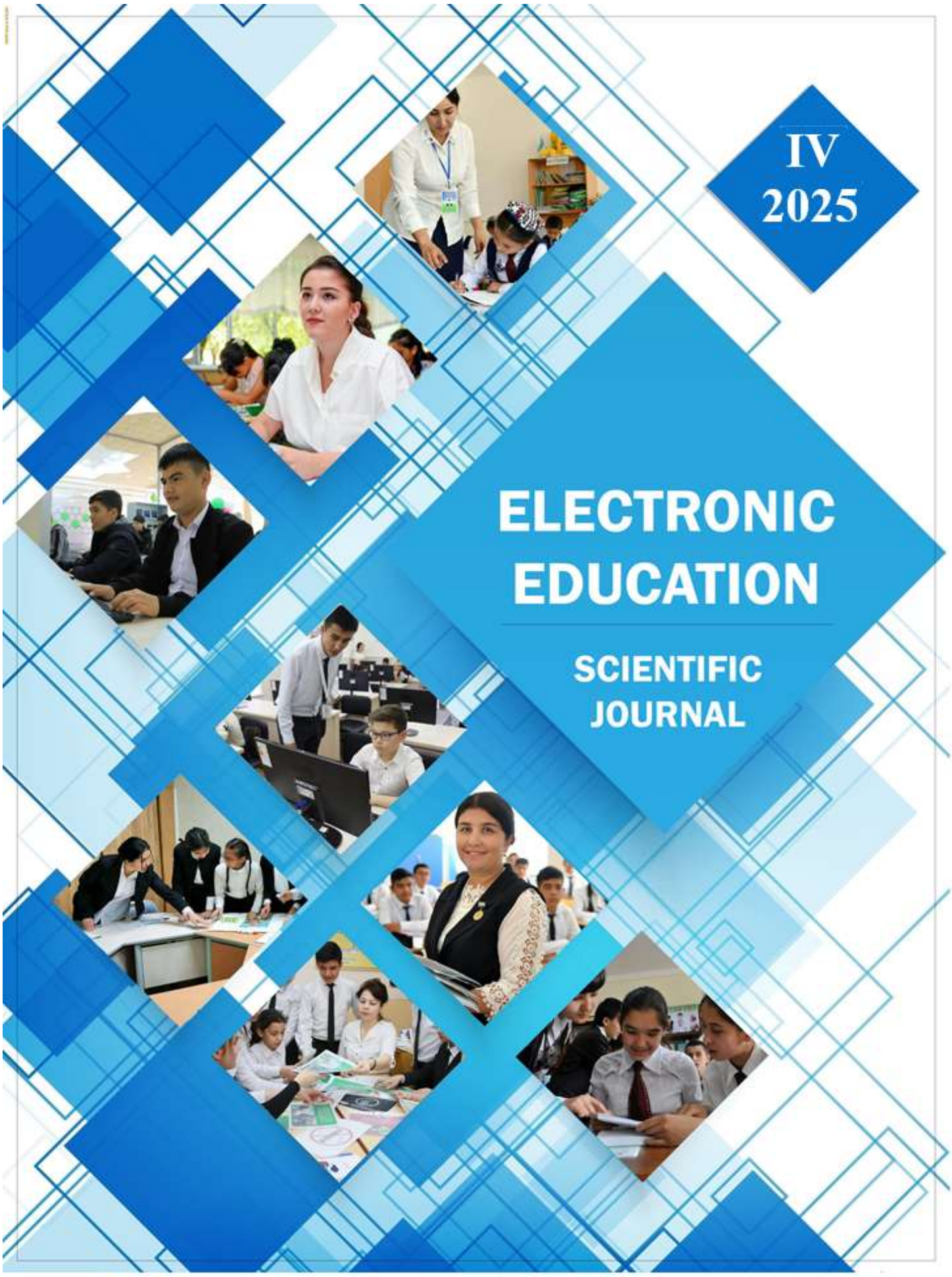

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СОДЕРЖАНИЕ

CONTENT

Aniq fanlarda axborot texnologiyalari

INSON YUZINI ANIQLASH BO‘YICHA DASTURIY TA‘MINOTNI (FACE ID) ISHLAB CHIQISH USULI

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Annotatsiya: *Ushbu maqolada inson yuzini aniqlash bo‘yicha dasturiy ta‘minotni (face id) ishlab chiqish muammolari, unga oid olimlarning ishlari tahlil etilgan. Shuningdek, mazkur maqolada inson yuzini aniqlash bo‘yicha dasturiy ta‘minotni (face id) ishlab chiqishning dastlabki bosqichlari keltirilgan.*

