

Project Proposal for AD4CV: Scan2Cap

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Abstract

The ABSTRACT is to be in fully-justified italicized text, at the top of the left-hand column, below the author and affiliation information. Use the word “Abstract” as the title, in 12-point Times, boldface type, centred relative to the column, initially capitalized. The abstract is to be in 10-point, single-spaced type. Leave two blank lines after the Abstract, then begin the main text. Look at previous CVPR abstracts to get a feel for style and length. In this work we analyse a pipeline to generate description of 3D scenes using attention methods.

1. Introduction

The “Deep Learning” revolution has enabled great progress in the field of captioning or image description. This task has been studied in a sophisticated way for 2D images using different attention mechanisms. However, transferring this task to generate a description of an object representation in point clouds or 3D data, there has been no work so far to the best of our knowledge.

Therefore, we are interested in implementing a pipeline to obtain a description for a given object in a 3D scan, using state-of-the-art point cloud feature extractors, object detectors, and a captioning mechanism to generate a semantic description for a given object in the 3D scene. This allows the object to be placed in a global semantic context within its environment.

2. Related Work

Our work will be based on the ScanRefer dataset [2]. The dataset consists of 1513 RGB-D scans of ScanNet[3] 5 unique object descriptions for all existing objects in a scene. The work of [2] will also be used as guideline in this project.

The extraction of features on point clouds is presented by [7] applies the feature extraction directly on the point cloud on a hierarchical level, allowing the extraction of local features in a global context. The task of object detection on point clouds is studied by [6].

Methods for image captioning using visual attention are described by [9], [4] and [1]. These methods have in common, that they generate a caption for the entire image. Since our goal includes using a bounding box for the object to be set in context to the scene, the work of [8] is also of interest for this project.

3. Methods and Concept

Given a point cloud $pc \in R^{N \times (d+C)}$ and an object in that scene, which is described by a target bounding box $b_{target} \in R^6$, our goal is to generate a meaningful caption for the object embedded in the context of the scene. To this end, we plan to use the pipeline described in the following, which was inspired by [1].

To infer information specific to the target object itself, we crop out the points belonging to the bounding box of the object and use a PointNet++ [7] network on the obtained sub point cloud. This will give a feature vector $target_feats \in R^{128}$. In order to compute meaningful features, we use weights pretrained for point cloud classification.

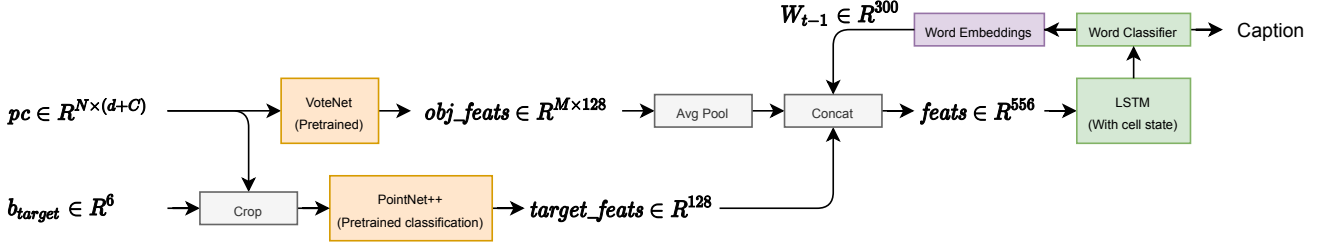
To infer information about the scene in general, we employ a VoteNet [6] network. We don’t use the final object labels and bounding boxes, but the feature vectors $obj_feats \in R^{M \times 128}$ generated by the *ProposalModule*.

In our initial pipeline, we combine those features through average pooling into $scene_feats \in R^{128}$. At a later stage, it is possible to replace this step with attention-based pooling, similar to [1].

For the generation of the caption, we use a classical LSTM. As input, we concatenate the $target_feats$, $scene_feats$ and word embedding vector of the previously generated word together. The word embedding is taken from a pre-computed GloVe [5] word embedding matrix. The output of the LSTM is passed through a fully-connected layer and softmax function to obtain probabilities for the various possible next words (similar to [9]).

Figure 1 summarizes the project pipeline.

Non-Attention based captioning



Attention based captioning

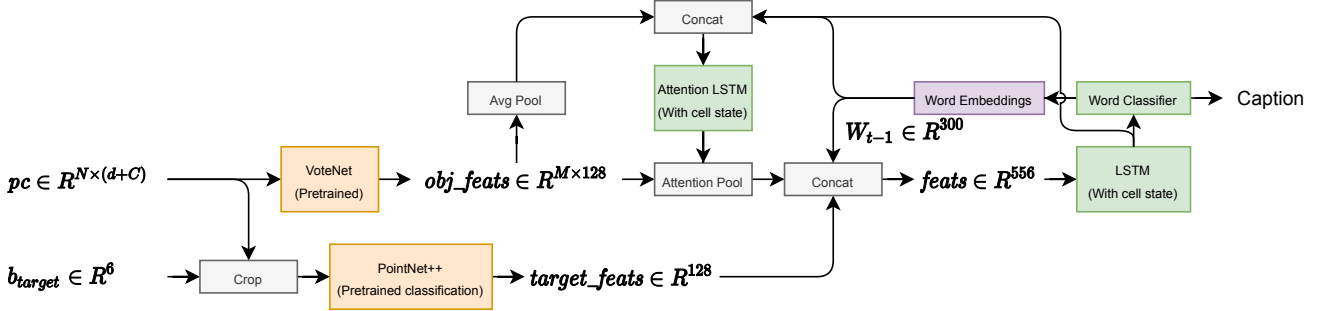


Figure 1. Pipeline for project

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