International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

Built-in Face Recognition for Smart Phone Devices

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Abstract - *This paper presents the deployment of face recognition on mobile phones. Smart phones have become the most convenient and ubiquitous interface for Internet services. They are equipped with massive amount of sensors that can significantly improve the user's cognitive ability. Face recognition is one of the fastest increasing applications in mobile domains due to the broad range of potential uses. However, face recognition is a computation-intensive process and requires resources beyond the capacity of modern mobile devices. . The architecture performs initial image processing on the mobile devices to decrease the network traffic and save battery power before offloading the recognition to the server. Mobile phones are becoming the convergent platform for communication and personal sensing such as clicking pictures. Due to this, the invent of digital camera is reduced to much greater extent.*

We envision AutoFace Tagger, a mobile phone based collaborative system that senses the people and context in a picture. This paper describes about a prototype of Auto Face Tagger on Android Phones.

Key Words: Face recognition, Face detection, Viola Jones, Auto Face Tagger, Image tagging, Android phone.

1. INTRODUCTION

Biometrics is the up-and-coming area of bioengineering; it is the automated means of recognizing person based on a physiological or behavioral attributes. There exist several biometric systems such as finger prints, iris, signature, voice, retina, ear geometry, hand geometry, and face. Among these systems, facial recognition appears to be one of the most collective, widespread, and available systems.

Biometric face recognition, otherwise known as Automatic Face Recognition (AFR), is a particularly attractive biometric technique, since it targets on the same identifier that humans use chiefly to differentiate one person from another: their "faces". One of its foremost goals is understanding of the complex human visual system and the knowledge of how humans represent faces in order to discriminate different identities with high precision. The face recognition dilemma can be divided into two main stages: face verification (or authentication), and face identification (or recognition).

The detection stage which is the first stage includes identifying and locating a face in an image. The recognition stage which is the second stage includes feature mining, where important data for discrimination is saved, and the matching, where the recognition result is given with the assistance of a face database. Face recognition is used in identifying a person from an image. This expertise has received much attention because of the extensive flexible nature of interest involved in it. It can be used as a biometric system for authentication of the user, distinguish someone and tag him, identify people and remember their preferences and peculiarities, etc. Adapting such kind of systems to mobile devices would possibly benefit because of the portability of mobile devices. Table 1 shows different areas where face recognition systems are used. Creating a standalone mobile application that does face recognition on captured images is a remarkable chance to explore.

The integration of face recognition algorithms into mobile devices has been an intricate task due to the restraints on processing power, limited storage of the mobile device, inadequate network bandwidth and connection instability, privacy and safety interest. Hence client-server architecture is developed. Facial detection based on color segmentation, pattern correspondence, etc on the captured image are performed on the client side and necessary features are extracted. These features are then sent to the server which does the computationally comprehensive task of evaluation with the database image set that would assist in the face recognition and then sends the data back to the client. The client then displays the necessary information to the user.

Areas	Applications
Information Security	Access security (OS, data bases) Data privacy (e.g. medical records) User authentication (trading, on line banking)
Access management	Secure access authentication (restricted facilities) Permission based systems Access log or audit trails
Biometrics	Person identification (national IDs, Passports, voter registrations, driver licenses) Automated identity verification (border controls)
Law Enforcement	Video surveillance Suspect identification Suspect tracking (investigation) Simulated aging Forensic Reconstruction of faces from remains
Personal security	Home video surveillance systems Expression interpretation (driver monitoring system)
Entertainment - Leisure	Home video game systems Photo camera applications

Table -1: Applications of face recognition

The general structure followed by any face recognition technique is shown below.

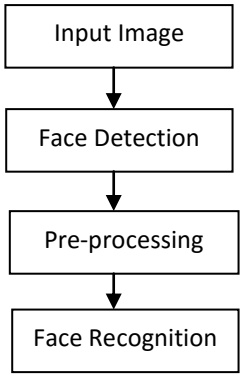


Figure -1: Steps followed during face recognition

2. REVIEW OF PREVIOUS WORK

A. Related Work

Face Detection: Face detection is a well researched region and nowadays detection is not required for face recognition. This is because there are already present face images in the database in some cases. There are many challenges associated with face detection of faces taken in unrestrained environments. Pose variance, facial expression, feature occlusion, imaging conditions, etc are some of the factors.
Some of the common ways used for face detection are Haar-cascades and scanning images using an increasing window, morphological processing algorithms, skin color segmentation and template matching. An impressive accomplishment in face detection would be efficient face detection at frame rate.
1) Haar-cascades algorithm: This algorithm is commonly referred to as Viola-Jones face detector and its efficiency is due to the robust real-time processing capabilities. Training of the system is done by using a set of labeled images containing faces using the AdaBoost learning algorithm. For rapid processing, an idea called integral images is used.

