DDISMedia: A Digital Media Library for Pest Diagnosis

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Abstract

A Distance Diagnostic and Identification System (DDIS) was developed at the University of Florida to assist in pest diagnosis. Since its original deployment in 1999, thousands of digital pest photos were collected and catalogued in DDIS. This paper describes DDISMedia, a user-friendly rich Internet digital media library application developed to help users to collect, manage, and retrieve high-quality media from the database, and to assist specialists in pest diagnosis. The DDISMedia is a peer-reviewed media database, which contains a collection of digital media of plant pests, diseases and plants produced by specialists of different disciplines. The system allows registered users to submit pest images or video clips into the database. Techniques employed in implementing DDISMedia include a peer review process, library management and extensive search functions. DDISMedia, coupled with the DDIS diagnosis environment, provides a new tool to improve diagnosis and identification of pests by specialists. The media library could also be used for research, educational programs, teaching and learning.

Keywords: RIA, web application, pest diagnosis

Introduction

DDIS provides a unique environment to conduct pest diagnosis through the Internet (Xin, et al., 2001, 2003). Because the primary information transferred from agricultural extension agents to diagnosticians are photographic images, thousands of digital pest photos have been collected serve as an archived database for research, educational programs and teaching/learning since its original release. However, DDIS lacks effective image management and search functionality. For example, inconsistent image quality in DDIS database is because majority of the photos were taken by extension agents, not a professional photographer, in laboratories of agricultural fields. Also, users cannot search images directly. In addition, DDIS images are only available to DDIS users, but agricultural extension clientele and other external users are interested to view pest data in response to their location. As feedback from users, it is desirable to develop a digital media library in DDIS. This media library would include high quality video clips or photos of pests, plants and invasive species that are submitted from any registered user around the world.

DDISMedia, a web-based digital media library, has been introduced to address the problems discussed above. A required feature of DDISMedia is to adopt a peer-review process to ensure the quality and accuracy of the media and information attached to media. Another requirement is to develop an extensive media search capability to return associated results from different pests and hosts. The search function should be embedded into DDIS diagnosis user interface to assist and improve the pest diagnosis process for specialists. To improve the user experience, up-to-date techniques, such as Ajax (Asynchronous JavaScript Technology and XML), need to

be applied to provide a friendly and rich user experience. The objectives of this project were: 1) to establish a digital media library for pests and plant diseases with extensive search capability, 2) to develop a web-based peer-review process that ensures the quality and accuracy of the media information, and 3) to assist diagnosticians on pest diagnosis by coupling the media library with DDIS diagnostic interface.

System Descriptions

DDISMedia was developed jointly by extension agents, specialists, and IT specialists at the IFAS/University of Florida. This system aims to be a supplement of DDIS, which "allows users to submit digital samples obtained in the field for rapid diagnosis and identification of pests, plants, diseases, insects, and animals" (Xin, et al, 2001). Unlike digital diagnosis system, the purpose of this media library is to collect high-quality digital media (video clips or photos) submitted into DDIS system or the media library database. The library is currently a part of the DDIS website (http://ddis.ifas.ufl.edu). The same digital library is also shared with International Plant Diagnostic Network (IPDN) and Caribbean Regional Diagnostic Network (CRDN).

