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Multimodal Vietnamese medicinal plants retrieval system for Android

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Abstract— **Previous studies have found that Vietnam has a rich source of medicinal plants and the Vietnamese people has used these plants as a traditional medicine in an efficient and safe manner. However, on one side, not all people know and could recognize medicinal plants in reality. On the other, even being able to recognize it, it is not easy to access all the plant information. In this paper, we present a multimodal Vietnamese medicinal plants retrieval system. Our main objective is to bring to users a robust means to retrieve Vietnamese medicinal plants. Our system provides three main possibilities for searching a plant of interest: a conventional keyword based search engine, a fully automatic leaf images based plant identification and interactive plant identification with aids of the graphical tool. These search modes are integrated inside a generic framework with interactive user interface that facilitates the use of the system on a common Android platform.**

Keywords—medicinal plants; plant retrieval, leaf analysis

I. INTRODUCTION

In 1992, the World Conservation Monitoring Center evaluated Vietnam as one of the 16 most biologically diverse countries in the world. This rich biodiversity makes a major contribution not only to forestry, fishery, agriculture, tourism, industry but also to health. Previous studies have found that Vietnamese people has used a high number of species of flora and fauna as traditional medicine [1]. According to [2], there are more than 600 plants that have been recorded as used in traditional medicine remedies in Vietnam. However, the use of these medicinal plants is based on the user's experience. There are some books that have been published for the medicinal plants in Vietnam [2]. However, it is not easy to access the plant information. We believe that the use of Vietnamese medicinal plants will be increased if we can provide rich, trusted information by easy and friendly means. Moreover, nowadays, with the development of the technologies, it is affordable for individual to have a smartphone equipped with the camera. Therefore, the main aim of our work is to develop a Vietnamese medicinal plants retrieval system for smart phone in general and for Android OS in particular.

II. RELATED WORK

Plant identification method based on information technology goes from semi-automatic to automatic. Most semi-automatic method [3], [4] imitate the plant identification process of botanist with aid of a multimedia database and a set of questions. In [3], the scientists from IOWA state university developed web tool to help user identify species by choosing a number of plant’s characteristics. The users describe the species of interest step by step and they got the most suitable result at the end of the plant identification process. With the same idea, [4] introduced graphic tool named IDAO which is more visual and easy to use, especially for non-botanist users.

Concerning automatic and image-based plant identification system developed for mobile, there exists three main applications. Leafsnap [5] is the first automatic plant identification application. However, this application is dedicated to iOS users and is working with tree species of the Northeastern United States. Pl@ntNet is an image sharing and retrieval application for the identification of plants. It is developed by scientists from four French research organizations (Cirad, INRA, Inria and IRD), and the Tela Botanica network. Among other features, this free app helps identifying plant species from photographs, through visual recognition software. This app works on more than 4100 species of wild flora of the French territory. The authors in [3] introduced a plant leaf-based identification system for Android. This system determines the identity of the plant based on SURF descriptors extracted from plant leaf image.

III. VIETNAMESE MEDICINAL PLANTS IDENTIFICATION SYSTEM FOR ANDROID

A. Overview

Fig. 1 shows the architecture of our system. Our system is based on client-server architecture. The client is any Android mobile devices that are equipped a camera. The application is intended for mobile devices to allow a user to identify plants on the spot. The main functionality of the system is to identify a plant and display results visually on the screen. To do that, we provide three ways for users to search information of medicinal plants: text-based search, interactive search and automatic search based on images. We will describe in detail in the next sections these searches.

