

A Computer-based Knowledge Delivery System for Rural Communities – A Case Study using Beekeeping

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ABSTRACT

Over the years a wealth of knowledge resources has been developed and collected in the Himalayan region, but very often the people who need these resources either don't know that they exist or cannot access or understand them. Traditional methods of knowledge delivery are often not integrated with electronic sources of knowledge and means of transmission. The beekeeping project described here addresses the issue through preparation of multimedia information materials by domain experts and automatic generation of a browser to be used by people who have no training in computing. A data structure composed of multimedia objects (texts, images, video and audio clips) in a local language provides the input to a system that generates the browser. Local specialists with a basic knowledge of computing can modify and customise the system by adding new materials relevant to the local environment.

Keywords

Knowledge management, beekeeping, multimedia, browser

1.0 INTRODUCTION

Access to knowledge and knowledge sharing among remote and poor communities of the Hindu Kush-Himalayan (HKH) region one of the problems addressed by the information and knowledge management programme (IKM) at ICIMOD (International Centre for Integrated Mountain Development, Nepal). ICIMOD and its partners in the Hindu Kush-Himalayan region have produced a wealth of manuals, brochures and other printed materials that can be used to educate rural people about useful technologies and social issues. The knowledge described in these publications is based on both practical experiences and research; its needs to be delivered to diverse groups of people in the most effective ways. We explore tools and methods for knowledge delivery going beyond the distribution of printed materials and traditional training courses. In recent years, computer-based dissemination of educational materials and application of on-line learning have been successfully tried in rural areas. One of the main obstacles in using computers in this environment is the necessity to train users in computing and provide technical assistance. However, this obstacle can be

removed using advanced software technologies that allow for working with a computer (information retrieval and browsing through pre-loaded information) without any prior training or knowledge.

A small research project at ICIMOD developed a system for the delivery of knowledge on beekeeping. Domain specialists, researchers and beekeepers (Ahmad, F., Joshi, S., Partap, U. & Gurung, M. B., 2006) compiled a collection of multimedia materials and designed a tree-like data structure (computer directory) in English, Urdu and Nepali. The data structure is used to generate an XML code that allows for the presentation of information materials in Internet Explorer (customized for users who do not have computer training). The system is based on the concept developed by a Canadian company Solanta Technologies Inc. It also includes an Editor of the data structure. The Editor allows for modification of information materials, i.e. a user with some basic computer training can delete and add multimedia objects to the system.

2.0 KNOWLEDGE DELIVERY

Defined practically, knowledge is the ability to take effective action (Snowden, 2004). This means that just making information available is not enough. To become knowledge, information has to be used and have some kind of effect. For example, unless a farmer can understand information about fertilizers and use it to have a tangible effect on the yield from his field, the information is not knowledge.

Ultimately, knowledge resides in people, not in machines and books. The purpose of applying technologies in knowledge transfer, from printed books to the Internet, is to support the process of absorbing/internalizing the knowledge described by people who possess and are willing to share it.

Knowledge in the context of a computer system is a representation (text, data structures, structures of formal languages for knowledge description) of facts, objects, phenomena, abstractions (factual knowledge) and procedures/processes (procedural knowledge including tacit knowledge). Formal representations allow for automatic operations on knowledge (problem solving,

decision-making support, information retrieval, creating new knowledge, dissemination).

Knowledge can be delivered in many ways. The main issue is how to make knowledge available to those who really need it. It means that a knowledge delivery system should present information materials in such a way that effective internalization is possible. The use of multimedia – text, voice, video - to present properly structured information materials is one of methods of facilitating knowledge transfer.

The Solanta system used in this project enables the multimedia materials to be made interactively available to people who have no computer training and may be using a computer for the first time. The process of the preparation of information materials for and generating the delivery system does not require training in computer programming.

3.0 PREPARATION OF KNOWLEDGE REPRESENTATION STRUCTURE

Knowledge can be described and presented in a computer system as text documents, images, graphics, maps, animations, video and audio recordings, and combinations of these formats (multimedia presentations). We will call these presentations the knowledge objects. A book divided into chapters and sections is a structured representation of knowledge in a specific domain. Similarly, we may develop a structure of multimedia objects to be presented to the computer user in order to facilitate a learning process (internalization of information materials, i.e. knowledge transfer).

A delivery of an effective knowledge transfer system in a computer environment requires:

- deep expertise in a knowledge domain (e.g. beekeeping, ecotourism, soil erosion); the expertise is needed for structuring and presenting the domain knowledge at the level of cognitive capabilities of target users,
- participation and cooperation of all stakeholders (domain experts, computer experts, training specialists and users) in system conceptualization, design, implementation, deployment and operation,
- top level expertise in computing technologies and information system design.

