Crowd Counting via Multi-layer Regression

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Introduction

Crowd counting estimates the number of persons in a crowd image

Challenge: as congestion degree varies, people's appearances may seem different

Contribution: we propose the **first** method which estimates crowd densities on crowd regions with different regressors to provide more accurate crowd counting results
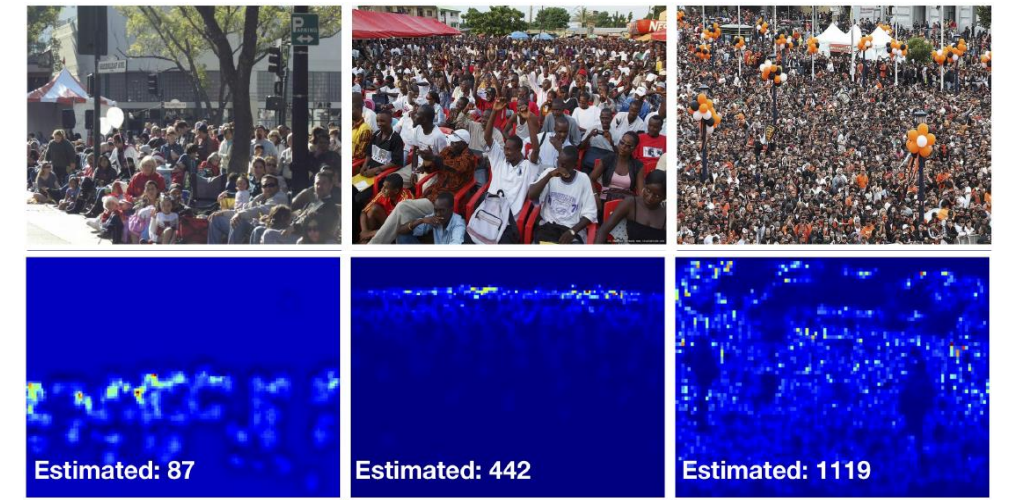
Method

We propose a **Multi-layer Regression Network (MRNet)** based crowd counting method

- **Recognition branch:** disintegrate a crowd image into background and several crowd regions with different congestion degrees
- **Density regressor:** generate a density map for the crowd regions with the specific congestion degree

