



Designing a Mobile User Interface for Automated Species Identification

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Overview

- Need for tool
- What is LeafView?
- Related Work
- Features of LeafView
- Testing
- Issues addressed
- Feedback
- Critique
- Future work

Need for automated species identification

- Inspection of characteristics such as plant structure and leaf venation with paper field guide
- Botanist must compare sample with (canonical specimen) voucher
- Identification is time consuming which involves shipment of vouchers from herbaria to remote local for verification. Voucher specimen might be lost or destroyed during transfer.
- Columbia University, University of Maryland, and the Smithsonian Institution are working to develop mobile electronic field guides for botanists that support vision based automated species identification

What is LeafView?

- Tablet-PC–based prototype, user interface for an electronic field guide that supports automated identification of botanical species in the field.



Figure 1: Smithsonian botanist using the Electronic Field Guide prototype, showing the sorted results from automated species identification. Each leaf represents a virtual voucher.

Related Work

- OSCAR
- Double Shot
- Cyber Tracker
- Butterfly Net

User Interaction

- Tabs for browsing
- Process starts by taking leaf photo
- Via IEEE 802.11 or Bluetooth
- Vision Algorithms
- GPS location, collector, time/date stored in database
- Search uses IDSC (Inner Distance Shape Context) algorithm
- Human interaction is required for zooming and identification of species

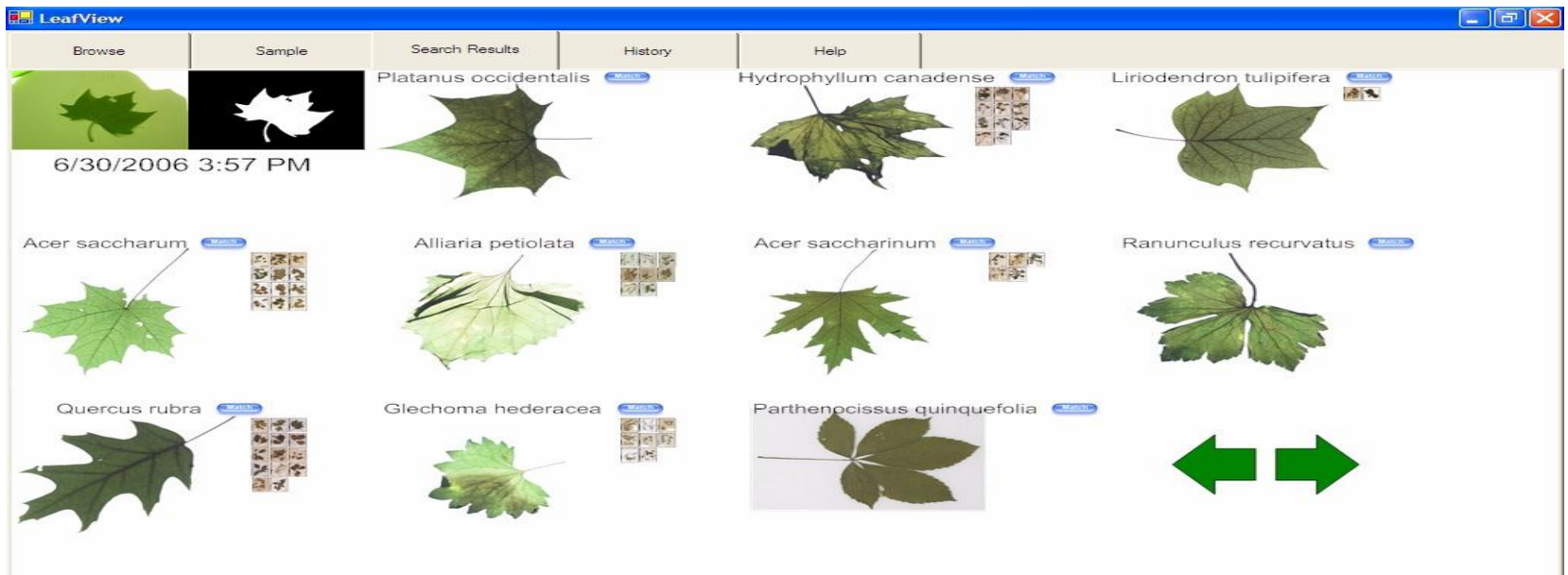
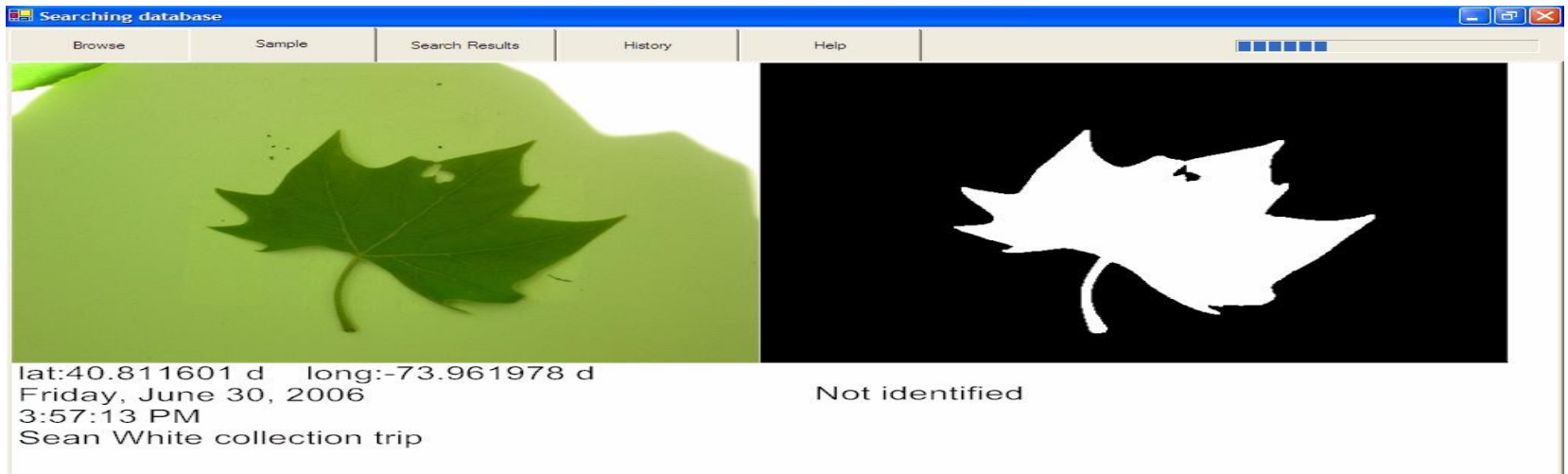


