AI to Identify Spontaneous Intracranial Hypotension(SIH)

Yuyang Zhu(yz3691) and Tianle Zhu(tz2434)

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Abstract

The main goal of this project is to build an AI program that can auto-detect spontaneous intracranial hypotension (SIH) and find where the leakage happens. We plan to try different methods in image processing. Then we will choose plausible features that describe the abnormality to give an answer to this problem. Finally, we will implement this algorithm on spinal MRI datasets from Taipei Veterans General Hospital.

1 Background:

Spontaneous intracranial hypertension(SIH) is a disease often caused by cerebrospinal fluid(CSF) [1] leakage. While epidural blood patch(EBP) is often the treatment to it, it is proved that targeted EBP, which requires the identification of the leak location, performs significantly better than the blind lumber EBP treatment.[3]

As a result, the accuracy of locating the leakage is crucial for both diagnostic and treatment, and it is completed manually by experts. However, due to the large number of details presented in magnetic resonance imaging(MRI), it can often be tedious and time-consuming for human operations and likely to cause unintended mistakes. Thus, there is high demand for auto medical image processing and lots of researches are related to it.

One approach in image classification is using convolutional neural networks (CNNs), such as U-net[2], Ynet and RCNN, to segment the image, which outputs the image with only several categories(like the nucleus, membrane, and mass). Other methods include manual feature engineering and cascade classifier, which has already been utilized by some software like Cellprofiler and requires the experimenter to have domain knowledge about distinguishing features for certain kinds of cells.

2 Introduction to the Project:

We intend to develop a method that automatically identifies CSF leakages from spinal MRI, and locate the cite where the leakage happens with high accuracy.

Since its most likely that the images will have no label, it is difficult to train a deep learning network model directly. We need to go over previous researches and try different methods corresponding to this disease before we get down to do classification.

Another major challenge in this project is that we need to choose an optimal way to classify the images. There might be no existing method in object detection that directly test on a spinal MRI, and we would expect difficulties in processing these images, such as image quality issues. We plan to go over different types of approaches (deep learning, feature engineering and cascade classification) to find a proper way to give a better solution.

3 Introduction to the Dataset:

We have not gotten the dataset for operations yet, but it will likely be spinal magnetic resonance imaging(MRI) from Taipei Veterans General Hospital. It should contain 600G of the MRI images (2G/image) of patients who have received EBP treatments at that hospital. It provides thorough information on how the cells look, but it might have some limitations: the images will likely contain no label; there is no verification group to validate the model; the original image size could be relatively large, and we might need to deal with the compressed version of the image. These would be the challenges in our project.

4 Plan

4.1 Milestone One

To begin, first, we need to understand the project background information and our dataset. Also, we need to be familiar with the relevant Artificial Intelligence Techniques such as Object Detection by using R-CNN or Haar feature-based cascade classifiers, and feature engineering with CellProfiler. Secondly, we will implement the Deep Learning method to the existing dataset (Cervical Cancer image).

4.2 Milestone Two

We will present our works on our milestone two using the practical dataset. After getting our dataset for this project, we can pre-process our data, such as compress the size of the data and do data augmentation and feature engineering. Later, find the suspicious area in the image and then do the classification on the region of interest. We also can find some existing pre-trained models using

the ImageNet dataset. Moreover, we will use existing labeled data to train the model and find a relatively excellent model.

4.3 Milestone Three

After present the model we got on milestone three, we will try to reinforce our model by parameter tuning to improve the accuracy in detecting leak sites.

4.4 Final

Finally, visualize model results and prepare the final presentation and report for our best model on this project.

References

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[3] J.-W. Wu, S.-S. Hseu, J.-L. Fuh, J.-F. Lirng, Y.-F. Wang, W.-T. Chen, S.-P. Chen, and S.-J. Wang. Factors predicting response to the first epidural blood patch in spontaneous intracranial hypotension. *Brain*, 140(2):344–352, 2017.