A DATASET AND PRELIMINARY RESULTS FOR UMPIRE POSE DETECTION USING SVM CLASSIFICATION OF DEEP FEATURES

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OVERVIEW

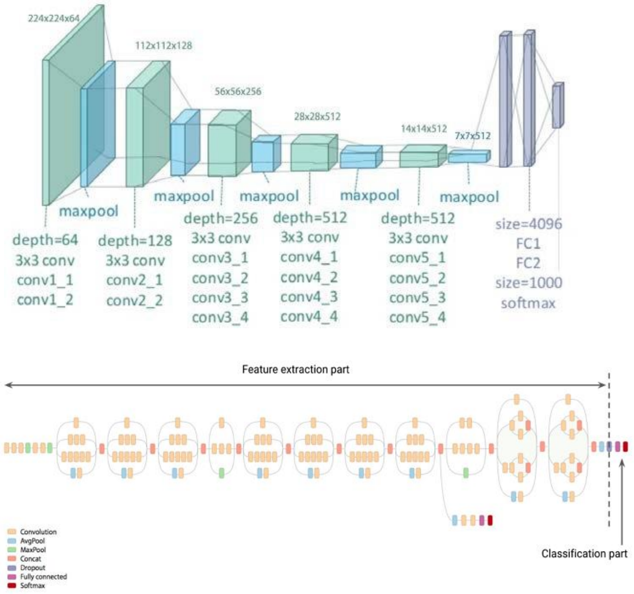
Introduction

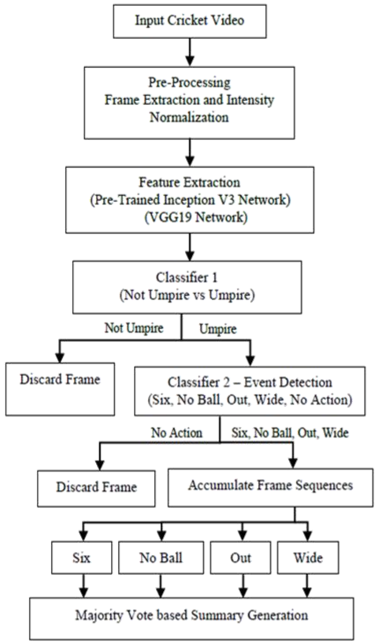
Related Work

SNOW Dataset

Methodology

Results





INTRODUCTION

Present Work

Sports Video Summarization – Highlights

Approach

Identify key events from sports videos and use them to automatically generate highlights

Cricket

Most popular game in the world after Soccer (2.5 billion viewers)

Key Event Detection

Role of Umpire

- Authority to make important decisions about events on the field
- Signals these events using hand signals, poses and gestures

RELATED WORK

Automatic Highlights Generation

- Automatic summarization of soccer videos has been proposed
- Similar studies for sports such as basketball, baseball and tennis have also been reported
- Hari et al. - Method based on intensity projection profile of umpire gestures for detecting events
- Chambers et al. - Fixing wrist bands on umpires for collecting accelerometer data, and using them to classify the gesture of umpires for labelling the events in a cricket video

Benchmark datasets for cricket videos are not available for further development on the existing ideas

CONTRIBUTIONS AND PROPOSED METHOD

Contributions

- A Dataset (SNOW) containing images of Umpires for Event Detection
- A System for Automatically Generating Cricket Highlights

Proposed Method

- Umpire Pose Detection based on Transfer Learning
- Features Extracted on Pre-Trained Networks
- Classification based on Linear Support Vector Machine (SVM)

SNOW DATASET

Umpire

- 390 Images
- 5 Classes – **S**ix, **N**o Ball, **O**ut, **W**ide (SNOW), No Action
- Each class consists of 78 Images
- Contains Images of Umpires with Different Colour uniforms, camera angles, lighting, etc.

Non Umpire

- 390 Images
- Contains Images of Team players, Field, Audience, etc.

