



金融 · 科技

SROIE Competition PAIC Submission

Ping An Property & Casualty Insurance
Company of China

Xianbiao Qi



Ning Lu



Yihao Chen



Wenwen Yu



Shaoqiong Chen



Yuan Gao



Rong Xiao



Outlines

01

Text Detection

02

Text Recognition

03

Key Information
Extraction

04

Lessons learnt from the
competition

Two small squares, one dark orange and one light orange, are positioned to the left of the title.

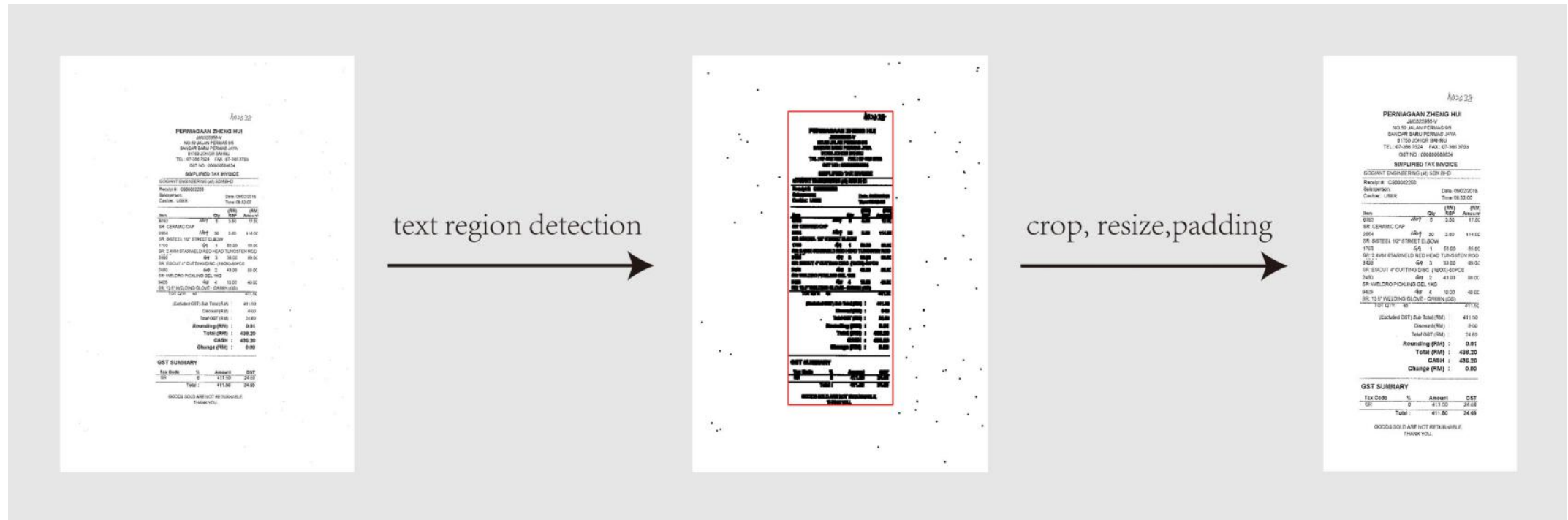
Text Detection

Outline

- Pre-processing
- Network Structure
- Loss Function
- Post-processing
- Results

Text Detection

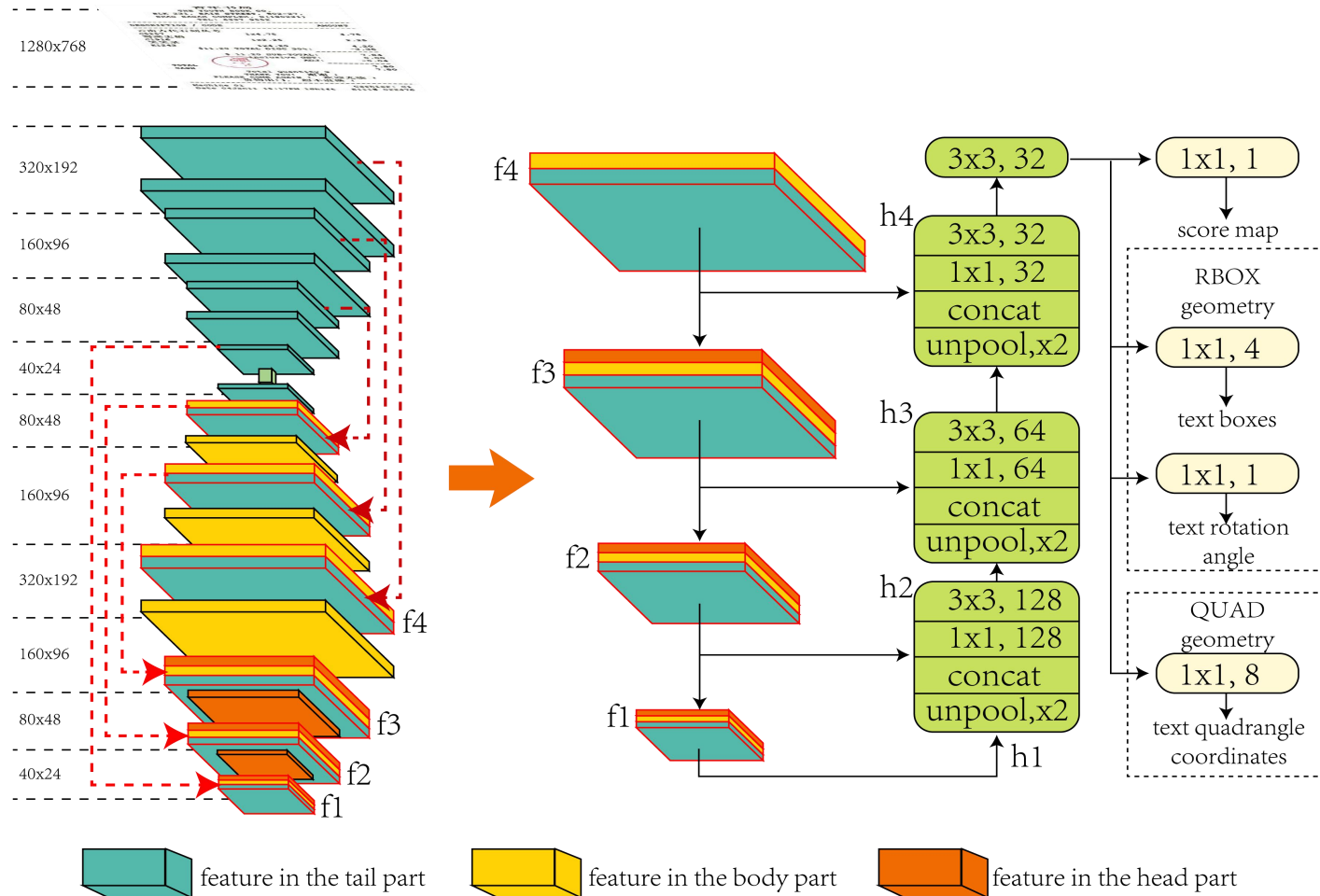
Pre-Processing



OpenCV Adaptive Threshold (OSTU)

Text Detection

Network Structure (FishNet)



SUN, Shuyang, et al. Fishnet: A versatile backbone for image, region, and pixel level prediction. In: Advances in Neural Information Processing Systems. 2018. p. 754-764.

