



模式识别国家重点实验室
National Laboratory of Pattern Recognition



生物识别与安全技术研究中心

UG²+ CHALLENGE

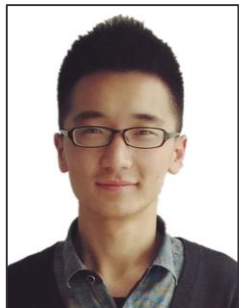


Selective Refinement Network for Dark Face Detection

Track 2.2

2019.06.16

Team Member



Shifeng Zhang



Ruizhe Liu



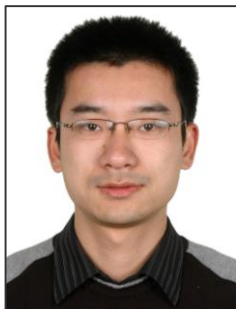
Cheng Chi



Zheming Zuo



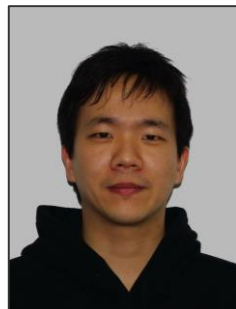
Chubing Zhuang



Zhen Lei



Shizheng Wang



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Stan Z. Li

Outline

- Introduction
- Solution Pipeline
- Image Enhancement
- Face Detection
- Result

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Introduction

- Face Detection: Determine whether there are faces on an image, and if so, give their location.



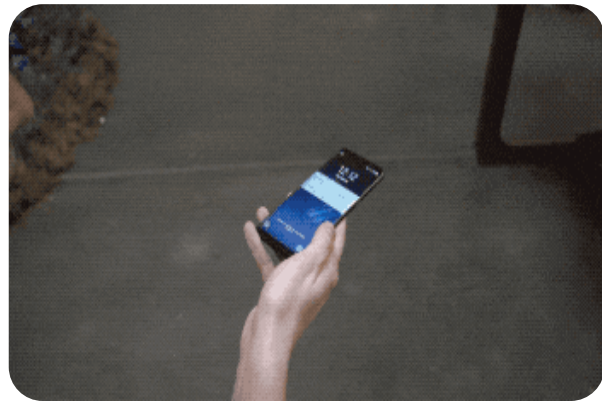
Introduction



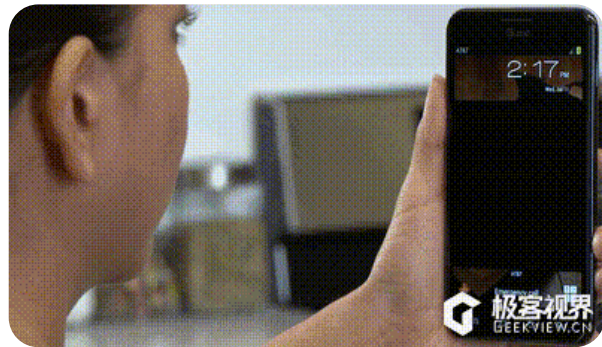
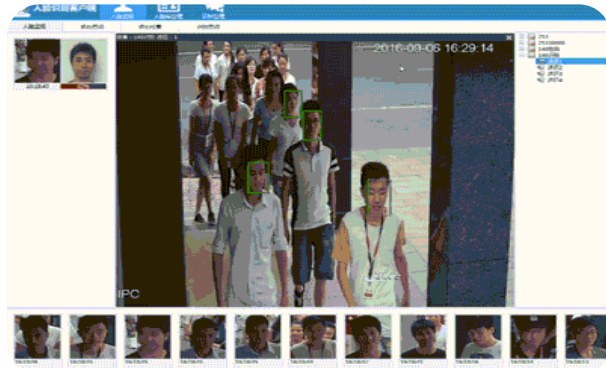
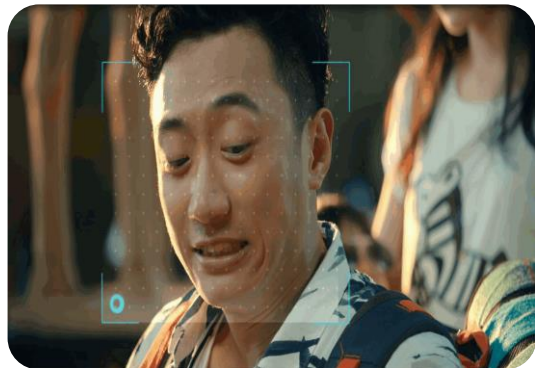
Face Analysis



