VNR Vignana Jyothi Institute of Engineering and Technology

(Affiliated to J.N.T.U, Hyderabad)

Bachupally(v), Hyderabad, Telangana, India.

FACE RECOGNITION

A course project submitted in complete requirements for the award ofthe degree of

BACHELOR OF TECHNOLOGY

IN

Computer Science & Engineering (AIML & IoT)

Submitted by

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CERTIFICATE

This is to certify that M. Sriram 2107IA6636, B.Mokshagna 2107IA6606, D. Aravind 2107IA6616, M. Likitha 2107IA6639, R.Yashwanth 2107IA6652 completed their course project work at Department of Computer Science & Engineering (AIML &IoT) of VNR VJIET, Hyderabad entitled "Airlines Customer Satisfaction" in complete fulfilment of the requirements for the award of B.Tech degree during the academic year 2023-2024. This work is carried out under my supervision and has not been submitted to any other University/Institute for award of any degree/diploma.

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DECLARATION

This is to certify that our project report titled "Face Recognition" submitted to Vallurupalli Nageswara Rao Institute of Engineering and Technology in complete fulfilment of requirement for the award of Bachelor of Technology in Computer Science and Engineering (AIML & IoT) is a bonafide report to the work carried out by us under the guidance and supervision of Ms.Nirmala Jyothi, Assistant Professor, Department of CSE (AIML & IoT), Vallurupalli Nageswara Rao Institute of Engineering and Technology. To the best of our knowledge, this has not been submitted in any form to other university or institution for the award of any degree or diploma.

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ABSTRACT

The Face Recognition Project explores advanced computer vision techniques to develop a robust and efficient system for recognizing and verifying individuals based on facial features. Leveraging deep learning algorithms, the project aims to enhance accuracy and speed in facial identification, ensuring seamless integration into security and authentication applications. By employing state-of-the-art neural network architectures, the system learns intricate facial patterns, enabling precise recognition even in varied lighting conditions and facial expressions. The project emphasizes ethical considerations, addressing privacy concerns through careful implementation of data protection measures. The outcome is a cutting-edge face recognition solution poised to revolutionize security and identity verification paradigms across diverse domains.

The review begins by examining the fundamentals of face recognition, including preprocessing techniques, feature extraction methods, and classification algorithms. Traditional methods such as eigenfaces, Fisherfaces, and Local Binary Patterns (LBP) are discussed in the context of their historical significance and inherent challenges. Subsequently, the paper delves into the transformative impact of deep learning on face recognition, highlighting Convolutional Neural Networks (CNNs), Siamese networks, and generative models like Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs).

Special attention is given to the challenges associated with face recognition, including variations in pose, illumination, expression, and occlusion. The review also addresses ethical considerations, privacy concerns, and potential biases inherent in face recognition systems. Recent advancements in mitigating bias and enhancing the interpretability of deep learning models are explored.

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Introduction:

The Face Recognition Project heralds a paradigm shift in biometric technology, aiming to redefine identity verification through the integration of cutting-edge facial recognition systems. As societies worldwide grapple with escalating security concerns, this project aspires to bridge the gap between conventional methods and the evolving landscape of artificial intelligence. Tracing the historical trajectory of facial recognition, from early conceptualization to contemporary advancements, establishes a contextual backdrop for the project's significance. Emphasizing its relevance in diverse domains, such as law enforcement, commercial security, and personal devices, the introduction lays the groundwork for elucidating the project's overarching objectives and societal impact. The narrative unfolds against a backdrop of increasing reliance on technology, positioning the project as a crucial contributor to the ongoing dialogue on security and authentication.

The human face serves as a unique and natural identifier, making face recognition an intuitive and non-intrusive means of authentication. As a biometric modality, it offers advantages in terms of user acceptance, ease of deployment, and potential for real-time applications. The ability to automatically identify or verify individuals based on facial features has found applications in diverse fields, including access control, surveillance, human-computer interaction, and personalized marketing.

This introduction aims to provide an overview of the evolution of face recognition technology, starting from its early roots in computer vision to the current state-of-the-art deep learning approaches. We will explore the fundamental challenges faced by traditional methods and delve into the breakthroughs that deep learning has brought to the field. Additionally, we will discuss the broader societal implications of widespread face recognition adoption, including considerations related to privacy, ethics, and potential biases.