Source

Google Images

YouTube Videos

Download Link

https://goo.gl/zkhVCK

SNOW DATASET - UMPIRES

Six

No Ball

SNOW DATASET - UMPIRES

Out

Wide

SNOW DATASET – NO ACTION AND NON UMPIRE IMAGES

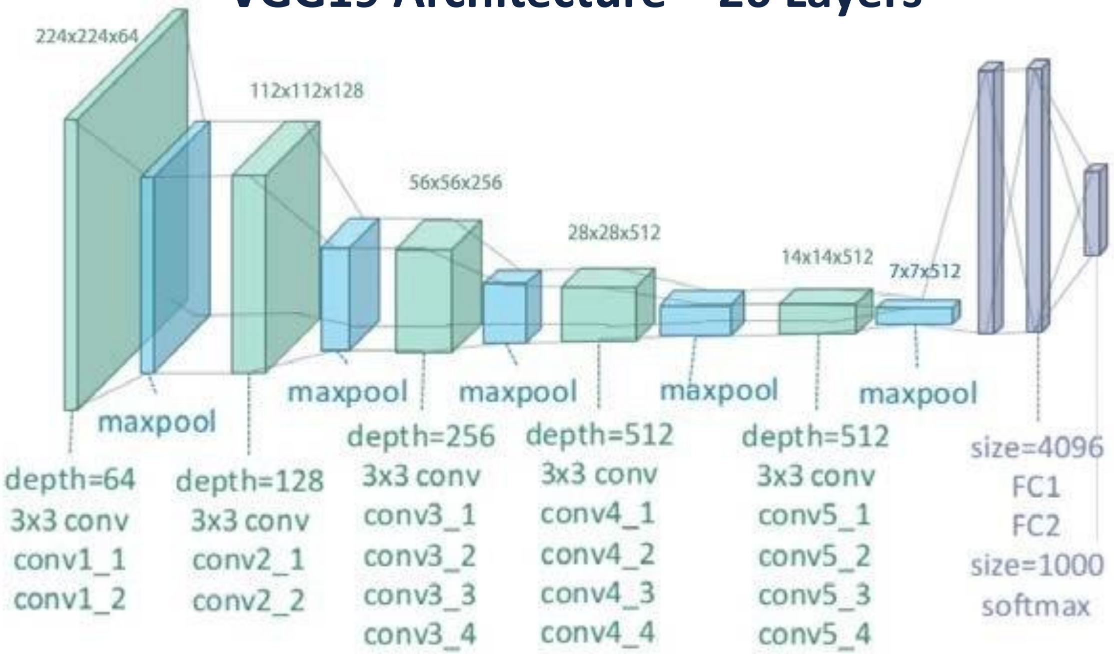
No Action

Non Umpire Class

METHODOLOGY – FEATURE EXTRACTION

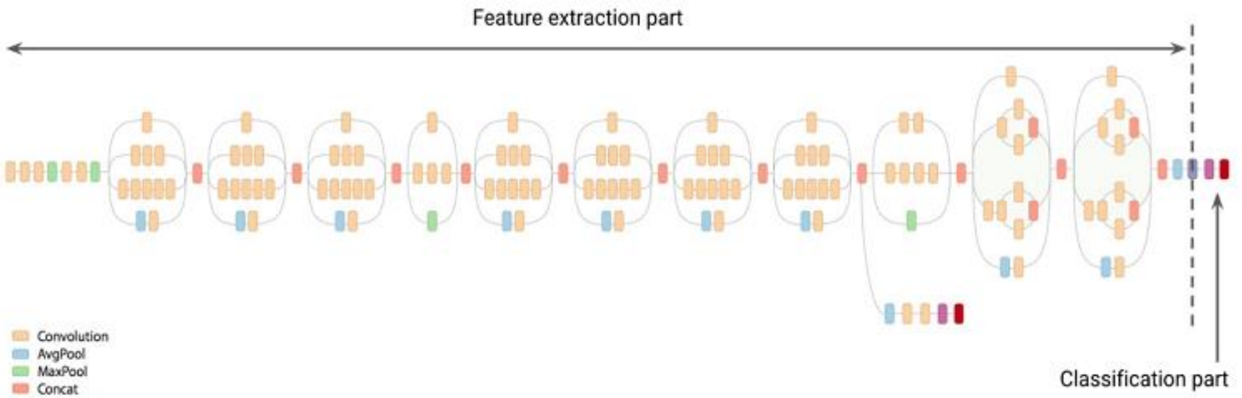
Pre-Trained Models on ImageNet Large-Scale Visual Recognition Challenge (ILSVRC)

VGG19 Architecture – 26 Layers



4096 Feature Vector

Inception V3 Architecture – 159 Layers



2048 Feature Vector

Sources:
https://www.researchgate.net/profile/Clifford_Yang/publication/325137356/figure/fig2/AS:670371271413777@1536840374533/Illustration-of-the-network-architecture-of-VGG-19-model-conv-means-convolution-FC-means_W640.jpg
https://software.intel.com/sites/default/files/managed/39/22/detecting-diabetic-retinopathy-using-deep-learning-on-intel-architecture-fig01.png

