Activity Recognition using Text Mining and Object Recognition

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Problem Statement

- What is Video Activity Recognition?

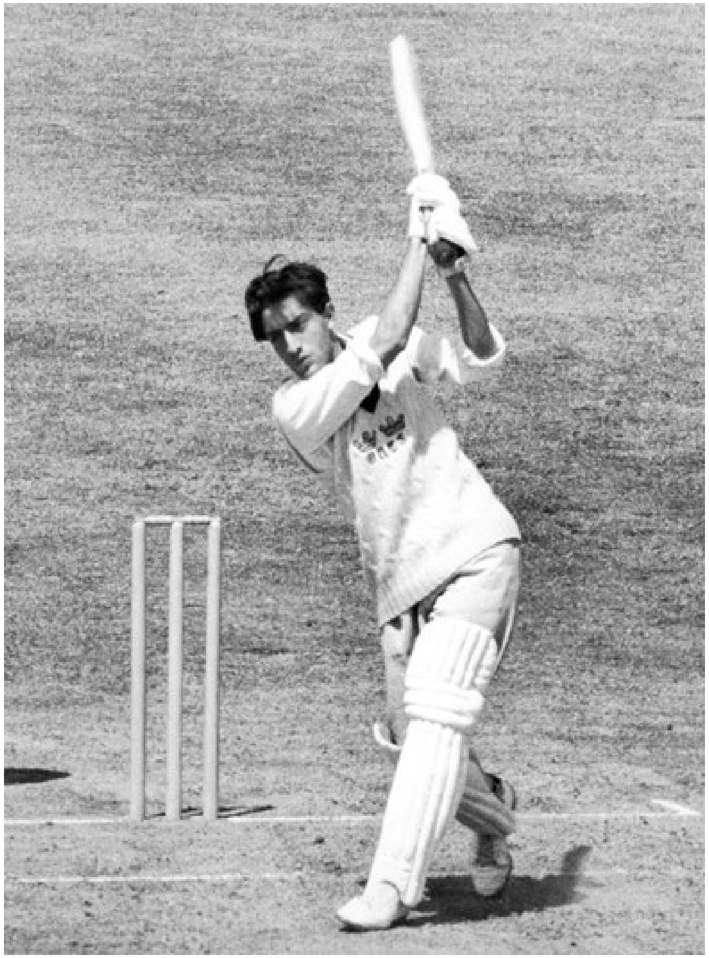
Problem Statement

- What is Video Activity Recognition?

Dance

Problem Statement

- What is Video Activity Recognition?



Play

Approach

Improving Video Activity Recognition using Object Recognition and Text Mining

by Tanvi Motwani and Raymond J. Mooney, ECAI-2012

Approach – Only Text Mining

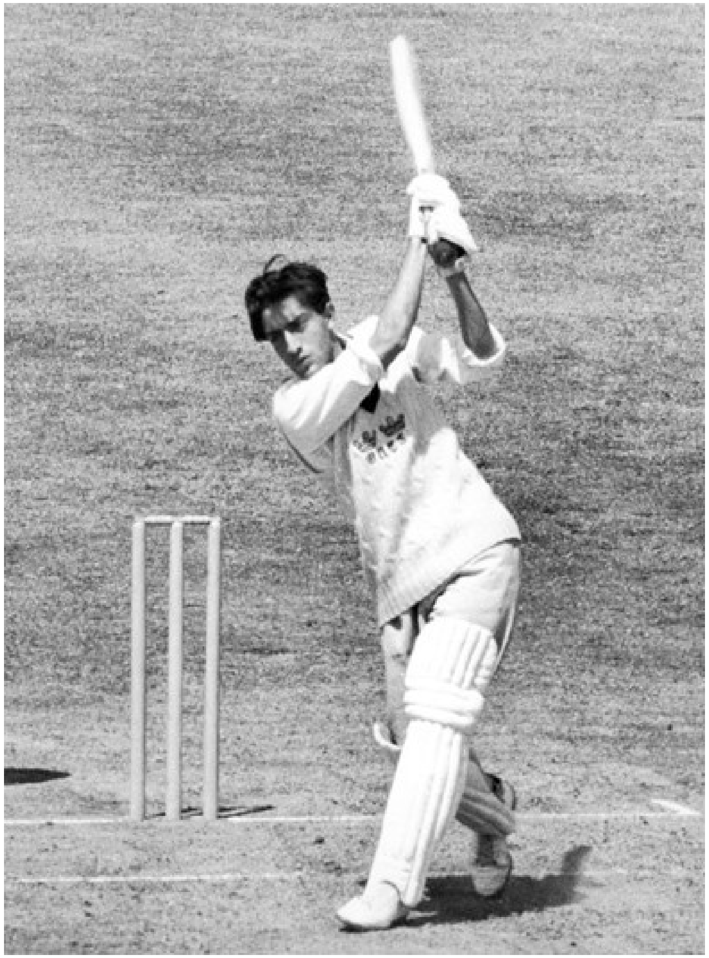
- Extract Labels - Use Natural Language descriptions of video clips.

