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Image Processing used as a Powerful Tools in Recent Biomedical Security

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Abstract*: A vital component of healthcare systems, biomedical security guarantees the integrity and confidentiality of sensitive patient data. The goal of this research is to improve biomedical security by incorporating image processing methods. Image processing can be used to watermark, authenticate, and encrypt biomedical images, protecting their integrity and secrecy. First, by encrypting data in a form that is difficult to decode without the right decryption keys, image encryption helps prevent unwanted access. Secondly, By putting undetectable markings inside photos, watermarking helps identify and discourage any alteration attempts. Robust security measures are necessary in the ever-evolving field of biomedical research and technology to protect sensitive data. Utilizing image processing in biomedical security can provide cutting-edge solutions for authentication, privacy protection, and other issues. This paper develops into the potential application , existing methodologies current challenges and also future prospects of utilizing image processing in biomedical security.*

Keywords: M.R.I, C.T, Fingerprint Scanning, IRIS, Face Scanning etc

I. INTRODUCTION

Biomedical pictures, such as CT (computed tomography scan), MRIs (magnetic resonance imaging), and X-rays (x-radiation), are becoming increasingly important in today's world for the diagnosis and treatment of many diseases. There is private information in these pictures that should be kept secure. Numerous additional technologies are employed to capture data regarding the position and operation of the body. The study of preventing manipulation, illegal access, or theft of patient data, especially biomedical pictures, is known as biomedical security.We are able to resolve several security issues, such as fingerprint, face, and iris identification, by using image processing.image processing are employed in many other industries than security, such as agriculture, IOT-based home security.

At the Massachusetts Institute of Technology's Bell Laboratory and Jet Propulsion Laboratory, DIP (Digital Image Processing) was created in 1960. Originally developed for satellite images, medical imaging, and other purposes, it has found several uses in a variety of disciplines in recent years. The quality of image processing outputs was poor in the past, but it has improved recently. The American Jet Propulsion Laboratory completed their initial application with success. They use image processing for noise reduction, gradient change, and geometric correction. Using an algorithm, digital computers are mostly used in digital image processing. A subdomain of DSP (Digital Signal Processing) is DIP (Digital Image Processing).It functions mostly with analog image processing. A greater variety of algorithms must be used and applied to the incoming data. DIP keeps processing sounds and distortions to a minimum. Digital filters are used in the DIP process to improve picture clarity.It provides advanced output in a task together with intricate algorithms. Filters are used in DIP to sharpen and blur digital pictures. There are several ways for filtering photos, such as convolution. Using an algorithm to process photos on a computer is known as image processing. Biomedical image security may be achieved by several image processing techniques. Here are some applications for image processing:

Watermark: Watermark images to detect unauthorized modifications.

Encrypt: images to restrict access to authorized users only.

Compress: Pictures need less space and bandwidth to transmit and store.

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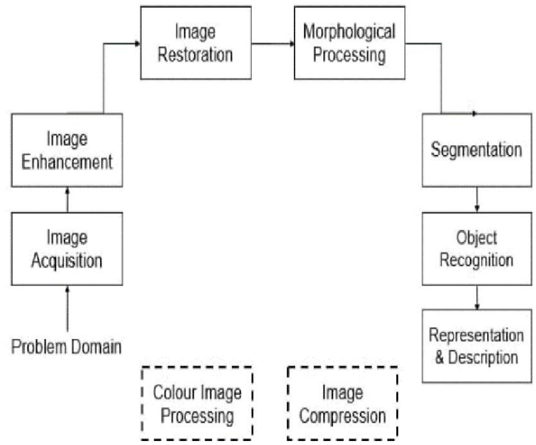

Fig.1. Block Diagram of DIP

II. APPLICATIONS

The use of image processing in CT, MRI, some forms of surgery (to be covered later), and complicated x-ray systems includes the investigation of human body datasets using three-dimensional images .We can tackle a number of security problems, including fingerprint, face, and iris recognition, with image processing.


Fig.2. 3D Image

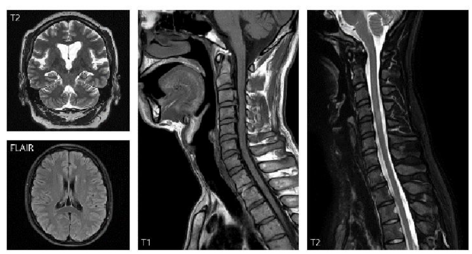
Fig.3. MRI Scan

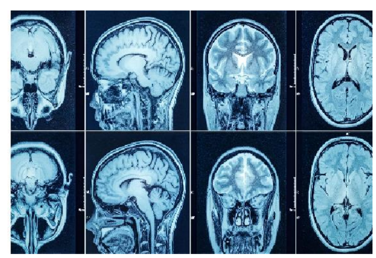
Fig.4. CT Scan

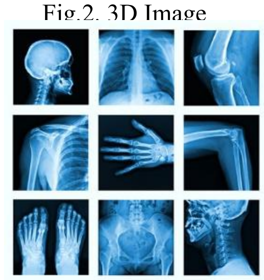
Fig.5. X-Ray


Fig.6. IRIS scan

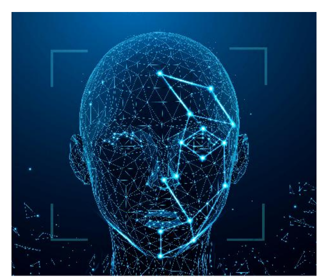
Fig.7. Face Scanning


Fig.8. Fingerprint Scanning

III. WORKING PRINCIPLE

X-Ray:

At the cathode, or negative terminal, an electron is being discharged by a hot filament. The term for it is Thermionic Emission. This phenomenon occurs in metals where a significant amount of thermal energy is transferred to the electrons, causing the electrons to dissipate from the metal. The electron beam was targeted by the positively charged anode. There is a voltage of 200 kiloelectrons between the two electrodes. Around the primary impacts, where x-ray photons are lost, electrons traveling at high speeds lose 1% of their energy. The electrons in the outer shell released the energy at lower energies. The tungsten anode rotates at 3000 revolutions per minute to minimize overheating and convert any leftover energy into heat.

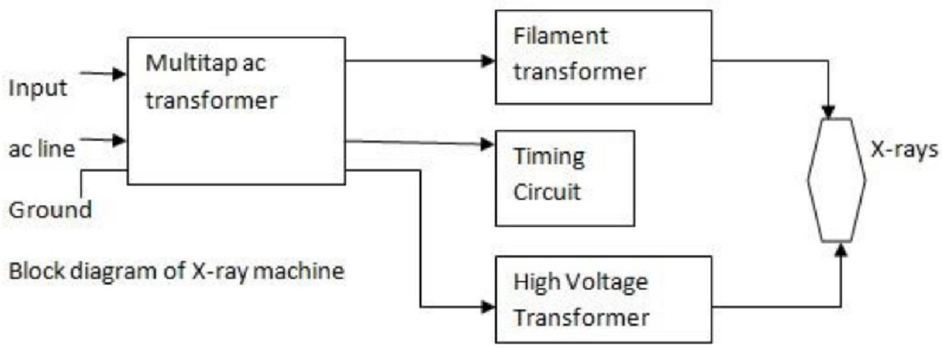

Fig. 9. Block Diagrams of X-Ray

MRI SCAN:

M.R.I. is a method of non-invasive imaging that produces three-dimensional anatomical pictures. It is also employed in the diagnosis, monitoring, and detection of diseases. By using advanced technologies, M.R.I. is able to identify and stimulate protons that are present in living tissues and water. Strong magnetic fields require protons to use strong magnets to align the magnetic field, which is made possible by MRIs. In order to process this, a radiofrequency is sent through the patient's body to replicate spinning against the magnetic field's attraction and out of equilibrium. When the MRI sensors are turned off, energy is released, which canbe detected by the magnetic field. Around that moment, the protons realign with the magnetic field, converting energy based on the molecules' chemical makeup and the surrounding conditions. However, there is always a distinction among the different kinds of tissues depending on the characteristics of themagnetic elements, which can only be identified by a doctor.

