Programmed Database System at the Chang Gung Craniofacial Center : Part II - Digitizing Photographs

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Background: The archival tools used for digital images in advertising are not to fulfill the clinic requisition and are just beginning to develop. The storage of a large amount of conventional photographic slides needs a lot of space and special conditions. In spite of special precautions, degradation of the slides still occurs. The most common degradation is the appearance of fungus flecks. With the recent advances in digital technology, it is now possible to store voluminous numbers of photographs on a computer hard drive and keep them for a long time.

Methods: A self- programmed interface has been developed to integrate database and image browser system that can build and locate needed files archive in a matter of seconds with the click of a button. This system requires hardware and software were market provided.

Results: There are 25,200 patients recorded in the database that involve 24,331 procedures. In the image files, there are 6,384 patients with 88,366 digital pictures files. From 1999 through 2002, NT$400,000 have been saved using the new system.

Conclusion: Photographs can be managed with the integrating Database and Browse software for database archiving. This allows labeling of the individual photographs with demographic information and browsing. Digitized images are not only more efficient and economical than the conventional slide images, but they also facilitate clinical studies.

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Key words: **digital images, photographic database.**

The storage of a large amount of conventional photographic slides needs a lot of space and specialized conditions. In spite of special precautions, degradation of the slides still occurs, the most common is the appearance of fungus flecks. With the recent advances in digital technology, it is now possible to store voluminous numbers of photographs on a computer hard drive and keep them for a long time. DiSaia et al.,[1] Fiorelli et al.,[2] Edstrom[3] and Galdino et al.[4] have noted the advantages of using digital technology in their centers. Allan et al.[5] and Roa et al.[6] used the tools of digital images to diag-

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nosis wound healing and burns. Price and Goldstein[7] even used the technology in their dermatological surgery practice. At the Craniofacial Center of Chang Gung Memorial Hospital, over 20,000 patients have been registered and several thousand pictures have been acquired during the past 20 years. Previously, photographs were taken and stored in the slide format. Since December 1998, the format was changed to computerized images taken with a digital camera. The old slides were then converted to digital images with the use of a scanner. To date there are 88,366 digitized images from 6,384 patients in the Center's computer data bank and this collection is growing. This has presented a new problem of storage and organization in the computer. One aim of this study was to explain how these images were stored and managed using an image archiving software called ACDSee Photo Browser. This software was linked to the Paradox-based data management system that is currently used at the Craniofacial Center (Part I of this paper). This integration of the database and image browser system has become a useful tool not only for data storage but also for patient follow-up and retrospective studies. Photographs can be managed with the Database software for database archiving, which allows labeling of the individual photographs with demographic information such as patient's chart number, date and number of photos taken. In addition, this labeling allows the database to be searched according to criteria such as patients name, diagnosis, treatment procedure, etc.

METHODS

Large conventional photographic archives require a large physical storage area, and a search for specific records of patients requires some time and manpower. This problem is overcome by using an integrated database and image browser system that can locate needed files in a matter of seconds with the click of a button. This system requires some computer hardware and software.

Hardware

Obtaining the hardware for digital image taking, storage and transfer is not much of a problem nowadays because the equipment is available in commercial computer stores.

Digital images in our center were recorded using either a Nikon Coolpix 950 or a D-1 Pro Digital camera while the conventional slides were converted to digital images using a slide scanner. The accessory equipment used in conjunction with the cameras included 1) eight personal computers (PCs) with 256 megabytes (MB) of random memory and ethernet communication card, installed in different clinics and offices; 2) compact flash memory cards with at least 64 MB of memory to provide for data storage in the camera; and 3) compact flash card reader which was the medium used to transport the photographic data to the computer. Since storage was an important factor, two large (73 Gigabytes) IBM hard drives were installed in each PC. The slide scanners used were a Microtek Artixscan 4000t and a Cannon Canoscan FS2710 slide-scanner.

Software

At first, an attempt was made to store the images in the archives of Paradox and other software called Presto! Manager 98 and Mirror Image. However the amount of data was too large and not only caused the hard disc to "crash" or "freeze" frequently but it also took a long time to search for a specific file in the directory.

The software used was the ACDSee Photo Browser, which was developed by ACD Systems Ltd. to facilitate the acquisition, storage and management of digital images. Generally, the software stores image files in the destination directory under the names assigned to them and are searched using the software- provided query tools. This method is not practical when there are thousands of patient data stored in the archives. We have taken advantage of the powerful search tool in the database integrated to the image browser system to operate the photo storage and search commands.

