Digital Image Processing in Medical Applications: A Case study

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***Abstract*-The rapid advancements in medical imaging and automated image analysis will continue and allow us to make significant advances in our understanding of human life and disease processes, and our ability to deliver quality healthcare. Medical images are used not only for diagnosis, but also in surgical interventions. In robotic surgery a surgeon uses a joystick to control a robot, which is armed with surgical tools and a camera. Imaging technology in Medicine made the doctors to see the interior portions of the body for easy diagnosis. Various Image Processing techniques developed for analyzing remote sensing data may be modified to analyze the outputs of medical imaging systems to get best advantage to analyze symptoms of the patients with ease. In this paper we will gives a brief overview of Endoscopy, Computer Tomography (Ct) and Ultrasonic Imaging System.**

Keywords- Image processing, Endoscopy, Computer Tomography (Ct) and Ultrasonic Imaging System.

I. INTRODUCTION

Medical imaging has contributed significantly to progress in medicine. The various imaging modalities developed over the last 50 years include radionuclide imaging, ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI) and digital radiography. Therefore, diagnostic imaging has grown during the last 50 years from a state of infancy to a high level of maturity. It is very clear that medical imaging has become established as having an important role in patient management, and especially radiologic diagnosis. In healthcare industry, there are so many applications of digital image processing. Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT) scan are most popular among them. Apart of healthcare, Digital Image Processing and analysis is also applied in different areas like office and industrial automation, Remote sensing; natural resources survey and management, Criminology, Astronomy, Meteorology, and artillery applications. Advantages of Digital Processing for Medical Applications

Digital data will not change when it is reproduced any number of times and retains the originality of the data.

- Offers a powerful tool to physicians by easing the search for representative images;
- Displaying images immediately after acquiring;
- Enhancement of images to make them easier for the Physician to interpret;
- Quantifying changes over time;
- Providing a set of images for teaching to demonstrate examples of diseases or features in any image;
- Quick comparison of images.

Digital Image Processing Requirements for Medical Applications

- Interfacing Analog outputs of sensors such as microscopes, endoscopes, ultrasound etc., to digitizers and in turn to Digital Image Processing systems.
- Image enhancements.
- Changing density dynamic range of B/W images.
- Color correction in color images.
- Manipulating of colors within an image.
- Contour detection.
- Area calculations of the cells of a biomedical image.
- Display of image line profile.
- Restoration of images.
- Smoothing of images.
- Registration of multiple images and mosaicing.
- Construction of 3-D images from 2-Dimages.
- Generation of negative images.
- Zooming of images.
- Pseudo coloring.
- Point to point measurements.
- Getting relief effect.
- Removal of artifacts from the image.

Image Processing Systems for Medical Applications

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(a) Endoscopy

Endoscopy is a medical procedure that uses an instrument called an endoscope The endoscope is put into the body to look inside, and is sometimes used for certain kinds of surgery. In each endoscope, there are two fiber bundles. One is used to illuminate the inner structure of object. Other is used to collect the reflected light from that area[1]. The endoscope is a tubular optical instrument to inspect or view the body cavities, which are not visible to the naked eye normally. In each endoscope, there are two fiber bundles. One is used to illuminate the inner structure of object. Other is used to collect the reflected light from that area. The endoscope is a tubular optical instrument to inspect or view the body cavities, which are not visible to the naked eye normally.