Video Surveillance



Face Unlock

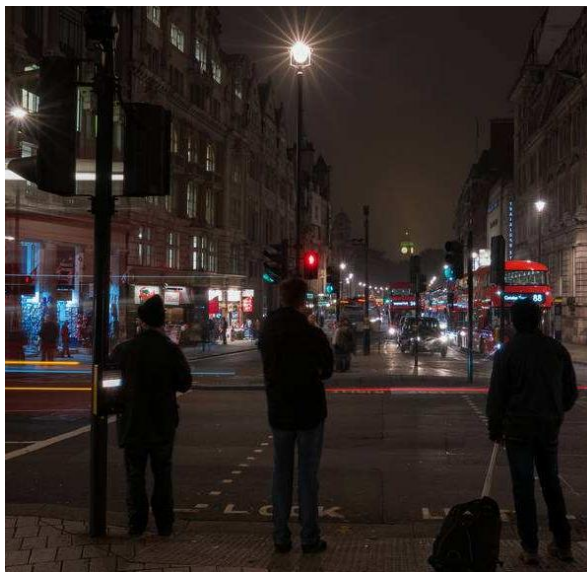


Introduction

- One of challenges: detecting faces in poor visibility environments.



Haze



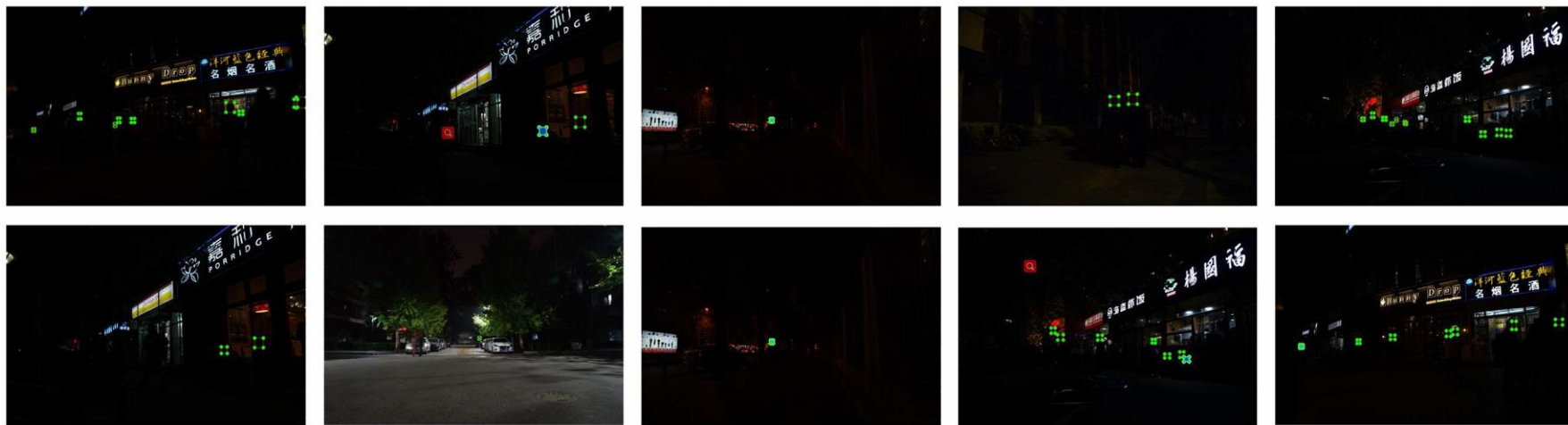
Low Light



Raindrop

Introduction

Track 2.2: (Semi-)Supervised Face Detection in Low Light Condition



- Captured during nighttime under low Light Conditions
- Training: 6,000 images with 43,849 faces
- Testing: 4,000 images with 32,571 faces

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Solution Pipeline

1. Train **SRN-Res101**^[1] on WIDER FACE dataset
2. Utilize **MSRCR**^[2] to process DARK FACE dataset
3. Fine-tune pretrained **SRN-Res101** on processed DARK FACE dataset

[1] C. Chi, S. Zhang et al. Selective refinement network for high performance face detection. AAAI, 2019.

