Implementation of Kernel function based on Ramanujan sums for computer vision to diagnose pulmonary diseases

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Problem Statement:

Amongst the common examinations in the filed of medicine, chest radiography plays an important role in diagnosing the lung diseases. Physicians generally use the stepwise approach to interpret PFTs and also determine when to order further testing and how to use PFT results to formulate a differential diagnosis. This would be consuming a lot of time in order to provide a precision and personalized medicine to the patients. If the chest radiography can be used for automatic detection of lung diseases, the time required for the diagnosis can be drastically reduced, in addition to helping the physicians in doing the precise diagnosis. Artificial Intelligence technologies assist the doctors in doing the precise diagnosis, thereby enhancing the treatment processes. This may also help in eliminating the wrong diagnosis done sometimes.

Approach:

Various image processing procedures can be applied on these radiographs in order to detect the specific type of a disease such as tuberculosis, pulmonary nodules, effusion, infiltration etc. Accurate image detection will be the fundamental requirement for achieving these diagnoses and categorizing them based on various parameters like contrast, intensity etc.

Kernel methods have proved successful in all areas of image processing such as optical character recognition, object classification, action recognition, image segmentation, content-based image retrieval mainly because of their interpretability and flexibility. Kernel methods have been established as powerful tools for computer vision. The paper titled **"Ramanujan Sums Based Image Kernels for Computer Vision"** is the reference paper which proves the validity of kernel function theoretically and depicts the application of the kernel in image vision. The paper discusses about the applicability of the kernel in various context of image processing.

Implementation:

Our aim in this project is to implement the kernel function for the detection and segmentation of pulmonary diseases. We will explore on the properties of Ramanujan sums and build an image kernel which is a matrix used to apply effects like the ones that are found in Photoshop or Gimp, such as blurring, sharpening, outlining or embossing. They're also used in machine learning for 'feature extraction', a technique for determining the most important portions of an image. We implement a novel kernel matrix based on Ramanujan Sums for computer vision, presented in this paper.

The data set for the given project contains the data samples provided in the 2nd reference paper collected from JSRT dataset, Shenzhen dataset and chest X ray14 dataset. Image Gradient Using Ramanujan Kernel and Edge detection using RS Kernel will be implemented and tested on the data set chosen.

Responsibilities:

Rakshith Churchagundi Amarnath:

- Understanding Ramanujan sums equation and converting into algorithm and its respective code.
- Validation of Ramanujan Kernel.
- Ramanujan sums kernel implementation.
- Mercer's Theorem Implementation.
- Image Gradient using RS kernel.

Megha Tatti:

- Understanding Image kernel concept and implementing it.
- Ramanujan kernel function implementation.
- Edge detection using Ramanujan Sums kernel.
- Collection of JSRT datasets and enhancement of images (Edge features, contrast and intensities).

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