Deep Learning for Computer Vision

Video Understanding using CNNs and RNNs

Vineeth N Balasubramanian

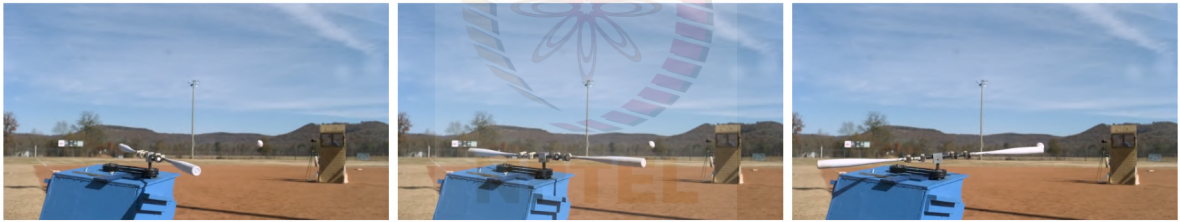
Department of Computer Science and Engineering
Indian Institute of Technology, Hyderabad

Review: Questions

How does GRU address vanishing gradients?

Same reason as the LSTM. There is a gradient highway, affected only by the update gate (which controls gradients by design and necessity)

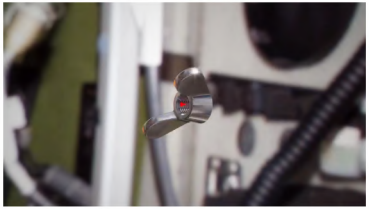
Why do we need to understand a video?



Credit: Smarter Everyday (Youtube)

Why do we need to understand a video?





Credit: Veritasium (Youtube)

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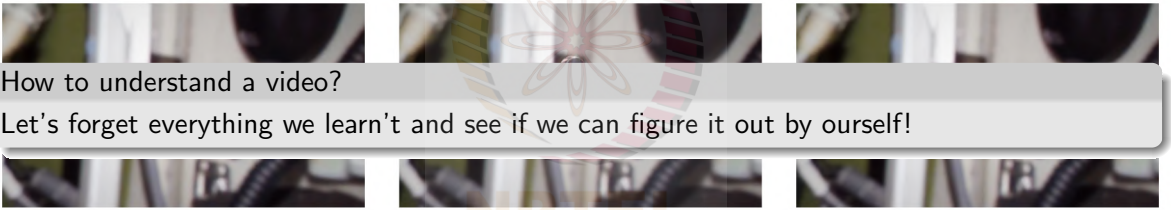

How to understand a video?

Let's forget everything we learn't and see if we can figure it out by ourself!

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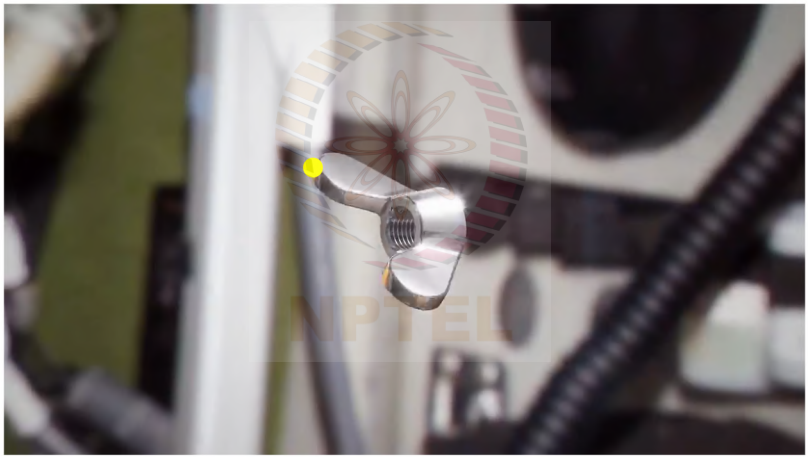

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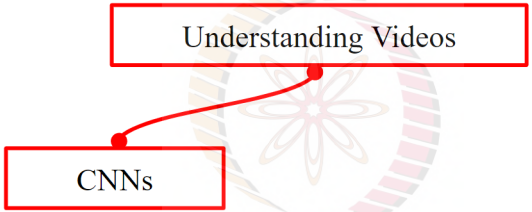

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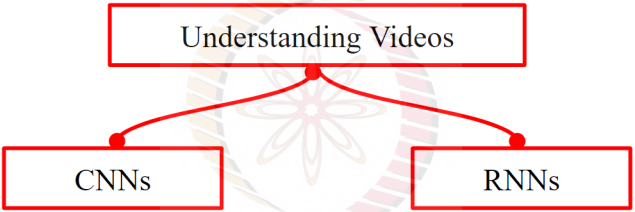

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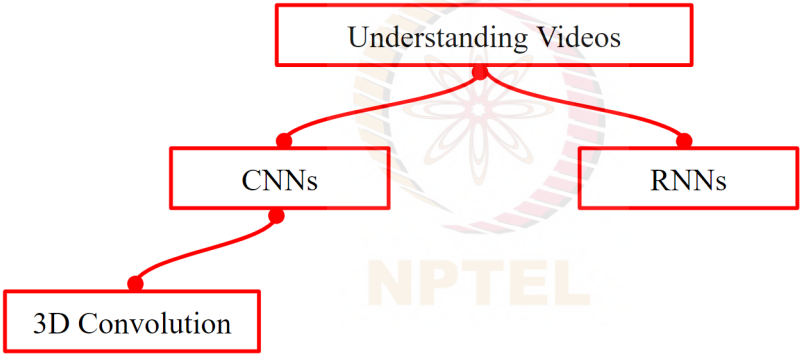

