

Facial Recognition System

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Northeastern EECE 2140

Introduction

Objectives and Goals:

- Implement OpenCVs LBPH Algorithm
- Create a program that can distinct between multiple faces
- Integrate this program to create a 2-step security system

Personal goals

- Gain more comfortability in python
- Understand facial recognition algorithms

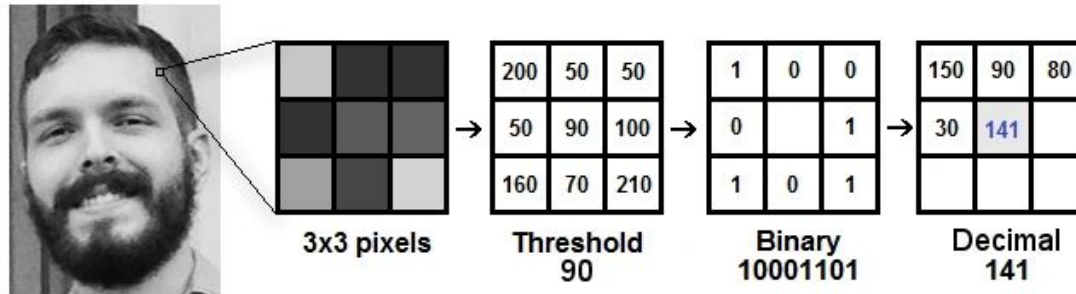
Project Scope

- Deliverables
 - Facial Recognition Program
 - 2-Step Security System
- Constraints
 - Time
 - OpenCV Models

Literature Review

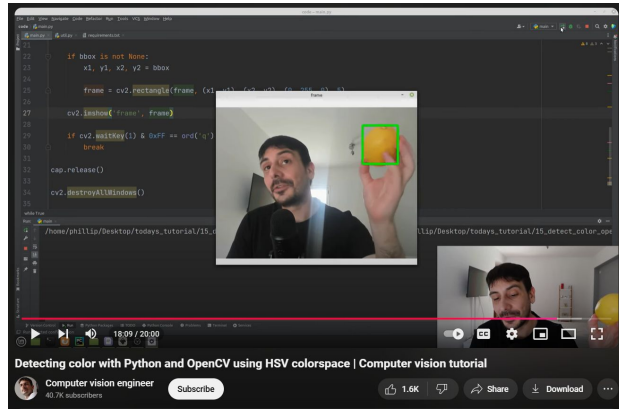
Local Binary Pattern Histogram Algorithm

- How OpenCV Facial Recognition library works
- Divides the image into regions
- Looks at each pixel in region and compares it to the center pixel and then assigns a binary number
- This makes an image that can be divided into smaller regions, and for each region, a histogram is calculated that represents texture features
- For our case, the histograms from given image are compared to the webcam and measures similarity and recognizes the face from there.