Tayanch so‘zlar: *OpenCV, VS Code, Haar Cascade, K-Nearest Neighbors, scikit-learn, Face ID.*

СПОСОБ РАЗРАБОТКИ ПРОГРАММНОГО ОПРЕДЕЛЕНИЯ ЛИЦА ЧЕЛОВЕКА (FACE ID)

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Аннотация: *В данной статье анализируются проблемы разработки программного обеспечения для распознавания лиц человека (face id) и работы ученых, связанных с ним. Также в данной статье представлены начальные этапы разработки программного обеспечения для распознавания лиц человека (face id).*

Ключевые слова: *OpenCV, VS Code, Haar Cascade, K-Nearest Neighbors, scikit-learn, Face ID.*

DEVELOPMENT METHOD FOR PROGRAMM DETERMINATION OF HUMAN FACE (FACE ID)

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Abstract: *This article analyzes the problems of developing facial recognition software (face id) and the work of scientists related to it. This article also presents the initial stages of developing software for facial recognition (face id)..*

Keywords: *OpenCV, VS Code, Haar Cascade, K-Nearest Neighbors, scikit-learn, Face ID.*

Kirish. Hozirgi kunda raqamli texnologiyalarning rivojlanishi natijasida shaxsni aniqlash va tanib olishga yo‘naltirilgan Face ID texnologiyalari kundalik hayotda keng qo‘llanilmoqda. Ushbu texnologiyalardan mobil qurilmalar, axborot tizimlari va

xavfsizlik platformalariga kirishni samarali nazorat qilish uchun foydalanilmoqda [1, 2, 3].

Inson yuzini aniqlash-bu kamera orqali olingan rasm yoki video tasvirda yuzni aniqlash hamda uni oldindan saqlangan ma‘lumotlar bazasidagi tasvirlar bilan solishtirish orqali shaxsni tanish jarayonidir. Ushbu jarayon kompyuter ko‘rishi va sun’iy intellekt texnologiyalariga tayangan holda amalga oshiriladi. Bunda yuzni aniqlash va tanib olish uchun OpenCV kutubxonasi imkoniyatlari hamda Haar Cascade algoritmidan foydalaniladi.

Adabiyotlar tahlili. Inson yuzini aniqlash va tanib olish masalasi bo‘yicha G.N. Yunusova [1], I.R. Axmadjonov [2], Y.A. Axmadjonova [2] kabi olimlar tomonidan izlanishlar olib borilgan.

Xususan, G.N. Yunusova [1] tadqiqotida Haar Cascade algoritmi yordamida yuzni aniqlash masalalarini o‘rgangan. Muallifning ta‘kidlashicha, Haar Cascade bilan yuzni tezda aniqlab olish va yuzga xos xususiyatlarni ajratib olish mumkin. N. Yunusovaning bildirishicha, taklif etilayotgan algoritm amaliy loyihalar qo‘llash samarali hisoblanadi. I.R.Axmadjonov [2], Y.A. Axmadjonova [2]lar Python dasturlash tili hamda OpenCV kutubxonasidan foydalanib inson yuzini va uning his-tuyg‘ularini aniqlash usullarini ko‘rib chiqqan. Mualliflar tasvir va videolarni tahlil qilish orqali yuzning asosiy belgilari ajratib olinishi hamda ular asosida inson holatini aniqlash mumkinligini isbotlagan.

Bu kabi tadqiqotlar M. Chorshanbiyeva [3], A. Tojiyev [4], O.O. Minavarjonov [5], M.M Usmonov [5], P.I. Wilson[6], Dr.J. Fernandez [6], Ramadan Th. Hasan [7], Amira Bibo Sallow [7], M. Khan [8], S. Chakraborty [8], R. Astya [8], Sh. Khepra [8], Banumalar Koodalsamy Manikandan Bairavan Veerayan [9], Vanaja Narayanasamy [9], Yuting Xing [10] larning ishlarida ham o‘z aksini topgan.

Yuqorida keltirilgan olimlarning ishlarini tahlil etish asosida inson yuzini aniqlash bo‘yicha dasturiy ta‘minotni (face id) ishlab chiqish muhim masalalardan biri sifatida e’tirof etish lozim degan xulosaga kelindi.

Tadqiqot metodologiyasi. Inson yuzini aniqlash bo‘yicha dasturiy ta‘minotni (face id) ishlab chiqish uchun Python dasturlash tili VS CODE dasturiga o‘rnatiladi. So‘ngra Python dasturlash tili bilan VS Code integratsiya qilinadi. Yuz bilan ishlash uchun OpenCV (kamera bilan ishlash, yuzni aniqlash) kutubxonasi, ma‘lumotlarni saqlash uchun pickle, yuzni tanib olish uchun esa scikit-learn kutubxonalaridan foydalaniladi (1-rasmga qarang).

1-rasm. Python bilan ishlash uchun VS Code konfiguratsiyasi qilish jarayoni

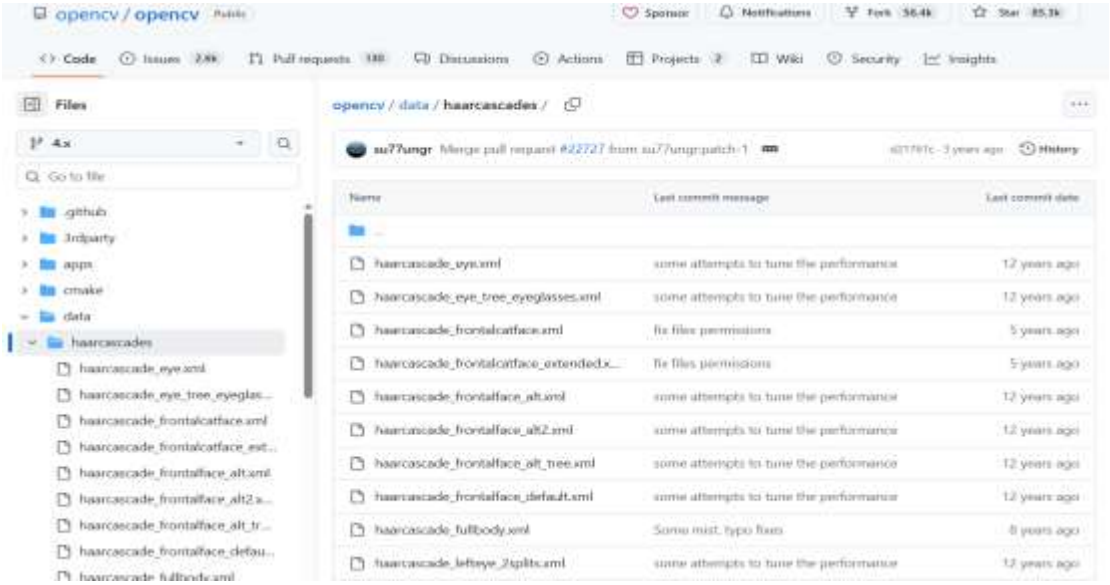
VS Code dasturiga quyidagi dastur kod yoziladi:

```
import cv2
import pickle
 import numpy as np
import os
video = cv2.VideoCapture(0)
 face_cascade=cv2.CascadeClassifier('data/haarcascade_frontalface_default.x
 ml')
eye_cascade=cv2.CascadeClassifier('data/haarcascade_eye.xml')
name = input("Enter person name: ")
face_data = []
count = 0
 while True:
ret, frame = video.read()
if not ret:
break
gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
faces = face_cascade.detectMultiScale(gray, 1.3, 5)
for (x, y, w, h) in faces:
```

```
  face_gray = gray[y:y+h, x:x+w]
eyes = eye_cascade.detectMultiScale(face_gray, 1.3, 5)
if len(eyes) >= 2:
face_resized = cv2.resize(face_gray, (50, 50))
  faces_data.append(face_resized.flatten())
count += 1
cv2.rectangle(frame, (x,y),(x+w,y+h),(50,50,255),1)
 for(ex, ey, ew, eh) in eyes[:2]:cv2.rectangle(frame,(x+ex, y+ey),(x+ex+ew,
 y+ey+eh),(255, 0, 0),2)
 cv2.putText(frame{count}",(20,40),cv2.FONT_HERSHEY_SIMPLEX,1,
 (0,255,0), 2)
cv2.imshow("Face + Eye Scan", frame)
if cv2.waitKey(1) == ord('q') or count >= 100:
break
video.release()
cv2.destroyAllWindows()
faces_data = np.array(faces_data)
labels = [name] * len(faces_data)
if os.path.exists('data/faces_data.pkl'):
with open('data/faces_data.pkl', 'rb') as f:
old_faces = pickle.load(f)
 faces_data = np.vstack((old_faces, faces_data))
if os.path.exists('data/names.pkl'):
with open('data/names.pkl', 'rb') as f:
old_names = pickle.load(f)
labels = old_names + labels
with open('data/faces_data.pkl', 'wb') as f:
pickle.dump(faces_data, f)
with open('data/names.pkl', 'wb') as f:
pickle.dump(labels, f)
```

