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Full Length Research Paper

Computerized system for identification of some savanna tree species in Nigeria

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A computerized system named LEASYS was developed to serve as a modern, less time-consuming and less cumbersome method of plant identification. The LEASYS system used was based on simultaneous narrowing of two classification systems that is, vertical and horizontal characters, and supplying these systems with an appropriate Boolean operator (the AND operator preferably). The system was based on leaf morphology of some savanna tree species in Nigeria. For the purpose of this study, selected plants were identified based on possession of either simple or compound leaves. The system is amenable to expansion to cater for identification of other species in the plant kingdom.

Key words: Computer, herbarium, LEASYS system, plant identification, taxonomy.

INTRODUCTION

One of the tools used in Plant Taxonomy to identify plants is the Taxonomic key example, dichotomous keys. While these tools are functional and helpful, their use is usually time-consuming and cumbersome. Hence, there is need to modernize the process of identification, so as to make it fast and simple to use. Information retrieval (IR) is the science of searching for documents, for information within documents and for metadata about documents, as well as that of searching relational databases and the World Wide Web (Doyle and Becker, 1975; Singhal, 2001). Information retrieval is fast becoming the dominant form of information access, overtaking traditional database style of searching. Automated information retrieval systems are used to reduce what has been called "information overload".

Many universities and public libraries use IR systems to provide access to books, journals and other documents. Web search engines are the most visible IR applications (Korfhage, 1997).There are thousands of plant species, which have been classified into 150 – 500 plant families. As a result of high number of plants on earth identifying them may at times be tasking and difficult one to do. It usually takes a long process of checking and checking cabinets in herbarium looking for like species that will serve as template for the identifying plants. Due to this reason, there is, therefore, need for an efficient and convenient means or system by which this identification process can be executed with ease. In this paper, an attempt was made to develop a computer-based information retrieval system which would go a long way in reducing the problems associated with conventional plant identification processes. The system is meant to serve as information retrieval model for use in herbaria.

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MATERIALS AND METHODS

Study materials

Photographs of leaves of some savanna tree species were loaded on the computer system where they can be easily retrieved. Leaf morphology was broadly divided into two groups' namely simple leaves and compound leaves (example, imparipinnate, paripinnate,

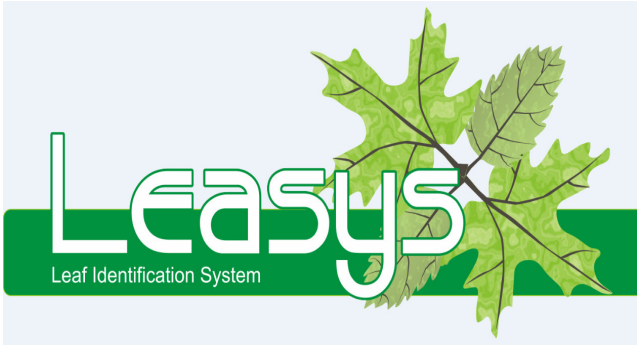

Figure 1. Leaf identification system.

bipinnate, trifoliate and digitate).

Program used

The program used was LEASYS. LEASYS is a program aimed at the automation of leaf identification with respect to time and effort saving. It was designed using a precise tabulation of leaf morphology which categorizes leaves according to their visible traits. It was built upon the Microsoft.NET Framework 2.0. The redistributable is found in the application CD and it is automatically installed if not previously installed on the system.

Research automation

The LEASYS system stems into two different procedures, the simple leaf deductions and the compound leaf deductions. The deduction mechanism was based on the principle of binary selection proposed by Hopkins and Stanfield (1966). Hence, there can only be one choice out of two independent selections; a horizontal classification and a vertical classification. Therefore, the selection was based on the simultaneous narrowing of both classification and supplying them with an appropriate Boolean operator (the AND operator preferably) that is, the Boolean algorithm was used in this study. Following the truth paths (that is enable features appear in white letterings) as a means to narrow choices and collate the deduction from individually defined Boolean variables. Thus, the need to provide a facility to respond to invalid selections that is false path (that is other features that are not related to the choosing path are not enabled and appear in black letterings) was designed.

System requirements

The minimum system hardware requirements of LEASYS are as follows:

1. 5 GB Hard Disk Space.
2. 256Mb RAM.
3. 1.0 GHz Pentium III or above Processor.
4. USB ports or CDROM drive.

The minimum system software requirements of LEASYS are as follows:

1. Microsoft .NET 2.0 Framework (Included as a redistributable) and
2. Direct X 9.0c (Included as a redistributable).

The software and hardware requirements must be met during the installation of the program itself for effective performance of LEASYS computer system programme (Figure 1).

