CROWD COUNTING

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INTRODUCTION

On the night 29/10/2022, 159 people were killed in a stampede in Itaewon (Seoul, Korea).

Therefore, estimating crowd sizes accurately from images or videos has become an increasingly important application of computer vision technology for crowd control and public safety. In some cases, such as public rallies and sporting events, the number or density of participants is critical for future event planning and space design.

PROBLEM DEFINITION

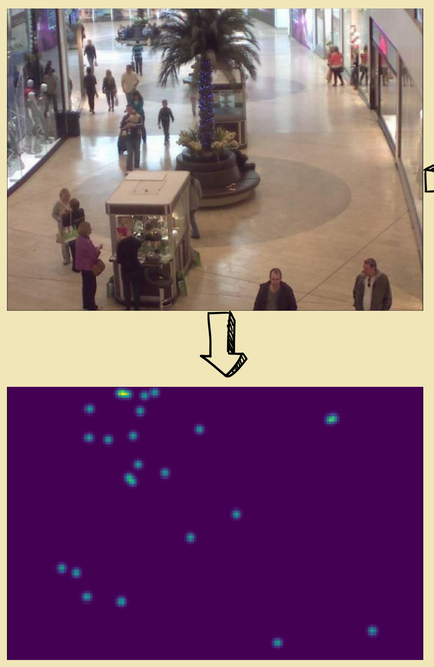
The people in a certain area are called a ***crowd***.
Examples: stage, festival,...
Crowd Counting is a problem to estimate the number of people in an image.

INPUT-OUTPUT

Input: a digital image

Output:
- Number of people
- Density map

EXAMPLE

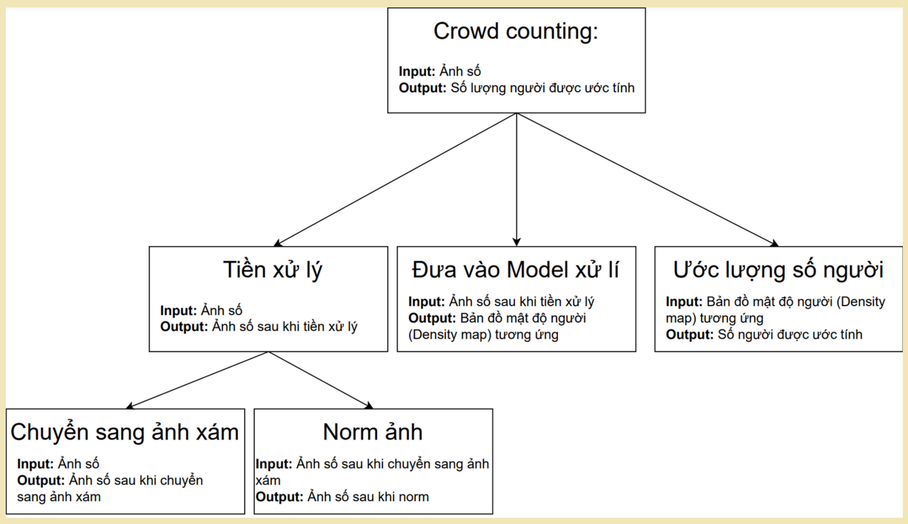


ABSTRACTION

The input is an image that contains one or more individuals. Besides, some constraints for input and output are also set as follows:

- Size of the input image: 128 <= width <= 1024, 128 <= height <= 768.
- The problem can handle difficult cases such as lighting or background but the accuracy may be reduced.
- Counting people does not aim for absolute accuracy.

DECOMPOSITION

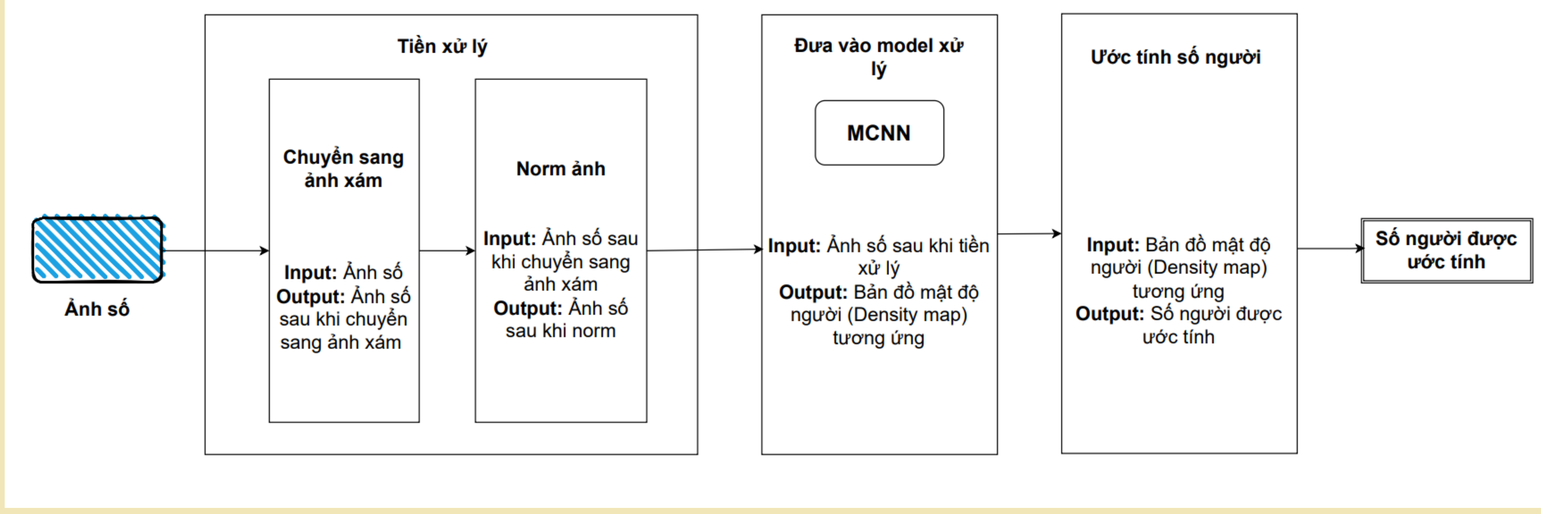


PATTERN RECOGNITION

The input-output of the general problem is combination of input and output:

Density map estimation:
- **Input**: an image may or may not have people.
- **Output**: a scale image, where the intensity or color of each pixel represents the density value. Brighter or higher intensity pixels correspond to higher crowd densities, while darker or lower intensity pixels represent lower crowd densities.

ALGORITHM



METRIC

Mean Squared Error (MSE):

$$\mathrm{MSE} = \frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y}_i)^2$$

Mean Absolute Error (MAE):

$$\mathrm{MAE} = \frac{1}{N}\sum_{i=1}^{N}|y_i - \hat{y}_i|$$

CONCLUSION

Crowd counting problem in general gave relatively acceptable results, the solution also solves the problem of low resolution. However, in some cases of occluding, the model does not detect well. In the future, the team will continue to learn and overcome the existing weaknesses.