KU LEUVEN

FACULTY OF ENGINEERING TECHNOLOGY

TECHNOLOGY CAMPUS DE NAYER

Counting shells

Are current neural networks performant enough to count various types of shells in an uncontrolled environment

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Summary

Every year the Flemisch Institute for the sea organises a shell counting day to map the diversity of our seaside. Thousands of volunteers go to the beach to count and classify shells. In this thesis we will try to automate this process by using neural networks. The goal is to be able to count the shells in an uncontrolled environment so the volunteers would only have to take pictures of the shells and the neural network would do the rest.

Of course this is not a trivial task, as the shells are not always in the same position, the lighting conditions are not always the same and the shells are not always of the same size.

Abstract

Het extended abstract of de wetenschappelijke samenvatting wordt in het Engels geschreven en bevat 500 tot 1.500 woorden. Dit abstract moet niet in KU Loket opgeladen worden (vanwege de beperkte beschikbare ruimte daar).

Keywords: Voeg een vijftal keywords in (bv: Latex-template, thesis, lang document, ...)

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Chapter 1

Introduction

Every year, one day per year, nearly a thousand volunteers travel to the Belgian coast to collect and categorize the shells that wash up on the beach. This data is collected by the flemish institute for the sea (VLIZ) to study populations of marine molluscs and the impact of their environment (climate change, fishing, etc) on the population. The volunteers participating in this study are mostly enthusiasts, but also scientists and families with children. To ensure a good quality of the data, most volunteers participate in a workshop. The counting of the shells is done by walking along the beach and noting every shell that is found individually. This is a very time consuming process, and the volunteers are often not very experienced in counting, resulting in mistakes with all but the most common shells. When a volunteer finds a shell that they are not familiar with, they can contact a helpdesk to help them.

Insert flowchart of usual process of counting here

The fact that the project relies on volunteers to do most of the legwork, combined with the fact that experts have to man the checkpoints and the helpdesk, makes the project unscalable beyond having a single dedicated day per year. With over 5 million people visiting the Belgian coast every year, there is a lot of potential to collect more data if the process of collecting the data could be simplified to be accessible to anyone visiting the beach at any time.

In this thesis, we will attempt to simplify the process of collecting data so that it can be done by anyone, anywhere, at any time. We will do this by training a counting network to recognize shells in an image and count them automatically. This is already done on a smaller scale by VLIZ with obsidentify. Obsidentify is a mobile app and website where users can submit pictures of a single shell and get a result of what kind of shell it is. This is a useful tool, but taking a close up picture of every single shell is a very time consuming process. We will have to work with a limited dataset to train the neural network as no dataset exist with large quantities of anotated pictures of beaches. After succesfull completion of this thesis, the new ideal scenario for collecting data can be found in figure **??**. Compared to the current process, found in figure **??**, this new process nearly elliminates the experts involvement and thus makes the process scalable. **Insert flowchart of new simplified process of counting here**

We will be studying if current counting networks are performant enough to recognize shells in beach

image. We will build up to this by first training a network to count objects from a more established dataset in order to have a baseline to compare our model to. Afterwards we will then train that network with a small dataset to count shells and study its performance.

In the remainder of this thesis we will first discuss the state of the art in the field of object detection and counting, with a focus on few-shot learning. We will then discuss the datasets and the network architecture we will be using. In the second semester we will implement the network and train it on the datasets. We will then discuss the results and the limitations of our model. Finally we will discuss the future work that can be done to improve the model.

Chapter 2

Literature Review

In this chapter we'll go over the state of the art in the field of object counting. We'll go over the techniques commonly used for counting and go in more depth about the topic of few shot object detection and why it should be applied to our problem. Finally we'll go over the metrics used to evaluate the performance of the models.

2.1 Counting

Counting networks are quite an established concept in machine learning as numerous papers tackle the issue of counting humans, cars, animals or cells. What those have in common is that they only encompass a small set of possible categories to count and that, as they have a large real life use, large annotated datasets exist for these problems like ShanghaiTech and COWC. The problem we're trying to solve is a bit different as we want to count a large set of objects and we don't have a large dataset to train on.

The methodology behind counting networks has two big streams. The first one applies a detection method to the image and then counts the number of detected objects. Many different detection methods can be used, from looking for characteristic features to matching the shape of the objects. The second one gives up on looking for an exact answer as it's too hard, with imperfect or low resolution images, and instead tries to estimate the number of objects in the image.

2.2 Proposed approach

In this section we'll go into more detail about the approach we'll be taking. This will include a number of subsections, each describing a different aspect of the approach.

2.2.1 Few-shot

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