FACULTY OF ENGINEERING
AND ARCHITECTURE

PROJECT COMPUTERVISION

Group 7 – 07/06/2021

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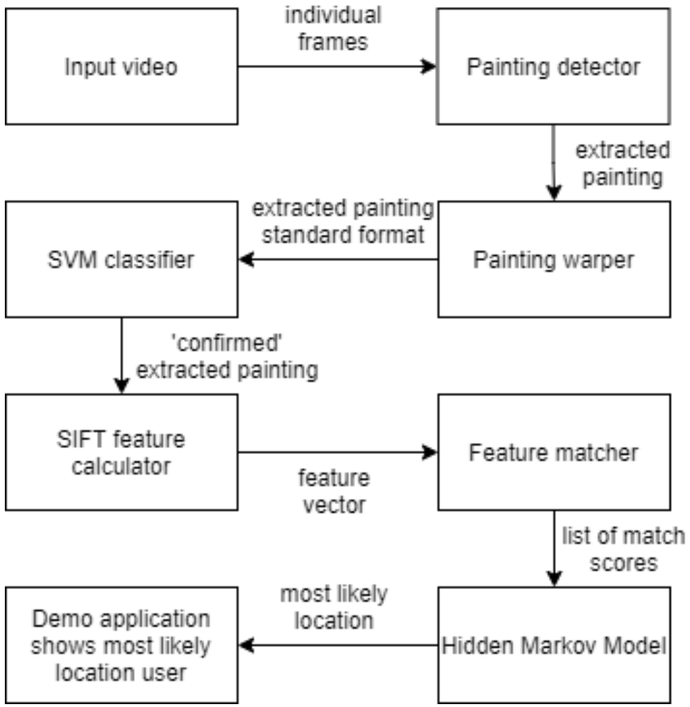
OVERVIEW

- Painting detection and extraction
- Painting classification
- Painting matching
- Localization
- Demo
- Conclusion and future work



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PAINTING DETECTION AND EXTRACTION

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DETECTION PHASES

- Filtering
  - Gray scale
  - Bilateral
  - Otsu’s thresholding
- Edge detection
  - Canny
  - Dilation
- Painting detection and extraction

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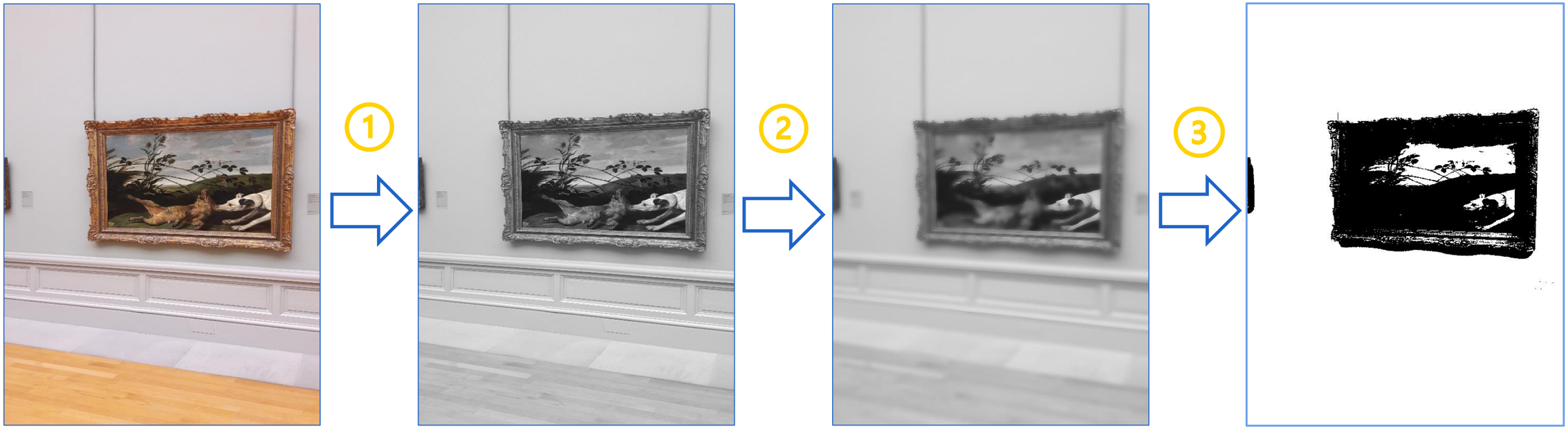
FILTERING



1. Convert to gray scale
2. Apply bilateral filter
3. Apply Otsu’s thresholding
4. The image is now ready to be edge-detected

