

Coarse Annotation Refinement for Segmentation of Dot-Matrix Batchcodes

Ning Jia, Christopher J. Holder, Stephen Bonner, Boguslaw Obara

Presented by Phillip Adey

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Agenda

- Objectives
- Related Works
- Proposed Method
- Experiments
- Conclusion

Objectives

- Batchcode segmentation - retrieve black dot matrix from images
- Challenges:
 - High variation of size, shape and orientation
 - Object features are tiny discrete dots - easily removed by morphological opening-closing
 - Noise around the batchcode shares similar low level features
 - Other text-like (noisy) features on the background
 - Accurate annotation is very expensive



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- Batchcode segmentation - retrieve black dot matrix from images (accurately)
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Related Works

- Applications:

- Scene Text Detection
- Barcode Detection

- Methods:

- Maximally Stable Extremal Regions (MSER): returns all the subregions with consistent pixel intensity
- Deep Object Detection Models: anchor-based region proposal networks for multi-class object localisation
- Semantic Segmentation Networks



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Proposed Method

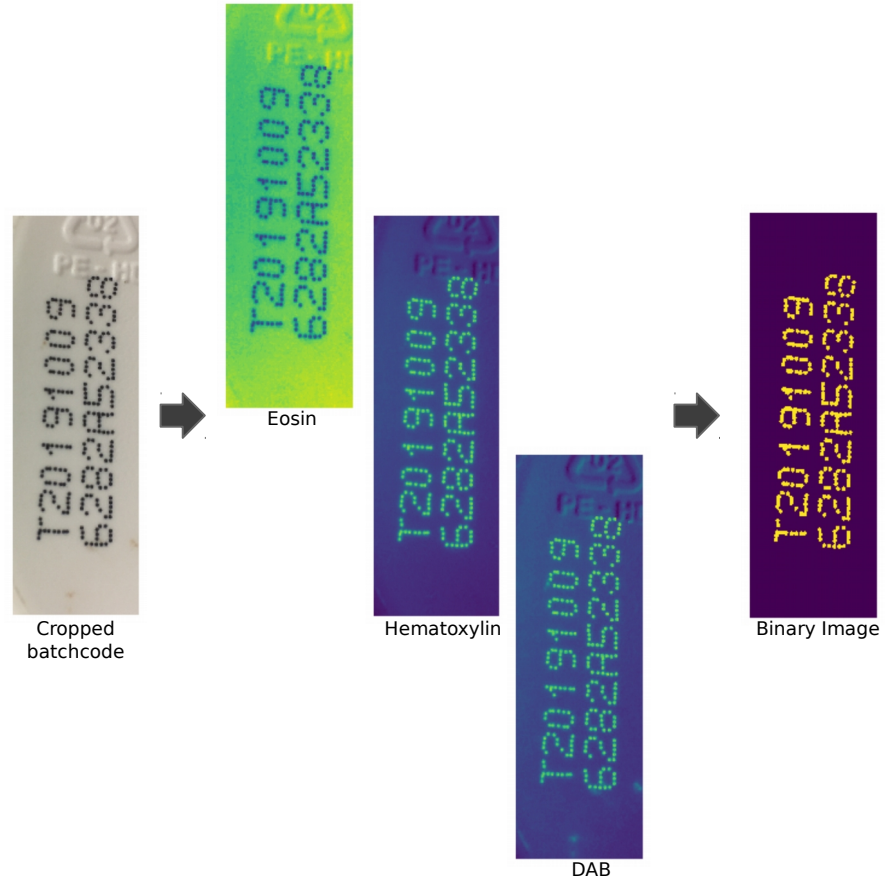
- Colour Space Transform: remove background noise by colour (contrast).
- Maximise Global Stability: Gradually reduce threshold until the region area is stabilised.

Algorithm 1 MSGR

```
1: procedure COLOUR SPACE TRANSFORM
2:    $I_{HED}(x, y, c) \leftarrow f_{HED}(I(x, y, c))$ 
3:    $t \leftarrow f_{Otsu}(I_{HED}(x, y, 1))$ 
4: procedure MAXIMISE GLOBAL STABILITY
5:    $a_0 \leftarrow \infty$ 
6:   for  $\lambda \in \{1, 1 - \delta, 1 - 2\delta, \dots, 0.5\}$  do
7:      $I_B(x, y) \leftarrow I_{HED}(x, y, 1) > \lambda t$ 
8:      $a \leftarrow f_{dim}(I_B(x, y))$ 
9:     if  $a - a_0 < 2$  then
10:      break
11:    else
12:       $a_0 \leftarrow a$ 
return  $I_B(x, y)$ 
```