RESULTS AND DISCUSSION

Identification of plants is a process of determination of identity of plants. This process is tedious using conventional methods but recent development of Computer-aided plant species identification system has opened the way for speeding up and simplification of the process, forming a solid basis for research and development (Zhang et al., 2008). LEASYS computer system program enhanced plant identification in two independent ways namely vertical and horizontal; both ways were used to identify simple and compound leaved plants. Either of the two ways brought about the same deduction or the same set of plant names through gradual subdivisions of two contrasting statements. The results are unique to each option, so when the option is matched at one point, it cannot match that of another point. This is due to the fact that each path of decision assigns a true value to an independent and separate Boolean variable and assigns a false value to the other variable of the binary path selection. For instance, if the ‘compound leaves’ section was clicked, and a user selects ‘plants without spines or thorns’ the rest of the options under that path are enabled, but if ‘plants with latex’ is selected, then all options not under the path are disabled, hence, an invalid selection is not possible.

There are many field guide books on how to identify plant species. Some guide books organize the plant by colour of flowers while others group plants by the number of flower parts (Breen, 2009). Savanna plants were grouped based on their leaf types, that is simple or compound leaves (Hopkins and Stanfield, 1966). It was this pattern that we used for this current computerized system of plant identification. Both Hopkins and Stanfield’s and Newcomb’s have a binomial key in the front of the book that lists plants in such a way that the user may compare two descriptions of a feature, determine which category the subject plant falls into, and continue to the next pair of descriptions, until reaching a page that shows drawings of a small number of plants that are similar to the subject plant. By comparing the plant to the drawings and associated description, it is usually possible to identify any plant (Hopkins and Stanfield, 1966; Partyka et al., 1980; Cope, 2001).

There are sets of procedures which guide a user to effectively use the LEASYS computer system programme with little or no expert assistant. Implication of this is that the system is self directive, if the user follows carefully the steps involved. These procedures were tagged as user manual which include the following steps:

1. From the desktop on a computer system, the user (a prospective plant identifier) will click on a short cut icon, LEASYS. This initiates a series of the identification

procedures.
2. The LEASYS Central Window (Figure 2) appears after the clicking of the LEASYS icon on desktop. On the window two possible operations namely simple leaves and compound leaves were displayed.
3. Then click on the most suitable operation that will facilitate the identification of the leaf you are identifying. At this point you must be sure of leaf type possess by the plant in question.
4. Each of the two selections or operations (that is simple leaves or compound leaves), when the mouse is on it, changes colour from black to bright green, as proof of being chosen.
5. If a simple leaves option is clicked, the following operations were performed which will eventually leads to identification of a particular plant species. The simple leaf classification contains 7 groups of binary options which are contrasting statements (Figure 3). A typical example is when the first option is chosen (plants with spines or thorns). The other disabled options (binary statements in black letterings that is false path) indicate that they are not valid under that category but if the other option (plants without spines or thorns) is chosen, the other options are enabled which means the characteristics are valid under that selection.

If the selection is completed, then the user clicks the continue button. Thereafter, the evaluation Window is displayed (Figure 4). On clicking the evaluation button, the deduction is drawn from the properties chosen previously. Here the deduction or names of plants can be copied by clicking on the copy deduction button; this prevents retyping of the results again. Clicking on a particular plant out of those displayed, photograph of such plant will be displayed for identification. Out of those species, a click on *Ziziphus mauritiana* displays its photograph (Figure 5). To select another plant, you close the current windows and click on the desire species. The back button returns you to the previous page.
6. If compound leaves option is clicked, the following operations were performed which will eventually leads to identification of a particular plant species.

The compound leaf classification contains 8 groups of binary options which are also contrasting statements (Figure 6). A typical example is when the very first option is chosen (Plants with Spines or Thorns), the other disabled options indicate that they are not valid under that category but if the other option is chosen, the other options are enabled which means the characteristics are valid under that selection. If the selection is complete, then the user clicks the continue button which will display the evaluation window where names of plants (or deduction) in that category are displayed (Figures 7). Clicking on selected plant name will displayed photograph of the plant. For instance, a click on *Acacia seyal* will display its photograph (Figure 8). To select another plant, you close the current windows and click on the desire species. Copy deduction button at the bottom of the window allows for copying of the plant names or deductions to desire destination for subsequent use. Similarly, the user clicks on back button to return him or her to the previous page. Using this computerized system, LEASYS will certainly make identification of plants

Figure 2. LEASYS Central Windows.

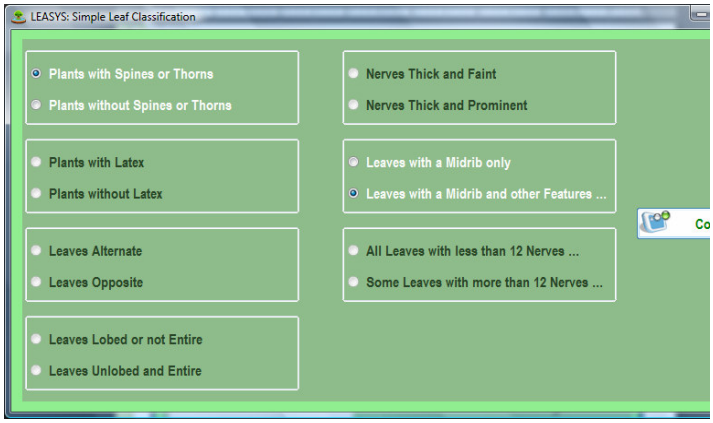

Figure 3. Simple leaf classification windows.