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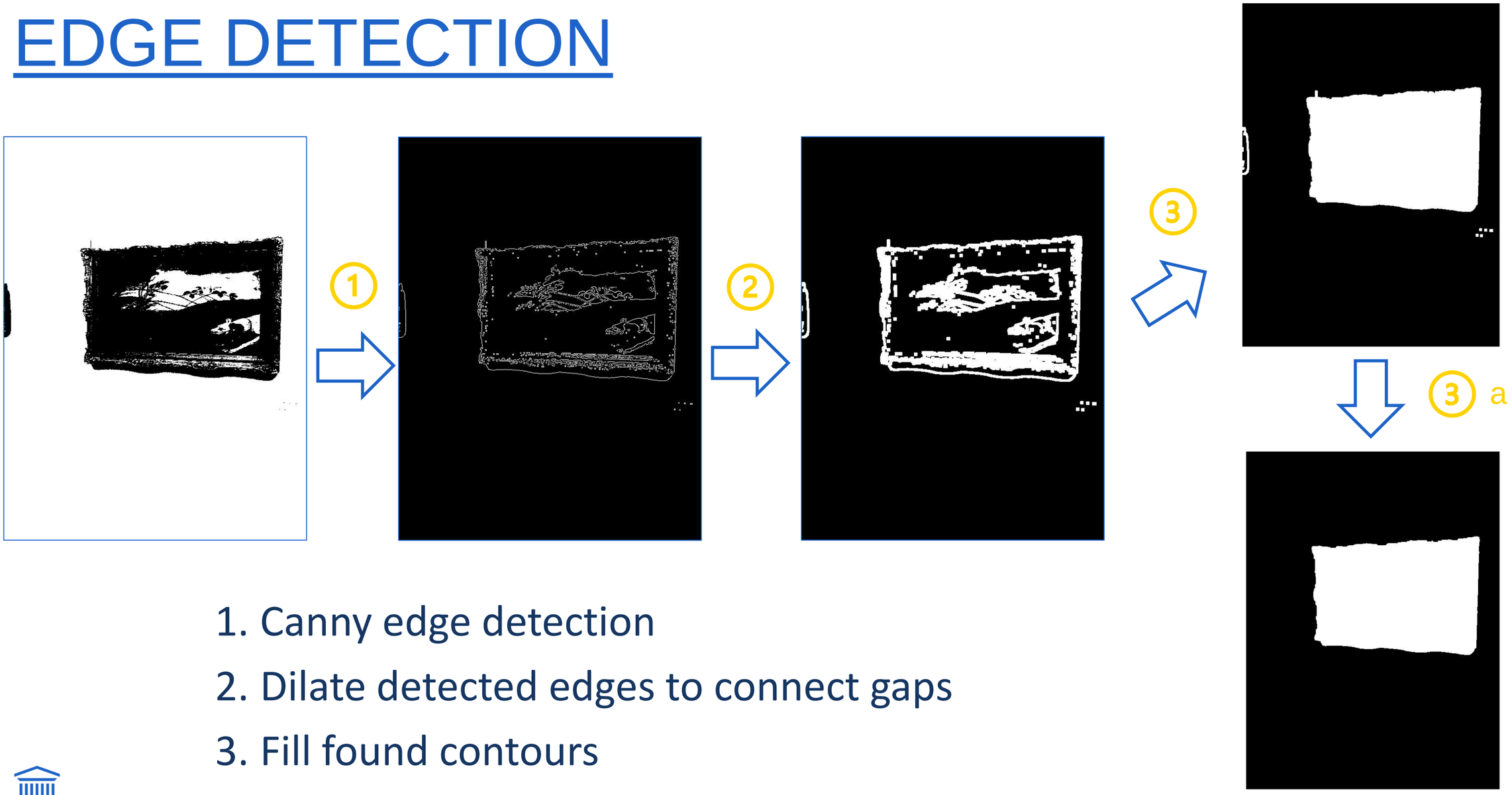
EDGE DETECTION



1. Canny edge detection
2. Dilate detected edges to connect gaps
3. Fill found contours
    a. Optional: erode away noise

