# 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 hand made 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.

## 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

### Capture

### Graphics card

### Output

## Software

### Applications for manipulating graphics