

(12) INNOVATION PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2019101827 A4**

(54) Title
A method for automatic vector watermarking

(51) International Patent Classification(s)
G06T 1/00 (2006.01) **G06T 7/00** (2017.01)

(21) Application No: **2019101827** (22) Date of Filing: **2019.08.30**

(30) Priority Data

(31) Number	(32) Date	(33) Country
62/298,900	2016.02.23	US

(45) Publication Date: **2019.09.26**

(45) Publication Journal Date: **2022.05.26**

(45) Granted Journal Date: **2022.05.26**

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Abstract

An automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering, as disclosed in this disclosure.

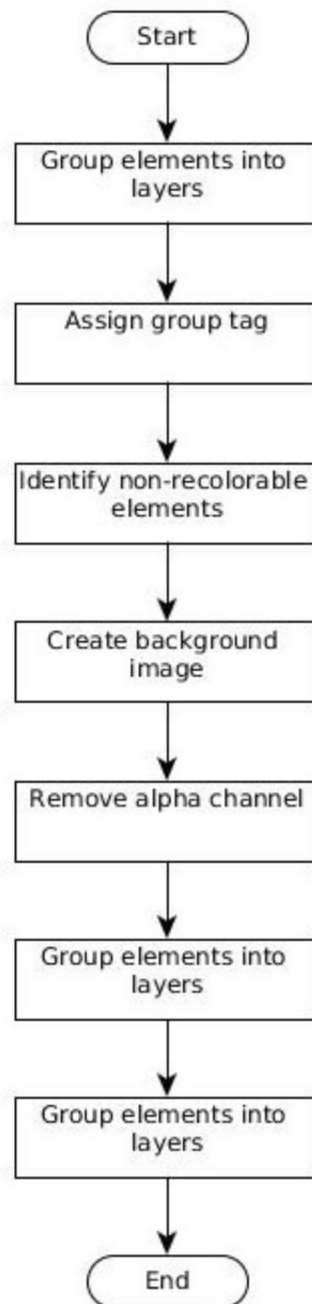


Figure 1

A METHOD FOR AUTOMATIC VECTOR WATERMARKING

FIELD OF THE INVENTION

[0001] The present invention relates generally to watermarking images, and more specifically to an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering.

BACKGROUND

[0002] In the graphics industry, watermarking images protects the image so that only authorized usages are permitted. However, currently available methods create lower resolution images that make it difficult for graphic designers and users to fully mock up a design or presentation for approval. These lower resolution images also make it difficult for decision makers to authorize the purchase of non-watermarked versions of the images without seeing the complete, full resolution graphic.

[0003] In order to sell individual vector images and maintain control of the image prior to, and after the purchase of the image, the images must be watermarked.

[0004] Natively watermarking a vector image can be done by adding elements that visually obscure the content of the document. However, these modifications can be easily undone with an image editing app or even a text editor. Another watermarking method is accomplished by obfuscating the vector image so it is very hard to tell which parts of it belong to the watermark and which belong to the document is a possibility but is hard to do in a way that doesn't affect how the vector image looks. Another method for watermarking vector images is to rasterize the vector image, by converting the vector image into an image specified by pixels, and then apply a watermark on top of the rasterized version. The conversion from a vector format to a raster format is generally lossy so the original cannot be reconstructed easily or as exact as the lossless vector image. Using this method would remove the benefits of a vector image, including being able to scale up the image larger without pixelation and being able to dynamically recolor elements in the image.

[0005] Therefore, there is a need for an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] These and other features, aspects and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying figures where:

[0007] Figure 1 is a schematic diagram of some steps of a method for an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering, according to one embodiment;

[0008] Figure 2 is a drawing of a sample vector image at it appears before the watermarking process;

[0009] Figure 3 is a drawing of a portable network graphic image (PNG) image sprite sheet showing the various layers of the vector image of Figure 2;

[00010] Figure 4 is a drawing of a recolorable watermarked vector in a graphic editor;

[00011] Figure 5 is a drawing of a second original vector image split into layers;

[00012] Figure 6 is a drawing of recolorable elements of the second original vector image set to black rasterized with a watermark;

[00013] Figure 7 is a drawing of the second original vector image of Figure 6 split into an alpha mask;

[00014] Figure 8 is a drawing of a background image output from the system, necessary for rendering the second original vector;

[00015] Figure 9 is a drawing of a rasterized second original vector image after setting the first layer elements to white;

[00016] Figure 10 is a drawing of the rasterized second original vector image of Figure 9 after subtracting the background image;

[00017] Figure 11 is a drawing of a rasterized image after setting the first layer elements to white are the same but for the second layer;

[00018] Figure 12 is a drawing of the rasterized image after setting the second layer elements to white after subtracting the background image;

[00019] Figure 13 is a drawing of a is the colored layer one of the second original vector image;

[00020] Figure 14 is a drawing of a is the colored layer two of the second original vector image;

[00021] Figure 15 is a drawing of recolored second original vector image layers composited together with the background image;

- [00022] Figure 16 is a drawing of an alpha mask applied to the composited second original vector image providing a final render;
- [00023] Figure 17 is a drawing of a second vector image with the first layer colored blue;
- [00024] Figure 18 is a drawing of the second vector image with a second layer colored red;
- [00025] Figure 19 is a drawing of a watermarked version of the second vector image where the image layers are recolored to the original colors; and
- [00026] Figure 20 is a drawing of an alpha mask applied to the composited blue and red second vector image showing a final render.

DETAILED DESCRIPTION

[00027] The present invention overcomes the limitations of the prior art by providing an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering. The automatic system and method described below produces rasterized vector images for watermarking while keeping the ability to dynamically recolor the rasterized vector images by rendering the rasterized vector images. The final output of the rendering is the same as if the vector had been recolored and then rasterized without the loss of image quality normally associated with current rasterization processes.

[00028] The system makes it possible to watermark any vector image and control or track the distribution and use of the vector image. This provides a way for single and multiple vector images to be purchased or licensed for a single use or multiple uses. The prices for various options will be available during the checkout process. This provides many more potential sales of vector images for use in various projects. It will also allow graphic designers to test various designs with different vector images prior to committing to, or receiving approval for, a specific layout, increasing the flexibility of the graphic design process and reducing the costs for stock images.

[00029] All dimensions specified in this disclosure are by way of example only and are not intended to be limiting. Further, the proportions shown in these Figures are not necessarily to scale. As will be understood by those with skill in the art with reference to this disclosure, the actual dimensions and proportions of any system, any device or part of a system or device disclosed in this disclosure will be determined by its intended use.

[00030] Systems and methods that implement the embodiments of the various features of the invention will now be described with reference to the drawings. The drawings and the associated descriptions are provided to illustrate embodiments of the invention and not to limit the scope of the invention. Reference in the specification to “one embodiment” or “an embodiment” is intended to indicate that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least an embodiment of the invention. The appearances of the phrase “in one embodiment” or “an embodiment” in various places in the specification are not necessarily all referring to the same embodiment.

[00031] Throughout the drawings, reference numbers are re-used to indicate correspondence between referenced elements. In addition, the first digit of each reference number indicates the figure where the element first appears.

[00032] As used in this disclosure, except where the context requires otherwise, the term “comprise” and variations of the term, such as “comprising”, “comprises” and “comprised” are not intended to exclude other additives, components, integers or steps.

[00033] In the following description, specific details are given to provide a thorough understanding of the embodiments. However, it will be understood by one of ordinary skill in the art that the embodiments can be practiced without these specific detail. Well-known structures and techniques can not be shown in detail in order not to obscure the embodiments. For example, algorithms can be shown in block diagrams in order not to obscure the embodiments in unnecessary detail.

[00034] Also, it is noted that the embodiments can be described as a process that is depicted as a flowchart, a flow diagram, a structure diagram, or a block diagram. Although a flowchart can describe the operations as a sequential process, many of the operations can be performed in parallel or concurrently. In addition, the order of the operations can be rearranged. A process is terminated when its operations are completed. A process can correspond to a method, a function, a procedure, a subroutine, a subprogram, etc. When a process corresponds to a function, its termination corresponds to a return of the function to the calling function or the main function.

[00035] Moreover, a storage can represent one or more devices for storing data, including read-only memory (ROM), random access memory (RAM), magnetic disk storage mediums, optical storage mediums, flash memory devices and/or other machine readable mediums for storing information, such as, for example a database. The term "machine readable medium" includes, but is not limited to portable or fixed storage devices, optical

storage devices, wireless channels and various other mediums capable of storing, containing or carrying instruction(s) and/or data.

[00036] Furthermore, embodiments can be implemented by hardware, software, firmware, middleware, microcode, or a combination thereof. When implemented in software, firmware, middleware or microcode, the program code or code segments to perform the necessary tasks can be stored in a machine-readable medium such as a storage medium or other storage(s). One or more than one processor can perform the necessary tasks in series, distributed, concurrently or in parallel. A code segment can represent a procedure, a function, a subprogram, a program, a routine, a subroutine, a module, a software package, a class, or a combination of instructions, data structures, or program statements. A code segment can be coupled to another code segment or a hardware circuit by passing and/or receiving information, data, arguments, parameters, or memory contents. Information, arguments, parameters, data, etc. can be passed, forwarded, or transmitted through a suitable means including memory sharing, message passing, token passing, network transmission, etc.

[00037] In the following description, certain terminology is used to describe certain features of one or more embodiments of the invention.

[00038] The term “vector image” refers to either a single image or an entire document that is constructed of one or more than one vector element.

[00039] The term “vector element” refers to any current or future multimedia files, design elements or objects including images, clip art, video and audio, fonts, design layouts, layouts that are in a vector format.

[00040] Various embodiments provide an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering. In another embodiment, there is provided a method for using the system. The system and method will now be disclosed in detail.

[00041] Referring now to Figure 1, there is shown a schematic diagram of some steps of a method for an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering, according to one embodiment. First, the system comprises instructions executable on a processor for grouping elements in the vector image document into layers that should be recolorable together in the rendered image. The elements are grouped into layers by color and the layers are annotated in the vector image document using unique identifiers on group tags that contain those elements. For example, the group tag: <g id='group_1'> would be a group tag

containing elements in layer 1. Not all vector image documents will comprise a group tag. However, the layers of the vector image document can be annotated. Also, not all elements in the vector image document need to be in a layer. Those elements that will not be recolorable during rendering will not be in a layer. This can be desirable if some parts of the vector image document will not be dynamically recolored at all. Additionally, the annotation is only required if it is desired to recolor the original vector in the same way as the rasterized version. The original vector image in the final print quality version of designs so it is necessary that it is colored the same way as the watermarked version the user sees. If this is not required the annotation part can be skipped and the elements for each layer can just be stored in memory.

[00042] Then, a fill color, normally black, is applied to all elements in each layer and rasterized the image to get a background image. Any available rasterizer can be used as the rasterizer.

[00043] Next, the alpha channel is removed from the rasterized background image and saved as an alpha mask for the rendered image.

[00044] Then, each layer, all of the elements of each layer is recolored white while keeping elements belonging to other layers black.

[00045] Next, the resulting vector image is rasterized, the alpha channel is removed and a per-pixel subtraction is performed from the background image. This results in a grayscale image where the grayscale value of a pixel is the amount of color of the layer contributes to the color of that pixel in the final image. For example, a pixel value of 0 indicates that the layer doesn't effect that pixel's color. Conversely, a pixel value of 255 indicates that the layer determines the color of the final pixel in the image.

[00046] Then, the alpha mask, the background rasterization and each subtracted layer rasterization are output. The output can be mosaiced together into a single spritesheet image for serving as a single image.

[00047] Next, Rasterization will protect reconstruction of the original vector image but a watermark can also be applied over the top of the vector at the start of the process or during each rasterization to remove information from the vector image document and protect it further.

[00048] Then, the resulting rasterized vector image document is rendered. To render the image each grayscale layer image is recolored by multiplying the desired color for the layer by the percentage gray each pixel in the layer image. For example, if a layer with an

red, green, blue (RGB) value corresponding to (244,164,96) the result for black (grayscale 0) will be (0, 0, 0), for white (grayscale 255) will be (244,164,96) and for a medium gray (grayscale 127, ~50% of 255) will be (122, 82, 48). As will be understood by those with skill in the art with reference to this disclosure, the methods and operations described above are not limited to the RGB color space. The method and operations can be applied in other color spaces. The RGB description above is an exemplar only and not intended to be limiting.

[00049] Next, the recolored layers are composited together with the background layer by directly adding corresponding pixel values.

[00050] Finally, the alpha mask is then applied to the resulting image to add transparency and produce the final recolored image.

[00051] Referring now to Figure 2, there is shown a drawing of an original vector image at it appears before the watermarking process. As will be understood, the vector image can be a stand-alone image or multiple vector images.

[00052] When the original vector image is rasterized the various elements of the original vector image are composited according to the rules of their surrounding tags, the net result is invariably that the contribution of each layer can be represented by a sum of weighted components.

[00053] The formula for alpha composition is:

$$C_0 = \frac{C_a \alpha_a + C_b \alpha_b (1 - \alpha_a)}{\alpha_a + \alpha_b (1 - \alpha_a)}$$

(Formula 1)

[00054] In this formula C_a represents the color you're changing (recoloring), and α_a represents the weight of its contribution (transparency) to a pixel. C_b and α_b represents everything else (the background). The contribution of that pixel, and the background are treated as constants then the formula becomes:

$$C_0 = C_a \frac{\alpha_a}{\alpha_a + \alpha_b (1 - \alpha_a)} + C_b \frac{\alpha_b (1 - \alpha_a)}{\alpha_a + \alpha_b (1 - \alpha_a)}$$

$$\begin{aligned}
C_0 &= C_a \quad k_a + k_{base}, k_a \\
&= \frac{\alpha_a}{\alpha_a + \alpha_b(1 - \alpha_a)}, K_{base} \\
&= C_b \frac{\alpha_b(1 - \alpha_a)}{\alpha_a + \alpha_b(1 - \alpha_a)}
\end{aligned}$$

(Formula 2)

[00055] That is simply the weighted color plus a constant. So for n different recolorable colors, each pixel is represented as:

$$C_0 = C_1 k_1 + \dots + C_n k_n + K_{base}$$

(Formula 3)

[00056] The can be stored in a component of the output image can be stored in 0-4 components, depending on if it contributes anything, or if transparency is needed.