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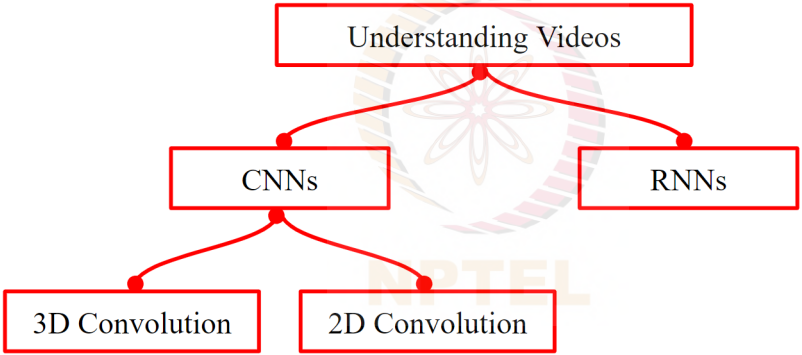

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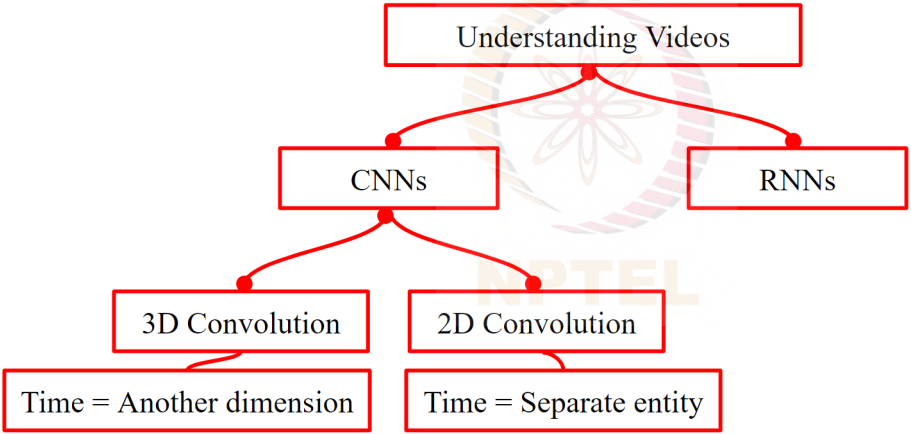

How to understand a video? 3D CNN

Frame 1

How to understand a video? 3D CNN

Frame 1

Frame 2

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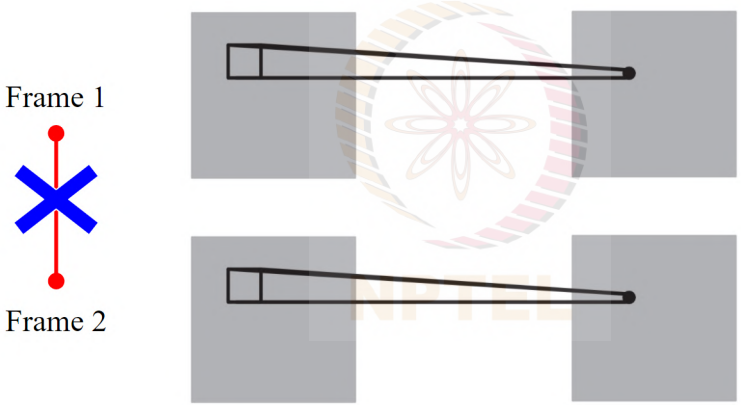

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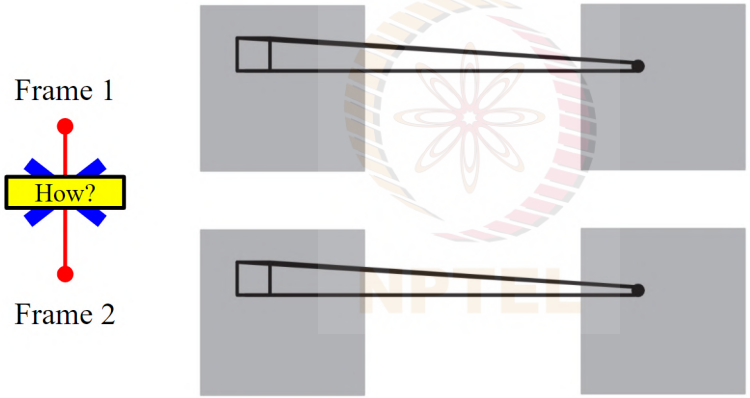

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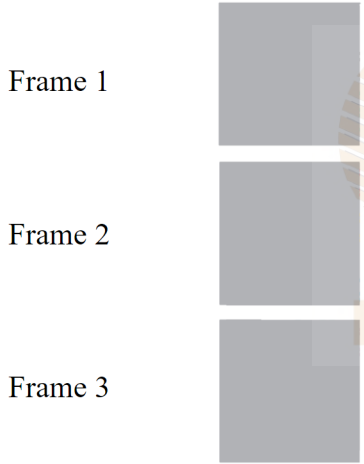

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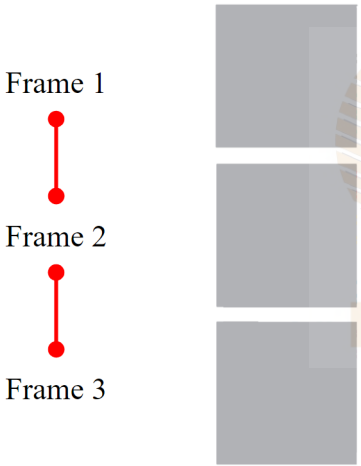

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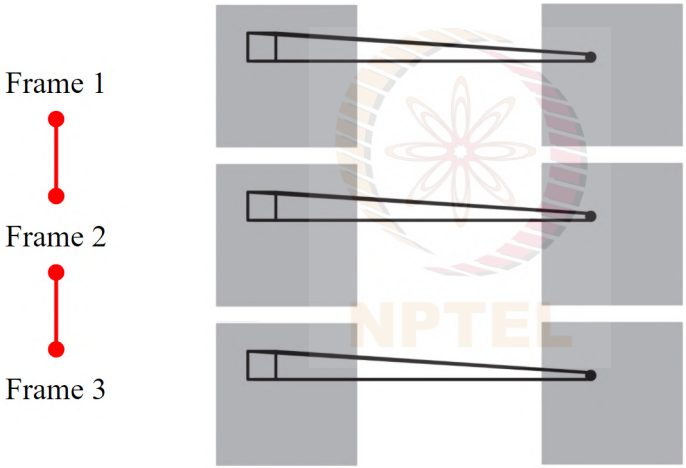

