that there are others that are much more significant and must be considered more than colour management.

Another example of a principle that is less impactful is anti-aliasing. Anti-aliasing is the process of making edges smoother and appearing less jagged. Furthermore, the process of anti-aliasing occurs in both 2D and 3D graphics and remains used to smooth both 3D

models, that can have sharp pixelated corners, or 2D images such as with text, used to smooth out the hard corners of text and make it easier to look at. The reason why it is a less impactful feature is because:

- Anti-aliasing is a feature that often goes unnoticed due to the fact that it often only makes small changes to details, on both 3D models and 2D images, and therefore it can be said that it is unlikely to notice whether or not anti-aliasing is enabled unless a user or consumer is specifically looking for signs of anti-aliasing.

For example, the image below is supposed to be an example of anti-aliasing, which smooths out jagged edges on 3D models and 2D images, however there is a negligible difference between the two, even then *specifically* looking for it so it can only be harder to notice when not paying attention to such a principle.

It is because of these factors that I believe that anti-aliasing is not as important as a factor in 2D and 3D graphic representation and their usability and accuracy, and that other principles are much more significant for the graphic representation of these respective options, 2D and 3D.

On the contrary, an example of a 2D and 3D graphic principle that has a more significant principle would be dimensions. Dimensions refers to the dimensions of the 2D graphic or the size of the 3D graphic, usually referring to how many pixels are in an image or the length, width, and height of a model respectively. Dimensions allow the manipulation of the 2D and 3D graphic respectively and therefore plays a large role in this. Additionally another reason of why dimensions greatly impact 2D and 3D graphics is:

- The impact that dimensions have on 2D, and 3D graphics is incredibly important. For example, in some choice fields, such as architecture or engineering, the dimensions of a project/model must be incredibly precise or it can lead to devastating consequences, such as buildings collapsing or products that do not fit together and are unusable.

Due to the significant impact of dimensions in different fields, I believe that dimensions play a major role compared to the aforementioned principles. Furthermore, it is important to consider the consequences of making errors with dimensions when considering the impact of them on usability and accuracy and therefore I believe that this reinforces my opinion adequately about the fact dimensions is more significant than the factors mentioned above.

Another example of a 2D and 3D graphic design principle that has much more value than the aforementioned principles, that being colour management, anti-aliasing, and quantisation, is scalability. Scalability is an important graphic design principle as it ensures that a design can be resized without losing quality or becoming distorted. This is particularly important in some fields such as digital design where these designs might be stretched and distorted on different screens and resolutions. Some other examples of why it is an important principle include:

- Scalability allows the option for designs to be adapted according to situation at hand, which might be common depending on the context. For example, an article of clothing that has a design might also have the same design on another clothing or accessory, such as a hat and a shirt, and in these scenarios the ability to scale the design is crucial.
- Finally, working with a scalable design is a very cost effective way to create a digital product, as it allows the same product to be reused on different platforms for the same version of a design, saving time and money for the designers.

It is due to the wide variety of factors that help to increase the value of scalability in comparison to some of the other 2D and 3D graphic principles that I believe scalability has a much more significant role compared to the other graphic principles.

To conclude, while I personally believe that some graphic design principles have more value than others, it is always much more important consider the context of the situation rather than a generalisation of common situations as has been done in this document. This means that although I consider colour management, anti-aliasing, and quantisation negligible compared to some principles like dimensions and scalability, they are, and will continue to be, crucial graphic design principles that should all be considered for 2D and 3D graphics respectively.

Hardware

There are many hardware tools involved in the process of development of 2D and 3D graphics and these are discussed below. They each play a vital role in how graphics are perceived by the consumer and are important factors when considering digital graphics in the modern world.

