Emotion detection and mental health analysis system

System Design Specification (SDS)

Version 2.0

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Project team members:
李榕成 2130026074
李剑文 2130026071
王诗妍 2130026137
刘泽宇 2130026091
纪懿烜 2130026059

Computer Science and Technology Program

United International College

1. Document Change Log

Change Date	***Changed By***	***Version***	***Change Description***
04/22/2023	*Rongcheng Li*	*1.0*	*First draft*
05/21/2023	Shiyan Wang	2.0	*Final version*

2. Table of Contents

3. Design Overview

In order to maintain the **mental health** and supervision record psychological state, user can upload a **face picture** to analysis the emotion of the picture, the emotional results of the picture are obtained 7 emotion types which are happy, sad, neutral, angry, surprise, disgust, fear.

System can record these results and conduct **data analysis** and **processing** then visual display the users' emotional data. In daily environment, it can combine with the access control facial recognition system then record and analyze the emotional and psychological states of the passing person. In medical environment, it can assist in the treatment of patients with psychological disorders.

4. Tools and Standards

4.1. Tools

Emotion detection system:

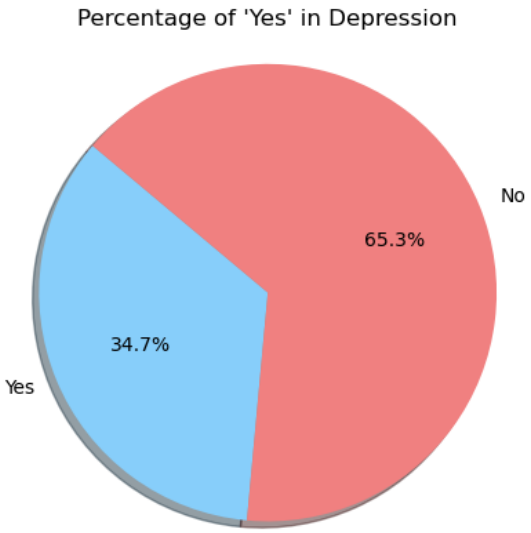
We will be developing the application using various technologies. Firstly, we will use **Python 3.8** as our programming language. We will utilize the powerful machine learning framework, **Tensorflow**, to build and train our model. In addition to that, we will also be using several Python packages such as **scikit-learn**, **Numpy, seaborn, matplotlib,** and **os** to preprocess data, visualize data, and evaluate the model's performance. To facilitate development, we will be using **PyCharm** as our primary integrated development environment (IDE).

Mental health data analysis:

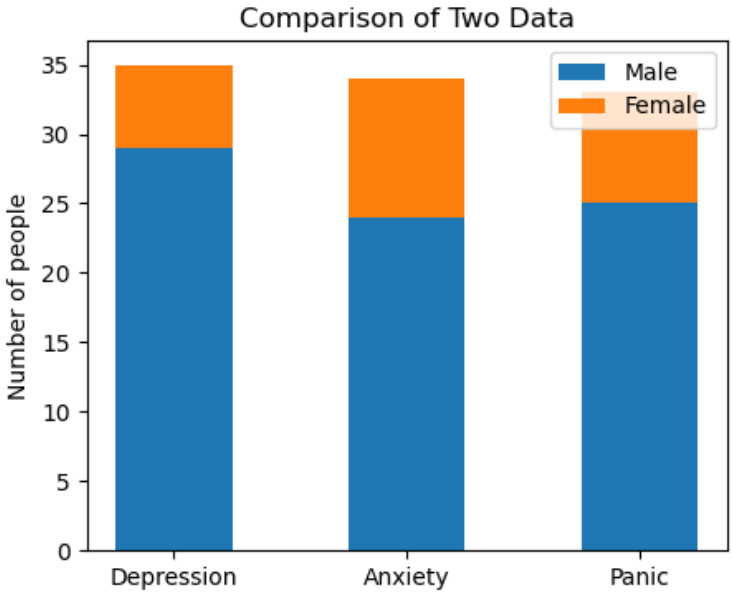
Assume that this project is used in a school, or a class, after the analysis of students' expression, it will generate a csv file recording the psychology conditions.

