UTM

UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF COMPUTING

SESSION 2022/2023, SEMESTER 2

SECV 1113 - MATHEMATICS FOR COMPUTER GRAPHICS

SECTION 01

GROUP PROJECT - MENU RAHMAH

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PROJECT TEAM MEMBER

NO.	NAME	TASK
1.	YAP YEE JIA	C++ Program: Scaling function, Shearing function Report: Explain scaling and shearing function applied in the project
2.	RAZIQ FITRI BIN ZAIFULNIZAM	C++ Program: Interpolation function Report:, explain rotation function, interpolation function applied in the project
3.	MUHAMMAD MUADZ BIN JAMAIN	C++ Program: Translation function Report: Explain Translation function applied in the project
4.	NUR ALIA MAISARAH BINTI WAN ASMIRA	C++ Program: Main function, Rotation function Report: Introduction

INTRODUCTION

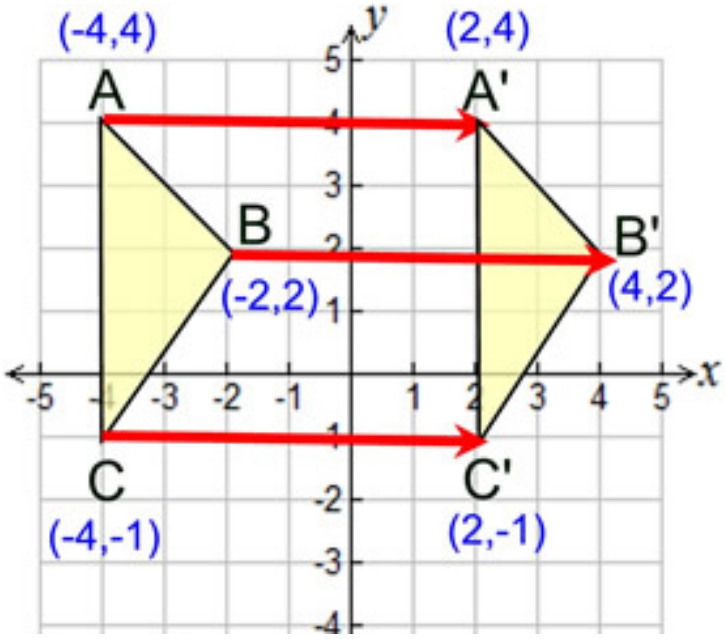
Based on the theme “MENU RAHMAH”, we have developed a simple graphic by using Dev C++ to design our ideas for this project in the Mathematics for Computer Graphics. As we know, the government launched the Menu Rahmah programme as an initiative to serve the food sets at a recommended price which is RM5. The Menu Rahmah can help people to save on daily expenses as it costs a maximum of RM5 for each meal.

In this project, we have applied the graphic library in order to draw some basic shapes such as line(), circle(), rectangle(), and so on to create the 2D shapes as our project design. We also implemented the interpolation function and 2D transformation functions including translation, rotation, shearing and scaling to manipulate the interaction between each graphic design. The further explanation for the application of 2D transformation and interpolation will be discussed in every part of the project.

2D TRANSFORMATION AND INTERPOLATION

1. TRANSLATION

A movement of things without deformation is called translation. Every position or point is translated by the same amount. The endpoints will be used to draw the translated straight line. Adding the translation coordinates (tx, ty) to the original coordinates (X, Y) in 2D results in the new coordinates (X', Y').



