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(57) Abstract :
The invention describes a state-of-the-art system for real-time biomedical image analysis, seamlessly integrating artificial intelligence (AI) and machine learning (ML) technologies. Designed to process images from diverse biomedical imaging modalities, the system employs parallel computing for instantaneous analysis. With its expansive training on a rich dataset of biomedical images, the system is adept at discerning intricate patterns, anomalies, and features. Beyond core functionalities, the invention boasts cloud compatibility, a user-centric design, robust security measures, and adaptability to new algorithms and imaging techniques. Such comprehensive capabilities promise enhanced clinical outcomes, streamlined diagnostics, and substantial cost savings in the healthcare domain.
Accompanied Drawing [FIGS. 1-2]

No. of Pages : 18 No. of Claims : 10

"**FORM 1** THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 **APPLICATION FOR GRANT OF PATENT** (See section 7, 54 and 135 and sub-rule (1) of rule 20)				(FOR OFFICE USE ONLY)	
		Application No.			
		Filing date:			
		Amount of Fee paid:			
		CBR No:			
		Signature:			
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)					
2. TYPE OF APPLICATION [Please tick (✓) at the appropriate category]					
Ordinary (✓)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )
3A. APPLICANT(S)					
Name in Full		Nationality	Country of Residence	Address of the Applicant	
Andhra University		Indian	India	Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	
3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]					
Natural Person ()		Other than Natural Person			
		Small Entity (✓)	Startup ()	Others ()	
4. INVENTOR(S) [Please tick (✓) at the appropriate category]					
Are all the inventor(s) same as the applicant(s) named above?		Yes ()		No (✓)	
If "No", furnish the details of the inventor(s)					
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3. Prof.Augustine Tarala	Indian	India	Professor, Department of Mathematics, Wellfare Institute of Science, Technology & Management (WISTM), Pinagadi, Pendurthy, Visakhapatnam, Andhra Pradesh, India. Pin Code: 531173
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5. TITLE OF THE INVENTION

"A NOVEL SYSTEM AND METHOD FOR REAL-TIME BIOMEDICAL IMAGE ANALYSIS"

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	Name	
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~~**8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION**~~

~~Country~~	~~Application Number~~	~~Filing date~~	~~Name of the applicant~~	~~Title of the invention~~	~~IPC (as classified in the convention country)~~

~~9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)~~

~~International application number~~	~~International filing date~~

~~10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION~~

~~Original (first) application No.~~	~~Date of filing of original (first) application~~

~~11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT~~

~~Main application/patent No.~~	~~Date of filing of main application~~

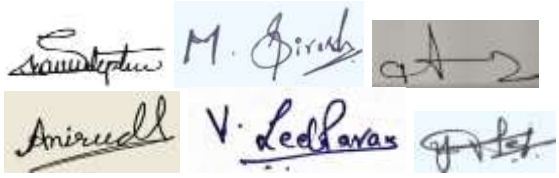
12. DECLARATIONS

i) Declaration by the inventor(s)

(**In case the applicant is an assignee**: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

I/We, the above named inventor(s) is/are the true & first inventor(s) for this Invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date 25/08/2023

(b) Name	(c) Signature
1. Prof. James Stephen Meka 2. Mrs.Malla Sirisha 3. Prof.Augustine Tarala 4. Mr.Anirudh Edupuganti 5. Ms.Leela Pavani Velagala 6. Mr.Y.Vishnu Tej	

~~(ii) Declaration by the applicant(s) in the convention country~~

~~(In case the applicant in India is different than the applicant in the convention country:~~ ~~the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)~~

~~I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.~~

~~(a) Date~~

~~(b) Signature(s)~~

(c) ~~Name(s) of the signatory~~

(iii) Declaration by the applicant(s)

