行政院國家科學委員會補助專題研究計畫成果報告

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※ **生命科學數位博物館** ※

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計畫類別：☑個別型計畫　　□整合型計畫

計畫編號：NSC 90-2750-H-038-170

執行期間：90 年 06 月 01 日至 91 年 05 月 31 日

計畫主持人：徐建業　　台北醫學大學 醫學資訊研究所

共同主持人：李友專　　台北醫學大學 醫學資訊研究所

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□**出席國際學術會議心得報告及發表之論文各一份**

□國際合作研究計畫國外研究報告書一份

執行單位：台北醫學大學 醫學資訊研究所

中　華　民　國　　91 年　　10 月　　10 日

行政院國家科學委員會專題研究計畫成果報告

生命科學數位博物館
Multimedia museum of the "Secret code of the human life"

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一、中文摘要

本計畫『數位生命科學博物館-生命密碼館』定位於促進自然科學大眾教育之發展，綜觀國內的一般網站及博物館網站，主要涵蓋了歷史、人文、自然科學……等等各方面，鮮少有關於生命科學之資料。本計劃為國內外首創有系統將生命科學之醫學資料數位化，以文字、圖片、影片及聲音方式，透過網路傳達知識及提供教育之網站，可達到增進教育以及間接促進經濟產業發展之社會效益。

在整體架構方面，我們延續第一年計畫，打造五個主題展覽館，依照目前功能性系統與器官的分類，再延伸至分子生物的層次。在技術方面，平面影像(2D image)處理上將利用 Live Picture 公司配合 Kodak 及 Adobe 等所共同開發的 FlashPix 技術；而 3D 虛擬實境(Virtual Reality)將利用 2D 之 image 做 3D 重建 reconstruction 模型，配合 POSER、LightWave 等軟體做物件創造。影音資料（Video）將以 Real player 作為網路上播放的格式，再加上目前廣泛使用之『隨選視訊』(Video On Demand)作為輔助工具，將可提供快速且多重需求(multipurpose)的影片檔案給參觀者觀看與學習。Searchable video clip－配合動態資料庫作為連結，依據時間點的定義，做出可搜尋的影音片段，提供使用者快速的得到資料而不會浪費時間及網路資源。

本計畫利用已有之醫學背景，還具備了一已充分開發之網路醫學媒體資料庫（Web Base Medical Multimedia Database），由於此一技術充分擁有通用性、相容性及規範性，本計劃願將此一技術作一應用、推廣，此技術具備了瀏覽者於網路上使用之通用性、各種資料媒介之相容性、建構數位化資料庫之規範性，故本計畫不但具有學術性之嚴謹、高品質的科學教育典藏，還具有未來增長的擴充性及適用性。

網路頻寬以及資訊量的增加使得搜尋功能極為重要，多媒體影片之搜尋更比傳統文字困難。本研究於數位博物館中製作虛擬導覽影片，並利用 metadata 記錄影片中各時間點所描述之資訊，使此影片內容得以擁有搜尋之能力，再利用 Java Scripts 控制播放時間點，進而使多媒體導覽系統具備搜尋影片內容之功能。

關鍵詞：數位生命科學博物館、生命密碼館、基因、分子生物學、數位博物館、生命科學、人體奧祕、人體電影院、人體圖書館

Abstract

Because of the advancement of medical technology, we can now obtain a variety of information from the human body with great details. For example, modern techniques such as the digital radiography, computer

tomography and magnetic resonance imaging have produced lots of information for human body. In this study, we have developed a multimedia framework that manages a wealth of medical information through the Internet and presents the information in a form of digital museum or library.[1] This multimedia framework has the capability of exchanging, storage/retrieval, presentation and management of medical multimedia information. To overcome the challenges described above, the framework was designed to be composed of three parts: the presentation module, the description of data (metadata), and the multimedia database. With this exchangeable open architecture, medical multimedia data can be operated in many different ways.

Keywords: digital museum of life science, genome, nucleotide, protein, inheritance disease, human body library, Digital Library, Human Body, Story-Telling Platform, Video on demand

二、緣由與目的

Due to the popularization of Internet applications, the traditional channel of propagating knowledge and information has been changed. Under the influence of this mutation, the approach to the learning and utilization of knowledge is getting more omnifarious and efficient.