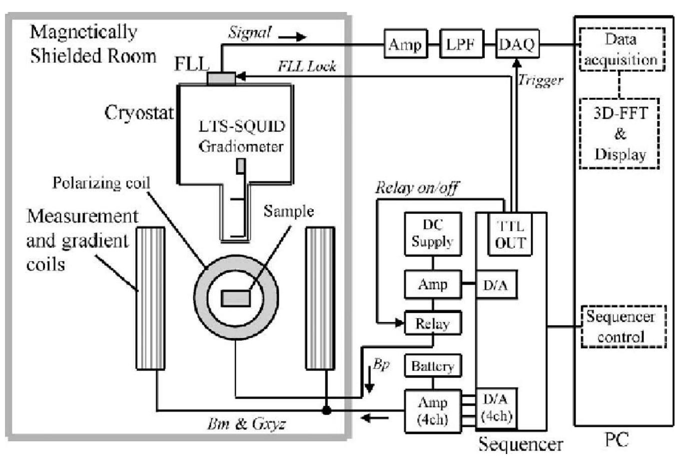

Fig.10.Block Diagram of MRI

The body's soft tissues and non-bony portions are captured by an MRI scanner. Differentiating Computed Tomography does not harm the ionizing exposure to x-rays. Compared to standard x-rays and CT scans, MRI scans provide a clearer image of the spinal cords, brains, and nerves as well as muscles, ligaments, and tendons. An MRI scans the image of injuries to the knees and shoulders. For the diagnosis of tumors and aneurysms, magnetic resonance imaging (MRI) is utilized to distinguish between white and gray matter. The M.R.I. is independent of the x-rays. For CT scanning and x-ray imaging, MRI is more economical. In particular, the structure of the brain is seen via Functional Magnetic Resonance Imaging (FMRI), which is used to determine which parts of the brain are more active during different kinds of cognitive tasks. With the help of this, we can improve the quality of MRI by assessing neurological risk and status and have a high chance of comprehending how the brain is organized.

CT SCAN:

Lung cancer cells are becoming more prevalent these days. C.T. scans image processing techniques sufficient in the breakdown in lung cancer cells to avoid this disease. By identifying benign from malignant tumors, Computed Tomography (CT) uses the Computer Aided identification (CAD) technology to aid in the early identification of lung cancer. Lung cancer comes in two varieties: non-small cell lung cancer and small cell lung cancer. These cancers can cause symptoms like shortness of breath, nausea, vomiting, loss of appetite, blood in the cough, and chest pain. We can see improvement rates of more than 15% to 50% if we can identify those diseases at an early stage. Furthermore, a greater rise in the survival rate than the existing levels is required. CT scans are recommended everywhere because they project a three-dimensional view of the lungs. The disease's death rate can be decreased by early discovery and treatment. Early identification had a critical role in preventing the cancer cells and stopping their spread. Other methods, however, are inaccurate when it comes to lung cancer. When scanning, a CT scan can simultaneously show images of blood arteries and bone .This is less sensitive to movements made by the patient during an MRI. It is also accurate, painless, and non-invasive. Additionally, the patient's body does not retain any radiation during the CT scan. These are the main benefits of CT scans.

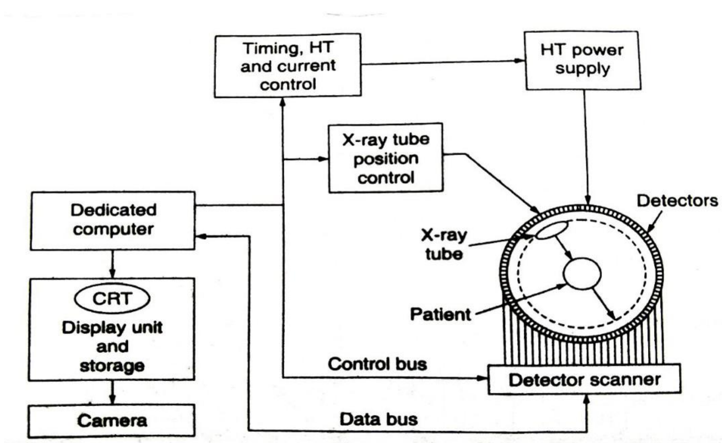

Fig.11. Block Diagram of CT Scan

FINGERPRINT SCANNING:

When CY and Yu Cc published a study on fingerprint pattern restoration using DIP (Digital Image processing) on September 1st, 2003. These days, fingerprints are the most valuable tool for solving criminal cases; yet, the procedure is complicated by incomplete or inaccurate fingerprint patterns. Image processing has a direct impact on forensic science in recent decades. This work aims to conceal the new digital image restoration methods that preserve faulty fingerprint patterns entirely through reaction-diffusion techniques based on FM (frequency modulation) and AM (amplitude modulation). We were able to apply this strategy to increase the recognition process's fingerprint pattern. In this manner, fingerprint patterns mostly function with DIP(Digital image processing) assistance