- Extract STIP features – Represent a clip in HoG and HoF features.

- Train a model

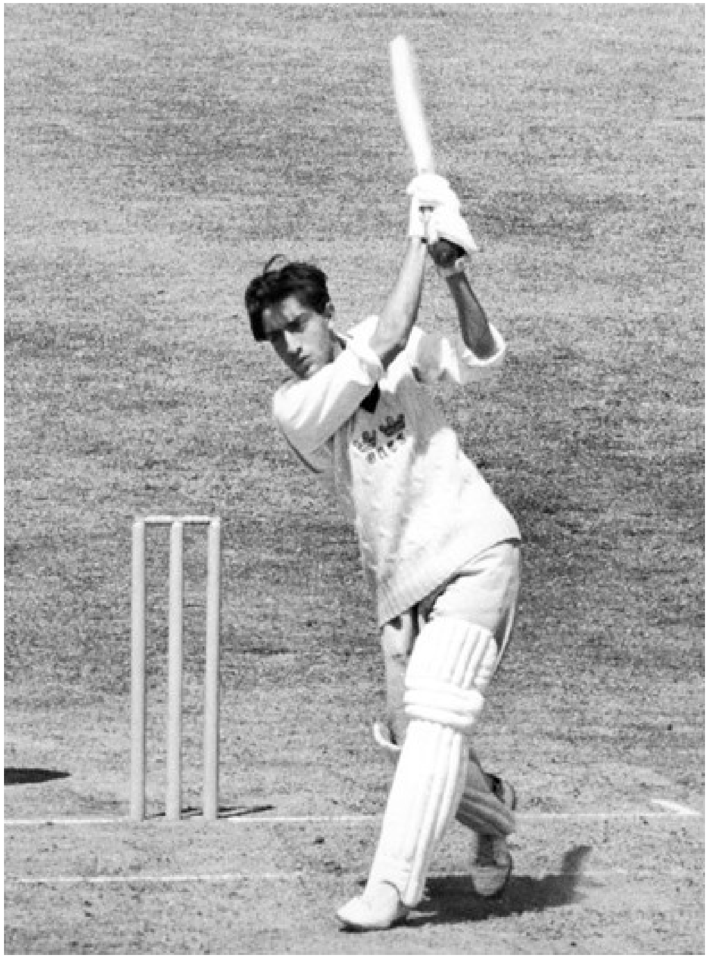
Approach – Only Text Mining

- Natural Language Description of a video



Approach – Only Text Mining

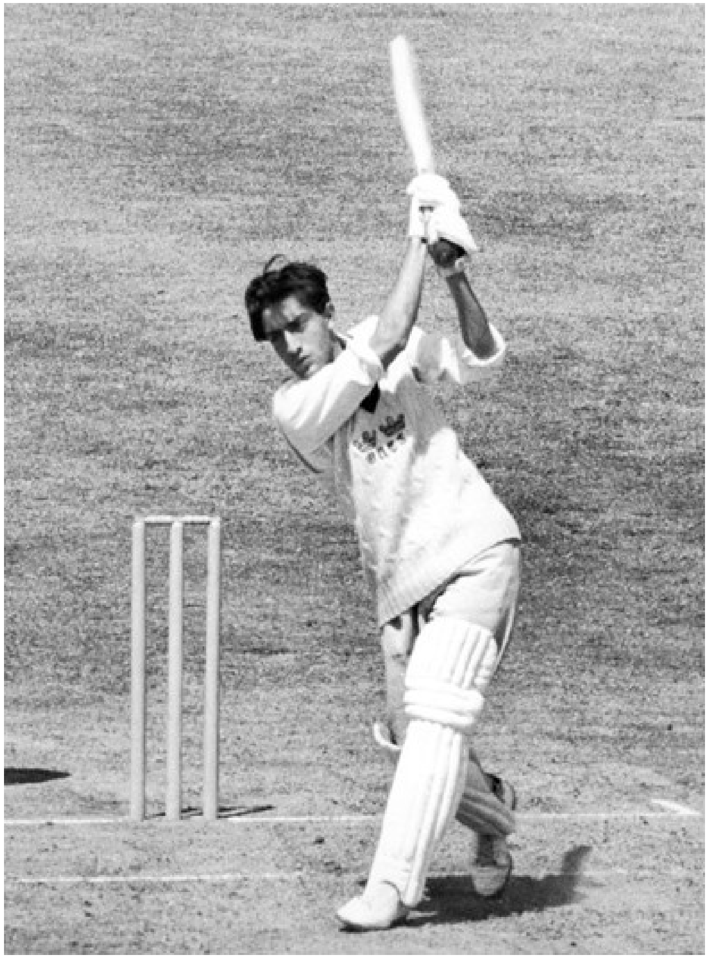