Medical database usually stores multimedia files. Hospitals have to store patient's X-ray films, endoscope videos and many other media files. By using the medical multimedia files and appropriate interface, a clinician can reveal more problems of a patient. Therefore, the issue of establishing and utilizing the medical multimedia database is very important. Traditional multimedia files have been digitized latterly. According to the development of the Internet the exchangeability of multimedia files is getting more effectually. And, it also makes education with multimedia through the web possible. People who did research on the topics of digital library had developed many kinds of method for dealing with the exchange of digital library's data. Metadata, which means the data about data, is the most important issue in the development and research of digital library. It will be more efficient and functional if a multimedia use metadata to describe what information contained in the multimedia itself. For example, a patient's endoscope video can't tell the clinician where the symptom is unless the clinician views the video from the beginning to the end. But if the video contains a metadata to describe the symptom's location, it makes the clinician find symptom's location more efficiently.

In this study, we developed a multimedia framework, which was equipped with a searchable multimedia database and the data can be exchanged. Thus, the utilization of the collected medical data can be expanded to a very wide rage, such as the purposes of research and education. The framework we developed not only exchanges the multimedia and metadata files, but also transfers the way that multimedia presented.

Started from January 2000, the Digital Museum for Human Body (DMHB) [2] project was supported by the National Science Council and executed by Medical informatics center of Taipei Medical University in Taiwan.[3 4 5 6 7 8] A lot of multimedia data related to human body has been collected and arranged by carefully defined metadata structure. The DMHB adopts the web-based interface. Based on the basic principle of science museums, DMHB project tried to collect all relevant information for human body. Hence, visitors can comprehend the secrets of human body completely and deeply. For the purpose of building up DMHB and propagating the digital information, medical specialists and computer technicians cooperated to make this work successfully.[9]

Digital Museum (DM) can be created by integrating the multimedia collected from different resources, such as texts, pictures, videos, and audio, etc. It covers various aspects, such as academics, culture, people and arts, etc. Under the well-designed guidance of the so-called "Story-Telling Platform" (STP) and web-based interface, via Internet surfing, people can easily reach the inquired knowledge and information without any limitation.[10 11] The DMHB project, "The

exhibition gallery for the secrets of human body" can provide interest, interaction, and incarnation for visitors as the traditional non-digital museum offered. Besides, with the basic principles, the systematic guidance, and friendly interface, a virtual digital museum can be constituted on the Internet by integrating digitized information.

The structure of DMHB is shown in figure 1. In the central layer, which is the database, we store images, three-dimensional models, audios and videos. In the second layer, the Technology layer, we adopt technologies including streaming image, streaming video, Virtual Reality Modeling Language, FLASH and the newly developed presentation, "Story Telling Platform" (STP). In the third layer, the User-Interface, we design a prototype including five sections, which are Exhibition Hall, Movie Theater, Virtual Reality Gallery, Library of Human Body and Gaming Zone.

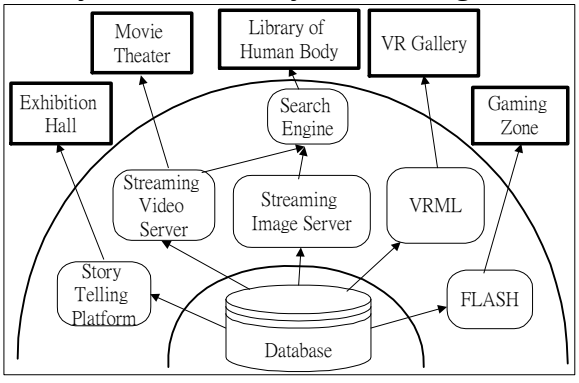

Figure1: Structure of DMHB

三、結果與討論

It is very important to establish the metadata for the large amount data we collected. Metadata means the data about data. We can use metadata to describe multimedia data and other kinds of data. It will be more convenient to search and exchange data if the metadata is well defined. The Dublin Core (DC) [12] standard defines a shared set of data attributes that can be used in metadata. Dublin Core has several advantages such as simplicity, semantic interoperability, international consensus and extensibility. Because the DC format fits our requirements, we decide to use DC format to build our metadata.

