METU, Department Of Computer Engineering

Graduation Project
Proposal Form

(Please read carefully, and follow the instructions to prepare the project proposal form.)

(Instructions to fill in this form are given in italic fonts and in parentheses.)

(To provide an input for a section of the form, delete the instruction and provide your input in place of the deleted instruction. In the final form that you will submit, there shouldn't be any instructions left over, including this section of the form.)

(If you feel that a particular instruction is not relevant to your project proposal, please use a proper explanation for this, rather than ignoring the instruction.)

(The final form should not exceed 4 pages, excluding this page and including the References section. Please use Arial, Normal, 10pt fonts and single line spacing.)

Important Notes

A project could be proposed by (i) a student group, (ii) a company, or (iii) a faculty member of the department by filling in this form and submitting it to 49x-proposal@ceng.metu.edu.tr by e-mail. For a project proposal, there might be a sponsoring company supporting the project and providing some form(s) of resources for the project.

If your proposal might contain a patentable idea or any type of intellectual property, please first make sure to follow appropriate steps (apply for a patent, etc.) before sending your idea to us. Once this form is received from you, the instructor(s) and the department has no responsibility regarding to intellectual properties of your project/idea.

All sources and documentation developed for this course are assumed to be public domain (GPL, CC or similar license) by default. If you need any exception for license and disclosure of project work, please specify this in detail in IP section of the form.

Please note that source codes, documents and issue tracking should be kept in department servers. No restrictions can be requested for limiting faculty and assistants access to student work.

Project Information

Title

A Mobile Application for a Leaf-Based Tree Identification System

Target

Public [X] Restricted [ ]

(If you would like to restrict your project idea to one or more groups, please mark "Restricted" and state the group or groups eligible for the project.)

Proposer Information

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IP (Intellectual Property) Information

All algorithms and dataset developed by this project must be in the public domain (default for this course). Implementors must share their source codes with the faculty and assistants and cannot claim patents on the algorithms and the dataset that will be produced.

Project Description and Background Information

Description

The primary goal of this project is to develop a mobile application, which can perform leaf-based tree identification using one or more pictures of a given leaf. The application should allow the users to take a picture or use an existing picture of a leaf. The leaf picture may be captured on a white background or on a cluttered background. It should then extract various features that can be used in identifying the type of the tree to which the leaf belongs. What features are appropriate is an open research questions and must be answered during the project. These extracted features must be compared against a database which contains features for many different tree species. The creation of such a database is also a part of this project. This database can be created from the pictures on the Internet as well as self-captured pictures by the project team members. This database should contain information about at least 100 local tree types.

The application should report a direct match, and if none is found, it should list the most similar tree types in the order of similarity. The user should be able to click on the tree names to see various information about the selected tree (this information can be crawled from Wikipedia). Alternatively, the user can be directed to the relevant Wikipedia page without leaving the application. In other words, the application should have a minimal web-browser to show the contents of a Wikipedia or a similar web-page that contains information about the selected tree species.

Similar Products/Projects

The most relevant and well-known product is an application called LeafSnap. The teams that want to undertake this project are strongly encouraged to check out this application. The algorithms used in LeafSnap are explained in the paper:

Kumar, N., Belhumeur, P. N., Biswas, A., Jacobs, D. W., Kress, W. J., Lopez, I. C., & Soares, J. V. (2012). Leafsnap: A computer vision system for automatic plant species identification. In Computer Vision–ECCV 2012 (pp. 502-516). Springer Berlin Heidelberg.

A similar application is developed for recognizing flowers. This application, called MobilFlora, is explained in the following research paper:

Angelova, A., Zhu, S., Lin, Y., Wong, J., & Shpecht, C. (2012). Development and deployment of a large-scale flower recognition mobile app. NEC Labs America Technical Report (December 2012), http://www. nec-labs. com/research/information/infoAM_website/pdfs/MobileFlora.pdf.

Another mobile application for plant identification is explained in the paper:

Mouine, S., Yahiaoui, I., Verroust-Blondet, A., Joyeux, L., Selmi, S., & Goëau, H. (2013, April). An android application for leaf-based plant identification. InProceedings of the 3rd ACM conference on International conference on multimedia retrieval (pp. 309-310). ACM.

A similar application is described in two papers:

Goëau, H., Bonnet, P., Joly, A., Bakić, V., Barbe, J., Yahiaoui, I., ... & Péronnet, A. (2013, October). Pl@ ntnet mobile app. In Proceedings of the 21st ACM international conference on Multimedia (pp. 423-424). ACM.

Goëau, H., Bonnet, P., Joly, A., Affouard, A., Bakic, V., Barbe, J., ... & Boujemaa, N. (2014, April). Pl@ ntnet mobile 2014: android port and new features. In Proceedings of International Conference on Multimedia Retrieval (p. 527). ACM.

