Explainable Epiletic Seizure Classification: A 2-stage Pipeline

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NEW FRONTIERS IN TECH

Introduction

Video based clinical in-bed action recognition is essential for many clinical applications. Such systems may be utilized in semiology based epileptic seizure classification for pre-surgical evaluation of patients (Fig. 1).

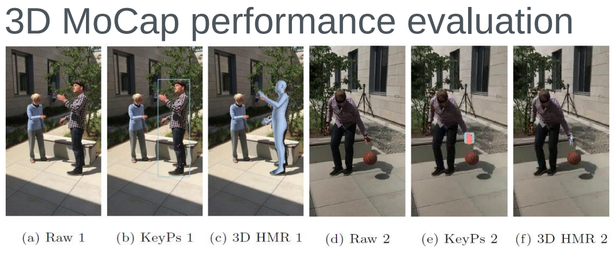
In order to provide the most clinical advantages a 2 stage deep learning based action recognition approach with 3D Motion Capture, as the first stage is essential for quantified evidence based clinical diagnosis support.

In the following the concept, initial results of the pipeline and future works are presented.

Fig. 1. Example frame of a person monitored in an Epilepsy Monitoring Unit [5] and treatment distribution of epileptic patients

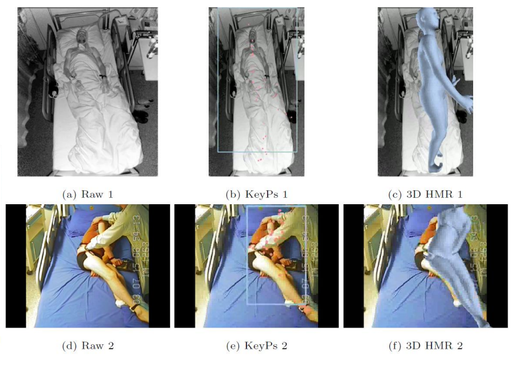
Results

3D MoCap performance evaluation



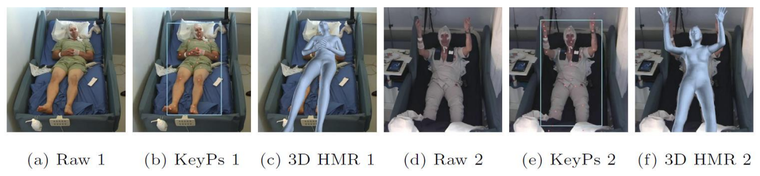
(a) Raw 1 (b) KeyPs 1 (c) 3D HMR 1 (d) Raw 2 (e) KeyPs 2 (f) 3D HMR 2

Fig. 2. (a-c) Reproduction on original data shows good results; (d-f) It significantly degrade performance on low resolution data from the same dataset



(a) Raw 1 (b) KeyPs 1 (c) 3D HMR 1 (d) Raw 2 (e) KeyPs 2 (f) 3D HMR 2

Fig. 3. (a-c) It significantly degrade performance on low resolution IR clinical data (d-f) Slightly improved, but still poor performance on low resolution RGB clinical data



(a) Raw 1 (b) KeyPs 1 (c) 3D HMR 1 (d) Raw 2 (e) KeyPs 2 (f) 3D HMR 2

Fig. 3. (a-f) Decent performance on clinical HD-RGB data, however it has a bias due to the uncommon viewpoint, performance significantly impacted by occlusions.

New dataset proposed: HD-RGB data collection of clinical data
Multi center collaboration: CHUSJ (Porto) + depth in LMU (Munich)
Ethical approval and collection are ongoing

Conclusions

Proposed 2 stage approach
Main adantages over end-to-end approaches:
- Transfer learning, movement quantification and explainability

Tested Hybrik MoCap performance
- HD-RGB data is required for optimal performance
- New clinical data collection initiated