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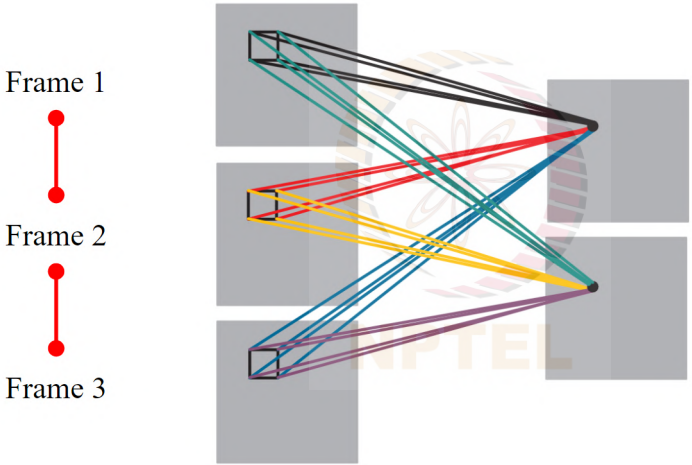

[1] Ji et al, 3D Convolutional Neural Networks for Human Action Recognition, IEEE Transactions on PAMI, 2012

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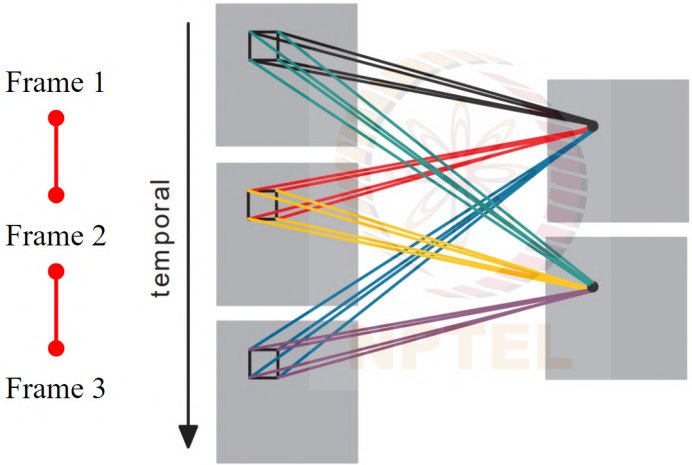

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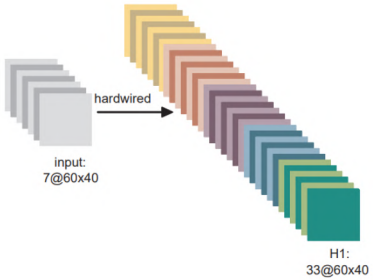

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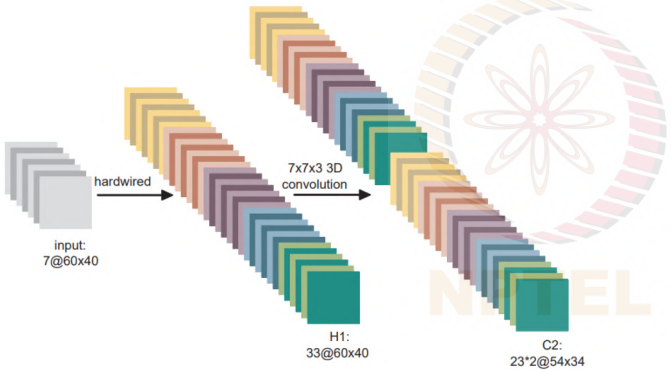

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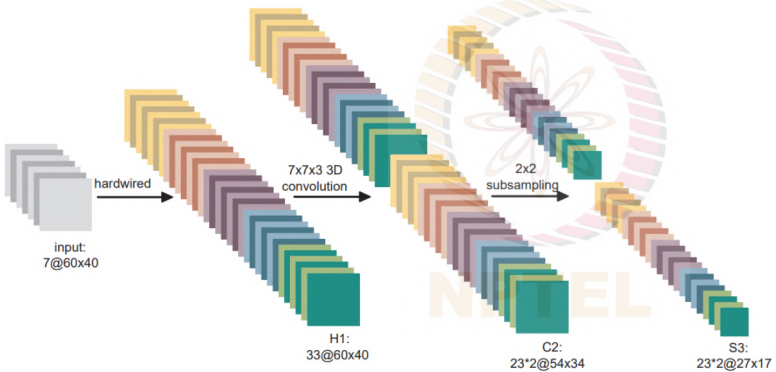

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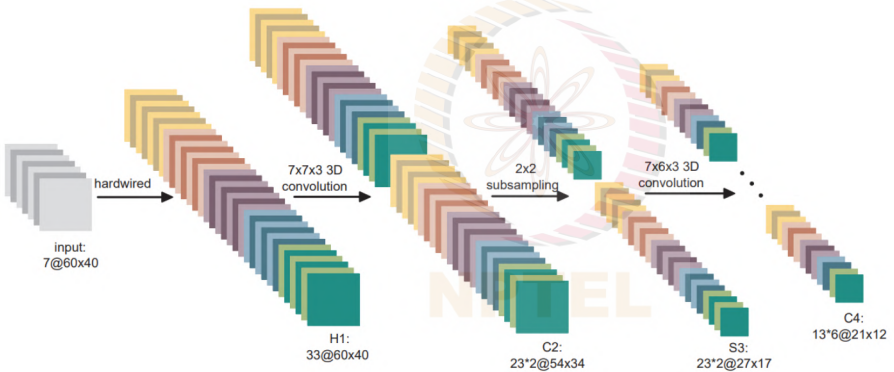

