Project Proposal

Matthew Shane Kingon

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Supervisor:
Prof. Peter Wentworth

1 Project Background

1.1 Usage of Facial Verification

By far the most well known use of facial verification today would be Facebook's own, automated tagging system. The System uses facial verification to assigning to each user a *template*. Using this *template* to match faces found in one image with other's found in new photo's. If they can be matched, it then suggests the new image for tagging.

Another popular idea would be its use in law enforcement. The main form of its use would likely be; suspect individuals, ones with a criminal record, could be highlighted via facial verification when entering banks, casinos etc. Any law enforcement individual present at the scene would be notified and can keep watch for suspicious behaviour. It could also be used to help police track fugitives in built up areas if there are any networked cameras in the area.

Sadly it would likely not be usable in court to place someone at a scene of a crime. Due to the fact that if there is any human doubt of who's face is in an image, then its even less likely that a machine would have gotten it right. Thus such evidence would always be confirmed via a human, usually during the proceedings, hence it would not be sensible to try automate the process. So uses in law enforcement would be very much preventative as opposed to a method of catching criminals.

Another way Facial verification could be used albeit in a more specific format is in casinos. A problem Gambler who is trying to recover could submit his face to his favourite casino. Then when their cameras pick him up, they would start a timer before he is asked to leave. Also problem individuals, known card counters etc, Would be picked up and flagged to security who would then confront highlighted individuals confirming their identity and ask them to leave if appropriate.

1.2 Facebook's Tagging

Facebook uses a template system for its automated face tagging, converting facial features, distance between eyes, position of nose etc. into numeric data and combining such data to form a single *template* for each person. It then takes this template and compares it against templates extracted from new images. [1]

There is a distinction to be made here, Facial recognition and facial verification are different concepts. Recognition implies taking a face and putting a name to it. while verification determines if two faces are from the same person, the latter better describes what Facebook's system does. However, they just use the extra knowledge they have to determine the name afterwords. This is possible as they have had a long time acquiring photos and allowing manual tagging of faces by humans.

2 My Project

2.1 description/Aim of my Project

The overall goal of this research is to determine if it is possible to efficiently automate attendance tracking in lectures via facial recognition. To achieve this we cluster faces of the same individual, normalizing this cluster into a single face for the purpose of recognizing who it is. In addition to a direct approach that finds the best match for each normalized cluster in the class list of faces, a second approach simultaneously takes into account all possible matchings and finds a globally optimized assignment of each cluster to the class list. A comparison of matching accuracies for the two techniques is provided.

2.2 what my code should do

My code should be able to: Take input of the form of an array of frames. In each frame would be a single face with around 3 such frames per student who attended that lecture. I would then take those images, compare them to each other, then take some form of *Average face* or possibly *Best face* and compare that against the database which consists of faces of all those students who should be attending the lecture. When I find a student I would create some form of dictionary with the students name and a true/false value indicating weather or not they where in attendance for that lecture.

2.3 Language choice

The Language my code will be implemented in will be Python, on a Linux based OS. Making use of the openCV image processing library. The Reason I've chosen Python is for its ease of use with regards to Image Processing. Similarly Choosing OpenCV as it is the most robust open source library package for image processing. Another reason I choose to use openCV is for cost considerations Part of my aim is to create a cheap system.

2.4 Things to note

I will need to find some form of database containing images of faces for testing purposes. Using them to train my system to recognise faces in a controlled manner. Once I have refined my system to recognise these faces I will extend it to recognize faces in every day images. Ultimately testing in a lecture venue environment.

A likely starting point to find such databases would be the site [2] which catalogues, with descriptions, many such databases. An initial overview of the site indicates that I should

look into the Yale face Database as it contains far more variety than others. However the FERET database makes use of notably more consistent backgrounds.

2.5 Outline of deadline's

This is a rough estimate of how my years time will be spent with regards to my project. It is highly liable to change. Ideally by only a few days about these posted times.