References

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[5]] J. P. S. Cunha, H. M. P. Choupina, A. P. Rocha, J. M. Fernandes, F. Achilles, A. M. Loesch, C. Vollmar, E. Hartl, and S. Noachtar, “NeuroKinect: A Novel Low-Cost 3Dvideo-EEG System for Epileptic Seizure Motion Quantification,” PLOS ONE, vol. 11, p. e0145669, 1 2016.
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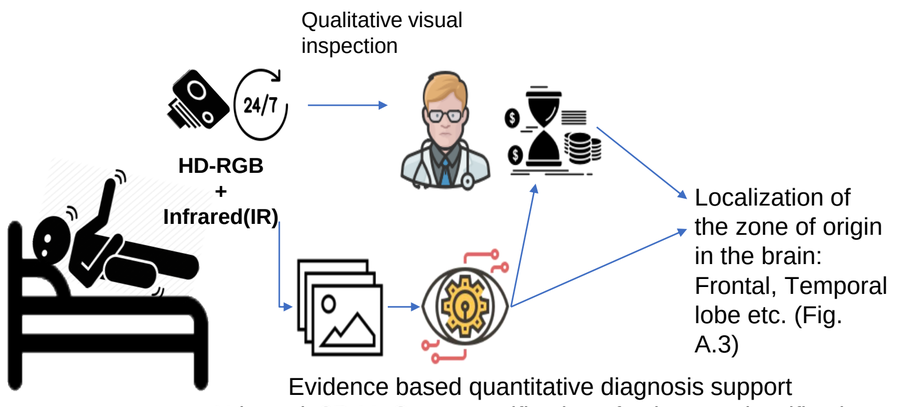
Methods

Localization of epileptogenic zone:
- Utilizing video-EEEG monitoring; by visual inspection of clinicians
- Diagnosis support for clinicians, by computer vision



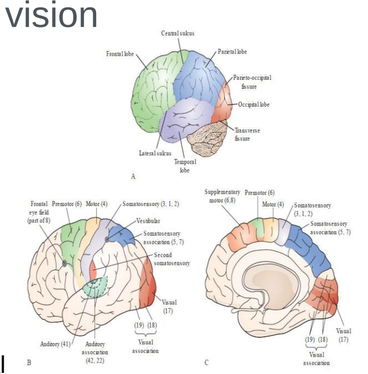
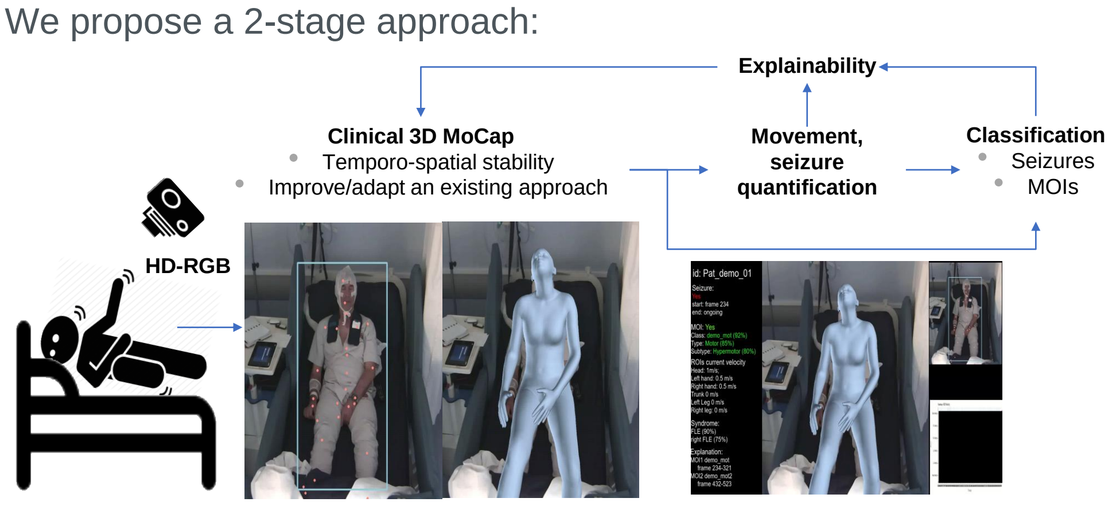


Figure A.3: The cerebral hemispheres, (A) The distinct lobes of the hemispheres, lateral view, (B) Motor and sensory cortexes Left lateral view, (C) motor and sensory cortexes, Medial section [6]

Goal: Explainable epileptic seizure classification from videos, evidence based, quantitative diagnosis support

Based on our previous publications [1-3]
- We showed feasibility of action recognition based seizure classification [1-2]
- Proposed a collaborative framework to develop the system with clinics [3]

We propose a 2-stage approach:



2-stage approach:
1. 3D Motion Capture
2. Action recognition based classification

3D MoCap initial evaluation with Hybrik [4] archtiecture
- Reproduction in the original and in clinical domain
- Impact of Low resolution
- Impact of IR videos
- Evaluation on HD-RGB videos in a clinical scene

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