Long-Distance Gesture Recognition using Dynamic Neural Networks

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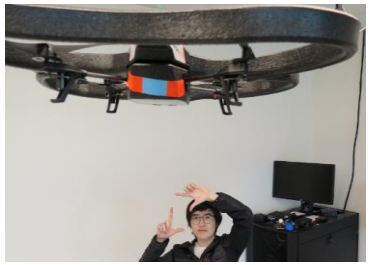
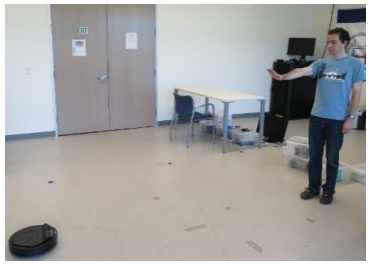
Motivation
Gesture Recognition for Human-Machine Interaction

- Gestures form a natural interface for communication between humans and machines
- Provide a convenient and contact-less way to communicate with robots



Mobile Robots and Drones

Home Automation



AR/VR

Conference Rooms

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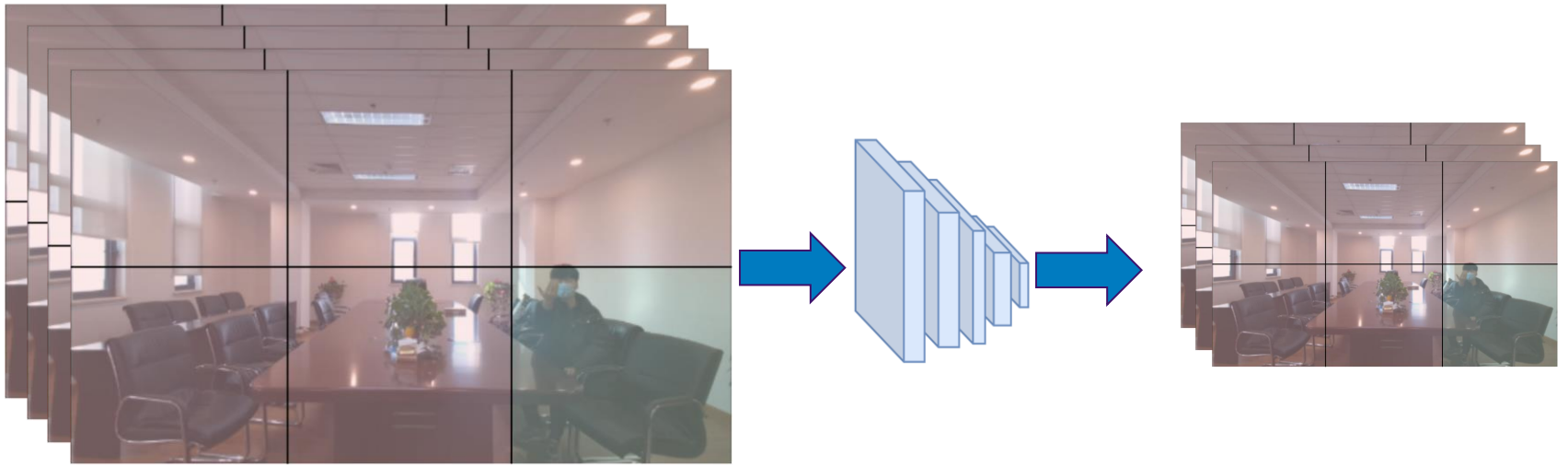
Challenges
Long Distance Gesture Recognition



Gesturing subject is small

3D CNNs down sample input

Features might lose too much gesture information

Higher resolution video requires more compute, bandwidth!