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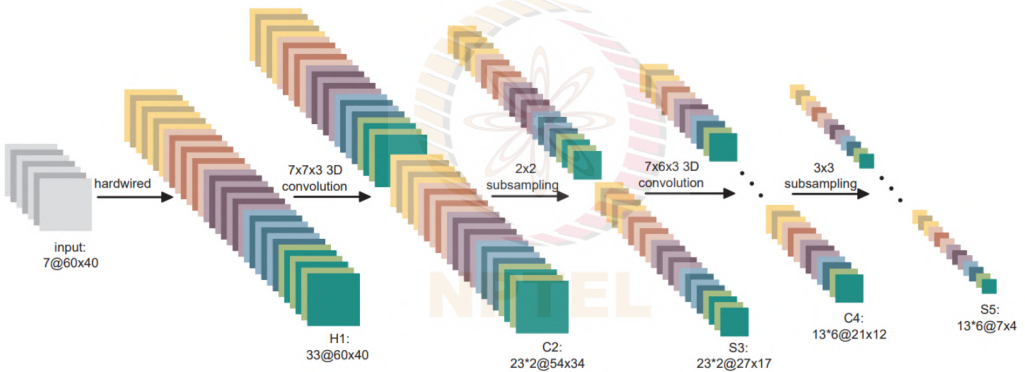

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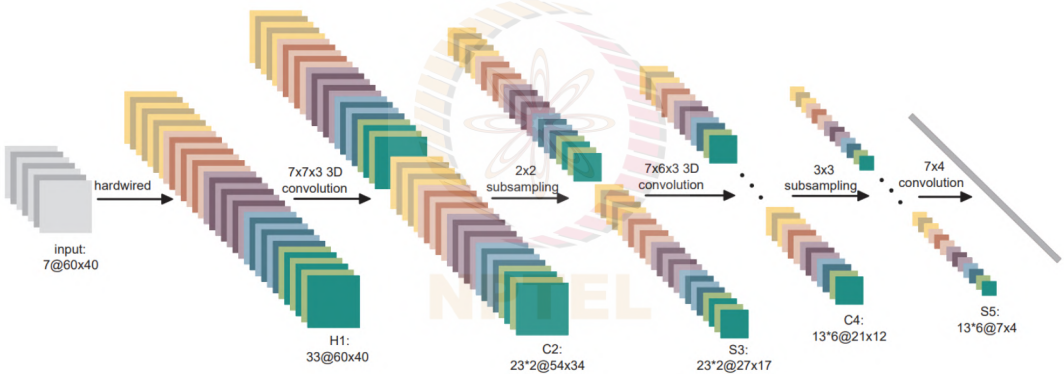

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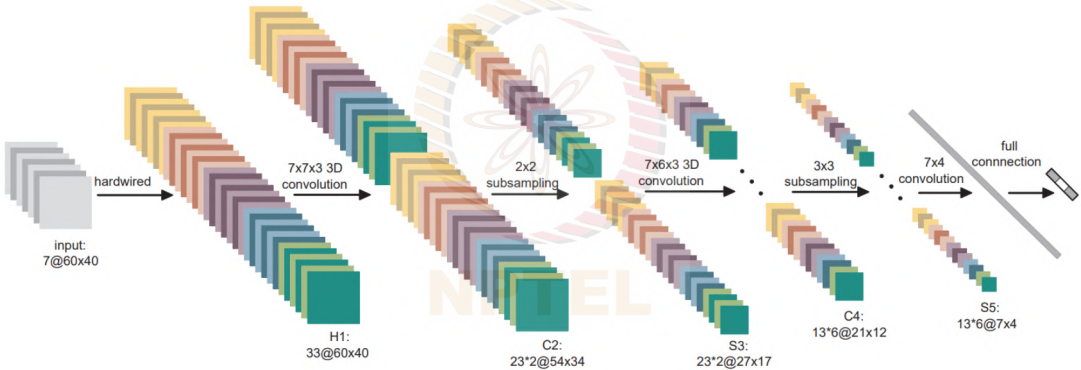

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How to understand a video? 3D CNN[1]

CellToEar - Someone puts a cell phone to his/her head or ear.

ObjectPut - Someone drops or puts down an object.

Pointing - Someone points

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How to understand a video? 2D CNN[2]

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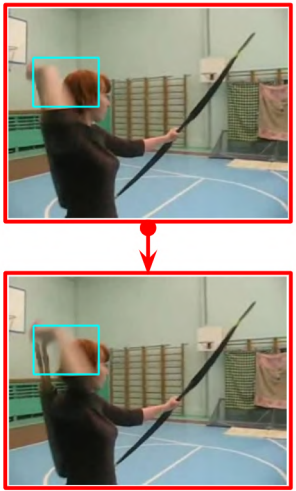

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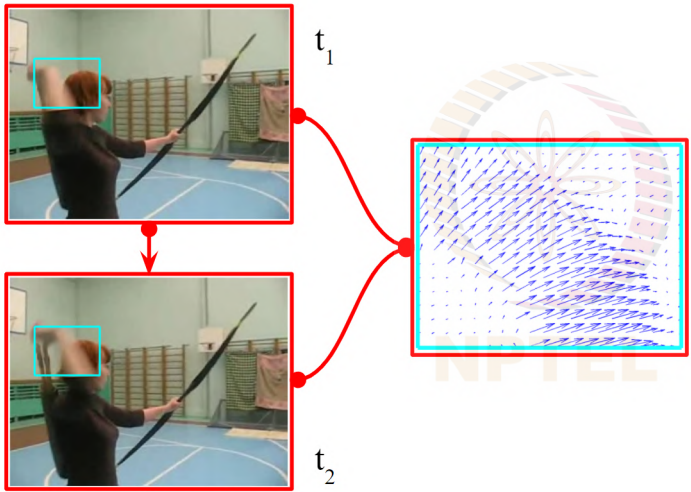