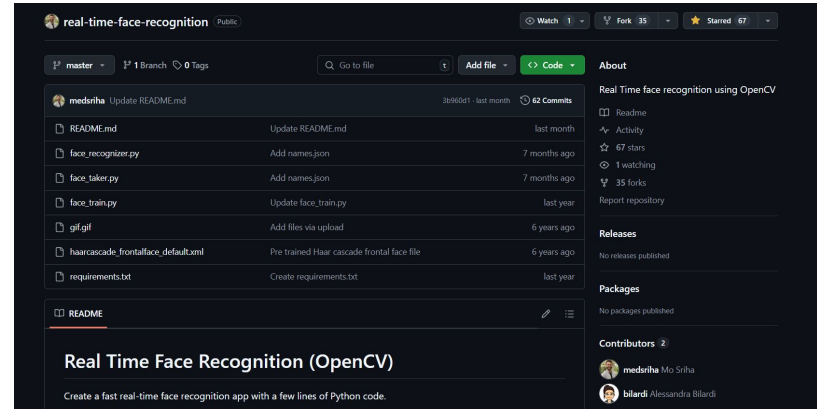


Literature Review/Background

References for project



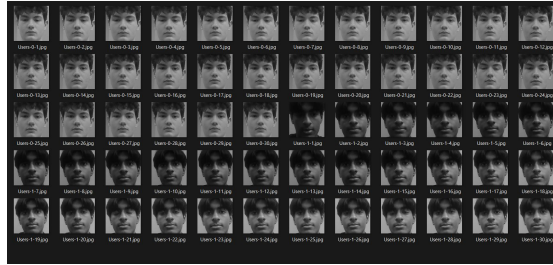
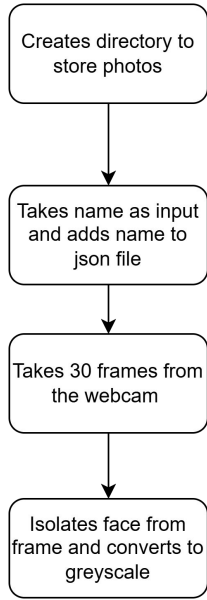
Computer Vision Engineer. "Detecting Color with Python and OpenCV Using HSV Colorspace | Computer Vision Tutorial." *YouTube*, YouTube, 27 Oct. 2022, www.youtube.com/watch?v=aFNDh5k3SjU.



Medsriha. "Medsriha/Real-Time-Face-Recognition: Real Time Face Recognition Using Opencv." *GitHub*, github.com/medsriha/real-time-face-recognition. Accessed 17 Nov. 2024.