Depression?	Anxiety?	Panic attack?
Yes	No	Yes
No	Yes	No
Yes	Yes	Yes
Yes	No	No

If a school want to learn about whether students have psychology problems such as anxiety, depression and panic attack, it can generate the pie chart with **pie()** function and selected data. For example, if we calculate the percentage of depression students, the output graph is just like the picture below:

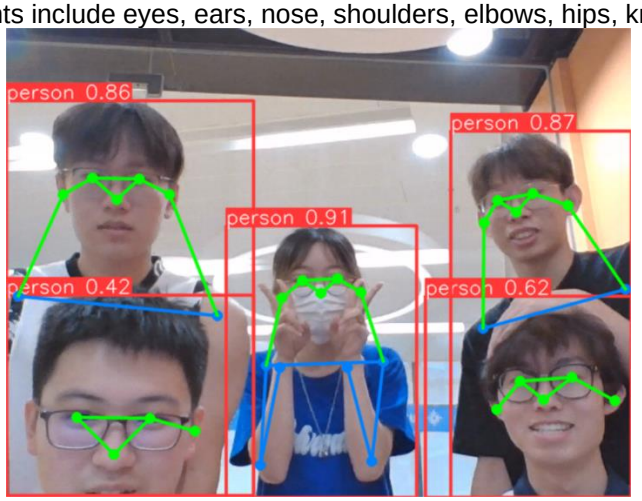


For these three conditions, we use another method **bar()** to draw a bar cahrt to show the amount of the students who have these problem, and the differences between two genders intuitively.



Computer vision and the embedded system:

After reading some materials about computer vision, we learnt some basic function of two powerful packets from OpenCV, they are cv2 and ultralytics. These two packets provide rich interfaces for us to implement our application. The picture below is a small function we make, if you run the code, it will open the camera in your computer, later it will recognize and mark down the key points of human body. The key points include eyes, ears, nose, shoulders, elbows, hips, knees and the ankles.



Briefly introduce the operating principle of the code. The code first imports two packets, they are cv2 and ultralytics. Then, the code uses a function from cv2 to open the camera in the computer. And next, we load the model from “yolov8n-pose.pt”. Then, in the while loop, the code will read each frame from the video. After processing each frame of the video, the code will finally print out the rendered image.

```
# First, we import these two packets
import cv2
from ultralytics import YOLO

# Second, use cv2 to open the camera
camera = cv2.VideoCapture(0)

# Then, we load this model
model = YOLO("yolov8n-pose.pt")

# Finally, in this loop, we read and process each frame
while True:
    flag, curr_frame = camera.read()
    if flag:
        modeling_frame = model(curr_frame)[0]     # model the frame
        processed_frame = modeling_frame.plot()   # process the modeled frame
        cv2.imshow("Live", processed_frame)       # output the processed frame to the scream
    else:
        break
    if cv2.waitKey(1) & 0xFF == ord("s"):   # user can type 's' to stop the program
        break
```