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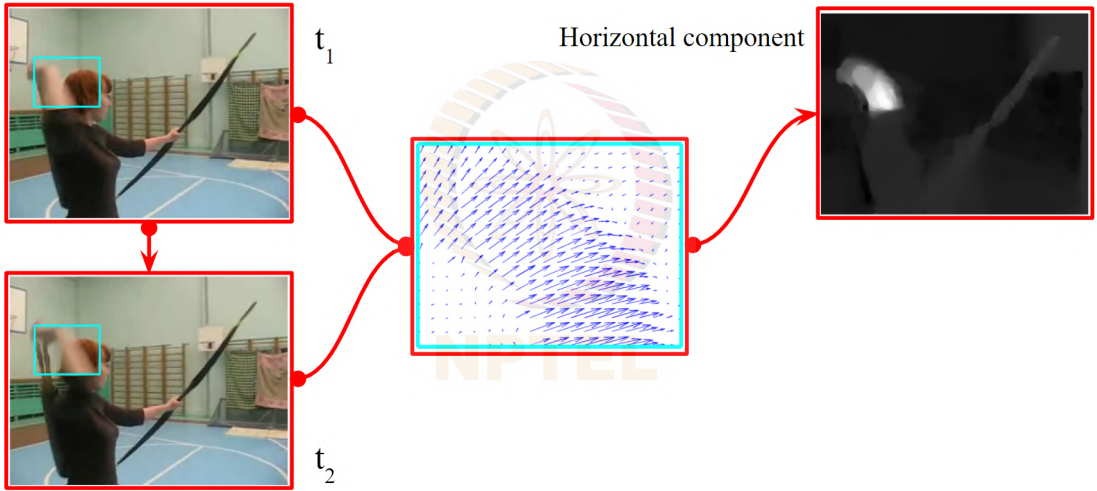

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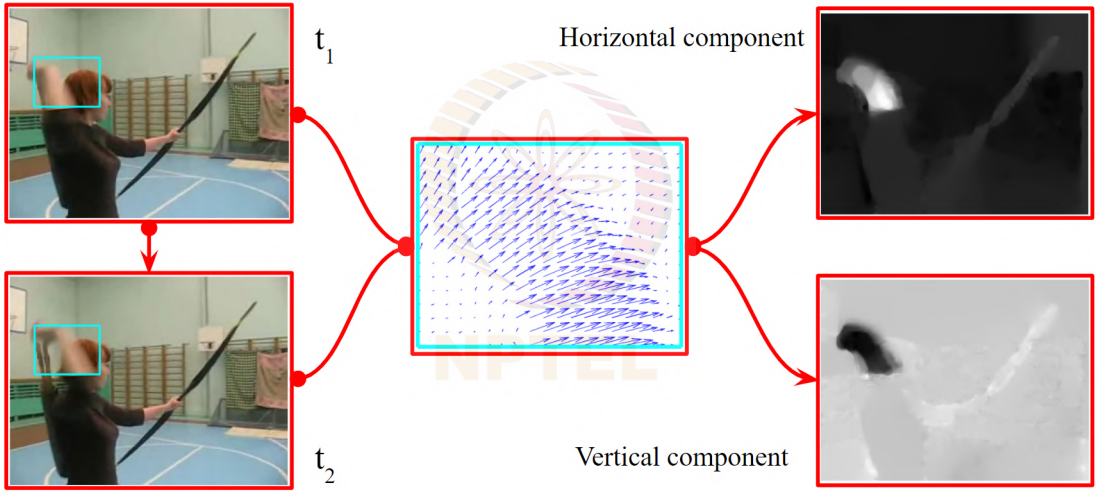

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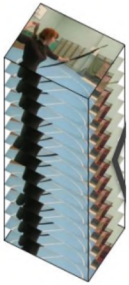

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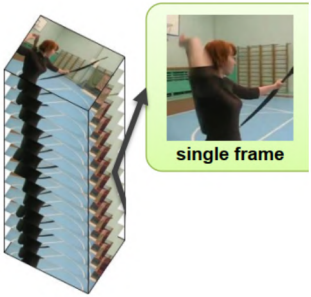

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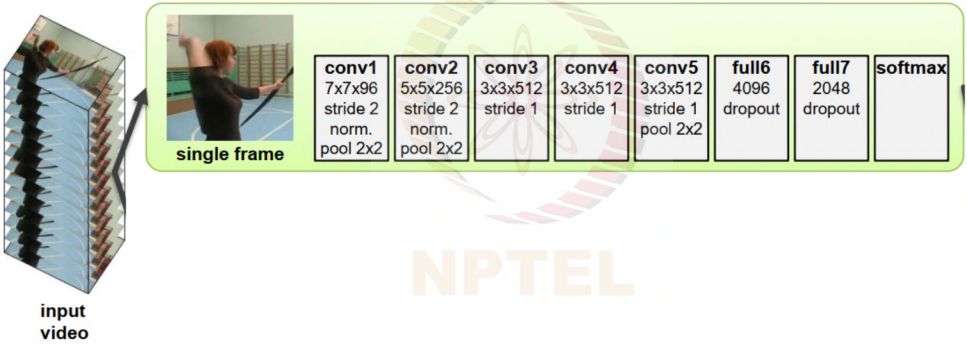

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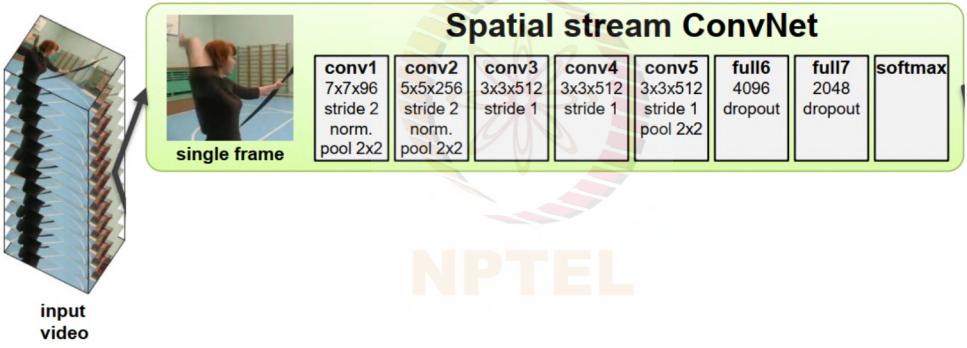