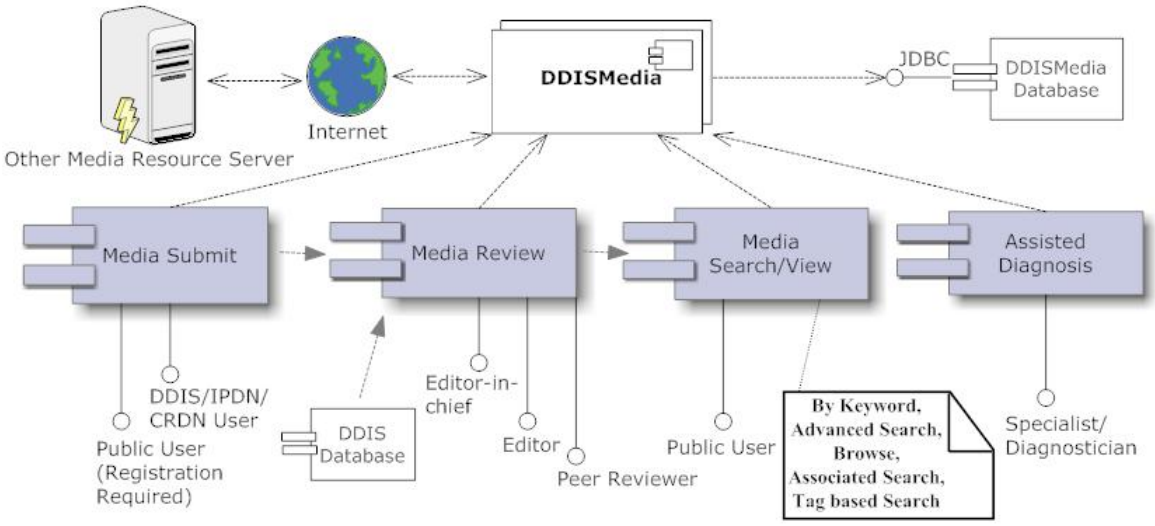

Fig. 1 An overview of the DDISMedia.

Fig. 1 exhibits an overview of the DDISMedia. The system contains four main components: 1) Media Submission, 2) Media Peer Review, 3) Media Search, and 4) Assisted Diagnosis. The Media Submission interface is open to the general public; any registered user in DDIS, IPDN or CRDN may contribute to DDISMedia. Any new submission must be reviewed by an editor and reviewers before its acceptance. The Media Peer Review component provides a rich user-interface that allows editors and reviewers to interact during the review process, which is very similar to a journal publication review process. Only those accepted media are included in the library. Providing an effective and easy-to-use search function is critical in the media library design. The Media Search component provides various search options: 1) search by keyword, 2) advanced search, 3) browse, 4) associated search, and 5) tag based search (to be released). Assisted Diagnosis component provides DDIS specialists/diagnosticians a convenient means to reference a diagnosis sample with existing media in the library. Future development plan includes interacting with other related media servers to extend the search scope.

1. Media Submission

The media submission forms are open to any registered user. Primary media submitters are personnel of agricultural clinics, diagnostic labs, or agricultural extension agents. In addition to the digital media, the submission forms collect textual information including 1) pest common and scientific name, 2) host common and scientific name, 3) pest family, 4) sample location, 5) geocode, 6) media collection date, and 7) copy rights and contact information.

