Chapter 4
KidNet:
Kidney Tumour Diagnosis System Design Using Deep Convolutional Neural Network

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ABSTRACT

Kidney cancer is one of the 10 most common cancers in both men and women. The lifetime risk for one developing kidney cancer is about 1.6%. The rate of kidney cancer diagnosis has been rising since the 1990s due to the use of newer imaging tests such as CT scans. The kidneys are deep inside the body and hence small kidney tumours cannot be seen or felt during a physical examination. Existing work on kidney tumour diagnosis uses traditional machine learning and image processing techniques to find and classify the images. Deep learning systems do not require this domain-specific knowledge. The kidney tumour diagnosis system uses deep learning and convolutional neural networks to classify CT images. A deep learning neural network model named KidNet has been implemented. It has been trained using labelled kidney CT images. To achieve acceleration during the training phase, GPUs have been used. The network when trained with abdominal CT images achieved 86.1% accuracy, and the one trained with cropped portion of kidney images achieved 89.6% accuracy.

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INTRODUCTION

Medical imaging technologies utilize Computerized Tomography (CT) scans or Magnetic Resonance Imaging(MRI) scans to assess the state of an organ or tissue and can observe a patient's condition for diagnosis and recommending treatment. It is because of these techniques we are able to diagnose cancers that might never have been diagnosed otherwise. Medical imaging is one of the applications that took advantage of Graphics Processing Unit (GPU) to get acceleration. The use of GPUs in this field has come to the point that there are several medical modalities shipping with GPUs.

The kidneys are internal organs that are so deep in the human body that tinytumors cannot be identified during physical examinations. Kidney tumor diagnosis is normally carried out by trained professionals manually, but it requires a very tedious process and is greatly dependent on the individual. So there is a need for an automated process.

Recently, there has been much important advancement in machine learning and artificial intelligence. They have played a major role in fields like medical image processing, computer-aided diagnosis, and so forth. Machine-learning techniques are used to minethe information from images and represent it effectively and efficiently. Machine learning and artificial intelligence techniques help doctors make a diagnosis, predict diseases accurately, and prevent them.

Existing work on kidney tumor diagnosis uses traditional machine learning and image-processing techniques to find and classify the images. The choice of descriptive features derived from the image greatly affects the performance of traditional machine learning neural networks. Also, identifying the required features is not a straightforward process, as it requires domain-specific knowledge.

Deep learning models do not require this domain-specific knowledge, as the network automatically learns high-level features from the input images. Deep learning methods have helped industries and researchers achieve very accurate results in various fields like speech recognition, computer vision, and natural language processing. Results produced by deep learning systems are on par with and sometimes better than those from human experts. Deep learning techniques provide state-of-the-art accuracy. It had created opportunities also in precise medical image analysis.

Deep learning using convolutional neural networks is becoming more important in image analysis as it is able to tackle complex problems successfully. The advantage of using a convolutional neural network (CNN), popularly used in image analysis, is that it requires reasonably fewer pre-processing steps compared to other image classification models.

Health care is a major domain in which deep learning provides solutions to a wide range of issues like cancer diagnosing, disease monitoring, and specific treatment suggestions. There is an enormous amount of data available at hospitals which can be used to train the diagnosing system. Image acquisition devices have improved so much that we are able to get X-ray, CT, and MRI scan images using radiology with better resolution.

GPUs are used in sophisticated systems likesmart phones, PDAs, workstations, and play stations, because they are very proficient in handling video, image, and graphics processing. This makes them a convincing choice over conventional processors in super computing systems. Deep Neural Network needs to perform thousands of identical operations on large data. The parallel processing capabilities of GPUs makes them capable of processing larger blocks of data in parallel, using a divide-and-conquer strategy (Owens, Houston, Lubeke, Green, & Stone, 2008).

A CPU may have limited cores optimized for sequential computing; a GPU's structural design has thousands of tiny but efficient processing elements that operate extremely in parallel for carrying out