Enhancing The Efficiency Of Medical Imaging Diagnosis By Leveraging The Computer Vision In Conjunction With The Deep Learning Approach

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ABSTRACT

Typically, medical specialists examine how medical data is interpreted. Subjectivity and visual complexity limit the ability of a medical expert to comprehend images. The goal of this research is to determine whether using computer vision in medical imaging will be harmful to patients and what kind of obstacles we will have to overcome in order to use computer vision in healthcare, particularly medical imaging. This study aims to determine how well deep learning algorithms perform in disease classification based on medical imaging when compared to health-care professionals. Our approach in this study is a methodical review of the computer vision literature. The key to helping doctors maximize diagnosis accuracy in computer vision for medical imaging is the deep learning approach; it is safe and harmless to utilize to support medical imaging diagnosis.

INTRODUCTION

Strong algorithm development is becoming more and more common for automated examination of digital medical images. The term "medical imaging" describes procedures and methods used to produce images of the human body for therapeutic purposes, as well as operations meant to identify, diagnose, or analyze disease and research into normal anatomy and physiology. In clinical practice, fast imaging methods such as magnetic resonance imaging (MRI) and computed tomography (CT) enable the acquisition of picture series, slices, or real volume data. Medical imaging has advanced from the first x-rays to the most recent MRI. The application of computer vision techniques in medical imaging has grown significantly as progress has been made [1].

MRI becomes a potent and essential technique for non-invasive exams since it may provide structural and functional information about biological tissue without interfering with the physiology of the organ system. Certain features are enhanced by several spectral channels, and multiple echo collecting enables improved distinction of various tissue types and anatomically functional units.

The ability of the human visual system to comprehend our natural surroundings is incredibly complex and takes a lot of practice, despite its high efficiency. Qualified physicists can visually analyze 2D and basic 3D phenomena by analyzing sets of slices. graphical evaluation or just On the other hand, in complex situations where both quantitative and qualitative outputs are required, interactive procedures may quickly surpass realistic time constraints, requiring automated solutions to assist them. Computer vision, which offers methods for analyzing complex 3D data and transforming it into representations suitable for human visual perception and cognitive processes, seems to be a good fit for this problem [1].

It has been demonstrated that the application of computer vision techniques to surgery and the treatment of different diseases is very beneficial. While digital photos can be processed quickly using simple image processing techniques,

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computer vision techniques that work well can yield a wealth of information for diagnosis and treatment. The intricacy of handling the images has made it difficult to employ computer vision to process medical images [2].

Computer vision uses deep learning technology, which is a new trend in data processing generally and has been named one of the top ten breakthrough technologies of the year.

Deep learning is a kind of artificial neural network that can predict data more accurately and at higher abstraction levels because to its several layers. In the field of computer vision, it is currently the most widely used machine learning technology to help with the interpretation of medical imaging [3].

After that, the doctor's diagnosis is made more accurately by using a Computer-Aided Diagnosis (CAD) system. CAD analyzes imaging data using a deep learning computer vision algorithm to diagnose the patient's condition, which can then be utilized to inform medical decisions. But is it really that important? The importance of computer vision in medical imaging and how it might improve healthcare will be covered in more detail in this study [4].

METHODOLOGY

The authors use item screening and inclusion criteria with the PRISMA flow diagram, shown in Fig. 1, to create a systematic literature review. The records that were available were examined independently by the writers. They gathered to discuss and present the results of their individual research at the conclusion of each round. After resolving disagreements and controversies, the writers decided on a list of tracks that will advance to the next phase.