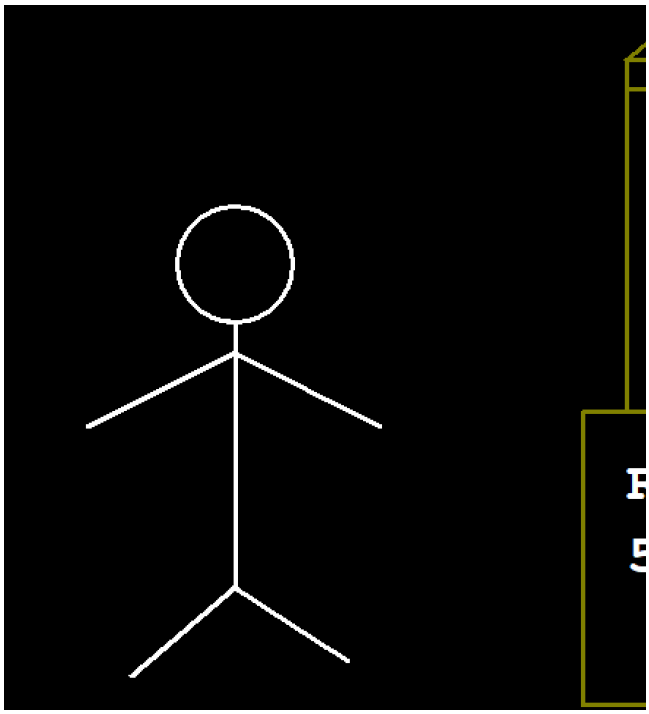
From the figure above, it is written that X' = X + tx , Y' = Y + ty. The translation vector or shift vector is the pair (tx,ty). Column vectors can also be used to represent the aforementioned equations.

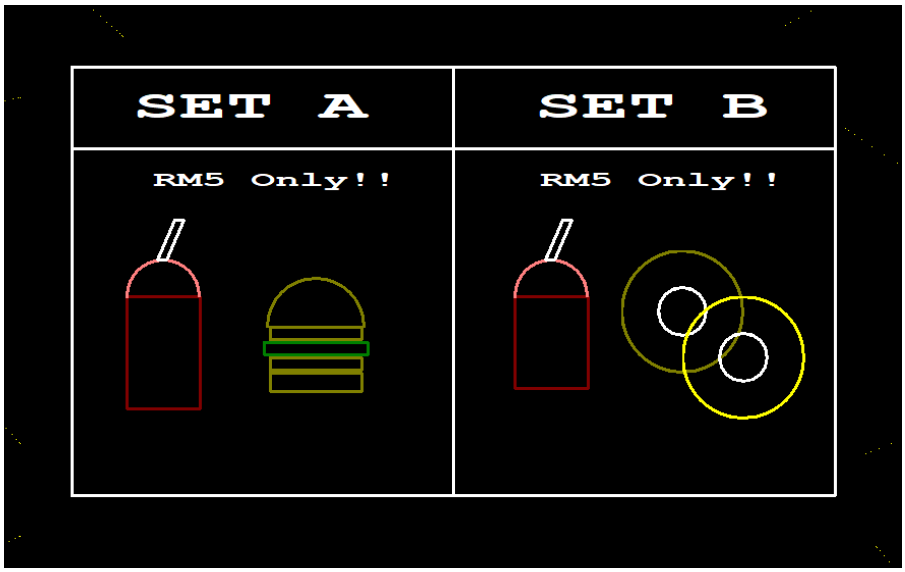
$$P = \begin{bmatrix} X \\ Y \end{bmatrix} \qquad p' = \begin{bmatrix} X' \\ Y' \end{bmatrix} \qquad T = \begin{bmatrix} t_x \\ t_y \end{bmatrix}$$

We can write as P' = P + T.