It is very important to meet all three of these requirements. Domain experts, even with a solid training in computer technologies and computer programming, will usually spend much more time solving computer technical problems than on concentrating on knowledge structuring and analyzing user needs and capabilities. On the other hand, if computer specialists are assigned to design the logical

structure of the knowledge delivery system, they concentrate more on finding ‘elegant’ technical solutions than on effective knowledge structures. They usually do not have sufficient in depth experience in the given knowledge domain to identify knowledge sources or the best means for presenting specific issues, and assess if the system covers the knowledge domain properly and corresponds with the cognitive capabilities of its users. Participation of all stakeholders ensures that the knowledge delivery system will meet the needs of intended users and allows for corrective actions at each stage of system development.

The process of preparing the input data (knowledge objects) structure by domain experts is as follows.

- Domain experts prepare a collection of questions (if possible together with target users) that can be asked by potential users.
- Questions are analyzed to determine if they cover the entire intended subject area.
- Experts cluster the questions to cover specific topics.
- Clusters of questions are the basis for selection of information materials, building the structure, and forming knowledge objects of manageable sizes.
- Domain experts create knowledge objects and locate them in the input data structure (computer directory).

In the case of beekeeping, four domain experts prepared over 100 questions that after several iterations were clustered into 11 topic clusters. This was a very important stage in system design, since the navigation through the tree-like structure of knowledge objects should allow finding of the relevant knowledge objects in no more than 2-3 steps (selections on the screen). Domain experts also identified a collection of relevant publications and thousands of photographs. They recommended the places in the structure where it would be useful to have video and audio clips (produced for the project or selected from existing materials).

The input data structure based on the analysis of questions and available information materials is a tree (a single computer directory). If the system is to be implemented for several languages then for each language is created a separate directory. All directories are completely parallel, i.e. they have exactly the same nodes and files and follow the naming convention that indicates the language and the position of the object (node or leaf) in the tree structure. The directories are enBeekeeping, npBeekeeping, and urBeekeeping, indicating structures in English, Nepali and Urdu.

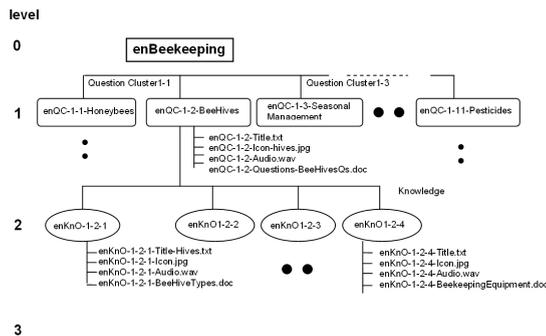


Figure 1: Solanta: Knowledge Browser – Input Data Structure

The tree data structure consists of the root (top directory named enBeekeeping) and two types of subdirectories – clusters and leaves.

Top Directory

The top domain directory (enBeekeeping) includes all other directories (clusters and knowledge objects) and a document (usually MSWord file) that contains a general description of the domain and the purpose of its presentation in the Solanta browser.

Question Cluster Directory (node)

Each Question Cluster directory/node must contain the following files:

- Question file (usually MSWord) for system documentation, e.g. enQCQuestions-01-01-IndigenousBees.doc
The question file contains questions pertinent to the topic to be covered by knowledge objects in the cluster.
- Title file, e.g. enQC-01-01-Title-Himalayan Bees.txt
The text in this file is used as the title/caption for the icon indicating the cluster and to create an audio file that is played when the pointer is located in the icon area
- Icon file, e.g. enQC-01-01-Icon-Himalayan Bees.jpg
This is an image file to create an icon indicating the cluster in the browser window
- Audio file, e.g. enQCAudio-01-01-Audio-HimalayanBees.wav
This is an audio file plying the cluster title.
The Question Cluster directory may contain subdirectories of two types:
 - question cluster (see above), and
 - knowledge object directory.

Knowledge Object Directory

Knowledge object directory contains files and subdirectories that constitute one knowledge object and its attributes:

- Title file, e.g. enKnO-01-01-01-Title-Himalayan Bees.txt
The text in this file is used as the title/caption for the icon indicating the knowledge object and to create an audio file that is played when the pointer is located in the icon area.
- Icon file, e.g. enKnO-01-01-01-Icon-Himalayan Bees.jpg
- Audio file, e.g. enKnO-01-01-01-Audio-Himalayan Bees.wav
This file is an audio file plying the knowledge object title
- Knowledge object file, e.g. enKnO-01-01-01-ApisCerana.doc

A knowledge object can be a single MSWord file with embedded images and graphics, or a .pdf file, or an HTML file, or a video clip, audio clip, or image.

