A Unified Framework for Semantic Matching in Architectural Floorplans

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Introduction

- Floor plans images are 2D cross sections depicting relationships between rooms, spaces and other physical features at one level of a structure.
- Symbol spotting, room layout analysis have been solved as individual problems but a composite retrieval framework in floor plans does not exist.

Motivation

- Provide automatic lookup to retrieve similar past architectural projects to aid architects.
- Help property buyers to select floor plans with more specificity in terms of both room décor and layout.

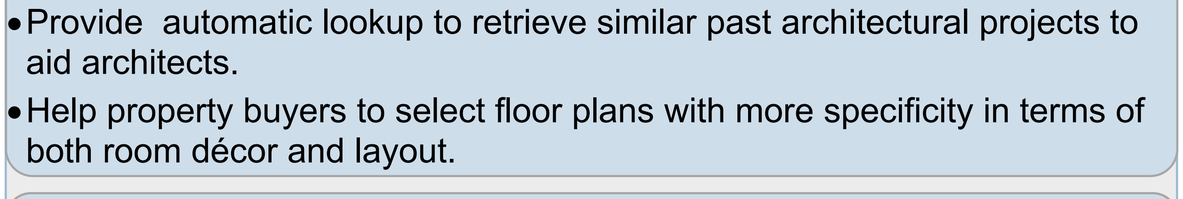
Related Work

- Symbol spotting in graphical documents: Dutta et al. 2011, 2013
- Sketch based retrieval of architectural floor plans: Weber et al. 2013
- Room detection in architectural floor plans: Ahmed et al. 2012

Stage 1 : Segmentation

I. Closing gaps at door locations.
II. Floor plan boundary extraction.
III. Dilation + erosion with unit radius structuring element.

Segmented layout



Stage 3 : Room Layout Matching

$\overrightarrow{F_k} = (\lambda_k{}^1, \lambda_k{}^2, \lambda_k{}^3 \ldots, \lambda_k{}^n)^T$

➢ Leading 'n' eigen values as feature vector ($\overrightarrow{F_k}$)

$\overrightarrow{x_k} = \phi^T \overrightarrow{F_k} = (x_k', x_k'', x_k''')^T$

➢ 3 - component vector through spectral embedding

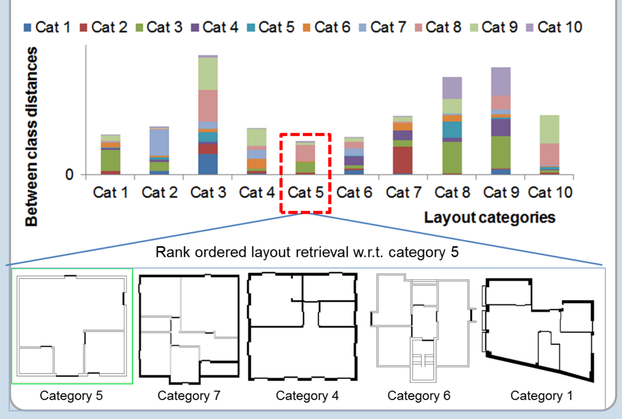
$d = \sqrt{(\overrightarrow{x_Q} - \overrightarrow{x_D})^2}$

➢ Similarity metric between query and database image feature vectors

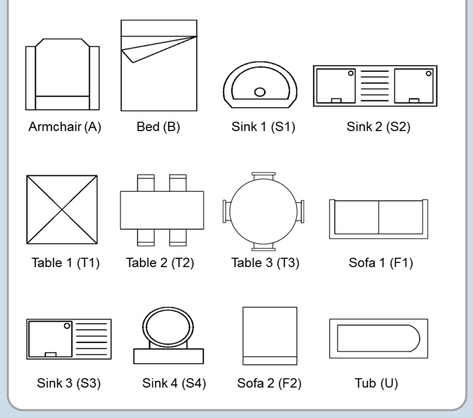
Experiments

On SESYD dataset, 10 classes, 100 samples/ class.