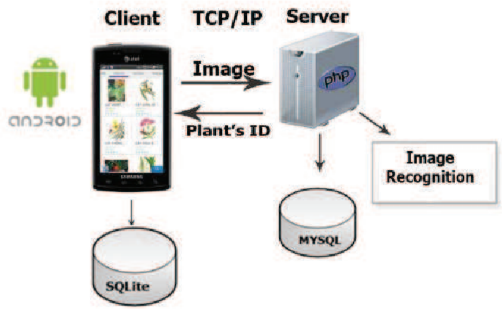

Fig. 1. Architecture of Vietnamese medicinal plant search

Besides these search functions, to store plant's information, we use SQLite database management system provided by the Android platform. For this, first we have to design database structure then we need to collect as much as possible Vietnamese medicinal plants. Basically, our database has 4 tables: medicinal group, medicinal plant, words and words frequencies. Two first tables are used to provide plant information to the users according to their request while the two last ones are served for text-based retrieval module. For plant information table, we provide 15 fields including name, family name, scientific name, introduction, description, distribution, collecting and processing, chemical component, usage and dosage, effect and prescription of the plant.

B. *Text-based medicinal plant retrieval*

When user wants to search a plant of interest using text-based mode, they can type their queries in Vietnamese. First, the system finds the name of medicinal plants and name of the medical group with query input. Then it will separate input query into single words and match it with a dictionary in database. At this stage, the system will find a list of plants with input keyword by determining a frequency of this word for each plant. For each stage, the system will return a list of ID of retrieved plants for each query.

C. *Automatic medicinal plant retrieval*

In [6], we have proposed to use Kernel descriptor (KDES) for leaf-based plant identification. The flowchart of the plant identification method is shown in Fig. 2. This method consists of four main steps: petiole detection and removal, leaf orientation normalization, modified KDES and SVM based classification. In this paper, we reuse this method for Vietnamese medicinal plant identification. However, the current version of automatic Vietnamese medicinal plant retrieval of our system supports only for leaf images. In order to activate this search mode, the user provides a leaf image of medicinal plant. This image can be captured directly from the camera or selected from existing album.

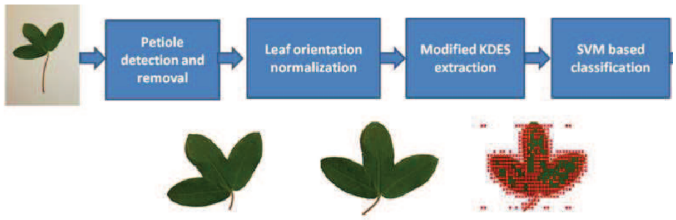

Fig. 2. Automatic medicinal plant retrieval results

D. *Interactive medicinal plant retrieval*

Even our system supports the automatic search mode of the Vietnamese medicinal plant based on image content. When working with the image retrieval in general and Vietnamese medicinal plant retrieval in particular, we believe that a retrieval system cannot always satisfy the user's requests without interaction with the users. However, the system should not always ask the help from users. These observations motivate us to propose new idea for Vietnamese medicinal plant retrieval system: interactive search. This work is based on our previous work presented in [7]. In this section, firstly we will describe briefly this work and present our proposition.

1) Graphical tool for plant identification

Architecture of the graphical tool for plant identification is shown in Fig.3. This tool has three main components: graphical interface, plant identification and result interface.

The graphical interface presents characteristics of different parts of plants such as leaf, venation, and bark under graphical icons. The designed graphical icons represent well jargons used by botanists. Figure 4 illustrates icons for 4 types of margin of the lamina with the corresponding technical terms. As we can see, with graphical interface, non-botanists may describe easily the characteristics of the interested plants.

Plant identification process aims at computing the similarity between plants in the database and the user query. In our work, each plant is represented by a vector of presence of defined features. If the plant has a feature, the value of vector element corresponding to this feature is set to 1. Otherwise, it is set to 0. Figure 5a illustrates several plants in the database. For example, Plan 1 has 'entire' margin of the lamina and is a 'tree'. In the similar way, the query is represented as a vector of defined features. In this vector, the corresponding elements of the chosen features are set to 1. An example of user query is shown in Fig.5c. Because features may play different roles in plant identification, in our work, we represent that by a weight vector. The value of this vector is defined by the botanists. An example of weight vector is given in Fig.5b. The similarity (S) between one plant and a query is defined as below:

$$S = \frac{\sum_i w_i * A_i}{\sum_i w_i} \times 100\% \qquad (1)$$

Where Ai is defined by AND operator between the ith element of vector of plant and that of the query. The similarity of plants (c.f. Fig. 5a) and the query (c.f. Fig. 5c) calculated by Eq. 1 is shown in Tab. 1. The similarity calculation permits information missing.

