VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY

UNIVERSITY OF ECONOMICS AND LAW

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FINAL PROJECT REPORT
SUBJECT: PROGAMMING TECHNIQUES

Topic
Face Recognition By Python

Group 1

1. Bui Van Toan	K204162002
2. Truong Cong Vinh	K204162008
3. Le Thi Anh Thu	K204160672
4. Le Minh Tri	K204162004
5. Nguyen My Tam	K204160670

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ACKNOWLEDGEMENT

Our project team would like to thank Ms. Lam Hong Thanh - the instructor and Mr. Le Ba Thien - Teaching assistant of Programming Engineering for equipping me with the basic knowledge and skills needed to complete this topic. However, in the process of researching the topic, due to limited specialized knowledge, our group still has many shortcomings when researching, evaluating and presenting on the topic.Therefore, we would like to receive your comments and suggestions to improve the report.

Sincerely thanks!

Group 1

MỤC LỤC

Chapter 1: Introduction:

1.1. Overview

Face recognition systems are part of facial image processing applications and their significance as a research area are increasing recently. They use biometric information of humans and are applicable easily instead of fingerprint, iris, signature etc., because these types of biometrics are not much suitable for non-collaborative people. Face recognition systems are usually applied and preferred for people and security cameras in metropolitan life. These systems can be used for crime prevention, video surveillance, person verification, and similar security activities.

Face recognition system is a complex image-processing problem in real world applications with complex effects of illumination, occlusion, and imaging condition on the live images. It is a combination of face detection and recognition techniques in image analyzes. Detection application is used to find position of the faces in a given image. Recognition algorithm is used to classify given images with known structured properties, which are used commonly in most of the computer vision applications. Recognition applications use standard images, and detection algorithms detect the faces and extract face images which include eyes, eyebrows, nose, and mouth. That makes the algorithm more complicated than a single detection or recognition algorithm.

There are many methods to improve performance, but more or less these methods are facing challenges in terms of brightness, tilt orientation, image size, or the influence of environmental parameters. And recognizing the cruciality of the problem, our group came up with the idea to create facial recognition software and print out student information.

1.2. Purpose

- Build a project practising face recognition.
- Get knowledge about OpenCV.
- Learn face recognition methods.

1.3. Research scope

- Build a project practising face recognition.

- Process raw images and then take them into the database.
- Face recognition and attendance.

1.4. Solution

The input of the face recognition system is an image, a video or by webcam. After processing and analysing, the system defines our face location (if any) and defines whether a person is stored or not. Before detecting one person, the system must prepare raw data. After that, training raw data to exact embedding vectors for later comparison. A face recognition system includes 4 processing steps:

1. Face Detection.
2. Face Alignment hay Segmentation.
3. Feature Extraction
4. Recognition or Face Classification.

Chapter 2: Theoretical basis and related research

1. Overview

Face recognition is an essential basic application of object recognition in general and is the first step of any automatic face recognition system. In addition, face recognition is also widely applied in many fields such as security, biometrics, establishing a new interface between human and computer, and many other important applications.

“Face detection is a technology that allows us to determine the position and size of human faces present in a digital image. This technology can detect facial details and ignore other objects such as houses, trees, or other parts of the human body.”.

http://en.wikipedia.org/wiki/Face_detection

The goal of face recognition of the topic is to identify and print out information of students such as Full name, Student ID, total score, ...

2. Related research

There are a lot of methods relating to face detection. According to Ming-Hsuan Yang, it can be classified into 4 main approaches:

- knowledge-based: This is a top-down approach, easily building basic rules to describe face features and corresponding relationships. For example, a face usually has two eyes that are symmetrical about the vertical axis in the middle of the face and has a nose and a mouth. The relationships of features can be described as distance and position relationships.
- Feature invariant:This is a bottom-up approach. The authors try to find the unchanging features of the human face to identify the human face. Based on actual observations, if people easily recognize faces and objects in different poses and different lighting conditions, there must be unchanged attributes or features such as: feathers. eyebrows, eyes, nose, mouth,…
- Template matching: In pattern matching, standard samples of faces (usually straight-up faces) are predefined or parameters defined via a function. From an input image, calculate correlation values against standard samples for contours of the face, eyes, nose, and mouth. Through these correlation values, the authors decide whether or not there are faces in the image. This approach has the advantage of being very easy to set up, but doesn't work when proportions, posture, and shape change (proven). Multiple resolutions, multi-scales, subsamples, and distortion samples are considered to be octaves in scale and shape.
- Appearance-based or machine learning-based:In contrast to methods that match patterns with predefined patterns by experts, patterns in this approach are learned from sample images. In general, these approaches apply statistical probabilistic and machine learning techniques to find relevant features of faces and non-faces. The learned features in the form of distribution models or discriminant functions should be used that can be used to identify human faces. At the same time, the problem of reducing the number of dimensions is often interested to increase the computational efficiency as well as the determination efficiency.

Chapter 3: Face recognition

3.1. Research scope

3.1.1. Analyze

The main idea of the software is testing whether a face is stored in the database or not. Besides that, the system also performs the work of detecting and separating human faces (if any) from a still image, or from image frames obtained from the camera. Then, save it to the database as a sample set.

