Product Requirements Document - Aryeo

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Overview:

This product will apply machine learning and computer vision processes to real estate images, extracting in-depth details about household amenities to be used for a number of different applications, including property description verification, property description generation, and website search components. The product will be integrated as a new feature on the existing Aryeo real estate content management platform, and will provide a UI for users to extract data from their images, in addition to running behind the scenes on every image uploaded to Aryeo's platform.

Definitions (if appropriate)

Computer Vision - Field of computer science focused on extracting data from images and videos.
Household Amenities - Common household items such as televisions, countertops, refrigerators, toilettes, ovens, pools etc.

Company

Aryeo (https://www.aryeo.com/)

Aryeo is a real estate content management service which provides an organizational platform and business solutions for real estate agents and real estate photographers so they can more effectively manage their businesses. Aryeo is a small sized startup with around 10 employees, who describe their company as the "Dropbox" of the real estate industry.

Motivation / Problem

In the industry today, millions of "property data points" are generated and distributed each year. These are common attributes such as the number of bedrooms, bathrooms, square footage, and roughly 150 other basic points. However, our project will focus on extracting data points from visual content - such as images and floor plans. As the old adage says, a picture is worth a 1000 words. The client would like to generate those 1000 words.

After having conversations with the client it is clear that they have no system in place to auto generate data about properties and they instead rely on users to input information about their own properties. This is unreliable as users are often incorrect, or incentivised to lie. This product is the first attempt by the company to utilize machine learning in any capacity, and more specifically, their first attempt at auto extracting data from images.

If this product were to be implemented, Aryeo would be able to generate information about all of the properties on their platform from images, which would open up a number of new features that could be added. They would have the ability to validate the existing descriptions of properties, and flag properties if they are captioned incorrectly (i.e. if the agent says there is a

jacuzzi but their really isn't), auto generate property descriptions to save their clients time, and incorporate a search component for clients and their customers to find properties by the number or type of amenities found in a property. There are a number of other possibilities and features that Aryeo would have the ability to implement with this technology, and by implementing this product Aryeo would be in a great position for growth and development down the road.

Scope (if appropriate)

It is important to note that there are a couple different parts to this product. The two most important components are to one, develop the ML model (system) that accurately extracts data from images and two, integrate the model into the existing code base. As the product is developed engineers should NOT forget to think about how the model will be integrated, and make decision throughout based on ease of integration.

Users + Benefits

Real Estate Agents

Real estate agents are the most popular client of Aryeo as Aryeo provides a clean way for them to organize their properties to market to their clients. In the current system, real estate agents have to manually input information about each property in addition to uploading their visual content which is time consuming and tedious. By having descriptions and information from their visual content be auto generated, they would save time, tedium, and frustration, which would overall improve their experience and business.

Real Estate Photographers

Real Estate Photographers are the other large clients of Aryeo as they use it to organize properties for themselves and to promote their business. Under the existing solution, photographers don't have a great way of locating specific properties other than by address, and would benefit from a search component on the platform as they would be able to find properties by amenity. For instance if a client wants to see all the photos they have taken of fireplaces, they can simply search their properties by the amenity "fireplace" and get all of those images. The proposed product would allow them to do this without having to tag each amenity in every photo they upload manually, a tedious process.

Use Cases

Validate Property Descriptions

When real estate agents upload properties to Aryeo, they also can link their Aryeo properties to their own personal websites in which they broker properties. It is important that the descriptions of these properties and specifically what each property contains is accurate, as if it is not, clients

might purchase properties that don't have the stated amenities, or rather, they will find out later and be disappointed. In addition, because the current process is tedious, real estate agents will likely make mistakes from time to time. By running every image uploaded on the process through the product, current descriptions can be validated by comparing the model's results to those that the agent provides.