Capture

There are a wide range of tools available to aid with the creation of 2D and 3D graphics, including capture devices that allow the creation and manipulation of those graphics. These devices include:

- Cameras. Cameras are often used for taking photographs and getting digital images. While there exists cameras for the everyday use, such as the smartphone camera, there are also cameras specifically designed for professional image capturing and these allow for extensive and detailed images to be taken. There are also a number of other features that help to enable effective photographs to be captured in regard to 2D and 3D graphics. These images include: image sensors, which is responsible for creating the photo based on the raw image data, connectivity, which enables the camera to be connected to different devices and enables the data transfers of the images, modes, which allows the camera to use different settings with the images, composition, which is how the contents of the photograph are arranged, and angles which refers to what angle the photo is taken at.
- Scanner. A scanner allows real life elements to be scanned, which can be great for capturing physical images or documents. There are a large number of scanners available, ranging from handheld to flatbed, and there are several features to consider for scanners that impact their capture. This includes resolution, the quality and scale of the scan, file type, which determines how much data from the scan can be kept, and colour format which handles the colour accuracy of an image.
- Graphics tablet. A graphics tablet enables 2D and 3D artists to create complex graphics. Graphics tablets work in conjunction with different styluses such as brushes or pens and these tools are needed to effectively and efficiently create 2D and 3D graphics. The type of stylus used in this will also have a great impact on the final product, as various brushes and pens can have a different effect, and through a combination of this and adjustments of settings, it is possible to create various visually striking digital graphics.

The capture aspect of the hardware for creating 2D and 3D graphics has as a large impact on the hardware and software tool selection on the digital graphic usability and accuracy as it plays the biggest role in deciding how the graphics will be presented and therefore are crucial in the process.

Graphics card

There are a number of graphics card components that help with rendering and actually viewing the graphics on the screen are crucial in the creation and modification of 2D and 3D graphics. These include:

- RAM. RAM, or random-access memory, is a form of temporary storage where the computer stores information/data that it needs to retrieve quickly. RAM data is wiped whenever the computer restarts and is a highly essential form of storage for a computer. Often times, the more RAM a computer has, the more processes that the computer can run simultaneously and at faster speeds. In regard to the graphics card, RAM determines the performance speed of the graphics card, alongside the quality of the graphic, as not having enough RAM for the graphics card will lead to lower quality graphics being displayed in order to maintain the speed that the graphics are refreshed on the screen.

- Cache. Similar to RAM, the cache stores data that is needed and used often, i.e., computer instructions that were recently/frequently used and allows it to be used repeatedly without having to constantly go through the fetch, execute cycle. However, the cache is different in that it is much smaller than the RAM, with the larger average cache size being 32MB, whereas RAM is usually 8GB minimum, and gets up to 128GB. This would allow the graphics to be processed much faster and load quicker at a higher quality than if the cache did not exist.

There are more factors that affect the graphics card, such as VRAM, the type of interface, and the processor however adding them here would only serve to repeat what has already been said. The aforementioned aspects of graphics cards have significant impact on them due to their role in processing the graphics and ensuring that they are on the computer screen.

Output

There are many options available for outputting 2D and 3D graphics, such as a computer screen or a printer. The output determines how 2D and 3D graphics are displayed whether it be digitally or physically.

- Screens. There are primarily two kinds of screens that can impact how images, or graphics in this case, are displayed. These are cathode ray tube (CRT) and liquid crystal display (LCD), both of which are very different from one another. CRT, being much older than LCD, uses a sharp beam of electrons to hit a phosphor screen which is in front of a tube. Through this method it manages to display graphics, however they have a much more limited framerate and quality compared to LCD, alongside consuming more energy. LCD, which is much more modern than CRT, uses liquid crystals to produce images on the screen. This makes the displays much thinner and more energy efficient. Additionally, they are also much higher quality than CRT monitors and therefore are much more common compared to CRT monitors in the modern day. LCD provides a higher refresh rate and image quality, allowing it to represent 2D and 3D graphics more accurately compared to CRT graphics.
- Printers. Similarly to scanners, printers work with physical aspects of digital graphics, and allows digital graphics to be printed, put onto a piece of paper, and viewed as such. The big part of printers remains the printer resolution, which determines what quality the image will be that is printed onto the paper. This determines whether or not the graphic will be accurately represented or manipulated incorrectly.

Within the output, I would argue that the screens are much more important than compared to the printer, and therefore this should be considered more than the printer. While the printer is also important, in the modern world digital graphics are viewed and displayed much more often compared to printed graphics, and therefore these should be focused and prioritised on instead of printers.

