

COSC 4370 - Homework 1

Name: Cyrus Shekari

PSID: 2042446

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1 Objective

The objective of this program is to implement an algorithm that rasterizes an ellipse using the BMP class. The BMP class is used to create an image with a dimension of 1600 x 2000 pixels and fill the ellipse with a color gradient of blue, light blue, and cyan. The ellipse equation is defined as $\left(\frac{x}{6}\right)^2 + \left(\frac{y}{12}\right)^2 = 64^2$ where $y \geq 0$. The image data containing the ellipse is then written to a BMP file named "output.bmp".

2 Method

The method applied in the program involves iterating over each row and column of the image, checking if the point (x, y) lies inside the ellipse using the provided equation. If the point is found to lie within the ellipse, the pixel at (x, y) is filled with a color based on its x-coordinate. The x-coordinate is also used to determine which shade of blue the pixel should be shaded, depending on whether it lies in the left third, middle third, or right third of the image. To achieve this, the program makes use of several functions including *fill_pixel*, *fill_ellipse_pixel*, and *rasterize_ellipse*. The *fill_pixel* function is responsible for filling the pixel with the desired color, while the *fill_ellipse_pixel* function fills the pixels that lie inside the ellipse. Finally, the *rasterize_ellipse* function calls the *fill_ellipse_pixel* function for each pixel in the image, ensuring that the correct pixels are filled to represent the ellipse.

3 Implementation

The implemented program encompasses several functions that work together to generate the desired ellipse. These functions include *fill_pixel*, *fill_ellipse_pixel*, and *rasterize_ellipse*.

3.1 fill_pixel

The *fill_pixel* function accepts a BMP object, an x-coordinate, a y-coordinate, and RGB values as inputs. Its purpose is to fill a single pixel located at the specified (x, y) location with the RGB values provided. The function calculates the index of the pixel to be filled using the x and y coordinates, as well as the width and bit count of the image. Then, it fills the pixel by assigning the red, green, and blue values to their respective indices in the data array of the BMP object. If the image has 4 channels (RGBA), the alpha channel is also filled with a value of 255, indicating full opacity.

3.2 fill_ellipse_pixel

The *fill_ellipse_pixel* function requires a BMP object and x and y coordinates as inputs. This function fills a pixel located at the specified (x, y) location if it lies within the boundary of an ellipse. To determine if a point is inside the ellipse, the function first calculates adjusted x and y values based on the center of the ellipse. Then, it verifies if the point satisfies the equation for an ellipse. If the point does lie within the boundary of the ellipse, the function calls the *fill_pixel* function and fills the pixel with an appropriate color, based on its x-coordinate.

3.3 rasterize_ellipse

The *rasterize_ellipse* function requires a BMP object as input. This function is responsible for filling all pixels within the boundary of the ellipse with an appropriate color. To accomplish this, the function loops over each row of the image, then over each column. For each (x, y) location, it calls the *fill_ellipse_pixel* function to determine if the location is within the boundary of the ellipse, and if so, it fills the pixel with the appropriate color.

4 Results

The results of the program is a 1600 x 2000 BMP image named "output.bmp" that is filled with a color gradient of color gradient of blue, light blue, and cyan.

The image contains an ellipse that is defined by the equation $\left(\frac{x}{6}\right)^2 + \left(\frac{y}{12}\right)^2 = 64^2$ and $y \geq 0$. When viewed through an image viewer, the top half of the ellipse can be seen.

