End-to-End Hierarchical Relation Extraction for Generic Form Understanding

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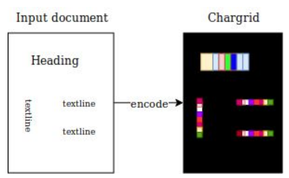
Overview

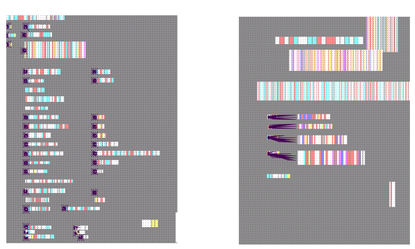
Motivation

- Generic semantic entities extraction and link prediction from documents.
- Using the 2D Char-grid representation
- Combine keypoint linking mechanism with semantic segmentation backbone to enrich spatial information.

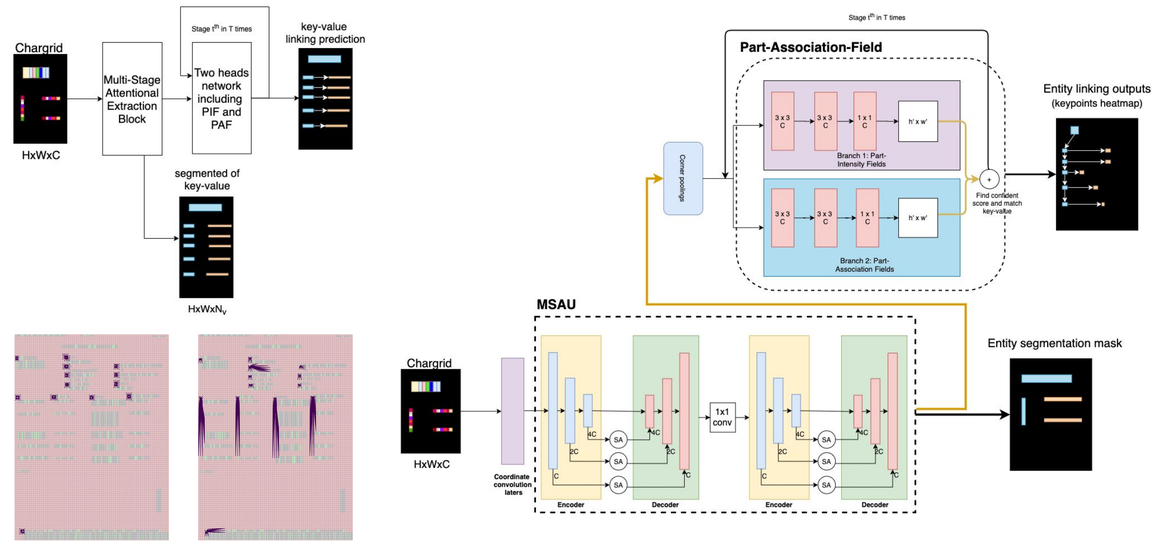


Contribution

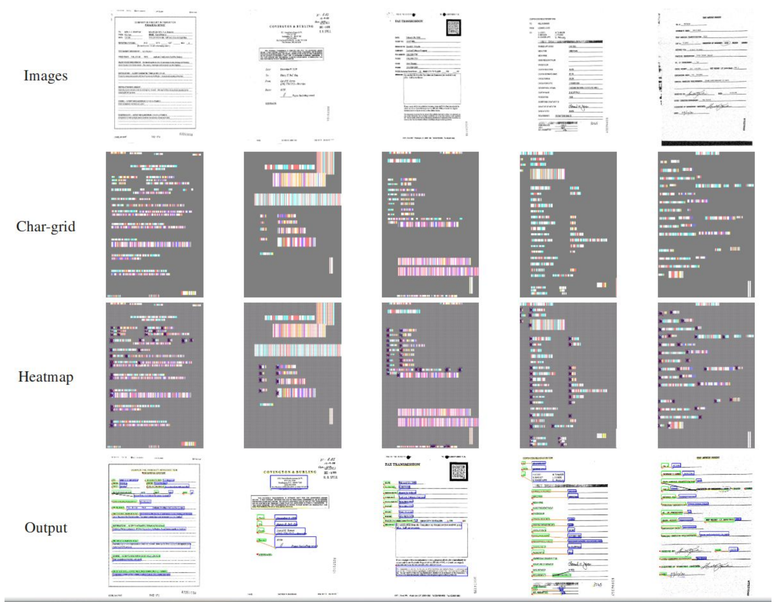
- End-to-end architecture **(MSAU-PAF)** combining semantic entity extraction and link prediction for form understanding.
- Adding Corner Pooling and Coordinate Convolution to aid spatial context modeling.
- Result shows that relations supervision can improve F1-score comparison with SOTA baselines



Method and Network Architecture



Proposed **MSAU-PAF** architecture with **Part-Association Field** and **Part-Intensity Field** for link prediction

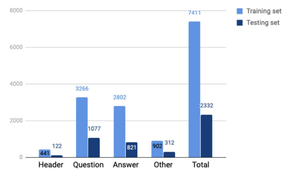


Visualized output with intermediate steps for **entity detection and linking**

Results

Benchmark datasets:

- FUNSD (Form Understanding in Noisy Scanned Document) - 199 samples
- 2 tasks: **Semantic Entity Labeling** and **Entity Linking**



Comparison with baselines

Result for Entity Labeling

Methods	Metric (F1 score)
MLP (BERT embedding) [5]	0.57
LayoutLM$_{BASE}$ [17]	0.69
MVLM + CLF [18]	0.74
MSAU (one-hot character) [9]	0.73
MSAU-PAF (one-hot character)	**0.83**

Result for Entity Linking

Methods	Metric (F1 score)
MLP (BERT embedding + Positional feat) [5] (Ground-truth entities class)	0.04
GraphCNN with Link prediction (Ground-truth entities class)	0.13
Heuristics (with MSAU-PAF middle output)	0.64
Heuristics (with Ground-truth entities class)	0.80
MSAU-PAF (Joint classification and link prediction)	**0.75**

Ablation studies

Model	Entity Labeling (F1-Score)	Entity Linking (F1-Score)
MSAU-PAF	0.80	0.72
MSAU-PAF + CoordConv	0.82	0.74
MSAU-PAF + Corner Pooling	0.81	0.73
MSAU-PAF + CoordConv + Corner Pooling	**0.83**	**0.75**

Paper, code & data
https://github.com/hoangthanh283/MSAUPAF

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