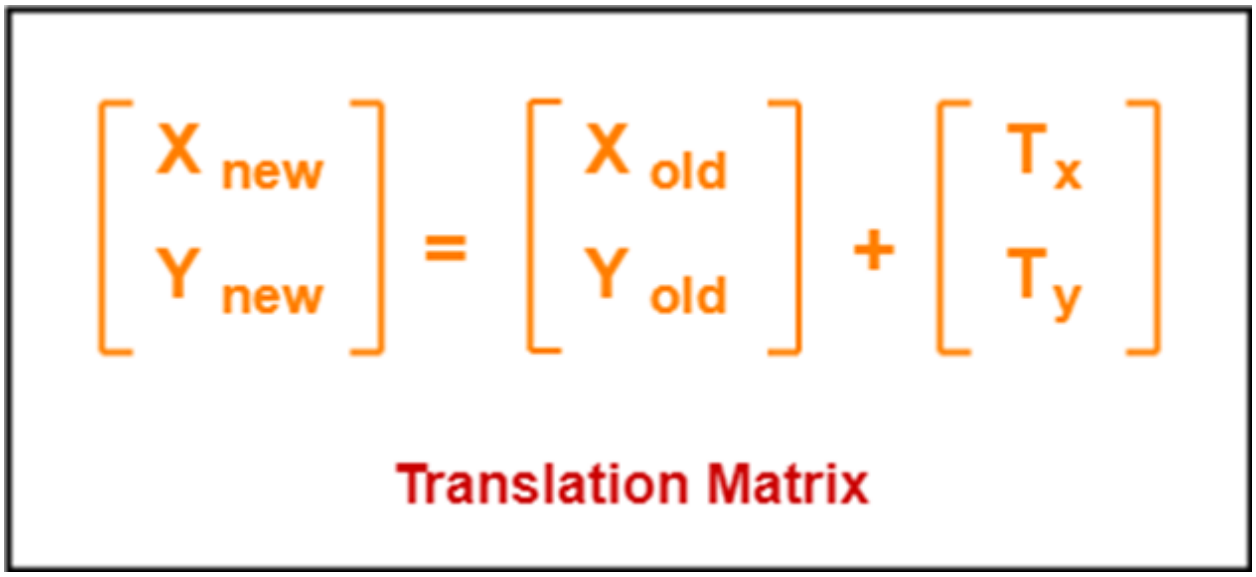
Based on our project, translation has been implemented on the stickman where a circle and any other lines were formed by translating it to the right before its stop on the left of the stall. Translation also implemented on the menu to move the enlarged menu to the center of the screen.

Example of translation :





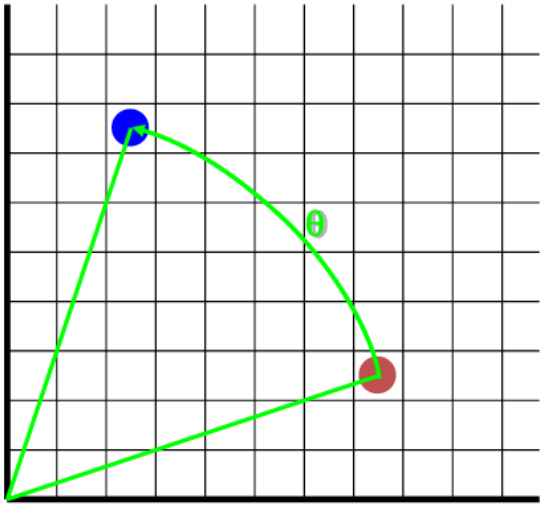
In matrix form, translation of equation may represented as : -



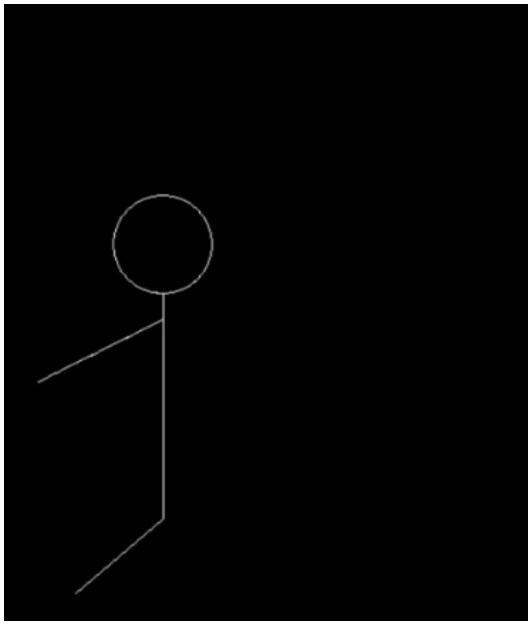
- (X, Y, 1) is the homogeneous coordinate representation of (X, Y).
- Using matrix and vector multiplications, all transformations are possible with this representation.

