

Medical Technology (Medtech), A Digital Innovation Transforming Healthcare Rationale to Digitize Humans to Overcome Unsustainable Healthcare System

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Abstract:- The World Health Organization states that Health Technology is used to solve a health problem and thereby improving quality of lives by applying organized knowledge and skills by using

- *Devices*
- *Medicines*
- *Vaccines*
- *Procedures*
- *Systems*

The two main areas of medical technology are :

- *Diagnosis*
- *Treatment*

Diagnosis is a way to determine the nature and cause of certain phenomena into separate and distinct categories that helps treatment and prognosis to be made. Diagnosis in other words can be explained as “cause and effect” using various logic, analytical tools and experience. Technology has helped to a great extent in diagnosing type of disease, extend and stage. The various techniques used for diagnosis are infectious agents, and imaging techniques, such as

- *Radiology*
- *Ultrasound Examination.*

Treatment is the manner in which the individual physique responds to the corresponding diagnosis. Treatment is done using infusion pumps, lasers called medical lasers and surgical machines called LASIK for certain diagnosis.

The paper does an analysis of the existing data with relevant to the topic.

Keywords:- *Diagnosis, MedTech, Medical Technology, Treatment, Imaging Techniques, Infectious Agent Detection.*

I. DIAGNOSIS

Technology has played a vital role in the area of diagnosis. The various techniques used for diagnosis are:

- ❖ *Infectious Agent Detection*
- ❖ *Imaging Techniques*

There are various diseases detected using this techniques. The various diseases detected using the techniques are :

- *Skin disease*
- *Cancer*
- *Allergies*
- *Gynecology diseases*
- *Diabetes*
- *Others*

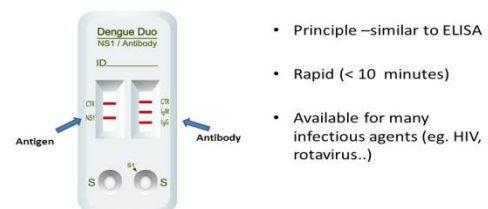
- ❖ *Infectious Agent Detection*

The various techniques used for infectious agent detection are :

A. Point-of-care Test

The invention of novel sensors, advanced wireless communication along with errorfree liquid handling methods and careful manufacturing process has made the POC testing the best testing technique.

Point-of-care tests for Ag and Ab detection



- Principle –similar to ELISA
- Rapid (< 10 minutes)
- Available for many infectious agents (eg. HIV, rotavirus..)

Fig 1:- POC

- Technology: Sensor, Wireless Communication

B. Biosensor using NRL Array

A biosensor is used to detect an analyte and hence called an analytical device, used for the device that combines biological component with a physicochemical detector to detect antibody.

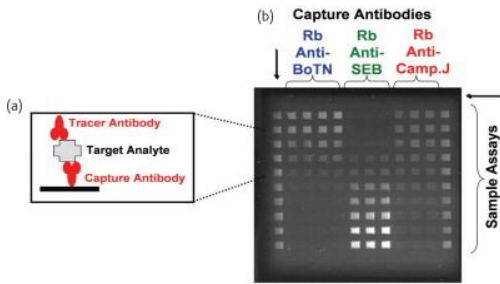


Fig 2:- Biosensor

➤ Technology: Detector

❖ *Imaging Techniques*

The different types of Imaging Techniques are:

A. *MRI stands for Magnetic Resonance Imaging*

The most effective informative imaging modality for the Central Nervous System is MRI:

- MRI uses Radio Frequency (RF) signals to detect and go into the skull and spinal column without losing the quality of the image.
- the hardware allows tremendous flexibility in rotating the image to the requirement defined as imaging orientation .It also allows great flexibility in spatial resolution indicating number of pixels used for generating image .

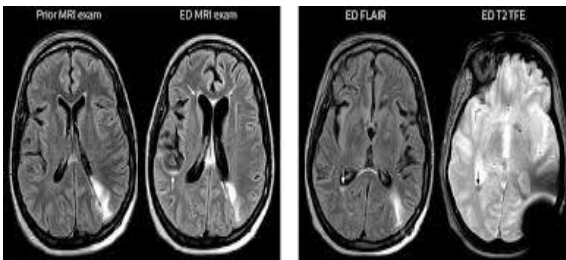


Fig 3:- MRI

➤ Technology: Radio Frequency, Image Processing

B. *X-Ray Computed Tomography (CT):*

CT scan is a nondestructive technique which is used to detect ,measure the damage mechanism in the form of corrosion or cracks. It helps to conceptualize the internal structure within solid objects, and to get digital image as result .The digital information is in the format of on 3D geometries and properties.