Navbatdagi bosqichda yuzni aniqlash uchun lozim bo‘lgan bazalar yuklab olinadi: https://github.com/opencv/opencv/tree/4.x/data/haarcascades (2-rasmga qarang). Taklif etilgan manzildan quyidagi fayllar yuklanadi: **haarcascade_frontalface_default.xml (**yuz uchun**)** **haarcascade_eye_tree_eyeglasses.xml (**ko‘z uchun**)**.

Haar Cascade algoritmi yordamida tasvirdan inson yuzi aniqlanadi va uning joylashuvi belgilanadi. Ushbu modellar tasvirdan inson yuzi va ko‘zlarini aniqlash uchun xizmat qiladi.



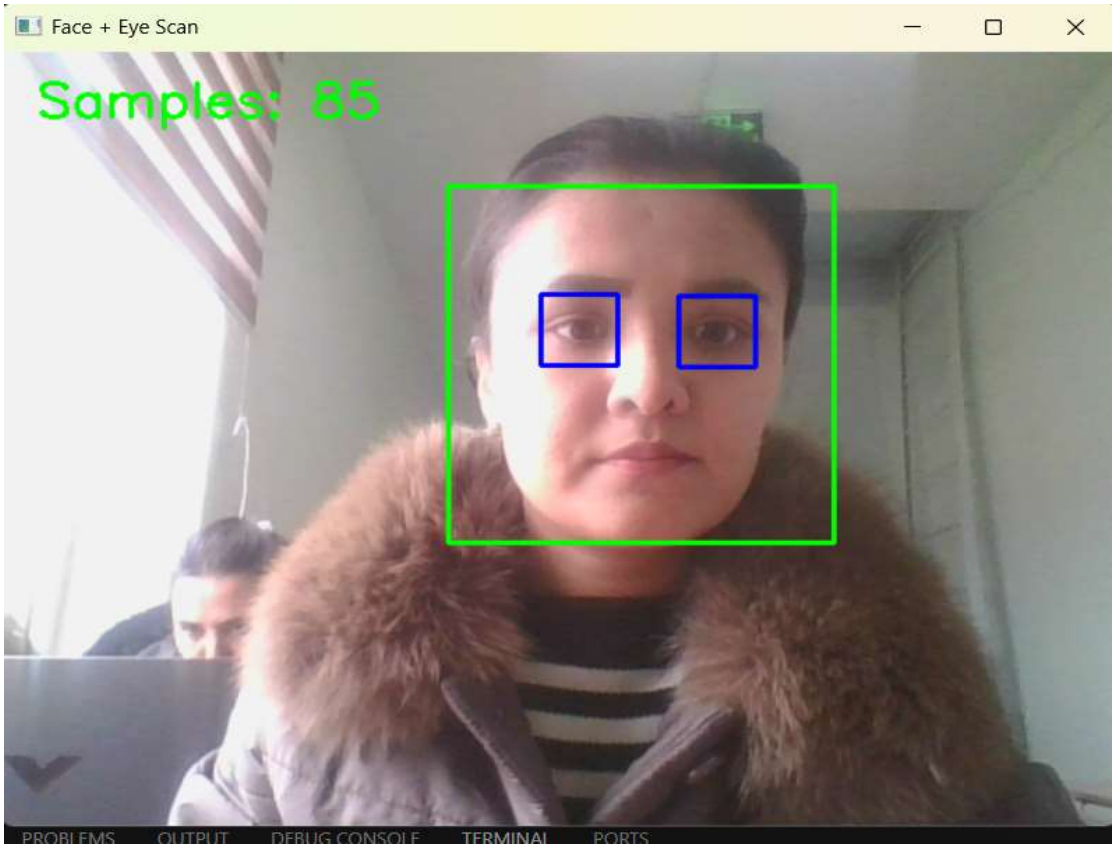
2-rasm. https://github.com/opencv/opencv/tree/4.x/data/haarcascades **sayti.**