2. ROTATION

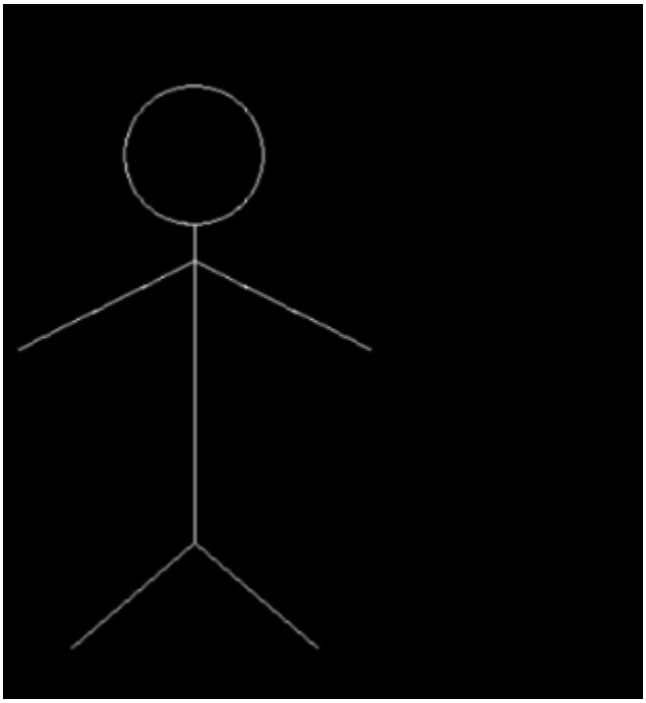
Rotation in mathematical graphics refers to the transformation of an object around a fixed point or axis, resulting in a change in its orientation. It is a fundamental operation used to manipulate and animate objects in two-dimensional (2D) or three-dimensional (3D) space.



In our project we use rotation to make the hand and leg of the people walking towards the stall by using rotation. By default the people created did not have the the right hand and right leg.



We use the rotation by using the body as the pivot is at the origin, then we write the component by sing matrix form thus the points can be rotated to create the right hand and right leg.



3. SCALING

Scaling is a process of modifying or altering the size of an object. It can either increase or decrease the size of the object. When the scaling factor is greater than 1, the size of the object will be increased. Conversely, the size of the object will be reduced when the scaling factor is less than 1. If the scaling factor is equal to 1, the size remains unchanged.