Fig2: (a) A sample leaf and segmented representation provide feedback on the image. (b) Display of potential matches with virtual voucher representations.

System Requirements

- Software used C#, MatLab, and Piccolo
- Hardware consists of Motion Computing LEI 600, Lenovo ThinkPad X41 Tablet PCs, a Delorme Earthmate GPS, a Nikon Coolpix P1 Wi-Fi camera, and a Sony Ericsson T616 Bluetooth camera phone

Testing

- **Plummers island**
 - 4 botanists collaborators.
- **Exhibition event**
 - 2 LeafView prototypes were available for attendees to try in an exhibit at the 2006 Smithsonian Institution staff picnic
 - Bucket containing large variety of plant samples

Supporting Comparison and Inspection

- Additional information about species is maintained in virtual voucher which is displayed only on user request
- When a botanist believes that a species is present in dataset and is not matched, visual and textual browsing of entire data set for matching is made possible

VISION ALGORITHMS

- Provide no feedback on success or failure modes.
- Quality of segmented image is related to the accuracy of the results and botanists can make minor adjustments based on seeing the segmented image.
- To address this display of segmented image alongside the sample image while the IDSC algorithm is executed (Fig. 2a) provides immediate feedback regarding the quality of the segmentation.
- For example, if a shadow causes poor matching, the botanist can observe this and retake the photograph to fix the error.

Individual and Batch Identification

- Identification in two very different ways.
 - 1) Image was taken and the system was immediately checked to see results
 - 2) A series of pictures taken
- Earlier prototype did not support approach 2.

As one botanist put it, “*the system gets very confused if you send too many [images]*”.















Queuing, Pipelining, and History

- History display acts as both a queue and as an indication of the stage of progress for each leaf sample, supporting both individual and batch identification
- Multiple photographs can be taken in succession
- Segmentation is shown on sample tab, alongside the leaf image
- Once final matching has completed, the results are shown in the results tab and reflected in the history.
- Images can also be deleted from history

History of collected leaves

LeafView

Browse Sample Search Results History Help

							
6/26/2006 11:15 AM		6/26/2006 11:19 AM		6/26/2006 11:22 AM		6/26/2006 11:25 AM	
							
6/26/2006 11:28 AM		6/26/2006 11:31 AM		6/26/2006 11:33 AM			

Feedback

- Botanists verified that prototype was effective than physical voucher.
- Providing feedback by displaying the segmented images enabled users to retake better pictures than those that originally produced bad matches

Critique

- 98.5 % accuracy
- Mobile user interface
- Some botanists may have apprehension about “plant identification system”

Reacted positively when realized tool intended to assist rather than replace them.

- Leaf view was mostly evaluated by only 4 botanists.
- Prototype never took weather changes into consideration since plant leaves color intensity varies with weather/location
- Carrying the prototype tablet, camera for fieldwork would not be practical

Future Work

- Display name of identified species
 - “...display the name of the plant selected for a match. That way the user would know what name was selected for something they saw earlier in the day...”
- Better Vision algorithms
- Upgrade in software and hardware
- Web based or cell phone based User interface could be used
- Researchers confirmed that current prototype version runs on UMPC (Ultra-Mobile PC) portal and iphone

Video

<http://www.youtube.com/watch?v=PUECpWnmnl0>

Questions?