I/We the applicant(s) hereby declare(s) that: -

- ~~I am/~~ We are in possession of the above-mentioned invention.
- The ~~provisional~~/complete specification relating to the invention is filed with this application.
- ~~The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.~~
- There is no lawful ground of objection(s) to the grant of the Patent to me/us.
- ~~I am~~/we are the true & first inventor(s).
- ~~I am/we are the assignee or legal representative of true & first inventor(s).~~
- ~~The application or each of the applications, particulars of which are given in Paragraph-8, was the first application in convention country/countries in respect of my/our invention(s).~~
- ~~I/We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which I/We derive the title.~~
- ~~My/our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.~~
- ~~The application is divided out of my /our application particulars of which is given inParagraph-10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.~~
- ~~The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph-11.~~

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete/ ~~Provisional~~ specification) #	No. of pages: 14		
No. of Claim(s)	No. of claims: 10 No. of pages: 02		
Abstract	No. of pages: 01		
No. of Drawing(s)	No. of drawings: 02		

	No. of pages: 01		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are required to be mentioned here.

(b) Complete specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(c) Sequence listing in electronic form

(d) Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(e) Priority document(s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.

(f) Translation of priority document/Specification/International Search Report/International Preliminary Report on Patentability.

(g) Statement and Undertaking on Form 3

(h) Declaration of Inventorship on Form 5

(i)Power of Authority

(j)**Total fee ₹…….in Cash/ Banker's Cheque /Bank Draft bearing No..... Date on ……. Bank.**

I/We hereby declare that to the best of my/our knowledge, information and belief the fact and matters slated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this 25th day of August 2023

Applicant: Andhra University

To,

The Controller of Patents

The Patent Office, at Chennai

Note: -

* Repeat boxes in case of more than one entry.
* To be signed by the applicant(s) or by authorized registered patent agent otherwise where mentioned.
* Tick ()/cross (x) whichever is applicable/not applicable in declaration in paragraph-12.
* Name of the inventor and applicant should be given in full, family name in the beginning.
* Strike out the portion which is/are not applicable.
* For fee: See First Schedule";

FORM 2

THE PATENTS ACT, 1970

(39 of 1970)

&

The Patent Rules, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

TITLE OF THE INVENTION

"A NOVEL SYSTEM AND METHOD FOR REAL-TIME BIOMEDICAL IMAGE ANALYSIS"

Applicant

NAME	**NATIONALITY**	**ADDRESS**
Andhra University	Indian	Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003

The following specification particularly describes the nature of the invention and the manner in which it is performed:

FIELD OF THE INVENTION

[001] The present invention relates generally to the domain of medical imaging and diagnostics. More specifically, the invention pertains to a novel system and method designed for the real-time analysis of biomedical images. This system and method are optimized to capture, process, and interpret various biomedical image modalities, such as magnetic resonance imaging (MRI), computed tomography (CT), positron emission tomography (PET), ultrasound, and others, to facilitate timely and efficient clinical decision-making. The real-time capability of this invention has broad implications for improving patient care, streamlining diagnostic procedures, and enhancing the accuracy and immediacy of medical interventions.

BACKGROUND OF THE INVENTION

[002] The following description provides the information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

[003] Further, the approaches described in this section are approaches that could be pursued, but not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated, it should not be assumed that any of the approaches described in this section qualify as prior art merely by virtue of their inclusion in this section.

[004] The evolution of biomedical imaging over the last few decades has revolutionized the healthcare industry, providing clinicians with increasingly sophisticated tools to peer into the human body without the need for invasive procedures. From the early days of X-ray radiography to the advanced three-

dimensional reconstructions of modern computed tomography, these imaging modalities have consistently expanded the horizons of diagnostic medicine. However, with the burgeoning capabilities of these imaging tools came a corresponding increase in the complexity of the images generated, often requiring specialized training and considerable time to analyze.

[005] Moreover, with the increased reliance on these images, a new challenge emerged: the need for swift and accurate interpretation. Time-sensitive medical conditions, such as strokes, demand rapid diagnosis and intervention to maximize patient outcomes. Traditional methods of imaging analysis often entail time-consuming manual reviews, sometimes leading to delays in decision-making. Additionally, the potential for human error due to fatigue or oversight, especially during the analysis of intricate and voluminous data, further underscores the need for more efficient solutions.