Integration between the Database and Image-browser

For the thousands of patient records in the archives, we integrated the search tool in the Paradox software and linked it to the ACDSee browser system to present or show all the patient records at one time. This integration is not inherently provided in any of the software programs available on the market. It was programmed in our system using the Paradox-provided Object Paradox Application

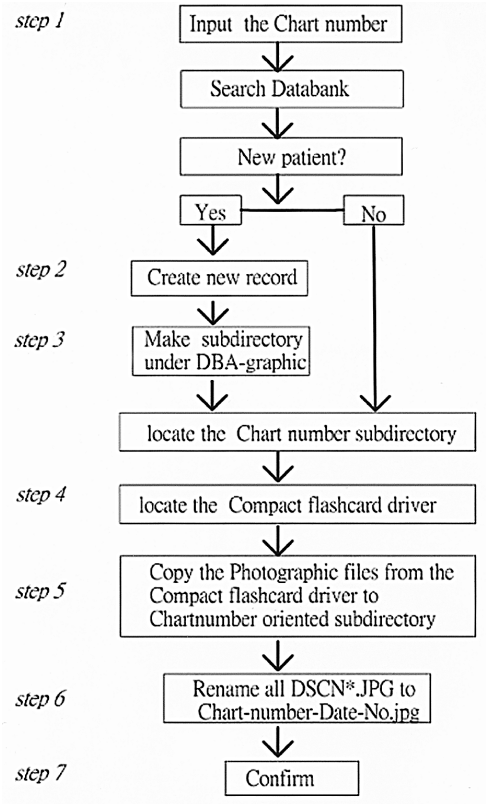

Fig. 1 Diagram of step by step procedure that the system to operate in the Database to integrate the Image Browser.

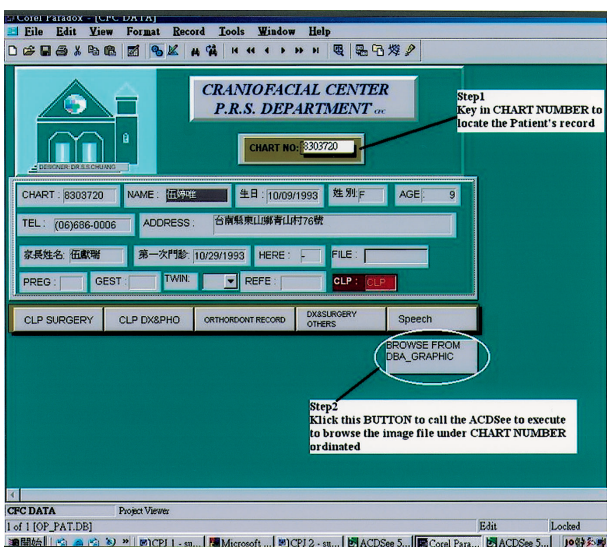

Fig. 2 Using the patient's chart number 8303720 at Step 1, all of the patient's data could be accessed; pop up images were accessed with ACDSee in Fig. 3 following clicking on the Browse Push button in Step 2.

Language (PAL) computer language.[8-10] For the purpose of searching we designed the storage of image data in the subdirectory under the chart number ordinal. With the scripting language of Paradox, the dialog box was linked through the chart number to the image folder. This opened the ACDSee browser system to retrieve the patient's images together with all of the patient's data (Figs. 1-3).

The images were filed using the combination of chart number, date when photographed, and the number of the photograph in that set was the file name; i.e. chart number-date-number in set .jpg (Fig. 4).

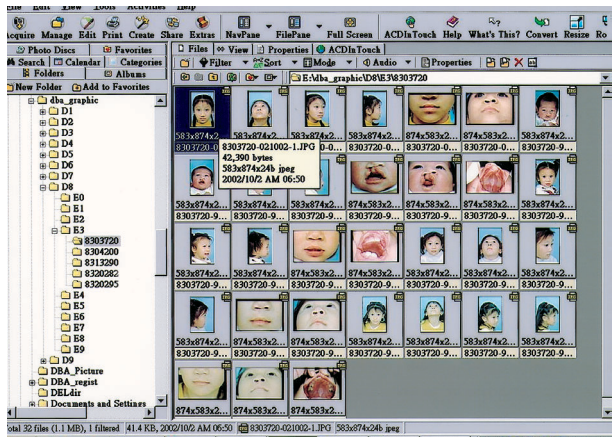

Fig. 3 An example of the ACDSee image folder of the patient with chart number 8303720 opened through a Paradox dialog box that was linked to the patient's database.

