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INTEGRATION OF AI IN MEDICAL DIAGNOSIS AND TREATMENT

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ABSTRACT

Artificial intelligence has grown considerably in recent years. Digital AI models can create almost life-like videos and images and solve complex problems and prompts, and a new application of AI in medical diagnosis and treatment is being used for patients. AI can use patients' information and tests such as MRI and CT scans to make an accurate conclusion and diagnosis of the patient, which may be more efficient and precise than being diagnosed by a doctor. To make AI models that are capable of analyzing complex images and diseases, we use machine learning and deep learning, which is how AI can be made to be able to process information through pattern recognition. Through this study, it was found that the increasing use of artificial intelligence holds much promise for improving the medical industry and patients' health.

KEYWORDS: Artificial Intelligence, Diagnosis, MRI, CT Scans, Deep Learning, CNN, Cancer, Neural Networks

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Thesis: The application of AI in medical fields, such as diagnosing and treating patients, will further develop and improve the medical industry.

INTRODUCTION

CT and MRI scans create digital images of the patient's body, which doctors use. CT images are 2D images made through a process called reconstruction, which combines X-ray imaging through different angles to create a cross-sectional image and capture the specific structure the doctors are looking for. Since CT images are 2D, the pixels in the image determine certain information, such as thickness, contrast, and details of the body part (LaGratta, 2022). On the other hand, MRI uses a magnet to create a magnetic field, which causes atoms in your body to align in the same direction as the magnetic field. Then, the MRI machine sends radio waves, which cause the atoms to move out of position. The radio waves stop, and the atoms return to their original positions, returning radio signals. The radio signals are received by the computer, which converts the signals into an image on the screen, which can then be examined using *Magnetic Resonance Imaging* (MRI).

The image can be put into an artificial intelligence model and can determine the patient's diagnosis. There are two ways that AI can analyze the image. The first way uses machine learning, which needs a region of interest (ROI) to be determined from an outside source and then identifies features such as volume, shape, size, intensity, and location to conclude. Although CT and MRI images usually have multiple regions of interest, using machine learning models is less efficient than deep learning, which, unlike machine learning, does not require a region of interest to be determined and can be given the entire image to analyze. It uses layers of classification, which is called the neural network, and each layer gets more specific until a clear conclusion is reached. Deep learning is especially good for CT and MRI scans because of RAGCN (Region Aggregation Graph Convolutional Network), which can segment the image into different sections and analyze each ROI separately without any human intervention. Although deep learning may be better for images with more than one ROI, both methods are viable and will increase work efficiency and accuracy in the field of radiology.

METHODOLOGY

This study employs a mixed-method approach, utilizing both qualitative and quantitative secondary data to explore the integration of artificial intelligence (AI) in medical diagnosis and treatment. The quantitative analysis draws from existing datasets, including studies on the accuracy of AI models in diagnosing various types of cancers and other medical conditions. Qualitative data is gathered from a comprehensive review of literature discussing the application of AI in healthcare, including its potential benefits, limitations, and ethical considerations.

This approach is justified as it allows for a thorough examination of AI's impact on healthcare, combining measurable outcomes with in-depth

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analysis of the challenges and opportunities presented by AI technology. While the study relies on secondary data, which may have limitations such as varying methodologies and data collection techniques, the mixed-method approach provides a balanced perspective, enabling a deeper understanding of how AI is reshaping medical practices.

RESULTS & DISCUSSION

Approximately 340,000 Americans die from misdiagnoses each year, and diagnostic errors by radiologists are a contributing factor to these deaths. Heavy workloads and understaffed work environments make it difficult for radiologists to ensure accurate diagnoses and provide patients with the best quality of care. To counter this, early developments in AI are being implemented to diagnose diseases and cancers more effectively.