4.0 SOLANTA BROWSER

The Solanta browser has been designed to enable a novice user easy navigation through information materials and effective access to knowledge needed to answer questions and eventually solve user's problems.

The user interface provided by an operating system (Windows or Linux) and multimedia applications is too complex for most novice users; the idea of the Solanta interface is to make the use of a computer at the entry level no more complex than using a TV set. The main goal is to make it possible for users with no training in computing to obtain information relevant to everyday life (education, agriculture, small business, health care, etc.).

A user of the computer will be able to use installed application software and browse through information materials by selecting icons that are complemented by short descriptions in a local language and voice explanations.

The Solanta user environment allows for the user-computer interaction in which all user tasks (selection of an information material and executing an application) are performed in such a way that only correct actions relevant to the current task are possible, i.e. the user cannot accidentally close or open a window, invoke multiple applications or destroy the information material. At any time the user will deal with one window covering the whole screen (no close, move, resize functions in the menu bar). Direct operations at

the operating system level are not available while working in the entry level user environment.



Figure 2: Solanta browser's top screen for beekeeping in English

The top of the browser shows a pictorial list of clusters of knowledge objects. The user can navigate the structure up and down and select knowledge objects within a cluster.

The XML coding for the browser is generated by the Solanta software module. The browser opens automatically when the computer is powered on. A special code (password) is needed to exit from the browser to the operating system. The selection of the EXIT button in the browser's menu shuts the computer down (power off).

5.0 INFORMATION MANAGER INTERFACE (EDITOR)

The Solanta software includes an Editor of the input data structure and the Browser Generator using the input data structure. The Editor can be used by more advanced users who have some basic training in computing. A general knowledge of computer filing systems, MS Word editor, and basic image and voice processing is sufficient to develop or modify the structure of documents (knowledge objects) that will be presented to the user via the Solanta browser.

The Editor is a tool for domain specialists who can without training in computer programming or XML coding adapt the information materials and their structures to local needs and customize the presentation of the domain knowledge. For example, general information material on building hives can be supplemented with pictures of locally built hives and interviews with local beekeepers. Figure 3 shows the main dialog box of the Editor.

The information manager can prepare an external directory (a structure of additional knowledge objects) and then "Import" the new objects into the existing structure. The objects (clusters, knowledge objects) in

the existing structure can be modified, replaced or deleted. A "Preview" function allows for the examination of a modified structure before a delivery version is produced.

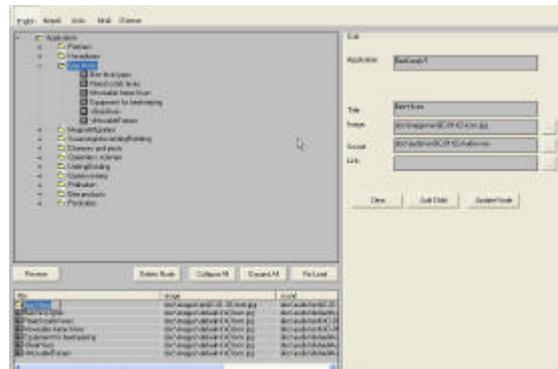


Figure 3: Solanta editor dialog box – cluster directory

Figure 4 shows a knowledge object directory containing files describing a single object named "Equipment for beekeeping.doc". The directory contains also the "defaultKnOIIcon.jpg" file that represents the knowledge object on the browser screen and the "defaultAudio.wav" that is played when the pointer goes over the icon. These files can be modified or replaced.

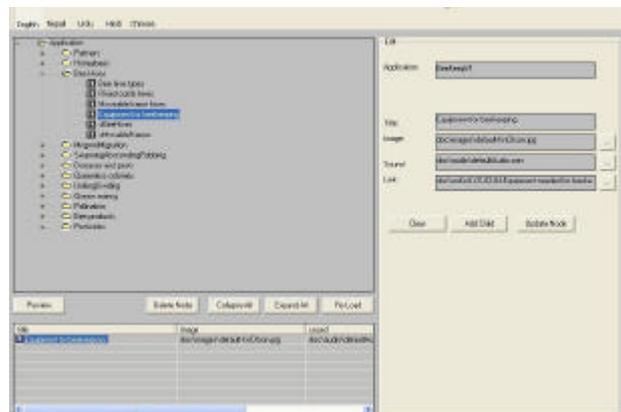


Figure 4: Solanta editor dialog box – knowledge object directory

6.0 CONCLUSIONS

1) The use of multimedia technology in knowledge delivery requires more efficient and easy to use software tools that would help domain experts and field specialists produce high quality educational materials.