- Natural Language Description of a video



- Batsman is playing cricket

Approach – Only Text Mining

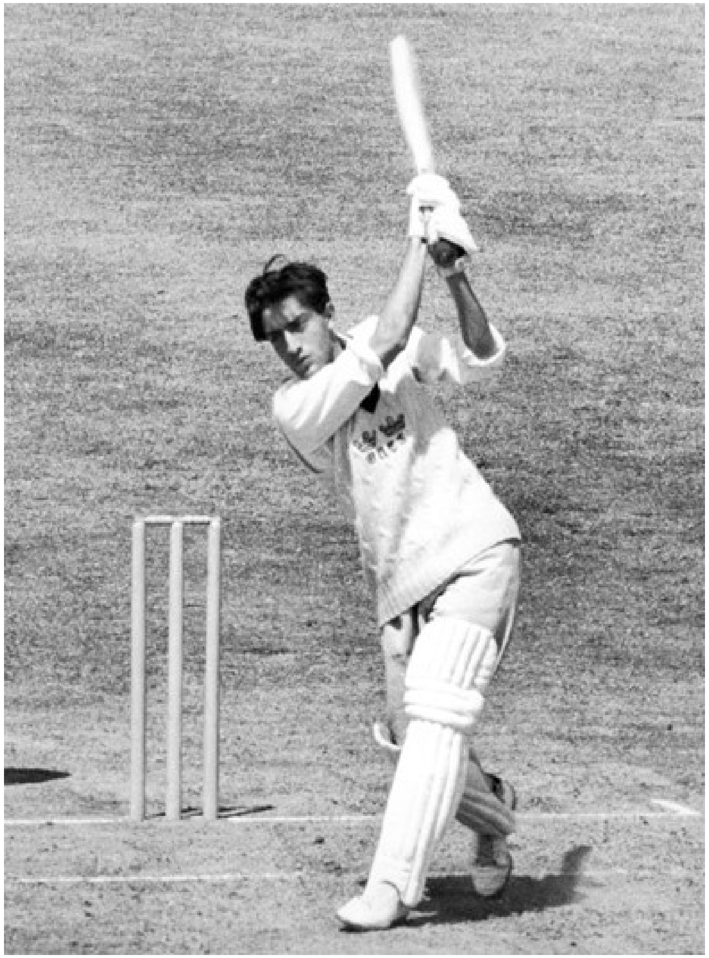
- Natural Language Description of a video



- Batsman is playing cricket
- Mansoor Ali Khan Pataudi is playing cricket.