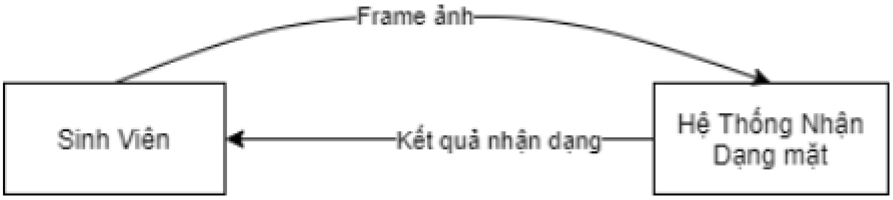


Figure 1: System context diagram

The program's functions include:

- Get an image from the connection to the webcam displayed.
- Perform face separation.
- Save the detected face to the database.
- Single-face image recognition. If "know" the person (with information stored in the database), then display the name and a picture of that person. If "don't know" (there is no information about that person in the database), the display will be: "Unknown"

3.1.2. Design system

With the function above, the system is divided into 5 main parts:

- Input image processing.
- Face detection.
- Face treatment.
- Output processing.
- Save attendance.

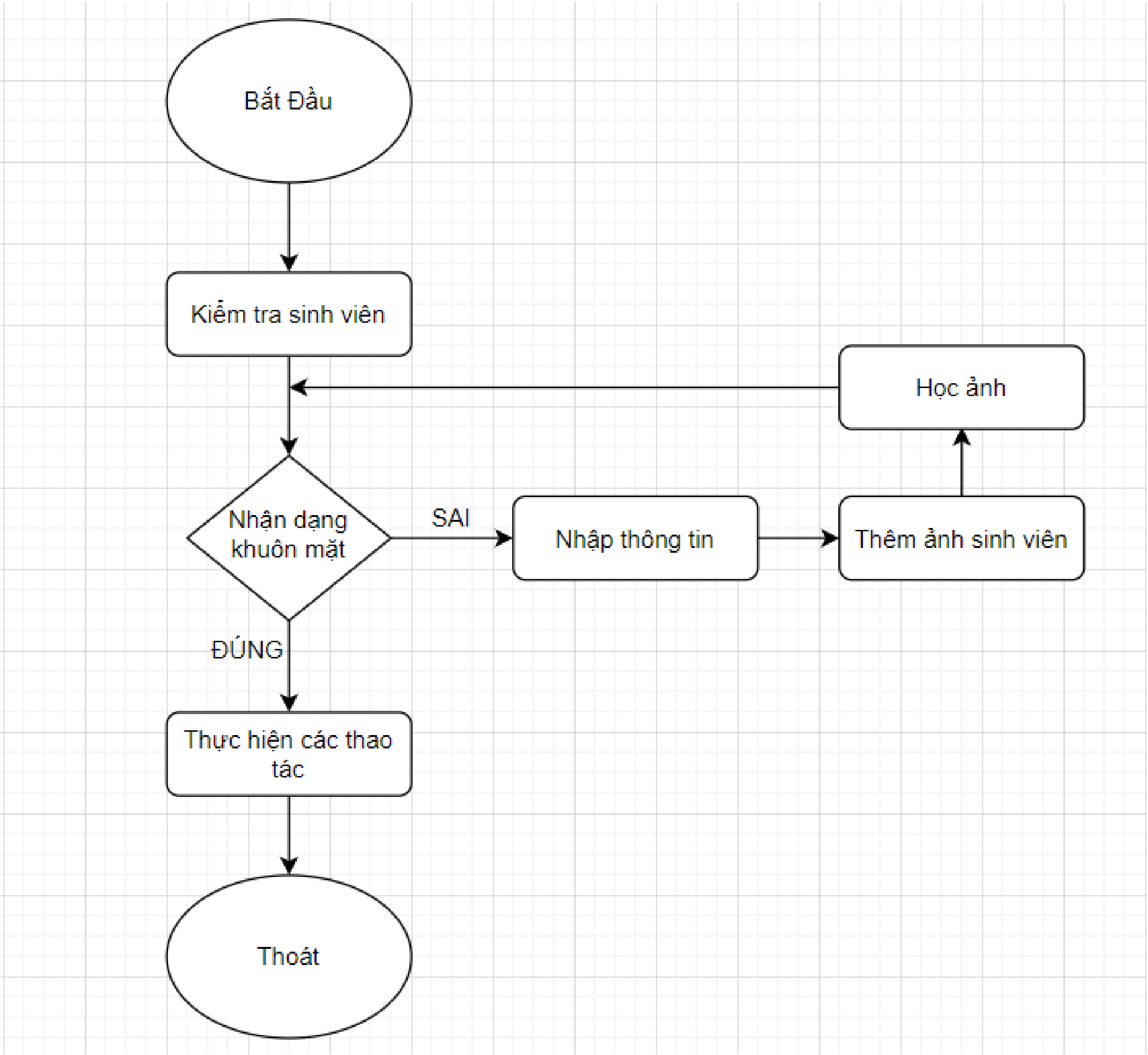
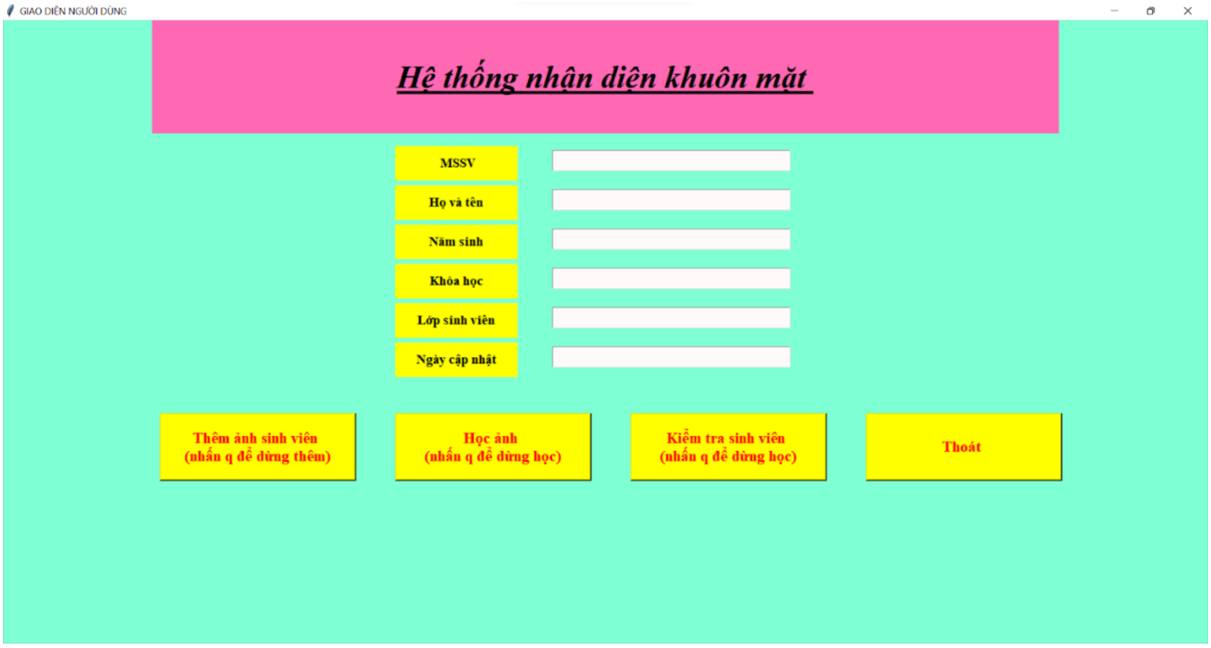


