Room Recognition Using CNN

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Abstract **- The Room Recognizer will classify an image of a room using Convolutional Neural Networks (CNN). CNN allow an image to be examined pixel by pixel and to generate models that learn patterns in the pixel arrangements. Each image in the dataset has a correct classification that the model will use to train itself by comparing to the prediction. For any correct prediction, the error will be 0, otherwise it is 1. This program has many real-world applications including generating captions on real-estate listings or hotel websites.**

I. Introduction

The physical world is quickly becoming digital. Activities like house hunting, which used to require being at the physical site, can now be done online. As more and more people take advantage of being able to view places online, a large amount of time can be spent formatting pictures and adding captions to appropriately describe the scenery. Being able to generate this information automatically is extremely valuable and can save someone hours of entering data.

The final program will allow a user to upload a picture and then the GUI will print the type of room based on the contents of the image. For example, any room with a toilet should be classified as a bathroom. But a room with a sink would need to factor in other furniture because sinks are found in both bathrooms and kitchens - maybe even laundry rooms. Each piece of furniture will be taken into account to generate the room classification.

II. Project Data

All CNN programs require excessive data and training to achieve good results. Each furniture classification algorithm will be trained individually. Then, they will be combined to train the full room images. It is essential that I am confident in the individual pieces before a room can be classified. I have a primary plan to generate my own training and testing sets, as well as a backup plan to use data from Kaggle. I will capture a minimum of 100 images for common types of furniture found in a room. The types of classifications are shown in table 1.

The types of furniture will include:

- Chair
- Table
- Bed
- Toilet
- Sink
- Cabinet
- Refrigerator
- Laundry Machine

And the types of rooms will include:

- Kitchen
- Bedroom
- Bathroom
- Hallway
- Living Space
- Office
- Laundry Room

In order to create a successful learning algorithm, each image will need to be the same format and resolution. Otherwise the pixels will not be processed the same. This is another benefit to creating my own dataset.

My backup plan is to use a dataset from Kaggle. There is collection of 194,828 images of 128 different categories of furniture and home goods. [1] Although this set will have more images than I plan to generate on my own, it is also comprised of more types than I need to complete this task, and the images are in the form of URLs which may no longer exist. The existing set will also require me to test all furniture together, but I planned to approach building a model incrementally.

III. Project Design

This project will be completed using Convolutional Neural Networks to learn the content of images. Each image will be sent through a convolutional layer first. Sections of pixels will all be filtered and sent through the pooling layer. Then analyzed and compared to a desired result to make a prediction of whether the image falls into a certain category. The image below shows an example of this process.

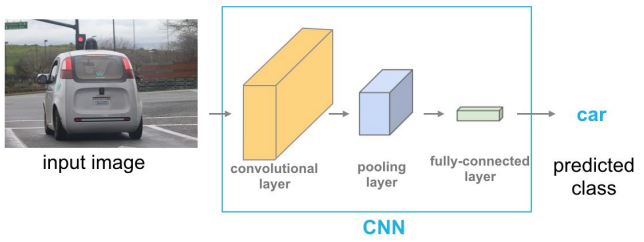

Figure 1. CNN process [2]

I will run through my collection of furniture data sets to train individual CNNs and optimize the filters for detecting each type. Then I will compile my algorithms to detect full rooms.

IV. Timeline and Milestones

I will spend the first few weeks generating the datasets to use. I will need to cultivate many images from different places and make sure each has a correct name associated with it to verify the correctness of the CNN. Then, I will have 3 weeks to generate the models and run training sets. I have built in an additional 2 weeks for cleaning the code, generating an interface for easy use, can getting user tests. These tasks are not essential to the completion of the project, so they will only be done if time allows. Then, in the final week I will collect my results, form conclusions, and generate a presentation for the class.

Table I
PROJECT TIMELINE AND MILESTONES

Task	Date	Milestone
Define project in formal proposal	9/27	Propose
Complete datasets for project	10/18	Prepare
Create model for identifying furniture	10/25	Model
Modify model to identify multiple pieces of furniture	11/8	Model
Great simple interface for running program	11/15	Clean
Perform User Testing and Collect Feedback	11/18	Get Feedback
Compile results and prepare presentation	11/22	Conclude
Final Presentation	12/2	Present

V. References

[1]"IMaterialist Challenge (Furniture) at FGVC5." *Kaggle*, 30 May 2018, www.kaggle.com/c/imaterialist-challenge-furniture-2018/data.

[2]abhinand. "In-Depth Guide to Convolutional Neural Networks." *Kaggle*, Kaggle, 16 June 2019, www.kaggle.com/abhinand05/in-depth-guide-to-convolutional-neural-networks.

[3] RUSSELL, STUART NORVIG PETER. *ARTIFICIAL INTELLIGENCE: a Modern Approach*. 3rd ed., PEARSON, 2018.