Approach – Only Text Mining

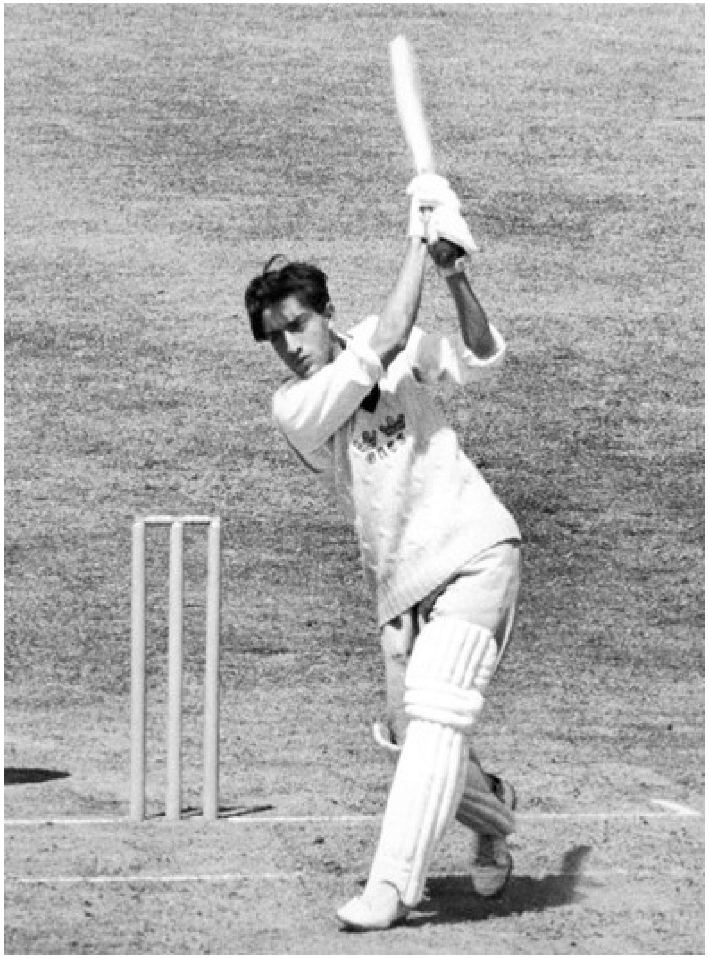
- Natural Language Description of a video



- Batsman is playing cricket
- Mansoor Ali Khan Pataudi is playing cricket.
- Players are playing cricket.

Approach – Only Text Mining

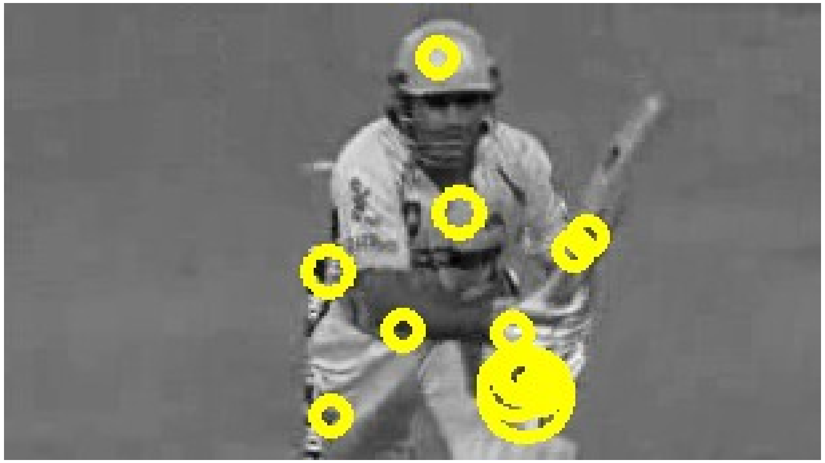
- Extracting Verbs from Description



- Batsman is playing cricket : PLAY
- Mansoor Ali Khan Pataudi is playing cricket. : PLAY
- Players are playing cricket. : PLAY