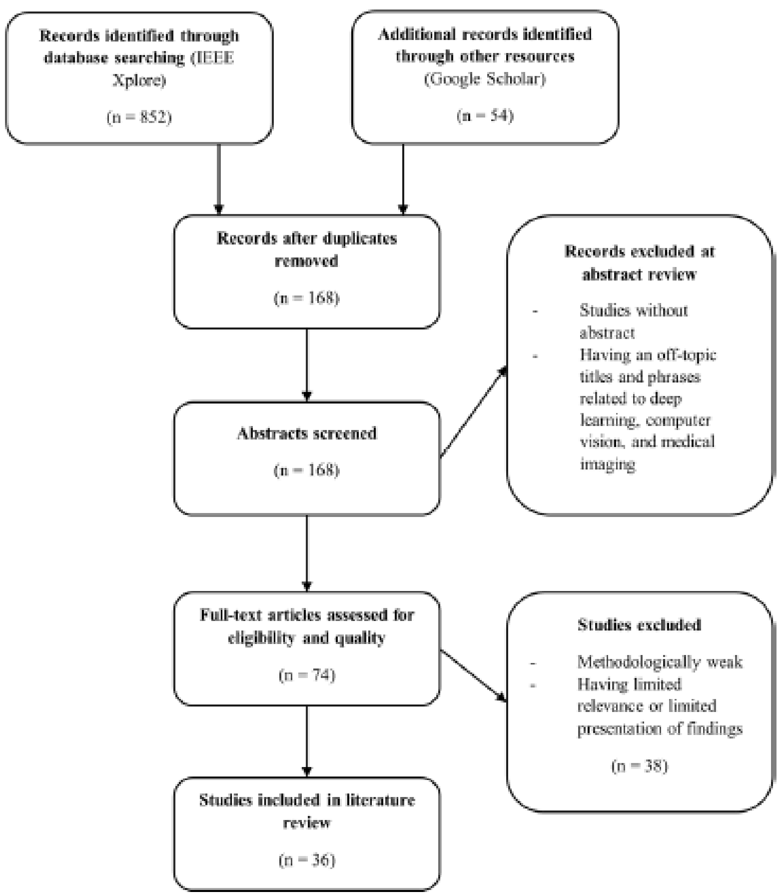

Figure 1: PRISMA flow diagram for the review of literature

Between January 2016 and May 2021, the writers used Google Scholar, IEEE Xplore, and other databases to perform a systematic search for pertinent literature. Healthcare, computer vision, deep learning, and medical imaging are the keywords that were utilized in the search. We kept our eyes on the goal of our study, "Is the use of computer vision in medical imaging harmful to people?" as we went through the records. What are computer vision's applications and difficulties in the medical field, particularly in medical imaging? After obtaining 168 papers that were relevant to our research themes, the authors thoroughly examined the abstracts, titles, and keywords of each paper.

Four exclusion criteria served as a guide for the analysis of these records: First of all (1) Papers lacking a medical imaging technique were eliminated; (2) papers lacking an abstract were removed from further screening due to unavailability; (3) items with titles and phrases unrelated to deep learning and computer vision in the healthcare industry were deleted; and (4) records that did not address the difficulties or success rate of using deep learning to detect diseases were also removed. After reading the abstracts, 74 publications are considered candidates, while 38 papers—as indicated in Table 1—were determined to be incompatible with the goals of the study and were removed from our database after thorough readings and consideration of exclusion criteria. As a result, our literature review included 36 records.

RESULTS

The world has rapidly moved from the analog to the digital and post-digital eras in recent years.

Nevertheless, little is known about how industry 4.0 will affect a company's capacity to satisfy consumer expectations and improve quality standards, especially for industries like healthcare that are impacted by the evolving digital era. To fully implement Industry 4.0, the governance method still needs to be developed and implemented [5].

A. Imaging in Medicine

A range of techniques known as medical imaging are employed to see a person's body in order to make a diagnosis. The CT scan, MRI (Magnetic Resonance Imaging), ultrasound, x-rays, and endoscopy are a few types of medical imaging.

Through the use of computers, medical image processing makes it possible to extract information from images that would not otherwise be possible. The two main jobs that require standard processing workflow are the focus of image processing techniques: (1) Segmentation and (2) Extraction of features [6].

Medical imaging requires segmentation, which is a time-consuming manual process that professionals can complete with great precision. The work of manually interpreting and analyzing data has grown difficult. Due to inexperience or weariness, radiologists can make incorrect diagnoses, which can lead to a variety of problems, including false negative results, benign cancer that is mistaken for malignant cancer, and many more. Data suggest that between 10 and 30 percent of medical image processing errors are due to human error [7]. However, methods that are both extremely precise and automatic are still lacking [8].

TABLE I. SELECTED PAPER DETAILS

Source	Studies		
	Studies Found (no duplication)	*Candidate Studies*	*Selected Studies*
IEEE Xplore	114	34	9
Google Scholar	54	40	27
Total	168	74	36

The application of imaging should improve an organization's capacity to deliver effective and high-quality care, both conceptually and empirically. [9] Advanced imaging provides better image quality and detail faster, especially with regard to newer technologies like CT scanning.