Method
Spatially Dynamic Neural Network

Use Spatially Dynamic Neural networks

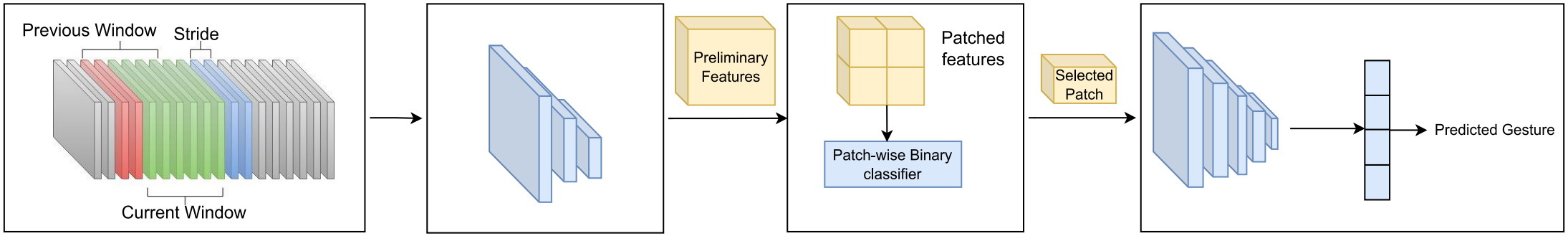
- Can adapt computational graph to input at run-time

Selectively Discard background features

Selectively Preserve gesturing subject features

Our Pipeline

3 blocks made of 3D CNN subnetworks



$\mathcal{I}$ Video Input

f_θ Preliminary Feature Extractor

g_ψ Patch Selection Subnetwork

h_ϕ Patch Gesture Classifier

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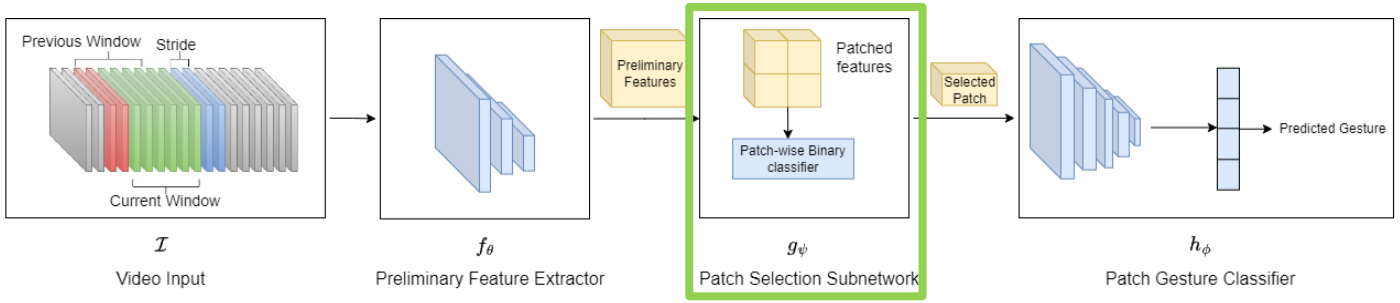
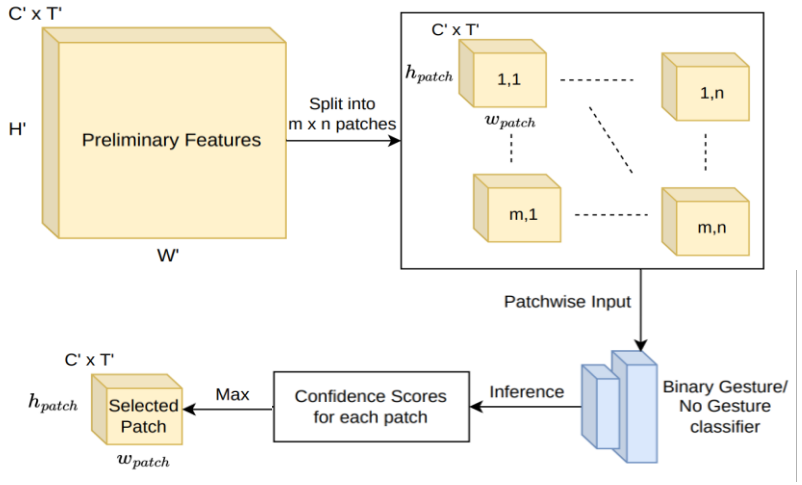
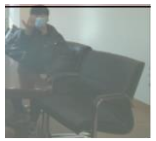
Patch Selection Subnetwork





Selected Patch



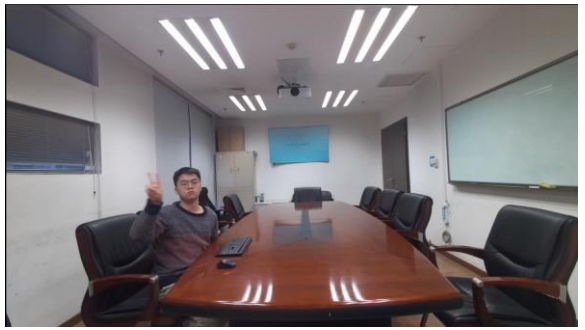
Discarded Patches

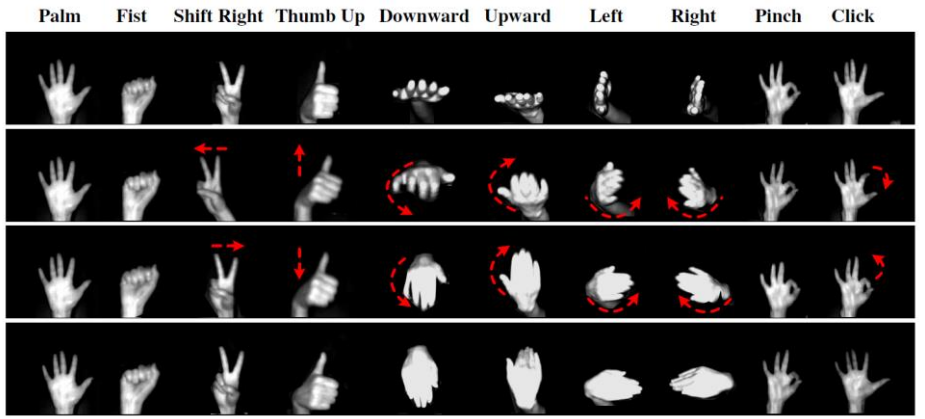
Benchmark

Long Distance Gesture Recognition

Measure Top-1 Accuracy on LDConGR [1] long range gesture recognition dataset

- subjects seated 1-4 meters away
- 10 gestures (static and dynamic)