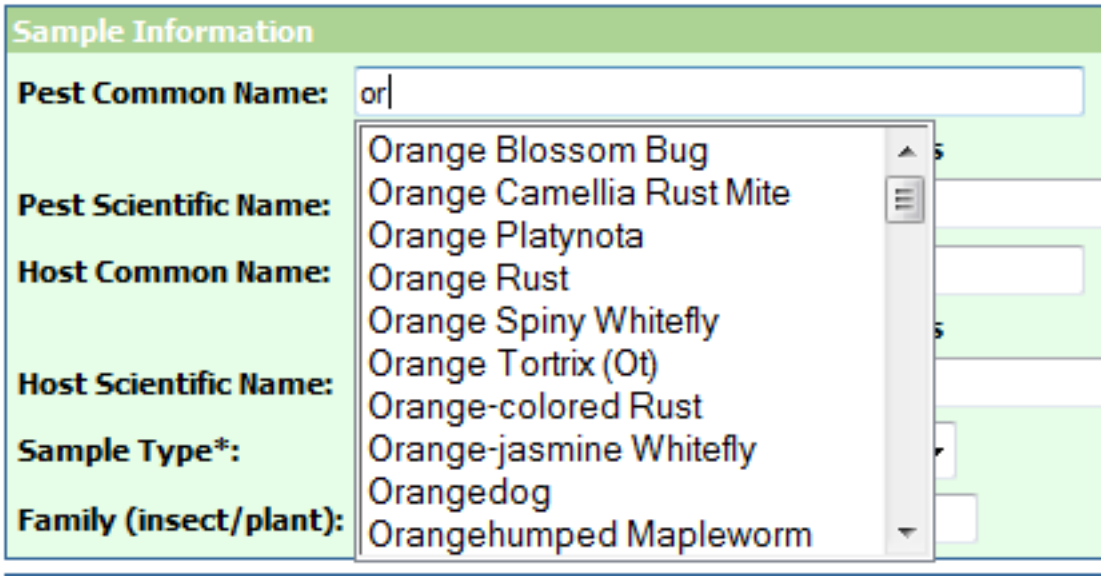

Fig. 2. Ajax-based auto-complete pest data entry.

The design concept of DDISMedia is to make the submission easy-to-use and to avoid user input errors. One of the design challenges of the submission form is to collect consistent user inputs of common and scientific names of pests and hosts. Since there are thousands of pest and host names, it is common for users to enter inconsistent pest names or other invalid input. Data inconsistency could jeopardize search ability. Hence, the submission interface employs Ajax to provide an auto-complete input for pest/host common names and scientific names as shown in Fig. 2. Both pest and host names are selected from a predefined list from the National Pest Diagnostic Network (NPDN). The current pest list contains over 16,000 pest names. In addition, the user interface allows users to choose number of media for the file upload. A user interface is developed that allow users to find geocode by navigating the Google Map and this information is used to display sample distribution map. With a newly designed GPS enabled camera, geo location can be obtained from metadata of the image.

2. Peer Review Process

DDISMedia is a specialized pest and plant media database. Expert knowledge is required to verify not only quality of the media, but, more importantly, to verify pest genus, species, or plant host name. The peer-review process mimics a journal publication review process. A technical editorial board is formed to oversee the review process. There are four user roles in this process: 1) submitter, 2) editor-in-chief, 3) editor, and 4) reviewer. Fig. 3 illustrates the relationships among users in this process. Once a new media is submitted, an email notification

is sent to the editor-in-chief, who will then assign an editor or reviewers to initiate a review process. Acceptance of the media is made by the editorial board, which is composed of one editor-in-chief and several editors with different areas of expertise. If a submission is assigned to one editor, the editor then has the same rights as the editor-in-chief does to this submission, except that he/she cannot reassign it to other editors. It is editorial board's responsibility to guarantee the media quality, completeness, and correctness of information associated with the media. All specialists in DDIS are potential peer reviewers because of their professional knowledge. If a media is accepted with revision, the editor is able to making changes on the submission form instead of having to resubmit a new form. A submitted media will be searchable as soon as it is accepted for publishing. Similar to the submission form, the reviewer interface also provides an auto-complete function to reduce possible data input errors. The peer-review provides an effective means for specialists to review and manage media in the library. As a reviewed media library, the data source can be used as authoritative references for research and educational purpose.

