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ABSTRACT

A hypermedia tutoring system for teaching parasitology to college students was developed using an object oriented software development tool, Knowledge Pro. The program was designed to meet four objectives: knowledge incorporation, tutoring, indexing of key words for Boolean search, and random generation of quiz questions with instant scoring. The educational material incorporated in the form of text and/or images with their relational linkages serve as the domain of the system. The tutoring system contains a graphical user interface which allows the user to access the educational material in four different interactive modes: Course, Review, Reference, and Self-Evaluation. Indexing of keywords is accomplished by using a program which first alphabetizes the words of the entire text and then filters out common words. This process leads to the creation of an indexed keyword database which is then used for Boolean searches. Quizzes are generated randomly by using a multiple-choice question and answer database. The main advantage of this system is that it allows the student to interact with the computer-tutor at his or her own pace for self-learning and auto-evaluation. A limitation of the program is its inability to support extended queries due to its reliance on the built-in Knowledge Pro facility. (Contains 26 references.) (AEF)

A HYPERMEDIA COMPUTER-AIDED PARASITOLOGY TUTORING SYSTEM

by
Georgios Theodoropoulos and Vassili Loumos

Introduction

The teaching of parasitology is a basic course to all life sciences curricula and to date no computer-assisted tutoring system has been developed for this purpose. By using Knowledge Pro®, an object oriented software development tool, a hypermedia tutoring system for teaching parasitology to college students was developed.

Generally, a tutoring system contains a domain expert, a student model, a pedagogical expert, and the user interface. In this project, particular emphasis was given to the user interface design and the expert knowledge representation.

The system allows access to the educational material through hypermedia and indexing at the pace of the student. The hypermedia access is facilitated through key words defined as hyper text and objects in pictures defined as hyper areas. The indexing access is based on a list of parameters which refers to various characteristics of the parasites, e.g., taxonomy, host, organ, etc. In addition, this indexing access can be used for testing the student's level of understanding. The advantages of this system are its user friendliness, graphical interface, and its ability to incorporate new educational material in the area of parasitology.

Computer assisted instruction is a recent development in the area of software engineering and refers to systems that can tutor humans. Their widespread use is due to their advantages which are: individualized and self-adjusted level of material, remedial or accelerated process, immediate feedback with explanations, consistency of teaching, updated material, no location restriction, and variety of presentations (Van Horn, 1991).

Various interactive computer-assisted tutoring systems have been developed in the area of veterinary medicine (Angarano, 1992; Eljack, 1992; Lalier & Beauchemin, 1992; Kazacos, Roesel, & Harrington, 1992). The operation of these systems is based on hypermedia technologies, while the man machine communication is facilitated by a graphical user interface.

Hypermedia is an environment for handling text and graphic information enabling the user to switch between various topics in a non linear fashion by following the paths defined by related ideas (Bielawski & Lewand, 1991). A graphical user interface (GUI) makes extended use of metaphors in a visual display in order to communicate graphical information (Laurel, 1990).

The teaching of parasitology is a basic course to all life sciences curricula but up to now no computer-assisted tutoring system has been developed for this purpose except a limited application of Hypercard® for teaching parasite life cycles (Wharton, 1990).

By using Knowledge Pro®, an object oriented software development tool, a hypermedia tutoring system for teaching parasitology to college students was developed. This object oriented system can be used by the student not only as a self-learning or auto-evaluation medium, but also as a reference tool by applying Boolean search on indexed data. Boolean search is based on Boolean algebra (Lidsay & Norman, 1977), where key words are used to establish a filter for search in text data.

Description of the Program

The program was developed by using Knowledge Pro®, an object oriented software development tool and was designed to meet four objectives: Knowledge incorporation, tutoring, indexing of key words for Boolean search, and random generation of quiz questions with instant scoring.