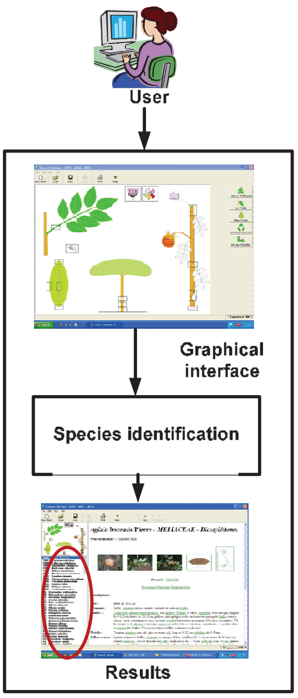

Fig. 3. Architecture of the graphical tool consisting of three main components: graphical interface, plant identification and result interface.

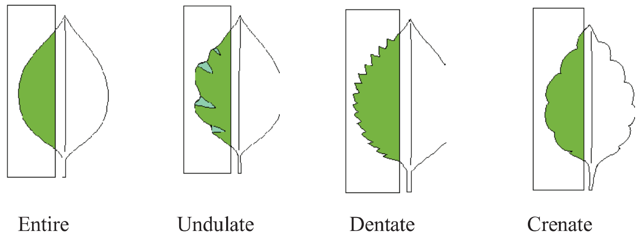

Fig. 4. Margin of the lamina feature icons and the corresponding technical terms

Characteristic	Margin of the lamina				Type		
Plant	Entire	Undulate	Dentate	Crenate	Tree	Climber	Palm
Plant 1	1	0	0	0	1	0	0
Plant 2	0	1	0	1	0	1	0
Plant 3	0	0	1	0	0	0	1
...	...	...	...	...	...	...	...
Plant N	1	0	0	0	0	1	0

(a)

Weight	7	5	5	3	3	3	3

(b)

Query	0	1	0	0	0	1	0

(c)

Fig. 5. (a) Plants in the database; (b) The corresponding weight for each plant characteristics; (c) The sample created from a list of characteristics provided by users.

The result interface allows to present the identification results to user. Plants in the database are sorted by decreasing order of similarity with the query. The result presentation way tolerates errors in feature selection step. Moreover, for each plant in result list, users can see its images, botanical drawings and descriptive information such as distribution, control method.

This tool has two main drawbacks. Firstly, the user is asked to select a number of plant characteristics in order to have a precise list of the retrieved plants. This is tedious task for the user. Secondly, this tool does not support the captured image as the input. In this paper, we propose two news improvements for leaf-based plant identification. The first one is that we extend the tool so that it is able to take an image provided by user as input. Since the capture image can contain not only the leaf of interest but also objects. We first segment this image. For this we propose an interactive segmentation image. Then from the leaf region defined previously, we try to automatically extract the features that are defined in the graphical too in order to reduce the work of the users.

TABLE I. SIMILARITY BETWEEN THE SAMPLE DEFINED IN FIG. 3B AND THE PLANTS IN THE DATABASE PRESENTED IN FIG. 3A.

Plants	S
Sp. 1	0
Sp. 2	100
Sp. 3	0
...	…
Sp. N	37.5

2) An interactive image segmentation

In this section, we describe an interactive image segmentation method to separate a leaf from the complicated background. The fact that conventional automatic segmentation methods such as thresholds, gradient operators and morphological operators are often ineffective for image captured in a natural/out-door scene. Some others robust segmentation methods such as graph-cut, partition tree require a lot of computational time. Therefore, fully automatic leaf segmentation is an unsolved problem. In this work, we exploit a well-known technique that is watershed algorithms [8] for interactive segmentation. Using this technique, an interested leaf is feasibly extracted from the complicated background. Furthermore, we propose a scheme to detect multiple leaf-parts such as vein, base, apex, margin of the segmented leaf. These leaf-parts will provide improving results of the interactive leaf recognition through the graphical tool.