Kamera orqali ma’lumotlar bazasiga kiritiladigan foydalanuvchilarning yuzlari tasvirga olinadi**.** Aniqlangan yuz 50x50 o‘lchamga keltiriladi va bitta qatorli massivga yoziladi. Natijada foydalanuvchining yuziga oid ma‘lumotlar yig‘iladi va ma‘lumotlar bazasiga saqlanadi. Yani yig‘ilgan yuz tasvirlari va ularga mos ismlar yuqoridagi ma‘lumotlar bilan birlashtirilib, **face_data.pkl** va **names.pkl** fayllariga saqlanadi.

Keyingi bosqichda inson yuzini tanish algoritmi ishlab chiqiladi. Yuzni tanib olish uchun K-Nearest Neighbors(KNN) algoritmida foydalaniladi. Bunda quyidagi fayllarga murojat qilinadi: **face_data.pkl** va **names.pkl** fayllaridan o‘qitiladi. Kamera orqali olingan tasvirdan yuz aniqlanadi, ko‘zlar tekshiriladi va yuz tasviri tayyorlanadi. So‘ng KNN modeli orqali yuz kimga tegishli ekanligi aniqlaydi.

Hosil qilingan dasturni ishchi holatga keltiriladi, bundan so‘ng ishchi oynasida **Enter person name** terminali hosil bo‘ladi. **Enter person name** terminaliga foydalanuvchining ismi kiritiladi (3-rasmga qarang). So‘ngra kamera ochiladi va yuz va ko‘zlar skaner qilinadi. (4-rasmga qarang)

3-rasm. add_person.py terminaliga ism kiritish jarayoni



4-rasm. Yuz va ko‘z koordinatalarini skaner qilish jarayoni

Natijani tekshirish uchun Python tilida quyidagi kod yoziladi:

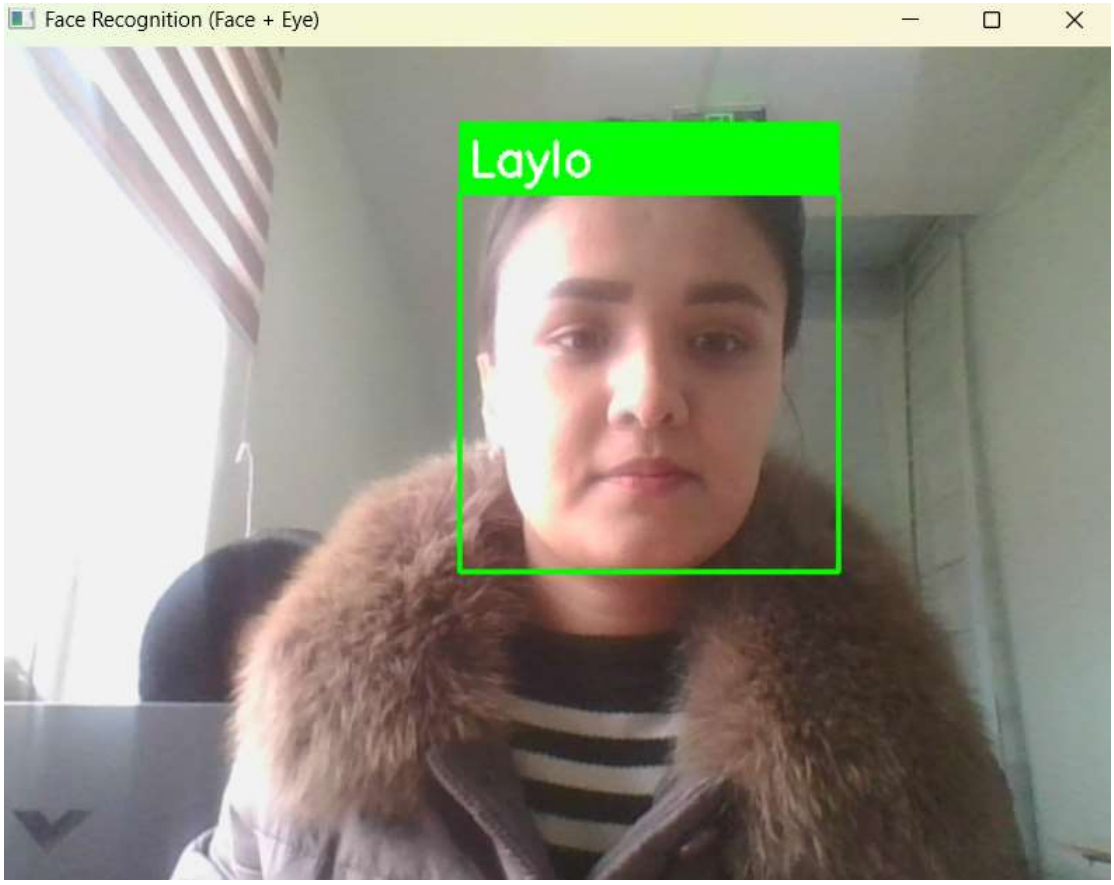
```
from sklearn.neighbors import KNeighborsClassifier
import cv2
import pickle
import numpy as np
import os
import csv
import time
from datetime import datetime
video = cv2.VideoCapture(0)
 face_cascade=cv2.CascadeClassifier('data/haarcascade_frontalface_default.x
 ml')
eye_cascade = cv2.CascadeClassifier('data/haarcascade_eye.xml')
```

```
with open('data/names.pkl', 'rb') as f:
 LABELS = pickle.load(f)
with open('data/faces_data.pkl', 'rb') as f:
FACES = pickle.load(f)
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(FACES, LABELS)
COL_NAMES = ['NAME', 'TIME']
while True:
ret, frame = video.read()
gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
faces = face_cascade.detectMultiScale(gray, 1.3, 5)
  for (x, y, w, h) in faces:
 face_gray = gray[y:y+h, x:x+w]
eyes = eye_cascade.detectMultiScale(face_gray, 1.3, 5)
if len(eyes) < 2:continue
face_img = cv2.resize(face_gray, (50, 50))
 face_flat = face_img.flatten().reshape(1, -1)
output = knn.predict(face_flat)
ts = time.time()
date = datetime.fromtimestamp(ts).strftime("%d-%m-%Y")
timestamp = datetime.fromtimestamp(ts).strftime("%H:%M-%S")
exist = os.path.isfile("Attendance/Attendance_" + date + ".csv")
cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)
cv2.rectangle(frame, (x, y-40), (x+w, y), (0, 255, 0), -1)
 cv2.putText(frame,str(output[0]),(x+5,y-10),
 cv2.FONT_HERSHEY_SIMPLEX, 0.9,(255, 255, 255),1)
attendance = [str(output[0]), str(timestamp)]
cv2.imshow("Face Recognition (Face + Eye)", frame)
```

```
k = cv2.waitKey(1)
if k == ord('o‘):
if not os.path.exists("Attendance"):
 os.makedirs("Attendance")
if exist:
 with open("Attendance/Attendance_" + date + ".csv", "+a", newline='') as
 csvfile:
writer = csv.writer(csvfile)
writer.writerow(attendance)
else:
 with open("Attendance/Attendance_" + date + ".csv", "+a", newline='') as
 csvfile:
writer = csv.writer(csvfile)
writer.writerow(COL_NAMES)
writer.writerow(attendance)
if k == ord('q'):break
video.release()
cv2.destroyAllWindows()
```

Ushbu dastur kodi **test.py** fayliga yoziladi.

Tahlil va natija. Ishlab chiqilgan dasturiy ta’minotning dastur kodi Python dasturlash tili asosida yozildi. Tadqiqot jarayonida inson yuzini aniqlash bo‘yicha Face ID dasturiy ta‘minoti ishlab chiqildi va sinovdan o‘tkazildi. (5-rasmga qarang)



5-rasm. Natijaning ekrandagi holati

Xulosa va takliflar. Taklif etilayotga g‘oya talabalarga inson yuzini aniqlash bo‘yicha dasturiy ta‘minotni (face id) ishlab chiqishga xizmat qiladi. Bu talabalarga inson yuzini aniqlash bo‘yicha dasturiy ta‘minotni (face id) ishlab chiqish uchun dastlabki amaliy ko‘nikmalarini hosil qiladi.

Dasturiy yechimni yanada samarali qilish uchun Pythonning 3.10 versiyasini ishlatish tavsiya etiladi, chunki ushbu versiyada yuzni tanish va aniqlash uchun mo‘ljallangan **dlib** kutubxonasi mavjud bo‘lib, u aniqlikni oshirish va yuzni tahlil qilish imkonini beradi.

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