# Rebuilding the cadastral map of the Netherlands:

# the Artificial Intelligence solution

## FIG 2021 Online Conference

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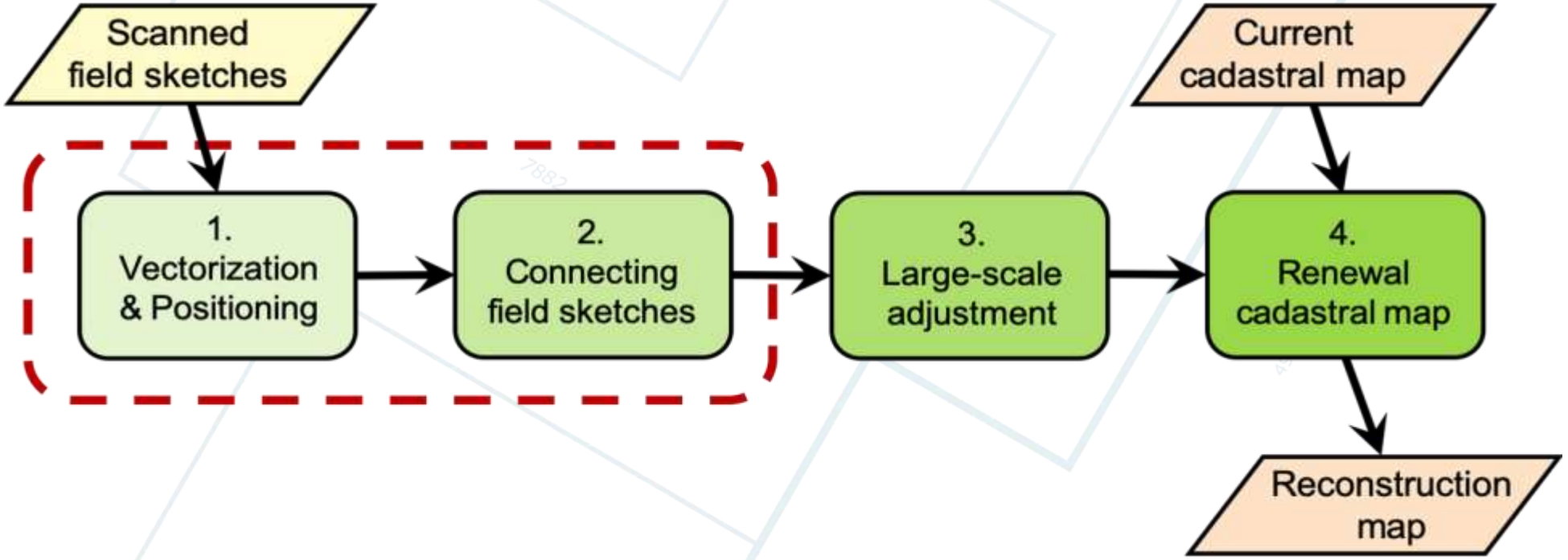
# Approach: from field sketches to updated cadastral map



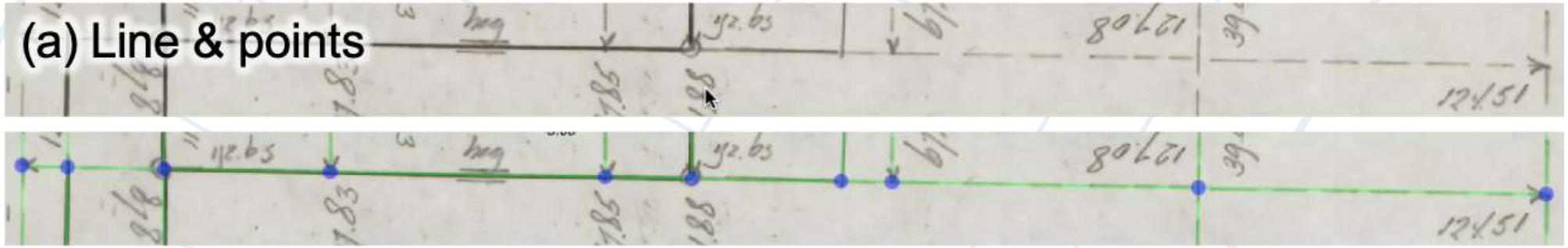

See also:

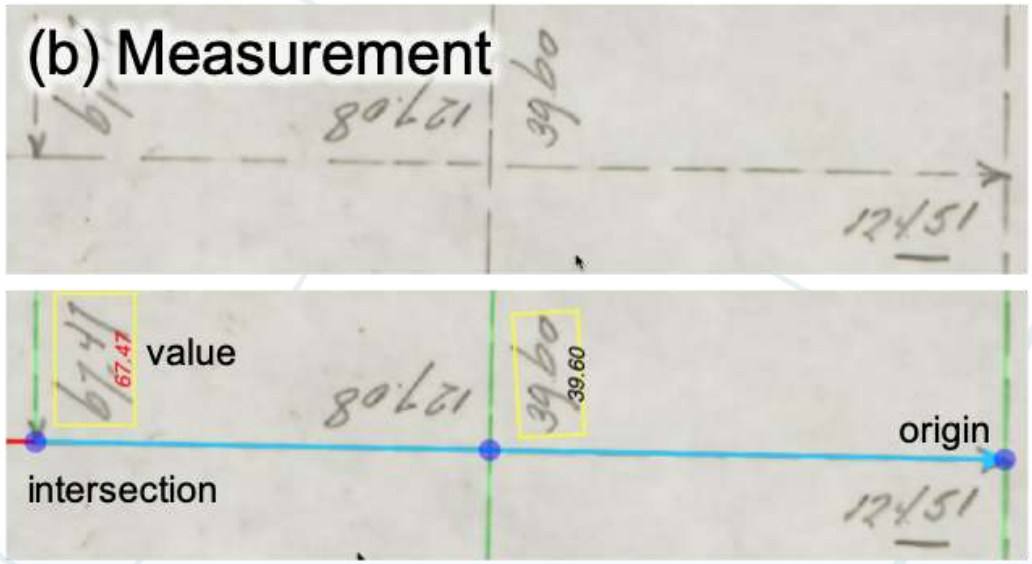
Hagemans et al.: Rebuilding the Cadastral Map of the Netherlands, the Overall Concept

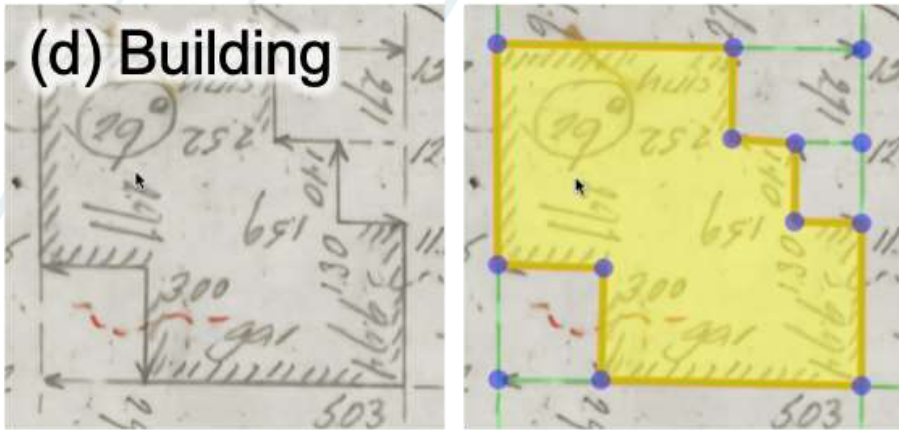
Van den Heuvel et al.: Rebuilding the Cadastral Map of the Netherlands, the Geodetic Concept