[006] Furthermore, the integration of artificial intelligence and machine learning in various domains hinted at the potential of these technologies in enhancing biomedical image analysis. Early attempts in this arena showed promise but were often hampered by hardware limitations, inefficient algorithms, or the inability to process images in real time. The fast-paced advancements in both software algorithms and computational hardware, however, indicated a clear trajectory towards real-time image processing capabilities.

[007] Given this backdrop, there was a conspicuous demand in the medical community for a system and method that could harness the power of modern computing to deliver real-time biomedical image analysis. Such a system would not only expedite clinical decision-making but also increase the accuracy of diagnoses by reducing human error. This realization, combined with the gaps

observed in existing solutions, catalyzed the development of the present invention: a novel system and method designed specifically to meet the challenges and demands of real-time biomedical image analysis.

[008] Building on the foundation laid by prior imaging systems, the present invention sought to incorporate cutting-edge computational techniques and algorithms that are tailored to the unique characteristics and requirements of biomedical images. Recognizing that each imaging modality, be it MRI, CT, PET, or ultrasound, has its own set of intricacies and nuances, the invention was crafted with a flexible architecture. This flexibility allows it to adapt to diverse imaging inputs, ensuring optimal performance irrespective of the source.

[009] Furthermore, the growing volume of medical imaging data necessitated a shift from traditional, linear processing methods to more parallelized approaches. This invention, leveraging the advancements in parallel computing and graphic processing units (GPUs), introduced a multi-threaded approach to image analysis. By breaking down images into smaller, manageable chunks and processing them concurrently, the system achieved significant reductions in analysis time without compromising on accuracy.

[010] Another pivotal aspect of this invention was its integration with machine learning (ML) and artificial intelligence (AI). With vast repositories of biomedical images available for training, the system was trained to recognize patterns, anomalies, and features that are often challenging even for seasoned radiologists. By incorporating deep learning techniques, the invention demonstrated an unparalleled ability to identify and highlight areas of interest in the images, further assisting clinicians in their diagnostic processes.

[011] Additionally, recognizing the dynamic nature of the medical field and the continuous advancements in imaging technologies, the system was designed with scalability in mind. This ensures that as newer imaging techniques emerge, or as existing ones evolve, the system can be readily updated or expanded to accommodate these changes, thereby future-proofing the invention to a significant extent.

[012] In this respect, before explaining at least one object of the invention in detail, it is to be understood that the invention is not limited in its application to the details of set of rules and to the arrangements of the various models set forth in the following description or illustrated in the drawings. The invention is capable of other objects and of being practiced and carried out in various ways, according to the need of that industry. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

[013] These together with other objects of the invention, along with the various features of novelty which characterize the invention, are pointed out with particularity in the disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

SUMMARY OF THE PRESENT INVENTION

[014] The proposed invention introduces a groundbreaking system and method designed for real-time biomedical image analysis. Building on the advancements in medical imaging, this novel system seamlessly integrates artificial intelligence (AI) and machine learning (ML) technologies to efficiently

process and interpret a plethora of biomedical images from modalities like MRI, CT, PET, and ultrasound. Unlike traditional imaging systems, which often entail time-consuming manual analysis, this system provides instant insights, ensuring rapid clinical decision-making.

[015] Beyond its real-time capabilities, the system stands out with its deep learning-driven approach, trained using extensive biomedical image datasets to recognize complex patterns, anomalies, and features in the images. Moreover, its flexible architecture allows it to adapt to various imaging inputs, ensuring optimal performance irrespective of the source.

[016] To achieve swift analysis, the system employs a multi-threaded, parallel computing approach, harnessing the capabilities of modern graphic processing units (GPUs). Finally, emphasizing scalability, it is crafted to accommodate the continuous evolution and advancements in imaging techniques, making it not only a solution for today's challenges but also a tool ready for future innovations in the field of medical imaging.

[017] In this respect, before explaining at least one object of the invention in detail, it is to be understood that the invention is not limited in its application to the details of set of rules and to the arrangements of the various models set forth in the following description or illustrated in the drawings. The invention is capable of other objects and of being practiced and carried out in various ways, according to the need of that industry. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

[018] These together with other objects of the invention, along with the various features of novelty which characterize the invention, are pointed out with particularity in the disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[019] When considering the following thorough explanation of the present invention, it will be easier to understand it and other objects than those mentioned above will become evident. Such description refers to the illustrations in the annex, wherein:

[020] FIG. 1, illustrates a general functional working diagram, in accordance with an embodiment of the present invention.