Knowledge Incorporation

Educational material in the form of text is incorporated in the system as ASCII files. This material is divided in parts, chapters, sub-chapters, and so on down to the level of the parasite which is referred to here as the knowledge set. Each knowledge set includes information on a given parasite arranged as a list of parameters describing various characteristics of the parasite, e.g., hosts, life cycle, pathogenesis, etc. The division of the educational material follows the taxonomic classification of the parasites, e.g., phylum, subphylum, class, etc. (Kassai, Corder del Campillo, Euzeby, Gaafar, Hiepe, & Himonas, 1988). Therefore the knowledge of the system consists of sets each of which has the same construction (parameters) regardless of the parasite. The knowledge sets are related with each other and these relationships correspond to the taxonomic classification of the parasites making an inverse knowledge tree (Figure 1). This arrangement allows the infinite incorporation of new educational material by fitting the new knowledge sets in the existing knowledge tree.

Educational material in the form of images is incorporated in the system as compressed files created by a scanner (Hewlett Packard ScanJet IIc) using Aldus Photo-Styler®. Image files are stored in BMP format (Rosenfeld & Kak, 1982) in order to be device independent, that is their presentation will not be affected by the type of the monitor. These files and relevant text are linked to specific words in the text defined as hyper words. Activation of a hyper word leads to the presentation of the image and/or text linked to it.

The educational material in the form of text and/or images with their relational linkages serve as the domain of the system.

The Tutoring System

The tutoring system is addressed to students at the college level and contains a sophisticated graphical user interface which allows the student/user to access the educational material in four different interactive modes.

The first mode is the Course Mode, where the student/user requests from the program to present the material in the

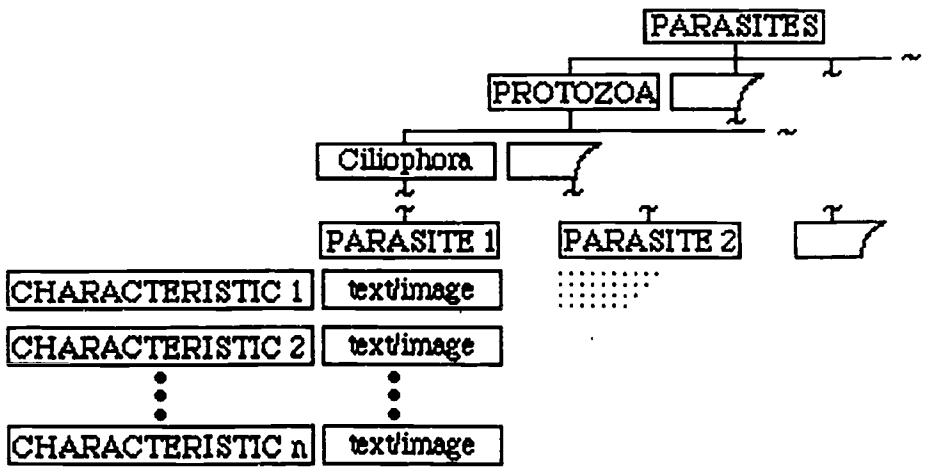

Figure 1. Inverse Knowledge Tree

hierarchical series of lectures given in the class during the semester.

The second mode is the Review Mode, where the student/user requests from the program to present a specific chapter from the whole material.

The third mode is the Reference Mode, where the student/user uses key words ıor Boolean searches in the entire material in order to locate specific information on a desired subject.

The fourth mode is the Self-Evaluation Mode, where the student/user requests from the program a quiz on one or more chapters in order to test his/her level of understanding of the material.

The above described tutoring system serves as the pedagogical expert.

Indexing of Key Words

Indexing of key words is accomplished by using a program developed for this purpose which first alphabetizes all the words of the entire text material and then filters out common words (Figure 2). This process leads to the creation of an indexed key word database. This database is then used for Boolean searches in the text material allowing the use of the system as a reference tool.

Quiz Generation

Quizzes are generated randomly by using a multiple-choice question and answer database. This feat is accomplished by using a program developed for this purpose which randomly selects a set of questions from the database every time the student-user wishes to evaluate him/her self. The student-user can select the quiz at the end of one or more chapters. For each quiz, a temporary database is created in order to keep the student's responses. Scoring of the quiz is executed automatically by the program at the end of each session. Also, the program can present the questions with the correct answers.

The quizzes along with the tutoring system supplement each other and implement the student model.