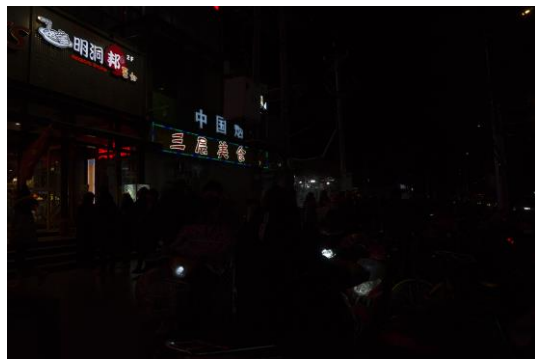
[2] S. Parthasarathy, P. Sankaran. An automated multi scale retinex with color restoration for image enhancement. NCC, 2012.

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Image Enhancement

- [3] X. Guo et al. Lime: Low-light image enhancement via illumination map estimation. TIP, 2017
- [4] C. Wei et al. Deep Retinex Decomposition for Low-Light Enhancement. BMVC, 2018
- [5] Z. Zuo et al. Saliency-informed spatio-temporal vector of locally aggregated descriptors and fisher vectors for visual action recognition. BMVC, 2018



Original



Lime^[3]



RetinexNet^[4]



Convolution



Saliency^[5]



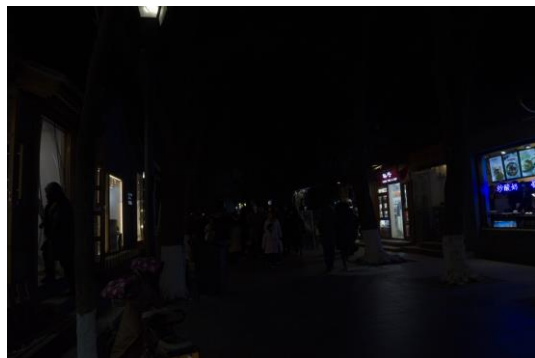
MSRCR

Image Enhancement

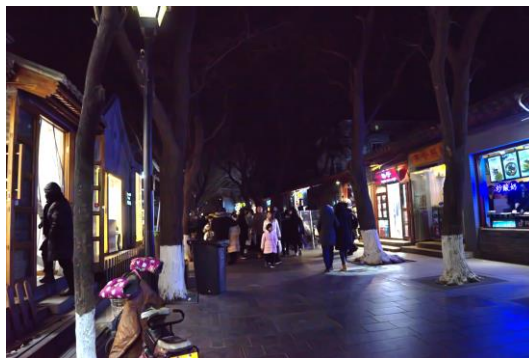
[3] X. Guo et al. Lime: Low-light image enhancement via illumination map estimation. TIP, 2017

[4] C. Wei et al. Deep Retinex Decomposition for Low-Light Enhancement. BMVC, 2018

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Original



Lime^[3]



RetinexNet^[4]



Convolution



Saliency^[5]