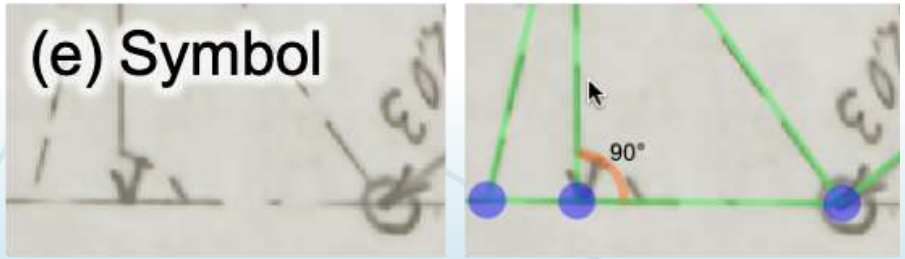
# Field Sketch Breakdown

5 million sketches

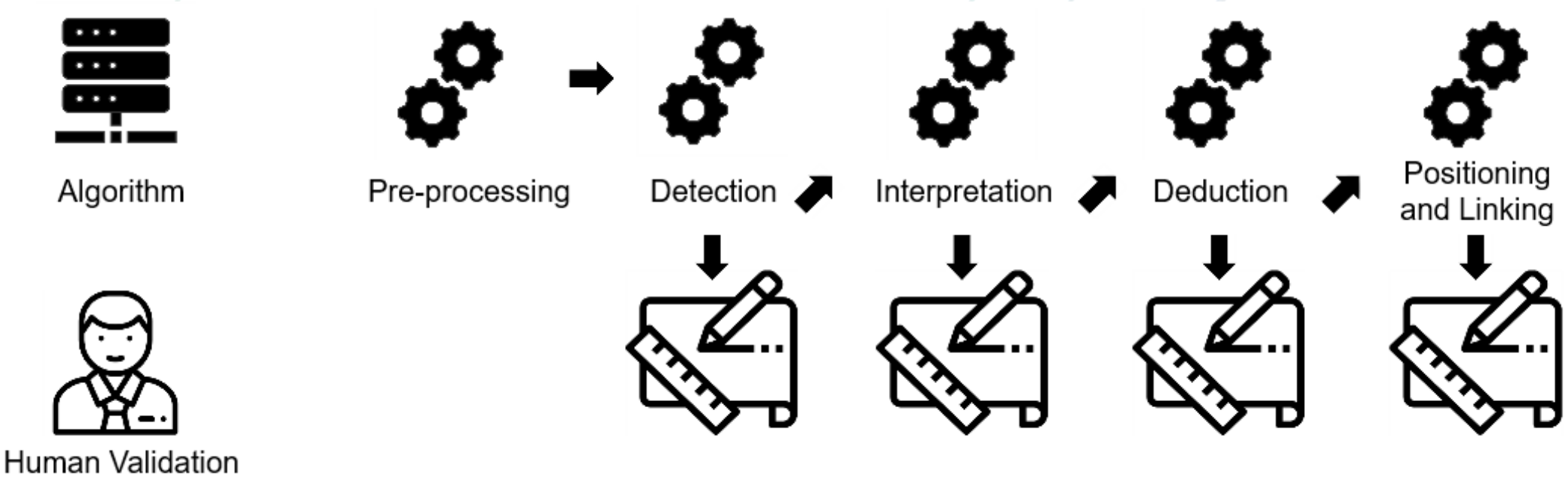


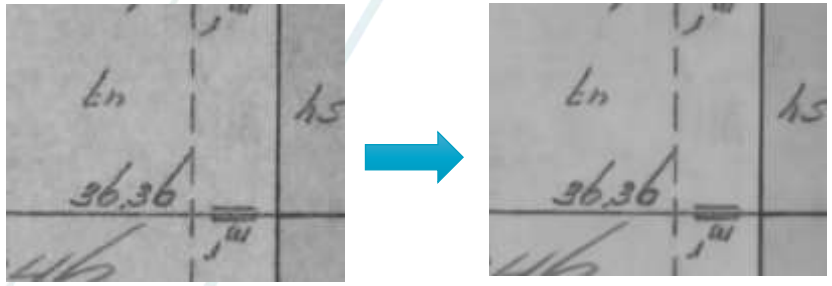




# VeCToR pipeline

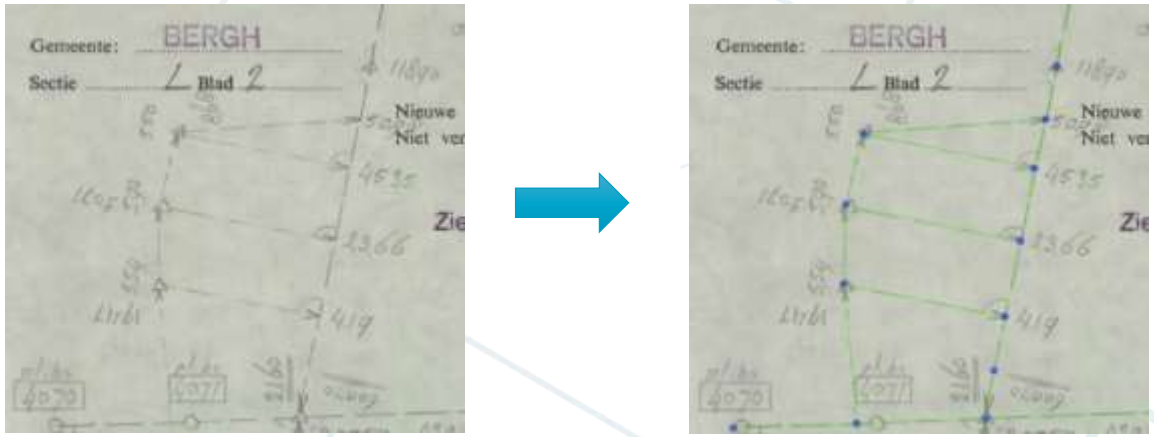


# VeCToR: AI components

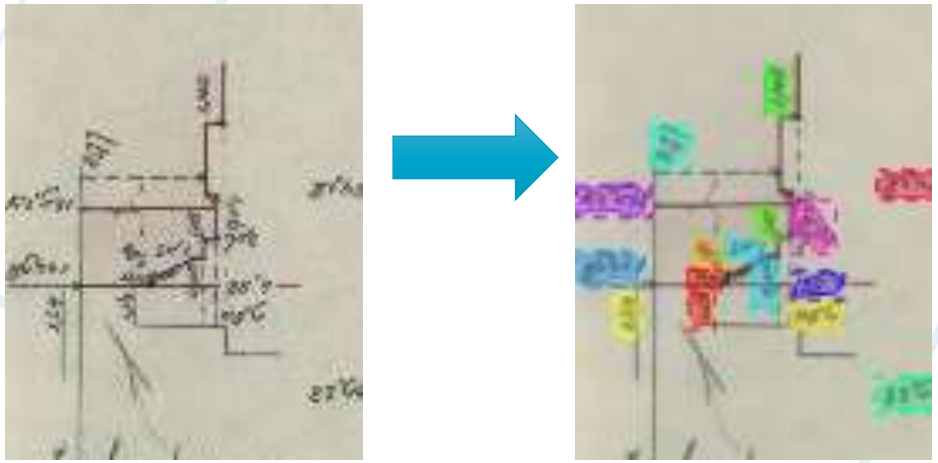