MRNet framework

recognition branch

density regressor
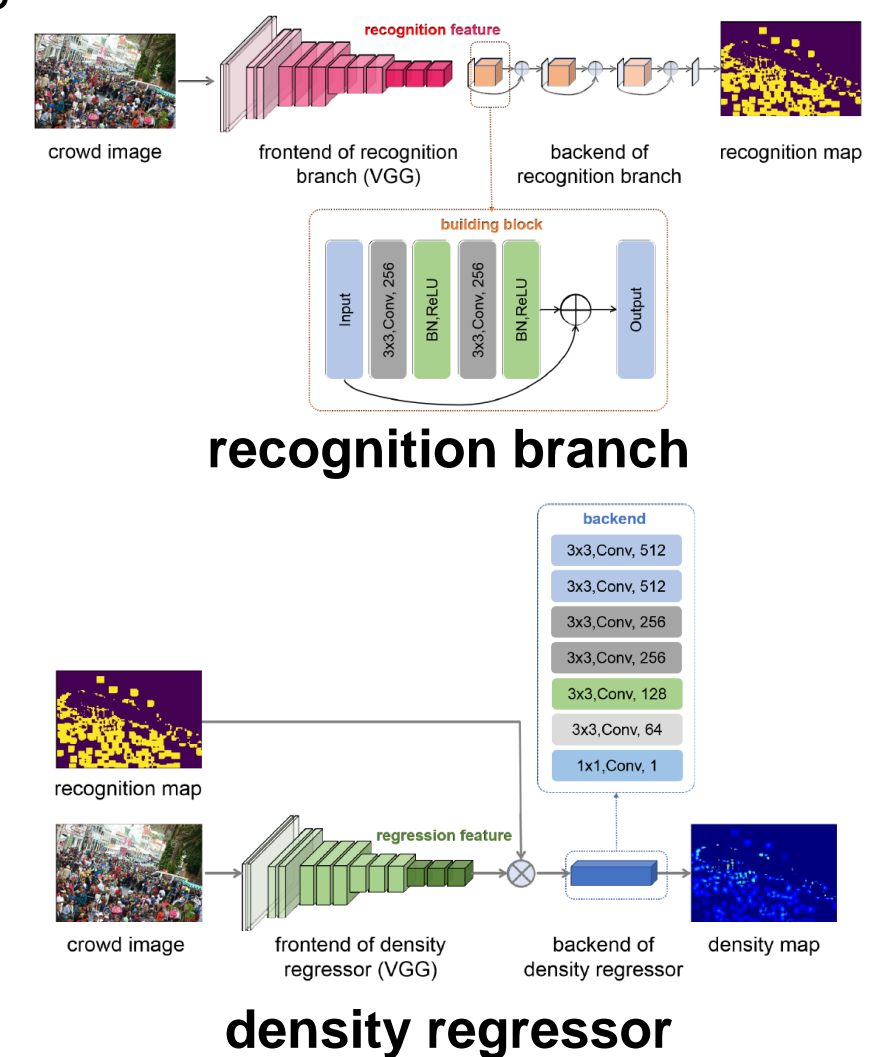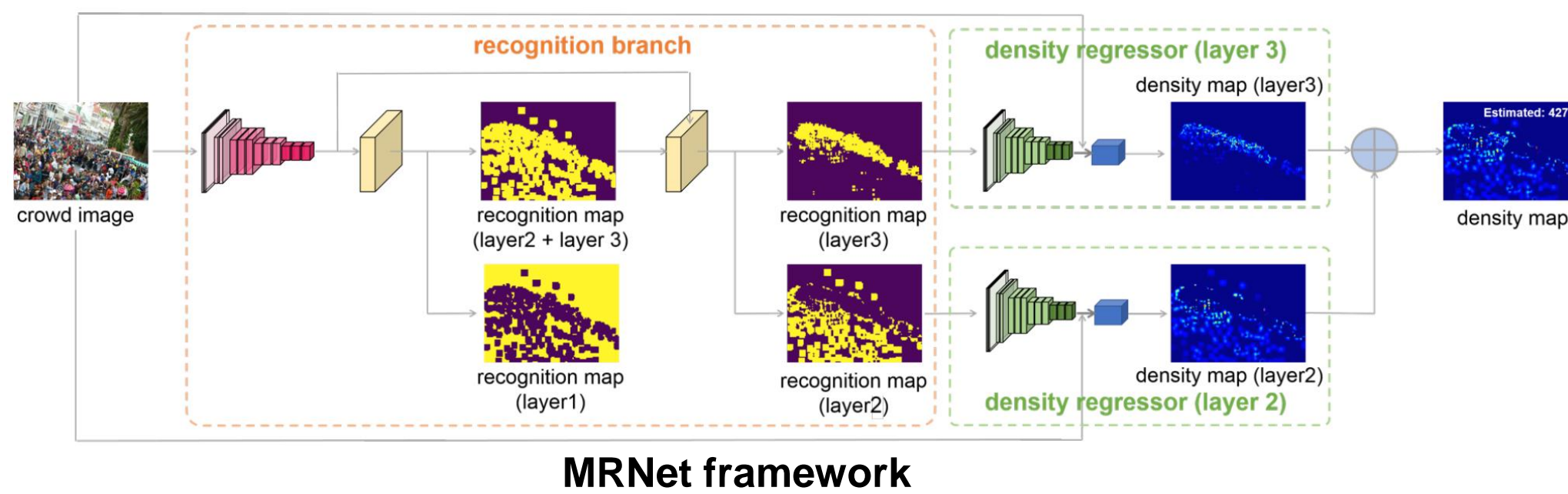
Experiments