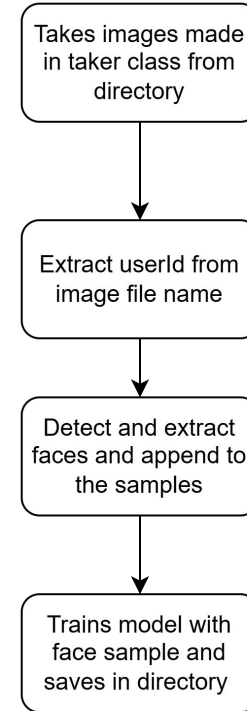
Methodology

Taker Class

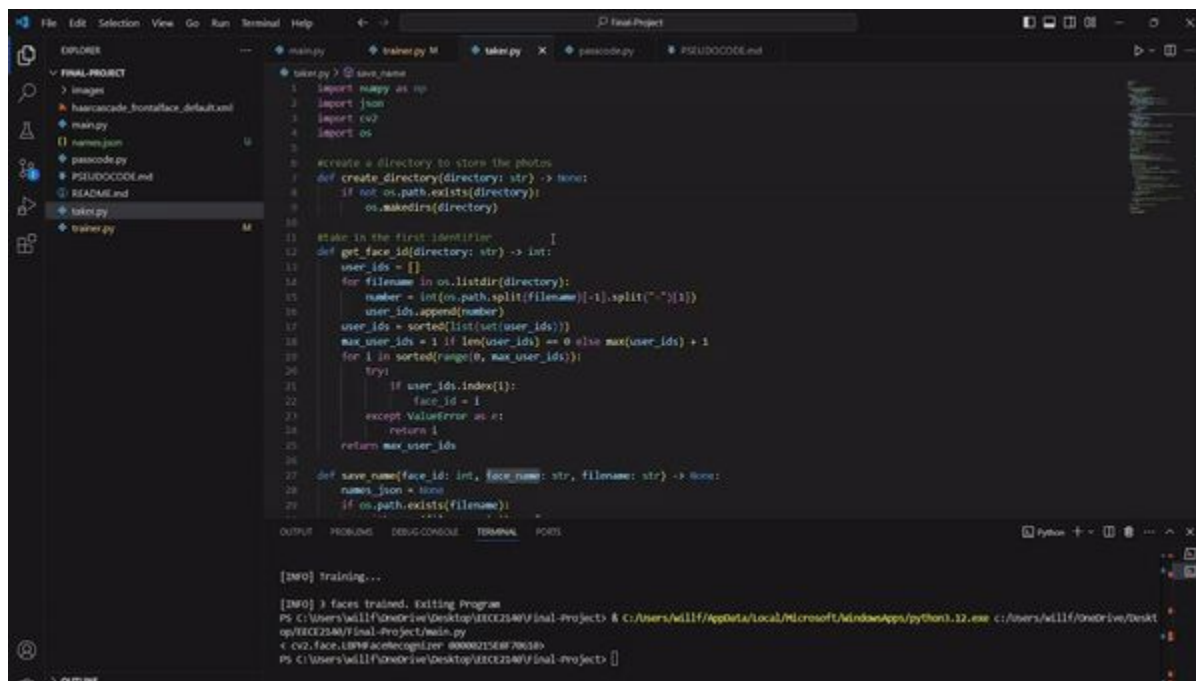


Taker class output

Trainer Class



Taker and Trainer class examples



The screenshot displays the PyCharm IDE interface for a project named "Final Project". The Explorer panel on the left shows the project structure, including files like `main.py`, `trainer.py`, `taker.py`, `password.py`, and `PSEUDOCODE.txt`. The main editor window shows the implementation of the `Taker` and `Trainer` classes in `taker.py`.

```
1 import numpy as np
2 import json
3 import cv2
4 import os
5
6 # create a directory to store the photos
7 def create_directory(directory: str) -> None:
8     if not os.path.exists(directory):
9         os.makedirs(directory)
10
11 # take in the first identifier
12 def get_face_id(directory: str) -> int:
13     user_ids = []
14     for filename in os.listdir(directory):
15         number = int(os.path.splitext(filename)[-1].split("-")[1])
16         user_ids.append(number)
17     user_ids = sorted(list(set(user_ids)))
18     max_user_ids = 1 if len(user_ids) == 0 else max(user_ids) + 1
19     for i in sorted(range(0, max_user_ids)):
20         try:
21             if user_ids.index(i):
22                 face_id = i
23         except ValueError as e:
24             return i
25     return max_user_ids
26
27 def save_name(face_id: int, face_name: str, filename: str) -> None:
28     names_json = None
29     if os.path.exists(filename):
30         ...
```

The bottom panel shows the terminal output:

```
[INFO] Training...
[INFO] 3 faces trained. Exiting Program
PS C:\Users\willf\OneDrive\Desktop\EECE23-WF\Final-Project > c:\Users\willf\AppData\Local\Microsoft\WindowsApps\python3.12.exe c:\Users\willf\OneDrive\Desktop\EECE23-WF\Final-Project\main.py
4 cv2.FaceRecognizerEngine: 80000/1548776380
PS C:\Users\willf\OneDrive\Desktop\EECE23-WF\Final-Project >
```

Methodology

Main Class

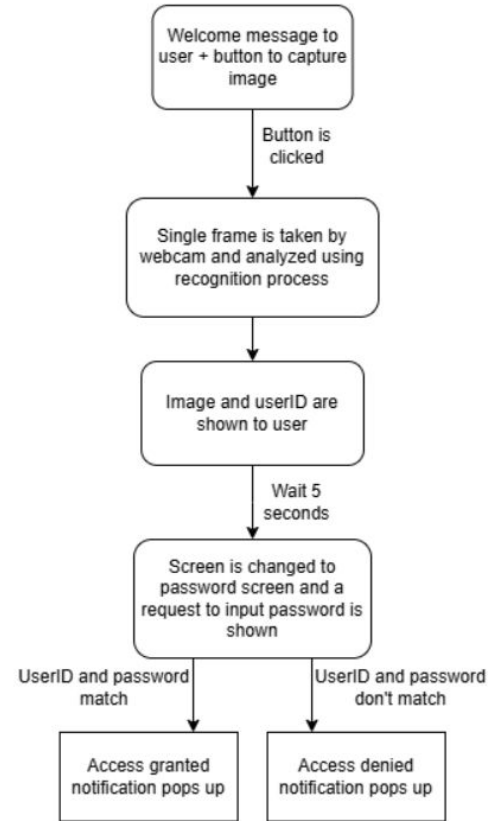
UI

- Tkinter (Python GUI toolkit)

