Mobile Phone Surface Defect Detection Based on Improved Faster R-CNN

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Outline

- Introduction
- Proposed Method
- Experiments
- Conclusion

Introduction

> Background

Mobile phone surface defect (MPSD) is an inevitable factor in the production process of mobile phones. Efficient defect detection can provide enterprises with production information in time to improve production technology.
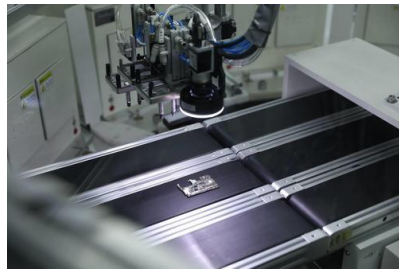
- Manual inspection

- Detection based on image processing methods

- Defect detection based on deep learning methods

Introduction

➤ Motivation

At present, Mobile phone surface defect detection faces two main challenges:

- the number of defective samples in mobile phone production is very small, and it is difficult to obtain high-quality defective sample images.
- size of the defect is very small.

The Deep Learning is rarely expanded into the field of MPSD detection. Therefore, we proposed a deep learning based method to cope with these problems.
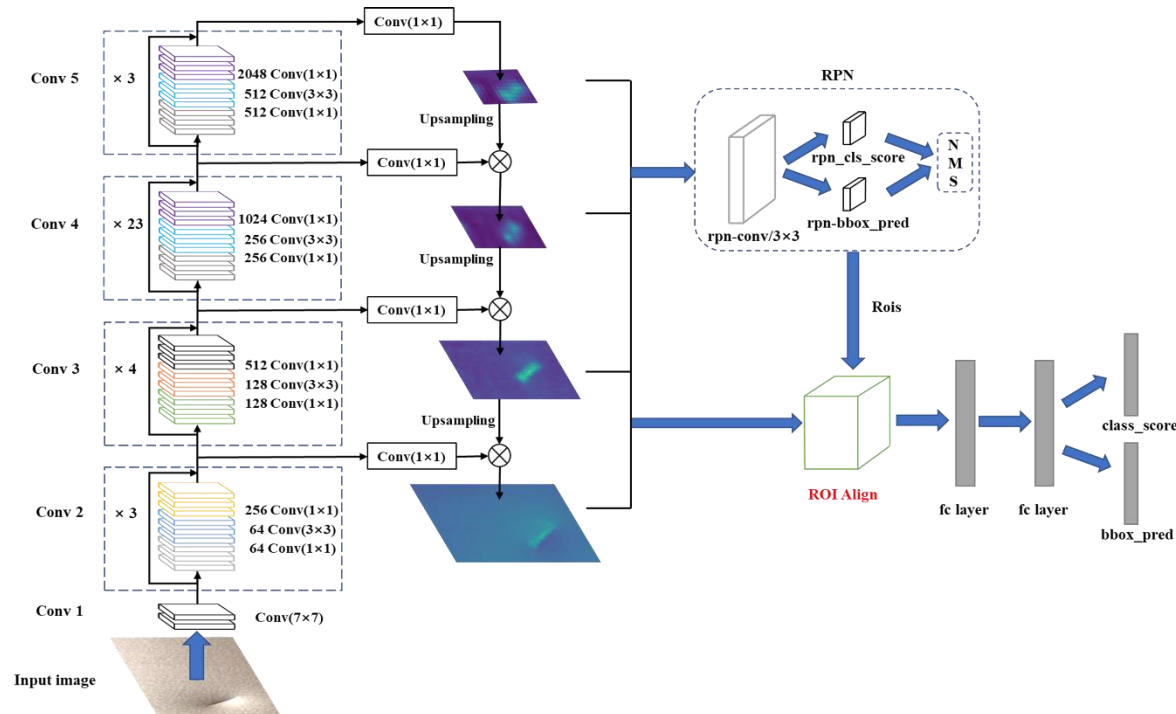
Method