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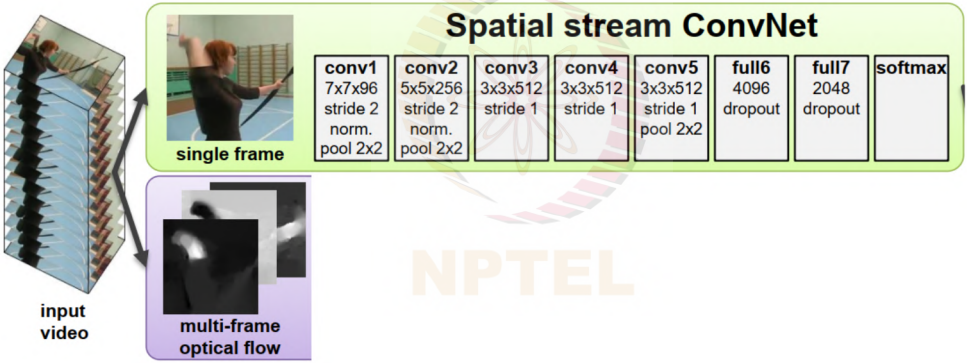

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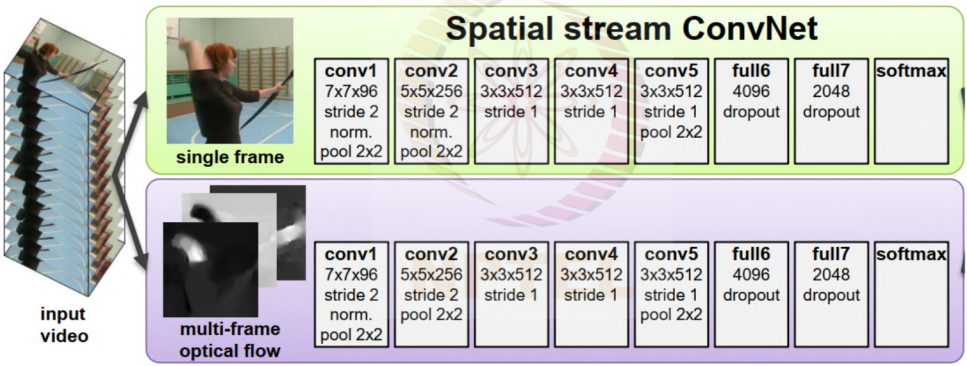

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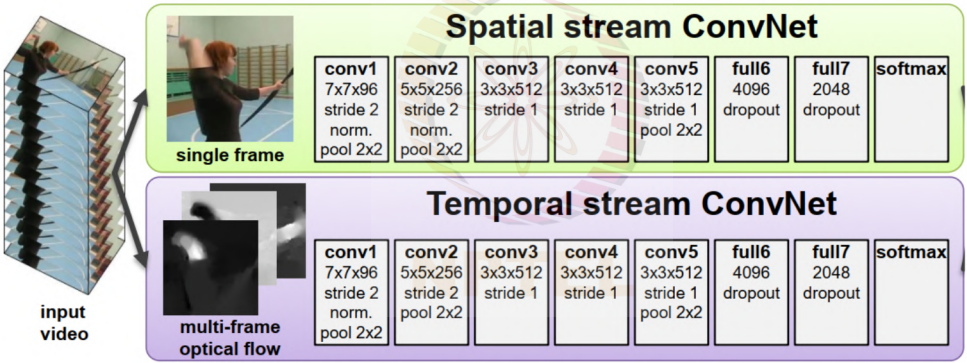

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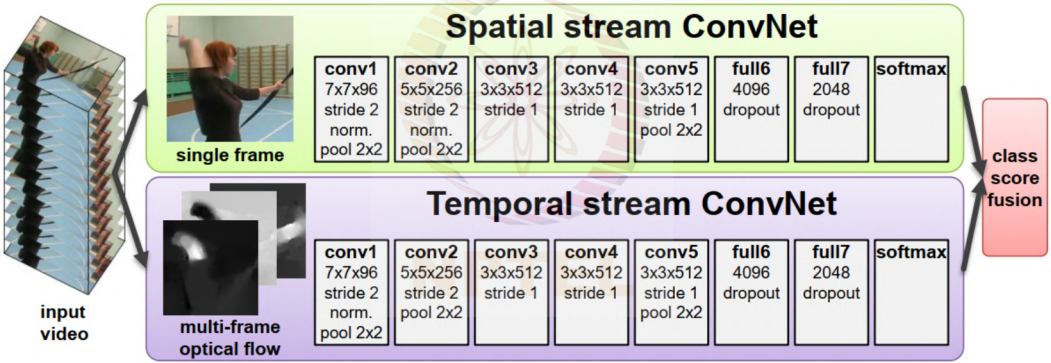

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How to understand a video? Using RNNs with CNNs[3]

[3]Donahue et al, Long-term Recurrent Convolutional Networks for Visual Recognition and Description, CVPR 2015

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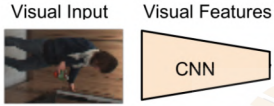

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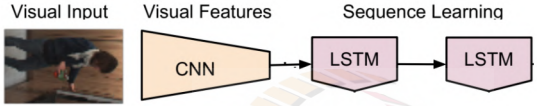