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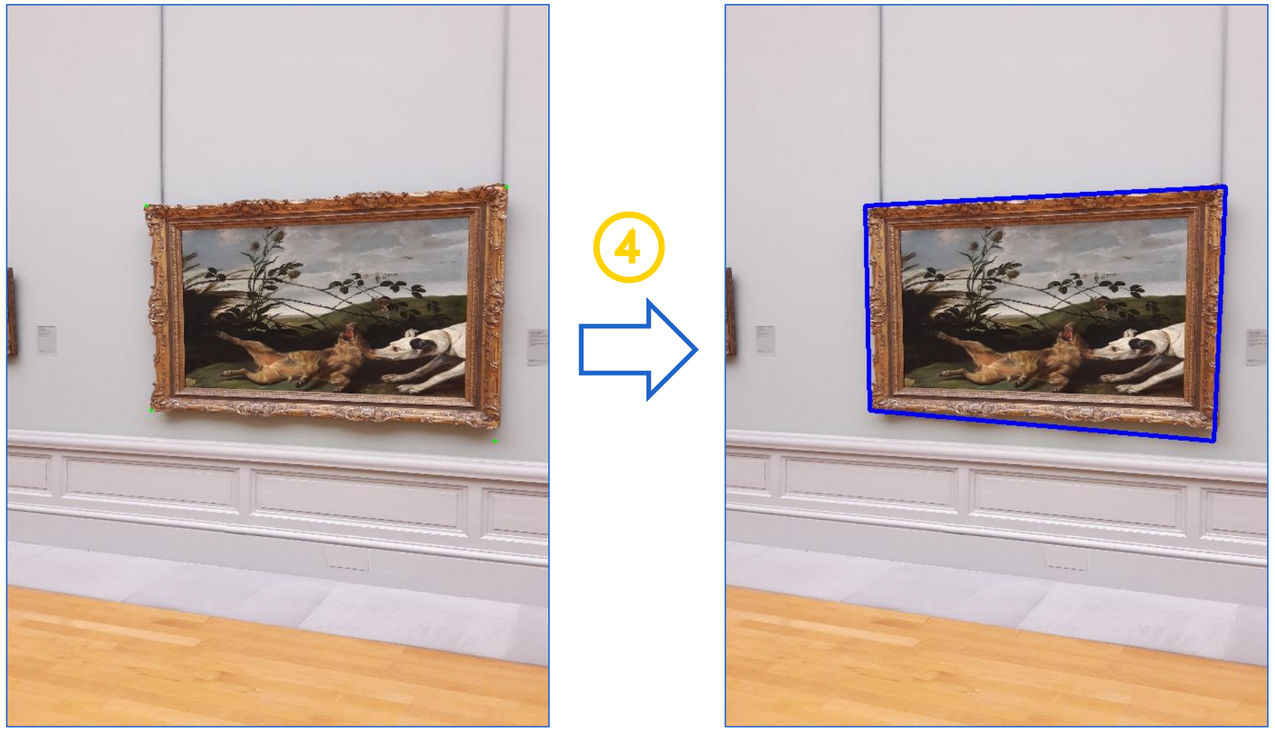
PAINTING DETECTION & EXTRACTION

1. Approximate contours to shapes
2. Set area constraints for detected shapes to >20% of largest found area
3. Set # of corners constraint to four corners
4. Connect four found corners for visualization (demo)
5. Extract painting to standard scale and orientation using perspective transform



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PAINTING CLASSIFIER

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SUPPORT VECTOR MACHINE

- Supervised machine learning algorithme
- Binary classification (environment or painting)
- Feature vector 32x32 image patch:
  - Histogram of oriented gradients (HOG)
  - Color histogram
- Normalize
- Balance trainings data (subsampling)

Accuracy (%)	Precision (%)	Recall (%)	F1-score (%)
80	81	80	80

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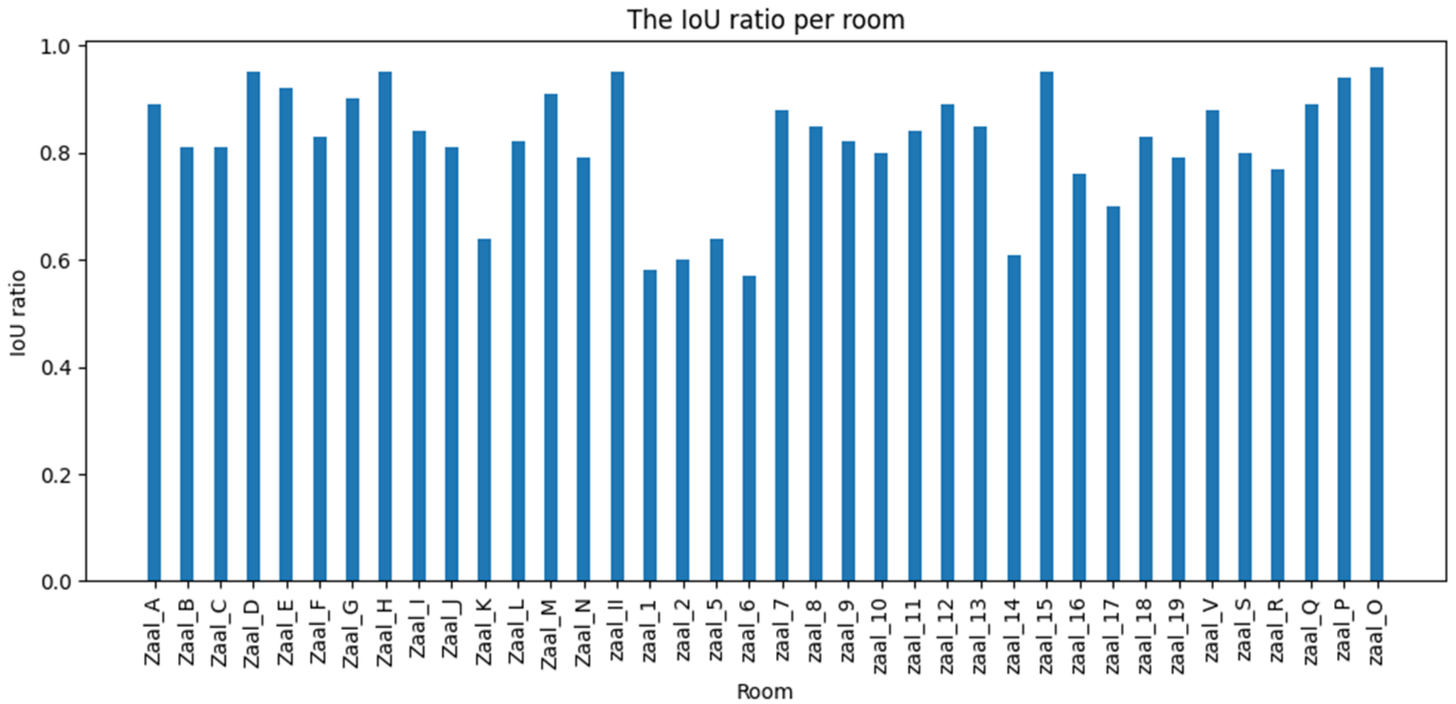
CLASSIFIER RESULTS

