CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Mythili Bhethanabotla

Project Number

S1503

Project Title

Automated Classification of Rhabdomyosarcoma Tumors: A Novel Method to Determine Appropriate Treatment

Abstract

Objectives/Goals

The survival rate of children with Rhabdomyosarcoma (RMS) cancer is under 30%. Among other challenges, existing research does not accurately classify between the subtypes of this disease. In fact, sarcomas may be misclassified in up to 25% to 40% of cases, which results in harmful under treatment and a lower chance of survival. Accurate classification of the subtypes of this disease will allow doctors to assign patients to the appropriate procedures and even save lives. Therefore, I propose a novel methodology to segment and accurately classify the two histopathological subtypes (Embryonal RMS and Alveolar RMS) of Rhabdomyosarcoma cancer.

Methods/Materials

I developed a computational pipeline that consists of three complementary procedures: segmentation, registration, and classification using a deep learning framework. Using a database of 1764 MRI and DWI scans after data augmentation, I segmented the tumor from each scan. I worked on a novel segmentation technique based on the level set method that can be used to segment 3D images. Once the scans were segmented, the MRI and DWI for each patient were registered using a complex registration algorithm. Registration is the process of fusing two images together in order to form a more comprehensive representation of the image. These registered images were the input to the deep learning framework. I used a Convolutional Neural Network (CNN) in order to classify the images as Embryonal RMS versus Alveolar RMS. After running the images through the network I created, I obtained an accuracy rate for the classification of the images.

Results

I visualized the weights of the first and second layer of the CNN, and the weights had smooth filters without any noisy patterns, indicating that the network is converged and well-trained. The results also show an 85% accuracy for the network using the pretrained weights and a 97% accuracy for the network trained from scratch.

Conclusions/Discussion

I present the first study to implement the fine-tuning of a pretrained CNN model on multimodal brain tumor image datasets. This methodology can be used by radiologists in practice when classifying a the type of cancer and deciding which treatment to give to the patient in order to increase their chances of survival against RMS. This method can be used for classification of other cancers and has the potential to replace manual classification, thus saving time and resources.

Summary Statement

I devised a novel methodology using segmentation, registration, and deep learning techniques in order to accurately classify between the histopathological subtypes of Rhabdomyosarcoma cancer.

Help Received

This project was conducted at the Stanford University's Department of Radiology under the supervision and guidance of Dr. Imon Banerjee and Dr. Daniel Rubin.