Software

Applications for manipulating graphics

There are many software options available for manipulating 2D and 3D graphics within the context of digital graphics. These options each present their own strengths and weaknesses within creation and manipulation of 2D and 3D graphics. The desired software will be chosen based on the graphics being made and the intended final product. The type of graphic software includes:

- Vector based software applications such as Inkscape or adobe illustrator. These software applications are used to create graphics that are made up of paths and curves, which are essentially vector graphics, which allow them to be scaled up and down without losing image quality. As mentioned previously, vector graphics are primarily used in scenarios where scalability is needed, such as architecture.
- Raster based software applications such as GIMP and adobe photoshop. Raster graphic software applications are used to create raster images, which are images that are defined using pixels and therefore have a limited resolution scalability as stretching or shrinking will change the quality of the image. These kinds of images and graphics are used when fields do not require much scalability, such as digital photographs or paintings as these are often created in the scale that they will be used for.
- 3D image editors such as Blender and Maya. This software is used to create 3D models that have meshes and other aspects of modelling. 3D image editors are often used in fields like game development in order to create assets that can be used. Game engines often come with options that support these 3D image editors, encouraging them to be used.
- Image galleries is a type of software that allows users to view their images/digital graphics. They often also have the option to organise and share the graphics. An example of this includes Picasa.
- File conversion software allows files to be changed from format to another compatible format. This means that you would be able to change a png file to a jpg, however you would not be able to change an fbx file into an mp4 file. This is often used when working with multiple kinds of software within the same field, as it allows them to be compatible with each other.

The choice of specific software greatly impacts the development process of the graphics and therefore it is important that the correct and most compatible options are selected. These decisions should be based on user experience too, but primarily on the desired outcome as

if the incorrect software is chosen then it is unlikely that the outcome will be to the highest standard.

Impact of the hardware and software tool selection

The hardware and software tool selection in the 2D and 3D digital graphics plays a large role in accuracy and usability of those graphics and therefore these must be discussed below:

Export Ratios

Export Ratios are the resolution of a digital graphic when being exported out of a digital graphic software development program, and therefore is important when considering how high quality the graphic will be. For example, while a higher export ratio will have a significant impact on making the graphic more detailed, it could also increase the file size and lead to the performance taking a hit.

Compression

Compressions is about the ability to compress and minimise a file size in order to increase the performance. This, of course, can lead to a loss in quality and accuracy of the graphic, however in some scenarios it may be necessary to do so at it will allow other functions such as being able to send the file across the internet. Additionally, there are different compressions modes available, such as lossy and lossless, and these have to be taken into account in order to ensure that the compression is accurate and does not limit the usability of the graphic.

Channels

Channels are the number of colour channels used in a digital graphic and therefore help to ensure that the graphics colour accuracy is high. Additionally, having an appropriate number of channels can ensure that the colours within the graphic are accurate and therefore increase its usability. This will allow the graphic to be used across many different devices.

File Format

The file format of a digital graphic is crucial when considering the consequences of choosing the wrong one. For example, choosing to use a file format that does not have any compression, like .tif/.tiff (tagged image file format), may be essential when needing an image that is high quality, however this will also increase the file size in conjunction with the quality. This will ensure that the graphic will have a high accuracy.

Proofing

Proofing is the concept of testing and verifying the accuracy of a digital graphic before that graphic can be finalised. This helps to ensure that the graphic will be accurate and therefore usable.

Combining raster and vector graphics

Combining the two graphic types can help to promote dynamic and unique digital graphics, however it is a complicated and intricate process that requires a lot of time and skill to execute at a high standard. If done incorrectly, the graphic will be inaccurate and therefore unusable.

Image manipulation techniques

Image manipulation techniques are the ability to change a 2D or 3D graphic based on the requirements of the user, such as colour adjustments, resizing, and cropping. If done correctly, this can help to increase the accuracy of a graphic greatly and allow it to be used widely.

Evaluation

While there are several factors involved in the creation of 2D and 3D graphics through the use of the correct software and hardware, there are a number of factors that I believe are more valuable compared to others, due to their impact on the accuracy and usability of the graphics, alongside their development ability and final product produced.

