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European Journal of Obstetrics & Gynecology and Reproductive Biology 120 (2005) 206–209
EUROPEAN JOURNAL OF OBSTETRICS & GYNECOLOGY AND REPRODUCTIVE BIOLOGY
www.elsevier.com/locate/ejogrb

Digital recording of surgical procedures using a personal computer

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Received 25 July 2004; accepted 11 November 2004

Abstract

Objective: To develop a system for recording surgical procedure digitally using a personal computer with real-time compression of the video signal.
Study design: We built the system around a modern personal computer with a large hard disk to allow recording of over 250 h of continuous surgery. Digital capture from the camera was achieved using a standard external analogue-digital converter linked to the computer via a firewire cable. The software for capturing, compressing and editing movie files were obtained free of charge from the internet. The optimal settings for the software was determined.
Results: We have successfully used this system to record over 100 major and minor hysteroscopic, laparoscopic, vaginal and open gynaecological. Despite compression, the quality of the movies was judged to be very good and still images excellent. The recordings could be integrated in to standard presentation. Still pictures could be printed to provide hard copies for patients and medical notes, and movies burnt on to CDs or DVDs.
Conclusions: A digital recording system built around a standard personal computer is relatively cheap, versatile and has a huge capacity to record surgical procedures.

Keywords: Digital recording; Computer; Surgery

1. Introduction

Minimal access surgery is becoming routine across many specialties, and has been heralded as ''the most important revolution in surgical technique since the early 1900s'' [1]. Numerically the most dramatic example of this change in surgical practice has been laparoscopic cholecystectomy which, since its first description in 1987, has replaced open surgery as the standard of care [2,3]. The list of endoscopic procedures is forever increasing and embraces not only gynaecology (e.g. hysterectomy, myomectomy, adnexectomy, pelvic floor reconstruction), but many other surgical specialities such as general surgery (e.g. appendicetomy, colon resection, Nissan fundoplication), urology (e.g. nephrectomy, adrenalectomy), cardiothoracic surgery (e.g. lung resection, coronary artery bypass surgery), and even plastic surgery (e.g. breast reconstruction) [3]. Developments in robotics and computer enhancement have been predicted to extend the role for this type of surgery [4].

A key component in the development of endoscopic surgery has been advances in miniature, high-resolution cameras which allow the surgical team to visualise the procedure on a colour monitor. This also makes it possible for surgeons to record their surgery as documentation of the procedure which can be used for teaching, research, audit and patient education. Currently, VHS video recording is the commonest media used, but digital recording is now a possibility offering superior quality and convenience.

Several instrument manufacturers sell camera systems which include the facility for digital recording. These systems are expensive and have limited capacity for continuous recording. We describe a video capture system which is based on a standard personal computer (PC) and is

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0301-2115/$ – see front matter
doi:10.1016/j.ejogrb.2004.11.003

therefore comparatively cheap, utilises software for capture and real-time compression which is freely available, and has good recording and editing capabilities.

2. Materials and methods

Continuous visual images of endoscopic, vaginal and laparotomy procedures were obtained using a standard three-chip endoscopic camera system (Karl Storz, Tuttlingen, Germany); in the case of conventional surgery, the camera was fixed to a modified microphone stand. All images were displayed on the colour monitor on the endoscopy stack and routed to the computer system.

2.1. Computer hardware

The hardware specification, cost and recording capabilities of our video capture system and that of three commercially available systems are summarised in sTable 1. A modern, off-the-shelf desktop or portable computer has more than enough computing power for video capture and editing; a desktop PC has the dual advantages that it can be fitted with a faster and larger hard disk (resulting in better recording quality and lomger recording capacity, respectively). Video capture in high-quality DV format is facilitated by the use of an external analogue-digital converter which is linked to the computer via a fast firewire cable (Fig. 1).

2.2. Computer software

The software we utilised for capturing, compressing and editing movie files are available on the internet and can be downloaded and installed free of charge; DivX™ is free provided it is for personal and not commercial use.

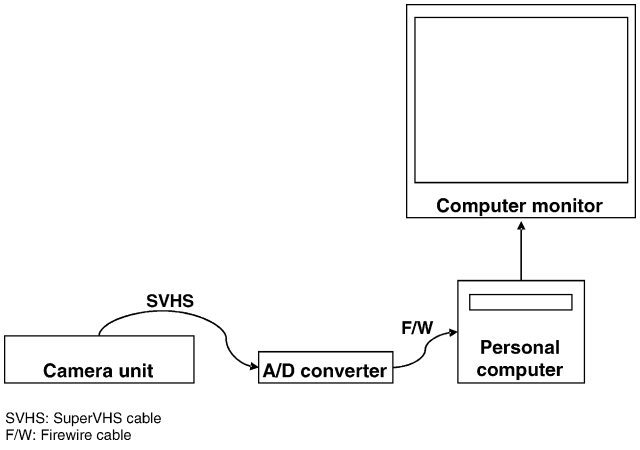

Fig. 1. Schematic diagram of the digital recording system.

The digital signal was captured in real-time using the video capture application VirtualVCR (available from http://virtualvcr.sourceforge.net). Usefully, the program provides real-time capture statistics of variables such as the number of frames captured, dropped frames, compression ratio, size of the file and the time left on the hard disk for further recording. The capture statistics can be saved along with the movie file if desired. As an added bonus with VirtualVCR, the teaching of trainees and students is facilitated as the standard Windows pointer is available on the colour monitor to demonstrate the anatomy and highlight steps involved in the surgical procedure. If desired, screen shots can be captured and saved using freeware programs such as ScreenPrint32 (available from http://www.provtech.co.uk/software/screenprint32.asp) or WinGrab (available from http://home.no.net/wingrab) as an alternative to post-recording frame capture with VirtualDub (see below).

Table 1
System specifications and cost

	Desktop computer system	Laptop computer system	Storz AIDA compact	Olympus UPAP100MD	Stryker SDCPro II
Computer (e.g. Intel Pentium 42.8 GHz processor, 512 RAM, 250 Gb 7200 rpm hard disk, firewire port (IEEE-1394), DVD/CD writer, keyboard and mouse, Windows XP operating system)	£ 600	£ 1000[a]			
External analogue-digital converter (e.g. Canopus ADVC-100)	£ 220	£ 220			
Colour monitor	£ 100	Included			
Video capture software (e.g. VirtualVCR)	Free	Free	Included	Included	Included
Video compression software (e.g. DivX™ MPEG-4)	Free	Free	Included	Included	Included
Video editing software (e.g. VirtualDub)	Free	Free	N/A	N/A	N/A
Colour photoprinter (e.g. HP Photosmart 130)	£ 80	£ 80	Included	Not included	Not included
Maximum continuous recording time	230 h	55 h[a]	45 min	4 min	60 min
Total recommended retail cost (excluding tax)	£ 1000, € 1430, $ 1720	£ 1300, € 1859, $ 2236	£ 9999, € 14299, $ 17198	£ 5250, € 7507, $ 9030	£ 13000, € 18590, $ 22360

[a] Hard disk size 60 Gb.