FUSION OF GLOBAL-LOCAL FEATURES FOR IMAGE QUALITY INSPECTION OF SHIPPING LABEL

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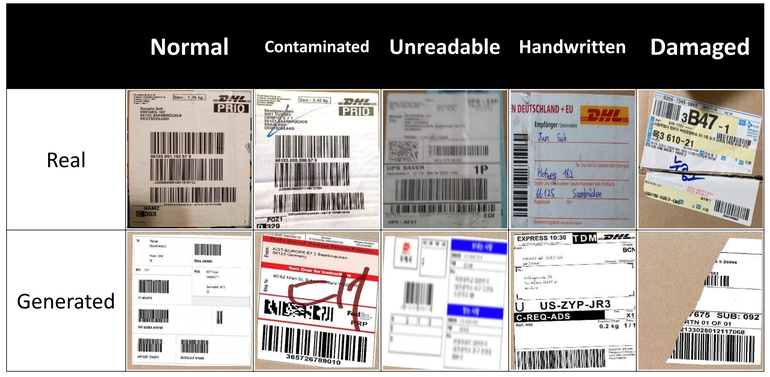
INTRODUCTION

- The performance of OCR engines and text detection engines is sensitive to image quality and defects on target objects (Problematic labels lead to High-cost loss problem)
- Bad quality image classification can reduce the processing time and improve the accuracy of the inspection
  - Unreadable image and the damaged label → Image reacquisition request
  - The contaminated and handwritten addresses → Parameter tuning for image enhancement and text recognition process

➔ **CNN model-based image quality verification by combining global and local features is proposed**

DATA ANNOTATION



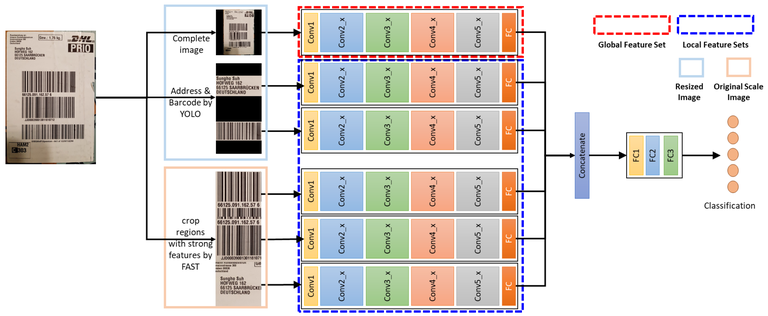
DATASETS

Table 1. Dataset of the shipping labels

Defect Type	# of Images (Generated)	# of Images (Collected)
Normal	1283	660
Contaminated	1054	139
Unreadable	904	107
Handwritten	988	52
Damaged	1077	134
Total	**5306**	**1092**

THE PROPOSED METHOD

- Challenges: Problems for image quality verification
  1. The varying aspect ratios and sizes of shipping label images
  2. Difficult to distinguish between contaminants in the address area and contaminants in other areas.



- Feature localization
  - Shipping Label : Contains barcodes and the address of sender and receiver
  - Detecting barcode and address areas by using YOLO
  - Localizing regions with strong features by using FAST

- Global-local feature fusion
  - CNN Networks: Deployed ResNet-50 pre-trained on ImageNet for global and local feature extractions.
  - Fusion of global and local features: A stacked generalization ensemble was adopted to combine the global and local features.
  - To verify the proposed method, we compared the proposed ensemble models with majority voting and weighted majority voting algorithms.

EXPERIMENTAL RESULTS

Table 2. Comparison of classification results on the generated dataset

Methods	VGG-19	ResNet-50
Only global features	95.98 ± 0.74 %	95.80 ± 0.38 %
Global-local fusion (majority voting)	96.40 ± 0.65 %	96.62 ± 0.43 %
Global-local fusion (weighted majority voting)	97.16 ± 0.43 %	97.02 ± 0.77 %
Global-local fusion (ours)	98.32 ± 0.49 %	**99.06 ± 0.66 %**

Table 3. Comparison of classification results on the collected real dataset

Methods	VGG-19	ResNet-50
Only global features	85.40 ± 2.43 %	86.00 ± 3.40 %
Global-local fusion (majority voting)	84.67 ± 2.27 %	86.40 ± 2.97 %
Global-local fusion (weighted majority voting)	85.00 ± 2.68 %	87.60 ± 2.70 %
Global-local fusion (ours)	87.80 ± 2.13 %	**89.26 ± 2.70 %**

CONCLUSION

- We have presented an input image quality verification method using CNNs combining global and local features for shipping label inspection.
- As the four different poor conditions of captured images were successfully classified, the performance of the shipping label inspection system could be improved and the cost in logistics could be reduced.
- In future work, we plan to apply the proposed method to a packaging machine with an industrial camera and will test it in the logistics industry.

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