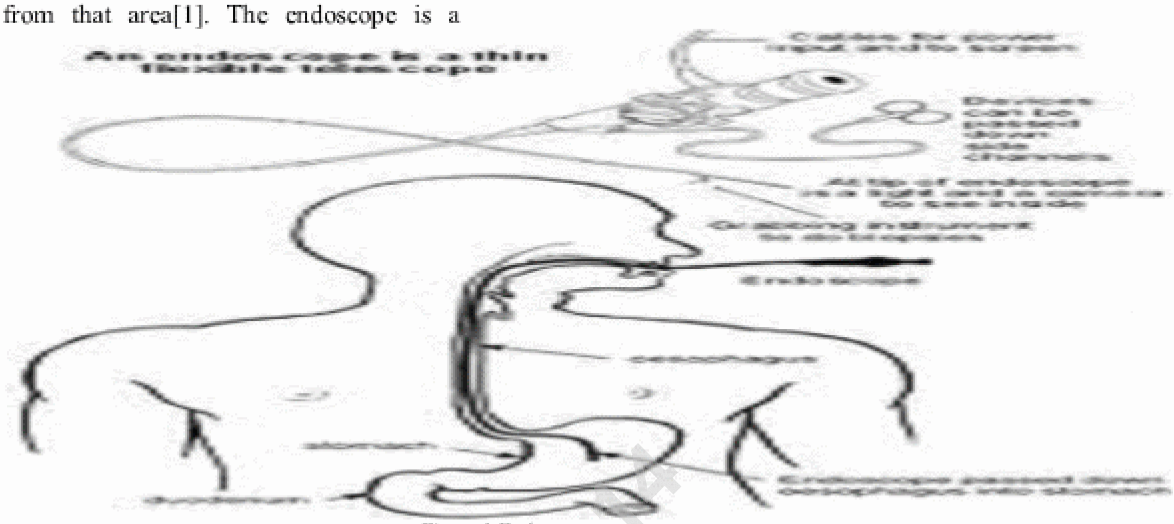


Figure 1 Endoscopy

Figure 2 Block diagram of endoscopy

Stereo Endoscope

Two cameras are mounted on a single laproscope. Images from the cameras are transmitted alternately to a video monitor. Few types of display techniques are used to realise stereo images from two-dimensional images recorded from the above cameras. As the cameras transmits images at 60-120 cycles per second a three-dimensional, real time image is perceived. As the images are transmitted at a high frequency, the effect is that of seeing different images simultaneously.

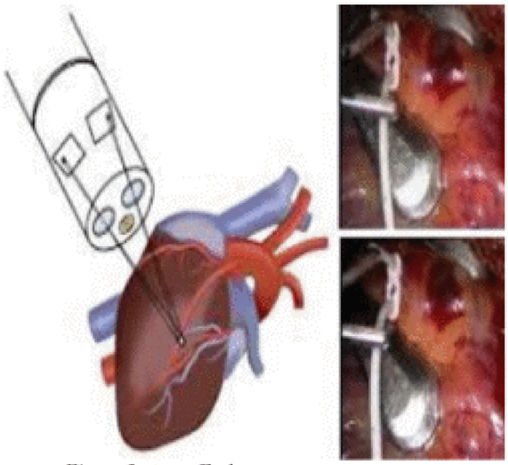
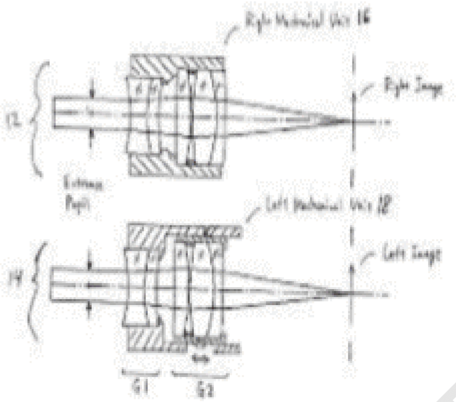


Figure 3 stereo Endoscopy



(b) Computer Tomography (Ct)