[00057] The weights $k_1 \dots k_n$ and k_{base} can be derived by rasterizing the original vector

image once for each color component, with $C_i = [1 \ 1 \ 1]$ (white) for the target component,

and $C_i = [0 \ 0 \ 0]$ (black) for every other component. The value of the component is

therefore:

$$k_i = C_0 - K_{base} \quad \text{(Formula 4)}$$

[00058] For watermarking, the contribution of the pixels under the watermark would be diminished, or entirely removed. This basically means that the pixel value would be small or zero, and therefore lossy or not recoverable (watermarked). The watermark is likely the main contribution for k_{base}

[00059] If the number of channels in the original vector image is less than four then it can be encoded as a normal jpg, if it is more than four then the original vector image can be encoded as a jpg or by tiling the components in groups of three or four. There would need to

be additional metadata about how many base components there are, including transparency, and what the default colors are. Although the jpg noted above is used as an exemplar, any raster image format will work. Also, because most image formats only have four channels, the example above only encodes each layer as a channel, which is why the limit, in this case, is four.

[00060] Any preprocessing of the original vector image can be done server-side or on an export machine.

[00061] Referring now to Figure 3, there is shown a drawing of a portable network graphic image (PNG) image sprite sheet showing the various layers of the vector image of Figure 2. As can be seen, the water mark in the upper third portion of the vector image document comprises watermarking elements that will be added to the original vector image of Figure 2. The middle third of Figure 3 shows various elements of the original image that are not changed as shown in the left-most image, and two changed vector elements to the right that have the watermark from the upper third of the Figure added to the spritesheet. Also in the lower third of the Figure, there are additional changed elements with the watermark added to them before additional processing is executed.

[00062] Referring now to Figure 4, there is shown a drawing of a recolorable watermarked vector in a graphic editor. As can be seen, the recolorable watermarked vector can be manipulated in any type of graphics editor that can accommodate the file format. This provides the user to make changes to the original vector image without altering the watermarks. This makes it possible to modify the original vector image to conform to the graphic design contemplated while still being protected. Until the vector image is purchased, the watermark is not able to be removed so the use of the original or modified vector image can be tracked.

[00063] Referring now to Figure 5, there is shown a drawing of a second original vector image split into layers. As can be seen there are three separate layers comprising various vector elements that can be watermarked.

[00064] Referring now to Figure 6, there is shown a drawing of recolorable elements of the second original vector image set to black rasterized with a watermark. Using the method described above, each of the layers of the second original vector image are converted, rasterized, a watermark added and recombined and rendered back into the second original vector image with watermark.

[00065] Referring now to Figure 7, there is shown a drawing of the second original

vector image of Figure 6 split into an alpha mask. The alpha mask specifies how the second original vector image pixel's colors should be merged with another pixel when the two are overlaid, one on top of the other.

[00066] Referring now to Figure 8, there is shown a drawing of a background image output from the system, necessary for rendering the second original vector. As can be seen the watermark is overlaid with the second original vector image after it has been rasterized.

[00067] Referring now to Figure 9, there is shown a drawing of a rasterized second original vector image after setting the first layer elements to white.

[00068] Referring now to Figure 10, there is shown a drawing of the rasterized second original vector image of Figure 9 after subtracting the background image.

[00069] Referring now to Figure 11, there is shown a drawing of a rasterized image after setting the first layer elements to white are the same but for the second layer.

[00070] Referring now to Figure 12, there is shown a drawing of the rasterized image after setting the second layer elements to white after subtracting the background image.

[00071] Referring now to Figure 13, there is shown a drawing of a is the colored layer one of the second original vector image.

[00072] Referring now to Figure 14, there is shown a drawing of a is the colored layer two of the second original vector image.

[00073] Referring now to Figure 15, there is shown a drawing of recolored second original vector image layers composited together with the background image. This is the final step before the newly watermarked image is compositing the watermark, the background and the recolored image together.

[00074] Referring now to Figure 16, there is shown a drawing of an alpha mask applied to the composited second original vector image providing a final render.

[00075] Referring now to Figure 17, there is shown a drawing of a second vector image with the first layer colored blue. As can be seen, the various layers and elements of the second original vector image can be altered during the process. This makes it possible to provide many different watermarked images without the normal manual processing that is currently associated with this process and without loss of resolution in the image.

[00076] Referring now to Figure 18, there is shown a drawing of the second vector image with a second layer colored red. As described above, the ability to alter colors during the rendering process provides additional options not previously available to graphics professionals prior to this invention.

[00077] Referring now to Figure 19, there is shown a drawing of a watermarked version of the second vector image where the image layers are recolored to the original colors.

[00078] Referring now to Figure 20, there is shown a drawing of an alpha mask applied to the composited blue and red second vector image showing a final render.

[00079] What has been described is a new and improved automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering, overcoming the limitations and disadvantages inherent in the related art.

[00080] Although the present invention has been described with a degree of particularity, it is understood that the present disclosure has been made by way of example and that other versions are possible. As various changes could be made in the above description without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be illustrative and not used in a limiting sense. The spirit and scope of the appended claims should not be limited to the description of the preferred versions contained in this disclosure.

[00081] All features disclosed in the specification, including the claims, abstracts, and drawings, and all the steps in any method or process disclosed, can be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. Each feature disclosed in the specification, including the claims, abstract, and drawings, can be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[00082] Any element in a claim that does not explicitly state "means" for performing a specified function or "step" for performing a specified function should not be interpreted as a "means" or "step" clause as specified in 35 U.S.C. § 112.

What is claimed is:

1. An automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering, as disclosed in this disclosure.
2. A method for using an automatic method for rasterizing vector images for watermarking and dynamically recoloring the vector images comprising a watermark using rendering, as disclosed in this disclosure.

