Facilitating learning for visually-impaired students using a haptic screen

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Problem & Solution 1: General Result to Images

1. **Default**

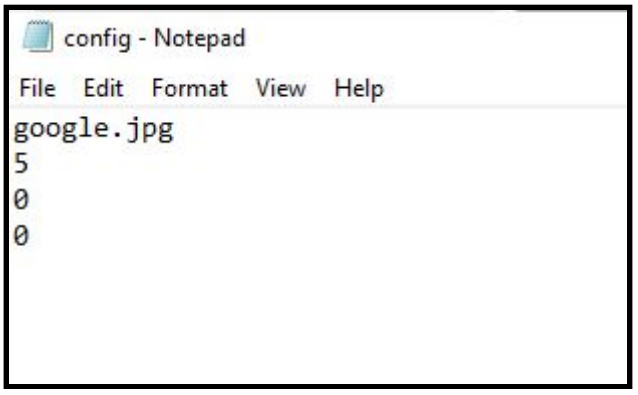
General Setting 1: All Zeroes

In the above settings, the first line is the **name** of the figure with its extension. The next line would be the **friction level**, while the third one will be the **level of zoom** the user wants. Lastly, the fourth line would be the input to determine the **resolution** the user wants to enlarge.

Original Image

Inverted Image

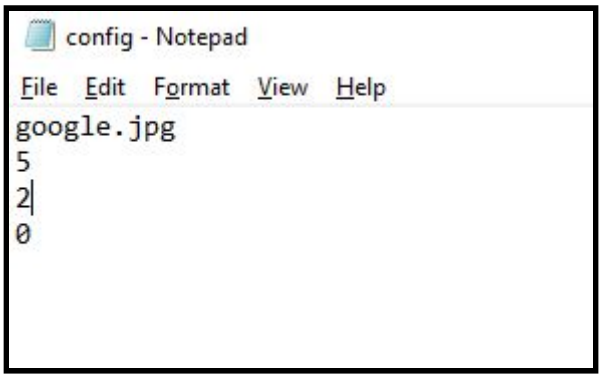
2. Friction level



General Setting 2: Change the friction level to 5

Brighter Inverted Image

3. **Zooming**



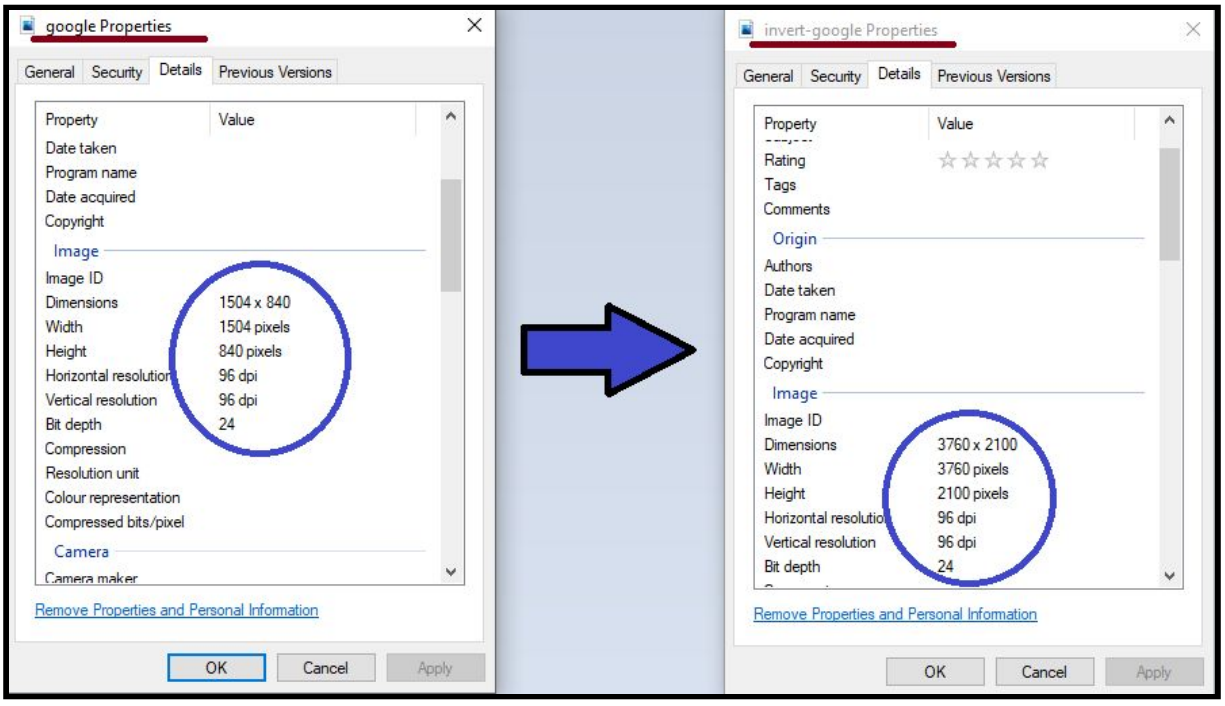