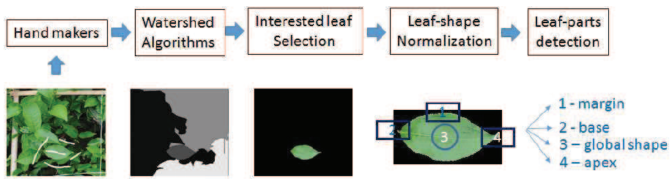

Fig.6. Proposed method for interactive leaf segmentation and recognition

The watershed method has been used in image segmentation since the early 90's [8]. It is analogous to placing a water source in each regional minimum and then flooding the relief. Barriers are built to prevent the different sources meeting. In interactive segmentation works, the markers based watershed approach is often employed with two markers: external and internal markers (Bovik et al., Ch. 5 [9]). An external marker coarsely marks boundary in order to quickly separate the foreground regions from background ones. Internal markers point out seed (a center area) of the interested regions. Meyer et al. use markers in conjunction with region growing to prevent over segmentation [10]. An Otsu threshold is employed to automatically create markers [11]. The practical implementations show that the higher the marker precision, the better the segmentation results.

In our work, we define makers through two steps:

- At the first step, user manually marks regions around an interested leaf. More makers created, more regions have been segmented.
- At the second step, the regions with same gradient levels as marker regions are selected. User selects the region including the interested leaf. It is simple point out the region of the interest.

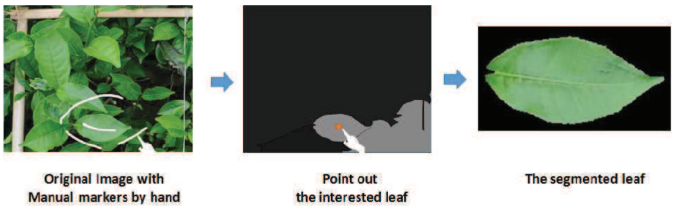

Fig.7. The proposed method for interactive leaf segmentation from a complicated background

3) Leaf-shape normalizations

The segmented leaf then is normalized in order to easy locate parts of the leaf. The proposed method is different from feature-based parts detection method (e.g., Olfa Mzoughi et al [12]). We deploy a normalization procedure to detection four main parts of the leaf (1- margin, 2-base, 3- Global shape, 4-apex) according to a prior template, as shown in Fig.

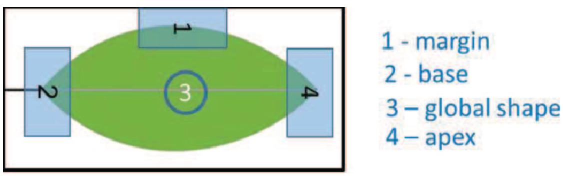

Fig. 8. An example of the leaf-template: 4 leaf-parts are extracted based on this template

For normalizing shape of the segmented leaf, two criteria below are deployed:

- Rotating the segmented leaf according to the main vein direction
- Preserving scale (uniform scale) between horizontal and vertical of leaf.

For the first criteria, we extract the contour of the segmented leaf. Then the first order of moments in horizontal, vertical, and both directions are calculated. Based on these moments, we calculate a rotation matrix. An affine transformation is followed ensure that the main direction of vein-leaf is parallel to the horizontal axis. However, current result does not fit the leaf into a pre-defined frame (or a rectangle box) of the leaf-template.

For the second criteria, in order to preserving scale between horizontal and vertical dimension of the segmented leaf, we utilize the uniform scaling method. The ratio for scaling is calculated by:

$$\begin{cases} w' = w_s \\ h' = \dfrac{w'}{w} h \end{cases}$$

In which:

w, h: Width and height of the segmented leaf

w', h': Width and height of the normalized leaf

w_s : width of the leaf-template

Based on the normalized leaf, four parts are easily located according to their position on the prior template. An example of the normalized leaf using the proposed method is shown in Fig. 9.