Removing JPG artifacts



Detect (dashed) lines and points

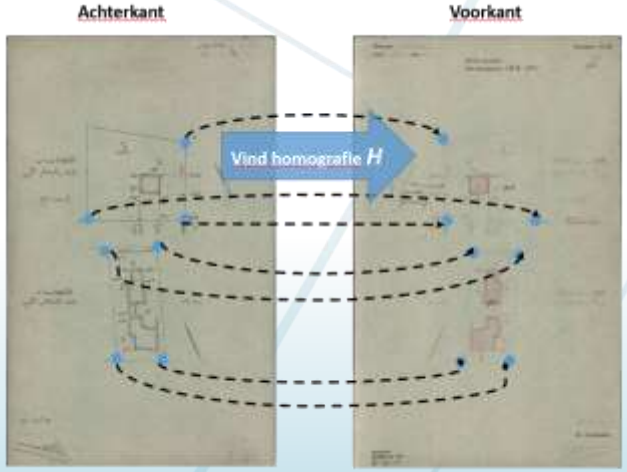



Localize measurements

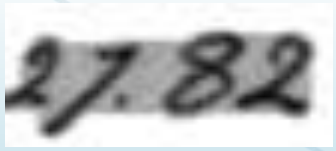


Detect Buildings

Combine two scans




Read handwriting



27.82

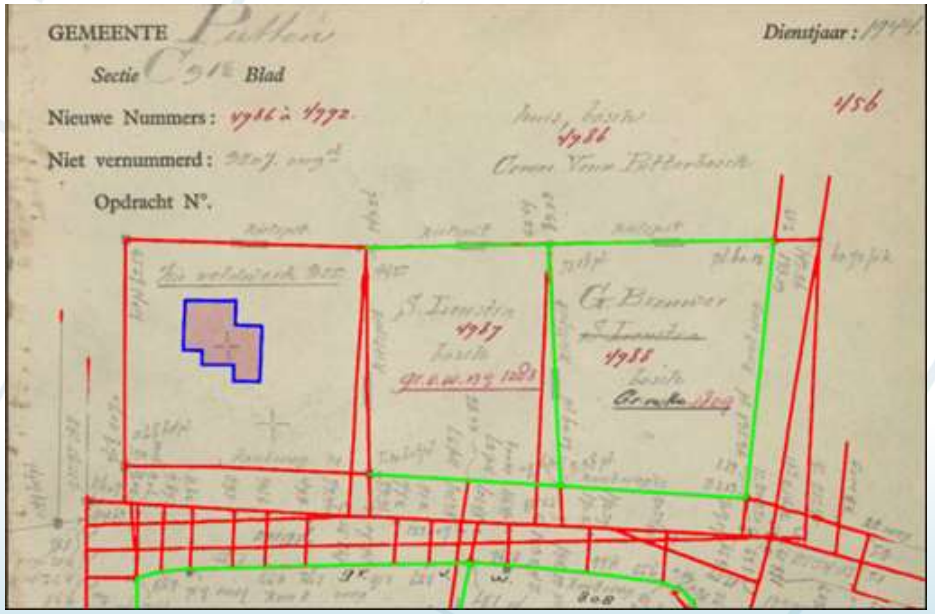
# VeCToR: Detect lines

## 1. Variants

- Normal line
- Building line
- New border


## 2. Solution

- Multi-label segmentation: predict pixels belonging to class
- U-NET based on Efficientnet-B5 architecture
- LSD and RANSAC are used to construct lines out of pixels
- Performance: pixel-wise F-score of 0.85