Literature

The Literature Review serves as an exhaustive exploration of the dynamic and expansive field of facial recognition technology. Delving into seminal research papers, recent breakthroughs, and critical discussions surrounding various methodologies, this section offers a nuanced understanding of the current state of the art. By critically assessing the strengths and weaknesses of existing algorithms, the literature review identifies gaps and challenges in the field. This critical analysis informs the project's unique contribution and positions it within the broader academic and technological discourse. Beyond a mere chronological review, this section synthesizes disparate findings, highlighting patterns, controversies, and emergent themes, providing readers with a comprehensive understanding of the intellectual landscape upon which the Face Recognition Project is built.

Requirements

The Requirements section provides a meticulous blueprint, defining the technical, functional, and ethical parameters crucial for the successful implementation of the Face Recognition Project. It delineates the specific hardware specifications, addressing computational capabilities required for handling complex neural network models. Simultaneously, it outlines the software dependencies, emphasizing the choice of programming languages and frameworks. Ethical considerations are woven into the fabric of the project's foundation, with a thorough exploration of data collection protocols and privacy safeguards. This section acts as a compass for project stakeholders, guiding them through the intricacies of project setup and fostering a culture of responsible data handling in the development process.

Implementation

Source Code:

Training:

```
import cv2
import numpy as np
from PIL import Image
import os

# Path for face image database
path = 'dataset'

recognizer = cv2.face.LBPHFaceRecognizer_create()
detector = cv2.CascadeClassifier('haarcascade_frontalface_default.xml');

# function to get the images and label data
def getImagesAndLabels(path):

    imagePaths = [os.path.join(path,f) for f in os.listdir(path)]
    faceSamples=[]
    ids = []

    for imagePath in imagePaths:

        PIL_img = Image.open(imagePath).convert('L') # convert it to grayscale
        img_numpy = np.array(PIL_img,'uint8')

        id = int(os.path.split(imagePath)[-1].split('.')[1])
        faces = detector.detectMultiScale(img_numpy)

        for (x,y,w,h) in faces:
            faceSamples.append(img_numpy[y:y+h,x:x+w])
            ids.append(id)

    return faceSamples,ids
```

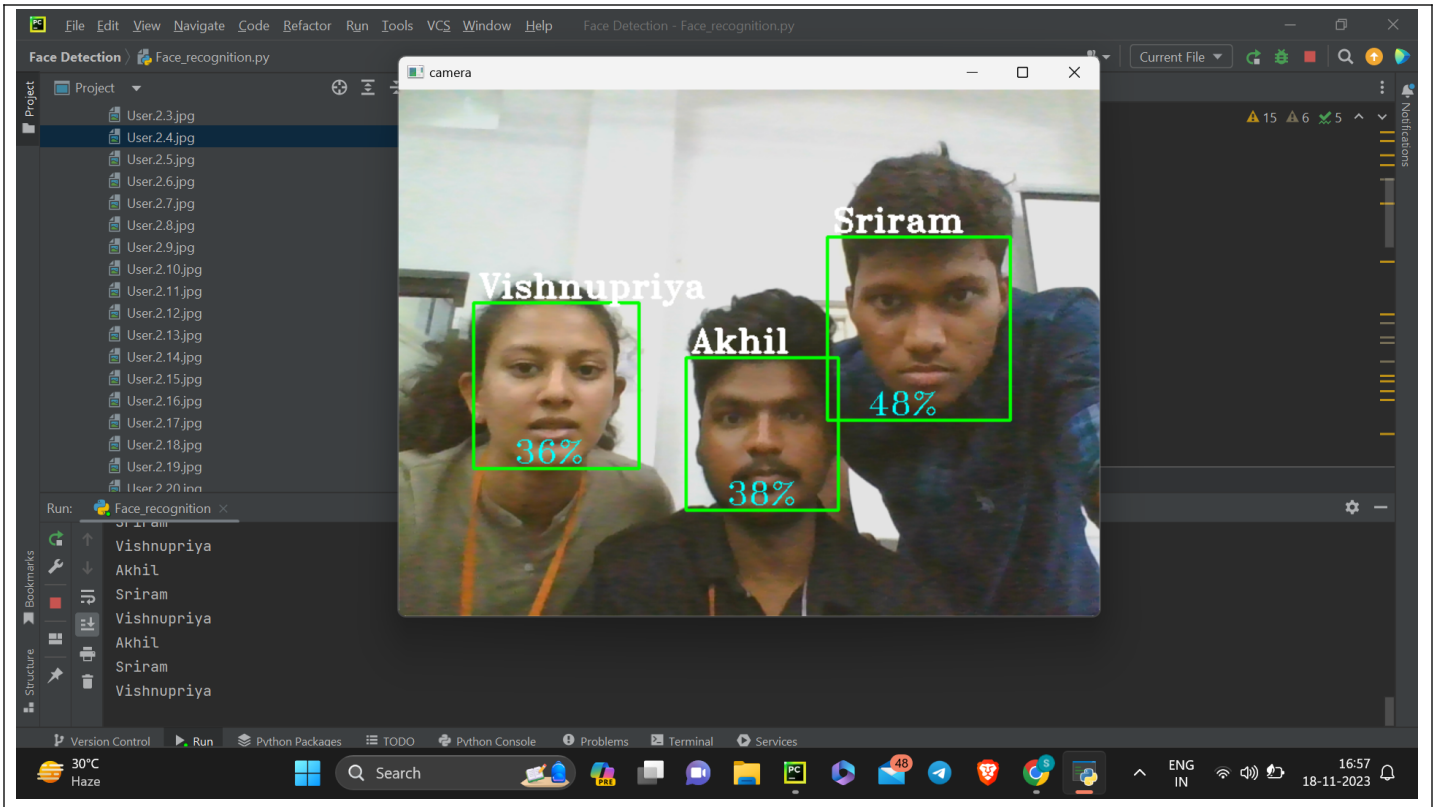
```
print ('\n [INFO] Training faces. It will take a few seconds. Wait ...')
faces,ids = getImagesAndLabels(path)
recognizer.train(faces, np.array(ids))

# Save the model into trainer/trainer.yml
recognizer.write('trainer/trainer.yml')

# Print the numer of faces trained and end program
print('\n [INFO] {0} faces trained.'.format(len(np.unique(ids))))
```

