MOVING FROM FUNDAMENTALS OF COMPUTER VISION TO MEDICAL AI APPLICATIONS

A PERSONNEL NOTE

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ABSTRACT

In the summer of 2015, I packed my bags and left my hometown of Hanoi, Vietnam, to pursue a research internship in Grenoble, France. I began learning the fundamentals of computer vision and was fascinated by the potential applications of this technology. Over the next few years, I focused on human action recognition and behavior understanding. I worked on developing algorithms that could analyze video footage and identify patterns in human behavior. It was an exciting time to be working in this field, as advances in machine learning were making it possible to analyze and understand human behavior in ways that were previously impossible. In 2019, I started to explore the use of AI for medical applications. I began attending medical conferences and networking with researchers in the field. I was struck by the potential of using machine learning to diagnose and treat diseases. I started working on developing algorithms that could analyze medical images and detect early signs of diseases. It was a challenging transition, but I was determined to succeed. I spent long hours studying medical imaging data and learning about the various techniques and tools used in medical research. I collaborated with medical professionals to gain insights into the clinical context of my work. Finally, my hard work paid off. I was offered a position in a medical research lab where I could apply my skills to the development of AI algorithms for medical applications. I was thrilled to be working on a project that could have a real impact on people's lives. Today, I continue to work on the development of AI algorithms for medical applications. I am grateful for the journey that brought me from Hanoi to Grenoble, and for the opportunities that I have had to make a difference through my research. I look forward to the possibilities that lie ahead as I continue to explore the intersection of AI and medicine.

1 Introduction

I am currently an Assistant Professor at the College of Engineering and Computer Science (CECS), VinUniversity, and a Research Fellow cum Associate Director at VinUni-Illinois Smart Health Center. I received his Ph.D. in Computer Science from the Toulouse Computer Science Research Institute (IRIT), University of Toulouse, France, in 2019. Previously, I earned the Degree of Engineer in Industrial Informatics from Hanoi University of Science and Technology (HUST), Vietnam, in 2016. My research interests include Computer Vision, Machine Learning, Medical Image Analysis, and their applications in Smart Healthcare. Before joining VinUniversity, I worked at Vingroup Big Data Institute (VinBigData) as a Research Scientist and Head of the Fundamental Research Team. With this position, I led several research projects on Medical AI, including collecting various types of medical data, managing and annotating data, and developing new AI solutions for medical analysis.

2 Research interests

My research interests include Artificial Intelligence (AI), Machine Learning, Deep Learning, Computer Vision, especially their applications in Smart Healthcare, e.g. Medical Imaging Diagnosis, AI-based Computer-aided Diagnosis (AI-CAD), AI-assisted Diagnosis and Treatment, AI-assisted Disease Prevention and Risk Monitoring.

3 My research journey

We have developed a software for the detection and characterisation of defects based on the analysis of 3D point clouds provided by a scanner. This software has been developed within an industrial application dealing with the control of an aircraft fuselage surface. We then published the paper titled "Detection and characterization of surface defects based on the analysis of 3D point clouds provided by a scanner" Jovancevic et al. [a,b] in 2016. Détection et caractérisation de défauts de surface par analyse des nuages de points 3D fournis par un scanner Jovančević et al. [2017a]. Détection et caractérisation de défauts par analyse des nuages de points 3D fournis par un scanner Jovančević et al. [2017b]. 3D point cloud analysis for detection and characterization of defects on airplane exterior surface Jovančević et al. [2017c].