Layout similarity plot



Symbol Library



Conclusions

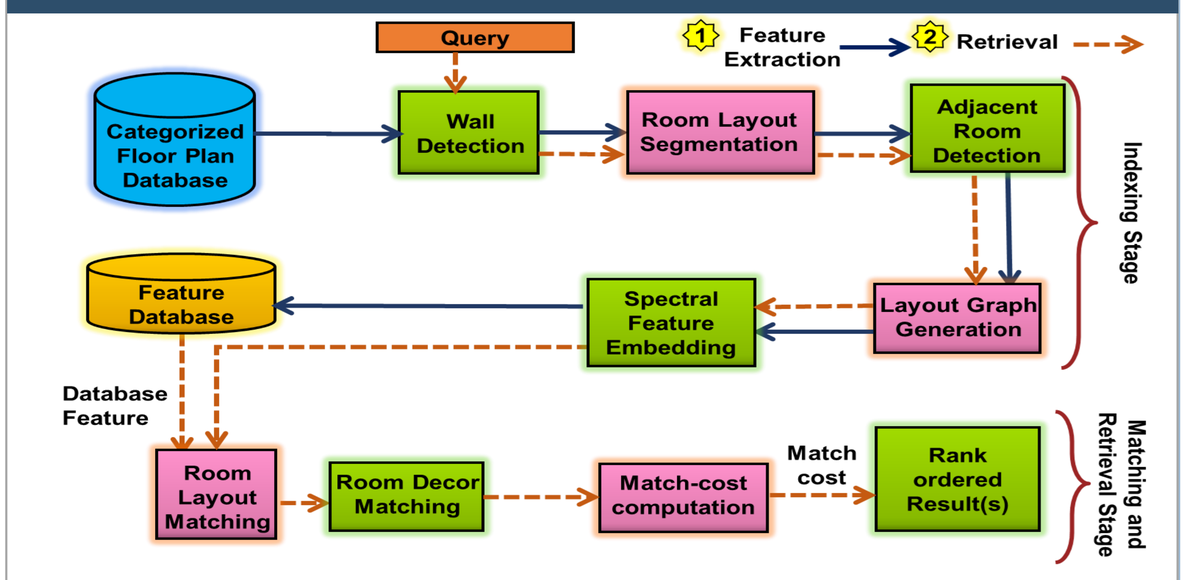
Conclusions and Future Scope:

- An inclusive framework considering structural and semantic similarity.
- A novel room décor matching algorithm for specificity while retrieval.
- Spectral embedding approach to represent layout graphs.
- Sketch based mode of query retrieval forms a future scope.

Contribution

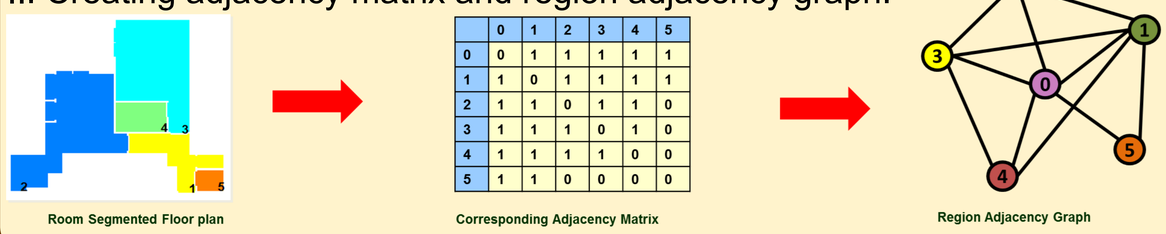
- Room segmentation and adjacent room detection algorithm to represent layouts as an undirected graph.
- Graph spectral embedding feature to uniquely represent floor plans for efficient matching.
- Two stage matching technique comprising both room layout matching and room décor matching.

Framework Diagram



Stage 2 : Room Adjacency Detection

I. Thresholding wall width and determining two-way adjacency in rooms.
II. Creating adjacency matrix and region adjacency graph.



	0	1	2	3	4	5
0	0	1	1	1	1	1
1	1	0	1	1	1	1
2	1	1	0	1	1	0
3	1	1	1	0	1	0
4	1	1	1	1	0	0
5	1	1	0	0	0	0

Stage 4: Room Décor Matching

- Detecting and categorizing furniture in the floor plan and initializing the matching cost .
- Adding a penalty matchcost if furniture count in two layouts not equal.
- Uniquely identifying furnitures in a layout and comparing type/ category of furniture in both layouts.
- Increment matchcost if furniture category matching, penalize otherwise.

Retrieval Results: