Assignment 3: Transformation and Simple Animation

Introduction

In this assignment, you will apply different types of transformation, i.e., translation, scale, and rotation on the Chinese hand fan you built in Assignment 2. In order to do Assignment 3, you need to have the basic part of **Assignment 2** complete. With '**glutTimerFunc**' callback function, you will create a simple animation of simultaneous folding/unfolding of the Chinese hand fan.

Specification:

1. **Apply scale factor**   **1 point**

   With the press of the keyboard button 's'/'S', the fan scales down to 25% of its original size. Toggling 's'/'S' brings the fan back to its original size and vice versa. In the scaled version, set the point size at 10 pixels.

2. **Add multiple fans**   **4 points**

   With both scale ('s'/'S') and multiple ('m'/'M') modes on, 6 fans appear surrounding the center fan. So, you need to add six more fans using different transformation as discussed in this week's lectures. All six fans are placed at an angle of 60 degrees from each other with a radial distance of 0.6 from the center fan as demonstrated in Figure 1b and Figure 1c respectively.
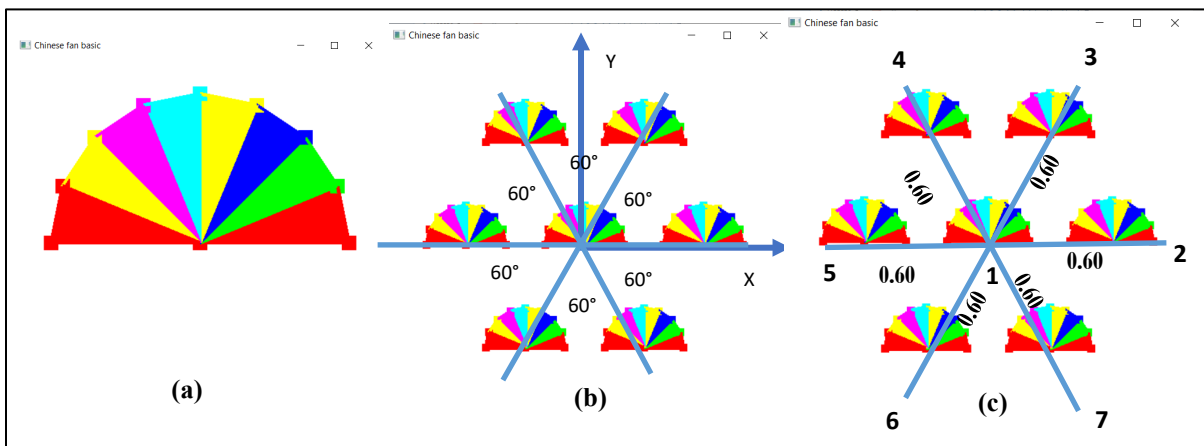

Figure 1: (a) Output from Assignment 2; with 'scale' and 'multiple' modes on (b) six fans are placed at an angular distance of 60 degrees from each other around the center fan and (c) fans are placed at a radial distance of 0.6 from the center fan.

3. Animation   7.5 points in total

All rotations are around Z-axis. You will be able to start/ stop all rotations of the center and surrounding fans by toggling a keyboard button (i.e., 'r'/'R'). Take a look at the attached video to get a clearer idea about the output.

i.   Rotation of the surrounding fans: 4 points

- All surrounding fans will rotate around the origin and remain 60 degrees apart from neighboring fans during rotation. You need to add **glutTimerFunc** callback function. Use 100 milliseconds delay between the frames; increment the rotation angle by 5 degrees.

ii.   Rotation of the center fan and surrounding fans: 2.5 points

- In addition, all fans (including the center fan) will rotate around their own axes and center. Use 500 milliseconds delay between the frames; increment the rotation angle by 5 degrees.

iii.   Simultaneous folding/unfolding of the fan: 1 point

The fan should fold/unfold simultaneously within a time interval of 500 milli seconds. Use '**glutTimerFunc**' to accomplish simultaneous updates of vertices by toggling the Boolean variable "vertex_update".
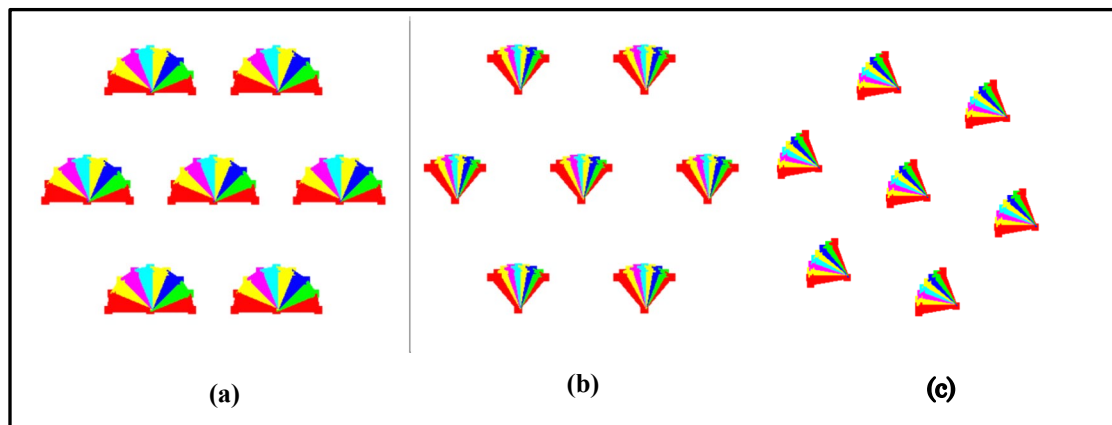

Figure 2: Some screen shots of animated fans.