Dublin Core has 15 data columns including title, creator, subject, descriptions, publisher, contributor, date, type, format, identifier, language, relation, coverage and rights. In addition to Dublin Core, DMHB used several special columns to accommodate the plenty of medical multimedia data listed in table1. According to different kinds of file types, we added different columns for annotation and the searching system. For example, we added time-code and keyword in the Metadata of video.

Table 1:Metadata columns in DMHB

	Dublin Core		Extended columns
Text	Title Creator subject descriptions publisher contributor date	type format identifier language relation coverage rights	
Video			length, size,frame rate, frame size, codec
Audio			length, size, sample rate, bit depth
Image			length, size,resolution, color bit, mode

Medical Multimedia data is very important due to the uniqueness of Medical data. When clinical doctors describe patients' situation, they cannot use only words but have to use multimedia data, which includes texts, pictures, films and audios to describe patients' conditions completely. For example, a patient with fracture must take a X-ray for his fracture area, a patient with gastroduodenal ulcer probably have the gastroscopy video or picture, a patient with otolaryngology surgery may have a video of surgery process. Similarly, our so-called medical library must have comprehensive capability of display pictures, words, videos and audios.[13]

The most famous standard of multimedia is Moving Picture Experts Group (MPEG) [14]. The group has produced MPEG-1, the standard on which such products as Video CD and MP3 are based, MPEG-2, the standard on which such products as digital Television set top boxes and DVD are based, MPEG-4, the standard for multimedia for the fixed and mobile web and MPEG-7, the standard for description and search of audio and visual content. The new standard MPEG-21 "Multimedia Framework" has started in June 2000. The aim for MPEG-21 is to describe how multimedia elements fit together. MPEG-21 is an open framework for multimedia delivery and consumption. The vision for MPEG-21 is to define a

multimedia framework to enable transparent and augmented use of multimedia resources across a wide range of networks and devices used by different communities.

According to nowadays framework of multimedia data, however, we cannot exchange data properly. When we exchange multimedia data directly, we can only get the display of pictures or the video data itself but not the data of the data. There is an example of ENT surgery video, people watch only the video but can't know where the surgeon want to highlight in the surgery process. If the data's data can also be exchanged with data, then the receiver can get the same information as that of the transmitter; this is the ultimate goal and result of data sharing. Our research established an appropriate and exchangeable framework for on-line medical learning.

In the Digital library, metadata is used to search and locate the record of any exhibition object. The most important aspect of using metadata is to provide search ability for none-words object such as simple pictures, sculpture or digital picture, audio and video data. Our research is to use metadata to interpret Medical data and use Dublin Core, which is the main stream of metadata, as our medical metadata format. Then we can ensure our medical multimedia data can be exchanged and can be used in online learning and research in a digital library.

The purpose of our research is to establish an appropriate and exchangeable framework for on-line medical learning. In addition to convert the pictures, texts, videos and audios into the pre-defined framework, we also make this framework to have the ability to do multimedia exchange. The multimedia framework we designed was much like MPEG-21 framework. But in our framework the presentation method can be exchanged and the information is reusable. The structure of the multimedia framework designed in this study is shown in figure 2. We use XSL to read metadata in XML format. Metadata in XML format is DC standard. Multimedia will be presented with browser.

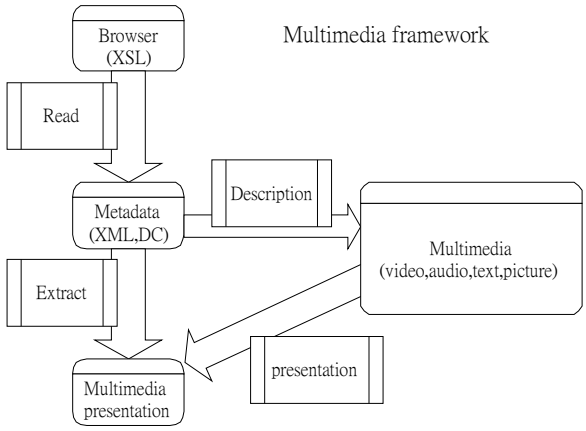

Figure 2: The structure of the multimedia framework presented in this study.