- Discard extracted painting :

  Exceeds environment over painting ratio

- False positives: 103
- False negatives: 197



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Current speaker: Arne Callaert

PAINTING MATCHING

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PAINTING MATCHING

- SIFT matching
- save keypoints, descriptors and metadata to a database
- calculate keypoints and descriptors once
- filter matches as per Lowe’s ratio test
- return a sorted list of all matched sets (ranked by best matches)

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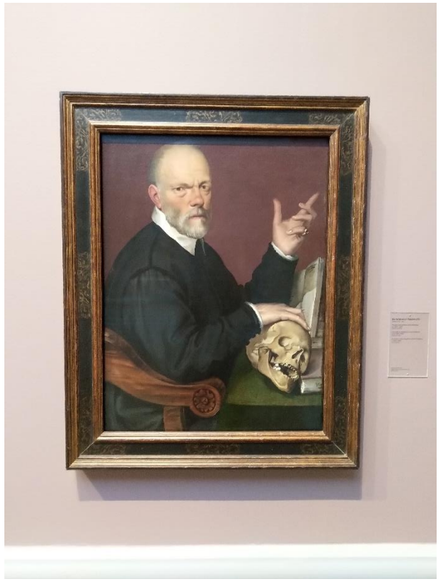
PAINTING MATCHING

- SIFT beneficial for environment of use
- evaluated on dataset
  - extraction from picture
  - matching



Matching performance	
Correct match	88,76 %
Correct match, excluding images with no matches	91,86 %
Average matching score for correct painting	62,83 %

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LOCALIZATION

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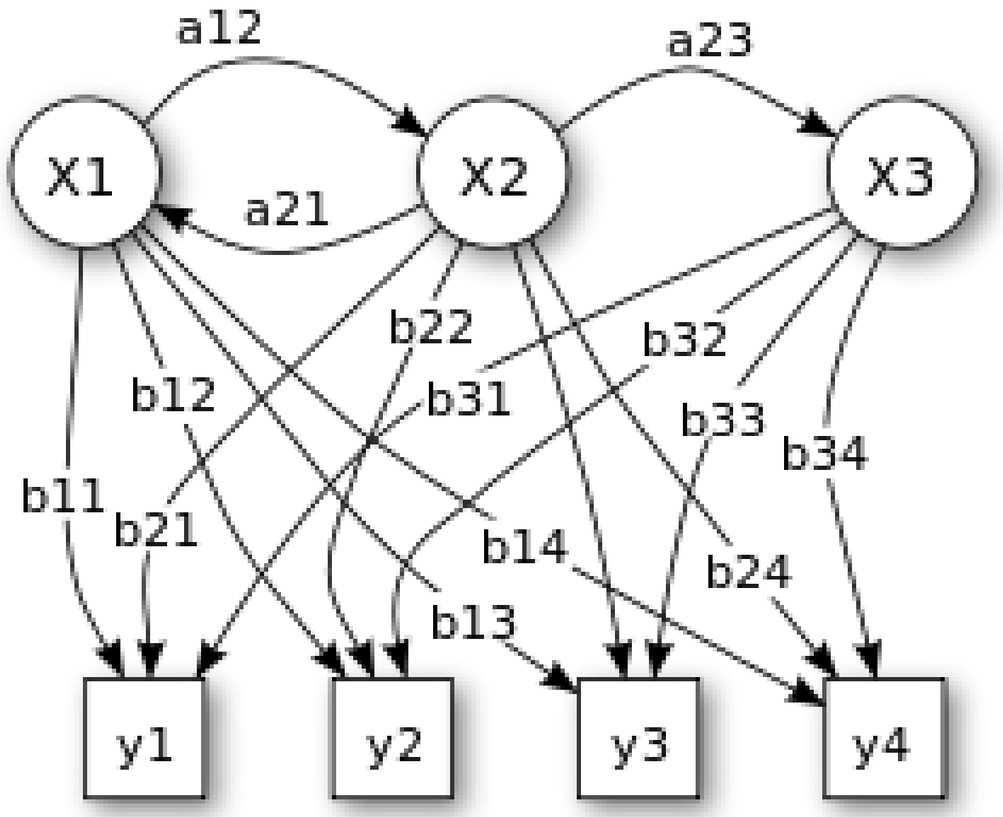
HIDDEN MARKOV MODEL



