Bachelor Project Proposal: Investigating the Importance of Textures, Color Spaces and Similarity Measures in Open-Ended 3D Object Recognition

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This research is aimed at object detection and recognition. In this project, we will explore the influence of texture and colour spaces for 3D object recognition in open-ended domains. Observing the advances that have been made in the field of 3D object recognition, we can see how the computational models are getting closer to modelling human object recognition. However, service robots face challenges in recognizing objects in unpredictable environments. Hence, the importance of this study lies in looking at the effects of different features in classifying 3D objects. The main research question this work tries to answer is: *Which combination of texture, colour spaces, and shape features make a reliable object recognition model that correctly classifies 3D objects in open-ended domains?* The performance of the system is judged based on computation time and accuracy of object classification.

The requirements of the relevant Bachelor project include a literature review within the discipline, the implementation of relevant code, experimentation with benchmarks as well as writing a thesis. We mainly use C++ based ROS as the primary programming language. Parts of the code can also be written in Python, and later integrated. On top of that, we will use the Keras framework for the deep learning part. In this study, we assume that an object has already been segmented from the point cloud of the scene, and we will mainly focus on detailing 3D object category learning and recognition.

To give a brief overview of the stages that make up the research, we begin by creating a global object reference frame for the given object using Principal Component Analysis. Afterwards, we use an orthographic projection method to create the views of the object. Then, we use the projections as input for a convolutional neural network and extract view-wise object representation. The obtained representation is then used for both learning and recognition processes. In this project, we will mainly use an instance-based learning approach and a K-nearest neighbour recognition. With this approach, we will evaluate the object representations. Since the object is represented as a feature vector, we will use different distance functions to determine the similarity between the two instances. We will use two standard datasets, including the Washington RGB-D object dataset and Restaurant object dataset, to evaluate the performance of the proposed approach and compare it with other state-of-the-art methods. At the end of the project, we will try to test this approach in a real robotic task such as clear-table or serve a drink scenario.

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