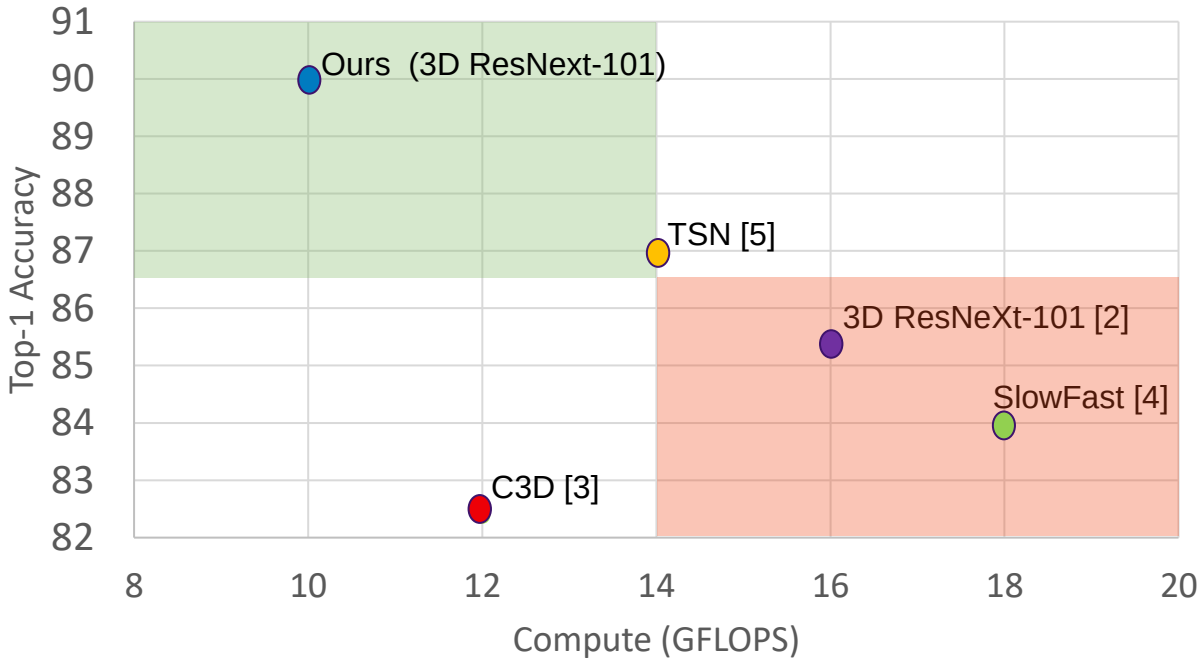


Results

Long Distance Gesture Recognition

Lower compute required compared to state-of-the-art

Better performance compared to state-of-the-art



Significant improvements in resource constrained settings

Method	Compute (GFLOPS)	Top-1 Accuracy
Ours (3D MobileNet)	1.5	**76.68**
3D MobileNet [6]	1.5	65.33

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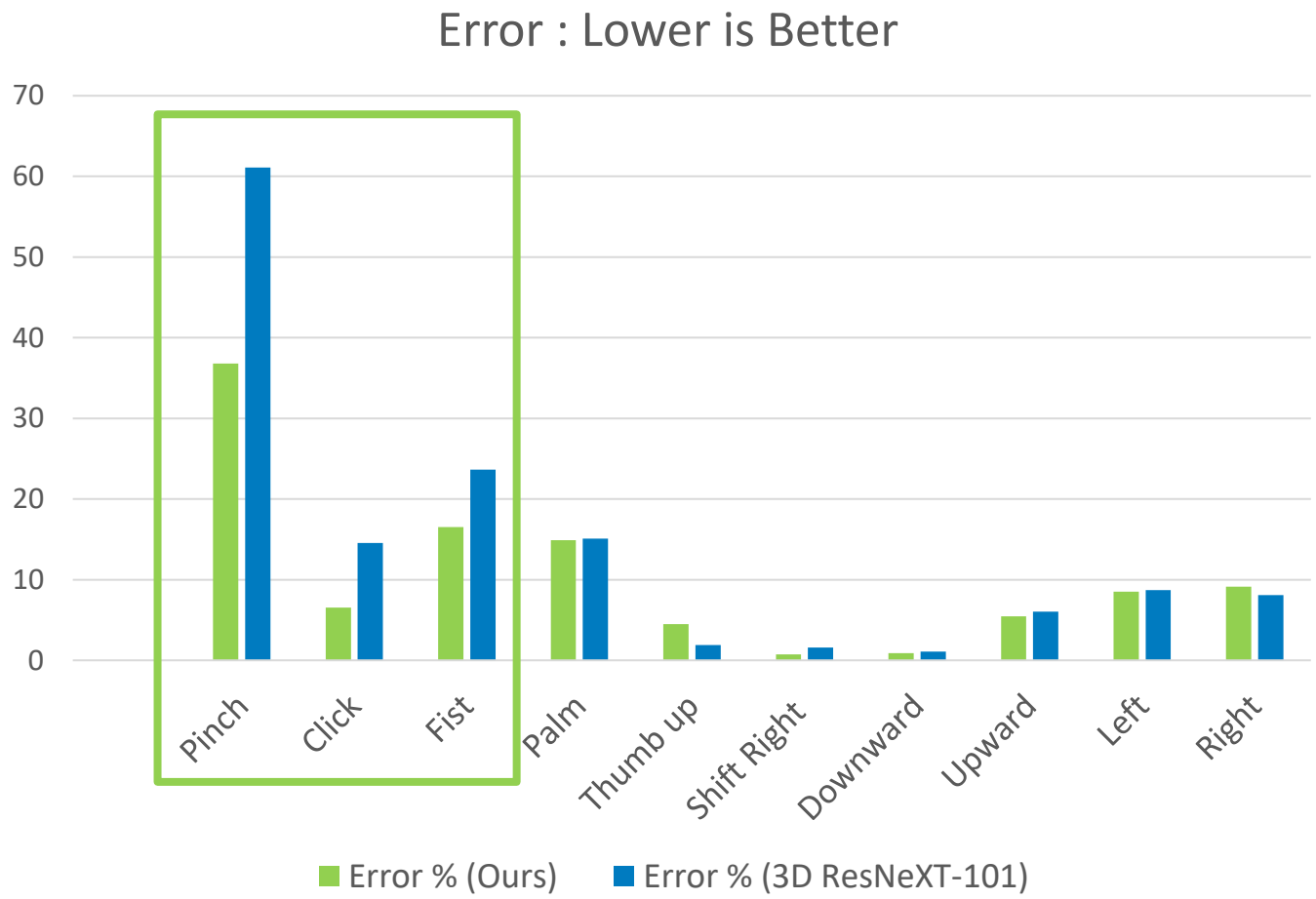
Results