- X: Staten = zalen
- y: Observaties = schilderijen
- a: Transitieprobabiliteit
- b: Emissieprobabiliteit

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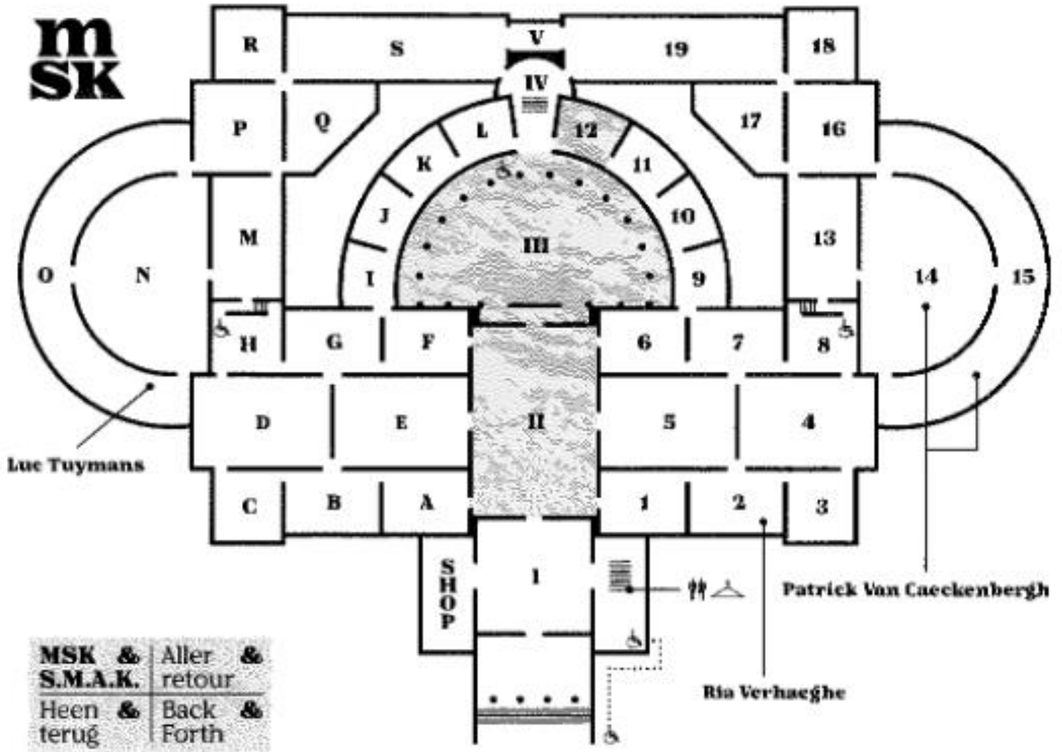
TRANSITIEPROBABILITEIT

Kans van zaal j naar i =

$$\frac{\#schilderijen\ in\ zaal\ i}{\sharp\ schilderijen\ in\ zalen\ waar\ j\ is\ mee\ geconnecteerd\ (inclusief\ zaal\ j\ zelf)}$$



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EMISSIEPROBABILITEIT

- Top 10 gematchte databaseschilderijen worden toegewezen aan één van de zalen
- De emissieprobabilieit bedraagt dan:

$$\frac{score\ top\ 10\ -score\ 11e\ match}{topscore}$$

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KANS OP HUIDIGE STAAT

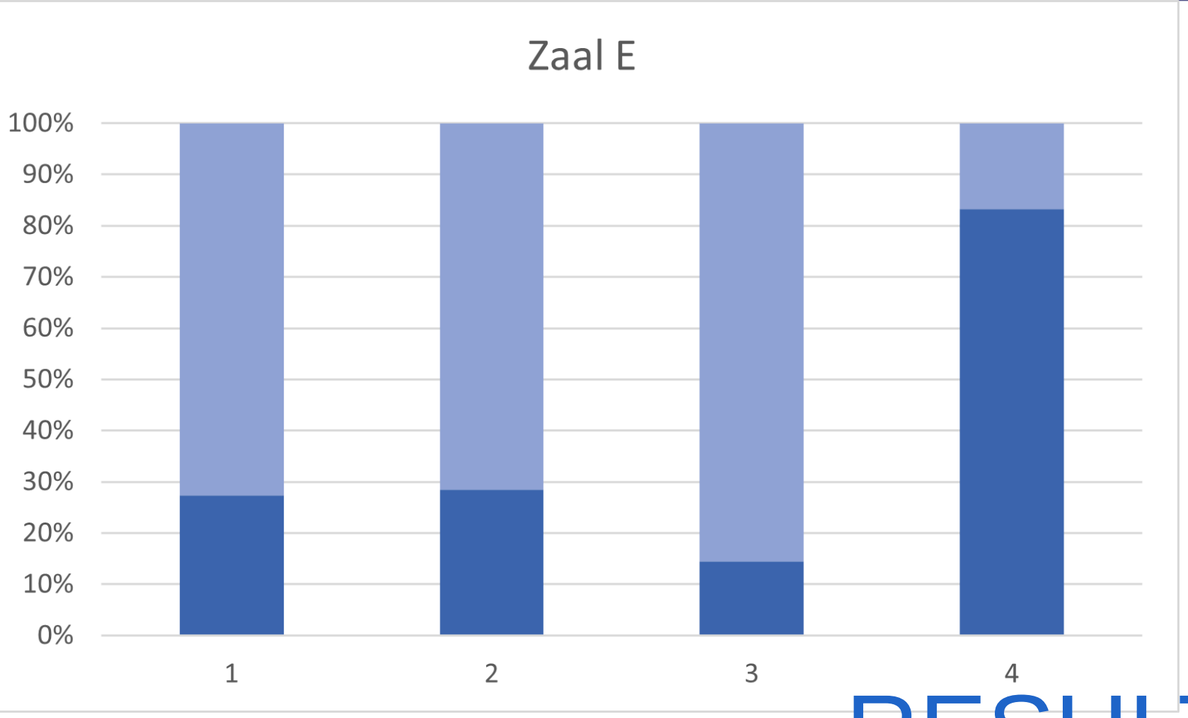
$$kans\ huidige\ staat\ is\ A$$

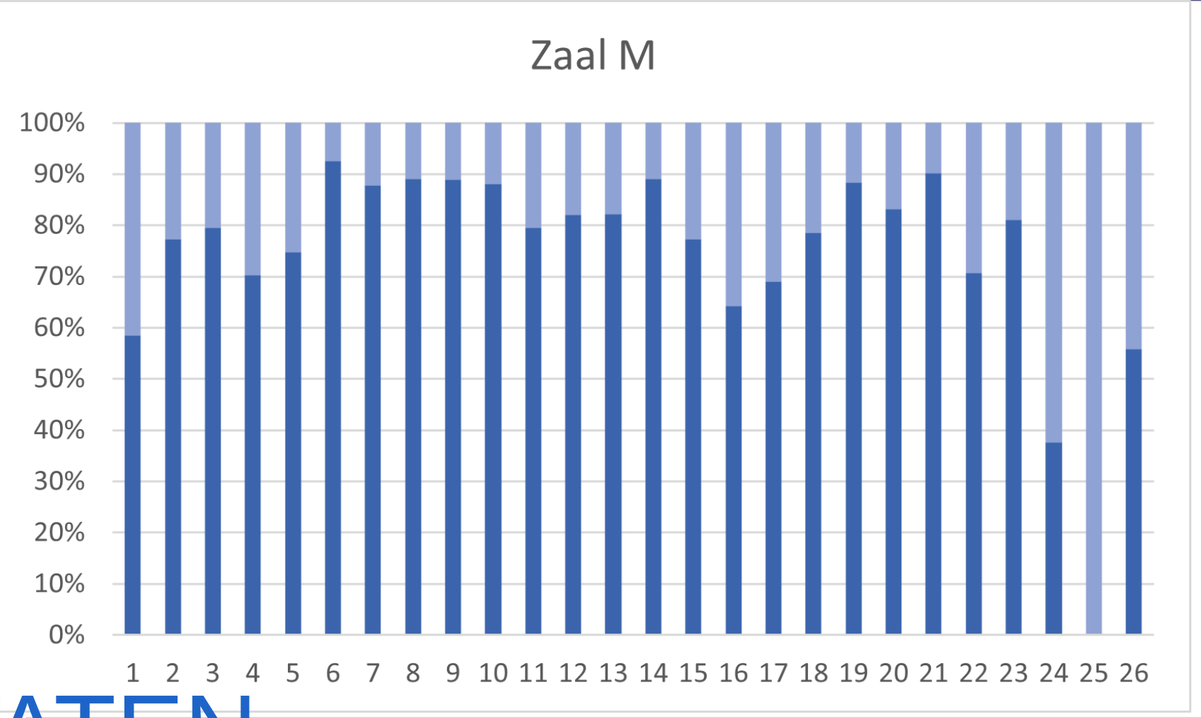
$$= \frac{emissieprob * (P(x_0 = A) * transitieprobVanAnrA + P(x_0 = B) * transitieprobVanBnrA + \cdots)}{\sum teller\ van\ elke\ kans}$$

