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Raster and Vector Graphics and Raster to Vector Conversion

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ABSTRACT: The purpose of this study is to introduce everyone with types of computer graphics i.e. Raster and vector graphics. Telling the differences between the two types and how one is better than other and which graphics type is better for your work. Introducing with the manual way to convert raster to vector graphics and vice versa and also to give brief introduction of various automatic software available for graphics conversion.

KEYWORDS: Pixels, Two-dimensional (2D), Three-dimensional (3D), Graphics Processing Unit (GPU)

I. INTRODUCTION

Graphics are something visual or what we can see on a surface but mostly we consider that surface to be a screen. Examples of graphics are photographs, drawings, diagrams, geometric shapes or anything that we see on our screen. There are two types of computer graphics and these are Raster and Vector graphics. A raster graphics is a dot matrix data structure which generally represents grid of pixels or point of colour on a monitor or display medium. Our normal use graphics are mostly raster graphics. These graphics have a fixed dimension and zooming further than that dimension will result in pixelating the graphics. Raster graphics format are jpeg, exif, tiff, gif, bmp, png etc. The other type of graphics is Vector graphics. vector graphics is a creation of digital images by commands or mathematical statements that place line and shape in a given two-dimensional or three-dimensional space. Vector graphics are difficult to create than the raster graphics but the main advantage of vector graphics over raster graphics is no matter the display size the graphics will look crisp or never look pixelated.

II. RASTER GRAPHICS

Raster graphics are made up of pixels. Pixels are small square of information. We give colour to each pixel and stacking pixels together makes a graphic. We zoom out we cannot see individual pixel and the graphics look beautiful and crisp to us. But if we zoom in we can see the graphics pixelating.



This is a raster image and in this resolution



But there is a fixed resolution of

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image looks very crisp.

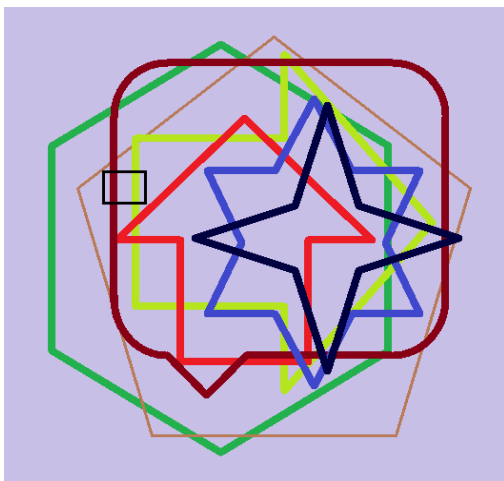
raster graphic and on zooming in you can see image pixelating which shows that the raster graphics are made by coloring individual pixels

Advantages: Raster graphics are the best way to create rich and detailed images. almost any program can work with a simple raster file. Every pixel in a raster image can be a different colour therefore you can create any kind of image you like with any kind of colour changes and variations you want. Due to the nature of the data storage technique data analysis is usually easy to program and quick to perform. The nature of raster maps is well suited for mathematical modeling and quantitative analysis.

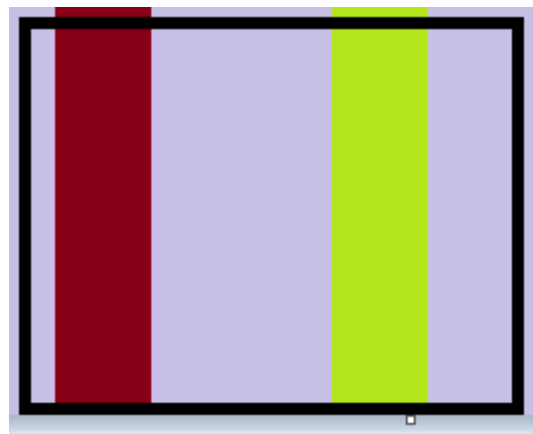
Disadvantages: Raster images cannot be scaled up in size very well. If you try to zoom in on a raster image, it will look pixelated and distorted. This is because raster images are created with a fixed number of pixels. When you zoom in on a raster image or increase the size of raster image beyond its fixed size, it becomes pixelated because there are no longer enough pixels to fill in this larger space, gaps are created between the pixels in the image. Even if you use photo editing tools the resulting image will be blurred. Raster graphics files are often quite large. Raster graphics files contain all the information for every single pixel of the image that you are working with. raster images hold so much data, they may be slower to edit. Each of these pixels has an X and Y coordinate as well as colour information associated with it therefore raster graphics files tend to be very large. Because raster images are based on square pixels, your drawing or diagrams may look like it has square edges. If you want an image with smoother edges, it is best to use vector graphics instead of raster graphics.

