Rebuilding the cadastral map • of the Netherlands:

the Artificial Intelligence solution

FIG 2021 Online Conference



kada

Presented at the HG

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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

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21/06/2021

#### **Field Sketch Breakdown**

#### 5 million sketches



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#### **VeCToR** pipeline



Algorithm

Pre-processing

Detection 🥒

Interpretation

Deduction

Positioning and Linking



Human Validation

#### VeCToR: AI components

#### Detect (dashed) lines and points



#### Detect Buildings





#### Combine two scans

Vind homografie H

#### Removing JPG artifacts





#### Localize measurements





27.82

Read handwriting

**VeCToR: Detect lines** 

### 1. Variants



### 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

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### 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





21/06/2021

## **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

10:56



### 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

Al components are used during vectorization, positioning and linking Al 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

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**Questions?** 

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