Fig 4:- CT scan

➤ Technology: Radiography

C. *Positron Emission Tomography*

It is an imaging technique, in which a nuclear medicine functional imaging technique is used to analyse the metabolic processes in the human body. A positron emitting radionuclide(tracer) is used which emits pairs of gamma rays on a biologically active molecule, on which the tracer is induced. The 3D images of tracer concentration are obtained using computer analysis within the body. The modern PET-CT scanner holds both PET and CT scanner for performing 3D imaging. The 3D dimensional imaging is performed using CT X-Ray scan on the patient at the same time ,in the same machine.

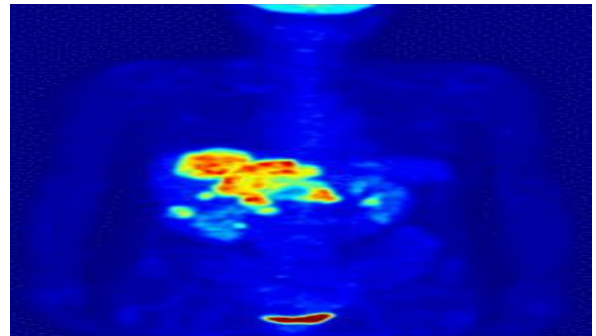


Fig 5:- PET scan

➤ Technology: Radiography, Tracer

D. *Functional Magnetic Resonance Imaging(FMRI):*

FMRI detects the changes linked with blood flow, that means it measures brain activity. The blood flow to the region increases when the area of the particular region is in use. FMRI technique is a combination of

- *Neuronal activation*
- *Cerebral blood flow*

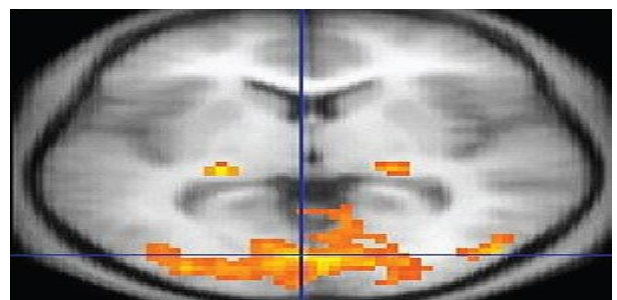


Fig 6:- FMRI scan

➤ Technology: Image Processing

E. *Radiography*

Radiography views the internal structure of an object using X-rays. The image is in the form of electromagnetic radiation created using a beam of X-rays. X-rays generator is used to produce electromagnetic radiation, which is projected towards the object.



Fig 7:- Radiography

➤ Technology: Imaging,X-Ray

F. Single Photon Emission Computed Tomography(SPECT or SPET)

SPET uses gamma rays.It is a nuclear medicine tomographic imaging technique.The technique delivers a gamma emitting radioisotope(a radionuclide),by injecting into the bloodstream of the patient.



Fig 8:- SPECT

➤ Technology: Gama rays,Image Processing

G. Medical UltraSonography

It is an application of ultrasound.It is a diagnostic imaging technique which is used to see the internal body.It is used to see internal body structures such as

- Tendons
- Muscles
- Joints
- Blood Vessels And
- Internal Organs.



Fig 9:- Sonography

➤ Technology: Ultrasound signals

II. TREATMENT

The different technologies used for treatment are:

A. Surgery Simulation:

The technology is a Robotic Surgery Simulator(ROSS) which allows real-world views of surgeries.It eliminates the need for a live environment,dummy or patient to train learning surgeons.This was invented by Roswell Park Cancer Institute along with University of Buffalo's School of Engineering and Applied Sciences.. It reduces the risks of making mistakes on real patients by giving the space for medical professionals to practice in a simulated environment using information technology.

B. Cloud-Based Data And Software:

Applications for example referral MD help healthcare providers create referrals digitally.The application helps to reach providers and millions of patients who want to get treated using excellent options.The present technology is a method which is time saving and excellent approach for patients to get treated and the healthcare facility to earn profit.This is an example of best software innovation in the field of health informatics which digitizes the information by collecting, storing, analyzing the information.