Facial recognition

- Takes 1 frame from webcam
- Perforates image for use in our system
- Compares frame using LBPH recognizer
- Returns user ID with highest confidence value

```
# Predict the user ID and confidence
user_id, confidence = recognizer.predict(gray_image[y:y+h, x:x+w])
```



UI Process flowchart

Results

- Generally, followed this outline for our project
- Had to redefine our goals during the project
 - Project would need work to implement into real life, but is fundamentally there

Week 5 tasks

- Brainstorm project idea
- Create project timeline

Week 6 tasks

- Set up IDE and repo
- Begin writing basic components of code
- Reflect on plan (10/10)

Week 7 tasks

- Begin putting code elements together
- Start work on initial facial recognition components

Week 8 tasks

- Continue working on facial recognition software

Week 9 tasks

- Finish working on facial recognition software

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- Begin UI system

Week 10 tasks

- Integrate keypad into project and finish working on UI
- Being integrating components for final product

Week 11 tasks

- Finalize facial recognition and integrate electronics if necessary

Week 12 tasks

- Finalize project functionality.
- Final debugging process

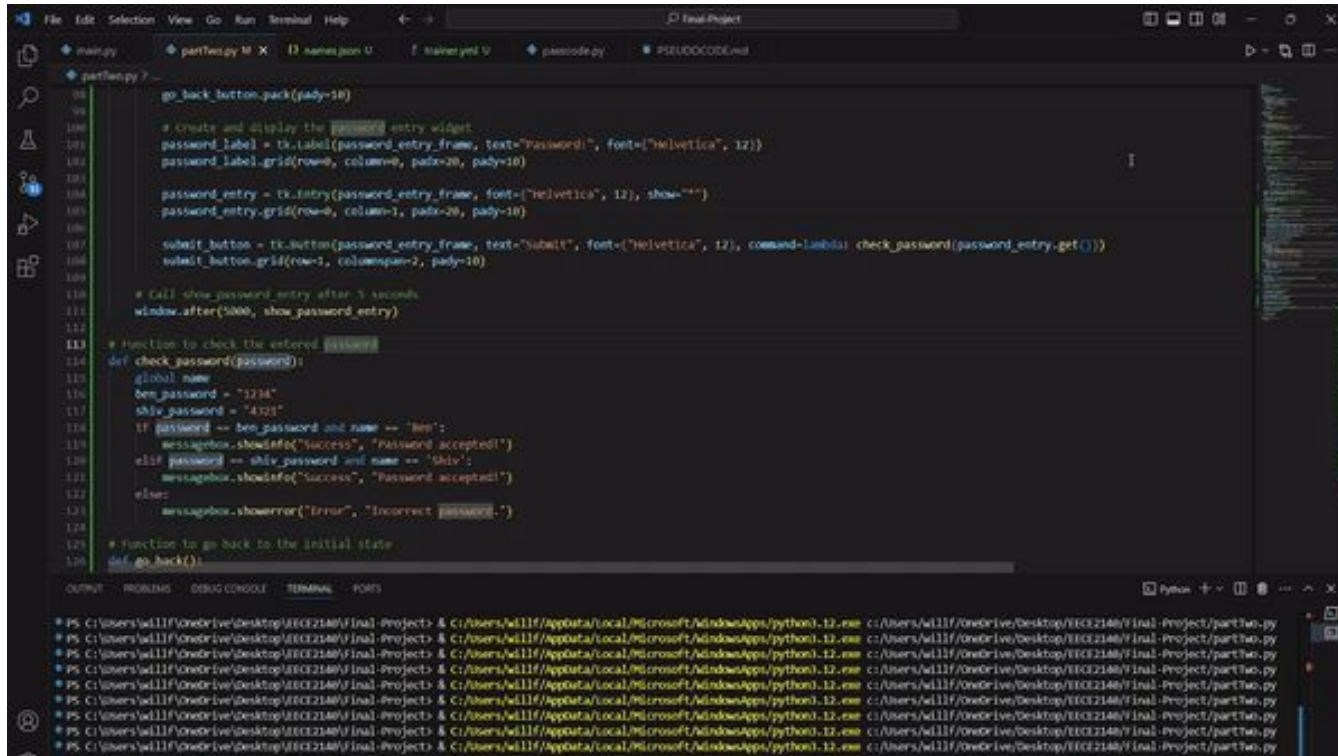
Week 13 tasks

- Make project presentation

Week 14 tasks

- Make sure everything is functional and ready
- Present project

Analysis



```
File Edit Selection View Go Run Terminal Help
partTwo.py X names.py U Main.py U password.py PS2UDOCODE.md
partTwo.py ?
98 go_back_button.pack(pady=10)
99
100 # Create and display the password entry widget
101 password_label = tk.Label(password_entry_frame, text="Password:", font=("Helvetica", 12))
102 password_label.grid(row=0, column=0, padx=20, pady=10)
103
104 password_entry = tk.Entry(password_entry_frame, font=("Helvetica", 12), show="*")
105 password_entry.grid(row=0, column=1, padx=20, pady=10)
106