More accurate and timely results will lead to earlier treatment initiation and a reduction in needless treatment. The way physicians evaluate, diagnose, and track illness has evolved as a result of medical imaging [10].

B. Image Processing

One of the areas of AI research that is growing the fastest is computer vision (CV), whose major goal is to use computers to replicate human learning and vision in addition to having the ability to draw conclusions and carry out operations based on visual data [11]. This technique relies on the identification of objects by computer senses and algorithms that enable computers to recognize what they view [12]. The relationship between CV and image processing is crucial for comprehending or analyzing images [8].

Computer vision has been applied extensively in the medical field. Every day, this technology may recognize our bodies or even detect mild illnesses [13, 14, 15,].

Examples include the ability to diagnose diseases using only a face image [19], detect the presence or absence of cancer in the tissue of the colon and lungs [18], detect the movement of adult patients in the ICU [16], do MRIs [17], mammograms and digital breast tomosynthesis [4], and more Using computer vision techniques, photographs of the patient's conjunctiva are captured and analyzed to determine blood parameters.

The canny edge detection approach with morphological methods is the mechanism used in the CIELAB color space [20]. Another method utilizing computer vision techniques is employed to detect vaginal epithelial secretions. The study uses dual process and nucleus-cytoplasm cross-verification techniques to help with the diagnosis.[21] Conversely, endoscopy, PET, and computed tomography (CT) are among the computer vision-based image processing methods that are employed to analyze oesophageal image data [22].

C. In-Depth Education

Deep learning is one of the CV strategies that is most dependent on it. It is a neural network-based method as well. Convolutional neural networks (CNNs) are among the most representative deep learning techniques. CNNs are also used by Region CNNs (RCNNs) to perform object classification and localization in images. The CNN and RCNN algorithms are used for unique picture categorization and object detection systems. CNNs are used for image classification, which is a technique for separating images based on their semantics. Object detection, on the other hand, combines image classification with object localization to determine the type of specific object in an image [8]. RCNN algorithms for object detection are made more concrete and complex than CNNs. Specific application-level requirements in the field of medical technology are met by both methods. [11].

Using a computer-aided diagnosis (CAD) to diagnose patients may reduce the average reading time by almost 50% [4]. A substantial portion of the architecture used in the healthcare industry is built on convolutional neural networks (CNN). According to the study, CNN processes lung cancer diagnoses more quickly than DNN (Deep Neural Network) and SAE (Stacked Auto Encoder). In this instance, 3D images will speed up CNN's diagnosis processing [23]. The number of techniques used to improve the accuracy of disease diagnosis is growing daily. The four phases of the CAD system in medical analysis are as follows: (1) pre-processing of the picture; (2) segmentation of the image; (3) extraction and selection of features; and (4) classification [7]. In computer-aided diagnosis, or CAD, picture segmentation is one of the most crucial components, and the algorithm itself is one of the most important and fundamental elements of image processing. Naturally, the speed of analysis will also vary depending on whether 2D or 3D images are used [3]. Numerous empirical instances of applying deep learning algorithms to disease identification exist (Table II). Tested diseases have been diagnosed with more than 80% accuracy. Still, how we select the deep learning model will determine the outcome. Since there are always new diseases to discover, the deep learning algorithm is constantly improving.

TABLE II: RELIABILITY OF DEEP LEARNING ALGORITHM IN DIAGNOSIS

Authors	Year	Imaging Modality	Diagnosis	Deep Learning Model	Accuracy (in percent)
Akiyama, Y., Mikami, T., & Mikuni, N. [24]	2020	MRI	Moyamoya	VGG16	92.8%
Al-Bander, *et al.* [25]	2017	Fundus Imaging	Glaucoma	CNN	88.2%
C.-F. Liu, *et al* [26]	2019	MRI	Alzheimer	Siamese Neural Network	92%
Mesrabadi, H. A., & Faez, K. [27]	2018	MRI	Prostate Cancer	AlexNet	86.3%
Nobrega, *et al* [28]	2018	CT	Lung Cancer	CNN-ResNet50	88.41%
Racic, *et al* [29]	2021	X-ray	Pneumonia	CNN	90%
Srivastava, *et al.* [30]	2019	Endoscopy	Environmental Enteropathy	CNN	96.7%
Tummala, S. [31]	2021	MRI	Autism	Siamese Neural Network	99%
Wang, *et al.* [32]	2021	CT-Scan	COVID-19	Modified Inception	85.2%
Wang, J. *et al.* [33]	2017	MMG	Coronary Artery Diseases	CNN	96.24%

D. Computer Vision's Challenge in Medical Image Analysis

Despite their outstanding efficiency, the deployed computer vision algorithms nevertheless face difficulties and constraints when it comes to analyzing medical images [23]. This is a list of difficulties that our referrals provided.