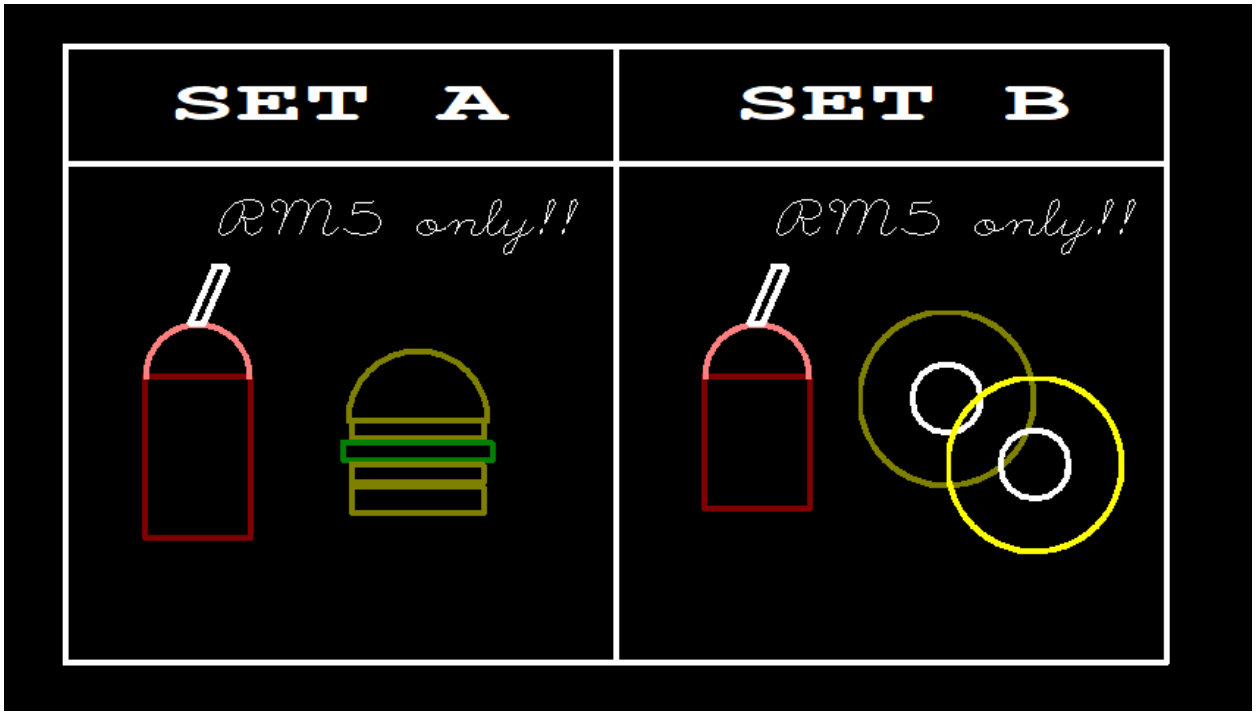
Scaling

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

$$P' = S \cdot P$$

In this project, we implement scaling to enlarge the menu. The initial object before performing scaling is the menu located in front of the stall. Using the coordinates of the small menu, we put a scaling factor, s_x and s_y of 3, so that an enlarged menu will be formed. Since the enlarged menu is out of our screen, we use translation function to move it to the center of the screen. Homogeneous matrix is used to calculate the coordinate of the enlarged menu and we use the formula above as our reference.