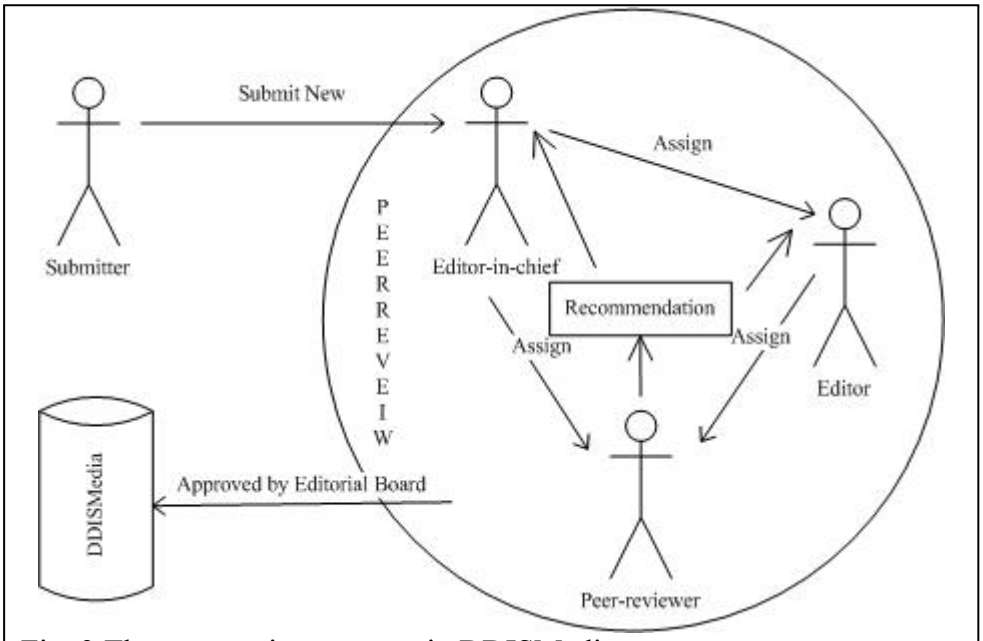

Fig. 3 The peer-review process in DDISMedia.

3. Extensive Search Ability

As the media library grows, it can be difficult for users to find relevant information. To improve the search capability of the digital library, the system provides the following search features.

Keyword Search: This is a generic search based upon keyword user ranked by inexact match.

Advanced Search: User may select different terms to specify their search conditions.

Browse: This feature allows users to easily view the database by browsing a number of thumbnail images. Each image has a mouse over to show common and scientific names of a pest.

Associated Search: As users find a search result, they can search related samples through either genius, species, family, media submitter or photographer as an associated field. All related terms are linked.

Tag Based Search: User-created tags or system-generated tags from the ranking of pest or host names can be created. This feature will be implemented.

With help of the DDISMedia search capability, it is easy for users to find information in the database; however, the current search capability is far from perfect. Compared with infinite expert knowledge in the real world, any search function might not be powerful enough. In other words, is it possible to fail to find out the relationship between two associated samples just due to the absence of similar keyword between them in database? The answer is yes at least for the currently dominant relational database system. As one of the solutions to the problem, in very small and specified field, people can apply their perception and knowledge in computer preprocessing, such as clustering, or building decision keys in the database to improve the search function. But when the scope increases, the manual work would go up exponentially and it might be impractical for implementation. Therefore, there is still a long way before reaching an ideal extensive search function.

4. DDISMedia in Pest Diagnosis

One of our design goals was to couple the media library database with DDIS pest diagnosis. The DDISMedia has been embedded in DDIS so that specialists can check the reference in the media library when they make a similar diagnosis. This feature brings two remarkable improvements for pest diagnosis in DDIS.

1) DDISMedia could serve as the primary reference for pest diagnosis and identification in DDIS. As specialists increasingly depend on multimedia to help them obtain information and make decisions, there should be no exception in pest diagnosis. In addition to the textual field information, it is convenient to compare a diagnostic sample directly with the archived media in the library. With the increase of media in DDISMedia, it will become an important resource referred to by DDIS and other systems.

2) DDISMedia provides a rich user interface to assist specialists with pest diagnosis. With its extensive search capability, DDISMedia exhibits the sample relationships among different plants, insects and diseases, which are not available in the DDIS search function.

Conclusion

DDISMedia, a digital media library, was designed, implemented and evaluated for use in pest diagnosis and identification. This web-based system allows users to submit digital media, such as video clips and photographic images, obtained from the field, clinics or diagnostic laboratories as an important reference for pest diagnosis in DDIS. DDISMedia provides a unique platform for agricultural specialists to approve and manage media through the peer review process to collect high-quality media and authoritative information within this library. Its extensive search capability provides users a good reference for their identifying and understanding of pest management, as well as for research and educational purposes. After the initial release of this library, DDISMedia has created great interest among users. Future work

may include enhancing the display of the sample relationship among result sets and improving the user experience by adapting rich internet technology, such as Ajax and Flex. The development of a web-based media process tool to improve image quality or emphasize its biologic features to assist pest diagnosis is also a potential improvement.

References

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