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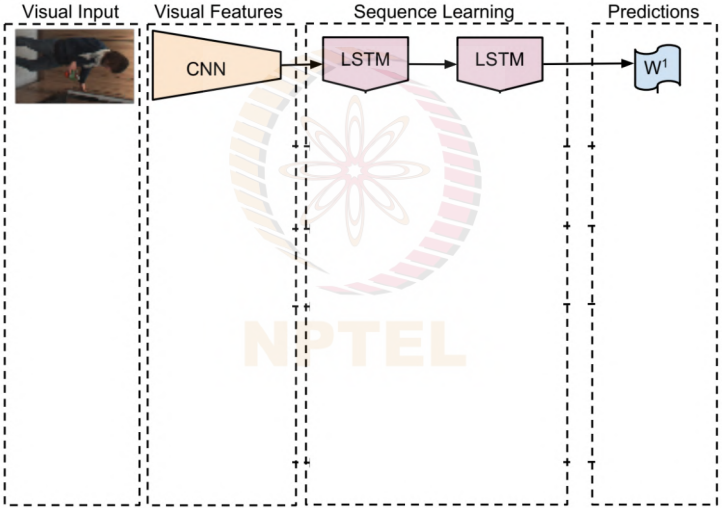

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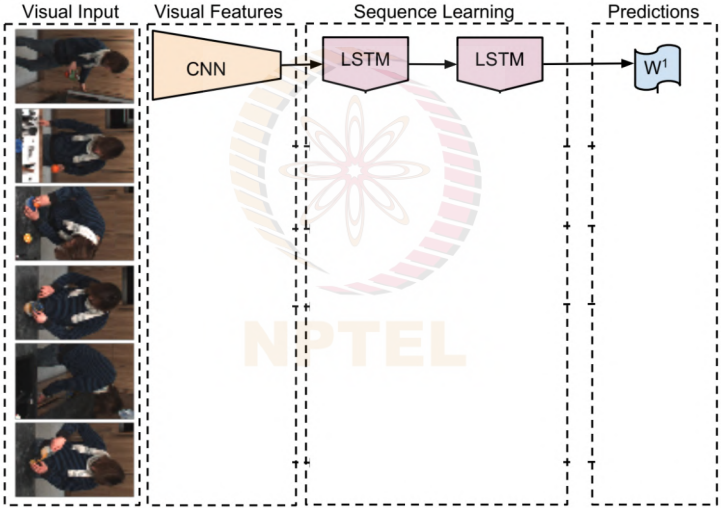

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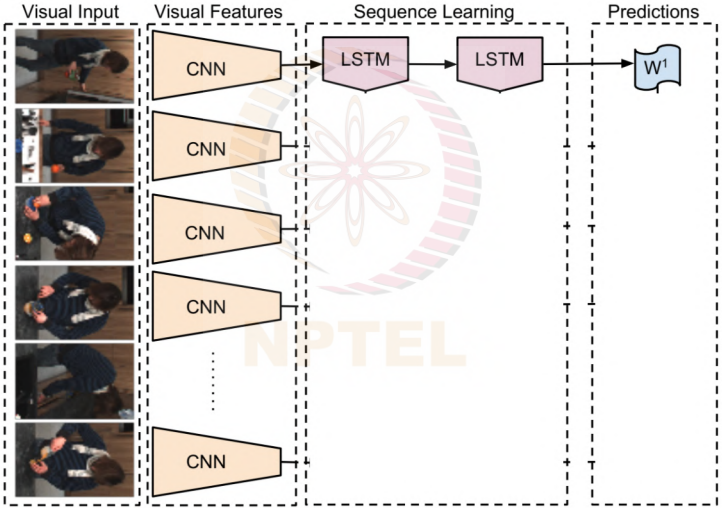

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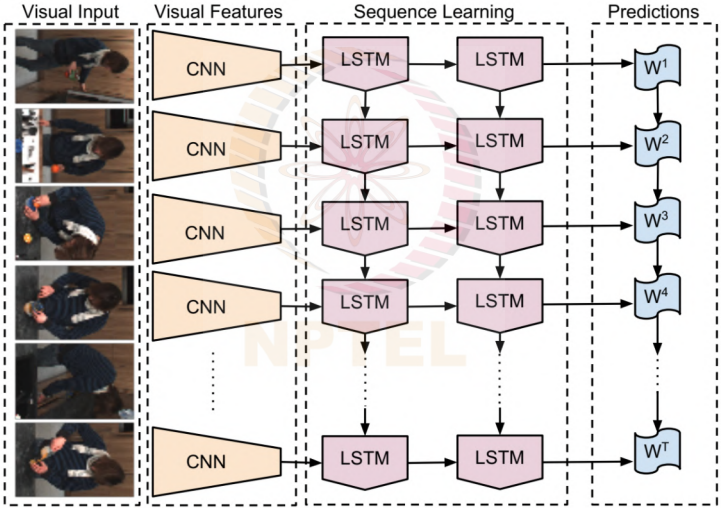

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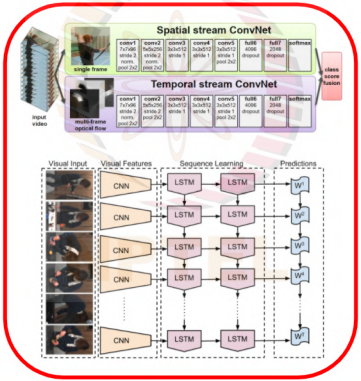

Soomro et al, UCF101: A Dataset of 101 Human Actions Classes from Videos in the Wild, 2012

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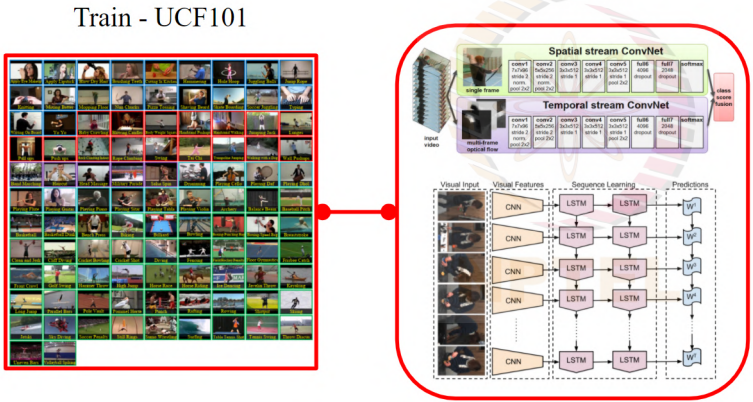