The screen display of the presentation of our framework is shown in figure 3. The framework can make pictures, texts, videos and audios merged together in a single web page. People can use any browser to view the data since the browser has the character that can access information across all kinds of computer platforms.

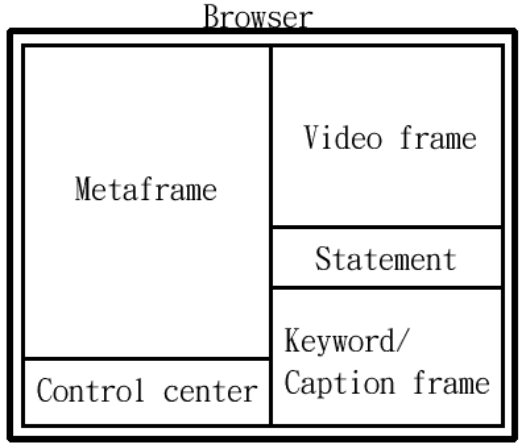

Figure 3: Presentation of our framework

In the past, multimedia data can only exchange data itself. It can't get related information about multimedia data. There are some metadata for multimedia, which has been established already and can be exchanged between each other. The framework of multimedia established in our research can exchange metadata with other databases. In our framework, the contents of multimedia can be well displayed and can be reused after exchange. This is the trend of multimedia development. The exchange method we used is shown in figure 4. We can see that the media data files as well as the description of the data are transferred between user A and B.

The material we collected for our research are eight guideline video which were manufactured in the digital museum for human body project, ten physical examination videos which were manufactured by Taipei Medical University, and clinical videos provided by Hospital of Taipei Medical University. We use the multimedia framework established in our study to interpret those data in order to display the content of the multimedia data.

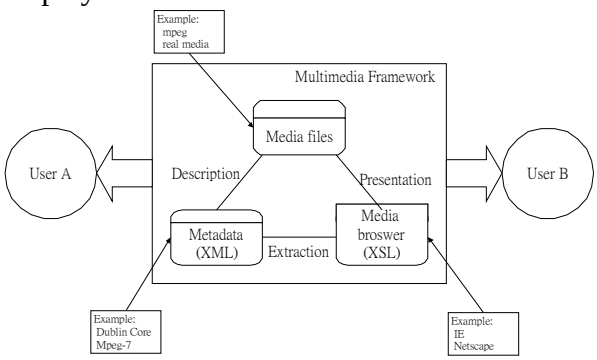

Figure 4: Exchangeable multimedia framework

四、結論

It is difficult to define medical multimedia metadata. There are several medical data format s such as ICD-9. Each medical educationist has developed multimedia-teaching system for themselves. The result of multiplicity of system cause each system has their own data format. It means to define a metadata format can be used in different systems is important. We have defined a metadata format base on DC standard. By the extension of DC format, we expect every format of other system can be imported into our data format and data can become reusable. Multimedia files have many different formats such as AVI, MPEG, Real media and Microsoft media. How to accommodate framework to different formats is difficult too. Because of using web-based framework, we use different XSL to accommodate different formats.

Open Archives Initiative (OAI) [15] is a new protocol for metadata harvesting. Because it uses http protocol to exchange metadata, we expect to expend our framework to match OAI protocol.

By utilizing new Internet technology, the access of knowledge and information has been expanded. The limitation of time and space cannot restrain people from acquiring knowledge and information. In addition, people's life style, the structure of the society, and academic culture has been changed significantly. This significant change is influencing people speedily and continually. Specifically, the propagation of Internet information is consequential and inevitable in the 21st century.