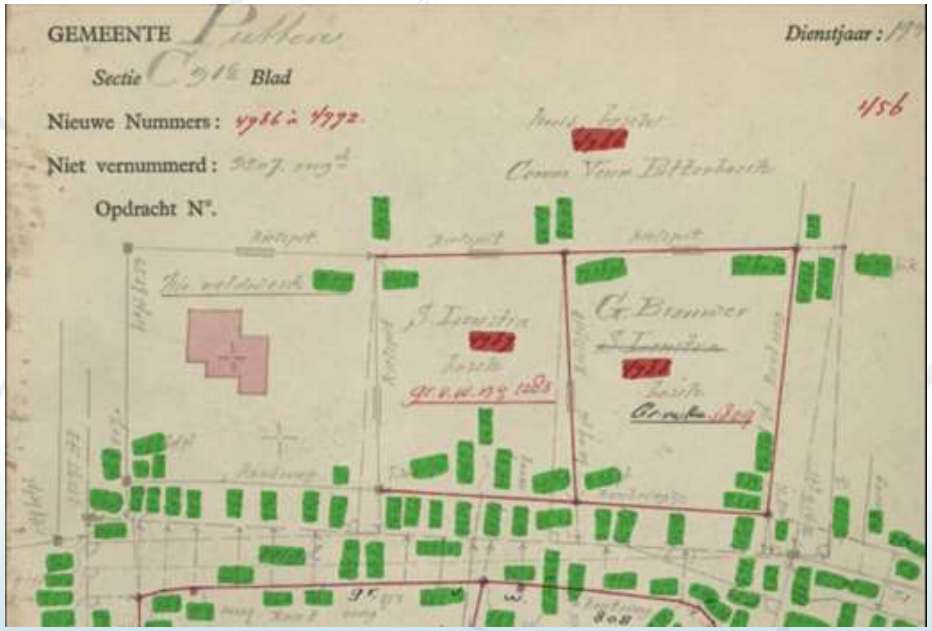
# VeCToR: Detect objects

## 1. Object Variants

- Measurement
- Parcel number
- Year, point number, etc


## 2. Solution

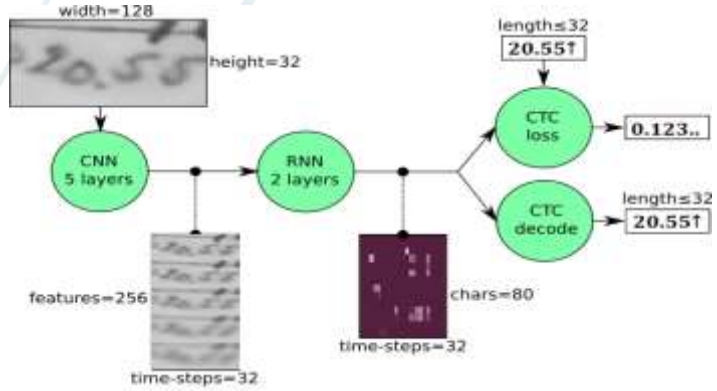
- Instance segmentation: Find and classify objects
- Mask-RCNN algorithm with multiple classes
- Performance: object-wise F-score of 0.84