Figure 2: Program execution diagram

3.2. Libraries used

- Python 3.9 and OpenCV: work with images.
- PIL: process images.
- Numpy => Numpy array: store images transacted from PIL.
- Tkinter: design user interface.
- Pandas: create DataFrame.
- OS: work with images saved in the system.
- Face_recognition: detecting face library by Python.
- Datatime: save present hour.

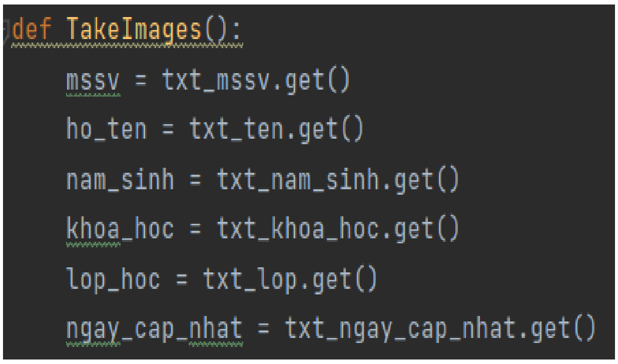
3.3. Create source code



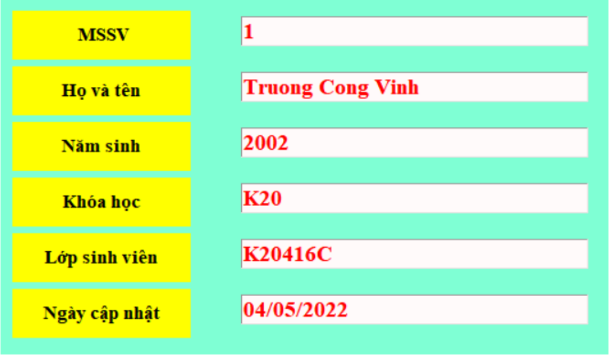
- Step 1: Create a Dataset for identification.
- Step 2: Create Data training used to train data.
- Step 3: Create a detector layer to detect

3.3.1. Take the data from keyboard and camera

- Take data:

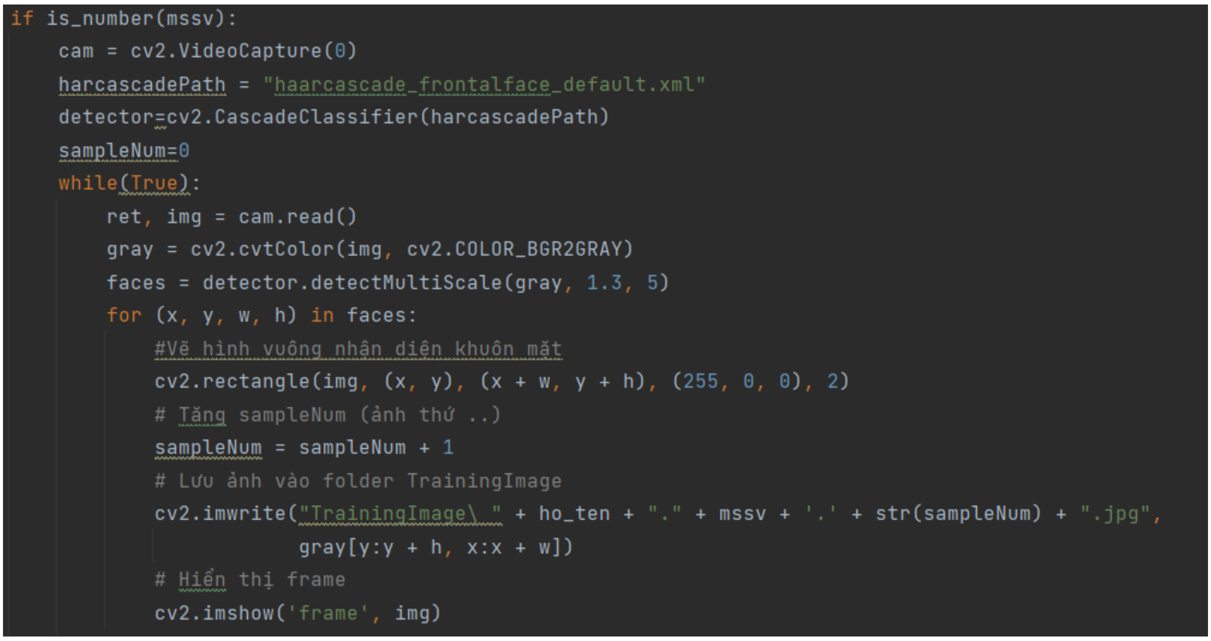


```
def TakeImages():
    mssv = txt_mssv.get()
    ho_ten = txt_ten.get()
    nam_sinh = txt_nam_sinh.get()
    khoa_hoc = txt_khoa_hoc.get()
    lop_hoc = txt_lop.get()
    ngay_cap_nhat = txt_ngay_cap_nhat.get()
```

