TJHSST Computer Systems Lab Senior Research Project Biometric Security- Face Recognition 2009-2010

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Abstract

In the modern world, sensitive data or access to buildings can be protected by more than just a key or a password. Biometric data unique to every human can be used to allow or deny access. The purpose of this project is to be able to create a "key" for any person who wishes to use the program. An image of the client's face will be taken and used as the base biometric key. When the client wishes authorization, a new picture of their face will be taken and compared to the base image. The program should be able to recognize the client and authorize him or her, while denying access to those not recognized. A neural network will be used to accomplish this purpose.

Keywords: computer vision, neural networks, image recognition

1 Introduction

1.1 Scope of Study

This project is mainly focused on the successful implementation of a neural network. The scope is to train the network on a small library of images of a face, and for the program to be able to recognize that face in a slightly different position at a later time.

1.2 Expected results

This project should be able to fulfill my goals of creating a successful facial recognition algorithm. I will develop an efficient neural network and perhaps stumble upon more efficient methods of image comparison.

1.3 Type of research

My reserch will be use-inspired basic research. I wish to fundamentally understand numerous computer vision techniques and the use of neural networks, but I am not seeking knowledge for it's own sake. I am researching this topic in an attempt to create a reliable facial recognition program.

2 Background and review of current literature and research

Several groups have worked on projects similiar to mine. The framework for my project is based off of a lesson for Computer Science students at Carnegie Mellon. Neural networks are the most efficient method of face recognition. Several alternatives have been explored, including various mathematical transformations in an attempt to change the visual data into a more easily comparable format. However, the best method is to utilize a neural network.

3 Procedures and Methodology

There are several tasks that need to be completed for this project. The first is developing a neural network program that can be trained to recognize faces. The second phase is training the network to recognize a specific face. The final phase is testing, resdesigning and refining the network until it can achieve fast, accurate results. Not much specialized equipment is needed for this project. However, a webcam might be a useful tool in demonstrating the capablities of the program and creating image files for use in training. The code will be written entirely in python.

Input data will be a training set of images of the user's face. These images will probably be collected with a webcam taking frames of a video.

Alternatively, these images could be obtained with use of a standard digital camera, although many pictures would need to be taken in order to ensure a suffienciently large training set. Displaying the calculations and information my program uses may be difficult. The calculation is mostly internal. I could display the error of the neural network as it makes it's calculations, as well as displaying sample inputs and what evaluation the program gives them as to how they compare to the learned images.

Neural networks have a built in error evaluation. Therefore there is no need to write additional code once the neural network is up and running. The program will improve it's efficiency and accuracy as it takes in more test cases and spends more time evaluating. What kinds of testing can you do to verify your program? Dynamic testing uses random inputs to your program. Specific structural and functional testing (how you verify particular sections of your program are working correctly) and path and branch testing (picking particular inputs that test internal paths of performance of your program) and are good techniques. Process modeling is a good verification technique in which you determining mathematical formulas that can be used to validate the performance of your program, check the predictive quality of your program. For example, how well does your program model existing or expected phenomena, and how well your program may be used to predict behaviors based on future input.

4   Expected Results

Hopefully if next year's seniors have an interest in neural networks and/or computer vision, they will be able to use my project as a starting point and look at my methodology. When this program is completed, it will be able to be implemented into any security system with fairly basic equipment. While there are no doubt professional programs that perform similar functions, these programs cost thousands of dollars. My program would be able to be combined with something as simple as a web cam, and could be used to create a very secure authorization process.