BEGAN

$\gamma = 0.5$
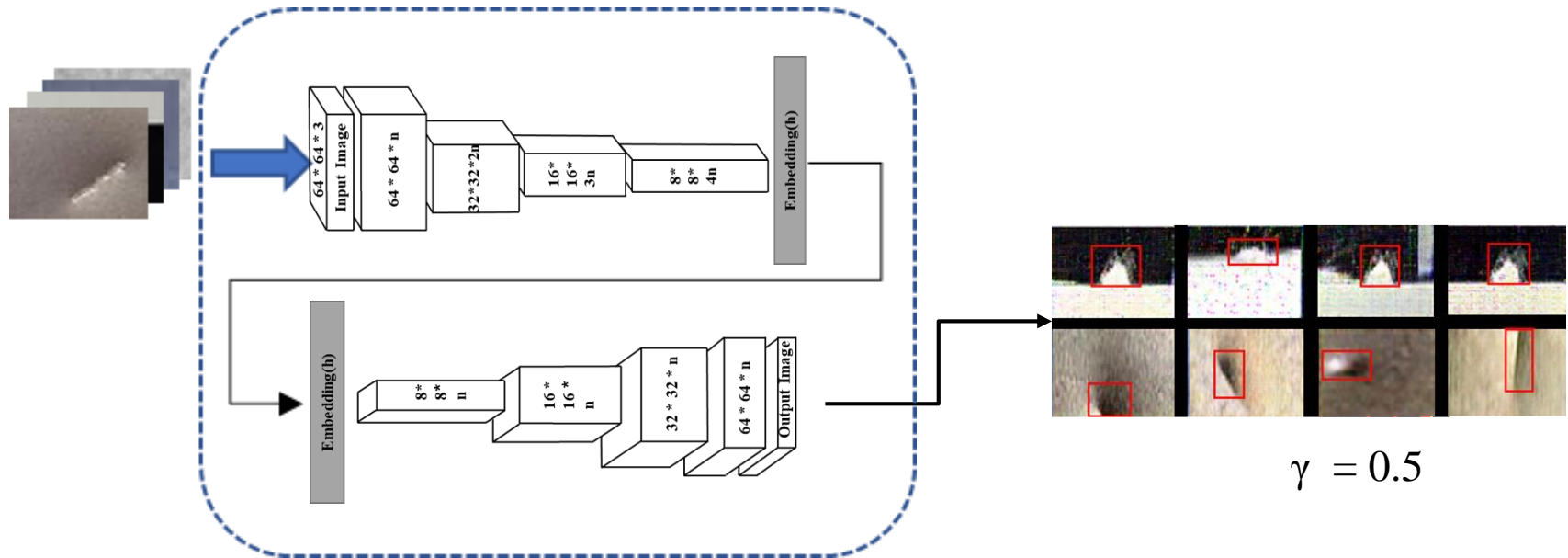
- Data from dataset are augmented using general methods (e.g. flipping, rotation, and color jitter.) off-line.

- Augmented data are input into BEGAN

- A hyperparameter γ is provided in BEGAN, this hyper-parameter can balance the diversity of the image and the quality of the generation.
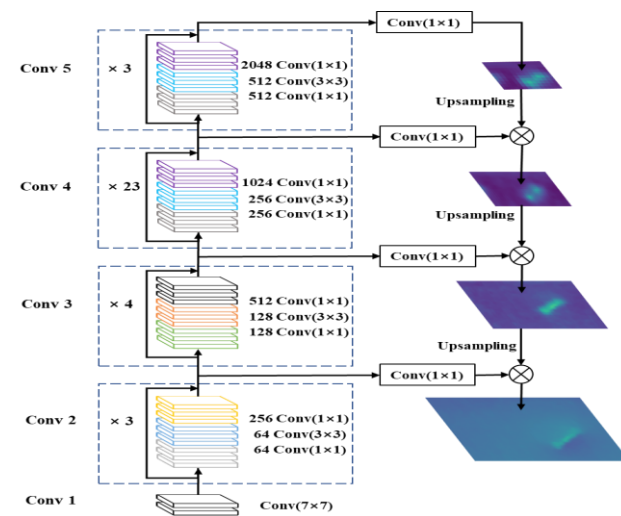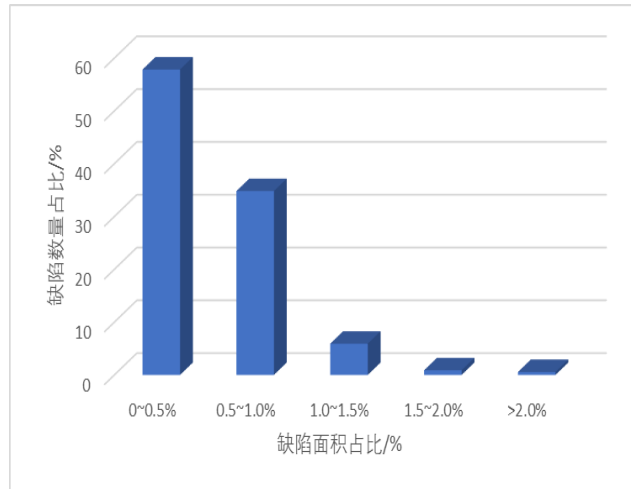
Method

