Intermediate report

Self learning software to identify illegally traded orchid material



Figure 1 *Cypripedium calceolus* [1]

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# Introduction

## CITES

There are thousands of different orchid species known all over the world [2]. None of these are allowed to be imported into the Netherlands without CITES permits.

Since 1973 orchids are primarily protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), which is signed by over 120 nations [3]. Despite this convention many orchids are illegally traded. To trade species that are protected by CITES, a licence or certificate is required. Each nation who signed the Convention must designate one or more Management Authorities. They are in charge of administrating that licensing system. All the nations have also to designate one or more Scientific Authorities. They advise the Management Authorities about the effects of trade on the status of the species.

It is difficult to monitor the illegal trade of orchids because some orchids look very similar to non-protected plants. So sometimes it is difficult to tell if the imported species is an orchid or not. To improve identification, software that can identify orchids from pictures of tubers, leaves or flowers can be used.

## Study group

During this project the focus is on slipper orchids and orchids from which *salep* is produced.

In Europe and Asia the slipper orchids (*Cypripedioideae*) are widely distributed between sea level up to 2000 m altitude. Species prefer to live in calcareous environments and are found in deciduous or mixed deciduous and coniferous woods. They grow best in light to deep shade. The slipper orchid is an herbaceous perennial plant species that can live very long. It can grow up to 60 cm and each season the slipper orchid will produce new growths. Each stem of the orchid can contain 3 to 4 leaves that often have upcurved sides. The flower stalk can be one-flowered or two-flowered with leaf-like bracts. The sepals and petals are rarely green but commonly brightly coloured. They are also often twisted [4]. Slipper orchids are highly desired ornamentals.

Ground orchid bulbs of the *Orchidoideae*, also known as *salep,* are very popular in Turkey. They are used to produce ice creams in summer and drinks during winter. *Salep* is also used as medicine. In the early 1990s the trade of *salep* increased strongly. The official statistics from the Turkish State Institute of Statistics show that the export between 1995 and 1999 was 282.000 kg annually. It is unknown if this information is related to pure *salep*, substitutes or mixtures. To achieve this amount of *salep* 9.825.000 – 19.650.000 bulbs are required. This is far too much so there are some laws established to protect these orchids. In Turkey there are three laws that would protect them. The first law is the Turkish Forest Law. This law regulates the use of non-wood forest products. In short this law states that it is forbidden to collect and remove any form of forest vegetation. The second law, the Turkish Law of Natural Parks states that “The production of forest products, hunting and disturbing the natural balance is prohibited.” Since collecting *salep* is classified as production of forest products, it is prohibited in all protected areas. The last law in Turkey is The Regulation on Collection, Production and Export of Bulbs of Wildflowers. As the title of this law reveals, this law regulates the production and the export of bulbs, roots and tubers of flowers. It also holds a list with species that may not be taken away from the wild for export [5].

## How a web application can improve control in illegal orchid trade

To make it easier to follow the trade routes of orchid smuggling, a web application that can identify different orchid species would be handy. This application can be used on smartphones/tablets and laptops/desktops by taking pictures of flowers, leaves and underground tubers and upload the pictures to the website. A simple workflow of the application can be found in figure 2. In this project the focus is on creating the website and integrate the identification application. This application is already available at Naturalis, and is not made during this internship.

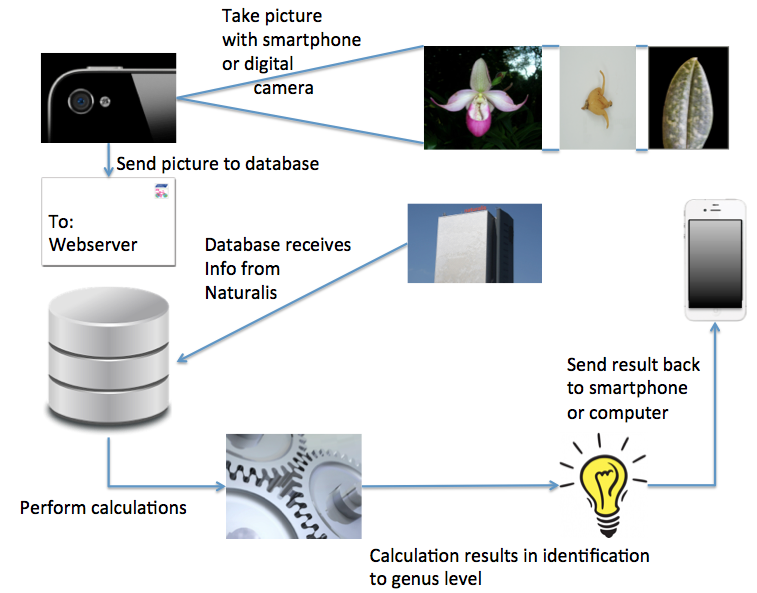


Figure 2 A simple workflow of the application made during this project. Resources of the pictures: [7-16]

## Comparable software

There is software available that can identify a person using face recognition. One example of software like this is KeyLemon [20]. This software could be used to unlock a computer.

The overall operation of software like this is to take a picture or series of pictures of your face. When it takes a series of pictures it is almost always required to move your head up and down and / or left and right. The software saves this picture / these pictures. When you use the software to unlock your computer the software takes a picture / a series of pictures of your face and compares this picture / these pictures with the saved picture(s). When it finds a match you will be logged-in to your own account.

# Materials and Methods

## Website

During this internship a website is developed. The processes behind this website are written in Python2.7 using the Django package. The layout of the webpages is written in html, using css style sheets. There are two versions of every html file, one for computers and one for mobile devices. The different python scripts, html files and css style sheets can be fount in appendices 2-x. Because there is little difference between the computer html’s and the mobile html’s only one mobile html can be found in these appendices.

## Training

To train the software pictures are needed. So at the beginning of this internship pictures of three types of orchid tubers (round, oblong and with spurs) are taken at the Sylvius lab. These pictures are uploaded to a shared Flickr account. To download these pictures, and their meta data, using the command line, a python script written by Hugo Haas, Offlickr, is modified and used [\*] (see appendix x).

The orientation for the tubers is unregulated. It is only required that it is the same for all pictures. For instance, if the first pictures of a hand-like tuber have the spurs on the right, all the other pictures of these tubers must have the spurs on the right. It is also required that the users use the same orientation as the trainer of the software. The orientation used by the trainer can be found in the user guide. At last it is required that there is only one tuber per picture.

To train the software as much as possible, well known look-a-likes are also used. This is to check if the application can see the difference between an orchid and a non-orchid. The look-a-likes that are used are adulterants such as *Arum maculatum*, *Asparagus officinalis, Polygonatum verticillatum, Tulipa greigii,* and *Tulipa sp.* [18]. Appendix x contains pictures of these tubers.

After downloading the pictures they need to be prepared for training.

The pictures are downloaded as jpgs. Because the trainings software can only handle pngs, they first need to be converted. After converting the pictures they are placed in the correct directory, using the tags in from the meta data. This is required for training the neural network. The last step before training the network is splitting the pictures. This means that the tuber is cutting out of the picture and the background is normalized. This step used the Perl script splitter.pl, written by Rutger Vos, which can be found in appendix x. All these steps are automated during this internship. The Python and bash scripts with these steps can be found in appendices x-y.

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# Appendix 1



Figure 3 *Arum maculatum* [16]



Figure 4 *Asparagus officinalis* [16]



Figure 5 *Polygonatum verticillatum* [16]



Figure 6 *Tulipa greigii* [16]



Figure 7 *Tulipa sp.* [16]