DEEP CONVOLUTIONAL NEURAL NETWORKS FOR AUTOMATED CONVULSION SCORING USING RGB-D IMAGES

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I. Introduction

- Rodent models, due to their small size, docility, and rapid breeding capability in captivity, have emerged as the primary choices for investigating the complex mechanisms underlying epileptogenesis, seizure generation, and subsequent suppression.

- We present a novel approach for automatic mouse behavior recognition in convulsion experiments using deep neural networks with RGB and depth (RGB-D) images, provided by MS Kinect® v2 2D/3D sensors.

II. Proposed Method

- The proposed framework and data flow for the automated mouse convulsion scoring.

- Data Preprocessing:
  1. Raw depth images are used to locate the animal (mouse) by a rodent detector algorithm based on background subtraction.
  2. The tracked coordinates are mapped from depth space (D) to color space (RGB), in order to generate mouse color crops.
  3. Image crops are further pre-processed based on the requirements of each CNN model.

- CNNs for Transfer Learning:
  1. Employing convolutional neural networks to extract high-level features directly from the image pixels enables transfer learning from existing CNN models, which are trained on large general purpose image datasets.
  2. Two popular CNN architectures are examined: VGG-16 network and Inception-v3 network.

III. Experimental Results

- Dataset Collection:
  - RGB-D videos recorded on a total of 14 male Swiss Webster mice that weighed 27 - 33 grams and aged from 2 - 2.5 months.
  - The mice were injected with a specific dose of cocaine hydrochloride based on their weight, and then individually placed in acrylic chambers.
  - Each frame of the video was annotated as one of the mutually exclusive behaviors for convulsion scoring, using the JWatcher software (www.jwatcher.ucla.edu/).

- Experimental Module:
  - The tracked mouse was used to generate mouse color crops, which were further processed based on the requirements of each CNN model.

IV. Conclusion

- Our model significantly outperformed the conventional SVM-based method, with the best results obtained using VGG-16 with data augmentation.

- Our future work involves combining features from preceding frames to integrate temporal information during model prediction.