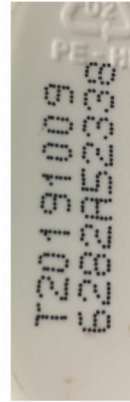
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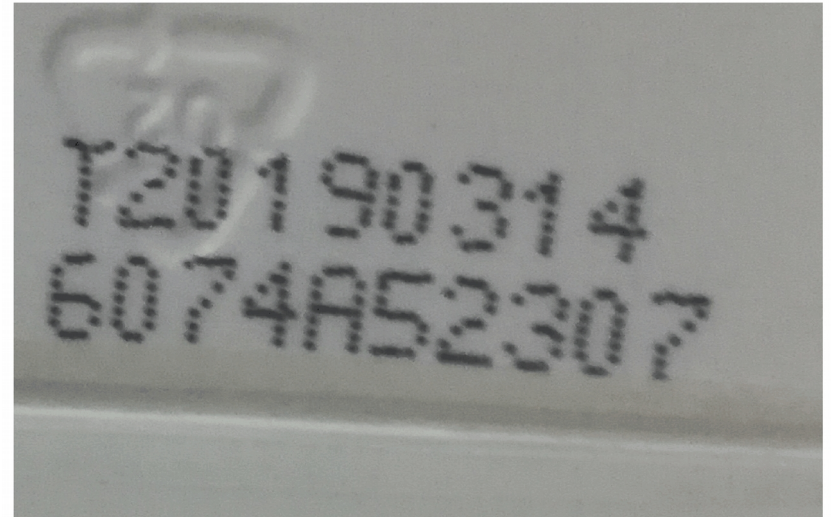
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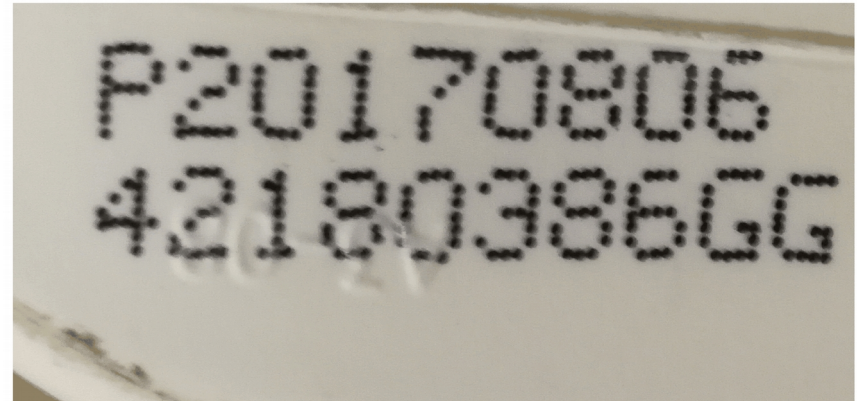
cropped image



Proposed Method

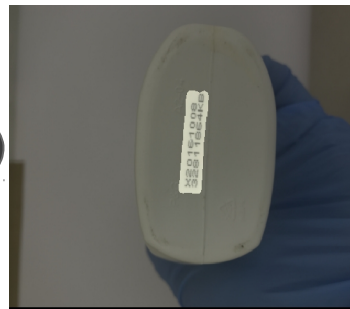
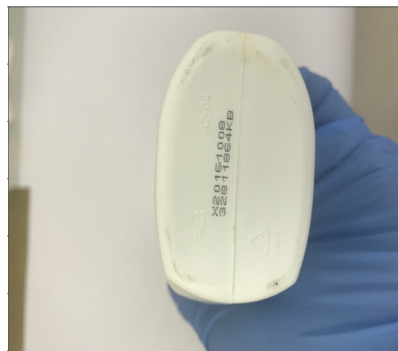
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cropped image



Deep Segmentation Model

- Trained with MSGR refined labels
- Output binary mask that highlight the batchcode region, tightly fit to the batchcode regions
- The results can be further optimised by MSGR



Experiments

- Deep models trained with refined labels outperforms those trained with coarse labels
- MSGR can further improve the prediction accuracy

Model	$p(\%)$	$r(\%)$	$j(\%)$	fps
Result1 (Trained with Coarse Labels)				
FCN	41.26	98.50	40.71	≈ 12
DeepLabV3	38.96	99.87	38.88	≈ 9
U-Net	38.77	99.44	38.23	≈ 23
PSPNet	66.69	61.33	42.51	≈ 10
Result2 (Coarse Labels + MSGR)				
FCN	86.90	93.91	84.16	≈ 3.5
DeepLabV3	83.87	97.43	82.11	≈ 3
U-Net	75.48	95.93	73.56	≈ 4.5
PSPNet	81.36	58.56	56.24	≈ 3
Result3 (Trained with Refined Labels)				
FCN	93.29	97.08	90.53	≈ 12
DeepLabV3	92.22	98.49	91.04	≈ 9
U-Net	92.54	94.86	88.25	≈ 23
PSPNet	91.06	77.84	72.94	≈ 10
Result4 (Refined Labels + MSGR)				
FCN	95.41	95.63	91.75	≈ 3.5
DeepLabV3	93.83	95.56	91.63	≈ 3
U-Net	93.73	94.43	90.51	≈ 4.5
PSPNet	92.79	82.39	78.50	≈ 3

Questions and Suggestions:

<https://community.dur.ac.uk/boguslaw.obara/>

ning.jia@durham.ac.uk

boguslaw.obara@durham.ac.uk

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Paper accepted to Machine Vision and Applications journal!
December 3rd, 2019
Our paper on 'Convolutional Networks for Appearance Based Recommendation and Visualisation of Mascara Products Machine Vision and Applications' has been accepted to Machine Vision and Applications journal today.

Two papers accepted at IEEE BigData 2019
November 3rd, 2019
"Analysing social media as a hybrid tool to detect and interpret likely radical behavioural traits for national security" paper by P. Cardenas-Canto, G. Theodoropoulos, I. Kureshi, and B. Obara and "Temporal neighbourhood aggregation: predicting future links in temporal graphs via recurrent variational graph convolutions" paper by S. Bonner, A. Atapour-Abarghouei, P. Jackson, J. Brennan, I. Kureshi, G. Theodoropoulos, S. McGough, and B. Obara have been accepted to Human-in-the-loop Methods and Human Machine Collaboration in BigData and Deep Graph Learning: Methodologies and Applications workshops at IEEE International Conference on Big Data, Los Angeles, CA, USA, 2019.

Paper accepted at IEEE ICMLA 2019
October 7th, 2019
Paper by Ning Jia, Chris Holder, Stephen Bonner and Boguslaw Obara on "Coarse annotation refinement for segmentation of dot-matrix batchcodes" has just been accepted at IEEE International Conference on Machine Learning and Applications conference, Boca Raton, FL, USA, 2019.

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