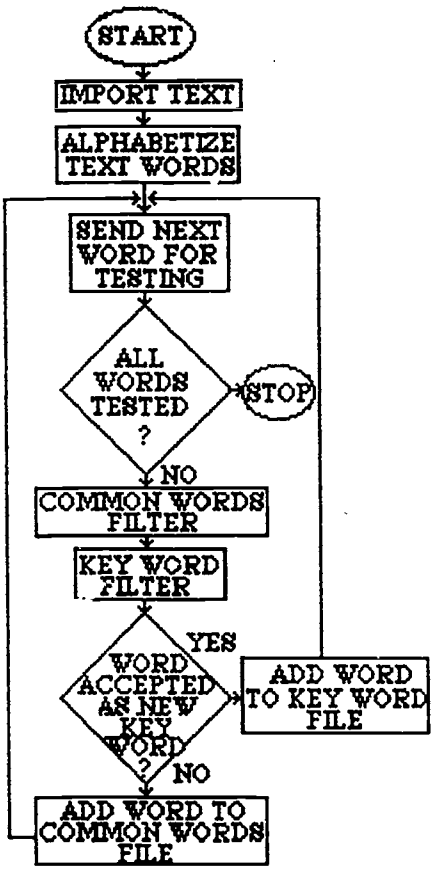

Figure 2. Key word/common word identification and indexing

Sample Run

The program starts by presenting the student-user with a window containing a series of action buttons activating the various interactive modes described above. For each mode selected, a series of follow-up windows are presented and lead the student-user through the educational material (Figure 3). At any point of the program, the student-user can switch to any other interactive mode.

