SBGAR: Semantics Based Group Activity Recognition

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Introduction

Automatically recognizing human activities in videos is one of the core tasks in the field of computer vision. Compared to the single-person activity recognition task, group activity recognition requires a more robust scheme that can capture correlated individual actions in group activities.

Common existing approaches:

Step 1. Identify individual person in video frames.
Step 2. Track and recognize individual actions.
Step 3. Infer group activities.

Biggest weakness:

High computation time.

Our Contributions:

1. We propose a novel solution, namely **SBGAR**, for group activity recognition.
2. The proposed scheme is **semantics-based**. It can generate a semantic representation for each video frame.
3. Our solution yields **better performance** than state-of-the-art approaches.

Intuition

In a Volleyball Game, given the following descriptions:

- **Frame t-1:** There is a player **jumping** on the **right** side, while others are **standing**.
- **Frame t:** There is one player **spiking** on the **right** side and three players **blocking** on the **left** side, while others are **standing**.
- **Frame t+1:** All players are **standing**.

One can easily infer: **Right team is Spiking**.

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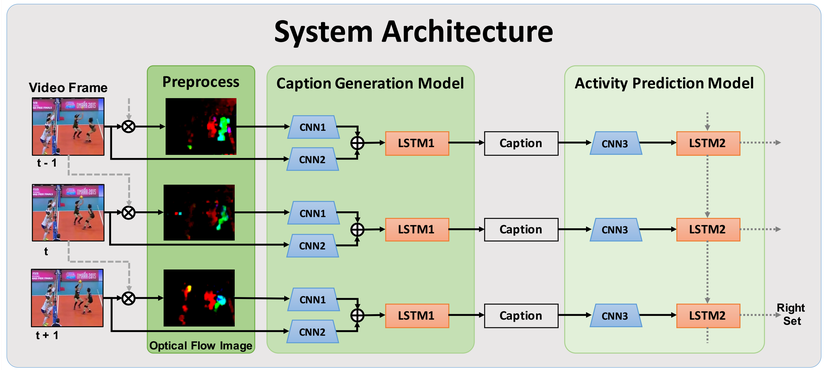
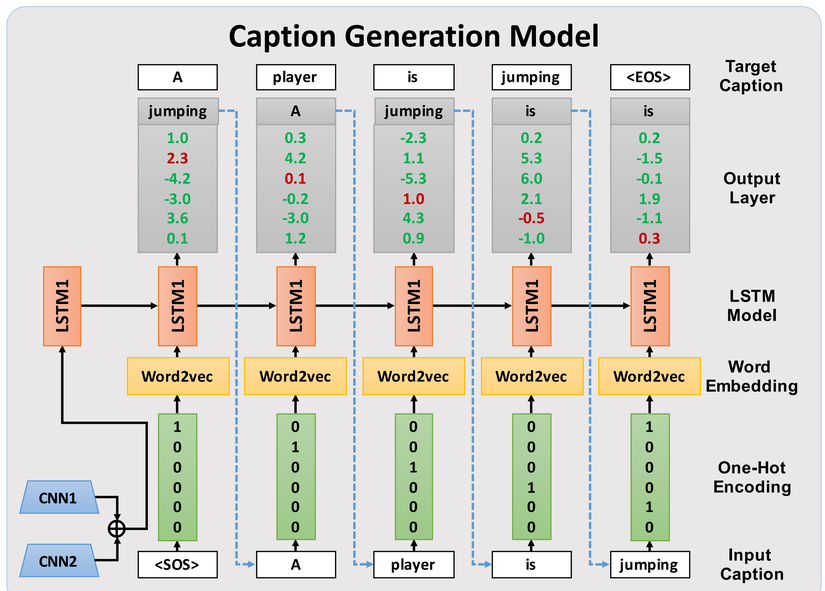
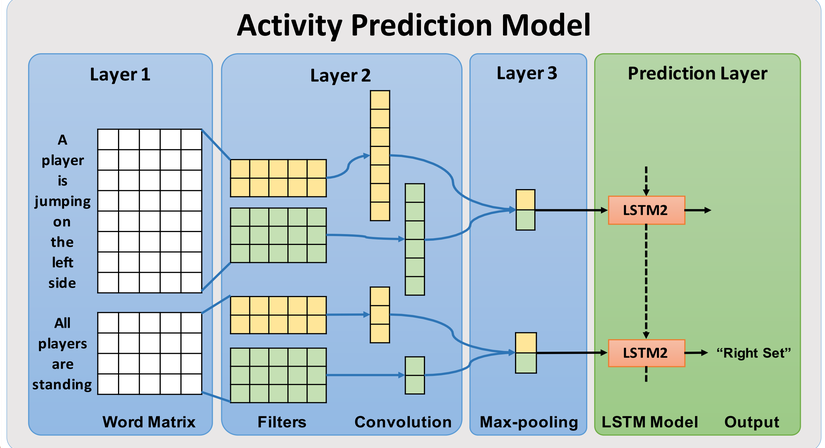
Proposed Solution







Experimental Results

Collective Activity Dataset:

Methods	Accuracy (%)
B1 - Single Frame Classification	67.2
B2 - Temporal Model with Image Features	68.5
B3 - SBGAR (RGB Frame Only)	83.7
B4 - SBGAR (Optical Flow Image Only)	70.1
Contextual Model [1]	79.1
Deep Structured Model [2]	80.6
Two-stage Hierarchical Model [3]	81.5
Cardinality kernel [4]	83.4
SBGAR (RGB & Optical Flow)	**86.1**

Volleyball Dataset:

Methods	Accuracy (%)
B1 - Single Frame Classification	41.9
B2 - Temporal Model with Image Features	44.3
B3 - SBGAR (RGB Frame Only)	38.7
B4 - SBGAR (Optical Flow Image Only)	54.3
Two-stage Hierarchical Model [3]	51.1
SBGAR (RGB & Optical Flow)	**66.9**

Computation Time:

Process	Computation Time (ms)
Optical Flow Image	22.19
Extract CNN1 Feature (Inceptionv3)	27.78
Extract CNN2 Feature (Inceptionv3)	27.78
Caption Generation	28.63
Activity Recognition (10 Frames)	2.15
In Total	108.53

[1] T. Lan, Y. Wang, W. Yang, S. N. Robinovitch, and G. Mori, "discriminativeminative latent models for recognizing contextual group activities," IEEE Transactions on Pattern Analysis and Machine Intelligence, 2012.
[2] Z. Deng, M. Zhai, L. Chen, Y. Liu, S. Muralidha- ran, M. J. Roshtkhari, and G. Mori, "Deep structured models for group activity recognition," arXiv preprint arXiv:1506.04191, 2015.
[3] M. S. Ibrahim, S. Muralidharan, Z. Deng, A. Vahdat, and G. Mori, "A hierarchical deep temporal model for group activity recognition." CVPR, 2016.
[4] H. Hajimirsadeghi, W. Yan, A. Vahdat, and G. Mori, "Visual recognition by counting instances: A multi- instance cardinality potential kernel," CVPR, 2015.