Project Proposal

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Problem statement

As many medical researches suggest, many physical as well as psychological diseases and disorders are related to sleep. Due to this fact, there are growing number of applications in the market that are designed for exploring the mysteries behind the human sleep. The majority of those applications tend to help user to achieve a healthier sleeping style via sleep monitoring and planning. Usually, those application will start with a short text survey to obtain the user's current sleeping condition; however, since text is extremely limited on expressing such information precisely, it is better to employ a more reliable way to gain this information. One pragmatic approach is applying computer vision and machine learning technology to analyze the user's current sleeping condition through selfie.

More specifically, if a person is lacking of sleep, there would be at least one of two major reflects will appear on that one's face. One of these two reflects is known as dark circle while another is know as eye bag. Normally, the latter indicates a more severe scarcity of sleep. By checking these two facts on the given selfie, the proposed approach shall be able to provide a reasonable sleeping condition feedback.

[**sleeping condition based on location**]Further and more importantly, if this approach is empowered with social media big data, we can actually analyze the sleeping conditions of various group of people across the United States by tremendous amount of selfies. For a long time, people incline to believe that those who work in high pressure cities like New York City, San Francisco Bay area, or Boston tend to suffer bad sleep condition more frequently due to the heavy workloads, and those sort of sayings can be verified or disproved by the outcome of the proposed approach.

[**sleeping condition based on age/gender**]Also, by applying Microsoft's Face detection on the acquired testing images, we can understand the gender and age of the subject inside the image. Therefore, analyze the sleep condition of based on age or gender group is also an interesting option. However, since elderly naturally tend to have wrinkles, therefore, old-age group should better be neglected.

Related works

The proposed approach relies heavily on the eye detection and supervised learning classification technologies. With respect to eye detection, there are many fruitful works and open sources can be directly applied, one of the commercial API of detecting face and face landmarks is Microsoft's project Oxford[1]. After we acquired the labeled eye patches, we will use **SVD**[2] to do the feature reduction on the given patches, and after we obtain the coefficient vectors, we then pass these coefficient vectors to **SVM**[3] to do the supervised learning.

Data acquisition

Training data:

1. possible sources:

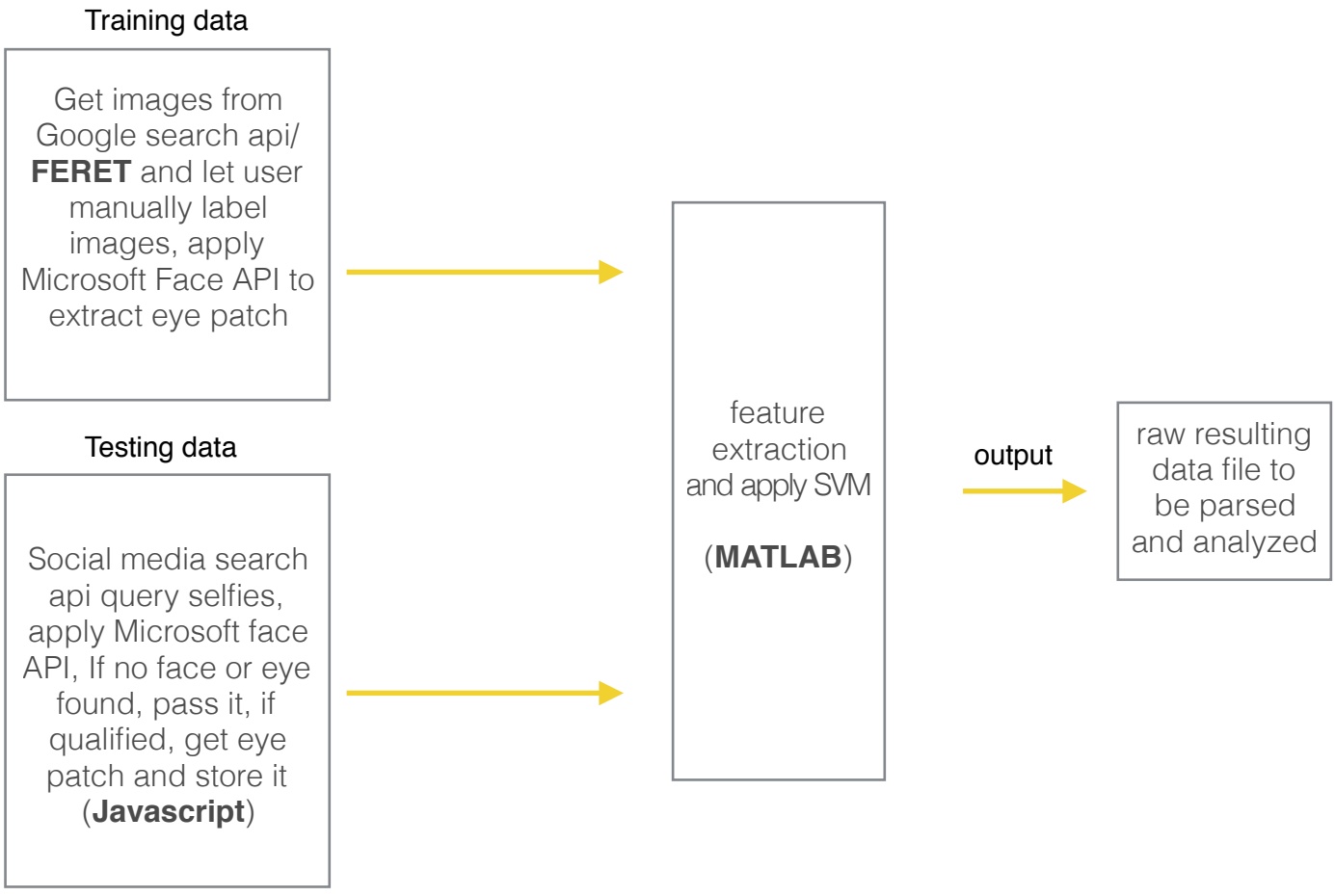
   The Color FERET Database[2] or **Google Custom Search Api**

2. acquisition method:
   - **The Color FERET Database:** apply from The National Institute of Standards and Technology and receive the static facial images. Then, manually tag enough positive and negative training images.
   - **Google custom search**: Build an application that queries Google custom image search Api and manually classify the query results. There is a 100 reqs/day rate limit, and each request will return 10 results. However, it is reasonable to consider that not all of these 10 images can be clustered into either positive or negative set.

Testing data:

1. Instagram: Search by selfie tag and parse based on geolocation. However, the Api access token can not be easily obtained any more.
2. Twitter: Search by selfie tag and parse via geolocation.
3. Tumblr: Search only by selfie and cities tags, api does not support geolocation, resulting JSON contains no geolocation. Many query results will be missed due to the absence of geolocation. (not efficient)

Program design and Software tools



There is one major third party software, which is supported by Microsoft, is used in this project. This software will provide the eye outline for further process.

Reference

[1] "Give Your Apps a Human Side." *Microsoft Cognitive Services*. N.p., n.d. Web. 31 Mar. 2016.
[2] Technicolor, Telecom Paristech /. (n.d.): n. pag. Web.
[3] "An Introduction to Support Vector Machines and Other Kernel-based Learning Methods." *Google Books*. N.p., n.d. Web. 31 Mar. 2016.