C. Electronic Medical Records:

This technology allows with just the click of a mouse to retrieve medical history,insurance information,medicines details etc.It allows to access patient information which are useful.The method is to store the information into database thereby reducing paper costs.

D. Brain-Machine Interfaces

The sensor is implanted directly in the brain of the patient.This technology helps the devices like headset to give signals to wheelchairs,limbs etc.The clinical trials have been launched with the FDA's approach of DARPS's design ,for the safe use in homely environment.This technique eliminates the help or advice of an expert.

E. Eko Devices, Berkeley, Ca

Eko Core (Eko Devices, Berkeley, CA) has a stethoscope which is an analog stethoscope which provides smooth analog and digital sounds,which is transmitted to clod via Bluetooth.The doctor can download it to any smartphone using an application.The reports can be checked which is in waveforms in real time,record and playback body sounds.The data can be shared and stored in the patients electronic helath record.This application was selected by *Time* magazine as one of the top inventions of 2015, The scope could help reduce healthcare costs by helping doctors take more advanced treatment options and avoiding unnecessary specialist care.



Fig 10:- EKO Devices

F. Pulse Oximetry

Pulse Oximetry is used for monitoring a person's oxygen saturation which is a noninvasive method. It is a safe, convenient, noninvasive, inexpensive pulse oximetry method. Though its reading of SpO₂ is not always same to the more accurate reading of SaO₂ from arterial blood gas analysis. The two are related and compared and used for measuring oxygen saturation in clinical use.



Fig 11:- Pulse Oximetry

G. Brain Implant

The electronic cure for memory loss seems to be the future of medical science. The maverick neuroscientist is working hard on an electronic cure. A memory-boosting implant that mimics the kind of signal processing that occurs when neurons are laying down new long-term memories. This is performed by Dr. Theodore Berger, a biomedical engineer at the University of Southern California, funded by DARPA.



Fig 12:- Brain Implant

H. Artificial Retina :

Scientists have developed a retinal implant that can restore lost vision in rats. The same implants are planned to trial the procedure in humans. The implant, could give hope to millions who experience retinal degeneration, which converts light into an electrical signal that stimulates retinal neurons. It can help patients with retinitis pigmentosa – blindness occurs when the photoreceptor cells in the eye begin to break down, leading to blindness.^[11]

III. CONCLUSIONS

The paper does an analysis of the already existing data to comprehend the digital innovation in the field of medical science. Thus technology helps us to sustain health and improve it. These advance methods are helping to cope with the health distress and quick recovery.

REFERENCES

- [1]. http://www.who.int/topics/diagnostic_techniques_procedures/en/
- [2]. <https://study.com/academy/lesson/medical-technology-definition-examples.html>
- [3]. https://en.wikipedia.org/wiki/Medical_diagnosis
- [4]. <https://online.king.edu/healthcare/digitizing-healthcare-how-technology-is-improving-medical-care/>
- [5]. <https://online.king.edu/healthcare/digitizing-healthcare-how-technology-is-improving-medical-care/>
- [6]. <https://www.asme.org/engineering-topics/articles/bioengineering/top-5-advances-medical-technology>
- [7]. https://en.wikipedia.org/wiki/Pulse_oximetry
- [8]. https://schedule.sxsw.com/2016/events/event_PP50701
- [9]. <https://www.sciencealert.com/scientists-have-created-an-artificial-retina-implant-that-could-restore-vision-to-millions>
- [10]. <https://en.wikipedia.org/wiki/Biosensor>
- [11]. <https://www.sciencedirect.com/science/book>
- [12]. <http://slideplayer.com/slide/8929954/>
- [13]. <http://www.sciencedirect.com/topics/medicine-and-dentistry/imaging-techniques>
- [14]. https://en.wikipedia.org/wiki/Positron_emission_tomography
- [15]. https://en.wikipedia.org/wiki/Functional_magnetic_resonance_imaging
- [16]. https://en.wikipedia.org/wiki/Single_photon_emission_computed_tomography
- [17]. <https://online.king.edu/healthcare/digitizing-healthcare-how-technology-is-improving-medical-care/>
- [18]. <https://www.asme.org/engineering-topics/articles/bioengineering/top-5-advances-medical-technology>
- [19]. https://en.wikipedia.org/wiki/Pulse_oximetry
- [20]. <https://www.sciencealert.com/scientists-have-created-an-artificial-retina-implant-that-could-restore-vision-to-millions>