KANS DAT VORIGE STAAT A WAS

KANS DAT VORIGE STAAT B WAS

RESULTATEN


Zaal E
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4


Zaal M
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70%
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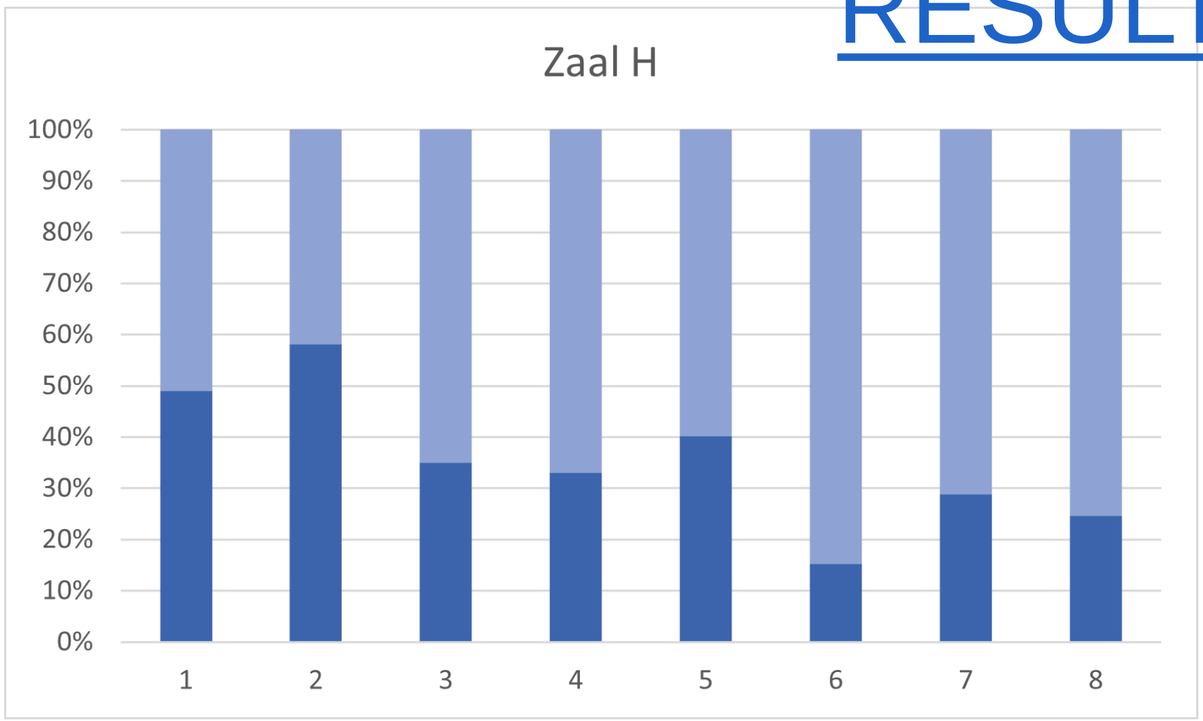
20%
10%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26


Zaal H
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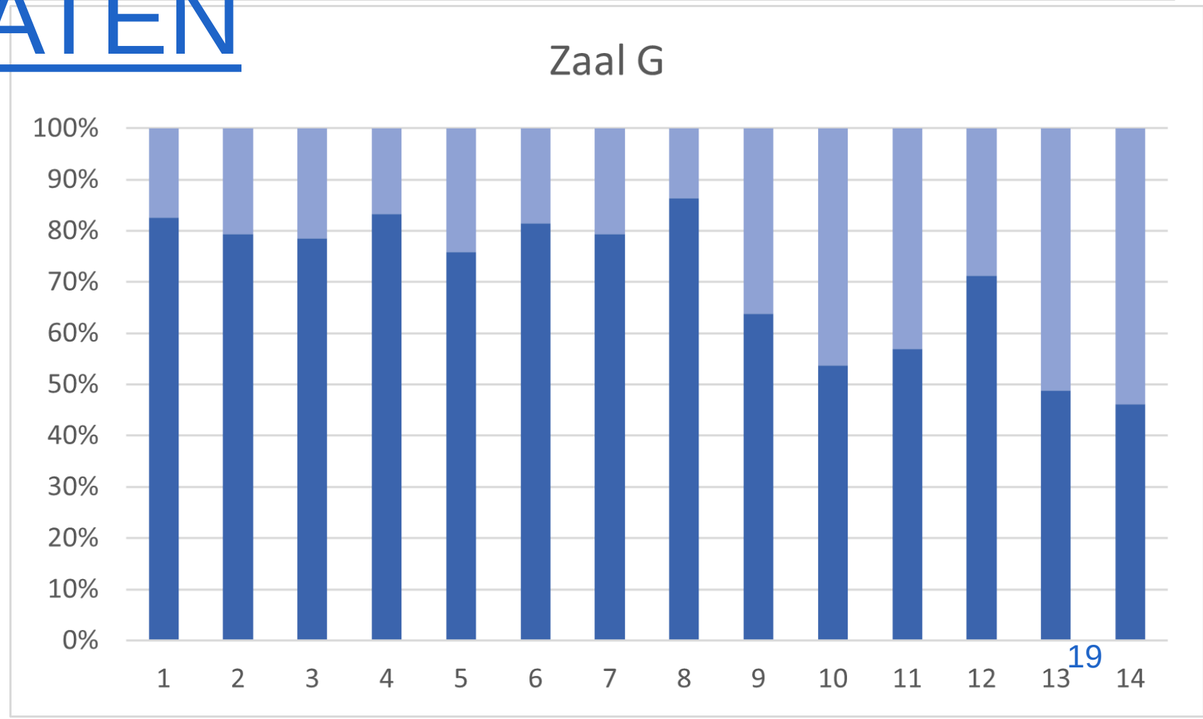
Zaal G
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60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9 10 11 12 13 14