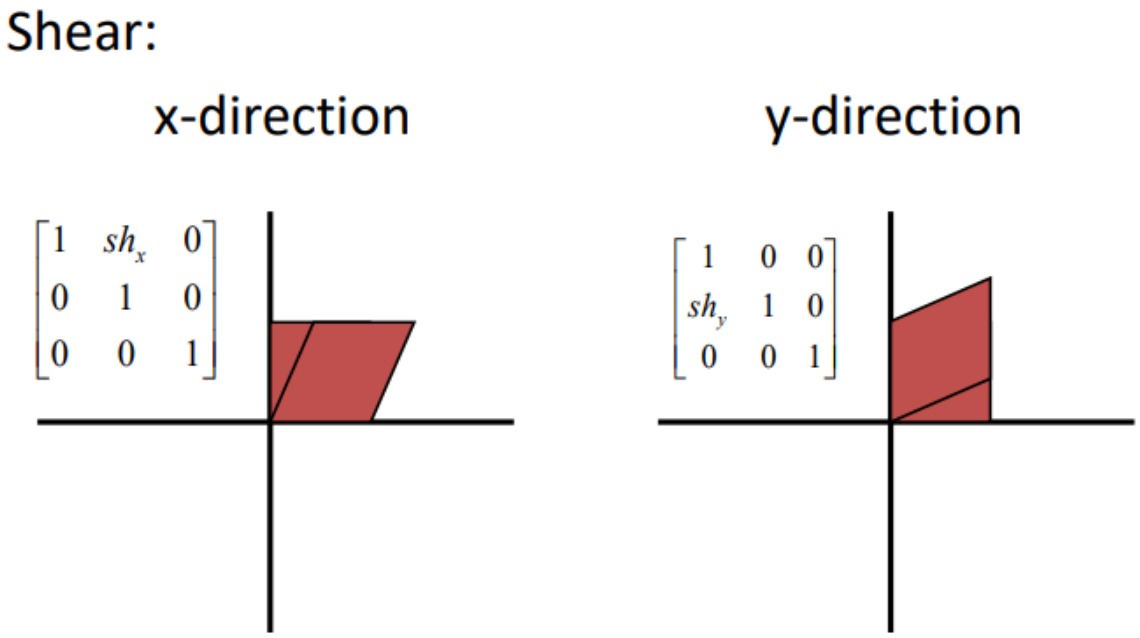
Before scaling



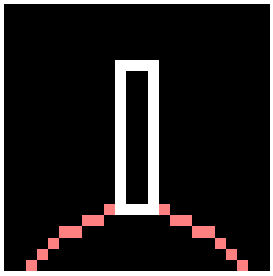
After scaling

4. SHEARING

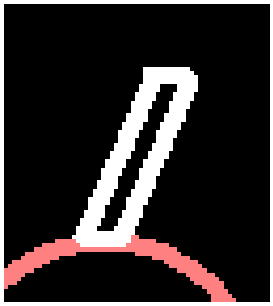
Shearing is a technique to change the shape of an existing object in a two dimensional plane. Shearing can be divided into two types, which are shearing in x-direction and shearing y-direction



In our project, we use shearing in x-direction. We implement it to change the shape of straw on the enlarged menu by referring to the formula above and using homogeneous matrix. Initial shape of the straw is a rectangle and after shearing in x-direction, it becomes a parallelogram. In this case, we use a shearing parameter towards x-direction, sh_x of 0.05, so that it only shears a bit.