Text Detection

Anchor-Free Based Method (EAST)

■ **For** each point, there are two loss parts: classification score and bounding box regression.

■ **For** classification score map, we use

- Origin (balanced-CE)

$$\begin{aligned} L_s &= \text{balanced-xent}(\hat{\mathbf{Y}}, \mathbf{Y}^*) \\ &= -\beta \mathbf{Y}^* \log \hat{\mathbf{Y}} - (1 - \beta)(1 - \mathbf{Y}^*) \log(1 - \hat{\mathbf{Y}}) \end{aligned}$$

$$\beta = 1 - \frac{\sum_{y^* \in \mathbf{Y}^*} y^*}{|\mathbf{Y}^*|}.$$

- Ours (Dice loss)

$$L_s = 1 - \frac{2TP}{2TP + FN + FP}$$

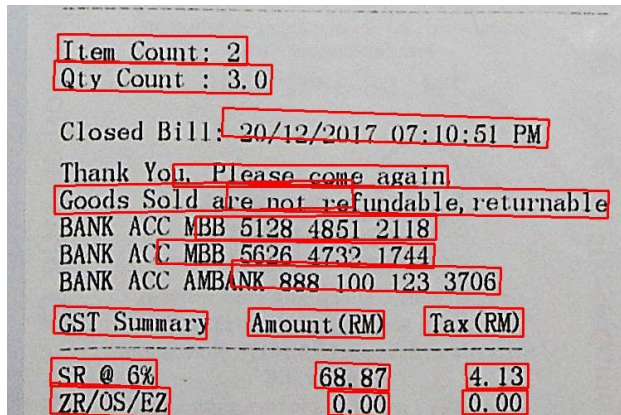
$$= 1 - \frac{2 \sum_{n=1}^N p_n r_n}{\sum_{n=1}^N p_n + r_n}$$

Results on ICDAR 2015

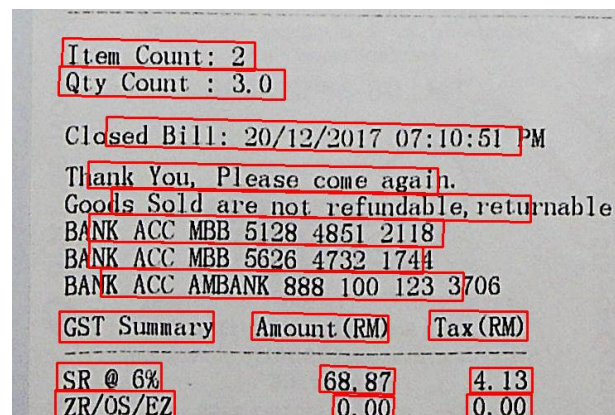
Original EAST	Our modification
80.7	84.0
UnKnown	86.2