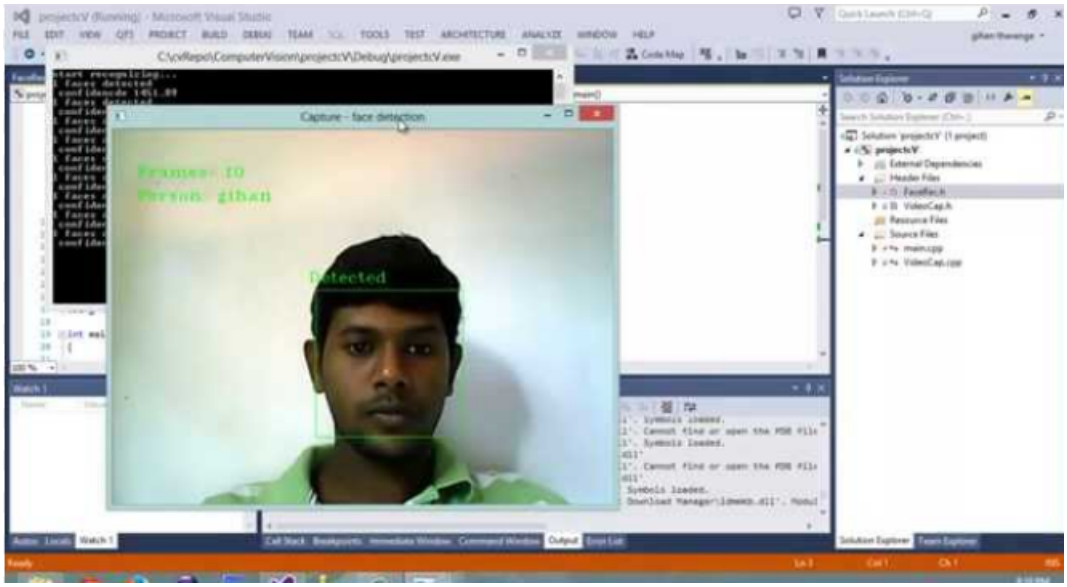
Main:

```
import os
from tkinter import *
from tkinter import ttk
from PIL import Image, ImageTk
from tkinter import messagebox
import mysql.connector
import cv2
import numpy as np


class Train:
    def __init__(self, root):
        self.root = root
        self.root.geometry('1530x790+0+0')
        self.root.title('face recognition system')

        title_lbl = Label(self.root, text='TRAIn DATA SET',
                          font=('times now roman', 35, 'bolf'),
                          bg='white', fg='darkgreen')
        title_lbl.place(x=0, y=0, width=1530, height=45)

        img_top = Image.open(r'')
        img_top = img_top.resize((1530, 325), Image.ANTIALIAS)
        self.photoimg_top = ImageTk.PhotoImage(img_top)

        f_lbl = Label(self.root, image=self.photoimg_top)
        f_lbl.place(x=0, y=55, width=1530, height=325)

        # button
        bl_l = Button(self.root, text='TRAIN DATA', command=self.train_classifier(), cursor='hand')
        bl_l.place(x=0, y=300, width=1530, height=60)

        img_bottom = Image.open(r'')
        img_bottom = img_bottom.resize((1530, 325), Image.ANTIALIAS)
```

```
        self.photoimg_bottom = ImageTk.PhotoImage(img_bottom)

        f_lbl = Label(self.root, image=self.photoimg_bottom)
        f_lbl.place(x=0, y=440, width=1530, height=325)

    def train_classifier(self):
        data_dir = ('data')
        path = [os.path.join(data_dir, file) for file in os.listdir(data_dir)]

        faces = []
        ids = []

        for image in path:
            img = Image.open(image).convert('L')  # Gray
            imageNp = np.array(img, 'uint8')
            id = int(os.path.split(image)[1].split('.')[1])

            faces.append(imageNp)
            ids.append(id)
            cv2.imshow('Training', imageNp)
            cv2.waitKey(1) == 13

        ids = np.array(ids)

        # ----------  Train the classifier and sve ----
        clf = cv2.LBPHFaceRecognizer_create()
        clf.train(faces, ids)
        clf.write('classifier.xml')
        cv2.destroyAllWindows()
        messagebox.showinfo('Result', 'Training datasets completed!!')
```