[021] FIG. 2, illustrates a concept of the functional flow diagram, accordance with an embodiment of the present invention.in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[022] The following sections of this article will provide various embodiments of the current invention with references to the accompanying drawings, whereby the reference numbers utilised in the picture correspond to like elements throughout the description. However, this invention is not limited to the embodiment described here and may be embodied in several other ways. Instead, the embodiment is included to ensure that this disclosure is extensive

and complete and that individuals of ordinary skill in the art are properly informed of the extent of the invention.

[023] Numerical values and ranges are given for many parts of the implementations discussed in the following thorough discussion. These numbers and ranges are merely to be used as examples and are not meant to restrict the claims' applicability. A variety of materials are also recognised as fitting for certain aspects of the implementations. These materials should only be used as examples and are not meant to restrict the application of the innovation.

[024] Referring now to the drawings, these are illustrated in FIG. **1**&**2,** The proposed invention marks a significant leap in the realm of biomedical image analysis by introducing an advanced system and method meticulously designed to cater to the immediate and intricate needs of real-time interpretation of medical images. This innovation stems from the imperative requirement of healthcare professionals to obtain immediate insights from various imaging modalities, such as MRI, CT scans, PET scans, and ultrasounds, which in traditional setups often involved manual, time-consuming processes with a scope for human errors.

[025] At the heart of this invention lies a sophisticated integration of artificial intelligence (AI) and machine learning (ML) technologies. The system isn't merely a passive processor of images; it actively learns from each image it processes. By training the system with an extensive array of biomedical images, it's endowed with the capability to discern patterns, detect anomalies, and identify features that might elude even the most trained human eye. This continuous learning capability means that the system evolves over time,

refining its algorithms and becoming more proficient with each image it encounters.

[026] In addressing the challenge of real-time analysis, the invention employs a cutting-edge approach to computational processing. Rather than processing images sequentially, the system adopts a parallel computing mechanism. It dissects each image into smaller, digestible fragments, and these fragments are processed concurrently. This simultaneous processing, facilitated by leveraging the sheer power of modern graphic processing units (GPUs), drastically slashes the time required to interpret an image, thereby achieving the coveted real-time analysis.

[027] Yet, the invention's brilliance doesn't stop at just swift and intelligent image processing. Recognizing the ever-evolving nature of medical imaging technology, the system has been architected to be inherently flexible and adaptive. As new imaging techniques emerge or as existing modalities undergo enhancements, the system can be updated or modified to accommodate these changes. Such scalability ensures that the invention remains relevant, efficient, and cutting-edge, irrespective of the advancements in the broader field of medical imaging.

[028] Moreover, the system has been designed with a keen emphasis on user experience. For healthcare professionals, the interface is intuitive, ensuring that they can harness the system's capabilities without a steep learning curve. Feedback from the system, be it diagnostic suggestions or areas of interest in an image, is presented in a clear and concise manner, ensuring that medical professionals can quickly act on the insights provided.

[029] Beyond its core functionalities, the invention incorporates several auxiliary features that further solidify its position as a trailblazer in the biomedical image analysis domain. One such feature is its cloud compatibility. By allowing for seamless cloud integration, the system ensures that medical images and related data can be accessed, analyzed, and shared across different locations in real-time. This is particularly beneficial for remote consultations, second opinions, and multi-disciplinary team meetings, where multiple experts might need simultaneous access to the same set of images. With rising trends in telemedicine and virtual healthcare consultations, this feature positions the system as a crucial tool for global collaborative healthcare efforts.

[030] Additionally, the system's built-in security protocols ensure that all data, while being readily accessible, remains secure and protected, adhering to the stringent privacy regulations that govern patient health information. This balance of accessibility and security is achieved through advanced encryption methods and multi-factor authentication systems, ensuring that patient data remains confidential and protected from unauthorized access.