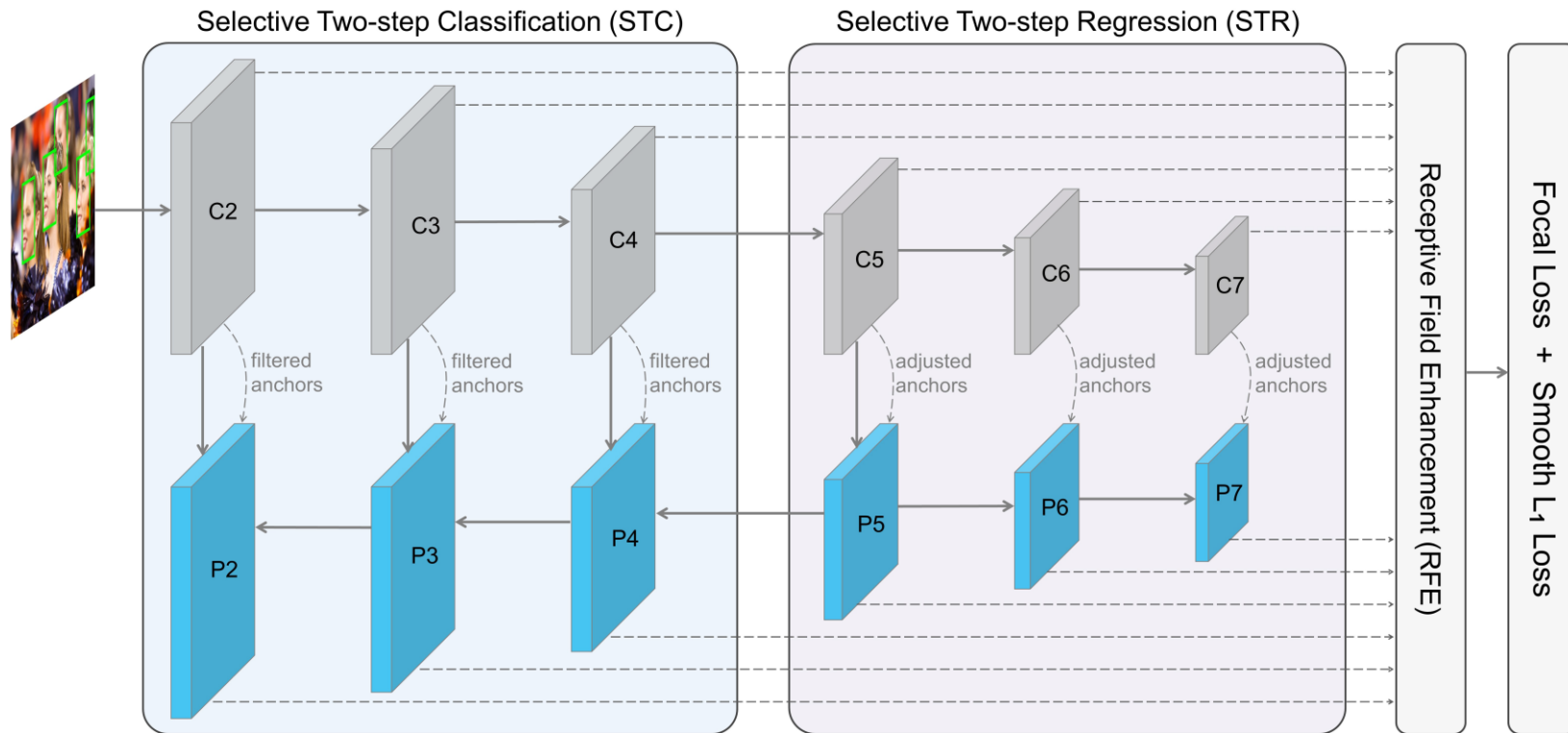


MSRCR

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Face Detection



- Selective Refinement Network (SRN): STC, STR, RFE

1. Selective Two-Step Classification (STC)

- Need to tile plenty of small anchors to detect small faces
- Cause extreme class imbalance between positives and negatives
- The number of positive samples is only a few dozen or less
- Doing two-step classification is essential to reduce the false positives
- Performing two-step classification on all pyramid levels is unnecessary

STC	B	P2	P3	P4	P5	P6	P7
<i>Easy</i>	95.1	95.2	95.2	95.2	95.0	95.1	95.0
<i>Medium</i>	93.9	94.2	94.3	94.1	93.9	93.7	93.9
<i>Hard</i>	88.0	88.9	88.7	88.5	87.8	88.0	87.7

- Select P2, P3, and P4 to perform two-step classification

2. Selective Two-Step Regression (STR)

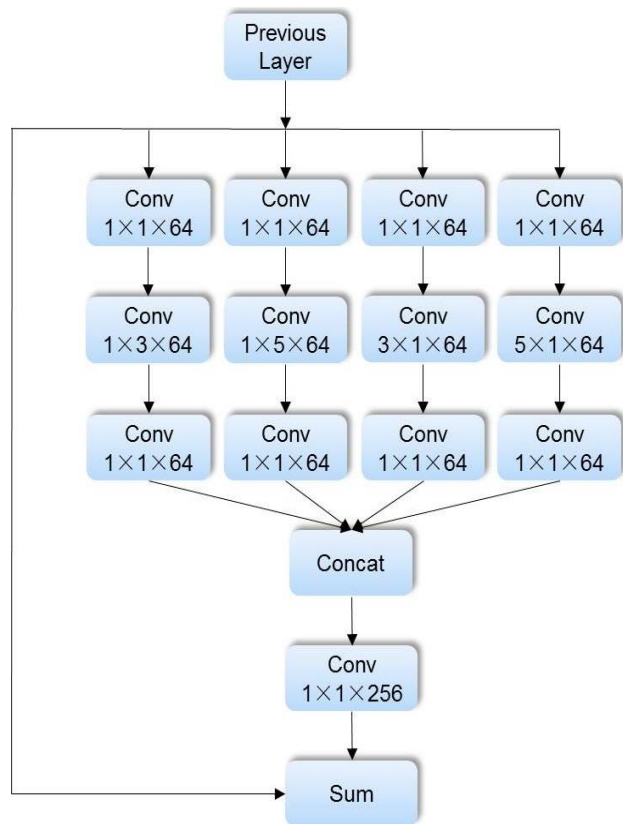
- Making the location of bounding box more accurate is a challenging issue
- Current one-stage methods rely on one-step regression
- It is inaccurate the in MS COCO evaluation metric
- Blindly adding multi-step regression is often counterproductive