Detecting Finer Gestures

Better Performance on **finer gestures** due to utilization of higher resolution features

- 25% lower error on Pinch
- 8% lower error on Click
- 7% lower error on Fist



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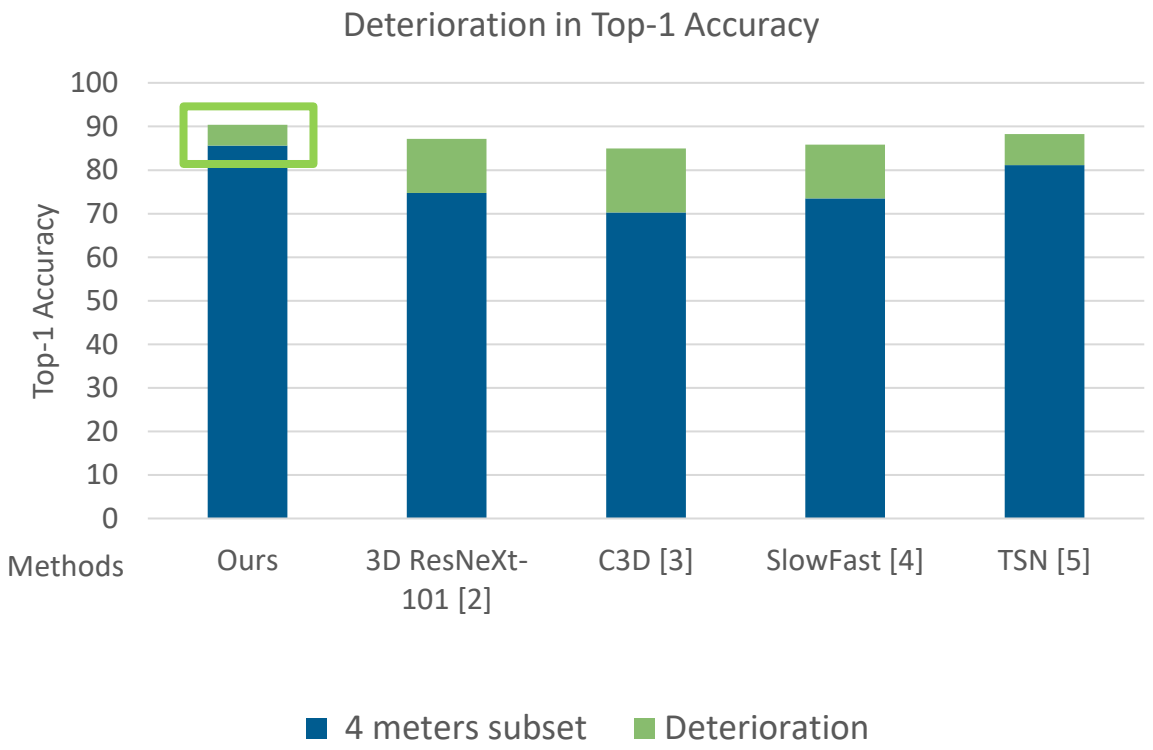
Results

Deterioration with Distance

Lower deterioration in performance with distance



Conclusion

- We propose a novel dynamic neural network for long distance gesture recognition
- Proposed network can recognize gestures more **accurately** and **efficiently** by discarding background features early on
- Shows state-of-the-art performance for long distance recognition, especially for resource constrained devices

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Visit us at 10 am @ Track 13 (Visual Learning) , Slot 9

Thank You!

Questions ?

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