The ImageCLEF 2013
Plant Identification Task

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Boujemaa N., Barthelemy D. and Molino J.-f.
The ImageCLEF 2013 Plant Identification Task

- Introduction
  - Task resources & description

- Participants and results
  - SheetAsBackground
  - NaturalBackground
  - Details by views

- Conclusion
Context & challenges

Biodiversity erosion & Global warming affects the **environment** as well as **agriculture** and **food security**

Accurate knowledge of **plants** (distribution and ecology) is essential for **sustainable agriculture** and **biodiversity conservation**

But accessing basic information about plants is still challenging

**Botanical data** is:
- decentralized and heterogeneous
- complex (un-structured tags, empirical measurements,...)
- sparse and incomplete
  - huge & unknown number of species (300K ?)
  - “long tail distribution” (1 record per species !)
Towards bridging the taxonomic gap

As a consequence, identifying plants is very difficult

-> How to control plant’s distribution and plant ecology?

Possible solutions

- **Collaborative Information Systems**
  Sharing and speeding up integration of raw data

- **Multimedia Image Retrieval & Identification Tools**

But ...

CBIR SoA not well studied on plants
Few, small, biased datasets

Motivations of this task
The ImageCLEF 2013 Plant Identification Task

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Task characteristics & Data creation

An **attractive** task as **simple** as possible but as **realistic** as possible

- **Simple**: 1 media type (image),
  2 mains categories *SheetAsBackground* ; *NaturalBackground*

- **Realistic**: collaborative data, numerous contributors

how to reduce bias between training data and real user’s data?

Let real users collect training data and botanists validate

Grow training data with an online Identification and Validation Tool

= *The PlantViews dataset*
## PlantViews dataset

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
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<tbody>
<tr>
<td>Species NB</td>
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<td>250</td>
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<tr>
<td>Images NB</td>
<td>5 400</td>
<td>11 500</td>
<td>26 077 (327 contributors)</td>
</tr>
<tr>
<td>View types</td>
<td>Leaves</td>
<td>Leaves</td>
<td></td>
</tr>
</tbody>
</table>

### 2 mains categories of images
- **11 031 img `sheetAsBackground`**
  - Leaf scan & scan-like (42%)
- **15 046 img `NaturalBackground`**
  - Leaf (16%)
  - Flower (18%)
  - Fruit (8%)
  - Stem (8%)
  - Entire plant (8%)
Pl@ntViews dataset

- **Metadata (XML)**
  - IndividualPlantID
  - Data and time
  - Image type “NaturalBackground” or not
  - Content (Leaf, Flower, Fruit, etc.)
  - Full taxon *(APGIII)*
  - ClassID Species identifier
  - Common name
  - Author name
  - Locality name
  - GPS
  - ...

- **A unique dataset!**
  - Pictures of views of species, coming from **different individual plants**
  - **Hundreds of contributors**, with numerous devices
  - Pictures at **different periods** of the year (over 3 years)
  - **Taxonomic validation** by a network of botanists
Quercus ilex L. (Holm oak)

Ilex aquifolium L. (European holly)

Intra-species diversity versus visual similarities between species

Growing stage: two compound leaves from the same tree! Gleditsia triacanthos L. (Honey Locust)

Leaflets number variability on Fraxinus angustifolia Vahl (Narrow-leafed Ash)

Leaf at different growing stage of Platanus × hispanica Mill ex. Münchh. (London plane)

Leaflets number variability on Fraxinus angustifolia Vahl (Narrow-leafed Ash)

Shooting conditions and used devices, Acer platanoides L. (Norway maple)

Lobe number and deep of leaf lobes on Ficus carica L. (Common fig)

# Users = # localities # seasons # environments # climate # ecosystems # devices

Leaf diversity

Pl@ntViews dataset

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### Pl@ntViews dataset

**Flower diversity**

<table>
<thead>
<tr>
<th>COLOR</th>
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<table>
<thead>
<tr>
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<td>Face, Profil</td>
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<table>
<thead>
<tr>
<th>Size</th>
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<tr>
<td>small, middle, big</td>
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</table>
Pl@ntViews dataset

**Fruit, Stem and Entire plant**

**Fruit types**
- Achene
- Berry
- Capeule
- Cone
- Drupe
- Folicle
- Legume
- Samara
- Sique

With an important diversity of colors, shape, texture, orientation, etc.

**Stem types**
- very young
- young
- adult
- old

The visual diversity of the bark of the *Robinia pseudoacacia*.