DEMO

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LENS DISTORTION

- GoPro = Wide angle lens
- Solution: Calculate camera intrensic parameters

UNDISTORT - RESULT

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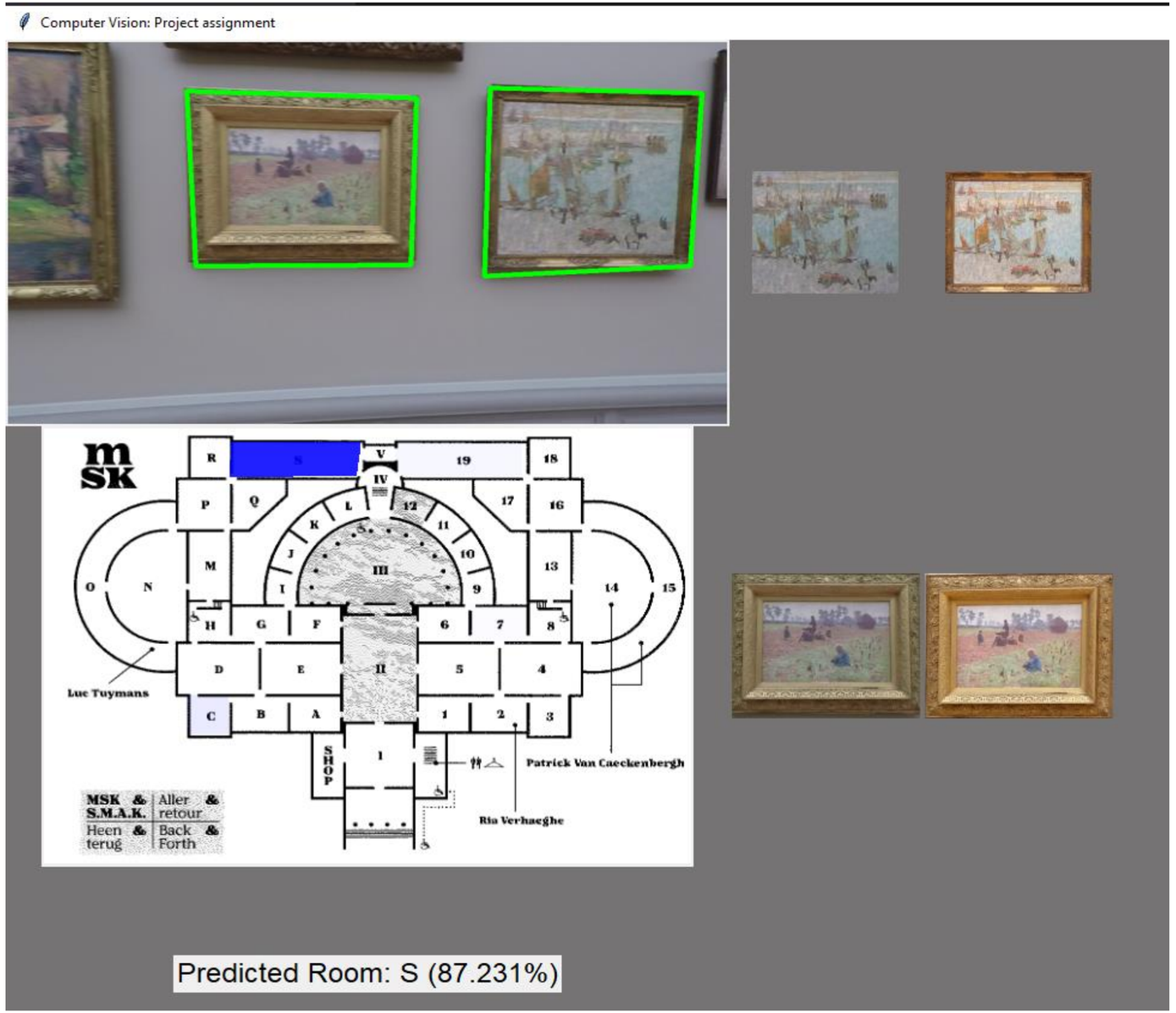
DEMO

- Frame buffering
- Minimum polygon size
- Blurriness validation
- Contrast validation



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Current speaker: Arno Hernou

CONCLUSION

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CONCLUSION

- Still many improvements possible
- Guesses location in a top 5
- Extraction and matching perform
  - Reasonably well in well-lit testing set
  - Worse on poorly-lit video room

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FUTURE WORK

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FUTURE WORK

- Color histogram for matching
- Scaling all images to the same size and compute with ORB
- Matching dependent on HMM
- Room-dependent preprocessing

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