For instance, gastric cancer is the fifth most common cancer, with one million new cases and 780,000 deaths annually (Chen, 2022). The stage at which cancer is diagnosed can greatly influence its survivability. However, early diagnosis is challenging due to its similarity to inflammatory lesions; here, AI has helped address this issue. Hirasawa et al. (2018) developed a deep learning model using a convolutional neural network (CNN) and trained it with 13,584 images. They then tested it with 2,296 gastric cancer images from 69 patients. The AI model successfully diagnosed 77 gastric cancer tumors in just 42 seconds, demonstrating its potential to improve diagnostic speed and accuracy.

Similarly, AI has been applied to liver cancer diagnosis. Nishida et al. (2022) created three AI models using datasets comprising 24,675 images, 57,147 images, and 70,950 images of hepatocellular carcinoma (HCC), metastatic tumors, hemangiomas, and cysts. The aim was to evaluate their effectiveness in accurately identifying lesions compared to human physicians. The AI models and a group of five specialized physicians, along with three non-specialized physicians, were given 55 video images from 55 different patients. They were tasked with identifying the type of lesion present. The median accuracy of the AI models for the four lesion types was 80%, 81.8%, and 89.1%, respectively. In contrast, the five specialized physicians achieved a median accuracy of 67.3%, while the non-specialized physicians achieved 47.3%. The performance of the AI models surpassed that of human physicians, highlighting AI's potential to reduce human error in diagnosis (Nishida, 2022).

One limitation of AI models is their difficulty in accurately identifying rare types of tumors and lesions. AI models require extensive training images for their neural networks, especially for diagnosing lesions with significant variation. Rare tumors, which have few cases and limited images, pose a challenge for AI models. For example, intrahepatic cholangiocarcinoma (ICC) accounts for only about 3–5% of primary liver cancer cases. The AI model, with limited training images, achieved a 71.5% accuracy rate for diagnosing ICC tumors, which is lower than its performance with other lesions (Nishida, 2022). Although artificial intelligence has made significant progress, further investment is necessary to develop models with higher accuracy.

While AI has shown promising results in diagnosing patients, concerns about job displacement among physicians and health workers exist. Some might argue that AI will replace human roles or that integrating AI will be challenging. However, a survey conducted by Sarwar et al. (2019) provides evidence to the contrary. The survey included 487 physicians from various parts of the world with differing levels of experience. It explored their perspectives on AI's future in medicine. When asked about AI's impact on employment, 184 respondents felt that AI would not affect job opportunities, 205 believed it would increase job numbers and demand for workers, and only 95 expressed concern. Furthermore, 346 respondents agreed that AI would enhance efficiency and accuracy in medical work. The survey results suggest that many physicians perceive artificial intelligence as a positive force in the medical industry, offering benefits such as new job opportunities, improved productivity, and quality of care.

CONCLUSION

In conclusion, integrating artificial intelligence systems, particularly those using deep learning and machine learning, have demonstrated significant potential for enhancing medical diagnosis and treatment accuracy. For instance, the Hirasawa (2018) model was able to analyze 2,296 images in just 42 seconds, highlighting the efficiency of AI in medical imaging tasks. Many physicians believe that AI will create more job opportunities and increase job efficiency (Sarwar et al., 2019).

However, there are limitations in training these models for rare disease types due to a lack of sufficient training images. This limitation can result in lower accuracy in diagnosing such diseases, as seen with intrahepatic cholangiocarcinoma (ICC) (Nishida et al., 2022). While this imperfection exists, it should not discourage the use of AI in healthcare. Instead, it underscores the importance of further investment in AI research and development to create models capable of achieving near-perfect accuracy in diagnosing a wide range of diseases.

The future of AI in medicine is promising, with the potential to reduce human error and prevent misdiagnoses that lead to avoidable deaths. As AI technology continues to evolve, it offers the possibility of improving patient outcomes, streamlining healthcare processes, and supporting healthcare professionals in making more informed decisions. By addressing current limitations and investing in advanced AI solutions, the medical industry can harness AI's full potential to revolutionize patient care and enhance the overall efficiency of healthcare systems.

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