Before shearing

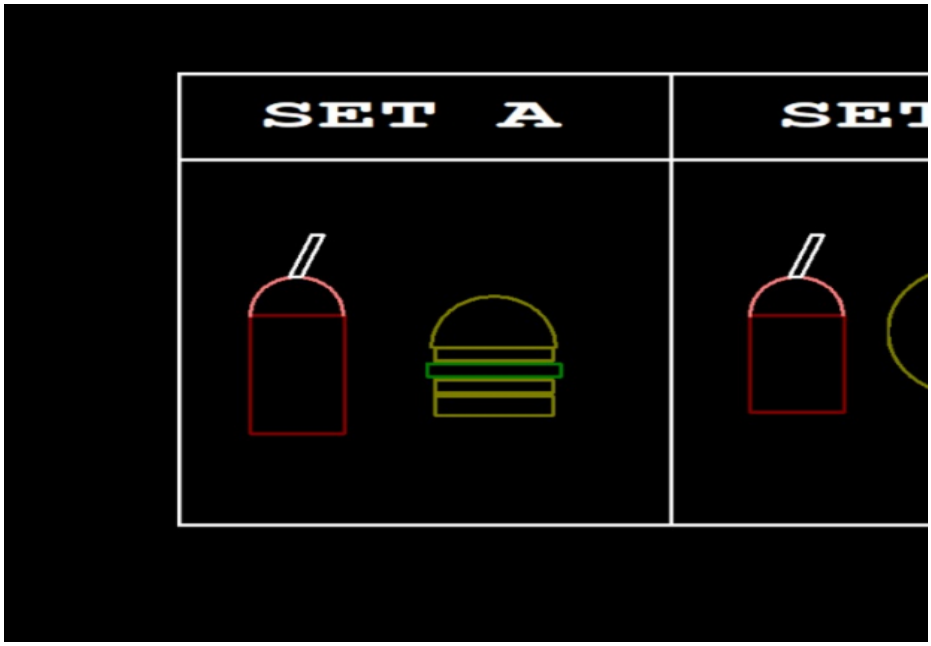


After shearing

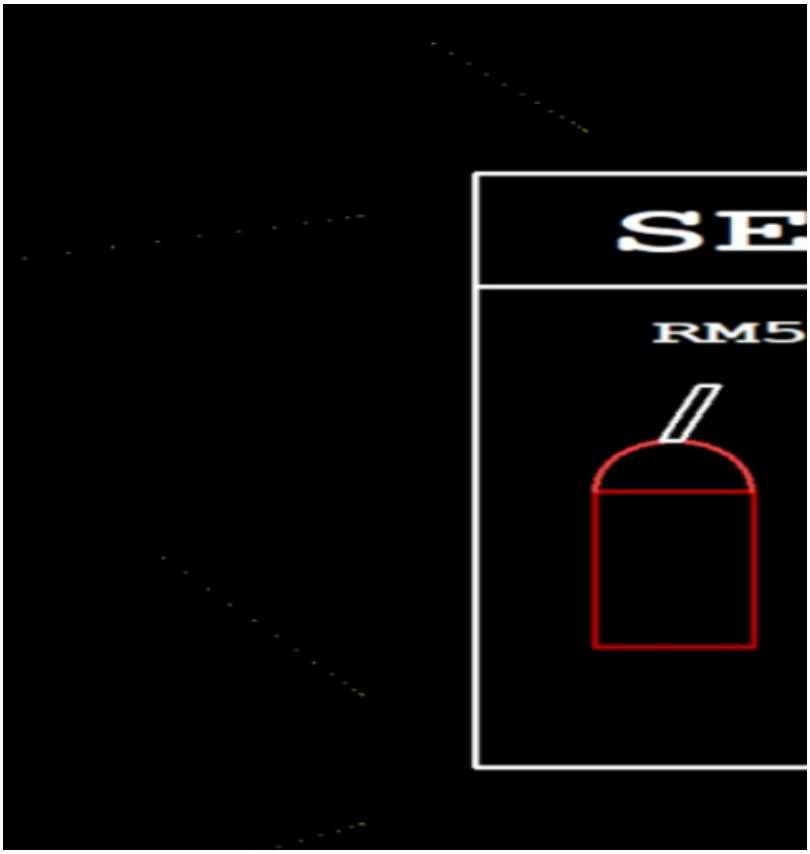
5. INTERPOLATION

In mathematical graphics, interpolation plays a crucial role in creating smooth curves and surfaces based on a limited set of data points. It helps in generating visually appealing and continuous representations of mathematical functions or geometric objects.

In our project, we use linear interpolation. We implement it to create a ray of light that appears when the enlarged menu is displayed. The yellow line formed by the dots using putpixel implement as interpolation in our program.

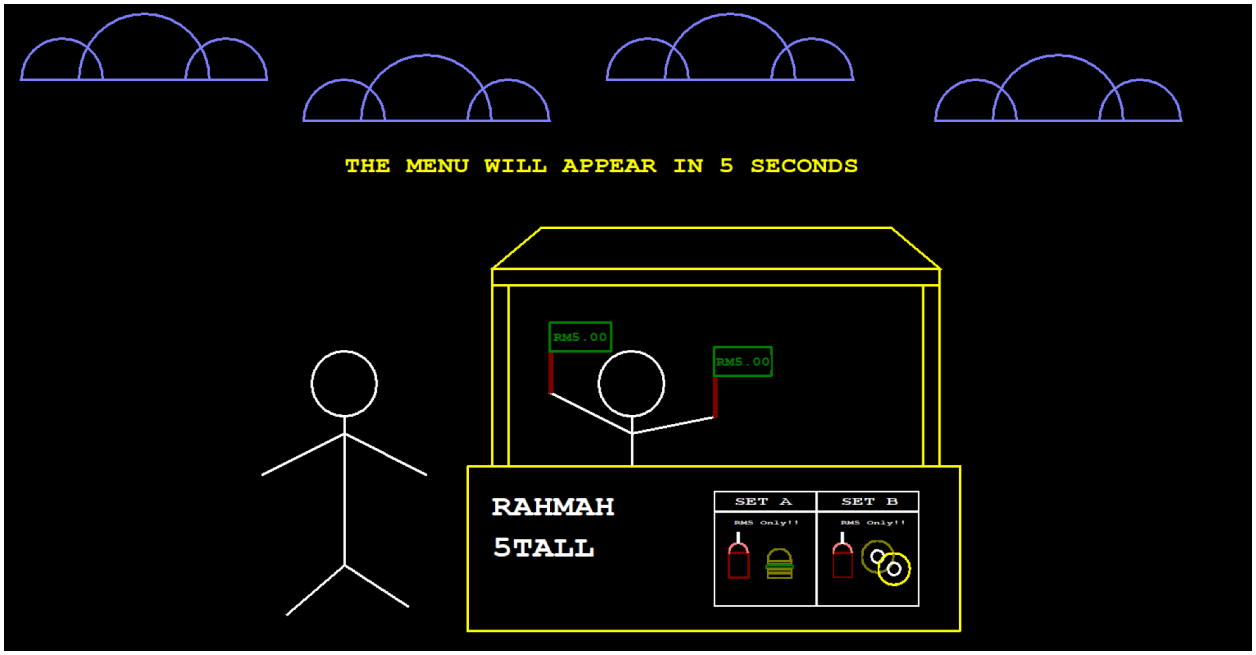


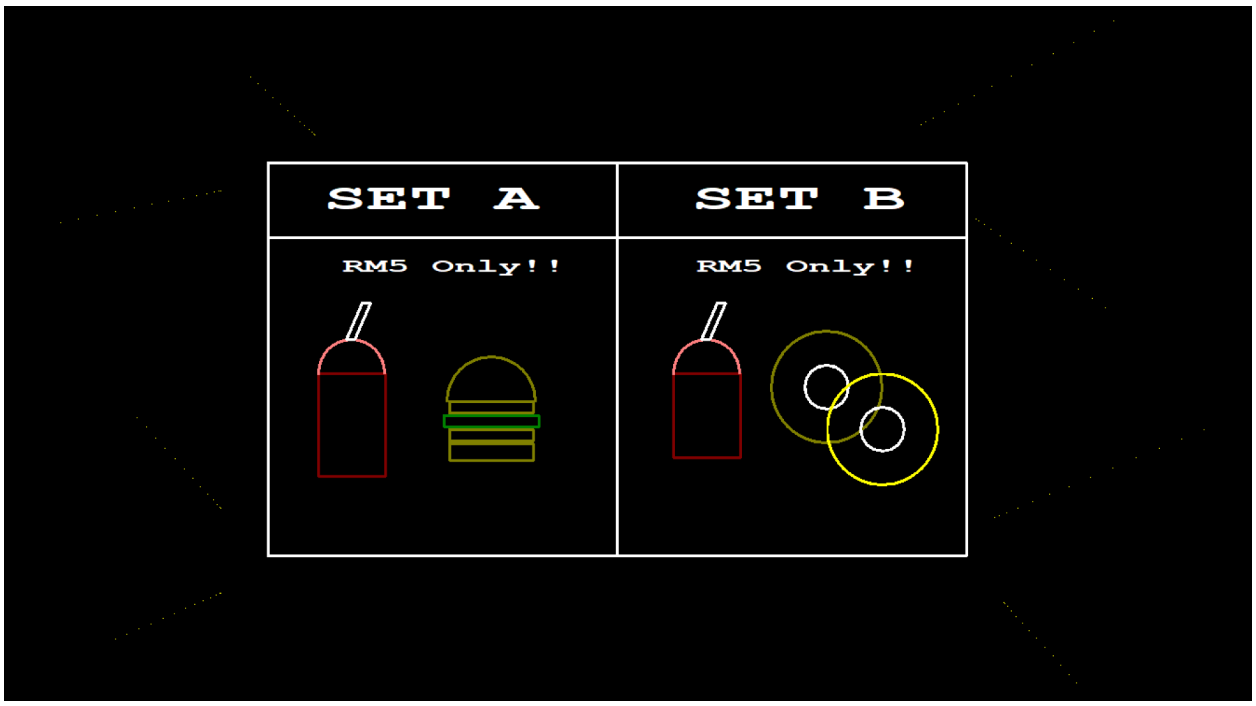
Before creating interpolation



After creating interpolation

EXAMPLE OF OUTPUT





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2) Akshay Singhal. (2019. December 21). 2D Scaling in Computer Graphics. Retrieved from: https://www.gatevidyalay.com/2d-shearing-in-computer-graphics-definition-examples/