STR	B	P2	P3	P4	P5	P6	P7
<i>Easy</i>	95.1	94.8	94.3	94.8	95.4	95.7	95.6
<i>Medium</i>	93.9	93.4	93.7	93.9	94.2	94.4	94.6
<i>Hard</i>	88.0	87.5	87.7	87.0	88.2	88.2	88.4

- Select P5, P6, and P6 to perform two-step regression

3. Receptive Field Enhancement (RFE)

- Current networks possess square receptive fields
- Mismatch between receptive fields and aspect ratio of faces affect the detection performance
- Propose RFE to diversify receptive fields before predicting classes and locations
- RFE replaces the middle two convolution layers in the class and box subnet of RetinaNet



Training Detail

- Backbone: ResNet-101 with 6-level FPN
- Loss: sigmoid focal loss + smooth L1 loss
- Data augmentation: color distortions, random cropping, random flipping
- Anchor design: two specific scales ($2, 2\sqrt{2}$) and one aspect ratio (1.25)
- SGD, 0.9 momentum, 0.0001 weight decay, batch size 32
- Learning rate to 0.01, 0.001 and 0.0001 for the 100, 20 and 10 epochs

Code has been released publicly:

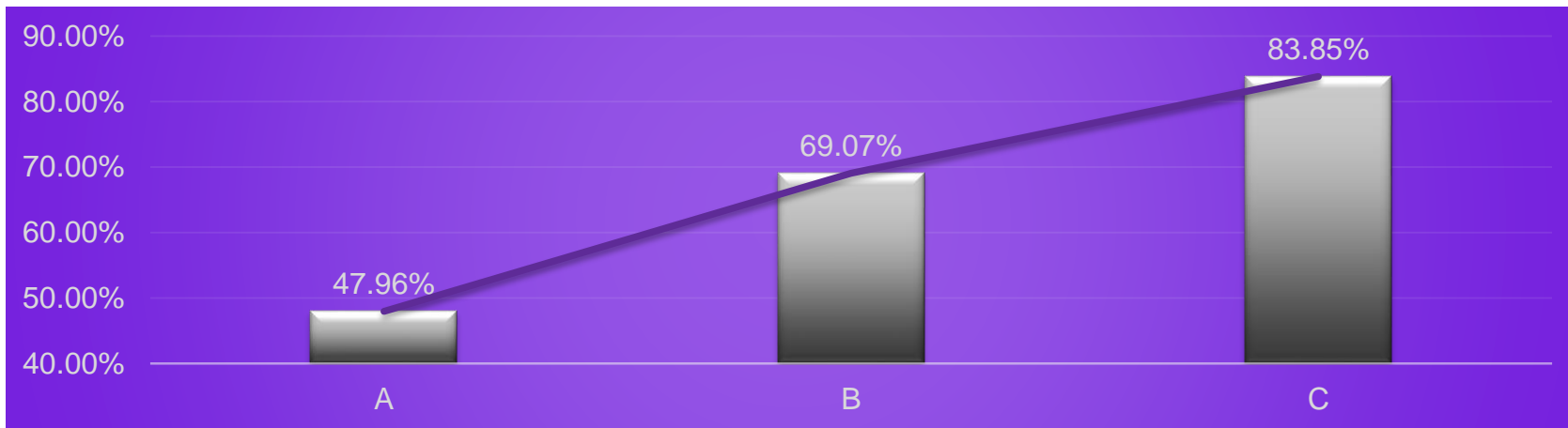


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Result

Experiment	Training Dataset	Testing Dataset	AP
A	WIDER FACE	DARK FACE	47.96
B	WIDER FACE	Processed DARK FACE	69.07
C	WIDER FACE +Processed DARK FACE	Processed DARK FACE	83.85



Thank you!