Highly-Parallel Hardwired Deep Convolutional Neural Network for 1-ms Dual-Hand Tracking

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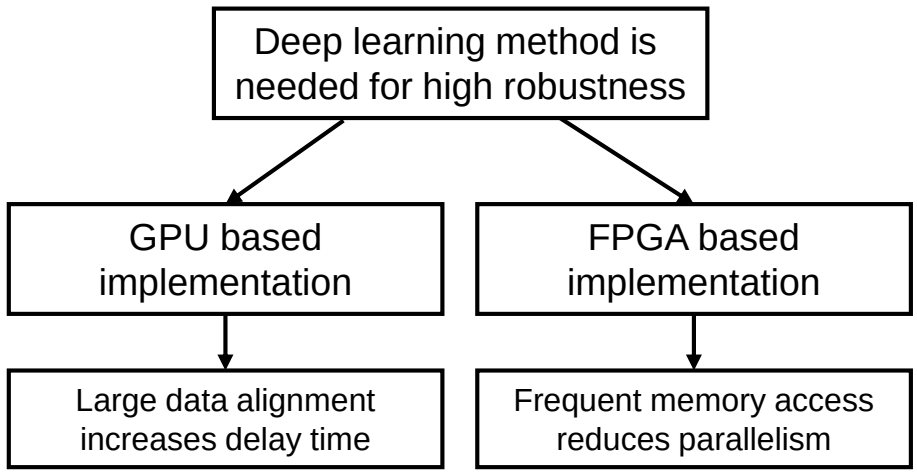
Research background

1-ms vision system represents the extreme case of temporal development of video system.

1-ms dual-hand tracking system is seamless and intuitive interface for Human Computer Interaction.

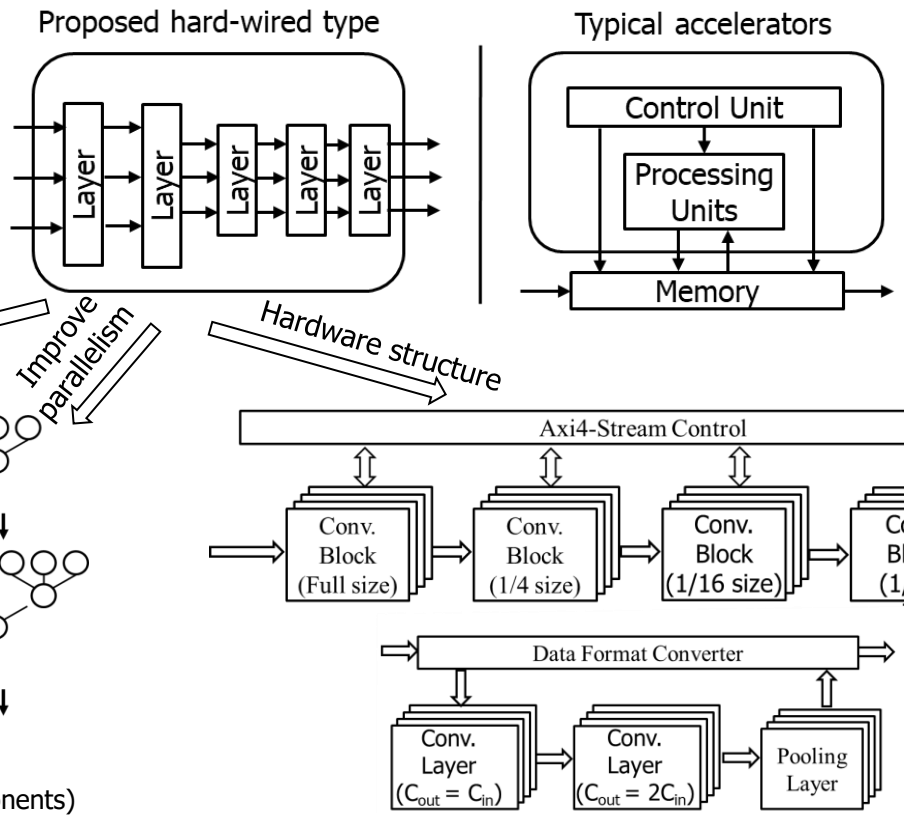
Problem statement



Proposed method

Directly map deep network as a hardwired circuit

- High processing frame rate
- Ultra-low processing delay
- Large resource usage
  (Solved by condensed binarization)



Experiments

Overall result

	Conventional work	Proposed system
Accuracy	74.5%	69.8%
Frame rate	61 fps	973 fps
Processing delay	16.32 ms	1.30 ms

Hardware resource

Resource Type	Total	Used	
		Amount	Ratio
LUT	203800	167437	82.16%
FF	407600	116291	28.69%
BRAM	445	18.5	4.16%
IO	500	28	5.60%
BUFG	32	4	12.50%

Conclusion

This work prove the possibility to improve the speed of CNNs to 1.30ms, and demonstrate how to design and assign tasks for the application of dual-hand tracking, and eventually achieve 69.8% accuracy for key applications in HCI.

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