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Classification of CT brain images based on deep learning networks

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Highlights

- A fused CNN architecture achieving classification accuracy rate of 87.62%.
- 2D CNN delivers 86.32% precision for the 3 classes of AD, lesion, normal.
- 2D SIFT and 2D KAZE give accuracy rates of 85.61% and 86.31% respectively.
- 3D SIFT and 3D KAZE achieve accuracy rates of 85.26% and 83.15% respectively.

Abstract

While computerised tomography (CT) may]
brain, it has not yet been implemented into clinical decision making process for diagnosis of Alzheimer's disease (AD). On the other hand, with the nature of being prevalent, inexpensive and non-invasive, CT does present diagnostic features of AD to a great extent. This study explores the significance and impact on the application of the burgeoning deep learning techniques to the task of classification of CT brain images, in particular utilising convolutional neural network (CNN), aiming at providing supplementary information for the early diagnosis of Alzheimer's disease. Towards this end, three categories of CT images (N = 285) are clustered into three groups, which are AD, lesion (e.g. tumour) and normal ageing. In addition, considering the characteristics of this collection with larger thickness along the direction of depth (z) (~3–5 mm), an advanced CNN architecture is established integrating both 2D and 3D CNN networks. The fusion of the two CNN networks is subsequently coordinated based on the average of Softmax scores obtained from both networks consolidating 2D images along spatial axial directions and 3D segmented blocks respectively. As a result, the classification accuracy rates rendered by this elaborated CNN architecture are 85.2%, 80% and 95.3% for classes of AD, lesion and normal respectively with an average of 87.6%. Additionally, this improved CNN network appears to outperform the others when in comparison with 2D version only of CNN network as well as a number of state of the art hand-crafted approaches. As a result, these approaches deliver accuracy rates in percentage of 86.3, 85.6 ± 1.10, 86.3 ± 1.04, 85.2 ± 1.60, 83.1 ± 0.35 for 2D CNN, 2D SIFT, 2D KAZE, 3D SIFT and 3D KAZE respectively. The two major contributions of the paper constitute a new 3-D approach while applying deep learning technique to extract signature information rooted in both 2D slices and 3D blocks of CT images and an elaborated hand-crated approach of 3D KAZE.

Previous Next

Keywords

Deep learning; Convolutional neural network; Classification; CT brain images; 3D CNN; KAZE

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