III. VECTOR GRAPHICS

Vector graphics are made through algorithms and mathematical formulas. A vector graphic is made up of small points that combine to make line and diagrams. No matter the resolution vector images will always look clean and crisp.



These geometric shapes are vector graphics and they don't have any fixed resolution.



Even after cropping the small region of the above image and zooming in you can't see any pixel. This is the main benefit of vector graphics.

Advantages: Vector files are small because they contain a lot less data than raster files. Vector graphics are more flexible than raster graphics because they can be easily zoomed in and zoomed out without any loss of quality of the image. Vector graphics have smoother lines when compared to square pixel-based raster graphics therefore, they are

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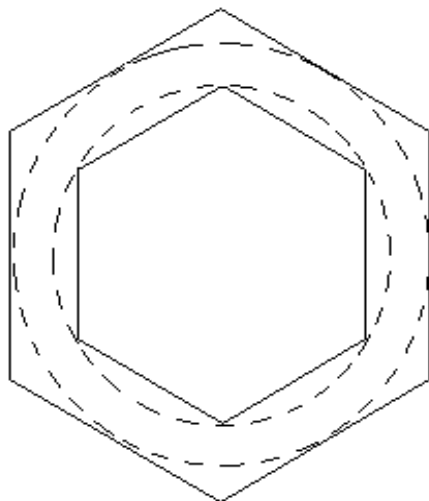
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better with straight lines and curves than the raster graphics. Data can be represented at its original resolution and form without any problem. Graphic output is usually more beautiful and crisp on any resolution.

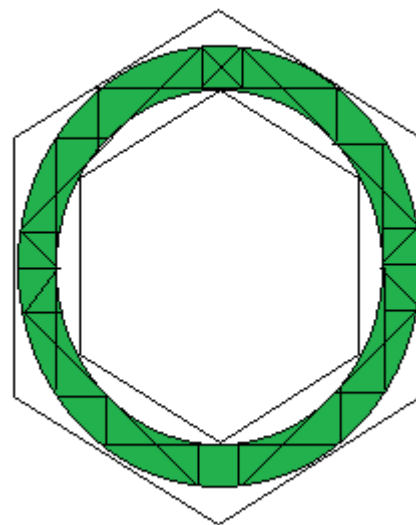
Disadvantages: If there are any small errors or deformities in a vector image, it will be seen when the vector image is significantly zoomed in or increased in size. Vector graphics are generally filled with a solid color or a gradient. They can't display the lush color depth of a raster graphic Algorithms for manipulative and analysis functions are complex and may be processing intensive.