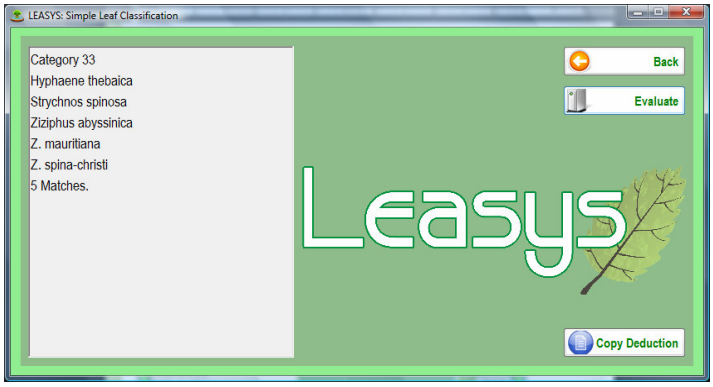

Figure 4. Evaluation window page for deduction of simple-leaved plants.

Figure 5. LEASYS image window page showing photograph of *Z. mauritiana.*

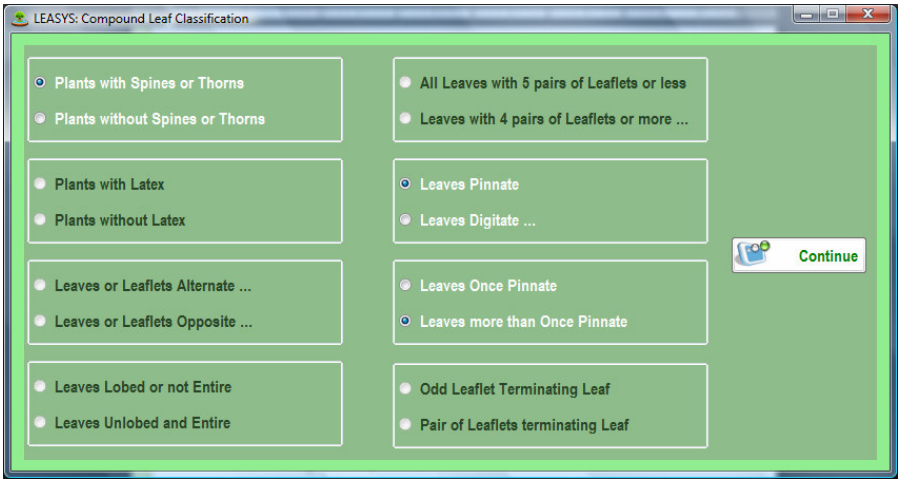

Figure 6. Compound leaf classification windows.

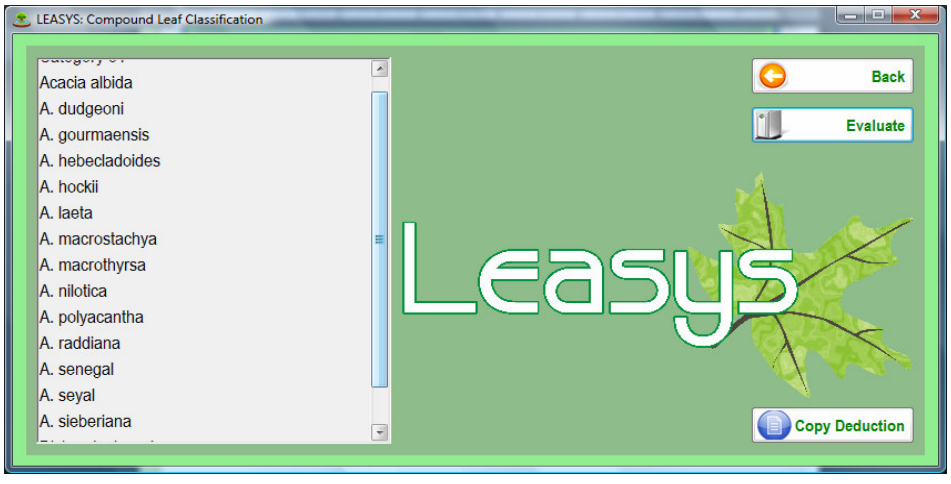

Figure 7. Evaluation window page for deduction of compound-leaved plants.

Figure 8. LEASYS image window page showing photograph of *A. seya.*

easier than the conventional method. Thus, we recommend that herbaria, as well as other places where plants are kept for research and identification purposes should adopt this new method in order to circumvent with problem of time-consuming and cumbersome nature of the traditional taxonomic keys such as dichotomous key.

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