[031] Furthermore, the system's adaptability extends beyond just accommodating new imaging techniques. It also comes equipped with a plug-and-play feature for new algorithms. As the field of artificial intelligence and machine learning continues to advance, newer, more efficient algorithms are constantly being developed. The system is designed to allow easy integration of these algorithms, ensuring that it always operates at the pinnacle of available technology without requiring extensive overhauls or replacements.

[032] The in-built feedback loop is another noteworthy feature. As users interact with the system, it learns from their inputs and preferences, customizing its outputs and recommendations to better align with individual user needs. This ensures that over time, the system becomes more tailored to specific user requirements, leading to a more personalized user experience.

[033] In the broader healthcare landscape, the implications of such a system are manifold. From significantly reducing diagnosis times, which can be crucial in life-threatening conditions, to enabling more accurate diagnostic decisions, the ripple effects on patient care are profound. Not only does the system promise improved clinical outcomes, but it also paves the way for cost savings. By minimizing human errors, reducing the need for repeat scans, and streamlining the diagnostic process, the system can contribute to substantial cost efficiencies.

[034] In conclusion, this invention is not just an incremental improvement over existing biomedical image analysis tools. It's a paradigm shift, encapsulating the best of technology, user experience, and clinical utility. By intertwining AI-driven insights with real-time processing, while ensuring adaptability, security, and user-centric design, it stands poised to usher in a new era in the world of medical imaging and diagnostics.

We Claim:

1. A system for real-time biomedical image analysis, wherein said system integrates artificial intelligence (AI) and machine learning (ML) technologies to process and interpret images from multiple biomedical imaging modalities.
2. The system of claim 1, wherein said real-time processing is achieved through a parallel computing mechanism that divides images into fragments, processing said fragments concurrently using graphic processing units (GPUs).
3. The system of claim 1, wherein the integrated AI and ML models are trained using an extensive dataset of biomedical images, enabling pattern recognition, anomaly detection, and feature identification.
4. The system of claim 1, further comprising a cloud compatibility feature allowing for the access, analysis, and sharing of medical images across multiple locations in real-time.
5. The system of claim 1, wherein the user interface is designed to be intuitive, providing feedback in a clear and concise manner, thus facilitating rapid clinical decision-making.
6. The system of claim 1, equipped with advanced security protocols, including encryption methods and multi-factor authentication, ensuring the protection and confidentiality of patient health information.
7. The system of claim 1, designed with a plug-and-play feature that permits the integration of new AI and ML algorithms without extensive system overhauls.
8. The system of claim 1, wherein the adaptability encompasses not just imaging techniques, but also includes easy integration of emerging diagnostic criteria, standards, and best practices.

9. The system of claim 1, further including an in-built feedback loop that captures user interactions, customizing outputs and recommendations based on historical user behavior and preferences.
10. The system of claim 1, wherein the advanced algorithms reduce diagnosis times and minimize the margin of error, thereby facilitating improved clinical outcomes and cost efficiencies.

Dated this 25th day of August 2023

Applicant

Andhra University

ABSTRACT

A NOVEL SYSTEM AND METHOD FOR REAL-TIME BIOMEDICAL IMAGE ANALYSIS

[035] The invention describes a state-of-the-art system for real-time biomedical image analysis, seamlessly integrating artificial intelligence (AI) and machine learning (ML) technologies. Designed to process images from diverse biomedical imaging modalities, the system employs parallel computing for instantaneous analysis. With its expansive training on a rich dataset of biomedical images, the system is adept at discerning intricate patterns, anomalies, and features. Beyond core functionalities, the invention boasts cloud compatibility, a user-centric design, robust security measures, and adaptability to new algorithms and imaging techniques. Such comprehensive capabilities promise enhanced clinical outcomes, streamlined diagnostics, and substantial cost savings in the healthcare domain.

