Machine Learning Engineer Nanodegree – Facial Keypoints Recognition

Capstone Proposal

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Proposal

(approx. 2-3 pages)

Domain Background

(approx. 1-2 paragraphs)

http://vismod.media.mit.edu/tech-reports/TR-516/node7.html

In this section, provide brief details on the background information of the domain from which the project is proposed. Historical information relevant to the project should be included. It should be clear how or why a problem in the domain can or should be solved. Related academic research should be appropriately cited in this section, including why that research is relevant. Additionally, a discussion of your personal motivation for investigating a particular problem in the domain is encouraged but not required.

Facial keypoints detection is a field of study that has been relevant for many years due to its potential in creating a non-invasive method of identifying points on a face that can be used to determine any number of details about a person. However, facial features can differ greatly on individuals due to many variations of conditions in gathering images of individuals; therefore, determining accurate information from these features can prove to be difficult.

A well-known beginning to facial recognition systems is due to Tuevo Kohonen, a Finnish academic, who explained that a neural network could perform facial recognition only on aligned and normalized face images utilizing eigenvectors eventually becoming known as eigenfaces seen in Figure 1. These eigenfaces are representations of what the average face may look like based on a large set of data and allow a computer to

determine what parts of the face generally look like. In modern facial keypoints detection, eigenfaces still exist as a primary method of identifying parts of the face although the science has become much more advanced.

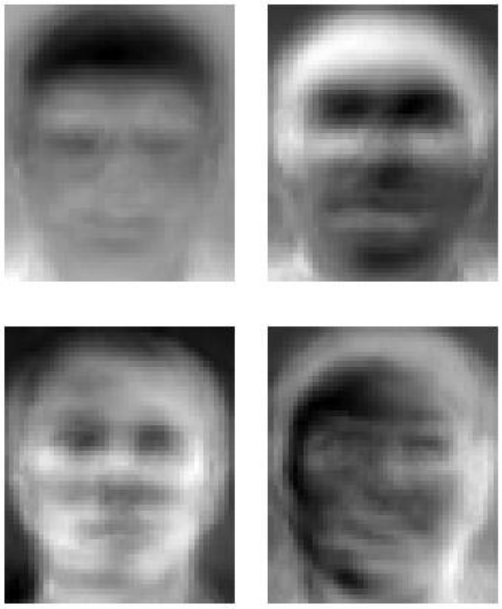

Figure 1: Example of Eigenfaces

By improving the method of facial keypoints detection systems, a number of solutions can occur. People may utilize these systems for lie detectors, medical diagnosis, biometrics, etc. On a bigger scale, every person may eventually have their own Sherlock Holmes, without the personality accompanying it (At least in the show “Sherlock”), to deduce the truth behind the many clues that exist within one’s face.

Problem Statement

(approx. 1 paragraph)

In this section, clearly describe the problem that is to be solved. The problem described should be well defined and should have at least one relevant potential solution. Additionally, describe the problem thoroughly such that it is clear that the problem is quantifiable (the problem can be expressed in mathematical or logical terms) , measurable (the problem can be measured by some metric and clearly observed), and replicable (the problem can be reproduced and occurs more than once).

The problem to be solved is to predict keypoint positions on face images. The goal is to predict the areas and parts where the mouth, eyes, ears, and nose are for all images with

high accuracy. By determining the positions of these keypoints, a machine can gather information about the face. The solution to the problem will be measured utilizing root mean squared error to determine the average of the squares of errors between a set of predicted outcomes and the actual outcomes.

Datasets and Inputs

(approx. 2-3 paragraphs)

In this section, the dataset(s) and/or input(s) being considered for the project should be thoroughly described, such as how they relate to the problem and why they should be used. Information such as how the dataset or input is (was) obtained, and the characteristics of the dataset or input, should be included with relevant references and citations as necessary It should be clear how the dataset(s) or input(s) will be used in the project and whether their use is appropriate given the context of the problem.

The 15 inputs being considered that represent elements in the face where left and right refer to the point of view of the subject are:

left_eye_center, right_eye_center, left_eye_inner_corner, left_eye_outer_corner, right_eye_inner_corner, right_eye_outer_corner, left_eyebrow_inner_end, left_eyebrow_outer_end, right_eyebrow_inner_end, right_eyebrow_outer_end, nose_tip, mouth_left_corner, mouth_right_corner, mouth_center_top_lip, mouth_center_bottom_lip.

Each data point for these elements is specified by an (x,y) real-valued pair in the space of pixel indices. Data points that are missing are left blank. The input image is displayed in the last field of the datasets consisting of a list of pixels (ordered by row), as integers between (0,255). The images are 96x96 pixels.

Solution Statement

(approx. 1 paragraph)

In this section, clearly describe a solution to the problem. The solution should be applicable to the project domain and appropriate for the dataset(s) or input(s) given. Additionally, describe the solution thoroughly such that it is clear that the

solution is quantifiable (the solution can be expressed in mathematical or logical terms) , measurable (the solution can be measured by some metric and clearly observed), and replicable (the solution can be reproduced and occurs more than once).

Benchmark Model

(approximately 1-2 paragraphs)

In this section, provide the details for a benchmark model or result that relates to the domain, problem statement, and intended solution. Ideally, the benchmark model or result contextualizes existing methods or known information in the domain and problem given, which could then be objectively compared to the solution. Describe how the benchmark model or result is measurable (can be measured by some metric and clearly observed) with thorough detail.

Evaluation Metrics

(approx. 1-2 paragraphs)

In this section, propose at least one evaluation metric that can be used to quantify the performance of both the benchmark model and the solution model. The evaluation metric(s) you propose should be appropriate given the context of the data, the problem statement, and the intended solution. Describe how the evaluation metric(s) are derived and provide an example of their mathematical representations (if applicable). Complex evaluation metrics should be clearly defined and quantifiable (can be expressed in mathematical or logical terms).

Project Design

(approx. 1 page)

In this final section, summarize a theoretical workflow for approaching a solution given the problem. Provide thorough discussion for what strategies you may consider employing, what analysis of the data might be required before being used, or which algorithms will be considered for your implementation. The workflow and discussion that you provide should align with the qualities of the previous sections. Additionally, you are encouraged to include small visualizations, pseudocode, or diagrams to aid in describing the project design, but it is not

required. The discussion should clearly outline your intended workflow of the capstone project.

Before submitting your proposal, ask yourself. . .

- Does the proposal you have written follow a well-organized structure similar to that of the project template?
- Is each section (particularly **Solution Statement** and **Project Design**) written in a clear, concise and specific fashion? Are there any ambiguous terms or phrases that need clarification?
- Would the intended audience of your project be able to understand your proposal?
- Have you properly proofread your proposal to assure there are minimal grammatical and spelling mistakes?
- Are all the resources used for this project correctly cited and referenced?