Text Detection

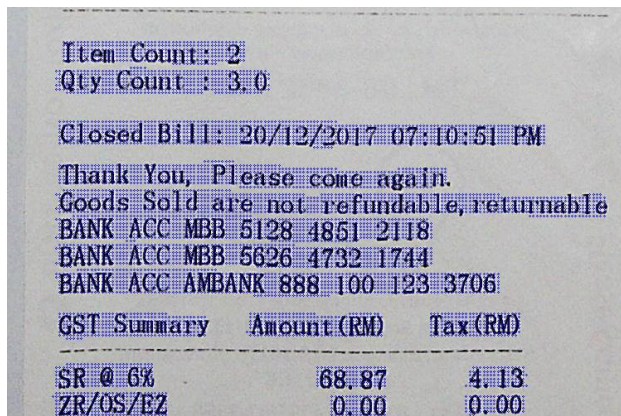
Post-Processing



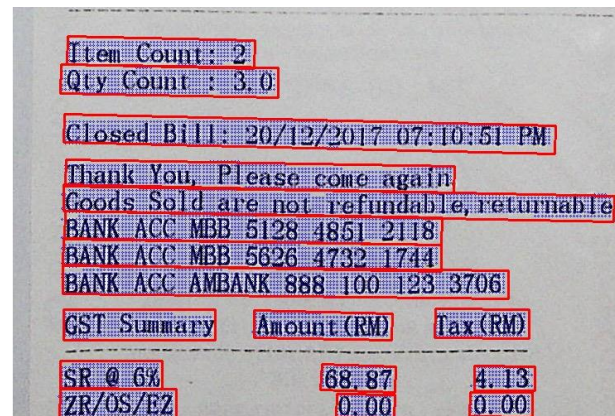
NMS



LANMS



Score Map



LANMS, Score Map
Elongation and Shortening

Algorithm 1 Elongation and Shortening

Input: Boxes, ScoreMap, Threshold

Output: Boxes

```
1: for each  $Box \in Boxes$  do
2:   do
3:      $Reduce \leftarrow GetReducedBox(Box)$ 
4:      $R \leftarrow Mean(ScoreMap(Extra))$ 
5:   while  $R > Threshold$ 
6:      $Box \leftarrow Box - Reduce$ 
7:   do
8:      $Extra \leftarrow GetExtraBox(Box)$ 
9:      $E \leftarrow Mean(ScoreMap(Extra))$ 
10:   while  $E > Threshold$ 
11:      $Box \leftarrow Box + Extra$ 
12:    $Box \leftarrow Box - Reduce$ 
13: end for
```



Elongation



Shortening

Text Detection

Detection Results

SY LIZ.

OLDTOWN WHITE COFFEE
Old Town Kopitiam Sdn Bhd (716269-X)
Sri Rampai
Tel: 03-4148 1876

Guest Check
THIS IS NOT A RECEIPT
GST ID:000801587200

4 COUNTER3 2009 LIZA
Check:37617 22 Mar 18 12:44:00 PM Cover:1
Table:5 / 1

----- Dine In -----
1 ST30 13.87 S
1 BR10 Stm Ginger R S
1 TF2 (H) Teh Tarik S
1 HS4 12.07 S
1 SN5 Curry Mee S
1 TF7 (C) Lemon T S

Subtotal: 25.94
10% Srv Chg: 2.59
GST @6% 1.71
Total: 30.24
Rounding: 0.01
Amount Due 30.25
INCLUSIVE 0.00 *

---3004 STORED 22 Mar 18 02:11:50 PM---

THANK YOU
PLEASE COME AGAIN
GST @6% included in total

GST Summary Amount (RM) GST (RM)
S=GST @6%: 28.53 1.71
Z=GST @0%: 0.00 0.00

xw

tan chay yee

*** COPY ***
OJC MARKETING SDN BHD
ROC NO: 538358-H
NO 2 & 4, JALAN BAYU 4,
BANDAR SERI ALAM,
81750 MASAI, JOHOR
Tel:07-388 2218 Fax:07-388 8218
Email: ng@ojcgroup.com

TAX INVOICE

Invoice No : PEGIV-1030765
Date : 15/01/2019 11:05:16 AM
Cashier : NG CHUAN MIN
Sales Persor : FATIN
Bill To : **THE PEAK QUARRY WORKS**
Address : .

Description	Qty	Price	Amount
000000111	1	193.00	193.00 SR

KINGS SAFETY SHOES KWD 805

Qty: 1 Total Exclude GST: 193.00
Total GST @6%: 0.00
Total Inclusive GST: 193.00
Round Amt: 0.00
TOTAL: 193.00

VISA CARD 193.00
xxxxxxx4318
Approval Code:000

Goods Sold Are Not Returnable & Refundable
****Thank You. Please Come Again.****

LIGHTROOM GALLERY SDN BHD
No: 28, JALAN ASTANA 1C,
BANDAR BUKIT RAJA, 41050
KLANG SELANGOR D. E. MALAYSIA
ROC No. : (1072825-A)
GST No. : 000584089600
Tel:03-3362 4395 Fax:03-3362 4395