Something that is not stated in the table is: I will be attempting to maintain a website along with a journal containing a description of any progress made with regards to my project. I shall try update these at least once every two weeks along with scheduled meetings with my supervisor to ensure I am making progress when I should be.

Date	Activity
Feb 27, 2015	Proposal Submission
Mar 3, 2015	Presentation 01
Mar 28, 2015	Course work
Apr 15, 2015	Graduation
May 4, 2015	Initial Lit Review and preliminary test-coding
May 29, 2015	complete Literature Review and Plan of action
July 28, 2015	Presentation 02
N/A	Short paper submission
Oct 26-28, 2015	Presentation 03
Oct 30, 2015	Hand in Project
Nov 6, 2015	Website complete
Nov 18, 2015	Research Oral Examination

3 Other Key Interests

3.1 Computer Vision

For my project I need to know how to recognise faces, hence a useful starting point would be how to interpret images. Both these requirements fall under computer vision. Computer vision is the field focusing on using image processing to gain information from images for a computer to use. Ideally in much the same manner as how we humans view the world. Computer vision makes use of edge detection, object recognition, feature detection and many other techniques to help make a computer see the world as we do. This concept is an infinitely harder task than someone outside our field may believe. Mostly due to the effortlessness at which our brain interprets what we see. [3]

3.2 Normalization

Apart from my main aim to Verify Faces in images there are certain other considerations to note. Before I can start to verify faces in images I would need to normalize those images. Normalizing with respect to image processing is the act of taking images of varying lighting, orientation and alignment and converting them into a semi-consistent form [4]. Not only will I need to normalise a face but also combine clusters of faces, either finding the best face to use or normalize each face cluster into a single image in an attempt to create an *Average face*.

3.3 Global/Greedy Optimisation

It would also be an interesting idea to compare Greedy and Global based optimising techniques. Seeing whether one method provides clear benefits over the other either from complexity to implement, or more importantly computation time and off course the big question; are there any notable accuracy improvements. A Global technique would try find the best fitting of faces such that we have the highest possible scores linking each face [5]. This would imply we would achieve higher Accuracy but possibly a more computationally expensive system. While a Greedy technique would try and find the first good match then remove the items in question simplifying future checks i.e. most likely less accurate but much faster.

4 Readings for Literature Survey

This section will highlight some sources I have found that will most likely be of aid to my project; To start off; I will be in need of some form of text that can explain in detail the process of facial verification as well as image processing concepts in general. To this end, I have highlighted [3] as one potential, probably invaluable, source.

In order to Run Facial verification on a collection of images it would be wise to know how best to align the faces on those images. This is a process known as: Normalization to help me figure out how this works I have highlighted [4] as possible useful information.

Another Area I would need to become proficient in would be mathematical Optimization. Namely Global optimization techniques. To help me with this I have highlighted [5] [6] as possibilities. However, I will likely need more.

If I intend for my system to learn from its mistakes and hence become more accurate with time, I would need to implement some form of A.I.. This is something that will most likely be done via a Neural-Network or similar approach. For now I have just highlighted a Thesis which has already done this namely [7]

References

[1] Facebook, "https://www.facebook.com/help/122175507864081," 22 Feb 2015.

[2] F. RECOGITION, "http://www.face-rec.org/databases/," 26 Feb 2015.

[3] R. Szeliski, *Computer vision: algorithms and applications*. Springer Science & Business Media, 2010.

[4] K. T. Talele and S. Kadam, "Face detection and geometric face normalization," in *TENCON, IEEE Region 10 International Conference*, 2009.

[5] A. Torn and A. Zilinskas, *Global Optimization*. New York, NY, USA: Springer-Verlag New York, Inc., 1989.

[6] P. M. Ortigosa, I. García, and M. Jelasity, "Reliability and performance of uego, a clustering-based global optimizer," *Journal of Global Optimization*, vol. 19, no. 3, pp. 265–289, 2001.

[7] H. A. Rowley, S. Baluja, and T. Kanade, "Neural network-based face detection," *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, vol. 20, no. 1, pp. 23–38, 1998.