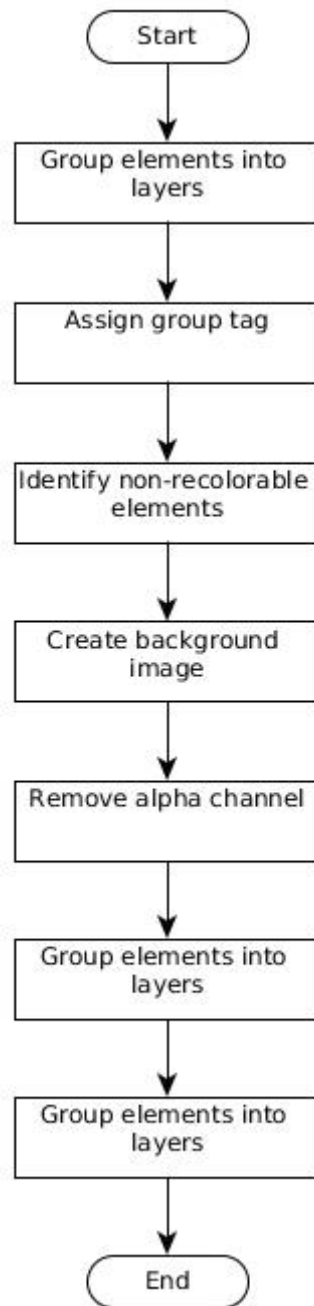


Figure 1



Figure 2

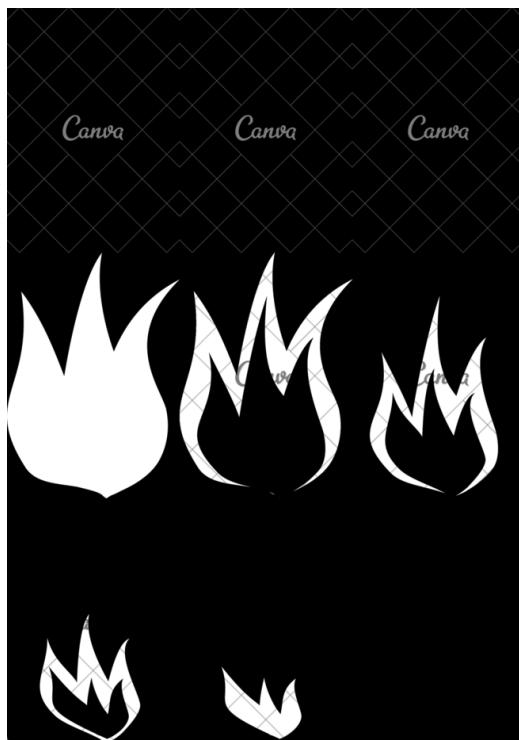


Figure 3

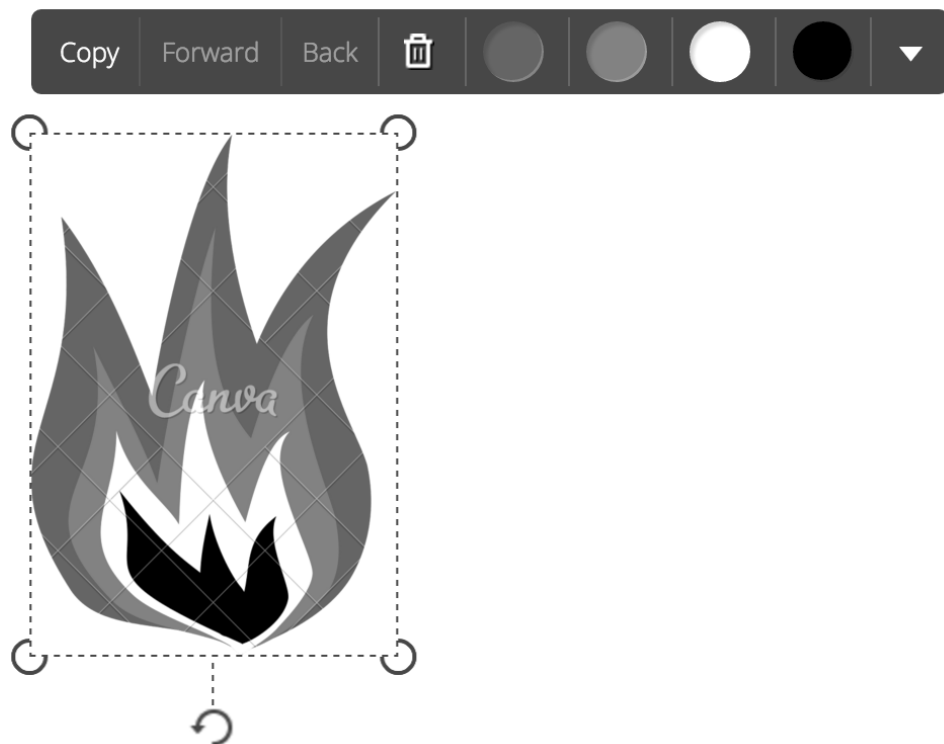


Figure 4