CREDIT NOTE
Station: CASHIER C/N No: LCN00212
Cashier: ANGELA Cover : 1
Bill Date : 20/11/2017
Bill Start: 20/11/2017 03:57:01 PM

Code : 300-E0009
Name : ESWARAN 012-6369400
Address :
GST No. :

YT51129 SR
YE36 BK 12W WW LED TRACK LIGHT
2 * RM 45.29 UNI (5.43)=RM 90.57
YT52683 SR
YE44 35W WW BK TRACK HOLDER
1 * RM 155.66 UNI (9.34)=RM 155.66
CH50688 SR
1METER TRACK-BK
1 * RM 16.99 UNI (1.01)=RM 16.79
SR
RM39.80 CONTRA W LCN00211
0 * UNIT

Sub Total : RM 263.02
Item Discount : RM 0.20
Service Charge : RM 0.00
GST/TAX 6% : RM 15.78
TOT : RM 278.80
CASH : RM 278.80
CHANGE : RM 0.00

Item Count: 4
Qty Count : 4.0
Closed Bill: 20/11/2017 04:01:23 PM

Thank You, Please come again.
Goods Sold are not refundable, returnable
BANK ACC MBB 5128 4851 2118
BANK ACC MBB 5626 4732 1744
BANK ACC AMBANK 888 100 123 3706

GST Summary Amount (RM) Tax (RM)
SR @ 6% 263.02 15.78
ZR/OS/EZ 0.00 0.00

Two small squares, one dark orange and one light orange, are positioned to the left of the title.

Text Recognition

Outline

- Synthesis Data

- True Data

- Improved SAR

- Results

Text Recognition

Synthesis Data

6

31.50 S

38.16

Undivergently

201.46

102749

nigranilin

rm0.00

778.28

CO-REG: 860671-D

PEPSINS ITEM CUSTOMER NAMA:

petaling java evangelion 19.20

SRO@0% 1.70 THREE-GROOVED

QTY GST SUMMARY CASHIER GOLDEN ARCHES RESTAURANTS SDN B

DEXTROLIMONENE 2.00 TOTAL AFTER ADJ INCL GST

SELANGOR DARUL EHSAN GST @0%: RM0.00 CASH

De Maximum Thai Express Sdn Bhd Credulousness

Text Recognition

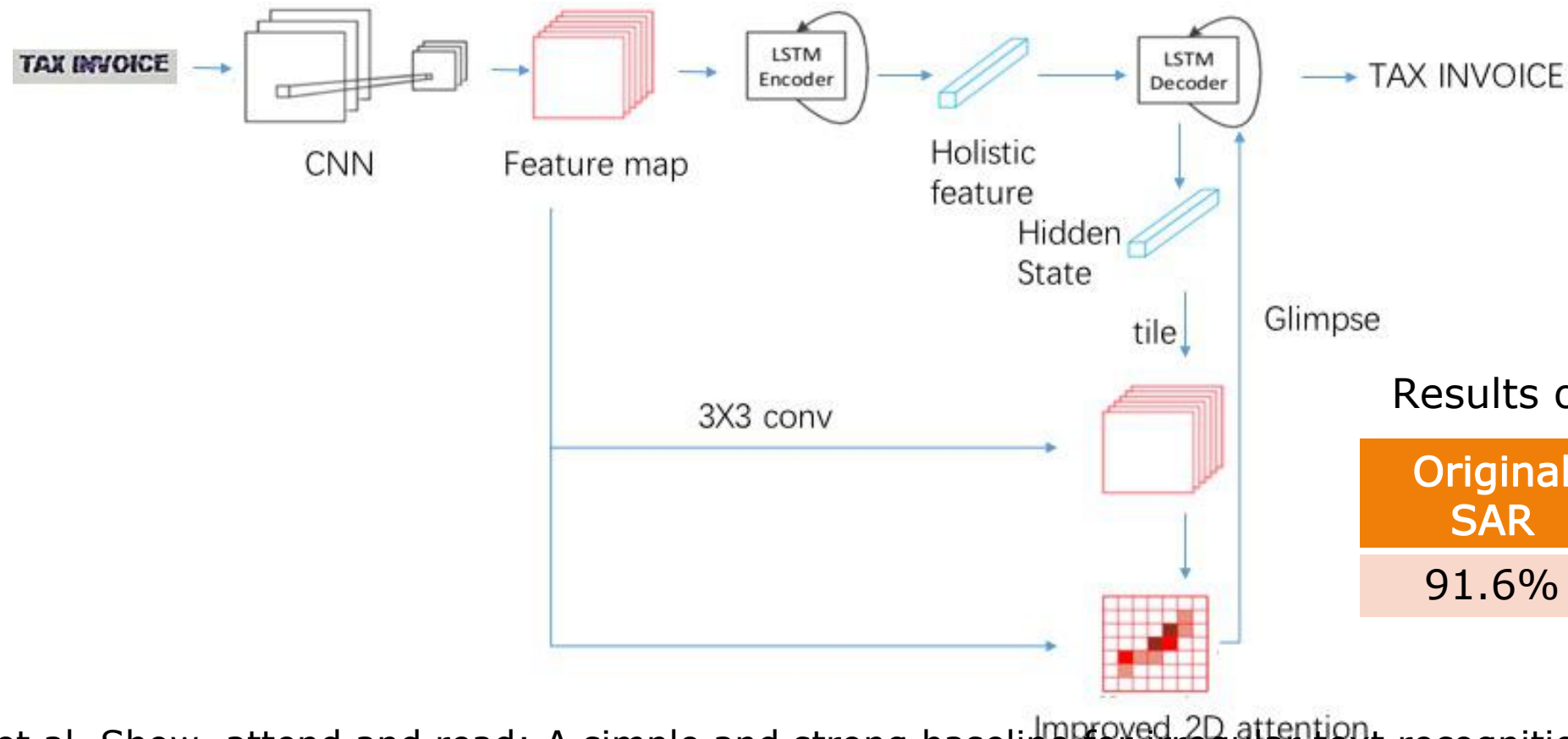
True Data

1	1	Qty	\$7.60	\$0.00	\$0.50	\$7.10	\$7.10
Tax(\$)	CASH	Amount(\$)	Item	Total	Change	\$0.50	Amount
SR - GST @6%	Payment Mode	(867388-U)	TAX INVOICE	Nett Total: \$7.60	GST @6%: \$0.43		
22 Mar 2018 18:24	Invoice # : OR18032202170428		12, Jalan Tampoi 7/4,Kawasan Perindustrian				
Total Amount: \$7.60	SR 100100000035- 1 Meat + 3 Vege			SR 100100000064-Add Vegetable			
GST Summary	Tampoi,81200 Johor Bahru,Johor			UNIHAKKA INTERNATIONAL SDN BHD			

Text Recognition

Improved SAR

- **Improved** SAR is a seq2seq model with 2d attention



Results on IIIT-5K

Original SAR	Our modification
91.6%	93.8%

LI, Hui, et al. Show, attend and read: A simple and strong baseline for irregular text recognition. In: Proceedings of the AAAI Conference on Artificial Intelligence. 2019. p. 8610-8617.

Text Recognition

Attention Drifting

tan chay yee

*** COPY ***
OJC MARKETING SDN BHD
ROC NO: 538358-H
NO 2 & 4, JALAN BAYU 4,
BANDAR SERI ALAM,
81750 MASAI, JOHOR
Tel: 07-388 2218 Fax: 07-388 8218
Email: ng@ojcgroup.com

TAX INVOICE

Invoice No : PEGIV-1030765
Date : 15/01/2019 11:05:16 AM
Cashier : NG CHUAN MIN
Sales Person : FATIN
Bill To : THE PEAK QUARRY WORKS
Address : .

Description	Qty	Price	Amount
000000111	1	193.00	193.00 SR
KINGS SAFETY SHOES KWD 805			
Qty: 1	Total Exclude GST:	193.00	
	Total GST @6%:	0.00	
	Total Inclusive GST:	193.00	
	Round Amt:	0.00	
	TOTAL:	193.00	
	VISA CARD	193.00	
	XXXXXXXXXXXX4318		
	Approval Code:000		

Goods Sold Are Not Returnable & Refundable
Thank You. Please Come Again.

TAN CHAY YEE

*** COPY ***
OJC MARKETING SDN BHD
ROC NO: 538358-H
NO 2 & 4, JALAN BAYU 4,
BANDAR SERI ALAM,
81750 MASAI, JOHOR
TEL:07-388 2218 FAX:07-388 8218
EMAIL: NG@OJCGROUP.COM

TAX INVOICE

INVOICE NO: PEGIV-1030765
DATE : 15/01/2019 11:05:16 AM
CASHIER : NG CHUAN MIN
SALES PERSON : FATIN
BILL TO : THE PEAK QUARRY WORKS
ADDRESS :

DESCRIPTION	QTY	PRICE	AMOUNT
000000111	1	193.00	193.00 SR
KINGS SAFETY SHOES KWD 805			
QTY:1	TOTAL EXCLUDE GST:	193.00	
	TOTAL GST @6%:	0.00	
	TOTAL INCLUSIVE GST:	193.00	
	ROUND AMT:	0.00	
	TOTAL:	193.00	
	VISA CARD	193.00	
	XXXXXXXXXXXX4318		
	APPROVAL CODE:000		

GOODS SOLD ARE NOT RETURNABLE & REFUNDABLE
THANK YOU. PLEASE COME AGAIN.

CROSS CHANNEL NETWORK SDN. BHD.
47, JALAN MERANTI 1, SEK. 3,
BANDAR UTAMA BATANG KALI,
44300 BATANG KALI, SELANGOR.
Tel : 03-6057 9688 Fax : 03-6057 9678
GST ID : 001151500288

Tax Invoice No. : BTG-052332

	Qty	RM	Tax
SCHNEIDER E15R 13A SWITCH	1	6.36	SR
SOCKET OUTLET @ 6.0000			
Total Amt Incl. GST @ 6% :		6.36	
Rounding Adjustment :		-0.01	
Total Amt Payable :		6.35	
Paid Amount :		10.00	
Change :		3.65	
Total Qty Tender :		1.00	