107 submit_button = tk.Button(password_entry_frame, text="Submit", font=("Helvetica", 12), command=lambda: check_password(password_entry.get()))
108 submit_button.grid(row=1, columnspan=2, pady=10)
109
110 # Call show_password_entry after 5 seconds
111 window.after(5000, show_password_entry)
112
113 # Function to check the entered password
114 def check_password(password):
115     global name
116     ben_password = "1234"
117     shiv_password = "4321"
118     if password == ben_password and name == "Ben":
119         messagebox.showinfo("Success", "Password accepted!")
120     elif password == shiv_password and name == "Shiv":
121         messagebox.showinfo("Success", "Password accepted!")
122     else:
123         messagebox.showerror("Error", "Incorrect password.")
124
125 # Function to go back to the initial state
126 def go_back():
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```

- Program runs how we wanted it to
- Because it calls to take in a single frame from webcam, it takes a while to connect and “capture” the frame
- GUI is bare, could use a different library

Discussion

Implications of Findings

- Adds multiple layers to security
- Applicable to many real life scenarios (e.g FaceID)
- Can be applied in a much larger scale

Limitations

- The algorithm isn't super accurate when not given enough samples
- Not having enough processing power to take more samples to attain an more accurate program
- Not having enough time to flesh out the 2-step security; looks simple.

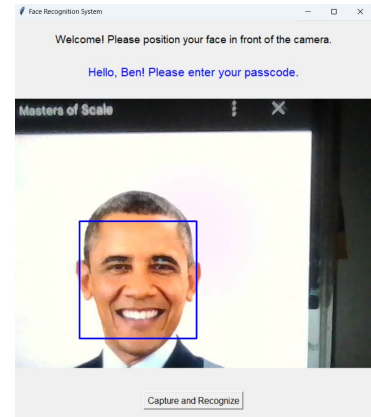
Conclusion

Conclusion

- Able to develop a Facial Recognition program using OpenCV
- Implemented it into create a 2-step security system
- Limited by technology and time

Recommendations for Future Work

- still use OpenCV and their library as LBPH is quite easy to understand and work with
- Find a way to make algorithm more accurate
 - Take more samples?
- Use different GUI library



References

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