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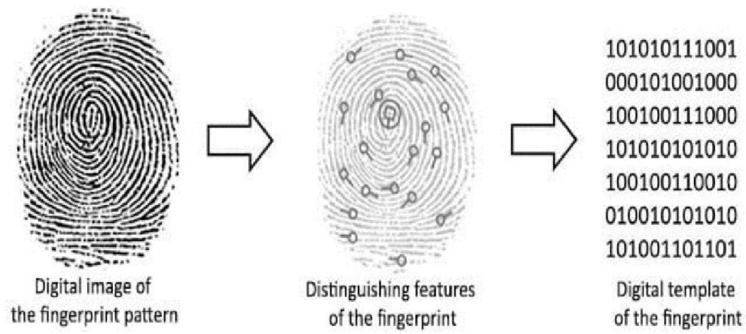

Fig.12. Working of Fingerprint Scanner

FACE SCANING:

This work was published in 2020 at the 2nd International Conference on Innovative Mechanisms for Industry Application (ICIMIA). These days, DIP (Digital Image Processing) plays a big part in facial identification. Face is an essential sign in the case of an individual. Since uniqueness makes people unique, face recognition technology aids in the facial identification of any individual. The entire facial recognition procedure was divided

into two phases. First, face detection is carried out, with the exception of situations in which the object is located far away. Face recognition is carried out in the second section. Following that, the entire process was redone to support the biometric technology face recognition model. Eigen face and Fisher faces methods are the two types of approaches used in the face recognition process. Principal Component Analysis, or PCA, is utilized in the Eigen face approach to minimize face dimensional space.

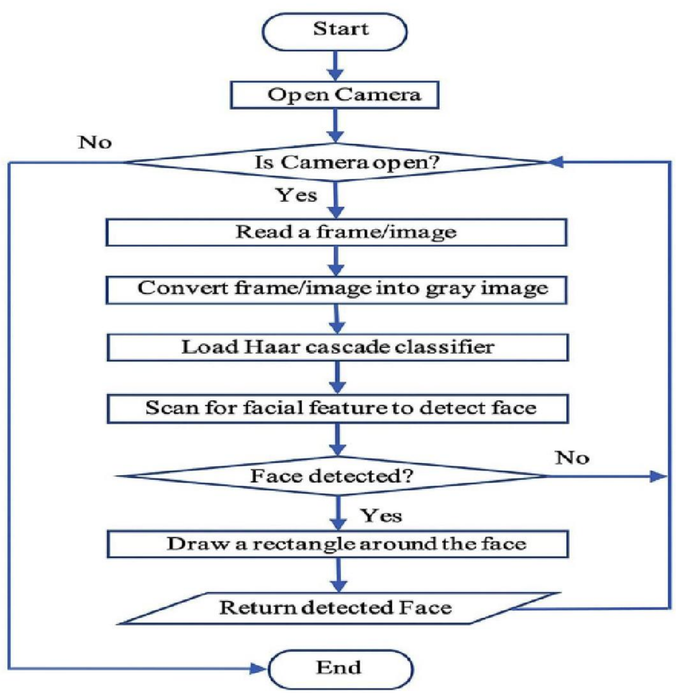

Fig.13. Flowchart of Face Detection

IRIS SCANNING:

Since it provides authenticity, iris recognition is crucial to security. Numerous scientists proposed novel iris recognition methods that improve system performance. Due to a number of problems, including its high production costs, lengthy processing times, and low recognition rates, this system is still not commonly employed. However, these problems will be resolved with the adoption of integrated circuit technology. The 2nd International Conference on Innovative Mechanisms for Industry Application (ICIMIA) hosted the publication of this paper in 2020. These days, facial recognition relies heavily on DIP (Digital Image Processing) .The face is a crucial indicator when it comes to a person. Face recognition technology helps withfacial identification of any individual because individuality is what makes people unique. There were two stages to the entire facial recognition process. Except for circumstances where the object is located far away, facial detection is done first. In the second stage, face recognition is implemented. After that, the entire procedure was modified to accommodate the facial recognition model of biometric technology. The two types of methodologies utilized in the face recognition process are Eigen face and Fisher faces methods. It may move forward in a few steps. The system first recognizes the inner and outer limits of the iris, then it looks for subroutines and excludes the eyelids and eyelashes. It can be used in a plethora of sectors, such as banking. Combined The iris recognition system was initially implemented in an ATM by Texas Bank. The Indian government implemented the Iris Pattern for the Aadhar Program.