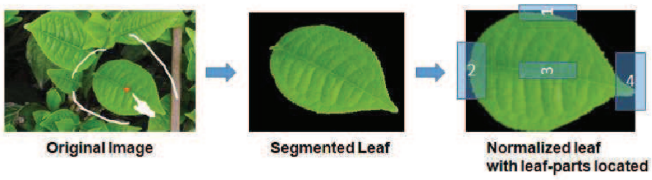

Fig. 9. An example of the normalized leaf-shape and detected leaf-parts

The detected parts will cooperate with graphical tool that is previously described.

IV. RESULTS

A. Databases

Our system has two databases. The first database is textual database of the Vietnamese medicinal plants while the second database is image database that is used for training medicinal plant classifiers.

Concerning the textual database, we build our database based on the most famous book on Vietnamese medicinal plants [2]. This database consists of 600 Vietnamese medicinal plants as listed in [2]. To build vocabulary from input data, we use a Vietnamese word segmentation toolbox [12] to segment paragraph into words and store their frequencies to determine the importance of each word for specific medicinal plant.

The last dataset is our own dataset built for Vietnamese medicinal tree. Since the image database building is a tedious and time consuming task and a number of Vietnamese medicinal trees are found in the far mountains of Vietnam, actually, we collect images for 55 plants. This dataset consists of 1312 images for 55 species. Fig. 10 shows some images examples of our dataset.

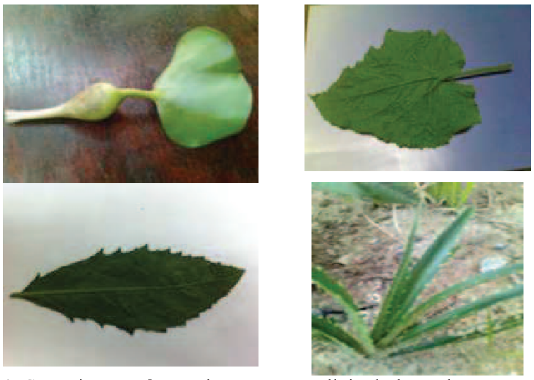

Fig. 10. Some images from Vietnamese medicinal plants dataset.

B. Our system

We have built our Vietnamese medicinal plants search application for Android devices. Concerning fully automatic leaf images based plant identification, we divide the dataset into training set (649 images) and testing set (663 images). We apply the method presented in section III. C and the obtained accuracy is 97.2%.
The GUI of interactive segmentation for separating a leaf from background is shown in Fig. 11.

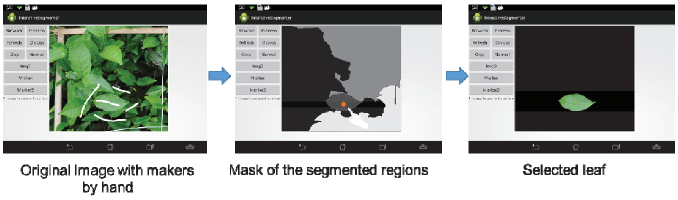

Fig. 11. The GUI of interactive segmentation

Some practical results are given in Fig.12. In these examples, an new user needs only few markers (three to four) to locate a leaf. The normalization steps procedure corrected shapes of the leaf in horizontal axis (e.g, leaf #2, leaf#3 in the first example in Fig.12). Therefore, it is feasible to detect parts of leafs. Further evaluations on effectiveness of the interactive segmentation, such as segmenting leafs from image caputured in real field, are implemented in future works.

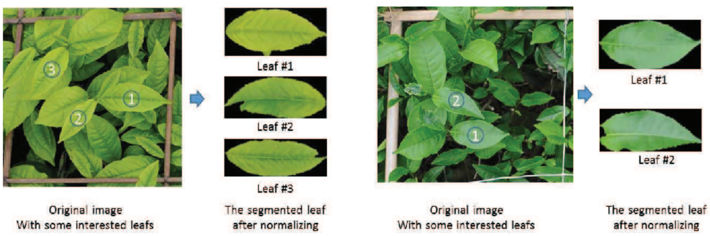

Fig. 12. Some examples for the results of the normalized leaf

Fig. 13-15 show several screenshot of our application.