General Setting 3: Adding Zooming

Inverted Zoom Image

In the backend of the application result above, the application increases the image resolution but draws the image onto old image resolution; therefore, cutting out some part of the image, making the text looks bigger.

4. Resolution Increase

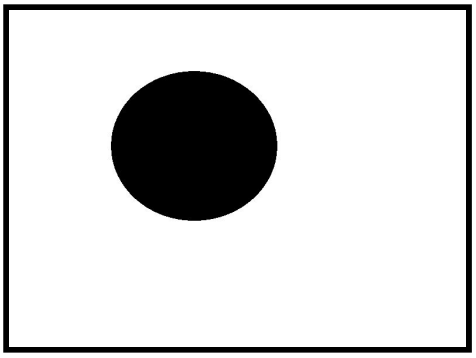
General Setting 4: Adding resolution increase



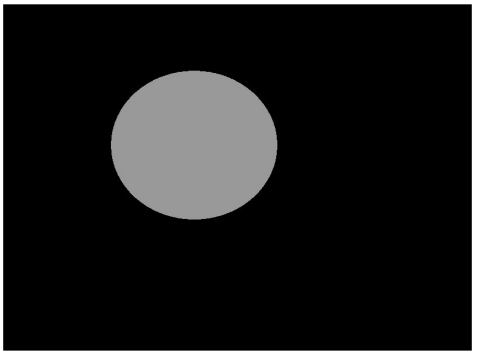
Changes in resolution numbers in the properties

Based on the above result, the approach is similar to the zooming section; however rather than drawing on the old image width and height; the image would enlarge the resolution and draw the image with the new given width and height; thus, increasing the resolution properties.

Problem & Solution 2: Tackling Friction Level

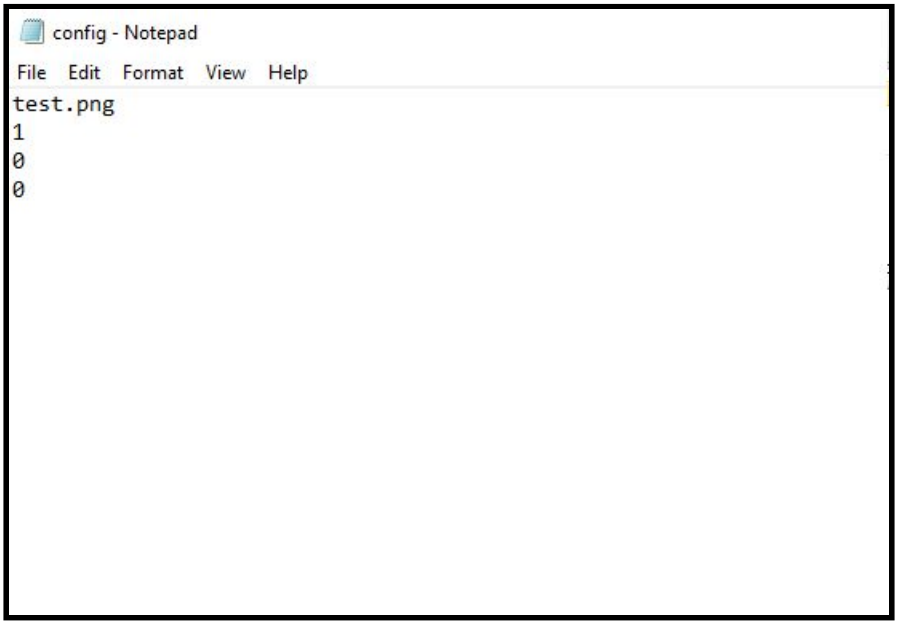


Original Image



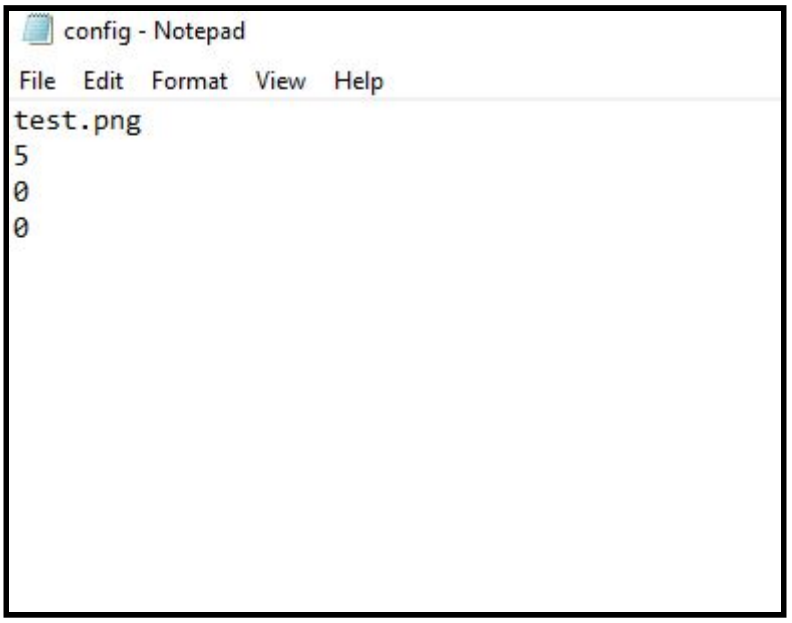
Inverted Image(*Friction Level 1*)

The result projected above arrived from an image in PNG format drawn in Paint application. In the Inverted Image, the circle was supposed to be white; however, in order to create lesser friction of the touch on the circle, the application will create a contrast that would lessen the whiteness and change it into a grey tone.



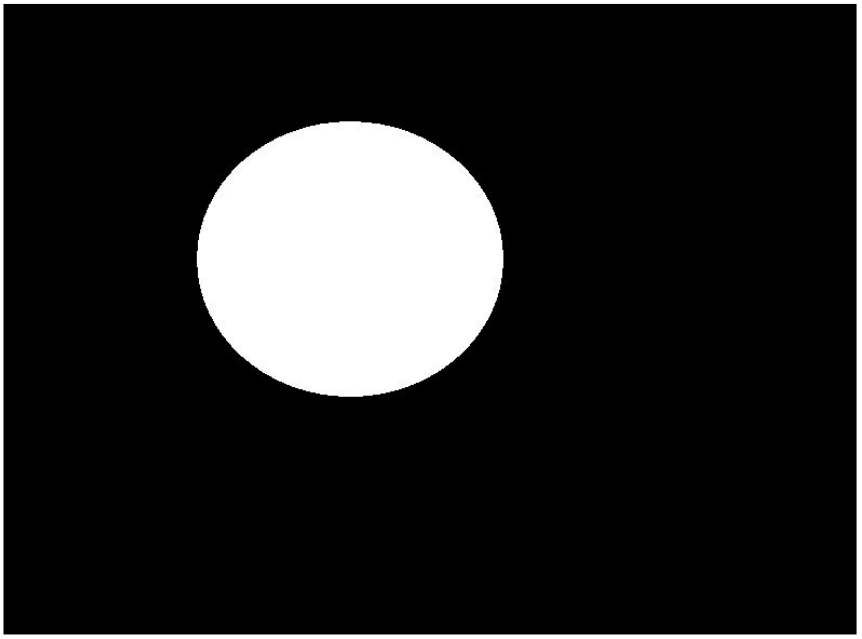
General Setting 5: Friction level

Based on the previous result above, the circle appeared grey due to the second line of the input. If we were to change the second line to an integer of *5* as the following.



General Setting 6: Changing friction level to 5

The circle inside the image will be changed to white. When the application integrated into the haptic device as a fully operated one, the change of whiteness will determine friction of the touch.



Inverted Image(Friction level 5)

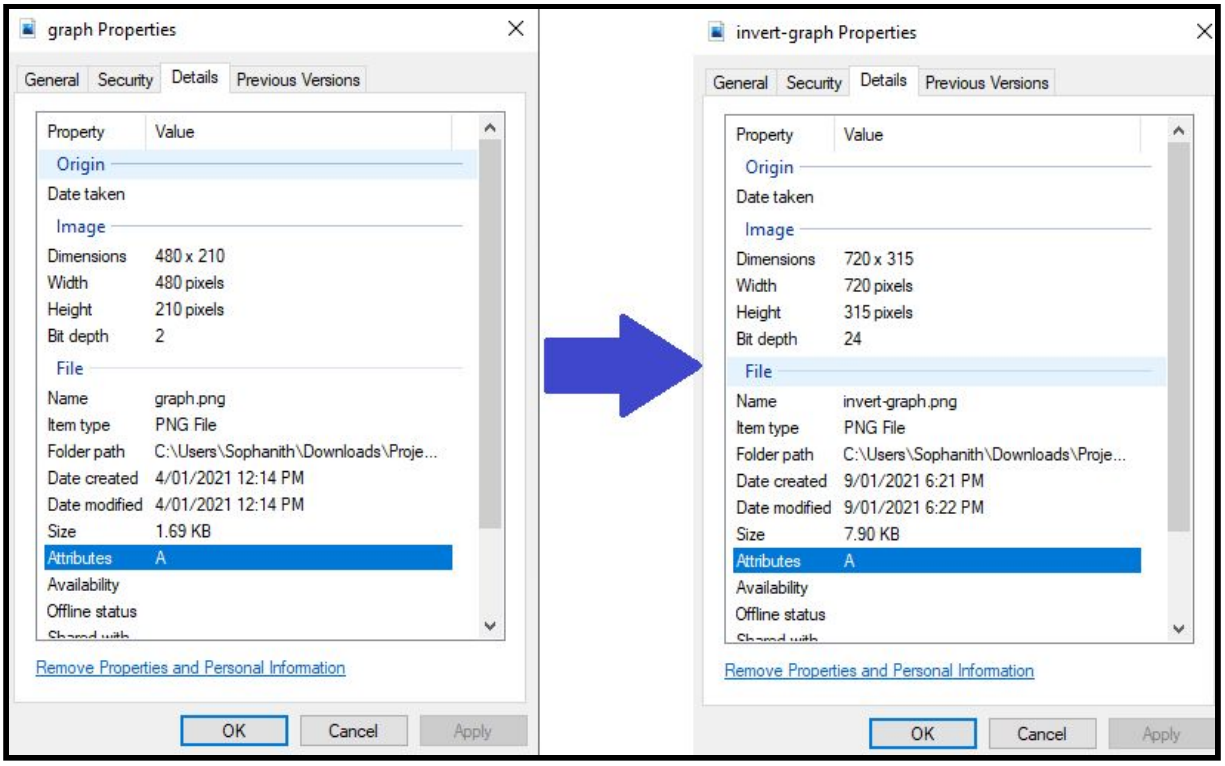
The approach to decreasing the whiteness is due to the inability to increasing the friction. To elaborate, if the application was to set the default friction to 0 or 1. A higher level of contrast would not work since the color white would be at its brightest peak. Therefore by decreasing the image to grey at 1 and let the whiteness one be 5 would be the desirable and applicable approach.

