Unsupervised Anomaly Detection of Coronary Angiogram Procedures in the Cardiac Catheterization Laboratory

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Aims: In cardiology, coronary artery disease is anticipated to rise by 40% by 2040 [1]. An efficient workflow management of the cardiac catheterization laboratory (cath lab) is important to improve the quality of care. Detecting anomalies during procedures provides insight into intraoperative events and allows timely intervention. In this study we developed an unsupervised approach to detect anomalies in video recorded coronary angiogram (CAG) procedures.

Materials and Methods: We collected a dataset of video recordings of 222 CAG procedures performed at Reinier de Graaf Gasthuis hospital, Delft, NL. We present an unsupervised anomaly detection pipeline for CAG procedures using video recordings. Our method uniquely combines pose estimation (extracted with poseBYTE [2]) with 3D convolutional feature extraction from pose heatmaps [3]. These embedded features are then analysed via unsupervised hierarchical clustering [4] to identify deviations from typical procedural patterns. This approach offers a novel, video-based method for quality control and anomaly detection in interventional cardiology.

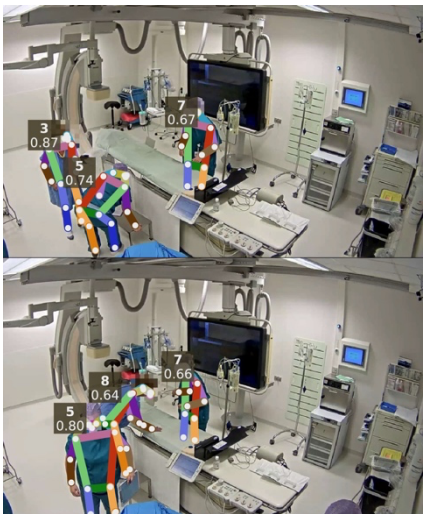

Fig. 1 Qualitative results of PoseBYTE during a CAG procedure performed in Reinier de Graaf Hospital [2].

Results: The pose extraction performance is measured on Cath Lab footage using Higher-Order Tracking Accuracy (HOTA). We achieve up to 0.71 HOTA where tested state-of-the-art pose trackers score up to 0.65 on the used dataset. In addition, the tracker achieves up to 22.5 frames per second, which is 9 frames per second faster than the current state-of-the-art on our setup in the Cath Lab. Currently, we are extracting the embedded features from the poses heatmaps. These consist of 512-dimensional vector per 10-second clip of each video recording. We will then feed these features to the unsupervised clustering algorithm to detect the anomalies in the procedures.

Conclusions: This ongoing work introduces a novel, unsupervised video-based pipeline for anomaly detection in CAG procedures. Our initial results demonstrate superior pose tracking performance on cath lab footage compared to state-of-the-art methods, achieving a HOTA score of 0.71 at a faster frame rate. We are currently extracting embedded features from pose heatmaps, which will be fed to a hierarchical clustering model to identify atypical procedural sequences. This approach holds promise for providing valuable insights into intraoperative events, and contributing to enhanced quality control in interventional cardiology workflows.

References:

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