Hints: This week's labs will be helpful for this assignment. However, you need to follow the assignment specification closely.

Bonus part: 4 points

In the basic part, fans have two states; they just switch between the folded and unfolded modes. In the bonus part, there will be gradual transition from unfolded to folded mode and vice versa. Please watch the attached video closely for a better understanding of this part.

In the bonus part, there will be a number of intermediate steps as fans gradually transition from the unfolded to the folded mode. A few of these intermediate steps are demonstrated below in Figure 3. In the basic part, you use **glutTimerFunc** to transition between two modes within a certain time interval. In the bonus part, you will do the same for each intermediate step. You may choose 3 to 6 intermediate steps. The higher the number of intermediate steps, the smoother the transition and animation.
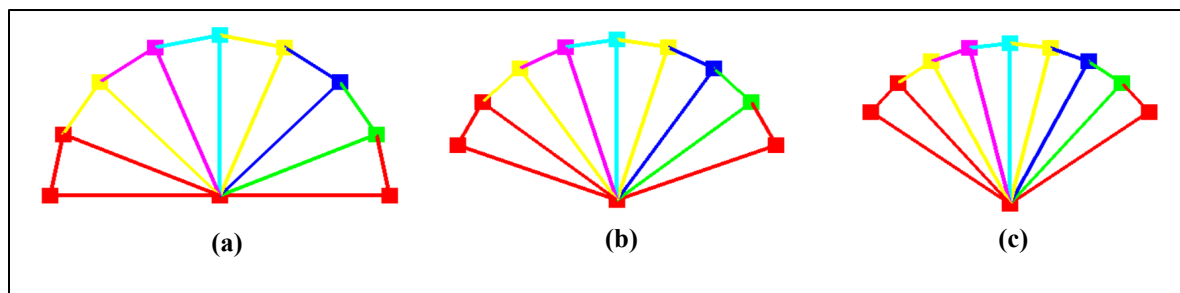

Figure 3: Some screen shots of animated fans in wireframe as the fan transitions from unfolded to folded mode via a number of intermediate steps.

As demonstrated in Figure 4, find out the angular differences between corresponding points i.e., A and A', B and B', ……, and I and I' in the original unfolded and folded versions respectively. Next, divide the angular differences into 3 to 6 in-between intermediate steps and determine the updated vertices for intermediate steps. Use **glutTimeFunc** to switch between intermediate steps (use a delay of 200 milliseconds) while folding or unfolding of the fan in a smooth fashion. Once the fan switches from the unfolded mode to the folded mode, you need to gradually switch back from the folded to the unfolded mode by reversing the direction of movements of intermediate vertices.
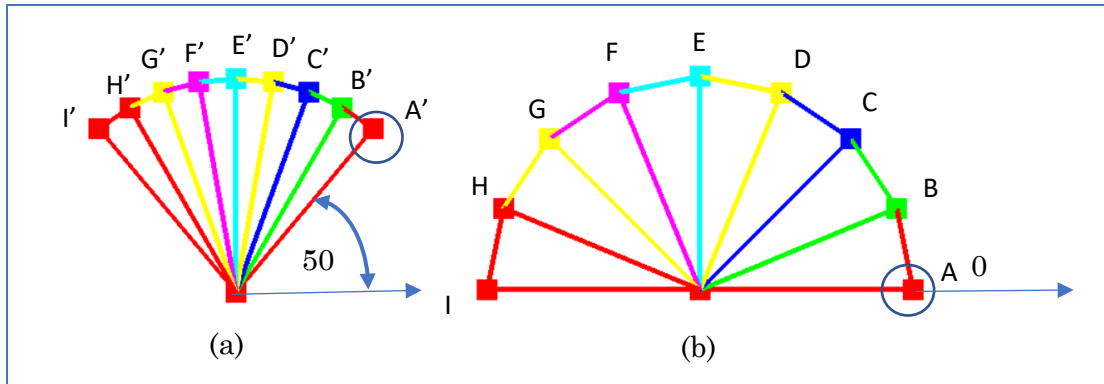
**Figure 4: Determining angular distance between the corresponding points, i.e., A and A'
between the unfolded and folded modes.**

GLM Library

Use **glm** library for applying different transformation, i.e., translation, rotation, and scale. All transformation for a particular fan should be reduced to a single transformation by concatenation of transformation and be declared as a uniform 4X4 matrix variable named "model_matrix" or "model_transformation".

Submission:

Basic Part:

Place your solution in a zipped file named with your last name followed by the first initial of your first name followed by 3 (ex: **CSCD377YasminS3Basic.zip**) and submit the solution via canvas. Thus, your zip should contain the following:

A file named **ChineseFanBasic.h**, **ChineseFanBasicAnimated.cpp**, and shader files **ChineseFan.vs**, and **ChineseFan.fs**.

Bonus Part:

Place your solution in a zipped file named with your last name followed by the first initial of your first name followed by 3 (ex: **CSCD377YasminS3Bonus.zip**) and submit the solution via canvas. Thus, your zip should contain the following:

A file named **ChineseFanBonus.h**, **ChineseFanBonusAnimated.cpp**, and shader files **ChineseFan.vs** and **ChineseFan.fs**.

Submission deadline is Friday, October 20, 11:59 pm. This assignment weighs 12.5% of this course.