A New Radiological Imaging Technique Employing a Fluoroscopic SystemVisiografo

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ABSTRACT

In present-day scoping studies the image obtained is the result of X-ray interaction with a fluorescent screen, and is directly analyzed by the observer. This system has a series of inconveniences: the image is not recorded, contrast is low and sharpíness relatively poor. In addition, observer difficulties are encountered in shifting from photopic to scotopic vision. The aim of the present study is to solve these problems by obtaining an image that may be saved, manipulated and contrasted by other specialists, while at the same time curbing the costs of currently employed image intensifiers. The results obtained may be applied to areas in radiodiagnostics, i.e., medical, veterinarian, industrial and in security systems. Research reporting is also made easier by allowing. the images to be processed along with text compositions.

Key words: Radiology. Imaging systems. Data acquisition (DAQ). Computer systems.

INTRODUCTION.

Current legislation forbids direct radiological scoping, except under urgent and extraordinary circumstances, as judged by specialist criterion. This is reflected by the third article of the 841466/EURATOM guidelines of the European Council health authorities.

This resolution was adopted in view of the high radiation doses to which both patients and physicians are exposed. In addition, direct scoping leaves no record of the observations, and so repeated exposures may be required to contrast opinions with other specialists._As a result, alternatives are needed to direct scoping X-ray generators and tubes.

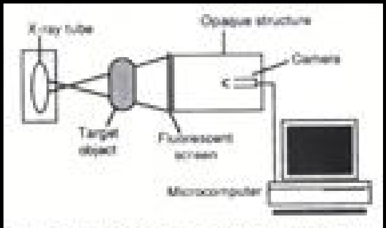


Fig. 1. Schematic representation of the X-ray image capture and processing setup.

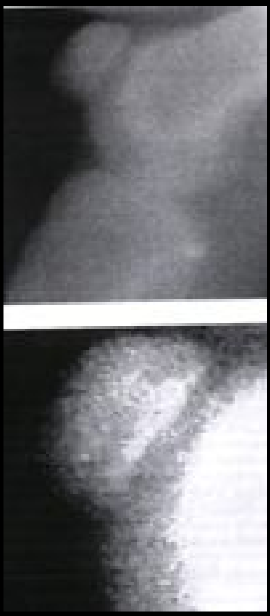
The radiation dose to which patients and operators are exposed depends on three factors: *distance* (absorbed radiation energy is inversely proportional to the square of the source-target distance), *time* (radiation intensity at a given point is directly proportional to exposure time), and the interposed protective *barrier* (radiation absorption is dependent upon the interposed material characteristics -density, atomic number, etc.- and increases exponentially with barrier thickness).

The aim of the present study was to optimize these three factors, i.e., to increase the distance between the emission source and operators, reduce exposure úm, and optimize the interposed barrier. In addition, improvements were obtaíned in image quality, system cost, and image storage, etc.

MATERIAL AND METHODS

A high-voltage generator was **employed (maximum** potential difference and intensity, 80 kV and 20 mA, respectively) in combination with a radioscope X-ray tube (fixed anode CRISA 100 kW).

Local attenuations of the incident X-ray beam occur as a function of varying tissue or objet thicknesses and densities. The image obtained is made visible by a fluoroscopic screen. (Sony high resolution b/w monitor) positioned behind the target object or patient, and is recorded by means of a video camera (Panasonic EP-500). Both the fluorescent screen and video camera are housed within an opaque structure. The data signals are in turn transmitted from the camera to a microcomputer, where data acquisition (DAQ) is carried out by a video digitizing card of the required resolution (Intel high resolution Smart Video Recorder, based on Video for Windows software).



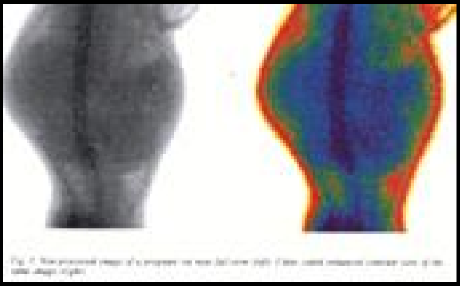
The choice of video camera was decided by the light intensity emitted by the fluorescent screen. As this intensity was less than 1 lux, conventional video cameras, requiring over 5 lux, were discarded.

By employing a high-resolution monitor, the signal transmitted by the camera may be visualized and stored by an 8-head video or video-printer. A resulting ímprovement was noted on contrasting the results obtained to date with those afforded by existing scoping techniques. In addition, the microcomputer link-up facilitates subsequent image storing and manipulation.

RESULTS

The diagnostic information derived from the X-ray image is fundamented upon the contrast between a given point and its surroundings. Thus, currendy available radiographic and scoping systems equipped with image intensifiers offer a range of between 6 and 10 shades of grey. In comparison, the image captured by the video camera provides 16 shades. Moreover, digitalization of the image affords all the processing and manipulation advantages of computer hard- and software:

On-screen image visualization. This is analogous to using image intensifiers, with ft added possibility of freezing the image.
Image printing (acetate or slide format) - the acetate- option allowing diagnosis on a negatoscope.
Amplification of the image zone of interest.
Image processing with different filters, in order to enhance the ama of interest.
Color introduction in the image makes it possible to differentiate very similar shades of grey, by applying Contrasting color tones.
Clarifying text messages may be introduced.
Modem and network communication allows instant transmission of the image and associated information to other locations.



An additional aspect to be considered is the patient exposure dose. Although the current intcnsity reaches 15 mA with this method, the exposure times involved are of the ordor of only a few tenths of a second; as a result, the total dose absorbed by subjects positioned in close proximity to the emitting tube is considerably reduced. Moreover, this arrangement allows the operator lo be positioned in a compartment removed from the area in which the radiological exploration is carried out, thereby limiting his or her exposure lo that of natural background radioactivity.

On the other hand, this capture method guarantees maximum image quality, with a minimum spatial resolution of 3 dots por millimeter; resolution unifórmity; contrasting of 16 tonos of grey; and the absence of image distorsion.

DISCUSSION

The radiological imaging system described in the present study offers a number of advantages over the classical radioscopic and radiographic techniques. Thus, the images may be saved and manipulated by computer, thereby allowing fast access lo patient information while reducing the volume of clinical histories. Data centralization at national level in turn makes it possible to access patient information in different centers, without having to repeat potentially hazardous exposures. Modem data transmission in this sense facilitates the exchange of detailed information among specialists.

In terms of radiological protection, the operator may be positioned outside of the exposure compartment, thus minimizing unnecessary irradiation. Patient exposure is also greatly limited, since the exposure times are much shorter than in the case of the scoping techniques, and the required intensity is much less than in radiography.

The method described may also be applied satisfactorily to disciplines unrelated lo the biosciences. Thus, the fact that the operator need not he in the same room as the emitting device is of interest in the development of explosivo detection systems.

Finally, the system described allows considerable economical savings. Indeed, the components involved (video camera, digitizing card, microcomputer) are available at a fraction of the cost of the most inexpensive image intensifier. Moreover, the system may be fitted lo existing X-ray machines - including those employed in scoping.

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