

Research & Development - DRAFT

Evaluation of current Approaches for Situation-Awareness in Autonomous Systems

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1 Introduction

Brief but concise review of the first four "W"s.

Applications: security-driven video surveillance in public environments, surveillance of children or the elderly in assisted living environments, patient monitoring, video retrieval (content-based video indexing) , human-computer interaction, robotics.

Requirement: Automated recognition of high-level actions.

Because of large variations in used datasets and evaluation practice, approaches are discussed conceptually.

Focus on Deep Learning approaches, since conventional methods have been surveyed in many articles before (see related work section).

1.1 Situation Awareness from video data

General Definition of Situation Awareness in the context of autonomous systems.

Placement of Action Recognition among other vision-based methods, i.e. Action Prediction, Anomaly Detection, Event and Action Detection, Person/Pedestrian Detection, Gesture Recognition.

Definitions of the above methods.

Simple case: Video contains the performance of a single human action which needs to be classified into one of several preknown classes.

General real-world case: System operates on a video stream and needs to perform continuous recognition of human actions, including detection of beginning and endings times of containing actions.

General Processing Pipeline for Action Recognition: Person Detection -> Tracking -> Action Detection -> Segmentation -> Action recognition.

Action Recognition: A part of Computer Vision research, its goal is to automatically analyze human actions/activities from video-data.

Other sensory input than video possible:

1.2 Survey Papers in Action Recognition (Related work)

Review of most important/recent review papers in Action Recognition with traditional and Deep Learning approaches.

1.2.1 A survey on vision-based human action recognition, Ronald Poppe (2010)

Definition of action: Uses the hierarchical classification of human motion in action primitives, actions and activities as given in Moeslund et al. (cite ??)

Action primitives are atomic movements at the limb-level.

Actions are possibly cyclic whole body movements and consist of multiple action primitives.

Activities consist of multiple actions whose subsequent execution make the movement interpretable.

Example: Action primitives: Left/right leg forward -> Action: Starting, Running, Jumping -> Activity: Jumping hurdles.

Scope: Gives a very good classification of conventional methods in human action recognition.

The discussion is split according to video representations and classification methods.

Challenges of the domain are described very well.

Deficits: No Deep Learning methods are discussed.

Datasets and benchmarks are discussed only very briefly.

1.2.2 Human Activity Analysis: A Review – Aggarwal and Ryoo (2011)

Gives an approach-based taxonomy.

1.2.3 A survey on vision-based methods for action representation, segmentation and recognition – Weinland et al. (2011)

1.2.4 A review of unsupervised feature learning and deep learning for time-series modeling – Längkvist et al. (2014)

1.2.5 Going Deeper into Action Recognition: A survey – Herath et al. (2016)

Definition of action:

1.3 Challenges in Action Recognition

Action Recognition is a classification-task.

Intra- and inter-class variances.

Background and recording settings.

Temporal variations.

Obtaining and labeling training data.

Difference to face/gate recognition: Generalize over person characteristics.

Main task of action recognition research: Overcome these challenges and build systems, that recognize actions robustly, even when performed by different persons in differently lighted environments at different speeds.

2 Conventional Methods in Action Recognition

META: Condensed overview and description of conventional Methods in action Recognition using the taxonomy of Aggarwal and Ryoo's fine survey paper. More detailed description of methods using local-features, since these have become the standard approach in action recognition after Aggarwal and Ryoo's overview.

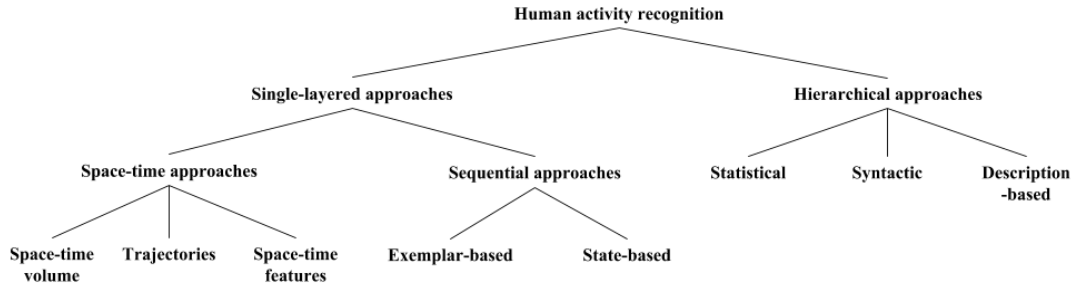


Abb. 1: Approach-based taxonomy for conventional methods in human activity recognition as given by Aggarwal and Ryoo[1]

3 Main components in action recognition using local features: Feature Extraction, Representation Building, Classification.

Methods for feature extraction: Interest point detectors or dense sampling.

Space-time interest point detectors: Harris3D[2], Cuboids[3], Hessian Detector[4]

Descriptors for 3D volumes around previously detected space-time interest points: Histogram of Gradient HOG[5], Histogram of Optical Flow (HOF)[6], 3D Histogram of Gradient (HOG3D)[7], Extended SURF (ESURF)[4]

3 Deep Learning Methods in Action Recognition

Review of approaches that use Deep Learning.

3.1 Spatio-Temporal Networks

I.e. convolutional methods.

3.2 Multiple Stream Networks

The most successful architecture at action recognition. They are equally powerful as the improved dense trajectories approach. cite TDD

3.3 Generative Models

Restricted Boltzmann Machine

3.4 Temporal Coherency Networks

4 Datasets and Benchmarks in Action Recognition

4.1 Review of Datasets for Human Action Classification

Review of the most important currently existing datasets, focus on newest ones (since 2013)

Reference dataset survey paper.

4.2 Data Augmentation

4.3 Alternative Benchmarks for Action Recognition Algorithms

4.4 Inter-Dataset Approaches

5 Evaluation

What do we need, what do we have, what is best suited so far?

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