Datasets

ShanghaiTech, UCF_CC_50, UCF-QNRF, WorldExpo'10

Evaluation criteria

$$MAE = \frac{1}{N} \sum_{i=1}^{N} |C_i - C_i^g|$$

$$MSE = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (C_i - C_i^g)^2}$$
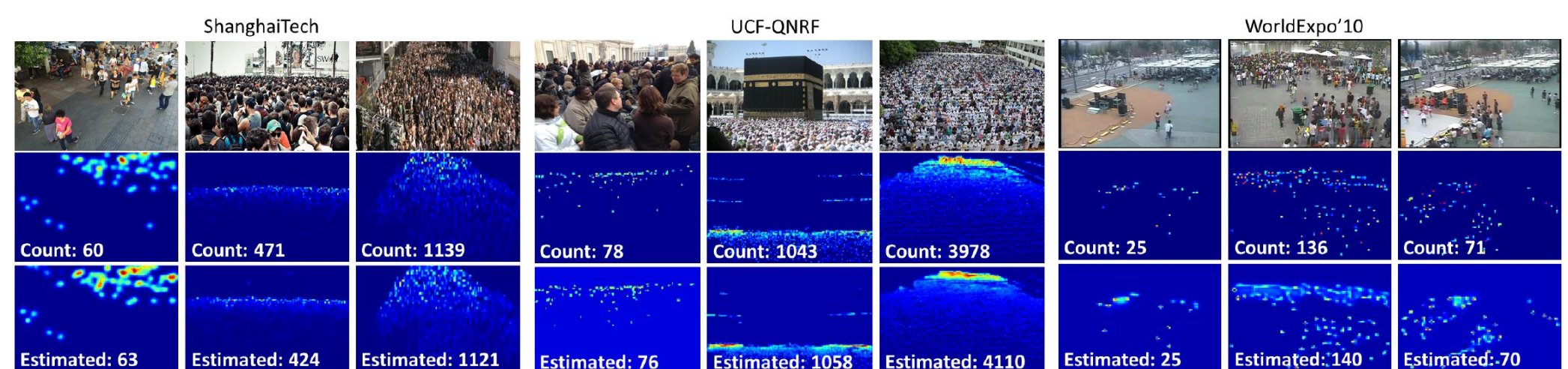
Component analysis

Configuration	MAE	MSE
MRNet (2-layer)	65.8	106.5
MRNet (3-layer)	**63.3**	**97.8**
MRNet (4-layer)	66.4	108.0
MRNet (3-class)	67.1	108.8

multi-layer disintegration strategy

Window Size	MAE	MSE
32	261.4	375.0
64	252.7	342.1
80	**232.3**	**314.8**
128	247.3	344.3

window size

Qualitative results

Comparison with the state-of-the-arts

Method	SHT Part_A		SHT Part_B		UCF_CC_50		UCF-QNRF		WorldExpo'10	
	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE	MAE	MSE
MCNN [34]	110.2	173.2	26.4	41.3	377.6	509.1	277.0	426.0	11.6	-
Cascaded-MTL [26]	101.3	152.4	20.0	31.1	322.8	397.9	252.0	514.0	-	-
Switching-CNN [23]	90.4	135.0	21.6	33.4	318.1	439.2	228.0	445.0	9.4	-
CP-CNN [27]	73.6	106.4	20.1	30.1	295.8	320.9	-	-	8.9	
CSRNet [15]	68.2	115.0	10.6	16.0	266.1	397.5	-	-	8.6	
CL [13]	-	-	-	-	-	-	132.0	191.0	-	-
SANet [3]	67.0	104.5	8.4	13.6	258.4	334.9	-	-	8.2	
ADCrowdNet (AaD) [17]	70.9	115.2	7.7	**12.9**	273.6	362.0	-	-	**7.3**	
ADCrowdNet (AbD) [17]	**63.2**	**98.9**	8.2	15.7	266.4	358.0	-	-	7.7	
SFCN (ImgNet) [32]	-	-	8.9	14.3	-	-	114.8	192.0	-	-
SFCN (GCC) [32]	64.8	107.5	**7.6**	13.0	**214.2**	**318.2**	**102.0**	**171.4**	9.4	
Ours	**63.3**	**97.8**	**7.5**	**11.5**	**232.3**	**314.8**	**111.1**	**182.8**	**7.1**	9.77

red denotes the first place and **blue** denotes the second place

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