Conclusions

The easy accessibility and the new developments in hardware and software

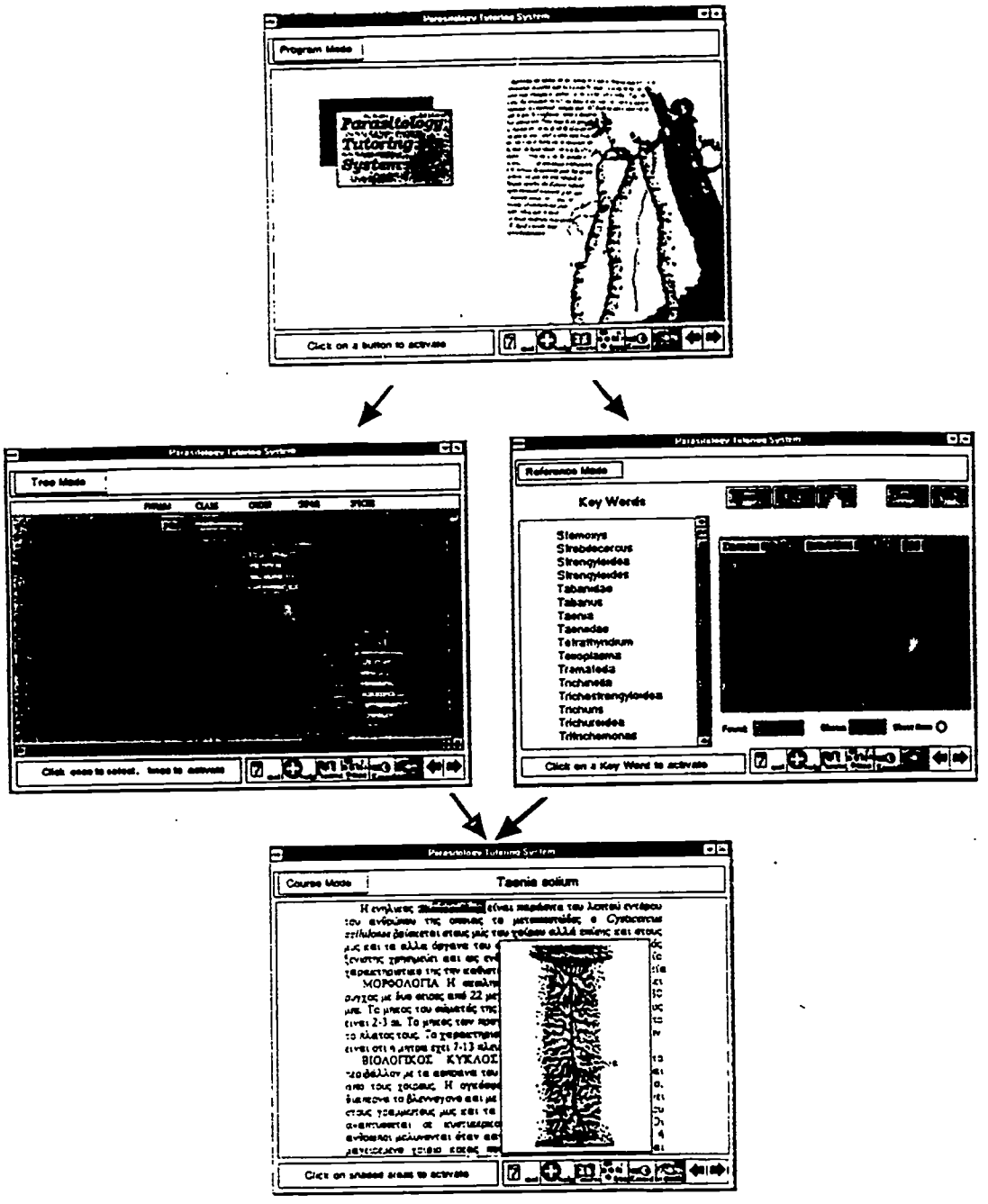

Figure 3. Series of follow-up windows

technologies make computers increasingly useful for various applications in the field of parasitology like image analysis (Kucera & Reznicky, 1991; Schall, 1989; Slomianny, 1990; Theodoropoulos & Theis, 1989, 1990), simulations (Barnes & Dodson, 1990; Mount, Haile, Davey, & Cooksey, 1991; Parry, Barratt, Jones, McKee, & Murray, 1992; Plaisier, van Oort, Remme, & Habbema, 1991), parasite identification (Theodoropoulos 1988, 1989; Theodoropoulos & Loumos, 1991, 1992), or tutoring (Wharton, 1990).

Generally, a tutoring system contains a domain expert, a student model, a pedagogical expert, and the user interface (Brown & Sleeman, 1982; Kearsley, 1987; Wegner, 1987). These concepts were used to develop an innovative

computer-aided parasitology tutoring system.

The present program is based on hypermedia and object oriented technologies and serves as a parasitology tutoring system for college level students. The scope of this program covers all aspects of parasitology like hosts, life cycle, pathogenesis, etc. The educational material is presented through a sophisticated GUI in the form of text and/or images. The main advantage of this system is that it allows the student to interact with the computer-tutor in his/her own pace for self-learning and auto-evaluation.

The innovation of this system is its reliance on object oriented structures between knowledge sets allowing interactive learning for the student-users and unlimited capacity for new knowledge incorporation.

Another innovation of this system is its ability to present the material in various ways. The system can present series of lectures or specific topics for review. In addition, the system can be used as a reference tool by presenting key words or as a self-evaluation tool by generating quizzes with auto-scoring capacity.

A limitation of this program is its inability to support extended queries (SQL) due to its reliance on the built-in facility of Knowledge Pro®.

A future improvement of this program can be its integration with a multimedia relational database for parasite identification (Theodoropoulos & Loumos, 1992) to serve as a comprehensive expert parasitology system.

Hardware Requirements

The use of the program requires the availability of an IBM or compatible personal computer (80386, 2 Mbytes of RAM, VGA monitor and above) under MS-Windows 3-1®.

References

Angarano, D. W. (1992, June). *Use of computer assisted lessons to teach dermatology.* Twelfth Veterinary Medical Education Symposium, Iowa State University, Ames, IA.

Barnes, E., H., & Dodson, R. J. (1990). Population dynamics of *Trichostrongylus colubri formis* in sheep: Computer model to simulate grazing systems and the evolution of anthelminthic resistance. *International Journal for Parasitology, 20,* 823-831.