**Entire plant**
- From large trees to small herbs
Task description

- **Retrieval task**
  - For each test picture, a list of ranked species
  - Separate scores for the 2 mains categories
  - Free training strategy

- **Plant-based splits:**

  A plant centered approach & a multiple organ queries

  Can’t be split all images in training or test dataset

<table>
<thead>
<tr>
<th>SheetAsBackground</th>
<th>Train</th>
<th>Images</th>
<th>Plants</th>
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<th>All</th>
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<td></td>
<td>5092</td>
<td>3842</td>
<td>229</td>
<td>241</td>
</tr>
</tbody>
</table>
Task description

**Score**

- **Unbalanced** real-world data
- **Normalized** Average Score

\[ S = \frac{1}{U} \sum_{u=1}^{U} \frac{1}{P_u} \sum_{p=1}^{P_u} \frac{1}{N_{u,p}} \sum_{n=1}^{N_{u,p}} s_{u,p,n} \]

\( S_{u,p,n} = \frac{1}{\text{RankOfCorrectSpecies}} \)

To not give too much importance to individual plants with numerous images.

To not give too much importance to users who contribute a lot.

« As a new user of the plant identification system, what is the score I can expect? »
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## Participation and Methods

<table>
<thead>
<tr>
<th>Groups</th>
<th>Runs</th>
<th>Features</th>
<th>Prediction based on</th>
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<tr>
<td>AGSPPR</td>
<td>3</td>
<td>SPACT, SIFT, global shape</td>
<td>SVM</td>
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<tr>
<td>BTU DBIS</td>
<td>4</td>
<td>Global color histograms EOH, Tamura, CEDD, FCTH.</td>
<td>SVM</td>
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<tr>
<td>I3S</td>
<td>2</td>
<td>SIFT + BOW</td>
<td>SVM</td>
</tr>
<tr>
<td>INRIA</td>
<td>4</td>
<td>Shape: Triangular, Directional Fragment, Context Corners, LBP/SURF/Fourier/EOH/HSV/wRGB, date</td>
<td>Matching + nn SVM</td>
</tr>
<tr>
<td>LAPI</td>
<td>1</td>
<td>Curve partitioning</td>
<td>Linear Discriminate Analysis</td>
</tr>
<tr>
<td>LIRIS ReVes</td>
<td>2</td>
<td>Lab/Gabor/SURF, Hu/Zernike/centered moments, geoloc.</td>
<td>Naïve distance based</td>
</tr>
<tr>
<td>MICA</td>
<td>3</td>
<td>GIST/SURF + BOW</td>
<td>SVM</td>
</tr>
<tr>
<td>Nlab</td>
<td>3</td>
<td>SIFT variation + FisherVector</td>
<td>Linear Logistic Regression</td>
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<tr>
<td>SABANCI-OKAN</td>
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<td>Numerous shape and texture desc. wHSV, date.</td>
<td>SVM</td>
</tr>
<tr>
<td>SCG USP</td>
<td>3</td>
<td>LBP, Fractal, Gabor, geometrical</td>
<td>Linear Discriminate Analysis</td>
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<tr>
<td>UIAC</td>
<td>4</td>
<td>Joint composite descriptor, geoloc.</td>
<td>Nn rules, naïve Bayesian</td>
</tr>
<tr>
<td>VicomTech</td>
<td>2</td>
<td>Trace transform, Shape relationship</td>
<td>SVM</td>
</tr>
</tbody>
</table>
Results - Key to succeed

SheetAsBackground

Individual-plants not split during preliminary evaluation:
- better choice of features
- avoid over-fitting problems

Sabanci-Okan, Turkey
Inria PlantNet, France
NlabUTokyo, Japan
Results - *Key to succeed*

*Natural Background*

Subject is not split during preliminary evaluation...

Inria PlantNet, France
Sabanci-Okan, Turkey

UlabUTokyo, Japan
Results – Complementary remarks
NaturalBackground (details)

Good results on flowers lead to high scores on scans of leaves.

Most useful view
1. Flower
2. Not clear

Entire : NLabUTaokyo
Flower : Inria PlantNet
Fruit : NLabUTokyo
Leaf : NLabUTokyo
Stem : NLabUTokyo
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Conclusion

- **Good participation** → Increasing interest of the community

- Still **good results** on *Leaf-SheetAsBackground*
  Performances with a realistic number of species (3000 to 5000 sp.)?

- Real **difference** between
  *Leaf-SheetAsBackground* and *Leaf-NaturalBackground*

- Challenging unconstrained pictures
  Very **promising results** on *NaturalBackground* (mainly for flowers)

- No method above the others for the 2 categories

- Training strategy is essential

- **Metadata:**
  - + Impact of dates
  - Not clear GPS impact
  - Still unused data (taxonomic context, common names, Exif, ...
Perspectives and issues

- Task evolution through a new Lab, close to ImageCLEF, dedicated to environmental data management

- Growing task, with
  - More data, depending on collaborative contributions
  - More species (up to 500 or 1 000 sp.)
  - More content types (branch images)
  - More metadata (data quality evaluation, ...)
  - More multi-modal information
    (multi-lingual species names, species distribution, species description, ...)

Life 2014
Thank you!!