Problem & Solution 3: Tackling Friction Level with Small Images

The application went into a problem when inputting an image that has low resolution. For instance, the following image below has a resolution of 480 x 210. Therefore, the application will check if the width or height of the image is lower than 210, then the application will increase the resolution by 50 percent.

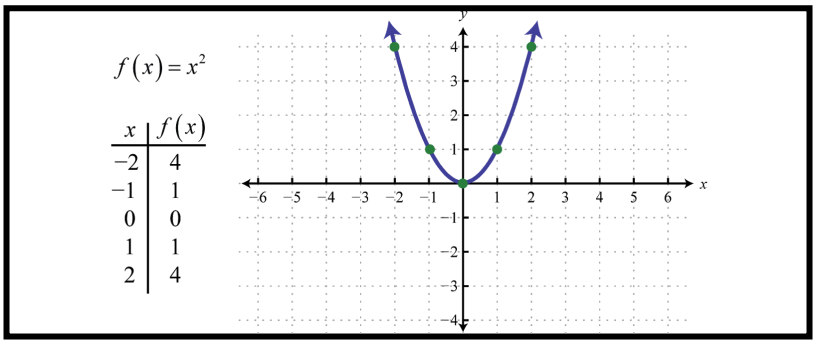
```
if(width <= 210 || height <= 210){
    width = (int) (width * 1.5f);
    height = (int) (height * 1.5f);
}

inputFile = new BufferedImage(width, height, BufferedImage.TYPE_INT_RGB);
Graphics2D addSize = inputFile.createGraphics();
addSize.drawImage(image, 0, 0, width, height, null);
addSize.dispose();
```

Code used to check and enlarge a small image

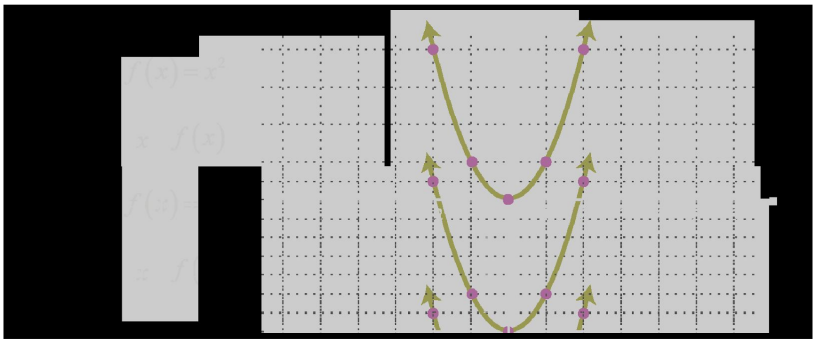


The resolution of the image that is small will be enlarged

Problem & Solution 4: Transparent Issue

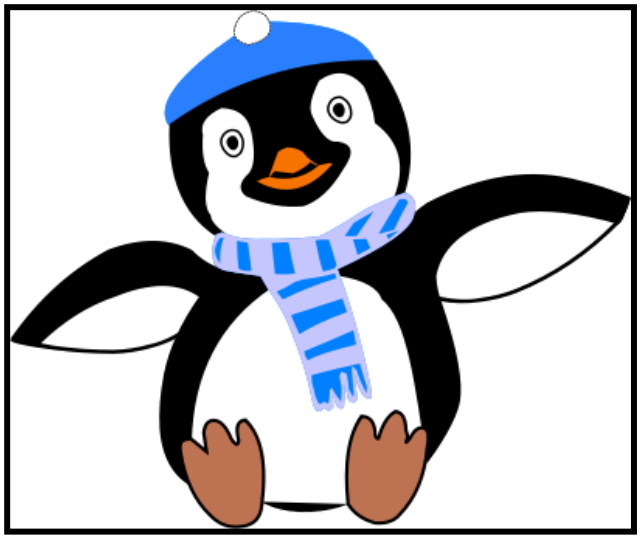


Original Image



Inverted Image

When inserting a transparent image, there could be an issue provided above. Some of the sections of the image would be grey out instead of blacked out. However, most of the images being inserted would be inverted properly.



Original Image

Inverted Image