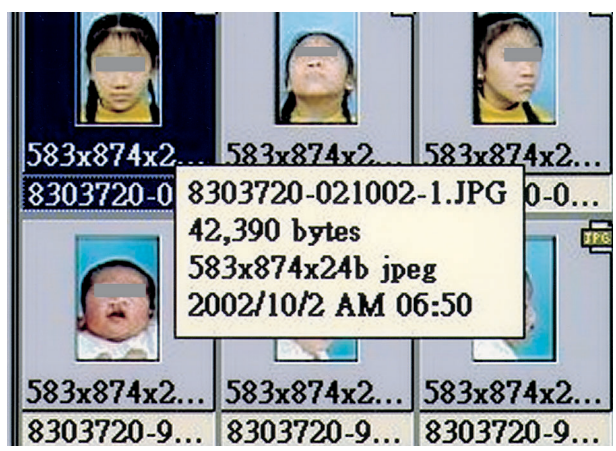

Fig. 4 The patient's image data filename was changed to the combination of component "chart number-date-number in the set" = "8303720-021002-1.jpg" by the programmed commands.

The folders were arranged according to the first and second digits of the chart number. The first folder contained the designated letter "D" and the digits 1 to 9, corresponding to the first digit of the patient's chart number. Each of these folders then contained subfolders with the designated letter "E" and the digits 0 to 9 corresponding to the second digit in the patient's chart number. The image files were operated using the Paradox database, through a chart number search that first identifies whether the chart number already exists. If it already exists, a new image files could be added immediately, otherwise a new file directory is automatically created as described above. The dialog system for the file management was programmed using the Paradox Data Delivery Embedded (DDE) system.

For scanning slides and changing them into digital format, the same procedure is followed except that the scanned photos are not located in the drive of the flashcard reader but in the hard drive of the PC where they were saved. Priority was given to scanning the slides of the patients who were actively being followed-up.

Back-up

Two separate forms of back-up were generated. One was developed within the same computer but in different hard drives (internal computer) and the other was in a different computer within the network (inter-computer). The internal and inter-computer back-ups are automatically updated from the main computer in the photo studio whenever the computer is switched on.

RESULTS

Since 1998, we have taken patient photos using digital cameras instead of the conventional cameras. The conventional slides that already existed were converted into digital images using a scanner. Currently there are 25,200 patients recorded in the database that involve 24,331 procedures. In the image files there are 6384 patients with 88366 digital pictures files, which include the diagnosis, pre-operative and post-operative photos.

DISCUSSION

In previous reports in the literature, most of the authors mentioned the hardware and the utility experience needed, but focused less on the software usage. DiSaia et al[1] presented several benefits of image digitalization and availability in hardware and software. They also mentioned about the archival tools being used in advertising were just beginning to develop. Their article provoked several discussion. Lapid[11] was against the trustworthiness with digital photos for publication, but Sankkar and Khan[12] in the United Kingdom pointed out that the quality of the images is the responsibility of the contributor. Although the digital pictures are not absolutely perfect compared with the conventional slides,[13-15] they are effective and efficient in respect to storage and organization. Thus, they are ideal for plastic surgeons. Edstrom[2] shared his experience in converting digital photography and photo archiving. He mentioned the Mirror image system as a slick and user-friendly system. This was the only article that talked about the software. We used a software program previously in the aesthetic center and had a negative experience. After inputting the data, the volume exceeded the system capacity. The system tended crashed and we lost lot of time and images during the rescue procedure. Due to this painful experience, we had the incentive to design own system. Our system consisted of two independent systems; one was specified for Database, and the other for Photo archive browsing. The image archives were built up independent of the other software. Thus, we ensured the safety and security to the Image files.

In this article, we described the long-term preservation and database organization of digitized images of the patient records at the Craniofacial Center. This process depended on several factors including software, file form, memory and search retrieval.

The software is one of the most important aspects of storage. It should have a convenient method of integrating with the other contents of the databank. It should allow easy access to the images from any computer in the system. It should also provide the assurance of being able to operate the images within the current software for a long period without deteriorating or being phased out. The first two requirements are resolved with a self-programmed database and linkage medium to the image browser. The third one depends on software compe-

tition in the free market. We have observed that very few imaging software programs have survived from the last decade, and this was our reason for storing the digitized images in an independent directory on the hard drive, which was not attached to any software. In any situation of software evolution in the future, even if the Paradox or the ACDSee programs should be eliminated from the market, the stored data would not be lost. It would still be possible to use any new database software provided with the Open Data Base Connection (ODBC) to retrieve our files. The usual image storage were either in the database (i.e. Microsoft Access, Paradox, Mirror image), which provide the graphic field for the accessory image storage (F and required to import and export the image file one by one; or in Image Browser/Editor (i.e. PhotoShop, Paint Shop Pro, Presto! Pagemanager, Corel Draw, etc.), which coded to their own fold and labeled the fold name as well as the image files like in Database. Both of them were stored in the system and software dependent. Once a new software program changed, or the system crashed, the image files needed to be exported one by one as the previous input, thus lots of time was lost.