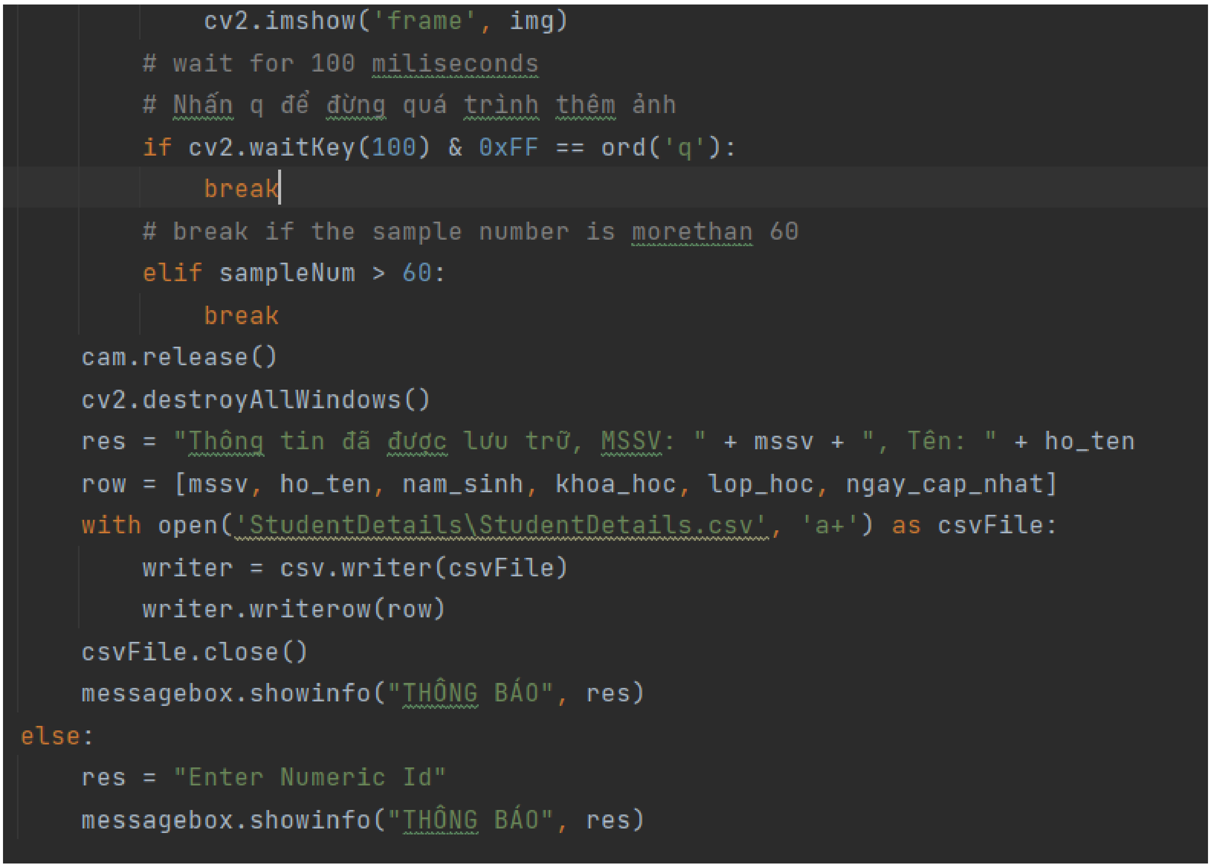


MSSV	1
Họ và tên	Truong Cong Vinh
Năm sinh	2002
Khóa học	K20
Lớp sinh viên	K20416C
Ngày cập nhật	04/05/2022

- Source code supports take the images:

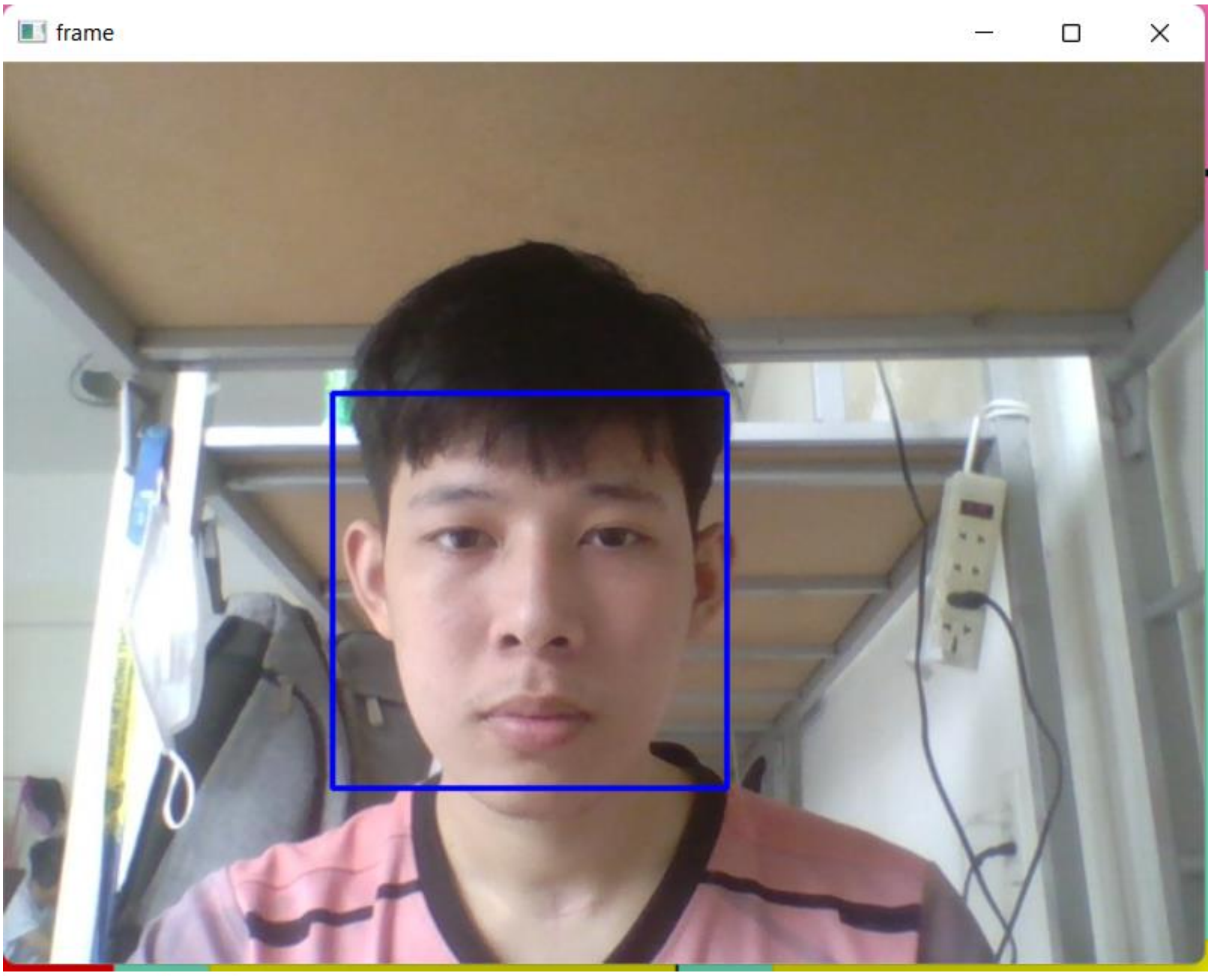


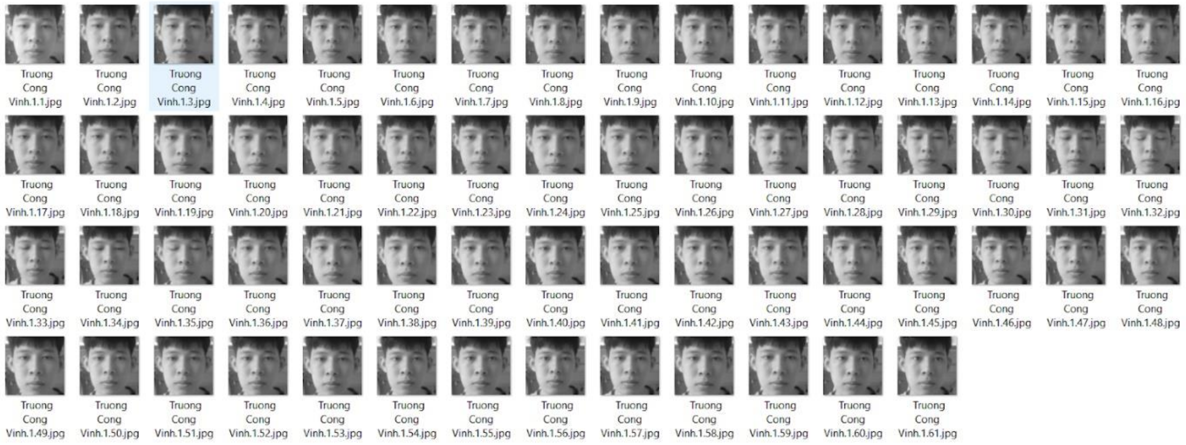
```python
if is_number(mssv):
    cam = cv2.VideoCapture(0)
    harcascadePath = "haarcascade_frontalface_default.xml"
    detector=cv2.CascadeClassifier(harcascadePath)
    sampleNum=0
    while(True):
        ret, img = cam.read()
        gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
        faces = detector.detectMultiScale(gray, 1.3, 5)
        for (x, y, w, h) in faces:
            #Vẽ hình vuông nhận diện khuôn mặt
            cv2.rectangle(img, (x, y), (x + w, y + h), (255, 0, 0), 2)
            # Tăng sampleNum (ảnh thứ ..)
            sampleNum = sampleNum + 1
            # Lưu ảnh vào folder TrainingImage
            cv2.imwrite("TrainingImage\ " + ho_ten + "." + mssv + '.' + str(sampleNum) + ".jpg",
                        gray[y:y + h, x:x + w])
            # Hiển thị frame
            cv2.imshow('frame', img)
```



```python
            cv2.imshow('frame', img)
        # wait for 100 miliseconds
        # Nhấn q để dừng quá trình thêm ảnh
        if cv2.waitKey(100) & 0xFF == ord('q'):
            break
        # break if the sample number is morethan 60
        elif sampleNum > 60:
            break
    cam.release()
    cv2.destroyAllWindows()
    res = "Thông tin đã được lưu trữ, MSSV: " + mssv + ", Tên: " + ho_ten
    row = [mssv, ho_ten, nam_sinh, khoa_hoc, lop_hoc, ngay_cap_nhat]
    with open('StudentDetails\StudentDetails.csv', 'a+') as csvFile:
        writer = csv.writer(csvFile)
        writer.writerow(row)
    csvFile.close()
    messagebox.showinfo("THÔNG BÁO", res)
else:
    res = "Enter Numeric Id"
    messagebox.showinfo("THÔNG BÁO", res)
```

