FIRST INTERIM REPORT

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Our project is on face recognition (and face detection). This topic is interesting to us because it has vastly grown in a couple of past years and has a lot of practical usage in everyday life. Some examples of practical applications of face detection and recognition are screen locking on your mobile device, government surveillance (it is actively used in Asian countries), buying tickets for a football game, or security measures for entering the building.

This project's primary goal is to create an application that will recognize the faces and identities of students and faculty staff (of those who will not mind sharing their photos) on our Linear Algebra course.

Based on the literature review that we have made on this topic, we determined that there are quite a few ways of solving the problem of face recognition. One of which is building a convolutional neural network model that first needs to be trained to detect distinct features of one’s face, transform them to numerical values, then process input image and compare the results of computations with the results of the person stored in the database (for example, by computing the triple loss function).

The other approach, and the one we are indeed going to use, is face recognition with Principal Component Analysis (PCA). We chose this method because it is more applicable to our linear algebra course as well as more exciting and engaging in general. First, you have to create value vectors (N2x 1, where N is image size) from your train images, and then you need to perform normalization (extracting common and most usual features on the human face from every photo, so they become distinct). After normalization comes the process of so-called dimensionality reduction (the central concept of PCA), where we create and choose eigenvectors (eigenfaces) with the highest eigenvalues to most correctly represent the space of faces that we have. Each face then can be represented as a linear combination of eigenfaces, where the weights (coefficients near eigenfaces) will serve as the main factor in recognizing faces. To perform the face identification, you compare the values of the weights you get from your input image with the ones you have stored in your database (calculate distance or perform other appropriate functions on weights vectors). Then you choose the person for which the result is the best or say that you cannot identify the person if the result does not pass the threshold.

The advantage of the PCA approach over neural network one is in the training data. To train a neural network model to determine different features on the face with high precision, you need to have a considerable amount of images (there is an option of using transfer learning, but that takes away the majority of work on the project), whereas, with PCA you can have around 50-100 training images to find most convenient eigenfaces to build face representation for every person.

To bring our project to life, we first need to gather training data (take photos of our colleagues or download some from the internet), then we need to implement the procedure that is explained above. After we get a good identification model, we need to create an application (interface for the program). When we are done with our primary goal, we will try to add face detection (this is an entirely different task from face recognition, it can be solved using Viola-Jones Algorithm).

We plan to test our project's implementation on our peers and colleagues (take a few pictures of them and feed them to the program and see if they get recognized). The data (photos) is still to be gathered.

We plan to implement the PCA approach before the next interim report and finish the main task with perhaps some additional features (like face detection) until the final project presentation.

The challenges that may face us are mainly based on data (images) distortion. The difference in image quality, lighting, face expressions, head position/rotation, etc., - these can make it harder to detect the right eigenvaluesand thus recognize faces.