The file form was also very important. We opted to label our files under the chart-number, date and number in the set format to allow automatic searching as soon as the chart number was input. There were several advantages to this file form. First, it was time saving because the custom-programmed system created the standard subdirectory and file name automatically. Second, under the ordinate subdirectory it became possible to retrieve the images using any type of browser system because of its independence from software. Third, it was easy to locate and identify the patients' records through this label. With the special components of the image file linked to the programmed medium it was possible to move from the database system to the image browser system instantly and to access old to recent patient data and digital images all at once.

There are several options to the image browser (i.e. ACDSee, Paint Shop Pro, Photoshop, etc.). ACDsee is one of the most efficient browsers. It facilitated searches in the image archive and their highlight image unlimited. Although it has limitations in photo editing, we do not need such a function to change our native Image color, ton, or even the special filtration.

The conventional slides have the tendency to fade with time. One of the purposes for converting to digital images is to provide photos that did not deteriorate. Nevertheless, digital storage presents with an all or none characteristic. This means that either a whole file or none of it can be stored depending on the available memory. Thus, a reliable memory medium was very important for our large storage needs. The 7,200 rpm high-speed (72 GB) hard drives with large volume memory were sufficient for this, but some products had the problem of overheating and inadvertently crashing. Thus, we chose a hard drive manufactured by IBM that was heat tolerant. However, in spite of the better heat tolerance of this hard drive, a cooling fan was still necessary.

The basic requirements for a camera such as macro capability, zoom, on-camera flash, or external flash connectability can be found in the high-end digital cameras. They have additional advantages over 35 mm cameras such as being economical in the long run, and environmentally friendly for they do not require the use of chemicals for developing. We have shown that images produced by them are capable of being stored for a long time and retrieved easily using computer technology. In our opinion, the resolution for the digital camera still lags behind that of the conventional cameras. However, some digital cameras have over two million pixels the image resolution quality that has been satisfactory in producing images on the computer and printouts of up to 20× 15 cm in size depending on the printer's capabilities. Storage was also economical and required low maintenance compared with the conventional optic slides.

Operating under this system solves not only the usual storage and long-term preservation problems but also time and money problems. Our system through the programmed interface could be operated to automatically label the file to the destined archive, but in the conventional model, one by one labeling was the only choice. The amount of time saved is several folded due to the number of the pictures processed. From our prior records, we shot about 1,000 rolls of 36-exposure slide film per year. The cost was NT$150 each including the development charge. Total cost was estimated to be more then NT$600,000 during the past 4 years. The total investment of the soft and hardware for the digitized system is only NT$200,000. Thus saving

NT$400,000. The number of cabinets needed to store conventional photographic slides has been reduced to the Desktop on one desk.

Our custom programmed system not only made storage more reasonable and secure, it also allowed for dialog between the database system and image browser system. In which independently labeled archives, assure the image files will not crash as occurs with contemporary operating systems. This provided a powerful tool to display a patient's data including the diagnosis, preoperative and postoperative photographs all at once with the press of a button. Under the utility of the two integrated systems, patient follow-up and retrospective studies are made easier and less time consuming.

Digital technology offers a reliable and inexpensive (from software, to the digital camera, the computer and its accessories) means of recording photographic information in the long run. Digital images can be integrated to the main database, photo browser, and presentation tool such as Powerpoint. The advantages are not only to facilitate clinical studies, but also the easy retrieval of information for teaching material and presentations.[16-18] Data are easier to transport and require small physical storage media such as a CD-ROM compared with the carousels, envelopes and filing cabinets needed for slide storage. With the impact of technology on daily life, digital imaging records could soon become the standard imaging tool in our field of work.

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長庚顱顏中心實用資料庫軟體：第二篇--數位影像

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背 景： 商業化影像資料庫的貯存軟體現在還未發展成熟，在長庚醫院顱顏中心，以前是以幻燈片來紀錄及保存，由於數量漸漸大增，造成貯存問題及發霉與退色問題。數位照相貯存硬體的普遍化，因此促使我們將以前的幻燈片掃瞄成數位影像，並將往後的照相紀錄改用數位相機貯存在硬碟中。

方 法： 用Paradox Application Language自行研發的界面連線Database & Browse 軟體作爲Image Operation的工具。

結 果： 25,200個病人登錄於資料庫，24,331個開刀數，6,384個病人，過去4年共貯存88,366數位影像，比起傳統的幻燈片節省NT$400,000。

結 論： 這篇報告只要討論在顱顏中心數位相片的貯存，及聯合資料庫的管理、搜尋功能的軟體、及程式設計的使用經驗。數位相片的貯存不但省時、省錢，更能夠提供方便的臨床研究。

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關鍵字： 數位影像，影像資料庫。

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