2) Target users who have had no opportunity to be trained in operating a computer should be able to use a computer-based knowledge delivery system. A simple browser allowing for selection of knowledge objects (multimedia materials), and in the future versions for

retrieval of relevant objects in response to a user's question, is one of the possible solutions.

3) The technology proposed by the Solanta system can be used for the development of a library of educational materials by domain experts without training in computer programming.

4) Closer collaboration between domain experts and computer specialists is needed to improve the Solanta technology and production of educational materials that will be effective in providing knowledge to people with little formal education and no training in operating a computer.

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8.0 APPENDIX: DATA STRUCTURE AND NAMING SYNTAX

Manuscripts Definitions, symbols and naming convention

< ... > - Angle brackets represent syntactical part

(...) - Parentheses represents syntactical grouping

[...] - Square brackets represent optional syntactical part

::= - Represents definition

[... | ...] - Vertical bar symbolizes "one-of" selection function

domain - Domain represents area of interest and is used to establish a boundary of the Question Cluster and subordinate Knowledge Objects. Domain is represented through its domain_name which should be unique.

Question Cluster - Cluster of Questions pertinent to the domain

Knowledge Objects - Knowledge Objects pertinent to the domain subordinate of Question Cluster

generic - Generic object supported by Solanta Desktop and Solanta Project Editor

character_string - String of up to 24 characters, excluding special characters: /,;,@.#!\$%^&*

Syntax:

<domain> ::= <domain_name>

<generic> ::= [<object> | (<object> <dot> <mime_file_type>)]

<object> ::= (<language_prefix> <object_type> <dash> <path> [<dash><object_suffix>] [<dash> <object_name>])

<domain_name> ::= (<language_prefix> <character_string>)

<character_string> - String of up to 24 characters, excluding special characters: /,;,@.#!\$%^&*

<language_prefix> ::= [en | np | ur | hi | cn]

en English

np Nepali

ur Urdu

hi Hindi

cn Chinese

<object_type> ::= [QC | KnO]

<object_type> to object mapping table

<object_type> object

QC Question Cluster

KnO Knowledge Object

Definition: <dash>

<dash> ::= "-"

<path> ::= <LL> | (<path><dash> <LL>)

Description: <path> - is represented by the group of numbers separated by <dash>.

Every number group indicates the position - level in the Knowledge Object hierarchy of Objects.

Example: 00-01-02-03- selects path from the following structure:

<object_suffix> ::= [Audio | Icon | Questions | Title | Sound | Video]

Note: Audio - contains recorded sound file (the text of the Title text file) to be played prior to opening an object (cluster or knowledge object)

Icon - contain object icon to be displayed (in one of the supported graphical file format)

Questions - contains object cluster questions (in text format) - for reference purpose and future expansion

Title - contains object title text file to be displayed in a Solanta Desktop and played when the pointer enters the object icon area

Sound - contains object recorded audio file to be played (in one of the supported audio file format)

Video - contains knowledge object recorded video file to be played (in one of the supported video file format)

<object_name> ::= <character_string>

characters: / <slash>, <comma>: <colon>; <semicolon>
 @ <ampersand>. <dot> # <hash> ! <exclamation mark>
 \$ <dollar sign> % <per cent sign> ^ <caret> & <and> * <star>

<dot> ::= "."

<mime_file_type> ::= [<document> | <graphics> | <audio> | <sound> | <video> | <text>]

Where:

<document> ::= [doc | pdf | rtf | htm | html | txt]

<graphics> ::= [jpg | gif]

<audio> ::= [wav | wma]

<sound> ::= [wav | wma]

<video> ::= [avi | wmv | mpg]

Expanded Syntax Sample

<generic> ::= [<object> | (<object> <dot> <mime_file_type>)]

<object> ::= (<language_prefix> <object_type> <dash> <path> [<dash><object_suffix>] [<dash><object_name>])

<generic> ::= [<language_prefix><object_type> <dash><path>

[<dash><object_suffix>] [<dash><object_name>] | (<language_prefix> <object_type> <dash> <path> <dash> <object_suffix> [<dash><object_name>] <dot><mime_file_type>)]