METHODOLOGY – CLASSIFICATION

Classification Tasks

Umpire vs Non Umpire
Classifier 1

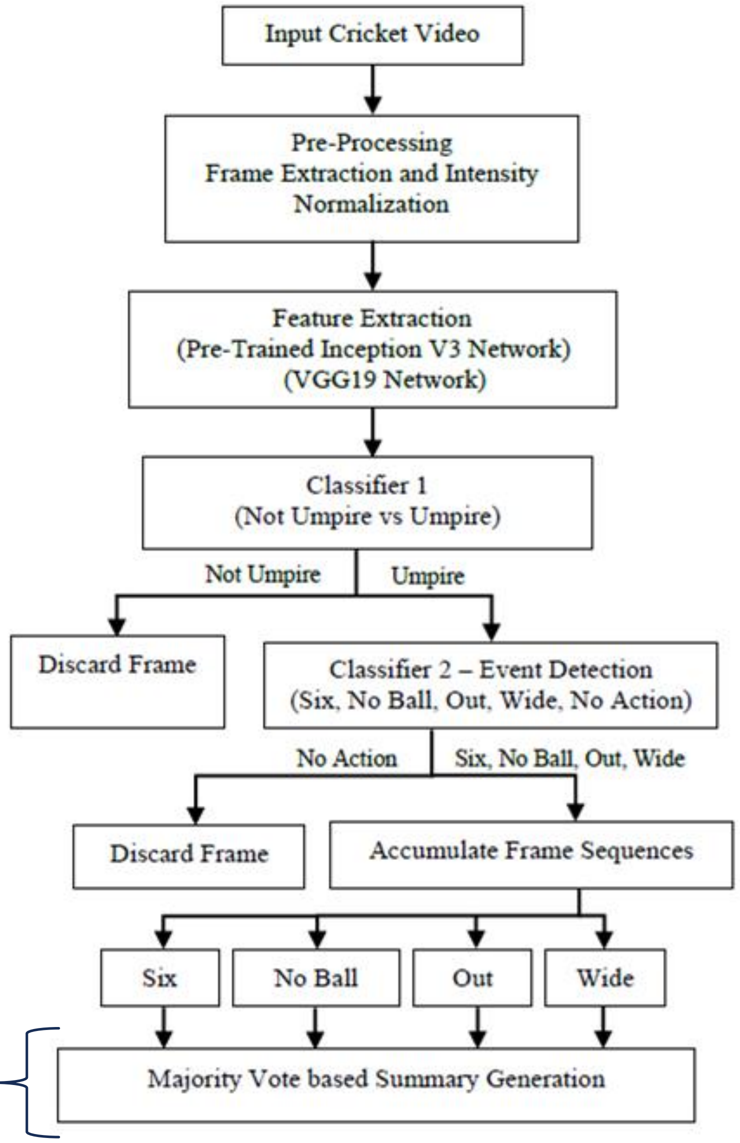
Event Detection/Umpire Pose Detection
Classifier 2

Linear Support Vector Machine (SVM) Classifier - C=10

METHODOLOGY – VIDEO SUMMARIZATION

Proposed Method

- Process each frame of the Video Sequentially
- Buffer every 250 frames and perform event detection ~10s of video
- Accumulate Frames into Event Sequences
- Based on Majority Vote sequences are combine into a summary



Output every 250 frames

RESULTS – CLASSIFIER PERFORMANCE

Classifier	Features	Accuracies		
		10-fold	Jack-Knife	Test
1	Inception V3	96.97%	97.76%	94.23%
	VGG19 – Fc1 layer	97.75%	97.59%	**96.15%**
	VGG19 – Fc2 layer	96.47%	96.79%	94.87%
2	Inception V3	77.71%	77.56%	85.90%
	VGG19 – Fc1 layer	82.43%	81.09%	**83.33%**
	VGG19 – Fc2 layer	78.14%	81.09%	78.21%

- Inception V3 and FC1 Layer of VGG19 features are selected for Video Summarization performance evaluation
- Classifier was evaluated based on 10-fold validation and Leave-One-Out/Jack-Knife

RESULTS – CLASSIFIER PERFORMANCE

A

B

Classifier 1 correctly classifying novel images as non umpire (left) and umpire (right).
Classifier 1 misclassifying both novel images as umpire images.

A

B

Classifier 2 correctly classifying novel images as OUT (left) and Six (right).
Classifier 2 misclassifying both non umpire images as Six (left) and No Ball (right).

RESULTS – VIDEO SUMMARY

Video	Event Category	Actual Number of Events	Features					
			Inception V3			VGG19 - FC1		
			TP	FP	FN	TP	FP	FN
V1	Six	1	1	0	0	1	0	0
V1	No Ball	3	2	0	1	2	0	1
V1	Out	2	2	1	0	2	1	0
V1	Wide	2	2	0	0	2	0	0
V2	Out	5	5	0	0	5	0	0
Total		**13**	**12**	**1**	**1**	**12**	**1**	**1**
True Positive Rate			**0.9230**			**0.9230**		
Positive Prediction Value			**0.9230**			**0.9230**		

Test Videos V1 and V2 generated

- V1 – 8 Events
- V2 – 5 Events

$$TPR = \frac{TP}{TP+FN},$$

$$PPV = \frac{TP}{TP+FP},$$

RESULTS – VIDEO SUMMARY

False Positive – Umpire image containing no action, but falsely classified as a Out.

False Negative – Umpire signalling a No Ball, but the frame is falsely classified as No Action (left) and the subsequent frame correctly classified as a No Ball (right).

RESULTS – VIDEO SUMMARY

Video Demo

CONCLUSIONS AND FUTURE WORK

Current Work

- A Dataset (SNOW) containing images of Umpires for Event Detection
- A System for Automatically Generating Cricket Highlights – Baseline for this Dataset

Future Work

- Improvements in Classifier Design
- Improvements to Summarization Technique
- Fine Tuning a Deep Neural Network model
- Other feature extraction techniques

Kimia Lab is currently exploring Dense Net based features

DATASET AND CODE

SNOW Dataset

https://goo.gl/zkhVCK

Code Implementation

https://goo.gl/UyBjTa

THANK YOU

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