Retrieval of Architectural Floor plans based on Layout Semantics

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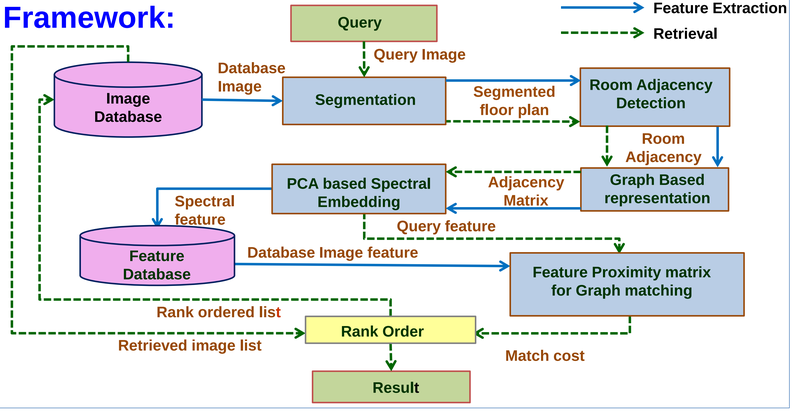
Motivation:

- 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.

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:



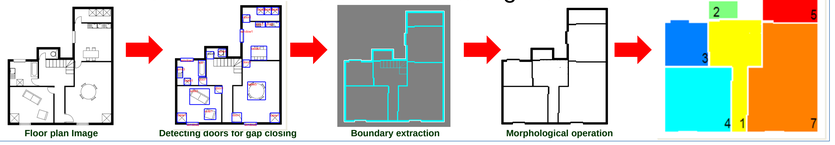
Related Work:

- 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

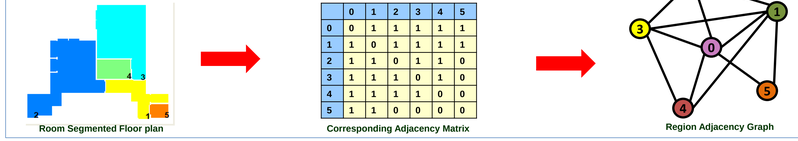
Segmented layout

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



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 3: Feature representation and 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 ($\overrightarrow{F_k}$)

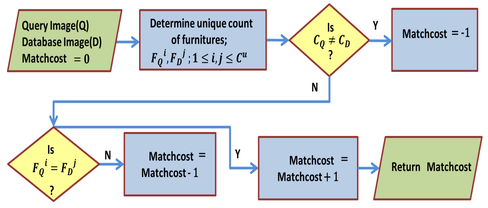
$\overrightarrow{x_k} = \phi^T \overrightarrow{F_k} = (x_k{}', x_k{}'', x_k{}''')^T$

- 3 - component vector through spectral embedding

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

- Similarity metric between query and database image feature vectors

Stage 4: Room Décor Matching



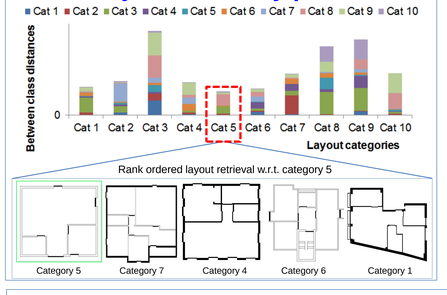
F_x : Array containing unique furniture ids in the layout x.

C_x: Count of furnitures in the layout x.

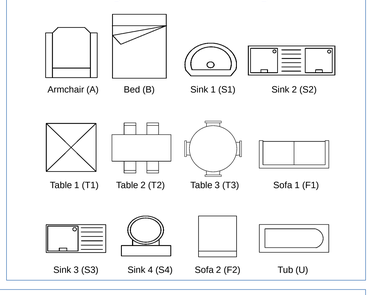
C^u: Unique count of furnitures in the layout.

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

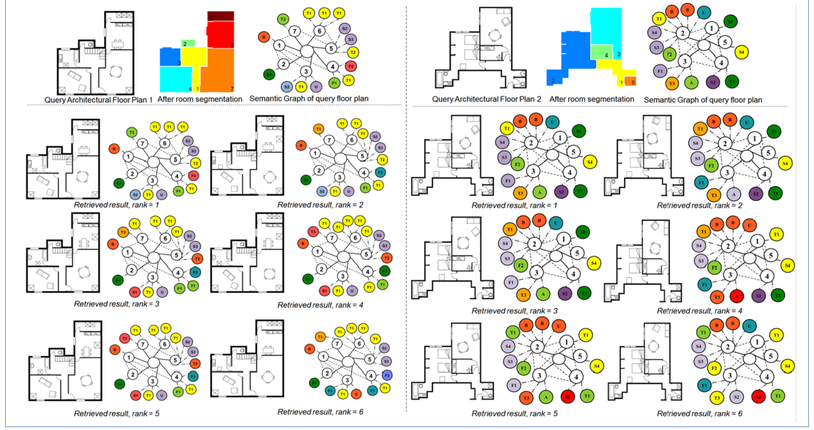
Layout similarity plot



Symbol Library



Retrieval Results:



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.