Medical Imaging techniques for Transformation and Inference using Deep Learning

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By

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DECLARATION

This is to certify that the Thesis entitled "Medical Imaging techniques for Transformation and Inference using Deep Learning", submitted by me to the Indian Institute of Technology Mandi for the award of the Degree of Master of Science [by Research] is a bonafide record of research work carried out by me under the supervision of (Dr. Aditya Nigam and Dr. Arnav Bhavsar). The content of this Thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any Degree or Diploma.

Mandi, 175 005

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CERTIFICATE

It is certified that the work contained in the thesis entitled "Medical Imaging techniques for Transformation and Inference using Deep Learning" by Preethi Srinivasan, for the award of the degree of MS (by Research) has been carried out under our supervision. The results embodied in this thesis, in full or in parts have not been submitted elsewhere for any degree or diploma.

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ABSTRACT

Medical imaging has significantly progressed to yeild high quality visual representations of the organs inside the body and is of critical value to health care. Multiple imaging modalities such as MRI, X-ray, CT and Ultrasound exist to serve different diagnostic purposes. Nevertheless, in addition to the actual energy signal, post-processing approaches exists which are intended to assist the diagnosis by performing simple improvements like enhancing the sharpness and reducing image noise, providing intelligent suggestions by segmenting the artefacts, classifying the diseases, making meaningful and critical inferences and enabling mass screening. These post-processing tasks can be improved and yield benefits such as decreased acquisition time, cost, need for expert training, increased comfort, and decreased radiation hazard. In this thesis, we have explored deep learning-based techniques for some advanced post-processing tasks like synthesise MR images, automate X-ray report generation, and denoise the CT Scan.

Synthesising inter modality images of MRI: MRI imaging can be utilised to interpret the distinct nature of tissues, characterised by two relaxation times, namely T1 and T2, producing contrasting yet related information. In order to reduce the acquisition time and thereby alleviate comfort and reduce the per-person cost, we propose an Encoder-Decoder-based deep learning architecture to reconstruct T2 weighted image from T1 weighted image.

Automating X-ray report generation: We propose an attention-based deep neural network to generate X-ray report automatically. X-rays can be used for mass screening in several critical/pandemic scenarios as is fast and cost effective.

Denoising low dose CT Scan: Computed Tomography (CT) scanners induce X-ray radiation through the body to capture images of the bones and tissues. A higher radiation dosage leads to clearer images but have harmful effects. We propose an architecture that computes visual attention across non-overlapping patches to denoise the low dose CT scans.

Dedicated

to

Gautam

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