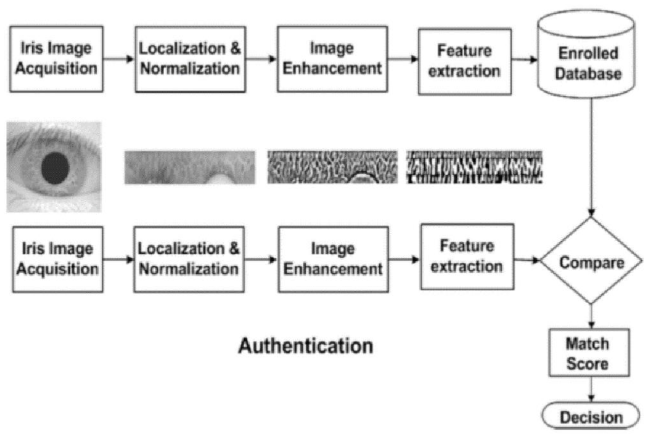

Fig.14. Block diagram of Iris Recognition

IV. CHALLENGES

Image processing issues in biomedical security often ensure the availability, confidentiality, and integrity of sensitive medical images while protecting patient privacy from unwanted access. Access control, secure storage, encryption, and transport are all necessary for protecting sensitive data.

In the field of biomedical image processing, challenges such as "enhancing image quality," "reducing noise," "computational complexity," and "standardizing imaging formats" are encountered.

Biometric security presents a wide range of complex issues for morally sound identity and verification. A few topics it addresses are "noise and distortions," "ethical and legal issues," "template security," "obstacles to partial occlusion," and "privacy concerns," among others. Because of these challenges, it is imperative to fully understand the ethical and legal implications of biometric security.

V. FUTURE PROSPECTS

In biometric feature extraction and matching, the combination of deep learning techniques—convolutional neural networks (CNNs) and recurrent neural networks (RNNs) in particular—has demonstrated notable advances. Accuracy and security are increased when different biometric modalities—like face recognition, fingerprint scanning, iris recognition, etc.—are combined. Combining data from several modalities will be made possible in large part by image processing techniques. The development of strong anti-spoofing solutions to thwart presentation attacks and guarantee the security of biometric systems will require sophisticated image processing techniques. Real-time processing will become faster and more effective with the development of image processing algorithms and hardware, which is essential for applications requiring quick authentication. Medical imaging will continue to rely heavily on image processing to help with illness monitoring and diagnosis. Deep learning and computer vision advances will improve the

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precision and effectiveness of medical picture analysis. Algorithms for image processing will advance precision medicine by evaluating medical photos to customize treatment regimens according to unique patient attributes. When paired with other technologies, such as wearables, image processing will enable remote patient monitoring.. This can enhance overall healthcare management and help in the early diagnosis of health concerns. Image processing will be essential to the study of cellular and molecular biology in order to track cellular events, analyze microscopic images, and comprehend complicated biological structures. The area of neuro imaging will benefit from advances in image processing, which will deepen our understanding of neurological illnesses and aid in the development of brain-computer interfaces. The examination of high-throughput screening data for drug discovery will be facilitated by image processing tools, which will speed up the identification of possible medicinal molecules.

VI. CONCLUSION

We address image processing applications in biomedical and biometric security in this research. Image processing is used in security-related technologies such as face identification, fingerprint analysis, and iris recognition. It is essential for interpreting MRIs, CT scans, and X-rays in the medical industry.

Nevertheless, image processing has many uses outside of security. It is also widely used in many other domains, including virtual reality, biometrics, picture conversion, and visual content analysis.

The purpose of this work is to help scientists improve image processing methods for use in security and medicine. Sustained investigation is essential to tackle the diverse obstacles linked to image processing. Recent developments in image processing have also completely changed the medical industry in addition to improving the way electronic gadgets are used. This technology helps medical professionals in their effort to save lives while enabling law enforcement and the military to apprehend criminals with greater effectiveness.

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