GST Summary	Amount	Tax
	(RM)	(RM)
SR @ A	6.00	0.36
Total	6.00	0.36

THANK YOU
Goods sold are not refundable nor exchangeable.
For any enquiry, please e-mail us:
gowa9688@gmail.com
29/01/2018 4:40:40 PM

CROSS CHANNEL NETWORK SDN. BHD.
47, JALAN MERANTI 1, SEK. 3,
BANDAR UTAMA BATANG KALI,
44300 BATANG KALI, SELANGOR.
TEL : 03-6057 9688 FAX : 03-6057 9678
GST ID : 001151500288
TAX INVOICE No. : BTG-052332

	QTY	RM	TAX
SCHNEIDER E15R 13A SWITCH	1	6.36	SR
SOCKET OUTLET @ 6.0000			
TOTAL AMT INCL. GST @ 6% :		6.36	
ROUNDING ADJUSTMENT :		-0.01	
TOTAL AMT PAYABLE:		6.35	
PAID AMOUNT:		10.00	
CHANGE:		3.65	
TOTAL QTY TENDER:		1.00	

GST SUMMARY	AMOUNT	TAX
	(RM)	(RM)
SR @ A	6.00	0.36
LTOTAL	6.00	0.361

THANK YOU
GOODS SOLD ARE NOT REFUNDABLE
FOR ANY ENQUIRY, PLEASE E-MAIL US:
GOWA9688@GMAIL.COM
29/01/2018 4:40:40 PM

Example 1

Example 2

Text Recognition

Other Issues

LIGHTROOM GALLERY SDN BHD
No: 28, JALAN ASTANA 1C,
BANDAR BUKIT RAJA, 41050
KLANG SELANGOR D.E. MALAYSIA
ROC No.: (1072825-A)
GST No.: 000584089600
Tel:03-3362 4395 Fax:03-3362 4395

CREDIT NOTE
Station: CASHIER C/N No: LCN00212
Cashier: ANGELA Cover: 1
Bill Date: 20/11/2017
Bill Start: 20/11/2017 03:57:01 PM

Code: 300-E0009
Name: ESWARAN 012-6369400
Address:
GST No.:

YT51129 SR
YE36 BK 12W WW LED TRACK LIGHT
2 * RM 45.29 UNIT (5.43)=RM 90.57
YT52683 SR
YE44 35W WW BK TRACK HOLDER
1 * RM 155.66 UNIT (9.34)=RM 155.66
CH50688 SR
IMETER TRACK-BK
1 * RM 16.99 UNIT (1.01)=RM 16.79
RM39.80 CONTRA W LCN00211
0 * UNIT

Sub Total: RM 263.02
Item Discount: RM 0.20
Service Charge: RM 0.00
GST/TAX 6%: RM 15.78
TOT: RM 278.80
CASH: RM 278.80
CHANGE: RM 0.00

Item Count: 4
Qty Count: 4.0
Closed Bill: 20/11/2017 04:01:23 PM

Thank You, Please come again.
Goods Sold are not refundable, returnable
BANK ACC MBB 5128 4851 2118
BANK ACC MBB 5626 4732 1744
BANK ACC AMBANK 888 100 123 3706

GST Summary Amount (RM) Tax (RM)
SR @ 6% 263.02 15.78
ZR/OS/EZ 0.00 0.00

Space Issue

LIGHTROOM GALLERY SDN BHD
No: 28, JALAN ASTANA 1C,
BANDAR BUKIT RAJA, 41050
KLANG SELANGOR D.E. MALAYSIA
ROC No.: (1072825-A)
GST No.: 000584089600
TEL:03-3362 4395

CREDIT NOTE
STATION: CASHIER C/N No: LCN00212
CASHIER: ANGELA COVER: 1
BILL DATE: 20/11/2017
BILL START: 20/11/2017 03:57:01 PM

CODE: 300-E0009
NAME: ESWARAN 012-6369400
ADDRESS:
GST NO.:

YT51129 SR
YE36 BK 12W WW LED TRACK LIGHT
2 * RM 45.29 UNIT (5.43)=RM 90.57
YT52683 SR
YE44 35W WW BK TRACK HOLDER
1 * RM 155.66 UNIT (9.34)=RM 155.66
CH50688 SR
IMETER TRACK-BK
1 * RM 16.99 UNIT (1.01)=RM 16.79
RM39.80 CONTRA W LCN00211
0 * UNIT

SUB TOTAL: RM 263.02
ITEM DISCOUNT: RM 0.20
SERVICE CHARGE: RM 0.00
GST/TAX 6%: RM 15.78
TOT: RM 278.80
CAS: RM 278.80
CHANGE: RM 0.00

ITEM COUNT: 4
QTY COUNT: 4.0
CLOSED BILL: 20/11/2017 04:01:23 PM

THANK YOU, PLEASE COME AGAIN.
GOODS SOLD ARE NOT REFUNDABLE, RETURNABLE
BANK ACC MBB 5128 4851 2118
BANK ACC MBB 5626 4732 1744
BANK ACC AMBANK 888 100 123 3706

