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Crowd Counting via Multi-layer Regression

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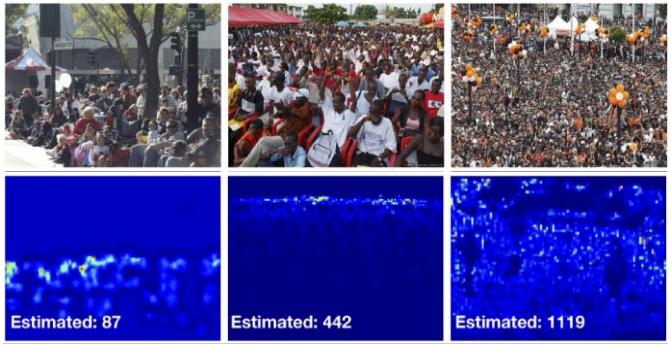
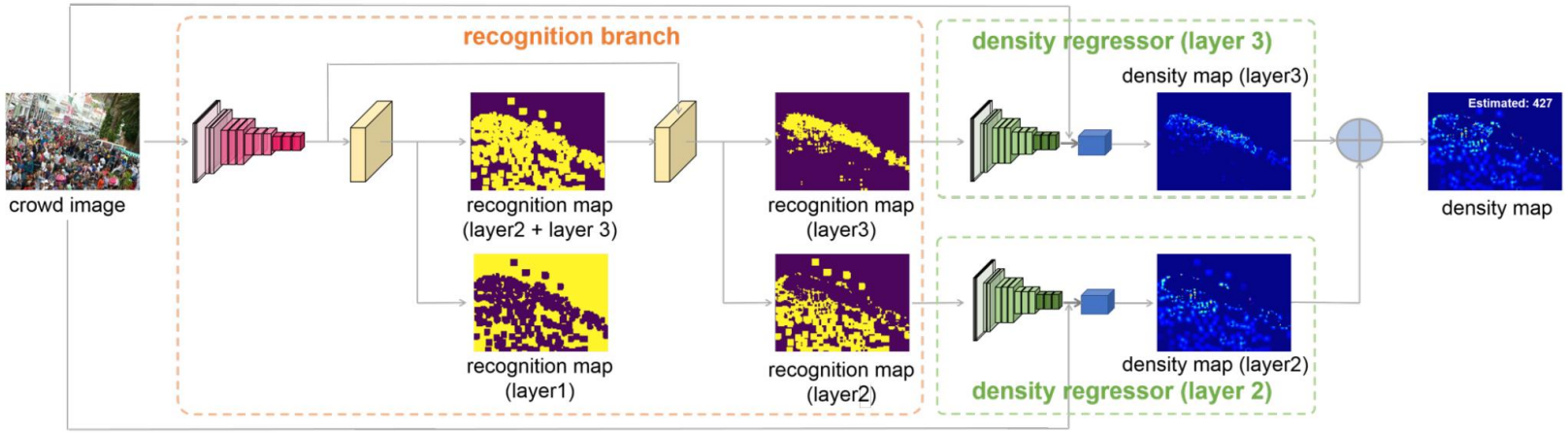
MAGUS
MediA recoGnition
and UnderStanding

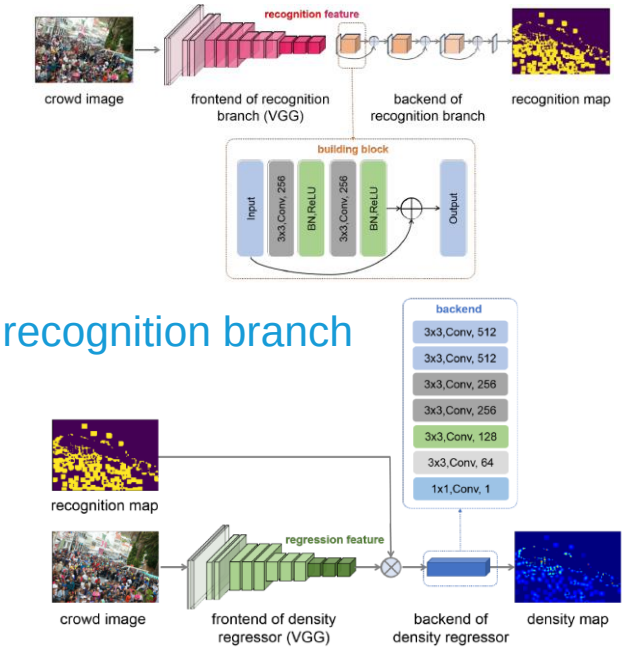
Motivation and Solution

- **Crowd counting** estimates the number of persons in a crowd image
- Challenge: as congestion degree varies, people's appearances may seem different
- Our solution: **Multi-layer Regression Network (MRNet)**
  - **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



density regressor

Experiments

- Datasets: ShanghaiTech, UCF_CC_50, UCF-QNRF and WorldExpo'10 datasets
- Evaluation criteria: MAE and MSE

$$MAE = \frac{1}{N}\sum_{i=1}^{N}|C_i - C_i^g| \qquad MSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(C_i - C_i^g)^2}$$

- Comparison
  - Our method **outperforms** the state-of-the-art methods

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

Different multi-layer disintegration strategies

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

Different Window sizes

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

Overall