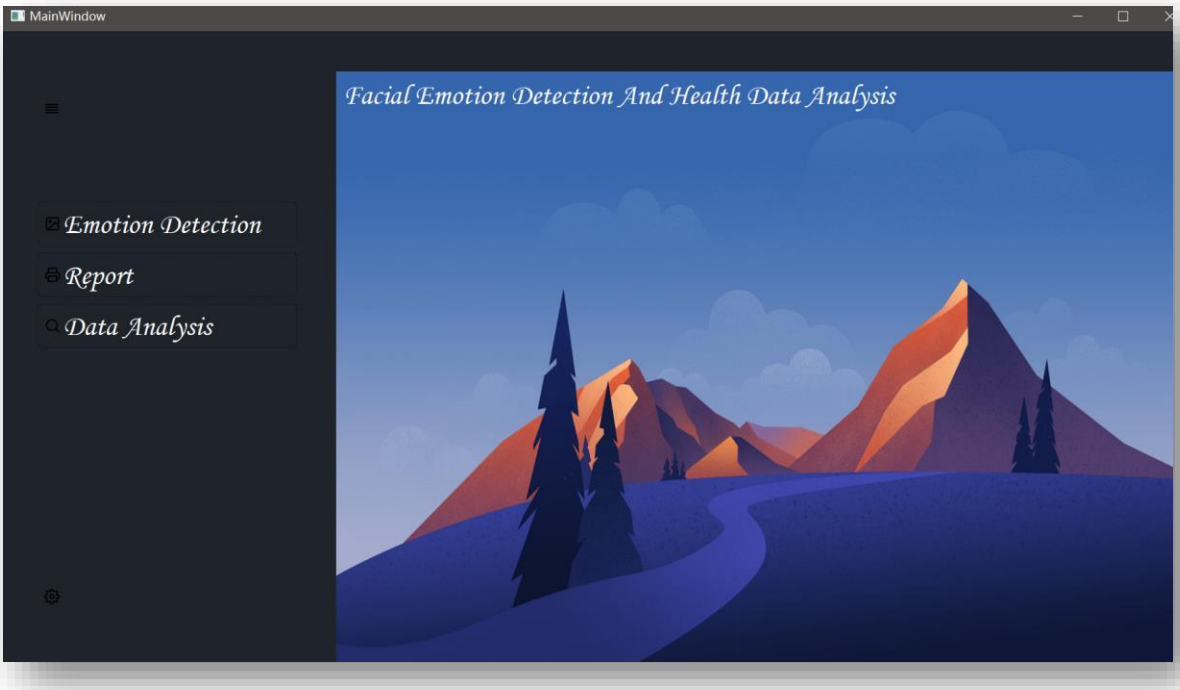
4.2. Standards

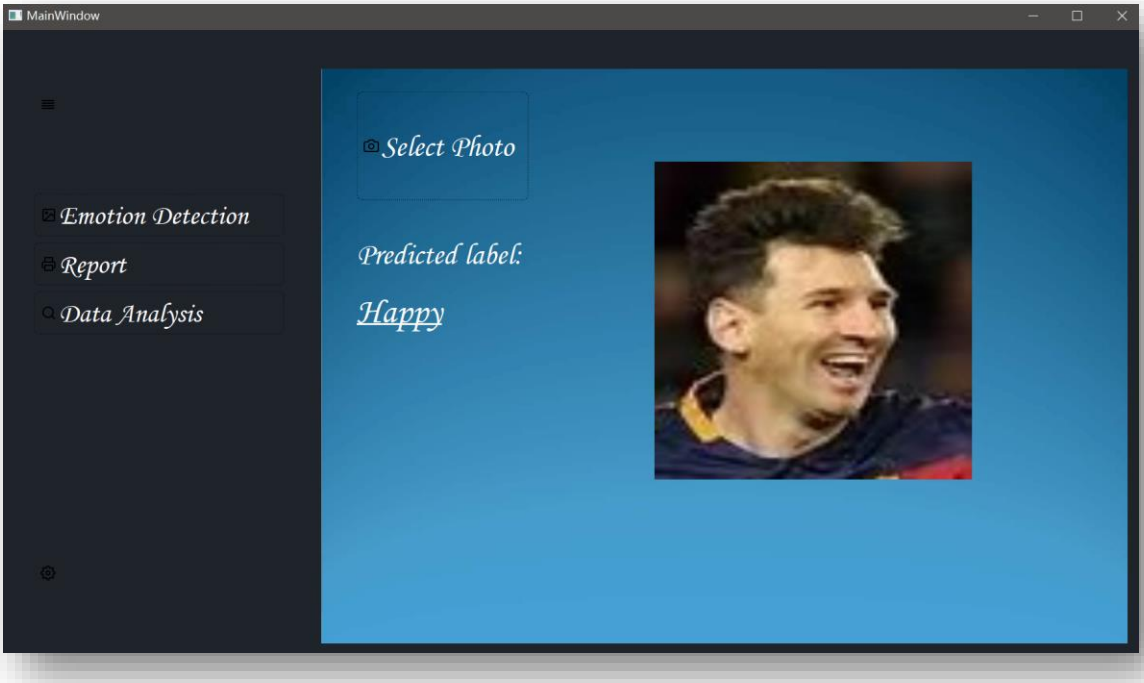
We follow the standard of running our project on the **Windows 10** platform. However, due to the need for high computing power and time required for training our model, we have decided to conduct the training process on **Tencent Cloud** using **Ubuntu 20.1**.