Auto Generate Property Descriptions:

For new photos that will be uploaded, the image data found from the product will be able to be utilized to auto generate descriptions of properties so that the Aryeo user won't have to do it themselves. This will save a lot of time as every caption takes a long time to write. This could start out simply by listing the amenities found in the images, and eventually down line apply NLP to generate more human sounding property descriptions

Search Component:

This is a rather simple use case, but by having accurate information of all the products, users will be able to search for a property based on the number of needed amenities. For instance if a real estate agent needs to show a client a property that has a pool and a jacuzzi, they could simply look up all their properties with those specifications to show their client.

Features / Requirements

Computer Vision Model:

The basis of this entire product is that visual content will be run on the Machine Learning system, and it will output the number and type of amenities in an image. Without this, the product is nothing and none of the aforementioned use cases will be viable.

This Requires:

- [P0]: Basic Working Classification Model
    - In its very basic form, the product must be able to take high quality images from real estate photos, and output in some data structure, a list of all the amenities present in the image, and which type of amenity they are. The Mean Average Precision (See Success metrics section below) should be 50% or higher to be minimally viable for business use.

- [P1]: Working Object Detection Model with Visual Output
    - The next evolution of the product, should the bounding box coordinates for the location of each detected amenity, in addition to outputting the input image with those bounding boxes drawn around each amenity detected. The accuracy and efficiency of the model should be improved.

- [P2] Other Forms of Visual Content:
    - The final evolution of the system should be able to utilize other forms of visual content to extract data from, such as videos, virtual tours, and floor plans.

User Interface

In addition to providing an accurate system by which images can be run on, it is equally important that users are able to interact with the model. We need to also build a user interface that will be integrated into the current platform so existing clients can use the new feature.

- [P0] Basica User Interface:
    - Have a basic webpage that users can access to upload images and see what the model outputs. The user interface should include information about the model and how to use it. They should be able to access a photo from their file library or from their existing photos on their webpage.

- [P1] Integrate within Aryeo Platform:
    - Ideally this user interface isn't an external website and instead is integrated within the aryeo platform itself. This user interface would maintain much of the layout of the current platform, and will just include a section to choose photos.

- [P2] Additional Features:
    - This tier should add additional features, such as a drag and drop feature which allows users to simply drag and drop photos from their aryeo page. It also should allow users to run more than one image at once, for instance all of the images from a property.

Client Expectations

Product:

- The Client expects to at minimum to have a backend model integrated with their existing code base so that they can run it on all of their images. In addition they expect to have a user interface built preferably integrated within their current platform.
- The machine learning model should store data in their existing property database system, and the user interface should be integrated in their current web stack.
- Should have working prototype integrated with platform

Team:

- Minimum Qualifications:
    - Currently enrolled in Bachelors, Masters, or PhD program in computer science or related field
    - Has experience in applied machine learning, computer vision
- Preferred Qualifications
    - Extensive computer vision work
    - Familiarity with transfer learning
    - A deep understanding of cutting edge Object model structures

Time:

- Should be willing to work 30-40 hours per week for 10 weeks.

Timeline

By Function:

1. Be familiar with frameworks, have all data collected and processed (2 weeks)
2. Have completed initial Modeling, Experimenting and Training big dog model (2 weeks)
3. Figure out how to integrate with Aryeo Backend (1 week)
4. Create simple user interface interacting with model; can be on separate local server (1 week)
5. Focus on Improve accuracy of model (2 weeks)
6. Integrate front end UI with current platform and finishing touches (2 weeks)
7. Celebrate (1 crazy night)

Success Metrics:

1. Accuracy of the Model
    a. We will use Mean Average Precision as our accuracy metric as it is the industry standard for object detection. It takes into account both precision and recall. The client specified a MAP of 50% as a benchmark to be viable for production
    b. User review of accuracy - asses how accurate users find the model by periodically asking them to compare model results to what is actually there

2. Speed of the Model:
    a. We will assess success by how quickly the model works

3. User Interface
    a. Easy metric is to see how often the feature is used. This can give us an idea about all parts of the product, but in particular if the UI is bad/annoying it won't be used often
    b. Client feedback survey

Contact Information

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Appendix

Fill in as you go!