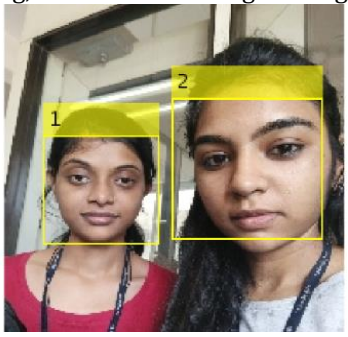


Figure -2: Image showing face detection

Automatic image tagging: Automatic image tagging has been an extensive existing problem. While the fields of image processing and face recognition have made noteworthy progress, it remains challenging to automatically label a given picture. However, digital pictures and videos are enduring an explosion, especially with the creation of high quality digital cameras embedded in mobile devices. As these pictures get stored in online content warehouses, the need to search and browse them is becoming essential. Furthermore, the increasing sophistication in textual search is boosting the expectations from image retrieval – users are expecting to search for pictures as they do for word-based content. Efforts to involve humans for labelling pictures may be a temporary solution, but is not barely to gauge in the longer run. The volume of content is mounting at intense speeds, and its need on a pair of human eyes is likely to become the bottleneck. This paper breaks away from established approaches to image tagging, and explores an alternative architecture ingrained in multi-dimensional, out-of-band sensing. Automatic image tagging can enable a variety of applications. One may imagine improved image search in the Internet, or even within one's own mobile phone– user may query his personal photo collection for all pictures of him and his friends playing together. Another application may tag videos with important event or activity marker. Today, such functionalities may be available in selected images and videos, where some humans have ardently tagged them. Auto Face Tagger aims to automate this process via face recognition algorithms.

B. Key Contributions

The key contributions of our work are:
a) We have developed a face recognition application on the ADROID phone which recognizes a face whose image is taken by the camera.

b) We have used a client server architecture where testing is done on the phone and training on the server.

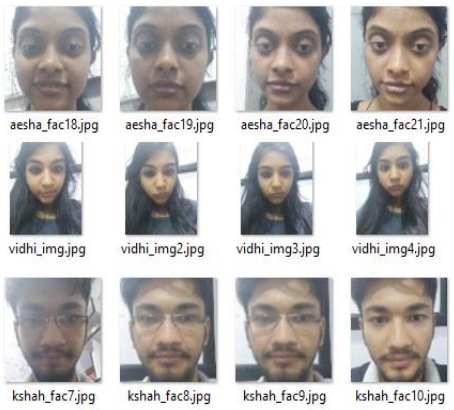


Figure -3: Image showing training data set

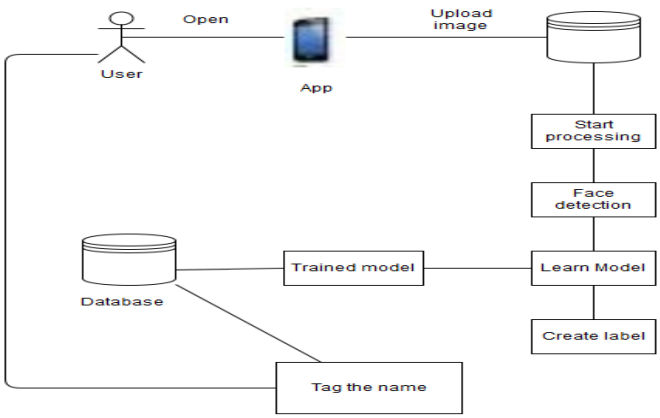
c) We also have provided the user, option to train on the mobile phone.

d) We also have provided the user, an option to upload images from the gallery.

e) We then use these trained images to automatically tag the person.

f) Searching of these images based on the tag helps in faster retrieval.

3. PROPOSED SYSTEM



4. TECHNICAL DETAILS

Cropping and detection of the face has to be done before testing and training can be done. In face detection we first find a face in the image and return the location of the image and the extent of each face. First we will explore into face detection before face recognition can be discussed.

Face Detection

Face detection algorithms focuses on the detection of frontal human faces. It is similar to image detection in which the image of a person is matched bit by bit. This image matches with the image stored in the database. Any facial feature changes in the database will nullify the matching process.
The distinctiveness of Viola–Jones algorithm which makes it a good detection algorithm are:
Robust – excessive detection rate (true-positive rate) & very low false-positive rate at all times
Real time – For realistic applications at least 2 frames per second must be handled.
Face detection only (not recognition) - The goal is to differentiate faces from non-faces.