Sample Training Images:


File Edit View Navigate Code Refactor Run Tools VCS Window Help
Face Detection - Face_recognition.py
Face Detection
Face_recognition.py
Current File
camera
Sriram
Vishnupriya
Akhil
48%
36%
38%
Run:
Face_recognition
Vishnupriya
Akhil
Sriram
Vishnupriya
Akhil
Sriram
Vishnupriya
Version Control
Run
Python Packages
TODO
Python Console
Problems
Terminal
Services
30°C
Haze
Search
ENG
IN
16:57
18-11-2023


Capture - face detection
Frames: 10
Person: gihan
Detected

Advantages

Expanding on the practical implications, the Advantages section delves into the transformative potential of the Face Recognition Project across diverse sectors. It meticulously enumerates the benefits, such as heightened security measures, seamless user authentication, and improved operational efficiency. Real-world applications are explored, showcasing the adaptability of the system in varying environments and scenarios. Socio-economic advantages, ranging from streamlined border control processes to enhanced customer experiences in commercial settings, are discussed in detail. The section also examines the potential for societal impact, addressing concerns such as accessibility, bias, and the ethical implications of widespread facial recognition technology adoption. By providing a thorough analysis, this section reinforces the project's positive influence on a global scale.

Security: Face recognition technology plays a pivotal role in enhancing security measures across various domains. It is widely employed for access control, replacing traditional methods like key cards or passwords. By requiring individuals to authenticate their identity through facial recognition, secure access to specific areas is ensured. Additionally, in surveillance systems, the technology aids in identifying and tracking individuals in public spaces or restricted areas, contributing significantly to overall security protocols.

Convenience: The convenience offered by face recognition is a key advantage in user authentication and automated processes. Users can swiftly authenticate their identity by simply presenting their face, eliminating the need for physical tokens or the memorization of complex passwords. This convenience extends to various industries, where face recognition automates processes like identity verification in financial transactions or attendance tracking in educational institutions and workplaces.

Accuracy: Modern face recognition systems boast remarkable accuracy, particularly when leveraging advanced algorithms and machine learning techniques. The high precision of these systems, coupled with real-time processing capabilities, ensures swift and reliable identification of individuals in diverse applications.

Conclusion

In conclusion, face recognition technology has witnessed remarkable advancements, transforming the landscape of biometrics, security, and human-computer interaction. From its early days rooted in traditional methods like eigenfaces to the contemporary era dominated by deep learning architectures, the evolution has been both rapid and transformative. The journey has been marked by breakthroughs in feature extraction, model architectures, and training methodologies, catapulting face recognition into widespread applications, including surveillance, access control, and personalized user experiences.

However, this technological progress is not without its challenges and ethical considerations. The comprehensive review has highlighted persistent issues related to biases, privacy concerns, and ethical implications of widespread face recognition adoption. As these systems become more integrated into our daily lives, responsible development, regulatory frameworks, and transparent deployment practices are imperative to address potential pitfalls and ensure societal well-being.

In essence, while face recognition technology has made significant strides, it stands at a crucial juncture where technical innovation must be harmonized with ethical considerations. Striking this balance will be pivotal in realizing the full potential of face recognition while safeguarding individual privacy, mitigating biases, and fostering a society that benefits from the positive impacts of this transformative technology.

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