Approach – Only Text Mining

- Extracting STIP features



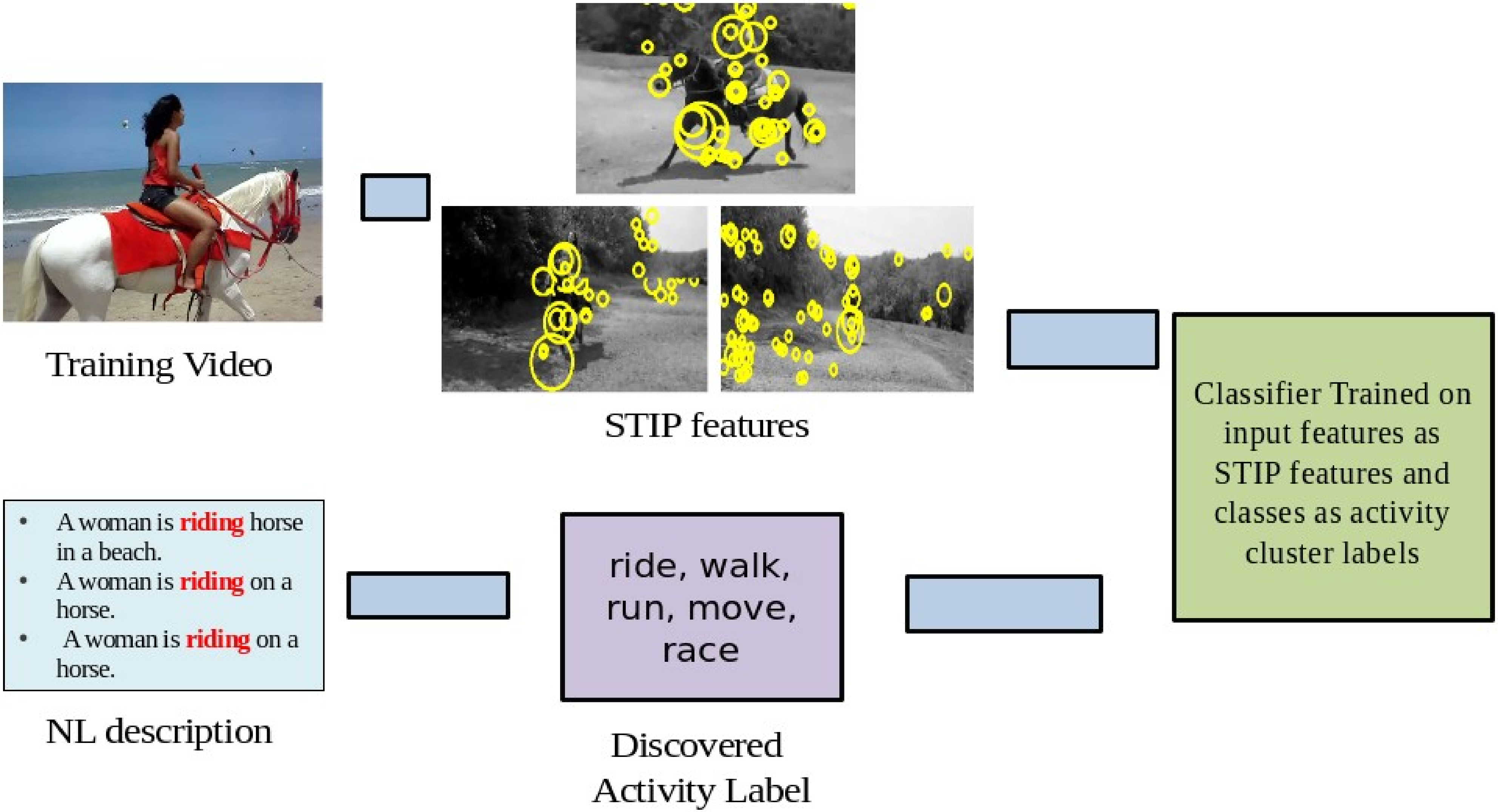
STIP HoG and HoF feature vector :

```
0.627496   0.0892087      0.0293946   0.253901   0.668772
0.160494   0.000758835  0.169975     0.414533   0.508073 …
……
……
```

Approach – Only Text Mining

- Take random samples of STIP feature descriptors
- Clustering K-Means
- Describe a video clip in terms of these clusters

Activity Recognizer using Video Features



Training Video

STIP features

Classifier Trained on input features as STIP features and classes as activity cluster labels

- A woman is **riding** horse in a beach.
- A woman is **riding** on a horse.
- A woman is **riding** on a horse.

NL description

ride, walk, run, move, race

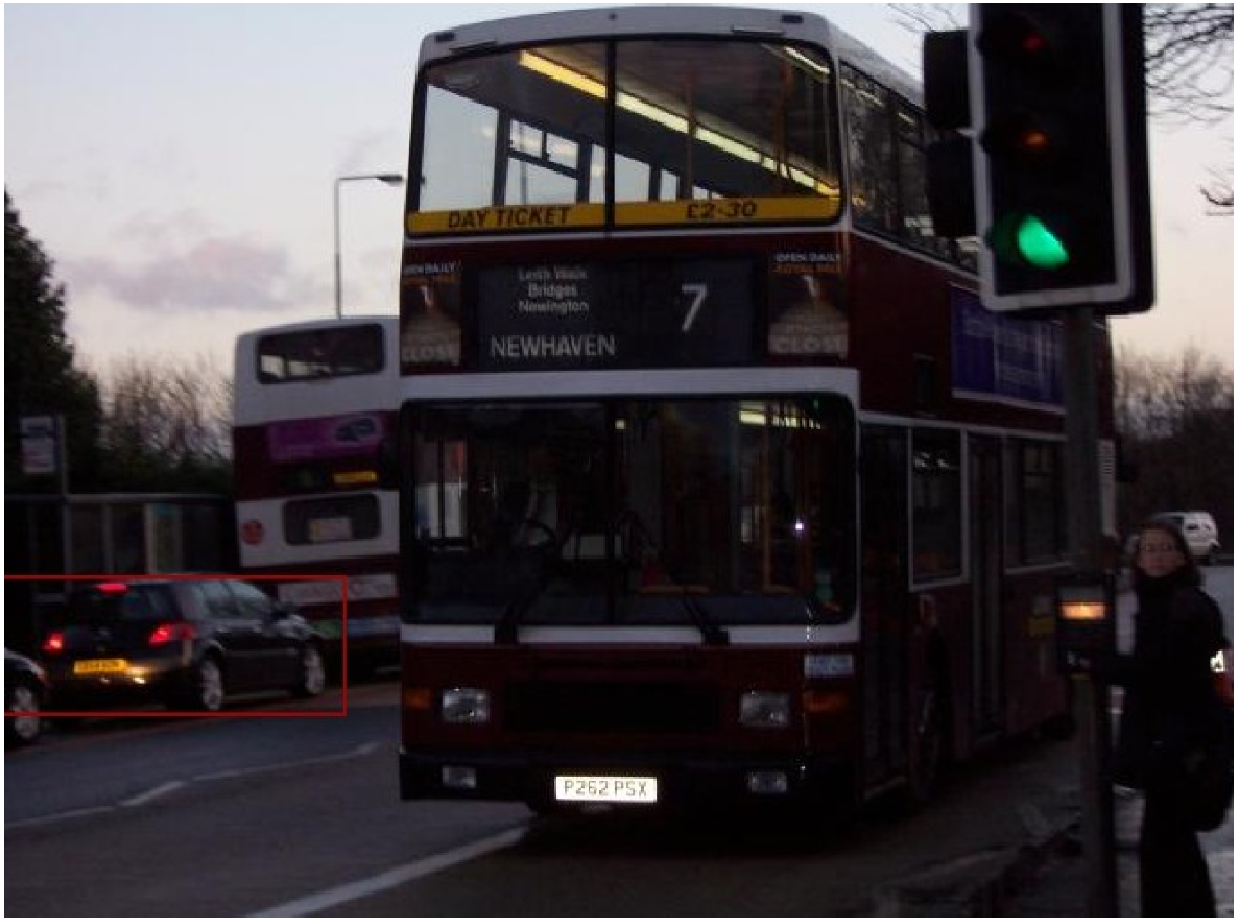
Discovered Activity Label

Object Detection

- Using Discriminatively Trained Deformable Part Models
  - Pre-trained object detector for 19 objects

Object Detection

Object Detection



Relation between Activity and Objects

- English Gigaword Corpus – 15 GB of raw text
- **Occurrence counts:**
  - of an activity A_i: occurrence of the verbs
  - of an object O_j: occurrence of object noun O_j or its synonym.
- **Co-occurrence of an Activity and an Object:**
  - ***POS Tagging***
    - Using Stanford tagger.
    - Occurrence of the object (tagged as noun) within a window of *w* or fewer words of an occurrence of the activity (tagged as verb).

Relation between Activity and Objects

Probability of each activity given each object

$$P(A_i|O_j) = (Count(A_i, O_j) + 1)/(Count(O_j) + |A|)$$

Integrated Activity Recogniser

- $P(A_i \mid F_v)$ – Calculated in 1st part.

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- $P(A_i \mid F_v)$ – Calculated in 1st part.
- $P(A_i \mid F_0)$ -

$$P(A_i|F_o) = \sum_{j=1}^{|O|} \underbrace{P(A_i|O_j)}_{\text{Gigaword Corpus}} * \underbrace{P(O_j|F_o)}_{\text{Object Detector}}$$

Integrated Activity Recogniser

- $P(A_i \mid F_V)$ – Calculated in 1st part.
- $P(A_i \mid F_0)$ -

$$P(A_i|F_o) = \sum_{j=1}^{|O|} P(A_i|O_j) * P(O_j|F_o)$$

- Consider only $P (A_i \mid F_V)$ when no object is detected and $P (A_i \mid F_0 , F_V)$ when objects are recognized

Work Done

- Verbs Extraction from Natural language description of clips done.

Clip Name	Natural Language Description
_0nX-El-ySo_83_93	A man is cutting a piece of paper.
_0nX-El-ySo_83_93	A man is cutting a paper by scissor.
_0nX-El-ySo_83_93	A man is cutting paper.
_0nX-El-ySo_83_93	A man is cutting a piece of paper.

Work Done

- Verbs Extraction from Natural language description of clips done.

Clip Name	Most frequent verb identified
_0nX-El-ySo_83_93	cut
_1vy2HIN60A_32_40	jump
_6OTzzK7t9Y_158_170	play
_6OTzzK7t9Y_73_78	crash

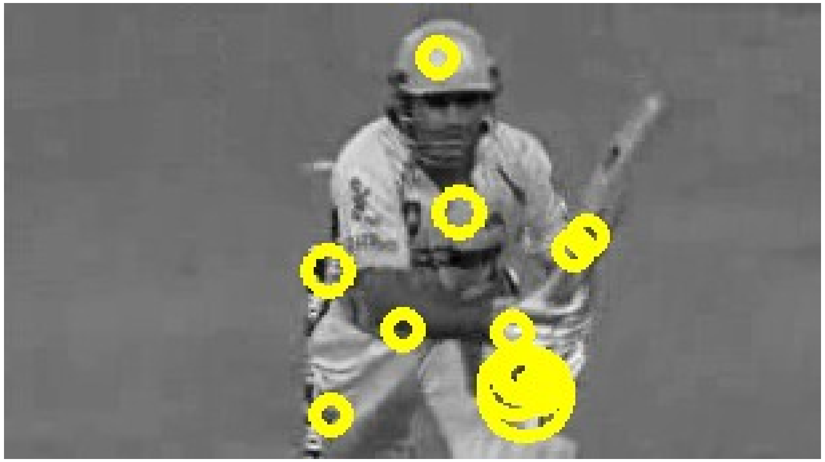
Work Done

- **Classes** Extraction from Natural language description of clips done.

Clip Name	Most frequent verb identified
_0nX-El-ySo_83_93	cut, slice
_O9kWD8nuRU_70_76	peel, remove
_JVxurtGIhI_32_42	sing, talk, bark
_WRC7HXBJpU_414_425	pour, stir, put

Work Done

- Classes Extraction from Natural language description of clips done.
- STIP features extraction done.



Work Done

- Classes Extraction from Natural language description of clips done.
- STIP features extraction done.
- Clustering done.

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Work To be Done

- Representation of each clip
- Learning a model

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Work To be Done

- Representation of each clip
- Learning a model
- Object Detection
- Learning Gigaword Corpus

Novel Idea

- Approach by Motwani et al. is only in forward direction.
- We plan to introduce notion of feedback
  - To improve accuracy of weak object detector and activity recogniser

References

- *Improving Video Activity Recognition using Object Recognition and Text Mining* by Tanvi Motwani and Raymond J. Mooney, ECAI-2012

- WordNet – 3.0 from Princeton University

- MIT Java Wordnet Interface from MIT

- WordNet Similarity from Sussex university