Finally an Android-based application called ApLeafis is described in the paper:

Ma, L. H., Zhao, Z. Q., & Wang, J. (2013). ApLeafis: an android-based plant leaf identification system. In Intelligent Computing Theories (pp. 106-111). Springer Berlin Heidelberg.

Justification of the proposal

Currently, there are many applications that are aimed to assist nature enthusiasts in various ways. There are applications for detecting star constellations in the night sky, identifying various types of plants, flowers, and

animals, helping people record their walking routes on uncharted walking trails, etc. This applications belongs to such a category.

More specifically for leaf-based tree identification there are only a handful of applications as listed above. None of these applications work perfectly and they are designed primarily for detecting North American and European tree species. There is no application which has a good performance and localization support for identifying tree species native to Turkey. This project is aimed to fill this gap.

Contributions, Innovation and Originality Aspects of the Project

This project is expected to on par with other products in terms of classification accuracy. It is expected to make a comprehensive analysis of image features to make suggestions about which features are the best for leaf-based tree identification.

Furthermore, currently there is no plant database for the tree species in Turkey. This project is aimed to create such a database that includes at least 100 tree species.

The user interface must be original, appealing, and intuitive to allow the usage of the application by the general public.

Technical Aspects of the Project

This project lies at the intersection of several areas such as image processing, pattern recognition, and UI design. The implementors will have to solve various problems about how to extract features from a given leaf image, how to decide on the best features, how to design a classifier, how to create a database of leaf images, how to solve these tasks efficiently, and how to package all of these algorithms within a clean UI so that the final product becomes usable by the general public.

Targeted Output, Targeted User/Domain Profile

The end-product is a smart phone (or tablet) application. The implementors are free to choose iOS or Android platforms.

The primary success measure is the classification accuracy. There are some existing databases in which such a comparison can be made. See ImageCLEF.org website for some example databases (look under years 2012 and 2013).

A database that includes at 100 local tree species must also be created and the classification accuracy must also be evaluated using this dataset.

Targeted user profile involve ecologists, amateur botanists, educators, children, and so on. Such a system can be implemented in the visitor centers of botanical parts, zoos, recreational areas, etc.

Project Development Environment

This project should run on iPhone and/or Android-based tablets and smartphones. It can be implemented by using any development environment that can produce an output suitable for these platforms. Implementors can use the OpenCV library for various image processing, pattern recognition, and classification tasks.

External Support

The proposer (or other faculty in the department) can provide technical support about the algorithms that will be developed. Implementors can also talk to faculty from other university's botany departments to learn more about the distinctive leaf features that may be used for leaf-based tree identification. However, no hardware or software support will be provided.

References

In addition to the applications cited above, here is a list of relevant technical papers about leaf-based tree identification.

Mouine, S., Yahiaoui, I., & Verroust-Blondet, A. (2013, April). A shape-based approach for leaf classification using multiscaletriangular representation. InProceedings of the 3rd ACM conference on International conference on multimedia retrieval (pp. 127-134). ACM.

Joly, A., Goëau, H., Bonnet, P., Bakić, V., Barbe, J., Selmi, S., ... & Barthélémy, D. (2014). Interactive plant identification based on social image data. Ecological Informatics, 23, 22-34.

Novotný, P., & Suk, T. (2013). Leaf recognition of woody species in Central Europe. biosystems engineering, 115(4), 444-452.

Goëau, H., Joly, A., Bonnet, P., Selmi, S., Molino, J. F., Barthélémy, D., & Boujemaa, N. (2014). Lifeclef plant identification task 2014. In CLEF2014 Working Notes. Working Notes for CLEF 2014 Conference, Sheffield, UK, September 15-18, 2014 (pp. 598-615). CEUR-WS.

Satti, V., Satya, A., & Sharma, S. (2013). An Automatic Leaf Recognition System For Plant Identification Using Machine Vision Technology. Int J Eng Sci Technol, 4(5), 874-879.

Sulc, M., & Matas, J. (2013, November). Kernel-mapped histograms of multi-scale lbps for tree bark recognition. In Image and Vision Computing New Zealand (IVCNZ), 2013 28th International Conference of (pp. 82-87). IEEE.

Haug, S., Michaels, A., Biber, P., & Ostermann, J. (2014, March). Plant classification system for crop/weed discrimination without segmentation. InApplications of Computer Vision (WACV), 2014 IEEE Winter Conference on(pp. 1142-1149). IEEE.

Soares, J. V., & Jacobs, D. W. (2013). Efficient segmentation of leaves in semi-controlled conditions. Machine vision and applications, 24(8), 1623-1643.

Grand-Brochier, M., Vacavant, A., Cerutti, G., Bianchi, K., & Tougne, L. (2013, July). Comparative study of segmentation methods for tree leaves extraction. InProceedings of the International Workshop on Video and Image Ground Truth in Computer Vision Applications (p. 7). ACM.