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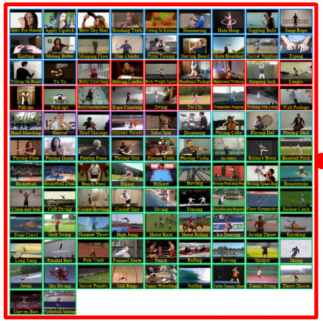
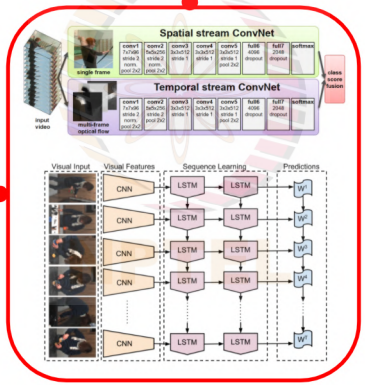
What can be done?

Train - UCF101





Action Recognition

Baseball Pitch, Basketball Shooting, Bench Press, Biking, Billiards Shot, Breaststroke, Clean and Jerk, Diving, Drumming, Fencing, Golf Swing, High Jump, Horse Race, Horse Riding, Hula Hoop, Javelin Throw, Juggling Balls, Jumping Jack, Jump Rope, Kayaking, Lunges, Military Parade, Mixing Batter, Nun chucks, Pizza Tossing, Playing Guitar, Playing Piano, Playing Tabla, Playing Violin, Pole Vault, Pommel Horse, Pull Ups, Punch, Push Ups, Rock Climbing Indoor, Rope Climbing, Rowing, Salsa Spins, Skate Boarding, Skiing, Skijet, Soccer Juggling, Swing, TaiChi, Tennis Swing, Throw Discus, Trampoline Jumping, Volleyball Spiking, Walking with a dog, Yo Yo

Apply Eye Makeup, Apply Lipstick, Archery, Baby Crawling, Balance Beam, Band Marching, Basketball Dunk, Blow Drying Hair, Blowing Candles, Body Weight Squats, Bowling,Boxing-Punching Bag, Boxing-Speed Bag, Brushing Teeth, Cliff Diving, Cricket Bowling, Cricket Shot, Cutting In Kitchen, Field Hockey Penalty, Floor Gymnastics, Frisbee Catch, Front Crawl, Hair cut, Hammering, Hammer Throw, Handstand Pushups, Handstand Walking, Head Massage, Ice Dancing, Knitting, Long Jump, Mopping Floor, Parallel Bars, Playing Cello, Playing Daf, Playing Dhol, Playing Flute, Playing Sitar, Rafting, Shaving Beard, Shot put, Sky Diving, Soccer Penalty, Still Rings, Sumo Wrestling, Surfing, Table Tennis Shot, Typing, Uneven Bars, Wall Pushups, Writing On Board

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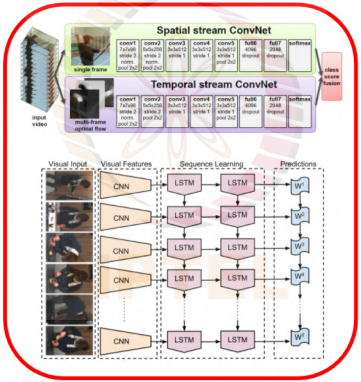
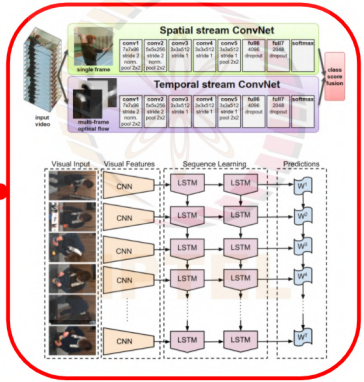
What all can be done?



Sigurdsson et al, Hollywood in Homes: Crowdsourcing Data Collection for Activity Understanding, ECCV 2016

What all can be done?

Train - Hollywood in Homes



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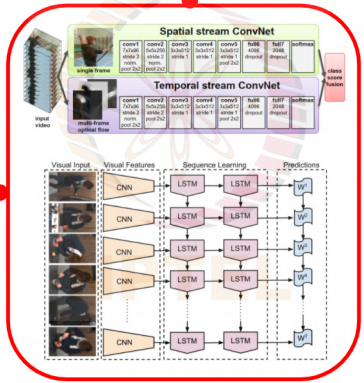
Train - Hollywood in Homes



Action Recognition

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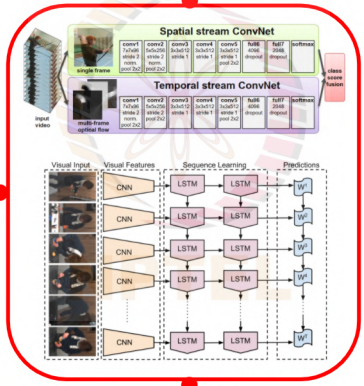
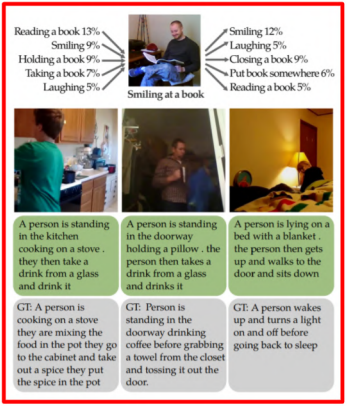
What all can be done?

Train - Hollywood in Homes



Action Recognition



Sentence Prediction

Sigurdsson et al, Hollywood in Homes: Crowdsourcing Data Collection for Activity Understanding, ECCV 2016

Other Tasks in Video Understanding

- Action Forecasting
- Object Tracking
- Dynamic scene understanding
- Temporal Action Segmentation
- ...

Homework

Readings

- Tutorial on Large-scale Holistic Video Understanding
- https://paperswithcode.com/area/computer-vision/video

Question

- What do you think will happen if you train a model on normal videos and do inference on a reversed video?