- Image limitation is 60.




Truong Cong Vinh.1.1.jpg
Truong Cong Vinh.1.2.jpg
Truong Cong Vinh.1.3.jpg
Truong Cong Vinh.1.4.jpg
Truong Cong Vinh.1.5.jpg
Truong Cong Vinh.1.6.jpg
Truong Cong Vinh.1.7.jpg
Truong Cong Vinh.1.8.jpg
Truong Cong Vinh.1.9.jpg
Truong Cong Vinh.1.10.jpg
Truong Cong Vinh.1.11.jpg
Truong Cong Vinh.1.12.jpg
Truong Cong Vinh.1.13.jpg
Truong Cong Vinh.1.14.jpg
Truong Cong Vinh.1.15.jpg
Truong Cong Vinh.1.16.jpg
Truong Cong Vinh.1.17.jpg
Truong Cong Vinh.1.18.jpg
Truong Cong Vinh.1.19.jpg
Truong Cong Vinh.1.20.jpg
Truong Cong Vinh.1.21.jpg
Truong Cong Vinh.1.22.jpg
Truong Cong Vinh.1.23.jpg
Truong Cong Vinh.1.24.jpg
Truong Cong Vinh.1.25.jpg
Truong Cong Vinh.1.26.jpg
Truong Cong Vinh.1.27.jpg
Truong Cong Vinh.1.28.jpg
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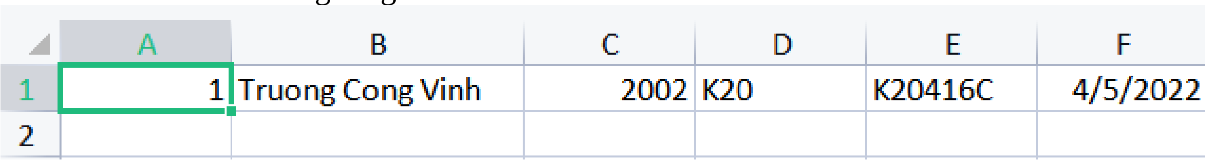
Truong Cong Vinh.1.57.jpg
Truong Cong Vinh.1.58.jpg
Truong Cong Vinh.1.59.jpg
Truong Cong Vinh.1.60.jpg
Truong Cong Vinh.1.61.jpg

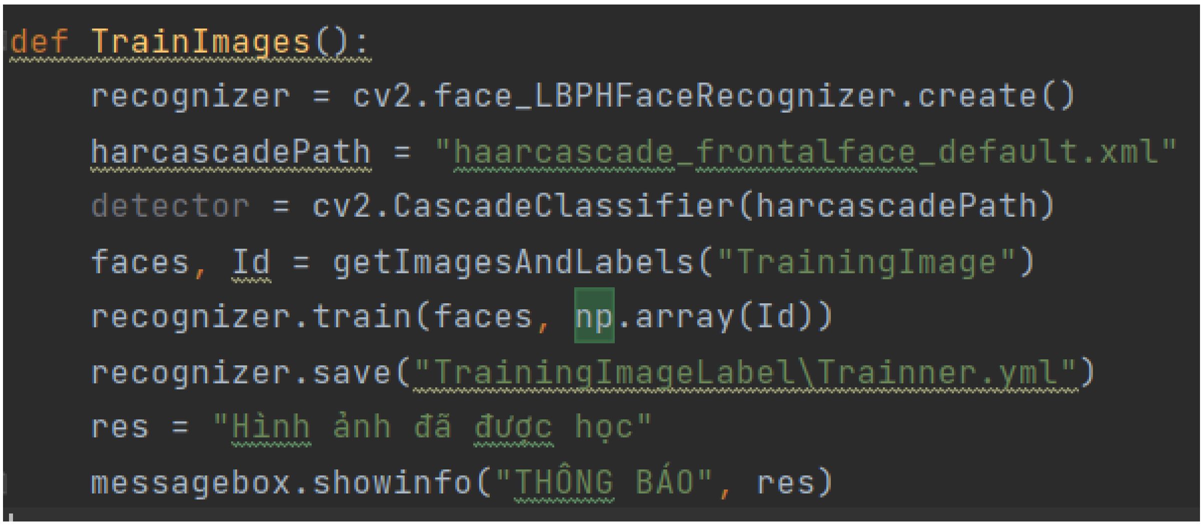
- Students information is saved in StudentDetails.csv and images is saved in folder name TrainingImage.