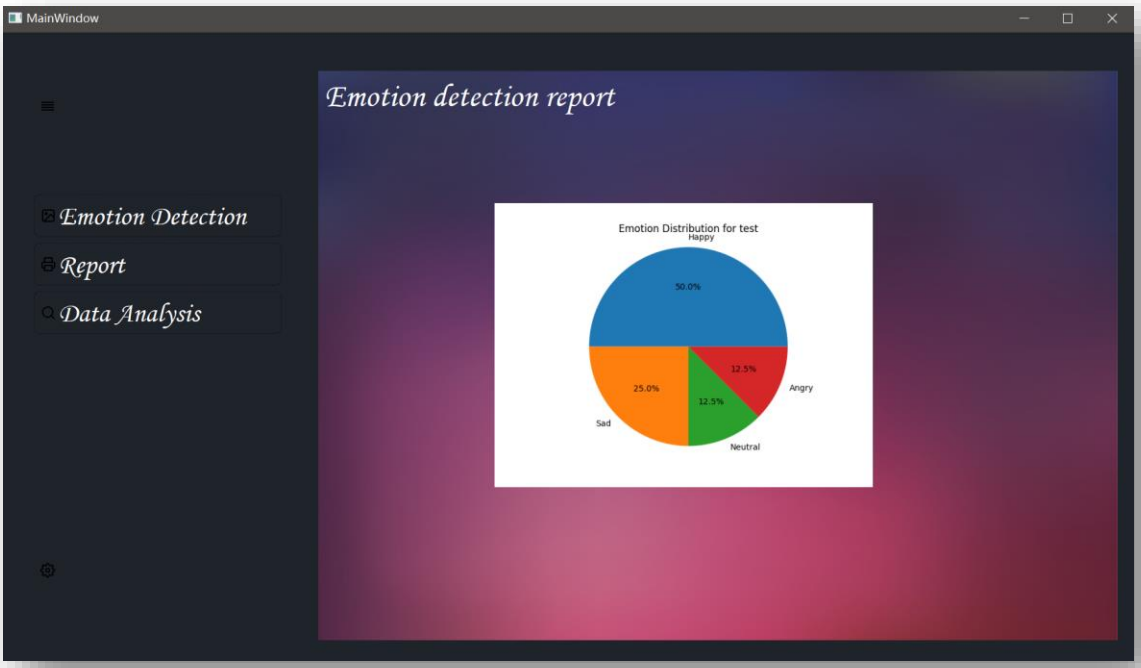
5. User Interface Design

5.1. Usage Scenario 1

Users can log in and **upload photos** of their daily records to record their and their family's mood changes, which can help them more keenly **detect negative emotions** and make adjustment as soon as possible. It will generate a pie chart to depict the distribution of their emotions during the specified time period.


MainWindow
Facial Emotion Detection And Health Data Analysis
Emotion Detection
Report
Data Analysis

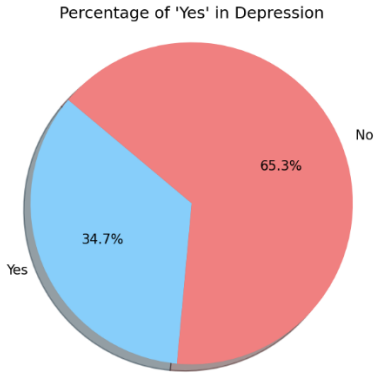

MainWindow
Select Photo
Predicted label:
Happy
Emotion Detection
Report
Data Analysis


MainWindow
Emotion detection report
Emotion Detection
Report
Data Analysis
Emotion Distribution for test
Happy
50.0%
12.5%
Angry
25.0%
Sad
12.5%
Neutral