Computerised Axial Tomography or computer transmission tomography or computer tomography is a method of forming images from X-rays. Measurements are taken from X-rays transmitted through the body. These contain information on the constituents of the body in the path of the X-ray beam. By using multidirectional scanning of the object, multiple data is collected. An image of a cross-section of the body is produced by measuring the total attenuation along rows and columns of matrix and then computing the attenuation of the matrix elements at the intersections of the rows and columns. The number omathematical operations necessary to yield clinically applicable and accurate images is so large that a computer is essential to do them. The information obtained from these computations can be presented in a conventional raster form resulting in a two dimensional picture. The timing, anode voltage and beam current are controlled by a computer through a control bus. The high voltage d.c. power supply drives an X-ray tube that can be mechanically rotated along the circumference of a gantry. The patient lies in a tube through the center of the gantry. The X-rays pass through the patient and are partially absorbed. The remaining X-ray photons impinge upon several radiation detectors fixed around the circumference of the gantry. The detector response is directly related to the number of photons impinging on it and hence to the tissue density. When they strike the detector, the X-ray photons are converted to scintillations. The computer senses the position of the X-ray tube and samples the output of the detector along a diameter line opposite to the X-ray tube. A calculation based on data obtained from a complete scan is made by thecomputer. The output unit then produces a visual image of a transverse plane cross-section of the patient on the cathode ray tube. These images are also stored into computer for image processing [4].

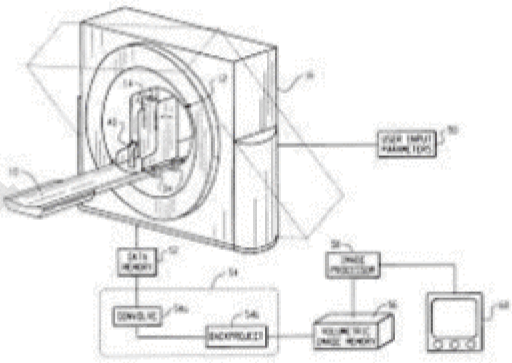


Figure 4 CT

(c) Ultrasonic Imaging System

Ultrasonography is a technique by which ultrasonic energy is used to detect the state of the internal body organs. Bursts of ultrasonic energy are transmitted from a piezo-electric o magnetostrictive transducer through the skin and into the internal anatomy. When this energy strikes an interface between two tissues of different acoustical impedance, reflections (echoes) are returned to the transducer. The transducer converts these reflections to an electric signal proportional to the depth of the interface, which is amplified and displayed on an oscilloscope. An image of the interior structure is constructed based on the total wave travelling time, the average sound speed and the energy intensity of the reflected waves. The echoes from the patient body surface are collected by the receiver circuit. Proper Depth Gain Compensation (DGC) is given by DGC circuit. The received signals are converted into digital signals and stored in memory. The scan converter control receives signals of transducer position and TV synchronous pulses. It generates X & Y address information and feeds to the digital memory. The stored digital image signals are processed and given to digital-to-analog converter. Then they are fed to the TV monitor. These signals are converted to digital form using frame grabber and can be stored onto PC/AT disk.Wherever the images lack in contrast and brightness, Image Processing techniques may be used to get full details from Ultrasound images.

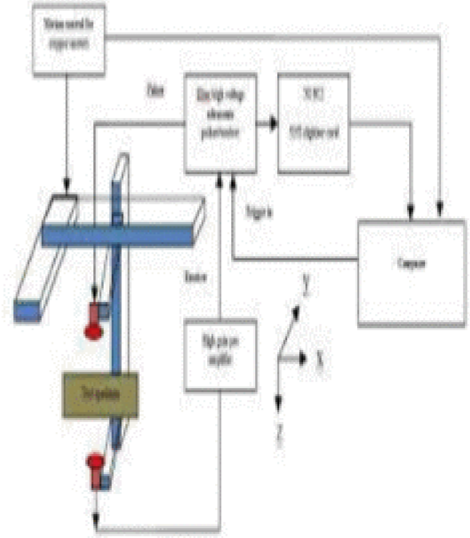


Figure 5 Ultrasonic Imaging

II. CONCLUSIONS

This paper gives an overview on the rapid advancements in medical imaging and automated image analysis will continue and allow us to make significant advances in our understanding of human life and disease processes, and our ability to deliver quality healthcare. Various Image Processing techniques developed for analyzing remote sensing data may be modified to analyze the outputs of medical imaging systems to get best advantage to analyze symptoms of the patients with case. On the present emerging technologies like Endoscopy, Computer Tomography (Ct) and Ultrasonic Imaging Systems

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