3.1 Human Action Recognition and Behavior Understanding

Real-time obstacle detection system in indoor environment for the visually impaired using microsoft kinect sensor Pham et al. [2016]. Exploiting deep residual networks for human action recognition from skeletal data Pham et al. [2018a]. Learning and recognizing human action from skeleton movement with deep residual neural networks Pham [2017]. Skeletal movement to color map: A novel representation for 3D action recognition with inception residual networks Pham et al. [2018b]. A deep learning approach for real-time 3D human action recognition from skeletal data Pham et al. [2019a]. Learning to recognise 3D human action from a new skeleton-based representation using deep convolutional neural networks Pham et al. [2019b]. Spatio–temporal image representation of 3D skeletal movements for view-invariant action recognition with deep convolutional neural networks Pham et al. [2019c]. Skeletal Movement to Enhanced Color Map: A Novel Representation for Rgb-d Based 3D Human Action Recognition with Densely Connected Convolutional Networks Pham et al. [2019d]. Video-based human action recognition using deep learning: a review Pham et al. [2022a]. A unified deep framework for joint 3d pose estimation and action recognition from a single rgb camera Pham et al. [2020]

My PhD these titled "Video-based human action recognition using deep learning" Pham et al. [2015] under four advisor Khoudour, Louahdi and Crouzil, Alain and Zegers, Pablo and Velastin, Sergio A.

3.2 Building Medical Imaging Datasets

VinDr-Mammo: A large-scale benchmark dataset for computer-aided detection and diagnosis in full-field digital mammography Pham et al. [a]

3.3 Medical AI Research

VinDr-SpineXR: A deep learning framework for spinal lesions detection and classification from radiographs Nguyen et al. [2021a]. Learning to automatically diagnose multiple diseases in pediatric chest radiographs using deep convolutional neural networks Tran et al. [2021]. Dicom imaging router: An open deep learning framework for classification of body parts from dicom x-ray scans **?**. VinDr-SpineXR: A large annotated medical image dataset for spinal lesions detection and classification from radiographs Pham et al. [b]. A clinical validation of VinDr-CXR, an AI system for detecting abnormal chest radiographs Nguyen et al. [2021b]. Interpreting chest X-rays via CNNs that exploit hierarchical disease dependencies and uncertainty labels Pham et al. [2021]. VinDr-RibCXR: A benchmark dataset for automatic segmentation and labeling of individual ribs on chest X-rays Nguyen et al. [2021a]. VinDr-PCXR: An open, large-scale chest radiograph dataset for interpretation of thoracic diseases in children Nguyen et al. [2022a]. VinDr-Mammo: A large-scale benchmark dataset for computer-aided diagnosis in full-field digital mammography Nguyen et al. [2022b]. VinDr-PCXR: An open, large-scale pediatric chest X-ray dataset for interpretation of common thoracic diseases Nguyen. Deployment and validation of an AI system for detecting abnormal chest radiographs in clinical settings Nguyen et al. [2022c]. Transparency strategy-based data augmentation for BI-RADS classification of mammograms Tran et al. [2022]. Phase recognition in contrast-enhanced CT scans based on deep learning and random sampling **?**. A novel multi-view deep learning approach for BI-RADS and density assessment of mammograms Nguyen et al. [2022d].VinDr-CXR: An open dataset of chest X-rays with radiologist's annotations Nguyen et al. [2022e]. Slice-level Detection of Intracranial Hemorrhage on CT Using Deep Descriptors of Adjacent Slices Ngo et al. [2022]. An Accurate and Explainable Deep Learning System Improves Interobserver Agreement in the Interpretation of Chest Radiograph Pham et al. [2022b].

Learning to diagnose common thorax diseases on chest radiographs from radiology reports in Vietnamese Nguyen et al. [2022f]. Detecting COVID-19 from digitized ECG printouts using 1D convolutional neural networks Nguyen et al. [2022g]. A novel deep learning-based approach for sleep apnea detection using single-lead ECG signals Nguyen et al. [2022d]. Enhancing Few-shot Image Classification with Cosine Transformer Nguyen et al. [2022h]. Learning from multiple expert annotators for enhancing anomaly detection in medical image analysis Le et al. [2023].

4 Federated Learning For Healthcare Applications

5 What's next?

6 Concluding remarks

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