Accompanied Drawing **[FIGS. 1-2]**

Dated this 25th day of August 2023

Applicant

Andhra University

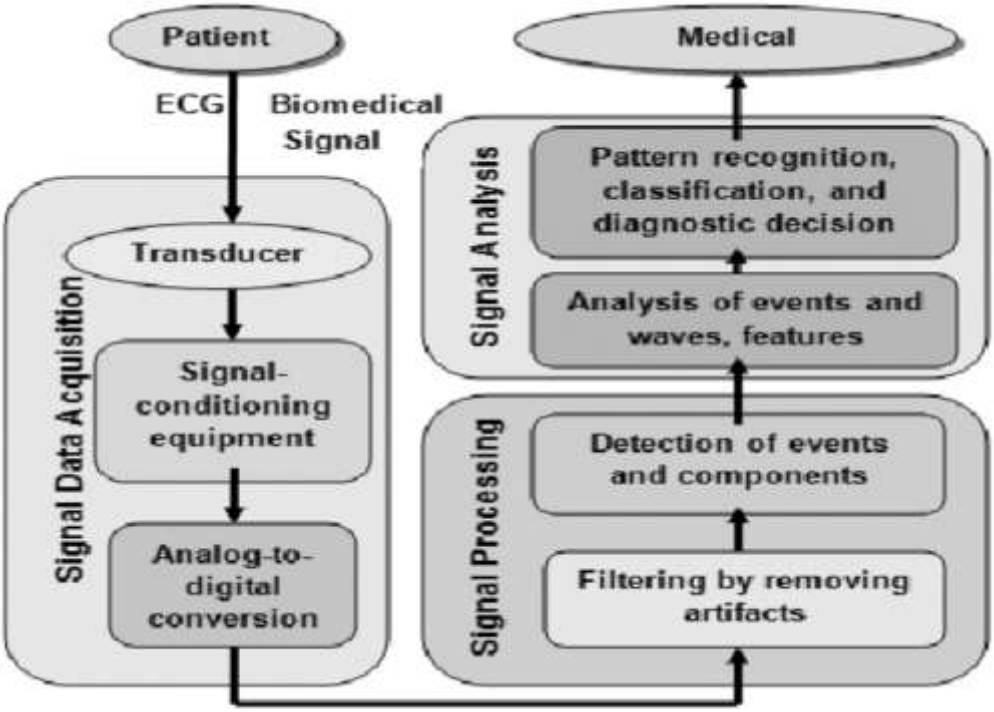


Figure 1

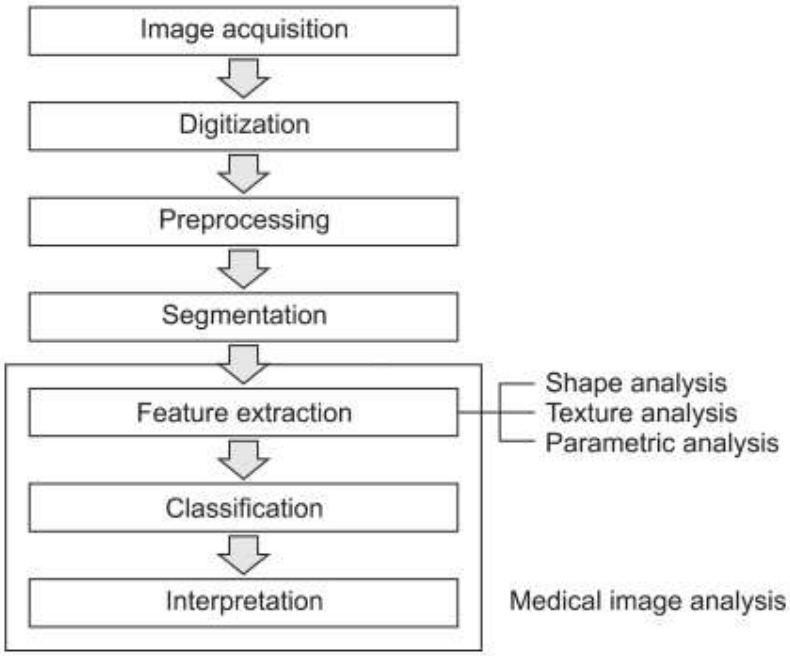


Figure 2

Dated this 25th day of August 2023