

Augmented Reality User Interfaces to an Electronic Field Guide

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ABSTRACT

We demonstrate a prototype mobile augmented reality user interface for automated identification of botanical species in the field, developed for the Columbia University, University of Maryland, and Smithsonian Institution Electronic Field Guide Project. Leaf images are captured with a head-worn digital video camera. A computer-vision component developed by our colleagues finds the best set of matching species, and our user interface presents the results as virtual representations along the side of a hand-held clipboard next to the physical leaf sample. A tangible card morphs into a given plant when placed over its representation. Virtual representations can be inspected and changed (e.g., from leaf image to full plant image) through gesture and movement through spatial zones. Samples are matched with existing species or marked unknown for further study. The system is being tested by botanists at the Smithsonian Institution.

CR Categories: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—*Artificial, augmented, and virtual realities*; H.5.2 [Information Interfaces and Presentation]: User Interfaces—*GUI*; J.3 [Life and Medical Sciences]

Keywords: electronic field guide, augmented reality, mobile computing, wearable computing, tangible user interface, computer vision, botanical species identification

1 SYSTEM OVERVIEW

As the understanding of ecoinformatics and biodiversity grows, so must the tools that botanists require for field-work and research. Of particular importance is the ability to identify existing and new species in the field. Our demo presents a mobile augmented reality user interface for automated identification and visualization of botanical species. This user interface was designed as a wearable alternative to a Tablet-PC-based user interface that we have developed for the same project [1].

In our prototype, a leaf is placed on a hand-held clipboard to provide a background for a computer-vision matching algorithm, developed by our colleagues [1]. A card containing a visual fiducial (not specific to the particular leaf) is then placed below the leaf to trigger image acquisition and initiate the visual search. The results of the search are displayed as virtual vouchers along the side of the clipboard next to the physical leaf sample in ranked relevancy order. (A *virtual voucher* [2] is a digital representation of the botanical reference specimen in conjunction with its contextual and characteristic data.) The card can then be moved to the same location as one of the search results images. This causes the card to morph into the image of the selected species, so that it can be manipulated for further inspection.

For the inspection task, the user can magnify the leaf and inspect venation or edge details by moving the card towards the user. The leaf image is magnified disproportionately relative to the actual distance traveled, as if the object was growing in size as it moves towards the user. Semantic changes are based on distance from the user, spatial zones, or orientation of the card. For example, if a card is held towards the left, the image of the full plant is shown, and if the card is held towards the right, the image of the individual leaf is shown. In another approach that we have



Figure 1. A user compares a virtual voucher, selected from the set of best matches, with the sample plant. (Captured through a video see-through display outdoors).

explored, the semantics are controlled by flipping the card. We have also applied tangible and gestural control to semantic zooming and transformation of the visualization.

Once the botanist has decided on the identification, they place the selected virtual voucher below the physical leaf, specifying a match. The proposed identification is added to the existing contextual data about the sample.

The user interface is being designed and developed with iterative feedback from the user community (botanists at the Smithsonian Institution) who are actively using our Tablet-PC-based user interface and have tested our augmented reality prototypes.

2 ADDITIONAL INFORMATION

Digital video of the running system can be viewed at <http://www.cs.columbia.edu/graphics/projects/efg/>

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REFERENCES

- [1] Agarwal, G., Belhumeur, P., Feiner, S., Jacobs, D., Kress, W.J., Ramamoorthi, R., Bourg, N., Dixit, N., Ling, H., Mahajan, D., Russell, R., Shirdhonkar, S., Sunkavalli, K., and White, S. First steps toward an electronic field guide for plants. To appear in *Taxon, Journal of the International Association for Plant Taxonomy*.
- [2] White, S., Feiner, S., and Kopylec, J., Virtual Vouchers: Prototyping a Mobile Augmented Reality User Interface for Botanical Species Identification, *Proc. IEEE Symposium on 3D User Interfaces*, Alexandria, VA, March 25–26, 2006, pp. 119–126.