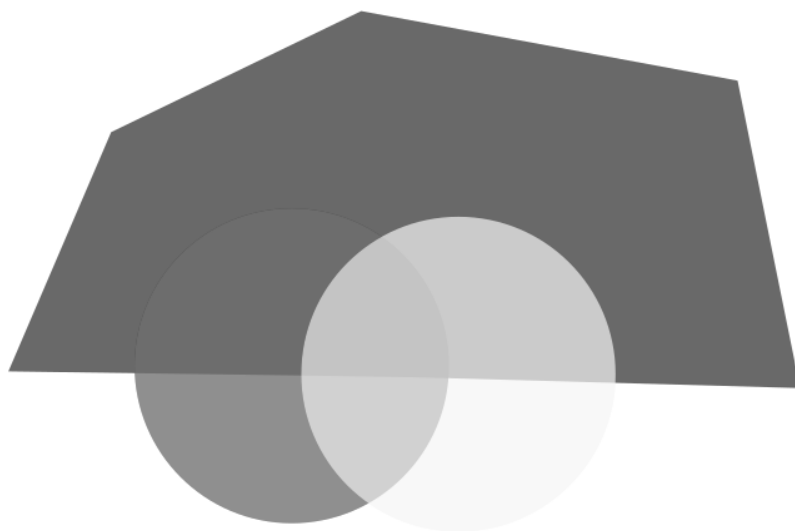


Figure 5

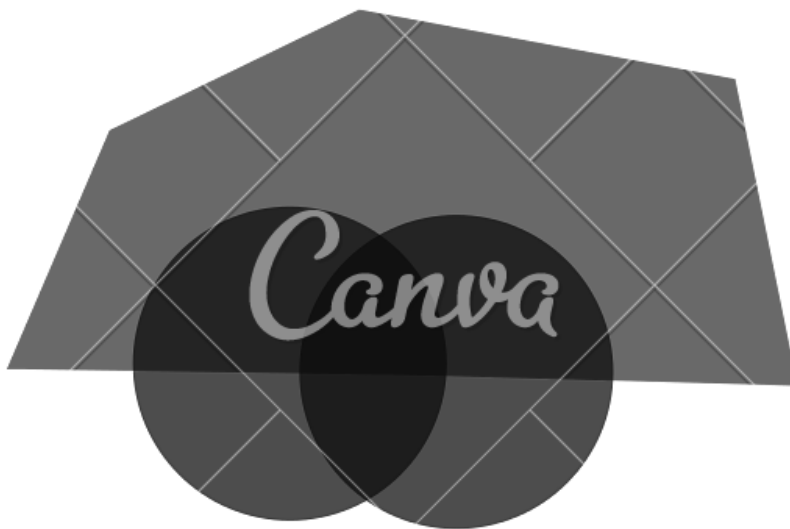


Figure 6

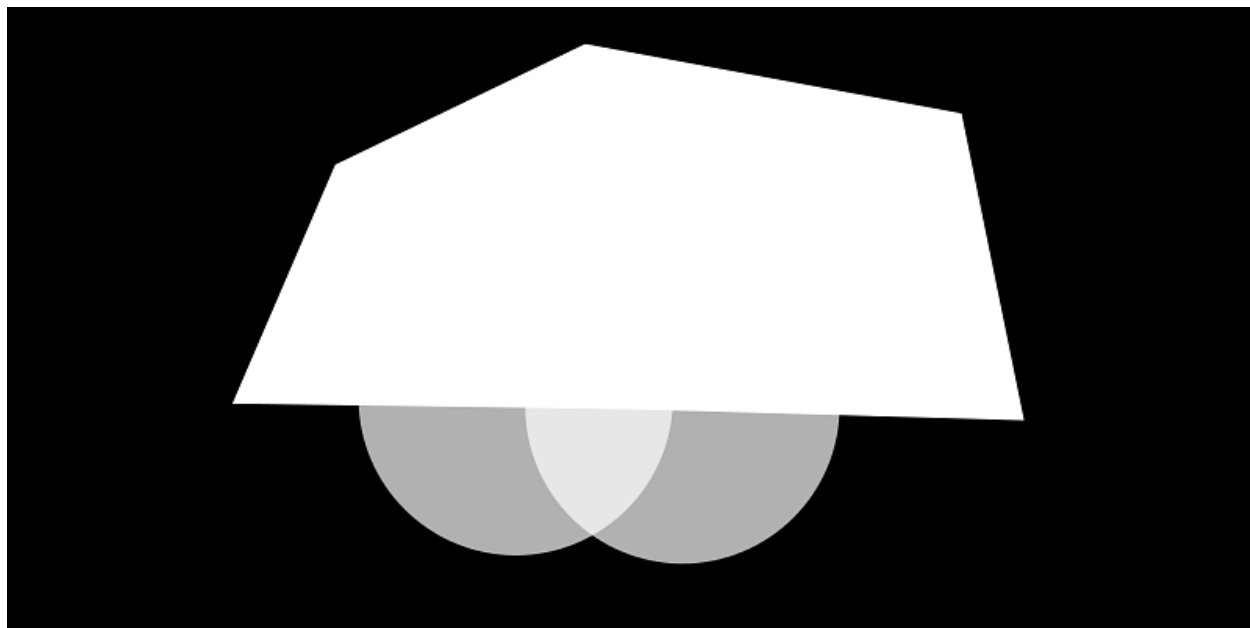


Figure 7

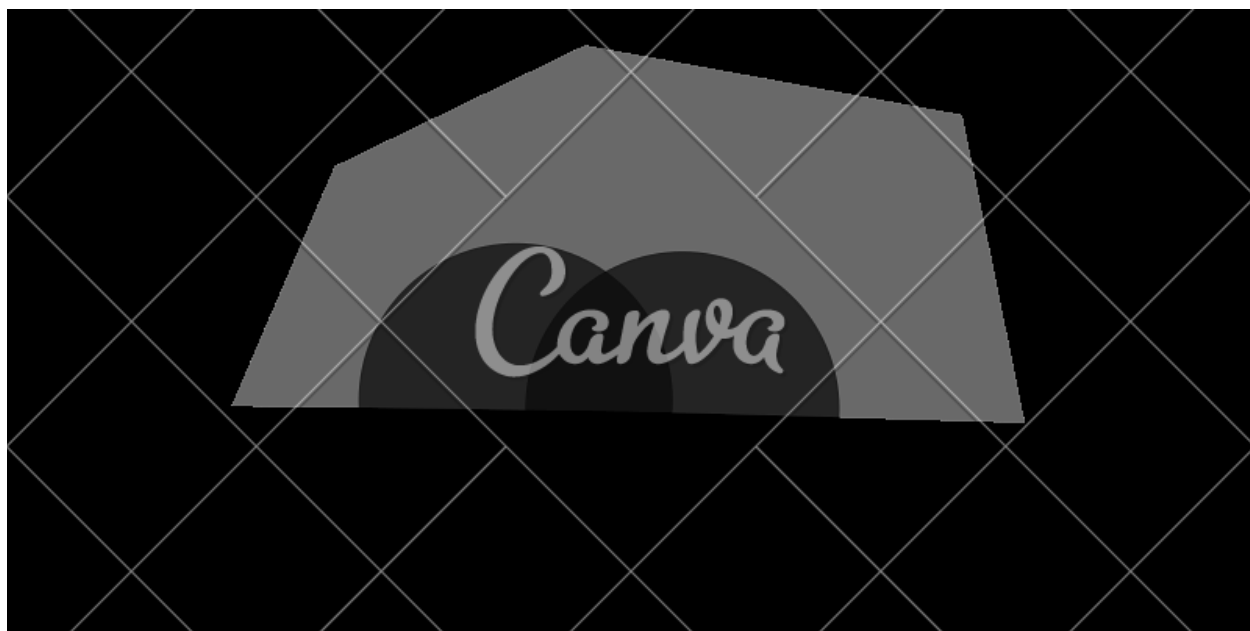


Figure 8

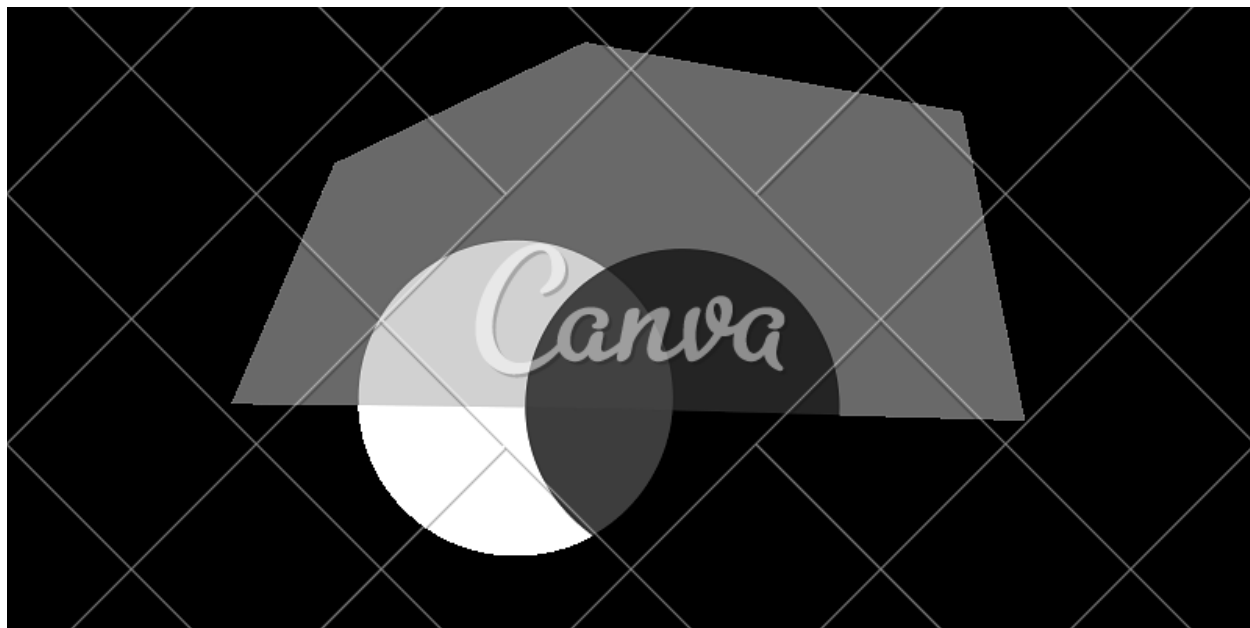


Figure 9

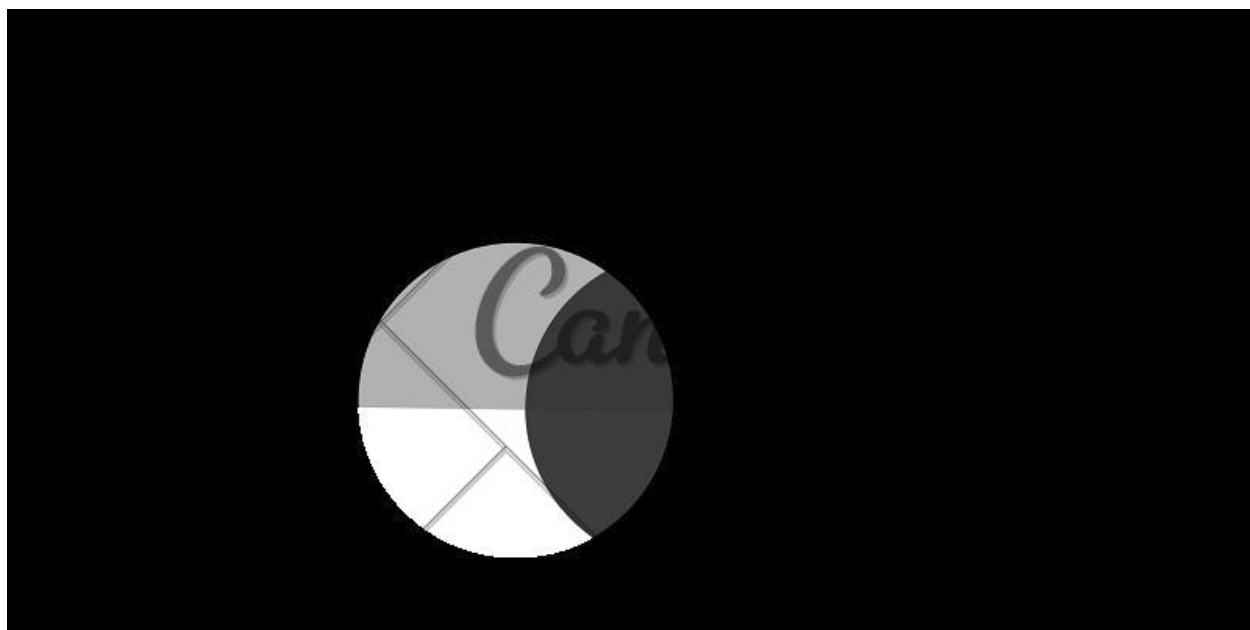


Figure 10

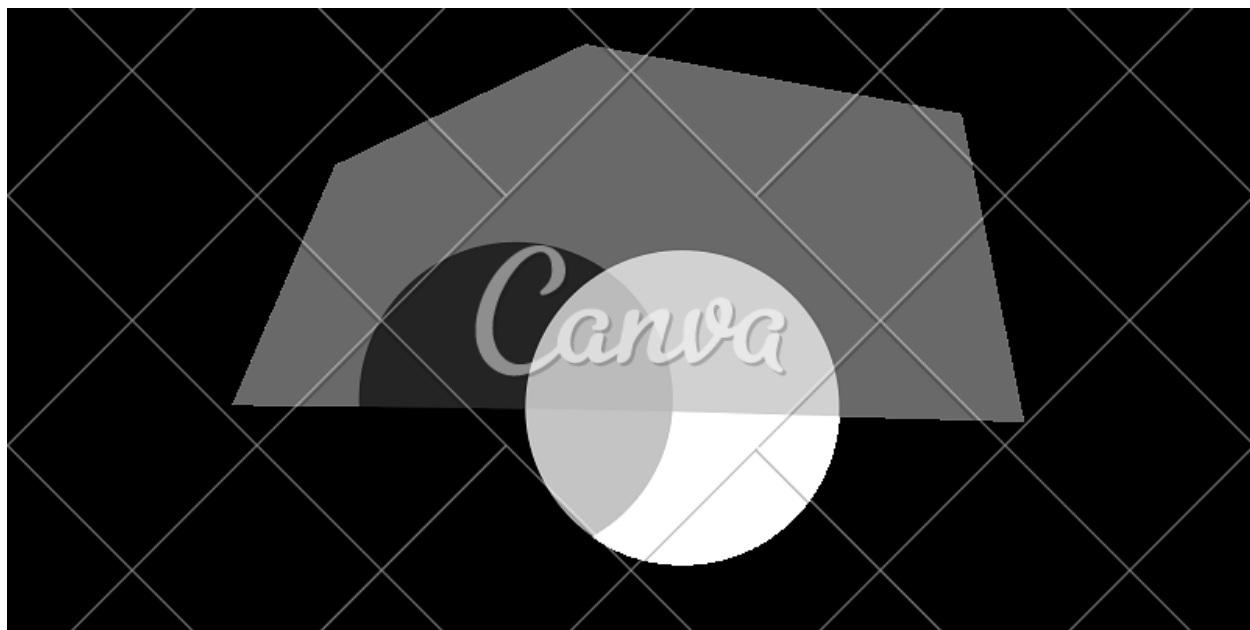


Figure 11

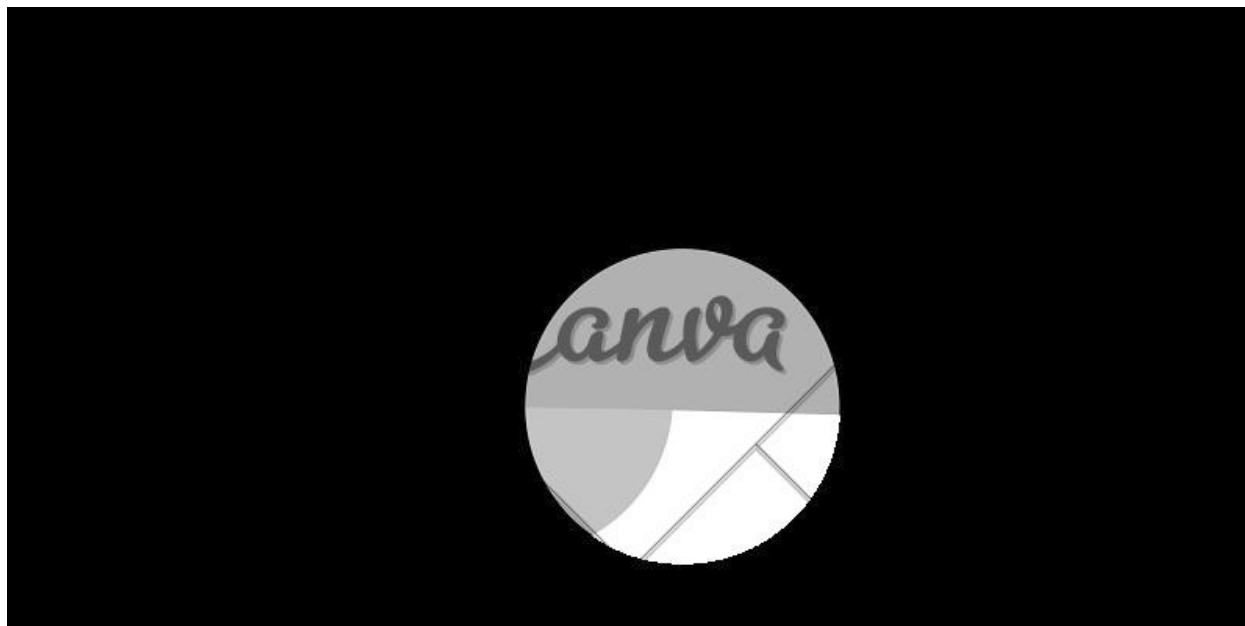


Figure 12

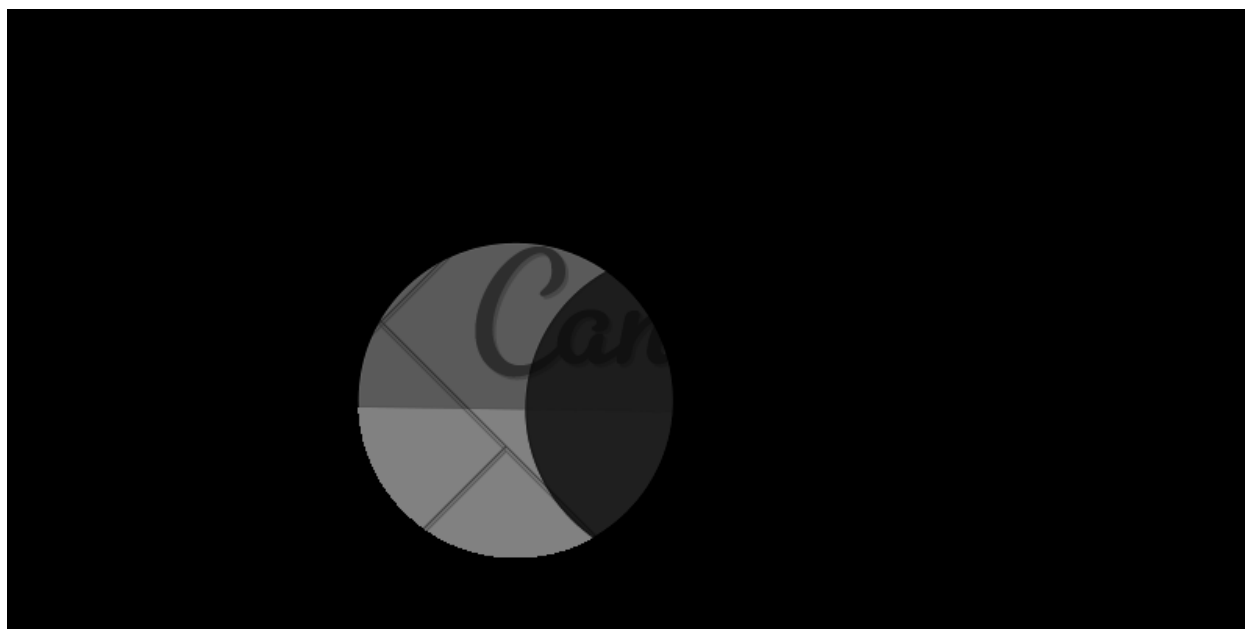


Figure 13

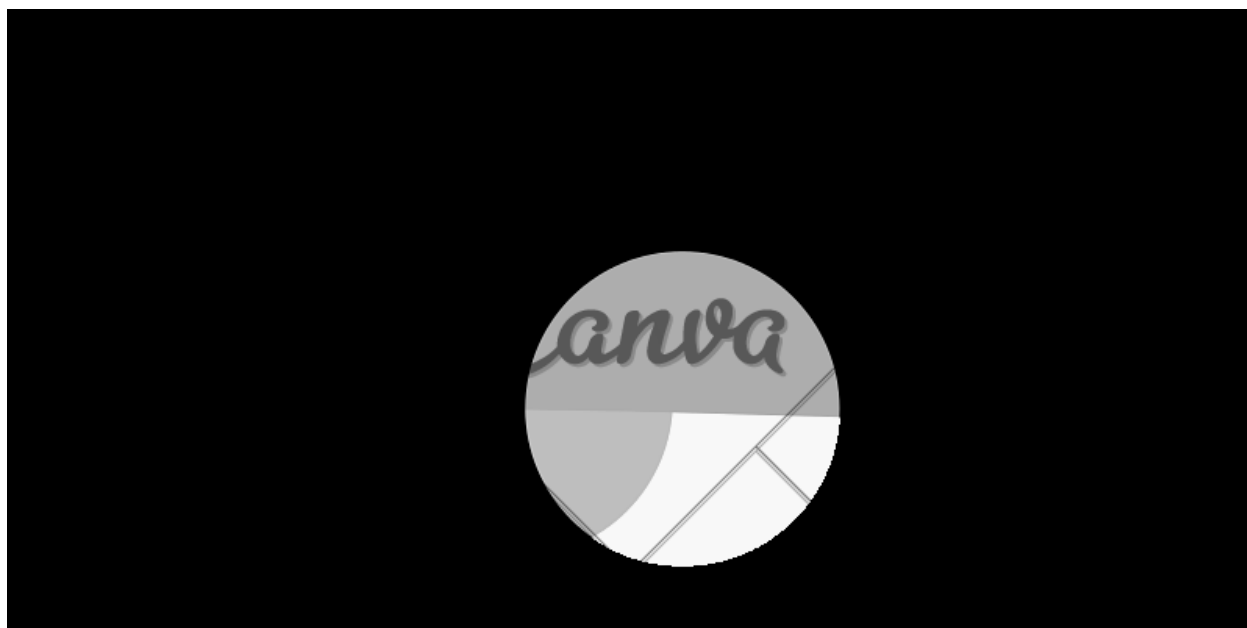


Figure 14