One example of a feature that I do not believe is as pertinent as the others is compression. While compressions does allow some features through the use of it, I believe that the alternative measures to compressing the files allow for better and more accurate graphics, therefore increasing their usability. This includes;

- While compression works to reduce file size by taking away from quality, I believe that this can be mitigated simply by introducing more storage space. In the modern world as well, the file space is not simply restricted to the users physical capabilities on their device, but there are also cloud storage options which function almost as effectively as physical storage, if not better, and therefore this means that the compromise that the users have to take with compressions for file size, reduction of quality for more space, is no longer necessary and should not be considered as significant as the other software and hardware tools.

It is because of this blaringly obvious option that I do not believe that compression is as important as a factor of hardware and software options, and that there are other options available that have a larger impact on the 2D and 3D graphics through the software and hardware.

Additionally, another example of a feature that I do not believe is as important as the others is the capture aspect of hardware that was previously discussed. While there are some aspects of creating 2D and 3D graphics that use the capture hardware in order to create effective and high quality graphics, I believe that the options available make it so that capture is not important or vulnerable to process of creating 2D and 3D graphic design. This includes:

- The stylus used to create 2D and 3D graphics often times does not matter. As long as it functions on the designated platform, then the other options that might be completed by the specific pen options, like a brush, can be achieved the software used for inputting the pens touch. For example, the brush type can be changed from a pen to a thick spray paint within the software, negating the need to change stylus and reducing the impact of the capture aspect of software and hardware features that impact the accuracy and usability of 2D and 3D graphics.
- Furthermore, the need of hardware like cameras or scanners to create 2D and 3D graphics is also reduced by the software options available. 3D modelling software, like blender, present the options to create models completely from scratch and are made to be fully customisable. Finally, 2D graphics can simply be created from scratch using software like photoshop and drawing applications like procreate, reducing the necessity of the hardware.

It is for these extensive reasons and ability to mitigate the need for the capture aspect of the software and hardware options that impact the usability and accuracy of 2D and 3D graphics, that I believe that capture is not as important or essential as other factors within software and hardware tools that impact graphic design and development.

On the contrary, I believe that something like the output hardware, from software and hardware tools, has a much more significant impact. The output, more specifically screens, allows the creation and manipulation of 2D and 3D graphics by displaying them on screen so that the users can see what they are actually interacting with. Further reasons include;

- Without the screens to output the graphics the users would be unable to even being editing or creating a graphic, making it an unmitigable and therefore essential, which is a direct contract to the capture and compression sections mentioned previously.
- Furthermore, with better screen to output information, the user can create higher quality and more detailed graphics, helping to increase their accuracy and usability in other fields.

It is for these reasons, and primarily due to the fact that an output cannot be mitigated unlike the others, that I believe that screens are one of, if not the most, important aspect of creating graphics in regards to software and hardware tools used that impact the creation of 2D and 3D graphics and their usability/accuracy.

Finally, I also believe that the software applications for manipulating graphics are also vital in the creating accurate and usable graphics for 2D and 3D in regard to the software and hardware tools available. I have not mentioned any specific software applications, only those specifically designed to manipulate 2D and 3D graphics as mentioned above, as they all play a specific role in their own respective fields, i.e., 3D modelling and 2D digital graphics. Further reasons include:

- The ability to physically create and manipulate these graphics that are made is only due to the software provided that allows these options. Similarly to the screen, without the software needed to do this, graphics for 2D and 3D could not be made in the first place and therefore are essential. Like the screen, it cannot be mitigated and this further promotes this.

It is due to the aforementioned reasons that I believe that software applications that allow the manipulation/creation of graphics, in regard to the software and hardware tools discussed previously, ensures that is more important than other aspects of software and hardware tools and the accuracy and usability of 2D and 3D graphics. Without software applications to do so, the ability to even make a graphic, let alone an accurate one, would be impossible.

To conclude, while I believe there are some aspects that are fundamental to the creation of 2D and 3D graphics in regard to software and hardware tools, alongside accuracy and usability of the final product, the context of the situations, similarly to before, is also crucial as this allows the correct decisions to be made and those choices should be based on a generalisation like this. Contrary to the previous evaluation, however, I still believe that

even if compression and capture aspects of software and hardware tools, among other potentially less impactful parts of software and hardware tools in regard to accuracy and usability of graphic, that the screens and software applications will always be the most important software and hardware tools to consider when discussing the impact of those tools on accuracy and usability of 2D and 3D graphics.