Acquisition and Segmentation of Historic Buildings of the City of Merced

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Abstract

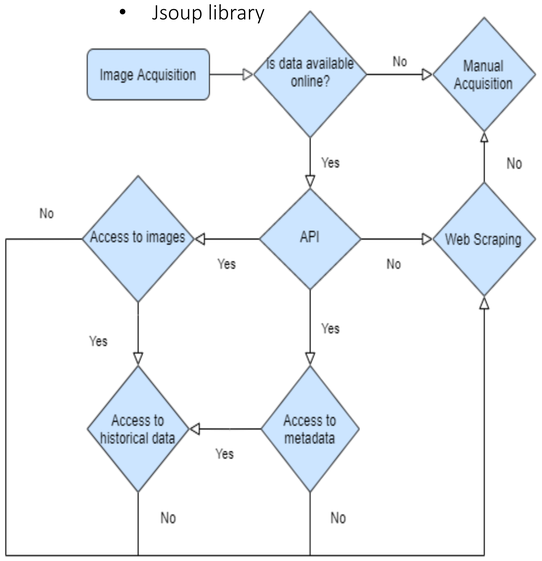
Convolutional Neural Networks along with automation and scraping tools can accelerate the analysis and acquisition of large image datasets. These tools fit the needs to solve the main challenge in understanding the preservation of an extensive list of historic buildings in Merced. Therefore, the Detectron2 pre-trained models and Selenium Webdriver and Jsoup libraries were used for the segmentation and acquisition of +2000 images from Google maps and real estate websites. This workflow resulted to provide great functionality in finding the changes in color, materials, and even the entire removal of a building. The final objective is to implement these findings in the Arches Heritage Platform for its curation and preservation for future studies.

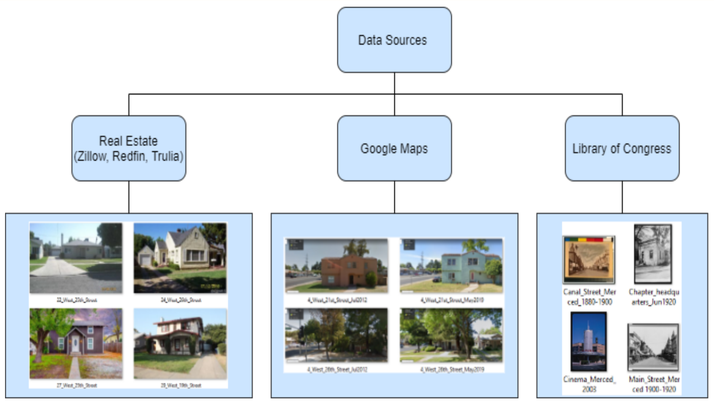
Background

The historic building survey of the City of Merced started in 1977 and it was retaken in 1984 with more comprehensive survey including architectural descriptions, major alterations, and general data about the building ownership. However, there are not images and no record of the changes in this buildings since 1985 when the survey was finished. It is important to keep track of the preservation of this buildings , however, one of the challenges is the extensive list of building addresses. Therefore is interesting to explore less expensive ways using tools such as automation, web scraping, and convolutional neural networks to acquire and analyze data at a big scale.

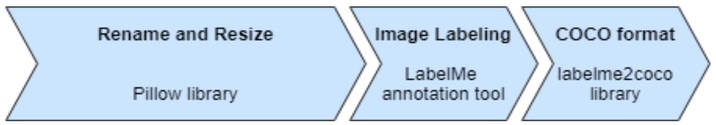
Data Acquisition

- Methods
  - Selenium Webdriver automation framework
  - Jsoup library





Data Processing



IMG0
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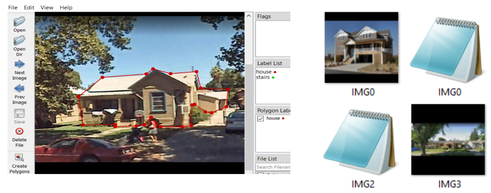
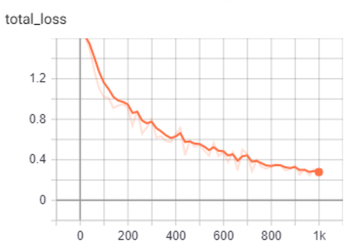
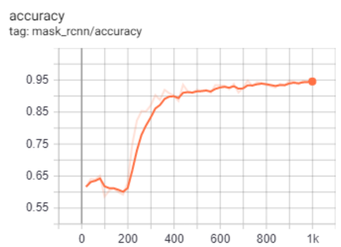
IMG240



Training

- Methods
  - Baseline[X101-FPN] with Mask R-CNN
  - Detectron2 vision library implemented in PyTorch
  - 240 images for training and 24 for validation





Evaluation results for bbox:

AP	AP50	AP75	APs	APm	APl
53.222	81.547	51.482	nan	nan	53.461

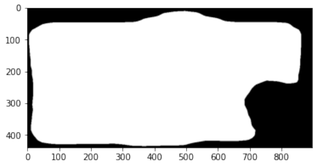
Evaluation results for segm:

AP	AP50	AP75	APs	APm	APl
51.572	80.204	56.689	nan	nan	52.002

Results

Instance Segmentation

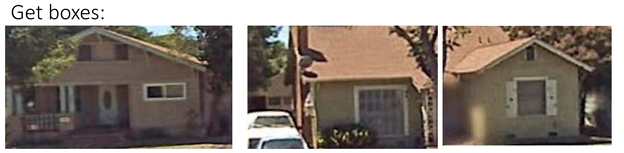
Get mask:



Fill mask:

Instance Segmentation

Get boxes:



Using instances for making assumptions

26 West 18th Street

August 2007

2 instances

October 2018

5 instances

- Assumptions
  - New houses were constructed
  - House was demolished

Conclusion

CNN demonstrated to have reasonable accuracy in the segmentation of buildings/houses

Buildings are considered background in pretrained models which indicates the lack of implementation in architecture

Automation and HTML parser libraries demonstrated to be extremely useful for the data acquisition for training models and the preservation of historical data

Future

Run the model in the full historical buildings data set and save images for the upload in Arches

Add more classes to the model such as windows, roof, color, door, etc.

Train new model for image similarity to find changes in images more accurately

Train new model for the classification of architectural styles

References

[1] B. Langborn, A. Liberda, A. Lilja, and J. Lindström, “Image segmentation and convolutional neural networks as tools for indoor scene understanding,” PhD Thesis, 2016.

[2] City of Merced Redevelopment Agency. “CITY OF MERCED HISTORIC BUILDINGS SURVEY FINAL REPORT,” THE NATIONAL HISTORIC PRESERVATION ACT OF 1966, pp. 1–450.

[3] C. Pesto, “Classifying U.S. Houses by Architectural Style Using Convolutional Neural Networks,” *Stanford University*, pp. 1–9.

[4] “Mask R-CNN,” *Facebook Research*. https://research.fb.com/publications/mask-r-cnn/ (accessed Jul. 15, 2020).

Acknowledgements

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