Implementation

As shown in figure 10, the entire Air Quality Detection system consist of two sections. The program defined a function to calculate air quality using a fuzzy logic system. In the first section of the system, the function takes crisp value from input variables detected by the sensor such as PM2.5, TVOC, CO, NO2, temperature, and humidity, and calculates crisp output variables API, TCI respectively. Then, the crisp value of API and TCI will be taken as crisp input and passed to the program to calculate the crisp output IAQ. The calculations are conducted based on the fuzzy membership functions defined and the complex rules set.

The function runs in a loop to continuously getting inputs from the sensor, validate them, and provide crisp output values. However, in conditions when the sensor is malfunction and leading the input values detected to be out of range, the loop breaks, and an error message will be displayed, as shown in figure 12.

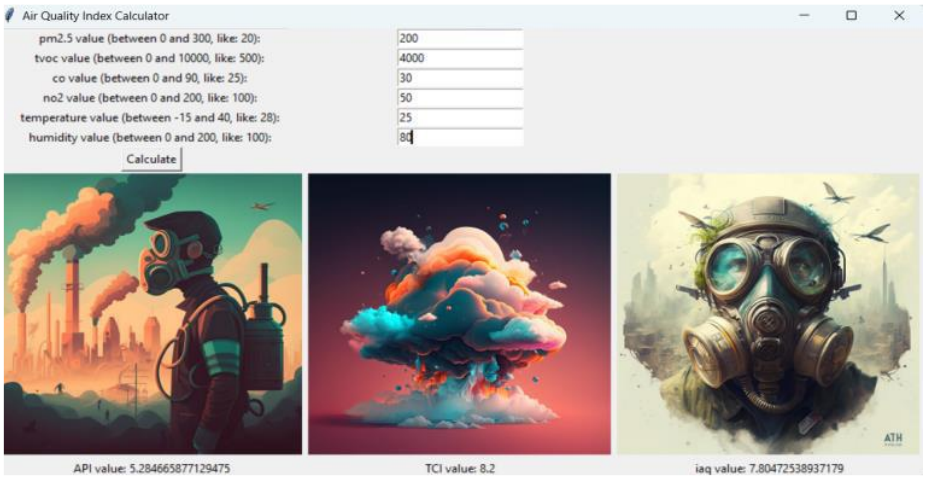

Figure 11 GUI window display output values when input is within range.

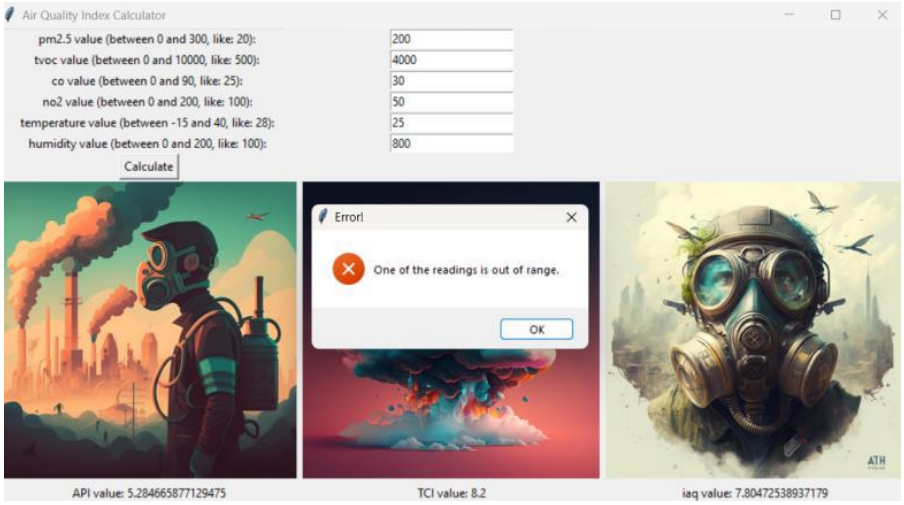

Figure 12 GUI window display error message

Below are the graphs generated in the fuzzy controller with the inputs (PM2.5=200, TVOC=400, CO=30, NO2=50, temperature=25, humidity=800):

The crisp output of IAQ is 6.73, which falls to the unhealthy category.

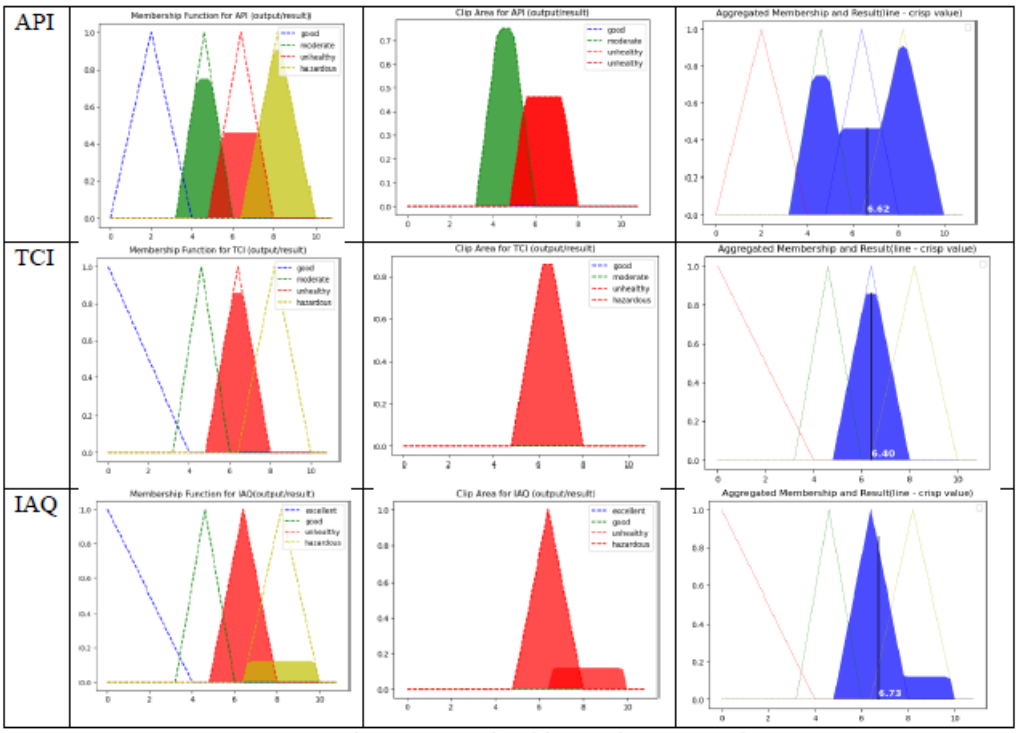

Figure 13 Membership Graphs Generated

This is the pseudo code is shown as follows whereas the code is presented as appendix.

pseudo code

```
# define a function to calculate air quality
def calculate_air_quality():
# Define input variables: pm2_5, tvoc, co, no2, temperature,humidity
# Define output variables: api, tci, iaq

# Define fuzzy membership functions for inputs and outputs
# Define complex rules
# Define a control system

 # Create a loop to get inputs from sensor
 while True:

# Get crisp input from sensor
# Check if the inputs are within valid ranges
# If input is not within range
      # Display error message
      # Break the loop
# Else
    # Set the input crisp values to the fuzzy system
    # Compute the crisp output values
#Display the results


# Call the function
calculate_air_quality()
```