The algorithm has four stages:

1. Haar Feature assortment
2. Constructing an Integral Image
3. Adaboost Training
4. Cascading Classifiers

Face Recognition

PCA is a statistical procedure and its assimilation into a face recognition algorithm requires plentiful design verdict. One of the uncomplicated and most useful PCA approaches used in face recognition systems is the so-called eigenface approach. This approach reconstructs faces into a small set of critical characteristics, eigenfaces, which are the core components of the initial set of learning images (training set).
Recognition is done by extruding a new image in the eigenface subspace, after which the person is classified by comparing its position in eigenface space with the position of recognized individuals . The benefit of this approach over other face recognition systems is in its straightforwardness, speed and inconsiderateness to miniature or steady changes on the face. The setback is restricted to files that can be used to recognize the face. Namely, the images must be vertical frontal views of human faces. The whole recognition process involves two steps:
A. Initialization process
B. Recognition process

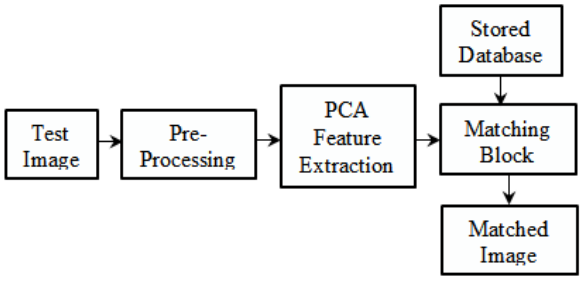


Figure -4: Flow diagram of PCA algorithm

Auto-tagging

Automatic image tagging (also known as automatic image annotation or linguistic indexing) is the process by which a computer system automatically assigns metadata in the form of keywords or captioning to an image. This application is used in image retrieval systems to locate images of interest from a database.

The advantages of automatic image annotation versus content based image retrieval (CBIR) are that queries can be more obviously specified by the user. CBIR generally requires users to search by image concepts such as color and texture, or finding example queries. Certain image features in example images may override the notion that the user is actually focusing on. The conventional methods of image retrieval such as those used by libraries have relied on manually annotated images, which is expensive and time-consuming, particularly when given the bulky and constantly increasing image databases in existence.

5. TECHNOLOGY

Android Studio

Android Studio is the official integrated development environment (IDE) released by Google for the Android platform. It provides build support based on Gradle, Android-specific refactoring and quick fixes, tools to catch performance, usability, version compatibility and other problems by Lint, some template-based wizards to create common Android designs and components, a rich layout editor that allows users to drag-and-drop UI components, an option to preview layouts in multiple screen configurations, support for building applications for Android Wear, built-in support for the Google Cloud Platform, integration with Google Cloud Messaging and App Engine, and an Android Virtual Device that is used to run and debug apps.
Android Studio has been used for the development and debugging of the Android application for the AutoFace Tagger.

MATLAB

MATLAB (**mat**rix **lab**oratory) is a fourth-generation programming language and multi-paradigm mathematical computing background. It is a proprietary programming language developed by MathWorks, allows matrix manipulations, implementation of algorithms, plotting of functions and data ,creation of user interfaces, and interfacing with programs written in other languages, including C#,C++,C, Java, Python and Fortan.

MATLAB has been used for face recognition and face detection once the image is captured .

WAMP Server

WAMP Stands for "Windows, Apache, MySQL, and PHP." WAMP is a variant of LAMP for Windows systems and is frequently installed as a software bundle (Apache, MySQL, and PHP). It is often used for internal testing and web development, but may be also used to serve live websites.
The most important part of the WAMP package is Apache which is used run the web server within Windows. A local Apache web server is run on a Windows machine, using which a web developer can test webpages in a web browser without publishing them live on the Internet.
WAMP also includes PHP and MySQL, which are two of the most common technologies used for creating dynamic websites. PHP is a scripting language that can be used to access data from the database while, MySQL is a high-speed database. By installing these two components locally, a developer can test and build a dynamic website before publishing it to a public web server.

While Apache, PHP, and MySQL are open source components that can be installed independently, they are usually installed together. The popular package called "WampServer" provides a user-friendly way to configure and install the "AMP" components on Windows.

6. CONCLUSION

We can see that the project is divided into three main parts- Android, Face recognition and Automatic tagging. The overall goal of this project is to investigate the extent to which predicting tags as sets increases annotation accuracy over automatic tagging methods that treat the tags independently.

In our app, Auto Face Tagger, the aim is to assign a list of keywords indicating core functionalities, main contents, key features or concepts of a mobile app. Mobile app tags can be potentially useful to improve categorization, browsing, app search, and advertising, etc.

The face recognition concept has a wide scope in the future of technology. It can be majorly used in security as well as in advertising sector.
This app makes it possible to improve quality of searching in numerous ways. For example, searching a picture by a person's name or the place name. Tagging a picture at the time it is taken only once, and then from next time when the picture of same person or thing is taken, tagging will be done automatically. It helps in saving time and gives an easier access for searching pictures.

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