GST SUMMARY AMOUNT (RM) TAX (RM)
SR @ 6% 263.02 15.78
ZR/OS/EZ 0.00 0.00

UROKO JAPANESE CUISINE SDN BHD
22A-1, JALAN 17/54,
SECTION 17,
46400 PETALING JAYA,
SELANGOR
03-7932 1023/0191
GST Reg No: 001126838272

Bill No: 01H-25029
Date: 20/03/2018 6:41:02 PM
Cashier: RESAN
Table No: S09

Qty Description Amount
1 KO NABE INANIWA UDON @ 24.00 24.00 SR
1 GREEN TEA @ 1.00 1.00 SR
1 GYOZA 5pcs @ 15.00 15.00 SR
1 GARLIC CHAHAN @ 6.00 SR
Total: 46.00
Discount: (0.00)
Service Chg 10.00%: 4.00
GST: 3.00
Grand Total: 53.00
Net Total: 53.00

GST Summary % Amount (RM) Tax (RM)
SR 6.00 50.00 3.00

Error

UROKO JAPANESE CUISINE SDN BHD
22A-1, JALAN 17/54,
SECTION 17,
46400 PETALING JAYA,
SELANGOR
03-7932 1023/0191
GST REG NO: 001126838272

BILL NO: 01H-25029
DATE: 20/03/2018 6:41:02 PM
CASHIER: RESAN
TABLE NO: S09

QTY DESCRIPTION AMOUNT
1 KO NANIWA UDON @ 24.00 24.00 SR
1 GREEN TEA @ 1.00 1.00 SR
1 GYOZA 5PCS @ 15.00 15.00 SR
1 GARLIC CHAHAN @ 6.00 SR
4 TOTAL: 46.00
DISCOUNT: (0.00)
SERVICE CHG 10.00%: 4.00
GST: 3.00
GRAND TOTAL: 53.00
NET TOTAL: 53.00

GST SUMMARY % AMOUNT (RM) TAX (RM)
SR 6.00 50.00 3.00

Key Information Extraction

Key Information Extraction

■ Regular Expressions

- address 64
- company 31
- date 38
- total 74

■ Patience is all you need

25/12/2018
25-12-2018
11.02.2018
02/JAN/2017
24-MAR-2017
2018/03/27
2016-07-31
23/2/2018
25/12/18
25-12-18
25/MAR/18
25-MAR-18
25.MAR.18
25 MAR 2018
25 MAR 18

Types of “date”

Learnt Lessons

Learnt Lessons

- Diving into the data
- Attention drifting is a serious problem in text recognition
- High-resolution is effective in text detection
- Multi-scale predictions help
- Pretrained model helps improve final performance
- High-quality synthesis data is important for recognition (1.0%)
- Model ensemble helps both in detection and recognition (0.5%)
- Patience is all you need

Relevant Work

MASTER: Multi-Aspect non-local network for Scene Text Recognition

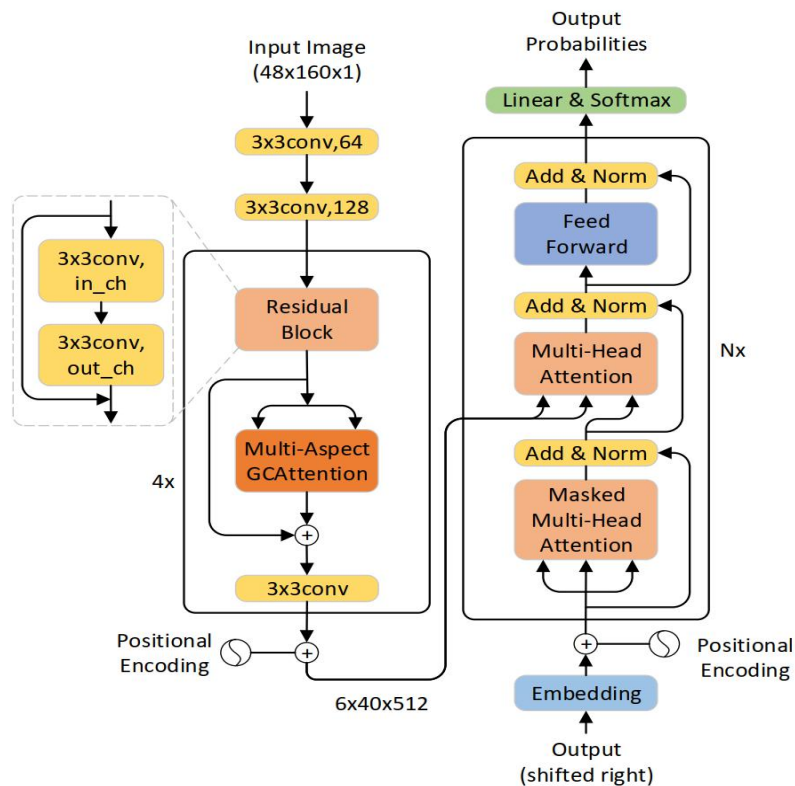
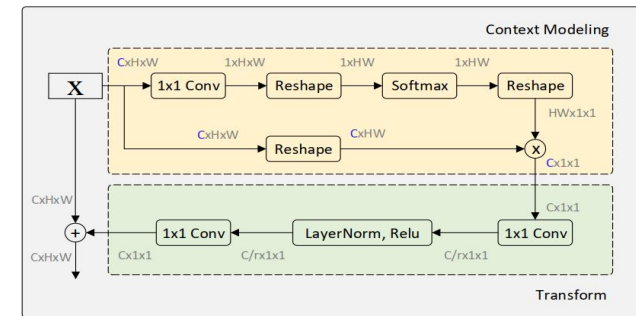
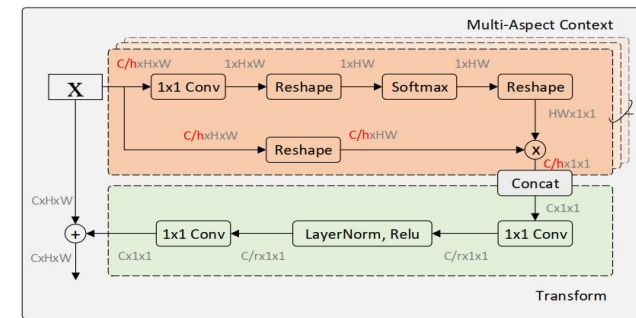