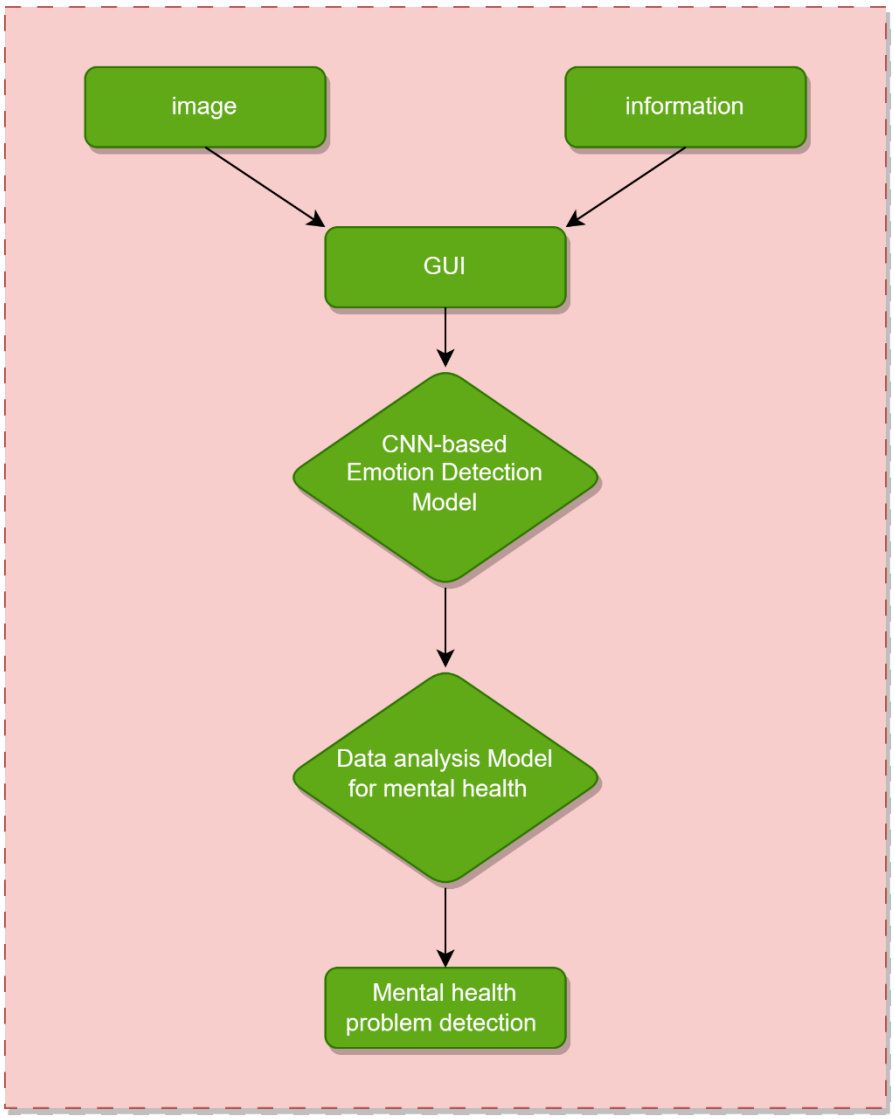

MainWindow
Emotion Detection
Report
Data Analysis
Percentage of 'Yes' in Anxiety
66.3%
No
33.7%
Yes
Percentage of 'Yes' in Depression
65.3%
No
34.7%
Yes
Percentage of 'Yes' in Panic attack
67.3%
No
32.7%
Yes
Comparison of Two Data
Male
Female
Number of people
35
30
25
20
15
10
5
0
Depression
Anxiety
Panic

5.2. **Usage Scenario 2**

For the knowledge of Data Analysis, Computer Vision and Machine Learning, we generate a great idea. So maybe, we can make our project as an embedded system and load it into the camera in our school. Then the camera may be able to collect some basic data about the emotion of students. If during a period of time, the school find that the percentage of students who is depressed is reach to 34%, for example, in the following graph, the school may have to do something such as conducting a lecture on mental health to protect our students or improve the happiness index of students by carrying out mental health education and psychological counseling. We want to implement this interesting applicant maybe in this summer holiday or in the FYP after we learnt some knowledge about the hardware.



6. Diagrams(Flow chart)



---flow chart of our project---