CS 411: Lab 03

1751037 - Quang-Thuc Nguyen

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1 Polygon Selection

My method is area-based to determine which polygon you are selected. The formulas for area computing are defined as:

$$
\begin{aligned}
T(p_i, p_j) &= \frac{(p_i.x - p_j.x) * (p_i.y + p_j.y)}{2} \\
S(p_0, p_2, .., p_{n-1}) &= \sum_{i=0}^{n-1} T(p_i, p_{(i+1) \bmod n}) \\
S_{\text{check}} &= \sum_{i=0}^{n-1} S(p_{\text{clicked}}, v_i, v_{(i+1) \bmod n}) \\
S_{\text{polygon}} &= S(v_0, v_1, .., v_{n-1})
\end{aligned}
$$

with S_{check} and S_{polygon} are total area created by clicked point and every two adjacent points, and area of polygon, respectively. v_i is vertex i-th of polygon in drawing order. So, if S_{check} equals to S_{polygon}, the clicked point is inside the polygon. This formula is true if and only if the polygon is not self-cut.

2 Polygon Transformation

With the rotation and scale transformation, we fix the centroid of the polygon by moving it to the center (0, 0) and handling the transformation. Moreover, instead of moving all the pixel of the polygon, we just modify the vertices of the polygon by Affine Transformation Matrix and draw the polygon again.

2.1 Rotation

Table 1: Rotation affine matrix

(a) Left rotation

$$\begin{matrix} cos(1) & sin(1) & 0 \\ -sin(1) & cos(1) & 0 \\ 0 & 0 & 1 \end{matrix}$$

(b) Right rotation

$$\begin{matrix} cos(1) & -sin(1) & 0 \\ sin(1) & cos(1) & 0 \\ 0 & 0 & 1 \end{matrix}$$

2.2 Scale

Table 2: Scale affine matrix

(a) Scale up

$$\begin{matrix} 1.1 & 0 & 0 \\ 0 & 1.1 & 0 \\ 0 & 0 & 1 \end{matrix}$$

(b) Scale down

$$\begin{matrix} 0.9 & 0 & 0 \\ 0 & 0.9 & 0 \\ 0 & 0 & 1 \end{matrix}$$

2.3 Moving

Table 3: Moving affine matrix

(a) Move up

$$\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 1 \end{matrix}$$

(b) Move down

$$\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & -1 & 1 \end{matrix}$$

(c) Move left

$$\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{matrix}$$

(d) Move right

$$\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{matrix}$$

3 Demo

Select and highlight

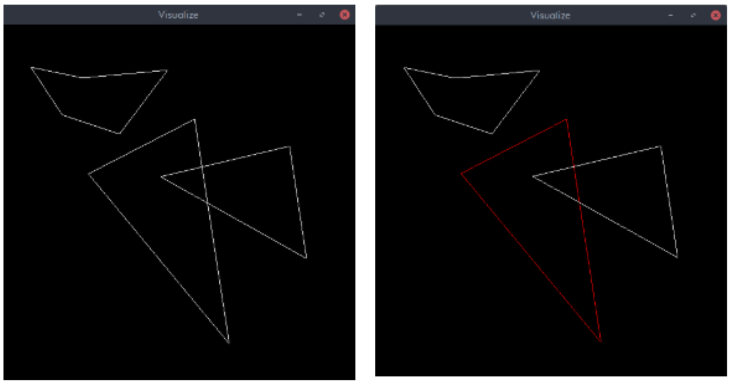

Figure 1: Original image in the left and highlight selected polygon in the right one.

Rotation

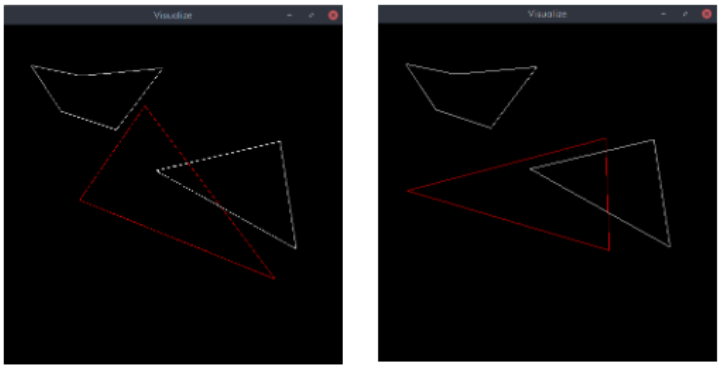

Figure 2: Left rotation and right rotation are the first and the second, respectively

Scale

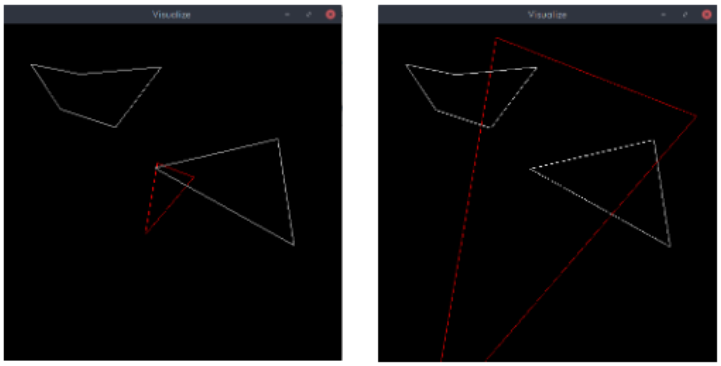

Figure 3: Scale down and scale up

Moving

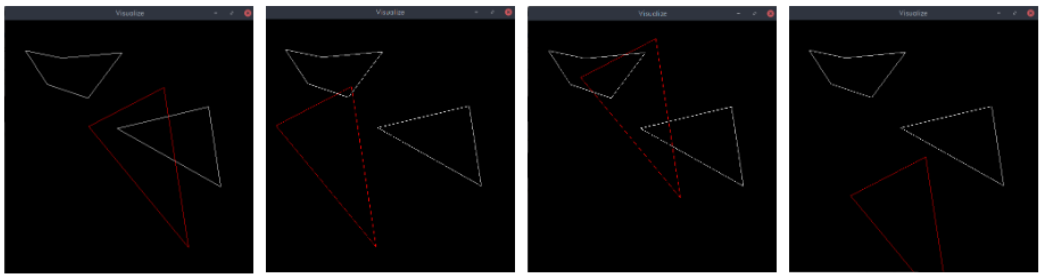

Figure 4: Moving the polygon in 4 directions