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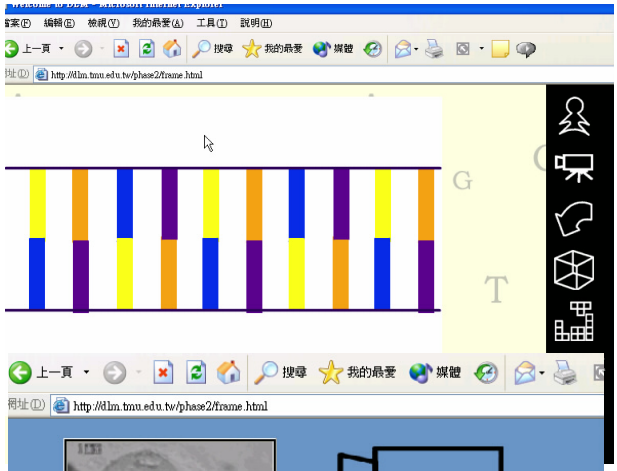
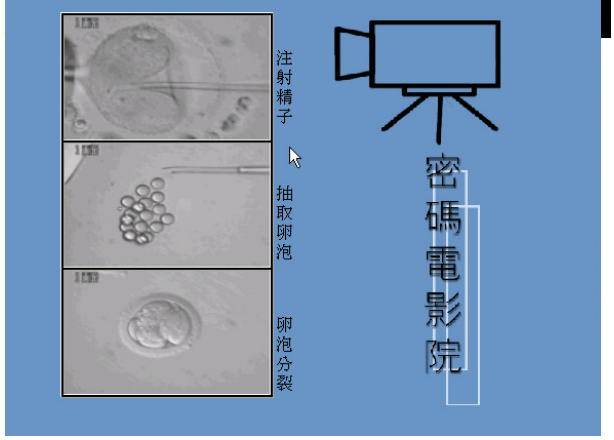
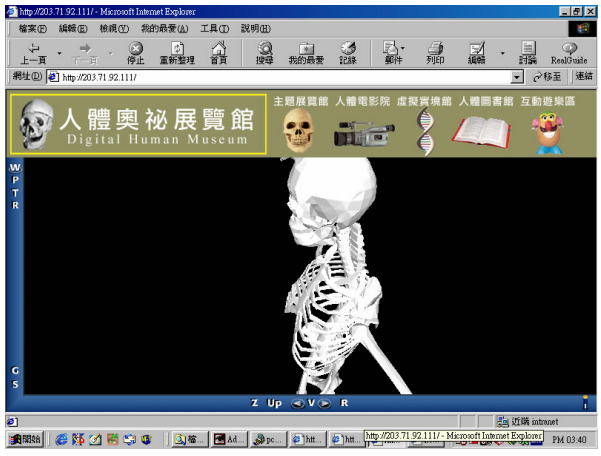
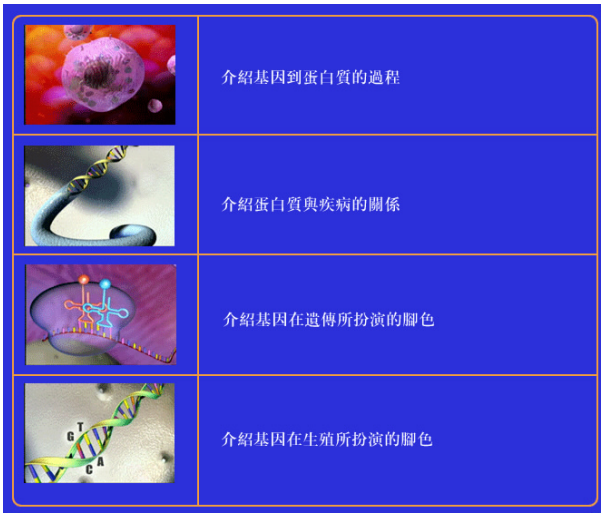




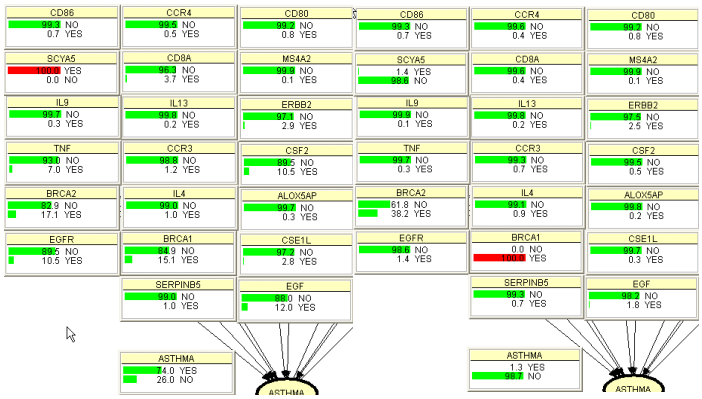


基因電影院



基因圖書館

基因實驗室



虛擬顯微鏡

生物資訊網站介紹