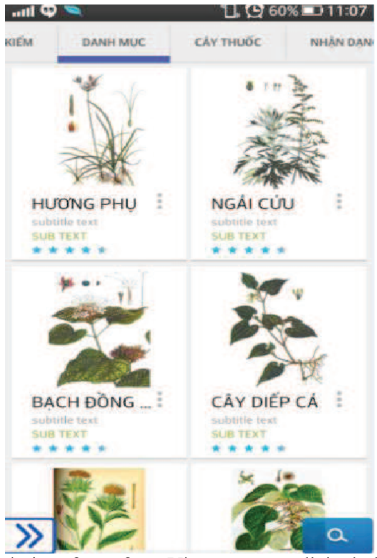

Fig. 13. Main interface of our Vietnamese medicinal plant search.

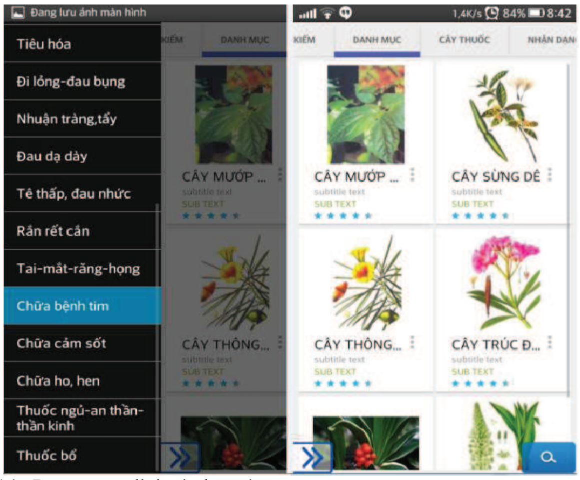

Fig. 14. Browse medicinal plants by group

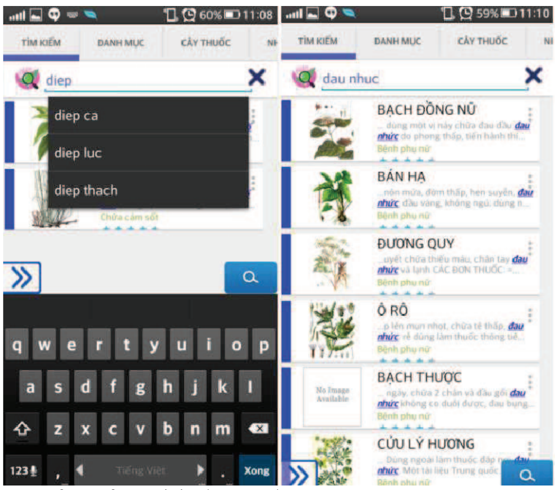

Fig. 15. Interface of search by keyword

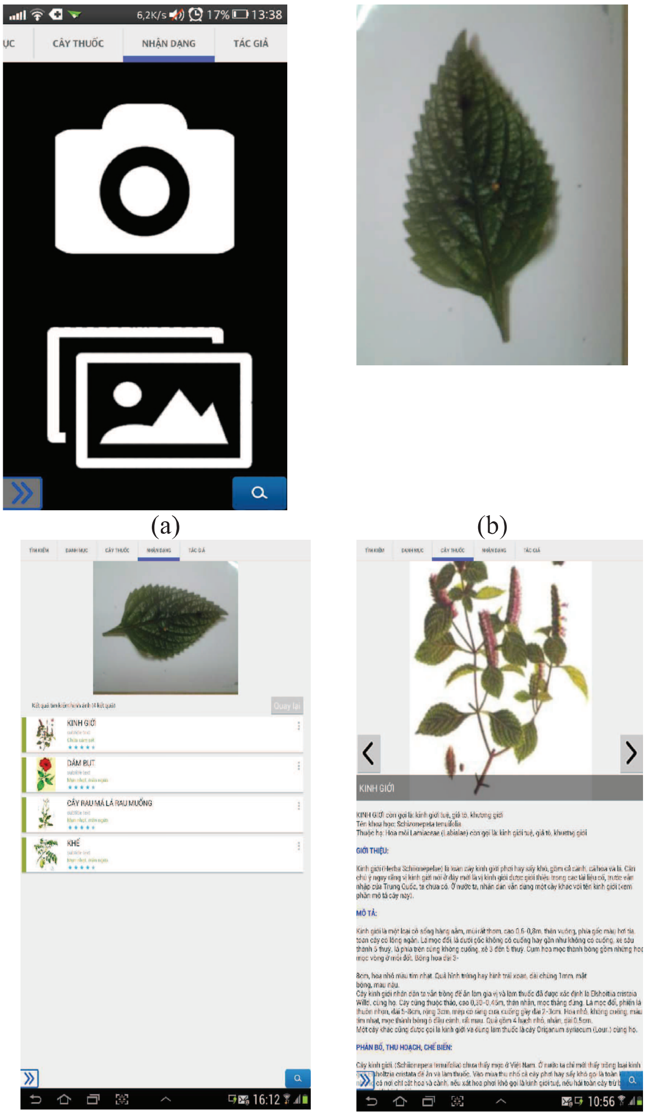

Fig. 16. Interface of search by image (a) the interface that allows users to connect with mobile camera to take a picture of plant of interest or to select an image in the album; (b) image input for leaf-based plant identification; (c) identification result: list of retrieval plants order by the probability; (d) detail information of identified plant.

V. CONCLUSIONS

In this paper, we present a multimodal Vietnamese medicinal plants retrieval system. Our system provides three main possibilities for searching a given plant: a conventional keyword based search engine, a fully automatic leaf images based plant identification and interactive plant identification with aids of the graphical tool. These search modes are integrated inside a generic framework with interactive user interface that facilitates the use of the system on a very common Android platform. In the future, we would like to extend our work by developing the interactive mode not only for leaf but also for others parts of the plant. Moreover, we have to focus on image database building in order to provide leaf image based search mode for all Vietnamese medicinal plant.

REFERENCES

[1] Van, N.D.N. and N. Tap, *An overview of the use of plants and animals in traditional medicine systems in VietNam*, A traffic Southest Asia Report.