	A	B	C	D	E	F
1	1	Truong Cong Vinh	2002	K20	K20416C	4/5/2022
2						

3.3.2. Training student images and storing

Processing to separate ID from name of the image file. Then convert images and add to Faces array with ID. With Classification problems, Feature is the image and Label is User ID.

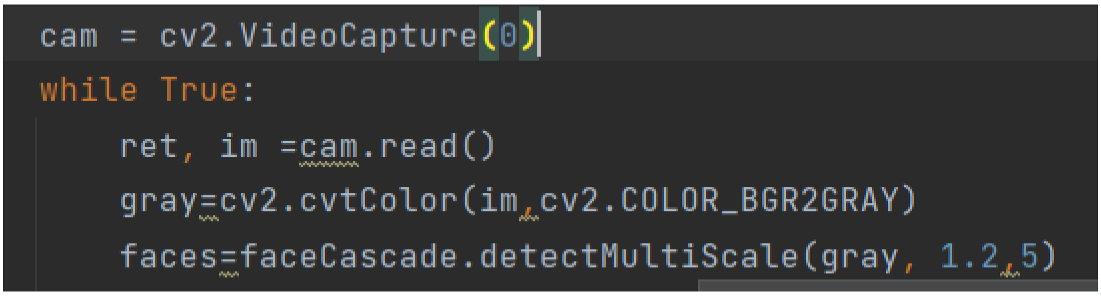


```
def TrainImages():
    recognizer = cv2.face_LBPHFaceRecognizer.create()
    harcascadePath = "haarcascade_frontalface_default.xml"
    detector = cv2.CascadeClassifier(harcascadePath)
    faces, Id = getImagesAndLabels("TrainingImage")
    recognizer.train(faces, np.array(Id))
    recognizer.save("TrainingImageLabel\Trainner.yml")
    res = "Hình ảnh đã được học"
    messagebox.showinfo("THÔNG BÁO", res)
```

Training process and saving into the file

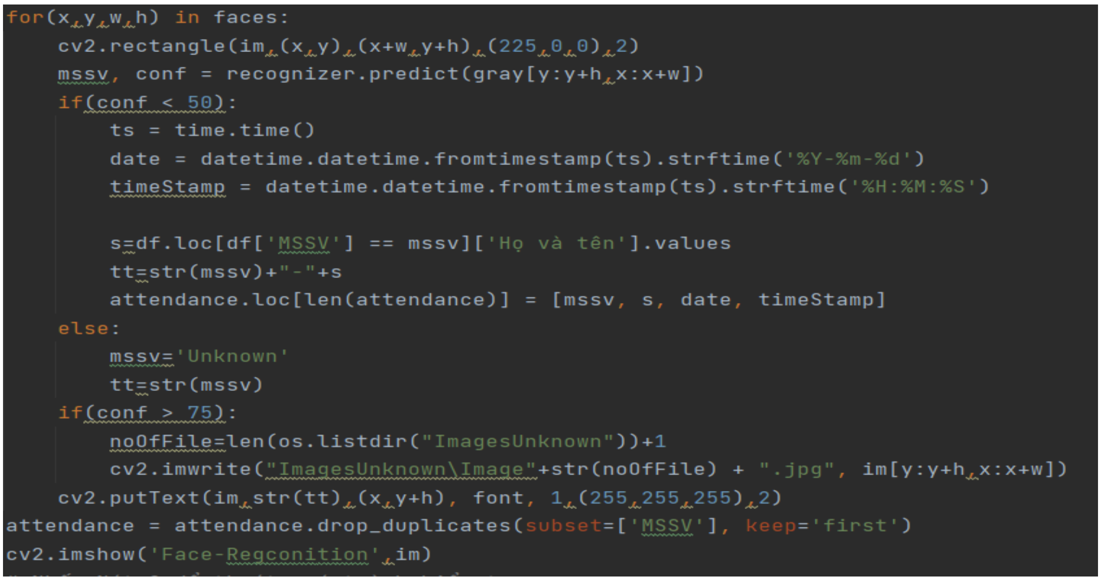
3.3.3. Detector trained faces:

- Using the camera to recognize user.



```
cam = cv2.VideoCapture(0)
while True:
    ret, im =cam.read()
    gray=cv2.cvtColor(im,cv2.COLOR_BGR2GRAY)
    faces=faceCascade.detectMultiScale(gray, 1.2,5)
```

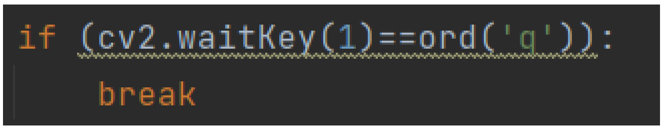
- Show student information



```
for(x,y,w,h) in faces:
    cv2.rectangle(im,(x,y),(x+w,y+h),(225,0,0),2)
    mssv, conf = recognizer.predict(gray[y:y+h,x:x+w])
    if(conf < 50):
        ts = time.time()
        date = datetime.datetime.fromtimestamp(ts).strftime('%Y-%m-%d')
        timeStamp = datetime.datetime.fromtimestamp(ts).strftime('%H:%M:%S')

        s=df.loc[df['MSSV'] == mssv]['Họ và tên'].values
        tt=str(mssv)+"-"+s
        attendance.loc[len(attendance)] = [mssv, s, date, timeStamp]
    else:
        mssv='Unknown'
        tt=str(mssv)
    if(conf > 75):
        noOfFile=len(os.listdir("ImagesUnknown"))+1
        cv2.imwrite("ImagesUnknown\Image"+str(noOfFile) + ".jpg", im[y:y+h,x:x+w])
    cv2.putText(im,str(tt),(x,y+h), font, 1,(255,255,255),2)
attendance = attendance.drop_duplicates(subset=['MSSV'], keep='first')
cv2.imshow('Face-Regconition',im)
```