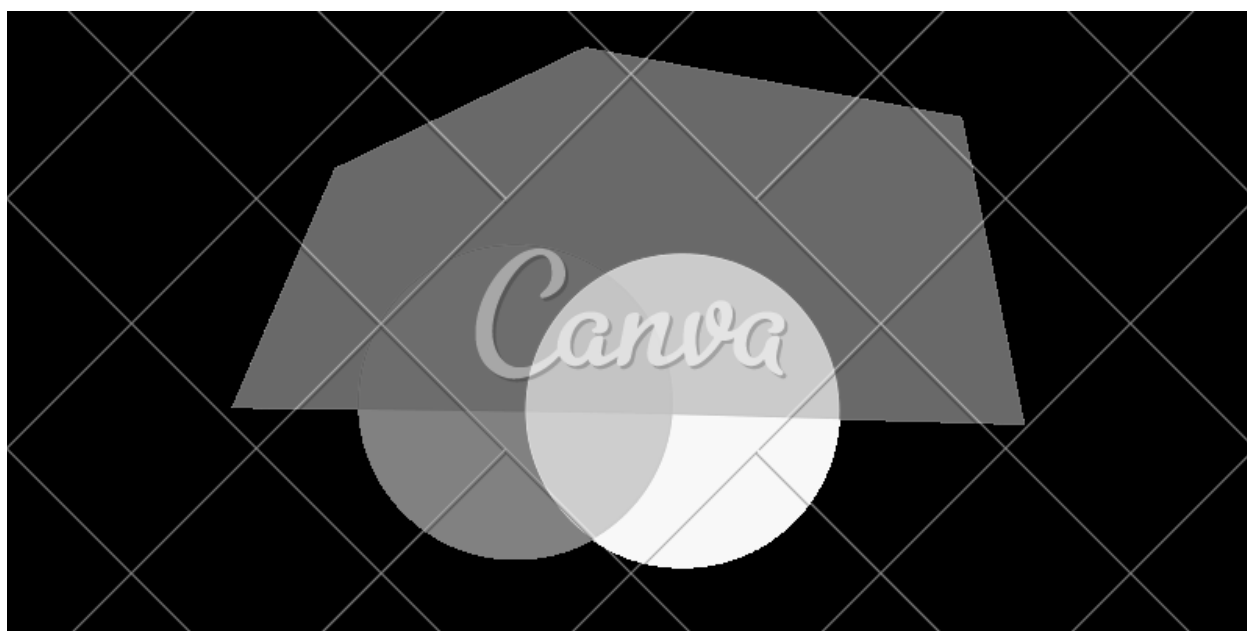


Figure 15



Figure 16

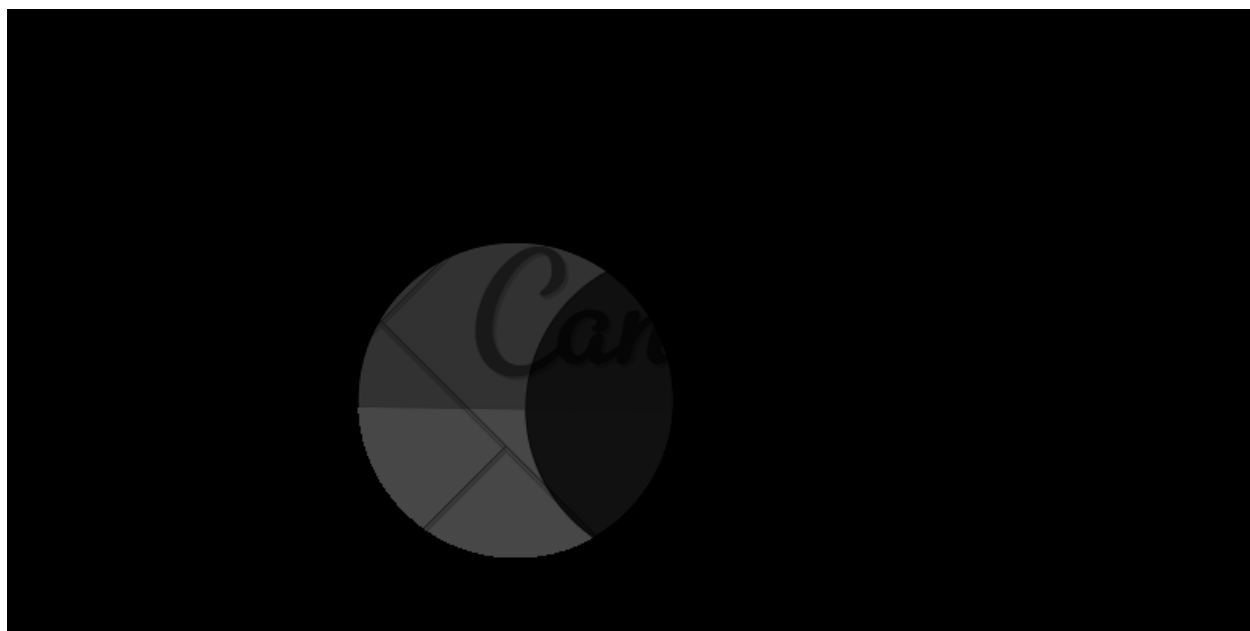


Figure 17

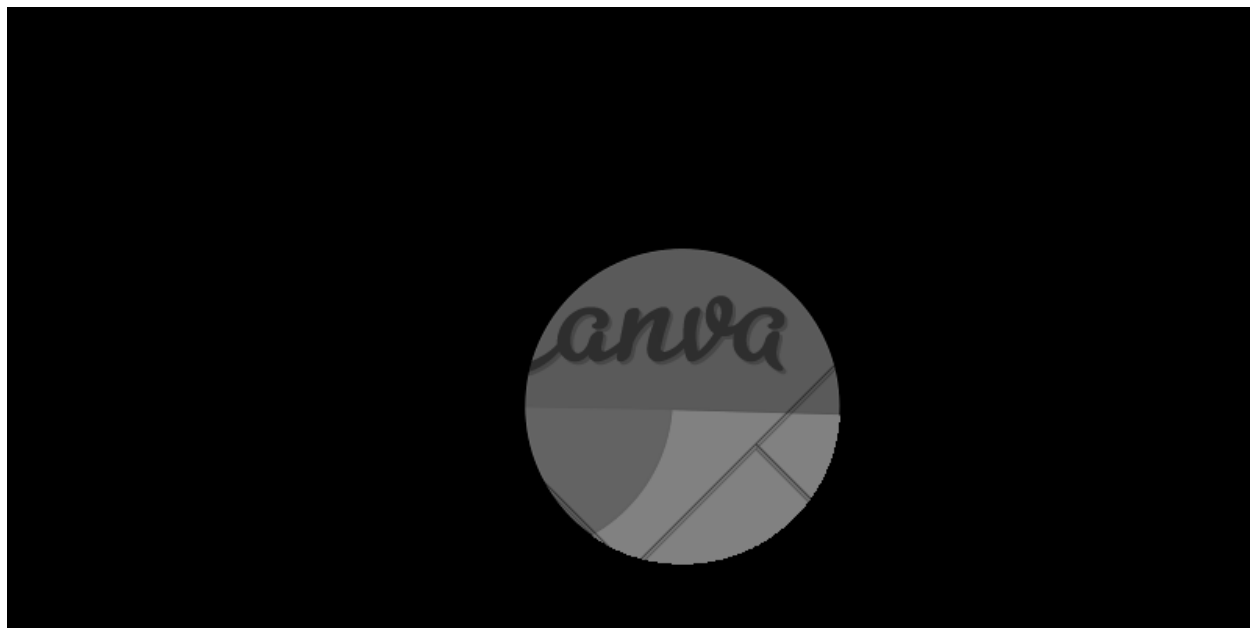


Figure 18



Figure 19



Figure 20