1) Deep Learning's Instability in Image Reconstruction A CT scan is an example of an image reconstruction, which is a pre-processing step that recreates an item from its projection. When deep learning is applied to picture reconstruction, unstable techniques may be produced. This instability typically manifests itself in a variety of ways. They first show up as a small disturbance in the image or domain sampling that hardly gets noticed and causes the image to deviate significantly from its intended state.

Second, there are numerous ways whereby structural changes cannot be recovered. One example would be the whole removal of detail, which would soften the distortion and hide the visual feature. The last is that an excessive number of samples could degrade the image's quality. This means that in order to identify every pattern of particular subsampling, ratio subsampling, and which dimension will be used, hundreds of networks must be trained [34].

2) Lack of Data Volume: Millions of data are required for computer vision, particularly deep learning, to be taught in order to achieve high accuracy. The previous 30 years have seen the use of several algorithms, including Dempster-Shafer theory, fuzzy systems, rough classification, Monte Carlo simulation, and Bayesian inference [34]. However, not everyone in the medical industry has a health issue, and not everyone requires a medical imaging test like an MRI or CT scan. As a result, there aren't many patients that deep learning can use as training data. Apart from that, the disease's unpredictability makes understanding it difficult [35].

3) Temporality: Disease always develops in tandem with time. Many new diseases have emerged in uncertain times. Because deep learning is unable to manage this level of ambiguity, a novel disease must be discovered and taught to the computer from the beginning in order for it to comprehend it. Because computer vision employs an algorithm to diagnose the disease, this problem still has to be solved so that we don't have to wait for so long [35].

4) Radiation in Medical Imaging: We must consider how to use this technology and whether using the radiation from MRIs and X-rays is safe if we want to try using it on a daily basis [36]. According to the study, radiation has a negligible potential to hasten diseases like cancer in our bodies [37]. Although many people are already aware of this, we nevertheless use radiation to check for illnesses or other damage to our bodies because, in most cases, the effects of radiation are so slight that they may not even be possible. But utilizing it frequently is a different issue and could be harmful to us.

DISCUSSION

The goal of this study is to determine whether using computer vision in medical imaging will be harmful to patients and what effects and difficulties might arise from doing so. Computer vision is being used extensively in healthcare, particularly in medical imaging. At the beginning of our investigation, we made the hypothesis that computer vision could be useful in healthcare but that there would also be certain hazards. Our results show that applying these algorithms to medical imaging yields very fast and accurate results, making it very helpful for supporting medical staff.

Our visual system is very good at interpreting our environment, but medical imaging is a specialized field that requires a lot of practice. Based on the results, we found that medical imaging has a higher accuracy than usual, which makes it better to use for determining the cause of a patient's disease. Accurate research tools that are suitable for the complex multiple information contained in the data are therefore necessary in order to adapt to the current progress in data processing. We may already conclude from this experiment that medical imaging is useful for determining a disease's origin because it has been demonstrated in earlier research on the subject. The only drawbacks to medical imaging are the fact that the machine needs to learn a lot of data and that we are unsure of the precise negative effects, which could occur if we use it excessively. There will be a significant increase in data because a new disease will occasionally surface.

CONCLUSION

Deep learning techniques in computer vision are very useful in the health sector notably for medical imaging diagnosis. Based on our research, the usage of these algorithms has extremely accurate and rapid results for medical imaging, in fact, it is quite helpful for medical staff in diagnosing diseases. The application of deep learning to support physicians shows no signs of danger. The only things that can be harmful are radiation-emitting medical imaging systems like CT Scan. Even so, there are still drawbacks and difficulties with the developed deep learning algorithms when it comes to analyzing medical images. For example, fluctuations in deep learning image reconstruction, insufficient data volume, and the occasional emergence of new diseases. So, deep learning algorithms must be upgraded every time.

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