Fig. 2. The whole model consists of two main parts: a Multi-Aspect Global Context Attention(GCAttention) based encoder for feature representation and a transformer based decoder model. in_ch/out_ch donates input/output dimensions.

MASTER: Multi-Aspect non-local network for Scene Text Recognition, Ning Lu, Wenwen Yu, Xianbiao Qi, Yihao Chen, Ping Gong and Rong Xiao, Arxiv 2019.



(a) Global Context(GC) block



(b) Multi-Aspect GCAttention

Fig. 1. Architecture of a standard Global Context(GC) block (a) and the Multi-Aspect GCAttention (b). $C \times H \times W$ denotes a feature map with channel number C , height H and width W . h , r , and C/r denotes the number of Multi-Aspect Context, bottleneck ratio and hidden representation dimension of the bottleneck, respectively. \otimes denotes matrix multiplication, \oplus denotes broadcast element-wise addition.

Relevant Work

MASTER Results

Method	IIIT5K	SVT	IC03	IC13	IC15	SVTP	CUTE
	None	None	None	None	None	None	None
[35]	-	80.7	93.1	90.8	-	-	-
[36]	78.4	80.8	88.7	90.0	-	-	-
[22]	81.9	81.9	90.1	88.6	-	71.8	59.2
[37]	83.3	83.6	-	89.1	-	73.5	-
[38]	80.8	81.5	-	-	-	-	-
[3]	81.2	82.7	91.9	89.6	-	-	-
[19]*	87.4	85.9	94.2	93.3	70.6	-	-
[39]*	87.0	-	-	92.9	-	-	-
[40]*	92.0	85.5	-	91.1	74.2	78.9	-
[4]*	88.3	87.5	94.6	94.4	73.9	-	-
[7]	87.0	82.8	91.5	-	68.2	73.0	76.8
[5]	93.4	89.5	94.5	91.8	76.1	78.5	79.5
[27]	86.5	88.3	<u>95.4</u>	94.7	-	-	-
[32]	91.5	84.5	-	91.0	69.2	76.4	83.3
[24]	93.3	90.2	-	91.3	76.9	79.6	83.3
[25]	91.2	88.3	95.0	92.4	68.8	76.1	77.4
[28]	93.3	88.1	-	91.3	74.0	80.2	85.1
[34]**	95.3	91.8	95.2	<u>95.3</u>	<u>78.2</u>	83.6	88.5
MASTER(Ours)	<u>95.1</u>	<u>91.5</u>	96.9	95.7	79.6	84.5	88.54

Method	Case Sensitive		Case Insensitive	
	Total Edit Distance	Correctly Recognised Words (%)	Total Edit Distance	Correctly Recognised Words (%)
SenseTime-CKD	4,054.8236	41.52	824.6449	77.22
HIK_OCR	3,661.5785*	41.72*	<u>899.1009</u>	<u>76.11</u>
Tencent-DPPR Team	4,022.1224	36.91	1,233.4609	70.83
CLOVA-AI [49]	<u>3,594.4842</u>	<u>47.35</u>	1,583.7724	69.27
SAR [32]	4,002.3563	41.27	1,528.7396	66.85
HKU-VisionLab [40]	3,921.9388	40.17	1,903.3725	59.29
MASTER(Ours)	3,272.0810	49.09	1,203.4201*	71.33*

MASTER: Multi-Aspect non-local network for Scene Text Recognition, Ning Lu, Wenwen Yu, Xianbiao Qi, Yihao Chen, Ping Gong and Rong Xiao, Arxiv 2019.

An aerial photograph of the Hong Kong Observation Wheel, a large Ferris wheel with a distinctive triangular frame. The sun is setting directly behind the wheel's central hub, creating a bright orange glow. The sky is filled with soft, colorful clouds in shades of orange, pink, and blue. Below the wheel, a dense urban landscape of high-rise buildings is visible, along with a body of water and distant hills. The word "THANKS" is overlaid in a large, orange, serif font across the center of the image.

THANKS