Improved Faster R-CNN

- The overall architecture of Improved Faster R-CNN, which consist of three parts: feature extract network, region proposal network and classification and regression network.

- To extract more features, we take ResNet-101 as backbone

Method

FPN

- A statistics of the dataset we made show that 58% of the defects are very small, accounting for only 0.5% of the image size.

- The original Faster R-CNN uses the last single feature map. And its resolution is greatly lost in the convolution process.

- To detect the small defects, FPN makes the feature map multi-scale, which constructed a network structure with strong semantic expression capabilities at all scales

Experiments

☐ **Dataset: MPSD**

- We collects 50 defective screens and 30 defective mobile phone cases. e samples are taken at different angles and light sources. A total of 1250 defective pictures are taken.
- After the general data augmentation, 2495 samples are obtained.
- Expanding the data through BEGAN, the total sample size increased by 2258.

(a) Point defect

(b) Edge defect

(c) Screen scratch

(d) Stripe dent

TABLE I
DATASET DETAIL

Dataset	Point defect	Edge defect	Screen scratch	Stripe dent	Total
Original number	560	560	670	705	2495
Augment number	523	536	583	616	2258
Total	1083	1096	1253	1321	4753

Experiments

□ **Compared with traditional methods**

TABLE II
COMPARED WITH TRADITIONAL METHODS

Method	mAP	Point defect	Edge defect	Screen scratch	Stripe dent	Inference time
HOG+SVM	63.45%	73.88%	62.33 %	48.52%	69.06%	–
LBP+SVM	72.39%	77.52%	75.21%	61.80%	75.03%	–
Faster R-CNN(VGG16)	90.84%	90.81%	90.96%	91.44%	90.15%	0.111s
Faster R-CNN(ResNet101)	93.92%	95.75%	93.61%	93.97%	92.35%	0.197s
SSD-300	90.47%	90.82%	89.58%	90.17%	91.31%	0.016s
Yolov3(Darknet-53)	92.47%	94.36%	88.63%	92.23%	94.45%	0.029s
Our method	**99.43%**	**99.39%**	**99.99%**	**99.45%**	**98.89%**	**0.208s**

- we can see that the proposed method obtains the highest mAP at 99.43%

□ **Ablation Experiment**

TABLE III
ABLATION EXPERIMENT

Method	FPN	RoI Align	Data Augmentation	mAP
	✗	✗	✗	93.92%
	✓	✗	✗	96.43%
Faster R-CNN(ResNet101)	✓	✓	✗	97.36%
	✓	✓	✓	99.43%

- Compared with original Faster R-CNN. Proposed method can largely increase performance

Conclusion

➢To achieve high-quality feature extraction for small size mobile phone defects.

➡ | FPN |

➢To generate diverse defect images.

➡ | BEGAN |

➢To prevent the regression from being affected by the quantization operation.

➡ | RoI Align |

➢Experiments MPSD dataset prove remarkable performance of our method.

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Thanks!