# VeCToR: Optical character recognition

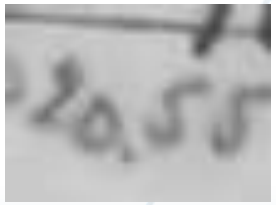
## 1. OCR: Textbox Variants

- Measurement
- Parcel
- Year, point number

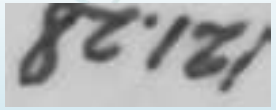



## 2. Solution

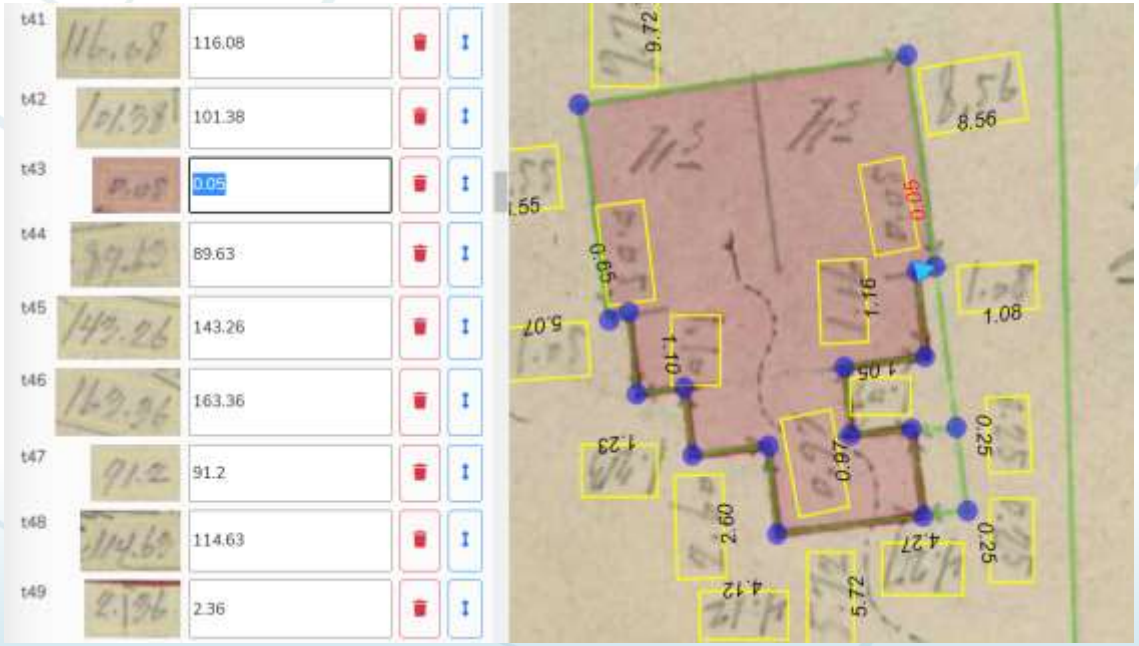
- Neural Net with CNN / RNN layers and CTC loss
- Performance: word-level F-score of 0.88