[2] Do, T.-L., *Some Vietnamese. Medicinal Plants and Materia Medica (in Vietnamese)*1991: Nhà xuất bản Khoa học, Kỹ thuật.

[3] Web1-IOWA, *IOWA department of nature resource -Tree Identification*, 2012.

[4] Grard, P., et al. *A graphical tool for computer-assisted plant identification*. in *TDWG*. 2009.

[5] Neeraj, K., et al., *Leafsnap: A Computer Vision System for Automatic Plant Species Identification.*, in *ECCV 2012*2012, Springer. p. 502-516.

[6] Le, T.-L., D.-T. Tran, and N.-H. Pham, *Kernel descriptor based plant leaf identification*, in *4th International Conference on Image Processing Theory, Tools and Applications*2014: Paris, France.

[7] Pham, N.-H., et al., *Computer aided plant identification system*, in *International Conference on Computing, Management and Telecommunications (ComManTel)*2013. p. 134-139.

[8] A. Bovik, Handbook of Image and Video Processing. ACADEMIC PRESS, 2000.

[9] Meyer F. and Beucher S., Morphological segmentation. Journal on Visual Commun. Image Represent 1(1), 1990, pp. 21-46.

[10] Wang X.F., Huang D.S., Du J.X., Xu H. and Heutte L., Classification of Plant Leaf Images with Complicated Background. Journal on Applied Mathematics and Computation 205, 2008, pp.916-926.

[11] Olfa Mzoughi et al., "*Advanced tree species identification using multiple leaf parts image queries*", in the Proceeding of ICPR 2013, Vol. 1., pp. 3967-3971

[12] Le, H-P. *vnTokenizer -- Vietnamese word segmentation* http://mim.hus.vnu.edu.vn/phuonglh/softwares/vnTokenizer