IV. WHICH TYPE OF GRAPHICS TO USE

Most of the graphics we use are raster graphics. Images we take through our camera or any drawing or sketch we make is a raster graphic. Texts in our computer Notepad or any text editor are vector images. No matter the size they will look aesthetically pleasing. Vector graphics take a toll on our graphic processing unit and are slower to load. In game development, each target platform's resolution and size has to be taken into consideration when creating artwork for games. Decisions have to be made on whether raster (or bitmap) images and/or Vector images are used for the artwork Raster graphics are made up of pixels. Pixels are small square of information. We give colour to each pixel and stacking pixels together makes a graphic. Vector graphics are made through algorithms and mathematical formulas. A vector graphic is made up of small points that combine to make line and diagrams. A vector image is not made up of pixels but of lines and curves that can be re-calculated and re-sized at runtime. This results in a smaller image file size than bitmaps and offers a lot more flexibility when it comes to scaling images. However, the most commonly used images are bitmaps. When it comes to achieving the highest performance with images vector images tend to be slower because of the re-calculations that have to happen at runtime. A bitmap image size and colour information is defined ahead of time and embedded into every pixel of the image which speeds things up. We always like to save effort of pre-calculation of size and resolution of raster graphic and will always like to use vector images so that images can just be scaled to fit whichever device the game needs to run on without any loss in quality but it is not just that simple. Bitmap images hold a lot more colour information and can have a much more realistic look and feel, whereas vector images can only render basic colours.



Bitmap generation step 1



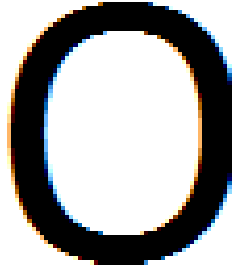
Multiple polygons/ quads with bitmap painted on

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Bitmap of a letter

You can run into another problem dealing with vector images when wanting to render your game using a GPU rendering engine because it takes a lot of processing to render a vector graphic. GPUs render various types of bitmap graphics depending on the unit. The GPU can calculate the position of polygons and render raster images to the screen faster than vector images.

V. MANUAL CONVERSION OF RASTER GRAPHICS TO VECTOR

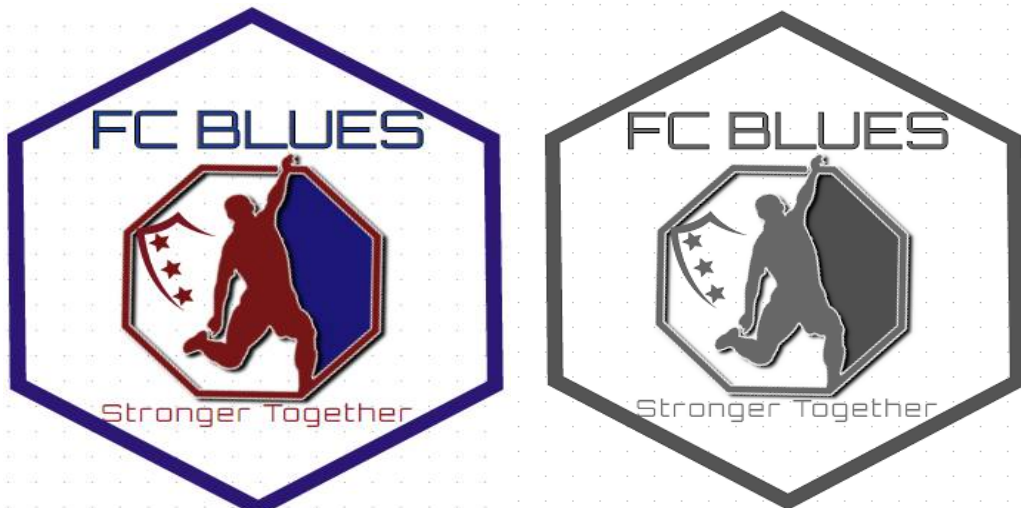
The process of raster image to vector image is known as vectorization. This process is not conversion of 2D image to 3D image. Any raster image containing geometric shapes, lines or curves are easy to vectorize. Continuous tone photographs such as portraits are not good candidates for this process.

Following steps are involved in Image vectorization:

1. Image greyscaling
2. Noise filtering
3. Segmentation
4. Thinning
5. Tracing
6. Filtration
7. Analysis and interpretation

Consider the following raster image. Now we will try to apply vectorization process on the image.

1. Firstly image is greyscaled and noise is removed from the image. We always going to need some kind of image editors for this purpose.