Bielawski, L., & Lewand, R. (1991). *Intelligent system design.* New York: Wiley.

Brown, J. S., & Sleeman, D. (1982). *Intelligent tutoring systems.* New York: Academic Press.

Eljack, A. H. (1992, June). *The ruminant stomach. A hypermedia computer-based instructional program using hyper-card-environment.* Twelfth Veterinary Medical Education Symposium, Iowa State University, Ames, IA.

Kassai, T., Corder del Campillo, M., Euzeby, J., Gaafar, S., Hiepe, T., & Himonas, C. A. (1988). Standardized nomenclature of animal parasitic diseases (SNOAPAD). *Veterinary Parasitology, 29,* 299-326.

Kazacos, E. A., Roesel, O. F., & Harrington, D. D. (1992, June). *Use of interactive videodisk programs in teaching pathology.* Twelfth Veterinary Medical Education Symposium, Iowa State University, Ames, IA.

Kearsley, G. (1987). *Artificial intelligence and instruction: Applications and methods.* Reading, MA: Addison-Wesley.

Kucera, J., & Reznicky, M. (1991). Differentiation of species of *Eimeria*

from the fowl using a computerized image-analysis system. *Folia Parasitologica, 38*, 107-113.

Lalier, R., & Beauchemin, R. (1992, June). *Multimedia for teaching microbiology. "Hyperlaboratoire et Hypermicrobiologie"* Twelfth Veterinary Medical Education Symposium, Iowa State University, Ames, IA.

Laurel, B. (1990). *The art of human computer interface.* Reading, MA: Addison-Wesley.

Lidsay, P., & Norman, D. A. (1977). *Human information processing.* New York: Academic Press.

Mount, G. A., Haile, D. G., Davey, R. B., & Cooksey, L. M. (1991). Computer simulation of *Boophilus* cattle tick (Acari: Ixodidae) population dynamics. *Journal of Medical Entomology, 28*, 223-240.

Parry, S., Barratt, M. E., Jones, S., McKee, S., & Murray, J. D. (1992). Modelling coccidial infection in chickens: Emphasis on vaccination by in-feed delivery of oocysts. *Journal of Theoretical Biology, 157*, 407-425.

Plaisier, A. P., van Oort marssen, G. J., Remme, J., & Habbema, J. D. (1991). The reproductive lifespan of *Oncocerca volvulus* in West African savanna. *Acta Tropica, 48*, 271-284.

Rosenfeld, A., & Kak, A. (1982). *Digital picture processing.* Academic Press.

Theodoropoulos, G. (1988). Computer diagnosis of gastrointestinal helminths of domestic and experimental animals. *Computer Methods and Programs in Biomedicine, 26*, 133-136.

Theodoropoulos, G. (1989). Computer-assisted diagnosis of gastrointestinal helminths of domestic and experimental animals. *Computer Methods and Programs in Biomedicine, 30*, 261-264.

Theodoropoulos, G., & Loumos, V. (1991). A compiled computer program for assisting the diagnosis of gastrointestinal helminths of humans and animals. *Computer Methods and Programs in Biomedicine, 36*, 237-238.

Theodoropoulos, G., & Loumos, V. (1992, November). A multimedia relational database system for parasite identification. Accepted for publication in *Computer Methods and Programs in Biomedicine.*

Theodoropoulos, G., & Theis, J. H. (1989). Decrease of acid phosphatase activity in murine peritoneal macrophages infected with *Leishmania donovani. International Journal for Parasitology, 19*, 813-816.

Schall, J. J. (1989). The sex ratio of *Plasmodium* gametocytes. *Parasitology, 98*, 343-350.

Slomianny, C. (1990). Three-dimensional reconstruction of the feeding process of the malaria parasite. *Blood Cells, 16*, 369-370.

Van Horne, R. (1991). *Advanced technology in education.* Brooks/Cole.

Wegner, E. (1987). *Artificial intelligence and tutoring systems.* Los Altos, CA: Morgan Kaufmann.

Wharton, D. A. (1990). The use of computer-aided learning for teaching parasite life cycles. *International Journal for Parasitology, 20*, 709-712.