- Escape the recognizing screen.



```
if (cv2.waitKey(1)==ord('q')):
    break
```

Chapter 4: Result evaluation

4.1. Purpose of the project

Attendance is a common job done in schools, agencies, and factories. Take attendance to check whether students come to class or not, take attendance for timekeeping at agencies and enterprises. However, the current manual method of attendance is still quite inadequate. If attendance is by reading the name, it takes a lot of time and is not accurate. If attendance by fingerprint scanning can spread infectious diseases or there are many cases where the attendance machine does not accept fingerprints, face recognition will overcome all these problems. Or if attendance is by swiping a card, it may happen that this person swipes the card to help others, the results are not reliable.

According to the name of the system, attendance management manages students entering and leaving the school instead of using the traditional attendance method with many shortcomings. The electronic attendance system by Face ID, uses facial recognition technology to authenticate the entry and exit of students, and at the same time displays student information such as name, class, student number.

The purpose of implementing this system is present in the following benefits:

- Save time and money by reducing manpower.
- Strictly control students' access to school.
- The school quickly captures the number of students coming to school, the number of students absent and late for easy tracking
- Modern, convenient in management stages
- The product is easily integrated with many security features, avoiding information leakage and intrusion from external devices.
- Quickly view individual student information

The thesis has developed a simple system consisting of 4 parts:

(a) Processing input images and videos.

(b) Division into frames

(c) Detecting user faces

(d) Displaying name

(e) Outputting student information and attendance.

Each of these components can be implemented using different specific algorithms based on the requirements.

With the algorithm already trained at this stage. With a new input on the student's face, we repeated the steps for this new image. Sample images were collected using a webcam.

After having the image data of the objects, the user only needs to stand in front of the camera position of the face recognition system.

Here, the face recognition system will scan the face nodes, then go through the process of comparing, analysing, and contrasting with available data sources. Within 1 second, the system will proceed to return the results. If it matches the previously stored information, the system will display the confirmation information on the screen. With the mechanism of collecting, analysing and comparing data, the face recognition system gives the fastest and most accurate results.

4.2. Difficulty of face recognition:

The system still has the following limitations:

- The system does not work, if the detection time is at night and the light is too strong.
- Inactive systems require high input costs to set up the necessary systems.
- The operation is not completely effective with people using masks and sunglasses.
- The attendance system is still not optimal when it comes to recording unidentified people

Chapter 5: Conclusion and Development Direction

5.1. State the conclusion for the whole problem

Through studying the problem of face recognition in images, we have seen the importance of image processing as well as the development and importance of the problem of human face recognition in life. In the process of building the program, I learned about OpenCV open source library. Thereby knowing how to use built-in functions in the OpenCV library.

The project report presented the basic knowledge to solve the problem of human face recognition. Particularly, the method of recognizing human faces using the OpenCV library is presented in Chapter 3. From the results, the system is also capable of distinguishing between different faces, but the accuracy of the program is only at 70. % correct identification.

Due to limited time, the program has many ideas that have not yet been implemented. It takes a lot of time to research and solve problems encountered, implement new ideas to improve the speed, performance and accuracy of the program.

5.2. New ideas:

- Apply facial recognition mechanism to view grades each semester without having to access the web, avoiding web interruptions.
- To detect fraud, the device can be programmed and used in an ATM.
- The device can be used in elections to identify voters by recognizing their faces.
- Take attendance by surveillance camera of the classroom. No need to perform manual adjustment as usual. Because when using webcam attendance, in turn, there are certain limitations.
- Apply to solve traffic jam problems by monitoring and controlling traffic volume and vehicle density and thereby giving warnings and instructions.
- Facial recognition systems are currently being researched or deployed for airport security. Data from a facial recognition system can be collected and stored without the subject's knowledge. The information can then be accessed by hackers or someone else with malicious intent.

5.3. Use the results of the assessment to develop into many other areas in the future:

- We want to create an application that will allow users to update image samples of students in a training dataset as part of future work.
- The following are some of the improvements that can be made in the future of this system. We will try to improve and optimize the application:
  + Optimising identification in difficult conditions such as light, wearing a mask, etc., and adding information such as class, gender, ID ... in the near future.
  + Continue to develop the demo into a finished product and, if possible, put it into practice.
  + The system can provide better results and accuracy when used with high resolution cameras.
  + Given the scale of face recognition application to the proposed job may require taking a large number of descriptive pictures of students and storing them. We also wanted to look at the detection algorithms. better face and face recognition to increase the number of students recognized and recognized
  + In this project, it was found that faces can only be recognized when the person's face is clearly seen, and that the face cannot be detected when the person is standing in any other direction. Therefore, more research is needed to use deep learning algorithms to detect people's faces unambiguously in all directions.

Chapter 6: Fixed report and Evaluation

6.1 Fixed report

In the Powerpoint submission on May 4, 2022, our team was a bit confused about the content of the PPT file, so we submitted the Ppt file that included a lot of unnecessary content. Our team would like to send you the Ppt file for presentation (fixed) in the .rar file.

Regarding the content of the report, our group did not add any additional information.