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2. Next step involves image segmentation. Image is segmented into small parts depending on complexity of the image. Let we cut a small segment of the above image and we will apply rest of the vectorization step on that segment.
3. Next image is thinning the borders in the segmented image and tracing line and curves.



4. Then we filter the vector curves of the image and keep only necessary curves and lines. The generated vector is then analysed with the original image.



5. In the end image is coloured to make the image look like the actual raster image.

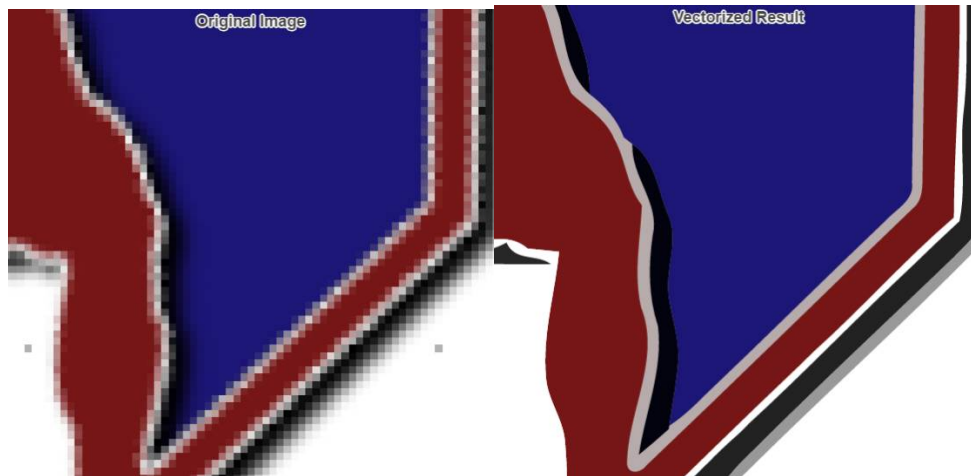
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Following are the vectorization steps performed on various image segments:



In the end vectorized image is saved into SVG format. In the above example, GIMP image editor is used because that's a free editor and you can use any of the image editor discussed in the next section. Following is the vector image of the original raster image we used:



VI. COMMERCIAL TOOLS FOR CONVERSION

There are various tools available on internet for graphics conversion i.e. from raster to vector graphics or vice versa. We can always get free software for any task but paid ones work better and have more features. Same is with the case



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of graphics conversion tools/software. There are tools like Inkspace, Imagetracer etc. but most famous are Adobe Illustrator and Super Vectorizer. These tools give different results and you may find different tools most satisfactory depending upon your taste and need. Following is the list of most famous tools for graphics conversion and their availability status:

NAME	AVAILABILITY
ADOBE STREAMLINE	DISCONTINUED
CORELDRAW	PAID
EASY TRACE	PAID
MACROMEDIA FREEHAND	PAID
ADOBE ILLUSTRATOR	PAID
INKSCAPE (USING POTRACE)	FREE
IMAGETRACER	FREE
MAGICTRACER	PAID
POTRACE	FREE
SCAN2CAD	PAID
WINTOPO FREWARE	FREE
WINTOPO PRO	PAID
XARA PHOTO & GRAPHIC DESIGNER	PAID
SUPER VECTORIZER	PAID

VII. CONCLUSION AND FUTURE WORK

In this paper, we studied two types of graphics i.e. raster and vector graphics. Raster graphics are fixed sized and support more colours whereas vector graphics can be scaled to any size without pixelating the graphic but support less colours. In game development, we try to use raster graphics because they need less processing from the Graphical processing unit. But if your application or game does not need much of processing then you can and you should use vector graphics as these graphics can be scaled to any size. Then we discussed about manual way to convert raster graphics to vector graphics and various automatic tools available in the market. The information provided in this paper can be used to decide the graphics type you should use in your game or any other application. We can also create our own tool for graphics conversion with much more study and research down this path.

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BIOGRAPHY

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