Critically Compressed Quantized CNN based High Frame Rate Ultra-Low Delay Fruit External Defect Detection

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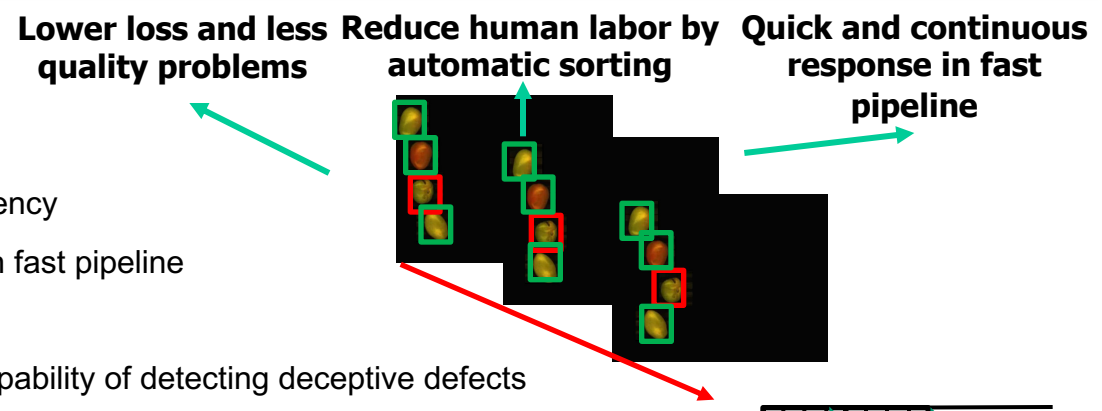
Research background

External defect detection plays a key role in fruit sorting

High frame rate detection ensures high production efficiency

Ultra-low frame rate detection enables quick response in fast pipeline



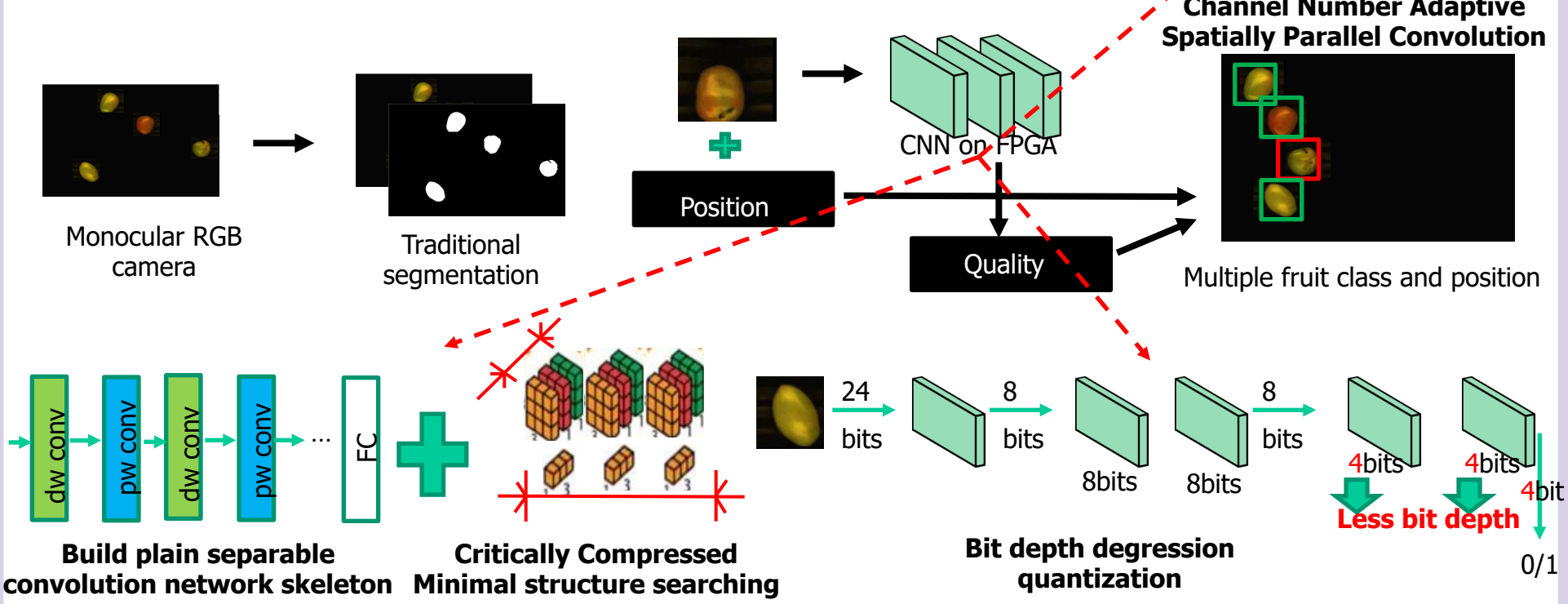
Problem statement

1.Traditional computer vision based method still lack capability of detecting deceptive defects

2.Large general CNNs are resource and time consuming, hard to achieve ms level process

Critically compressed CNN accelerated on FPGA is necessary!

Proposed method



Experiment results

Parameter Number

	Total parameters	Bit depth	Size Percentage
MobileNet(alpha=0.25)	219,058	32	100.00%
Our Network	1,310	8/4	0.10%

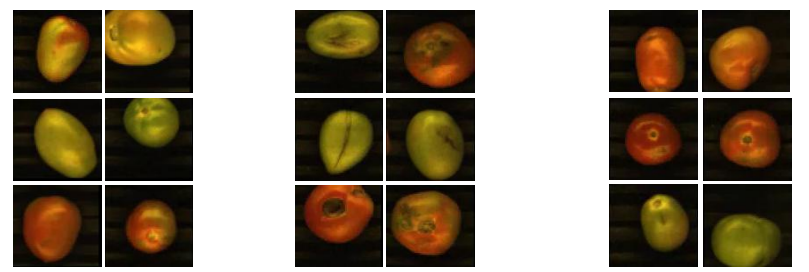
Accuracy

	Accuracy of healthy on validation set	Accuracy of defective on validation set	Overall accuracy on training set	Overall accuracy on validation set
MobileNet (alpha=0.25)	99.50%	85.08%	99.96%	97.88%
Our Network	99.31%	73.71%	96.90%	96.34%

Performance Estimation

Timing(ns)	Latency for all(clock cycle)	Total time(ms)
8.26	54409	0.449

Visual results for successfully classified instances



Healthy examples　Obvious defective examples　Deceptive defective examples

Conclusion

0.10% size of MobileNet[α=0.25], with 1.54% accuracy drop

Bit Depth Degression Quantization performs 6.95 times compression efficiency of full-4bit quantization on our network

Proposed unit work with 0.449ms delay per frame

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