Internship Report

AT

KARNATAKA STATE POLICE

Submitted by:

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Preface and acknowledgement

For nearly 1.5 months from May 29, 2019 till July 14, 2019, I did an internship at KSP, a law enforcement agency for the Indian state of Karnataka. The Department is headed by the Director general of Police. This Internship is not any part of my four year undergraduate program at NITK, I had applied externally for it.

I worked on project named as “Criminal Image search”. The main content of project is to use the data of criminal images available and find the criminal in the database based on the input image.

This project suits me as I had already done some work on Computer Vision, so I can possibly complete it in the required time. Through this project I not only gain a lot of knowledge but more importantly, I had also a great chance to sharpen my skills in a professional working environment.

At the start of the project I didn’t know web development which is the final outcome of the project, so I learned a new technology in this journey.

I am very appreciated to Mr. Kumar S, my supervisor during the internship gave me very in-time valuable instructions and put me in contact with experts in the field like Mr. Ambedkar, a machine learning expert at IISC Banglore, who gave me extensive guidance regarding many practical issues. I would like to thank him for his valuable advice and guidance.

I also would like to express my gratitude to Mr. Balaji for his permission to be my academic supervisor and more importantly for his enthusiastic encouragements and precious instructions during my internship period. He gave me in-time feedback on my projects and helped to improve my work by clearly explaining what he needs as outcome and providing me data in structured format.

Throughout the internship, I have also learnt many things about Karnataka Police Department whose benefits are far beyond what I could learn in a normal project. In short, I would like to thank Karnataka State Police, Internship Office for introducing me to this great opportunity in which I have developed myself both academically, professionally and socially.

Further I would thank all the staff members of HR division who have been very courteous in providing all other information about company and its product.

I am also thankful to all the respondents who spared their valuable time for fillingup the questionnaire and helped me out with this project.

I convey my heartful affection to all those people who helped and supported meduring course, for completion of my Project Report.

ABSTRACT

The face is one of the easiest ways to distinguish the individual identity of each other. Face recognition is a personal identification system that uses personal characteristics of a person to identify the person's identity. Human face recognition procedure basically consists of two phases, namely face detection, where this process takes place very rapidly in humans, except under conditions where the object is located at a short distance away, the next is the introduction, which recognize a face as individuals. Stage is then replicated and developed as a model for facial image recognition (face recognition) is one of the much-studied biometrics technology and developed by experts. There are three kinds of methods that are currently popular in developed face recognition pattern namely, Using Deep Learning, Eigenface method and Fisherface method. Facial image recognition Eigenface method is based on the reduction of facedimensional space using Principal Component Analysis (PCA) for facial features. The main purpose of the use of PCA on face recognition using Eigen faces was formed (face space) by finding the eigenvector corresponding to the largest eigenvalue of the face image. The area of this project face detection system with face recognition is Image processing. The programming language used in this project is Python, Html, CSS, JavaScript while several libraries and frameworks are used in this project like Keras, OpenCV, Numpy, Matplotlib, Django, Dlib.

Keywords: Face Detection, Eigen face, PCA, Face Recognition

Extension: There are vast number of applications from this face detection project, this project can be extended that the various parts in the face can be detect which are in various directions and shapes. The website which is created to make this project successful can be used to add more features related to facial things like Image Generation, Video Generation from the caption, Predicting images of person after 10-15 years from input image

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Chapter 1

Introduction

Face recognition is the task of identifying an already detected object as a known or unknown face. Often the problem of face recognition is confused with the problem of face detection Face Recognition on the other hand is to decide if the "face" is someone known, or unknown, using for this purpose a database of faces in order to validate this input face.

1.1 Biometrics

Biometrics is used in the process of authentication of a person by verifying or identifying that a user requesting a network resource is who he, she, or it claims to be, and vice versa. It uses the property that a human trait associated with a person itself like structure of data with the incoming data we can verify the identity of a particular person. There are many types of biometric system like detection and recognition, iris recognition etc., these traits are used for human identification in surveillance system, criminal identification , face detailsvetc. By comparing the existing finger print recognition.

1.2 Face Recognition

Human beings have recognition capabilities that are unparalleled in the modern computing era. These are mainly due to the high degree of interconnectivity, adaptive nature, learning skills and generalization capabilities of the nervous system. The human brain has numerous highly interconnected biological neurons which, on some specific tasks, can outperform super computers. A child can accurately identify a face, but for a computer it is a cumbersome task. Therefore, the main idea is to engineer a system which can emulate what a child can do. Advancements in computing capability over the past few decades have en-abled comparable recognition capabilities from such engineered systems quite successfully. Early face recognition algorithms used simple geometric models, but recently the recognition process has now matured into a science of sophisticated mathematical representations and matching processes. Major advancements and initiatives have propelled face recognition technology into the spotlight. Face recognition technology can be used in wide range of applications. Computers that detect and recognize faces could be

applied to a wide variety of practical applications including criminal identification etc. Face detection and recognition is used in many places nowadays, verifying websites hosting images and social networking sites. Face recognition and detection can be achieved using technologies related to computer science. Features extracted from a face are processed and compared with similarly processed faces present in the database. If a face is recognized it is known or the system may show a similar face existing in database else it is unknown. In surveillance system if an unknown face appears more than one time then it is stored in database for further recognition. These steps are very useful in criminal identification. In general, face recognition techniques can be divided into two groups based on the face representation they use appearance-based, which uses holistic texture features and is applied to either whole-face or specific face image and feature-based, which uses geometric facial features (mouth, eyebrows, cheeks etc), and geometric relationships between them. (A few example applications are shown in Fig 1)

Figure 1: Biometric Applications

In Fig 1.1 An important aspect is that such technology should be able to deal with various changes in face images, like rotation, changes in expression. Surprisingly, the mathematical variations between the images of the same face due to illumination and viewing direction are almost always larger than image variations due to changes in face identity. This presents a great challenge to face recognition. At the core, two issues are central to successful face recognition algorithms: First, the choice of features used to represent a face. Since

images are subject to changes in viewpoint, illumination, and expression, an effective representation should be able to deal with these possible changes.

Chapter 2

Problems and Objectives

The problem of face recognition can be stated as follows : Face Recognition human facial features like the mouth, nose and eyes in a full frontal face image. We will be adapting a multi-step process in order to achieve the goal. To detect the face region we will be using two method first is Dlib's facial detector and second one is OpenCV's Haar Cascade. First algorithm will check if there is any face in image if not detected then it will be again checked by OpenCV's Haar Cascade if again not found then output will be "No face is found in Image". If face is found then face alignment is done to make the face straight to remove any kind of problem to our algorithm. Face Alignment is done using Dlib's library. Finally face aligned face is passed to our trained model which is Keras pre trained model trained by Google on billions of images. Model will predict the 128 dimensional encoding of face image. And in database already encodings are stored to make the image search a bit faster. Then all the embeddings are compared from the database encodings to the encoding of input image. Facial features can be located in the interior of the face contour. We will use several different facial-images to test our method.

2.1 Objectives

1. Trying to find a face within a large database of faces. In this approach the system returns a possible list of faces from the database. The most useful applications contain crowd surveillance, video content indexing, personal identification, mug shots matching, etc.

2. Real time face recognition: Here, face recognition is used to identify a person on the spot and grant access to a building or a compound, thus avoiding security hassles. In this case the face is compared against a multiple training samples of a person.

Chapter 3

Weekly Report

https://github.com/kampaitees/KSP-Internship-projects/tree/master/Criminal%20Recognition

https://github.com/kampaitees/Criminal-Search-Web-App

Week 1:

Paper Reading for Face Recognition

Paper 1: Deep Face Recognition: A Survey

Paper 2: Support Vector Guided Softmax Loss for Face Recognition

Video Tutorial

Tutorial 1: deeplearning.ai specialization Course 4, Week 4, Part 1

Face Detection from the report Video Tutorial deeplearning.ai specialization Course 4, Week 3

Week 2:

Implementation of the above things on a small dataset(showing demo)

Week 3:

Building state-of-art models for criminal recognition using multiple models and libraries

Week 4 :

Testing on my own dataset as well as doing hyper parameter tuning and try to increase accuracy of models

Week 5:

Trying to learn a lit bit of web required to build a web page to build a web app for the model so learning a bit of web dev for task

Week 6:

Finally build the web app for the task

Week 7, 8:

Making UI better and user friendly, increasing the efficiency of algorithm

Completed :

- **Week 1**
- **Week 2**
- **Week 3**
- **Week 4**
- **Week 5**
- **Week 6**
- **Week 7**
- **Week 8**

Chapter 4

Summary

Face recognition systems are useful in law enforcement and justice solutions by staying gone step ahead of the world's ever-advancing criminals. This includes acclaimed CABS-computerized arrest and booking system and the child base protection which is a software solution for global law enforcement agencies to help protect and recover missing and sexually exploited children, particularly as it relates to child pornography. It is also useful in Homeland defence which includes everything from preventing terrorists from boarding aircraft, to protecting critical infrastructure from attack or tampering (e.g. dams, bridges, water reservoirs, energy plants, etc.), to the identification of known terrorists. It is also applicable in airport and other transportation terminal security. Face recognition software, can enhance the electiveness of immigration and customs personnel. The financial services industry revolves around the concept of security. Face recognition software, can improve the security of the financial services industry, saving the institution time and money both through a reduction of fraud case and the administration expenses of dealing with forgotten passwords. Furthermore, biometric-based access control units can safeguard vaults, teller areas, and safety deposit boxes to protect against theft. The use of biometrics can also ensure that confidential information remains confidential while deterring identity theft, particularly as it relates to ATM terminals and card-not-present e-commerce transactions. It allows capturing, archiving, and retrieving identifying characteristics as tattoos, marks, or scars. It can also analyse scenes from either streaming or archived video, looking" for out of the ordinary occurrences, the presence of certain vehicles, specific faces, etc. This is beneficial and can save significant time and money to those individuals who spend hours, days, or weeks monitoring video streams (i.e. examining a bank's security in a criminal investigation).

Chapter 5

CONCLUSION

The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with automatic face detection and automatic face recognition did have a recognition accuracy over 90%. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate. The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area. The fully automated face detection and recognition system was robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did display even a slight degree of invariance to scale, rotation or shift errors of the segmented face image. However, if some sort of further processing, such as an eye detection technique, was implemented to further normalise the segmented face image, performance will increase to levels comparable to the manual face detection and recognition system.

All other implemented systems displayed commendable results and reflect well on the deformable template and Principal Component Analysis strategies. The most suitable real-world applications for face detection and recognition systems are for mugshot matching and surveillance. There are better techniques such as iris or retina recognition and face recognition using the thermal spectrum for user access and user verification applications since these need a very high degree of accuracy. The real-time automated pose invariant face detection and recognition system proposed in chapter seven would be ideal for crowd surveillance applications. If such a system were widely implemented its potential for locating and tracking suspects for law enforcement agencies is immense. The implemented fully automated face detection and recognition system (criminal image search system) could be used for simple surveillance applications while the implemented manual face detection and automated recognition system is ideal of mugshot matching. Since controlled conditions are present when mugshots are gathered, the frontal view face recognition scheme should display a recognition accuracy far better than the results, which were obtained in this study, which was

conducted under adverse conditions. Furthermore, many of the test subjects did not present an expressionless, frontal view to the system. They would probably be more compliant when a 6'5'' policeman is taking their mugshot! In mugshot matching applications, perfect recognition accuracy or an exact match is not a requirement. If a face recognition system can reduce the number of images that a human operator has to search through for a match from 10000 to even a 100, it would be of incredible practical use in law enforcement. The automated vision systems implemented in this thesis did not even approach the performance, nor were they as robust as a human's innate face recognition system. However, they give an insight into what the future may hold in computer vision.

The website which is created for the task can also be used for various purposes.

Chapter 6

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Link for the demo website:

https://drive.google.com/open?id=1iw-bVxwMIuGMh9eGh7p7fQYo-XU_Esr0