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**DIGITAL PROCESSING OF MEDICAL IMAGES**

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**Abstract**. The article discussed with a wide range of methods and systems for medical imaging, such as Magnetic Resonance imaging, Sonography, X-ray Computer Tomography, Infrared Thermography, Isotope imaging, Tactile imaging, Positron Emission and photon emission computerized tomography. Finally, the main utility of medical imaging have been considered.

**Key words**: imaging, magnetic resonance, infrared thermography, X-ray, ultrasound, tomography.

Medical Imaging is defined as the process through which we are able to record images of different structures of human body for diagnostic as well as for research purposes. There is a wide variety of medical imaging techniques and systems available today which include Magnetic Resonance imaging, Sonography, X-ray Computer Tomography, Infrared Thermography, Isotope imaging, Tactile imaging and a lot more. There are marked differences in the sources and equipment used in various medical imaging procedures and the resulting images of the same structure also differ showing the variety of imaging techniques. Medical imaging has a great amount of utility in different disciplines of medical science like diagnostics, forensic, bioinformatics and telemedicine.

Medical imaging procedures use different sources such as ionizing radiations, non-ionizing radiations, high frequency sound waves to produce the image of the required structure of the patient. Different medical imaging procedures are distinguished:

– X-Rays are one of the many forms of electromagnetic radiations and were discovered by German scientist Wilhelm Rintgen. They can be used to produce 2D scans called projectional radiography. The 2D scans taken from different angles can be combined to produce a 3D image through a process called computed tomography. Real-time moving images of internal parts can also be obtained by using a fluoroscope with an X-Rays source called fluoroscopy [1].

X-rays have the ability to penetrate the skin and reach up to the bones which contain calcium, calcium due to its high atomic number effectively absorbs the X-rays, thus giving a visible image on the radiograph. X-rays are used to view not only bones but also lungs and tissues. However, it is hard to distinguish between different tissues based on an X-ray alone.

It uses for detection of pathologies in skeletal system (fractures, bone disorders); lung cancer, pneumonia through chest-rays; gall stones, intestinal obstruction through abdominal X-rays; esophageal disorders through fluoroscopy etc.

– Medical ultrasound imaging uses high frequency sound waves to visualize various structures of the body from the returned echoes using arithmetic and logic calculation. Pregnancy ultrasound and diagnostic ultrasound are of great importance.

It uses for fetal ultrasounds to check for Down’s syndrome, birth defects, amount of amniotic fluid, gestational stage; diagnostic ultrasounds to check for breast cancer, cancerous/non-cancerous growths in organs, infertility treatments etc. [2].

– Magnetic Resonance Imaging (MRI) uses magnetic scanners, which produce strong magnetic fields, radio waves to create images of organs. It is different from a computed tomography and PET scans in the sense that it does involve any X-rays or ionizing radiations. Clinical and research MRI utilizes hydrogen atoms of the human body to create polarization which is detected by antennae placed near the patient.

Magnetic Resonance Imaging is applied for to detect stage of prostate and rectal cancers, radiosurgery of intracranial tumors, assess myocardial ischemia, various vascular diseases, congenital heart diseases etc [3].

– Tactile Imaging – is an elasticity imaging technique which translates the sense of touch into digital image. Two-dimensional pressure patterns from deformed soft tissue are converted into three-dimensional image which demonstrates anatomy and elasticity of underlying structures. It uses for detection of tissue and organ disorders concerned with change in biomechanical properties like muscle mobility, contractility, soft tissue anomalies etc.

– Infrared Thermography is a process which involves a thermal scanner to detect radiation in the form of heat coming from an object, converts it to temperature and presents it as an image depicting temperature distribution called thermograms.

Infrared Thermography is intended for Spot infrared thermometers are used to detect and measure temperature at a specific spot on body surface, allergy detection, sometimes for breast screening [4].

– Single photon emission computerized tomography (SPECT) is a nuclear imaging technique which integrates computer tomography using a radioactive tracer which will allow to view blood flow through vessels. Prior to examination, radio-tracer which can be detected by a gamma camera is injected. It is represented as cross sectional slices therefore it provides true three-dimensional data through different angles. It uses for myocardial perfusion imaging to detect cardiac stress, cerebral blood flow, Alzheimer’s disease etc.

– Positron Emission Tomography (PET) uses the abilities of nuclear medicine and like SPECT scan uses a radio-tracer to visualize organs and tissues. But unlike SPECT, radio-tracer used in PET scan gets trapped within required tissues, unstable nucleus of radioactive element emits positrons which combine with surrounding electrons to produce gamma rays that are detected to visualize images. PET uses for imaging of tumors, metastasis in cancers, diffuse brain disorders, radio surgery etc[1].

Finally, the main utility of medical imaging have to be considered:

* Medical imaging techniques are extensively being used for detection, following the progress or regress of a disease and treatment of various disorders and diseases. Tumors, malformations, hypertrophy, etc. of different organs is effectively detected through segmentation and texture analysis of medical images [2].
* Research purposes has a major role in discovering new diseases, new technologies for treatment, pharmaceutical clinical trials to develop better diagnostic methods.
* The entire duration of gestation period requires time-to-time monitoring of the fetus inside the mother’s womb which will be impossible without non-invasive medical imaging. Such techniques help in detection of any developmental disorder in the unborn child and indicate complications if any.
* Forensics use various imaging procedures for identification of corpses, determining the cause of death whether accidental or non-accidental, to study the osseous skeleton during post mortem, in biometrics to scan fingerprints, face etc. [5, p. 1,3].
* Scans can be recorded and kept for future reference and study or can be communicated remotely using compression techniques contributing to bioinformatics.

In conclusion, medical imaging techniques are of great importance to medical science and they have a great scope in future diagnostics. They can lead to the discovery of still unknown features of structures and diseases of the human body.

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