Prediction: 20.55↑



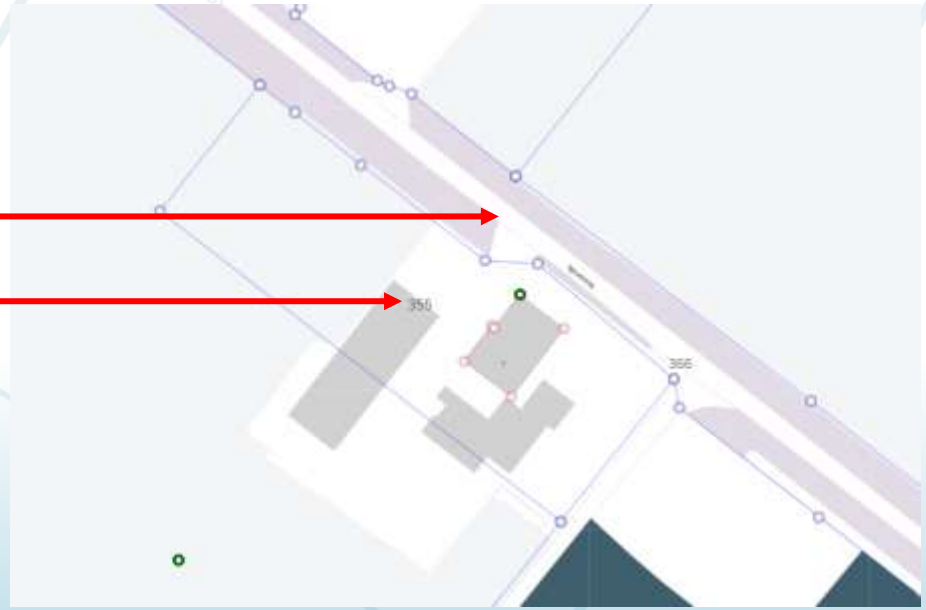
Prediction: 121.28↓



# Positioning

## 1. Find the sketch location on map

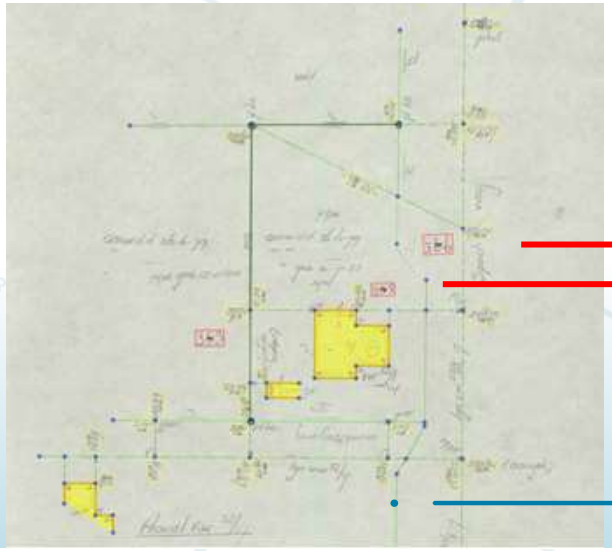
- Parcel numbers indicate rough location
- Used data sources: historical borders (HPD) and building map (DKK)
- Search translations from rough location to data sources

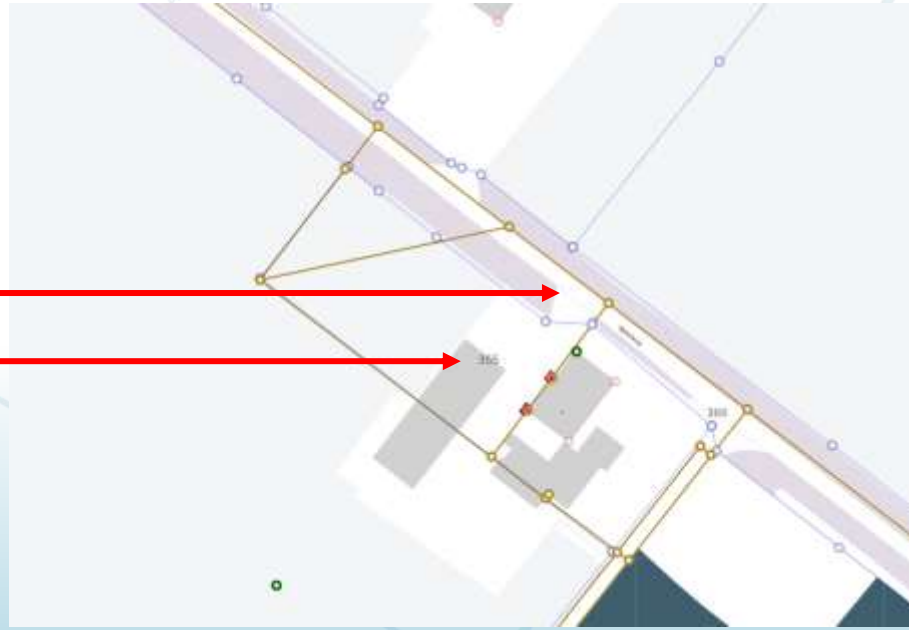


# Positioning

## 1. Hypothesis: Distance between sketch points ≈ distances between points on target map

- Select line segments from sketch, HPD en DKK
- Find all possible translations $[\Delta x, \Delta y, \phi]$ from location to sources.
- Cluster the possible translations (Nearest Neighbours)
- Biggest cluster of translations = optimal translation
- Performance: Accuracy of 52 – 87%





# Conclusion

- AI components are used during vectorization, positioning and linking
- AI components serve to reduce the necessary human labour
- Due to the usage of Machine Learning, performance increases with more data (during production)
- Significant reduction in annotation work makes KKN feasible

- Questions?

kadaster

# Rebuilding the Cadastral Map of The Netherlands

## the Artificial Intelligence solution

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**FIG**

**e-Working Week 2021**