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MINI REVIEW **ARTIFICIAL INTELLIGENCE**

Status of artificial intelligence in Pakistan and its implications in anesthesiology

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Abstract

Artificial intelligence (AI) refers to the technology that enables machine-based intelligent behavior. This descriptive article gives an overview of the implementation of artificial intelligence in the following disciplines within the field of clinical medicine: Anesthesiology, Cardiology, Pulmonology, Endocrinology, Nephrology, Gastroenterology, Neurology, Histopathology, and Radiology. In this article, we will discuss the employment of artificial intelligence in anesthesiology and provide an analysis of the several areas in which it is being utilized. We will also evaluate the current status of AI and its future in Pakistan. The importance of this manuscript is to highlight the benefits of artificial intelligence so that the benefits can be realized in Pakistan.

Key words: Artificial intelligence; Anesthesiology; Clinical medicine; Endocrinology; Gastroenterology; Histopathology; Nephrology; Neurology; Pakistan; Radiology

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1. Introduction

Artificial intelligence (AI) has altered the way many firms operate by assisting them in doing their tasks more effectively.[1] AI is basically a computer program that is capable of performing tasks typically associated with human intelligence, e.g. complicated problem solving, decision making, object detection, etc. AI makes use of the complex blend of mathematics and computer science. AI can provide outcomes that are more accurate than that of human beings.[2] AI performs more convenient work because it doesn't need any break and refreshment time compared to the human beings. It constantly performs its work for long time duration without facing any problem. There are no factors influencing the performance of AI as opposed to factors which influence the work of human beings.[3]

2. Background

Alan Turing created the "Turing test" in 1950 to determine if a computer could do a task indistinguishably from that of a person. After the 1990s, several AI approaches were used in the healthcare sector, including Bayesian networks, fuzzy expert systems, artificial neural networks, and deep learning, etc.[4] After the successful deployment of AI methods in a variety of sectors including healthcare, a significant investment was made specifically for the development of AI-based technologies for the healthcare sector.

The use of AI in medicine is divided into two parts. One part is physical and includes all robotic applications which can assist during surgeries, early diagnosis, and treatment of handicapped patients.[5] While the other element is virtual, which includes all programs that assist experts in making treatment decisions, such as massive recorded data systems analysis using neural networks.

3. Implementation of AI in healthcare system

The implementation of AI-based techniques gives a power to healthcare professionals to search for appropriate solutions for emerging clinical problems.[6] Healthcare sectors have a huge amount of medical data that are gathered from several areas of the medical sector, data that can easily be utilized by a deep learning algorithm. Currently, there are some departments of clinical medicine that use AI-based techniques and get advantages from them.[7] Some examples include: use of ECG in the detection of atrial fibrillation, detection of electrical activity in brain (like during epileptic seizures), detection of the sugar level in the blood, and detection of disease, related to deep tissue examination through imaging techniques in radiology, anesthesia, intensive care we well as interventional pain management.[8] This advanced technology helps healthcare professionals to indulge in the concept of personalized treatment.[9]

4. Application of AI in medicine

The following section discusses current uses of AI in medicine.[10]

4.1. Cardiology

AI transformed medicine for the first time in 2014 when it was used for the identification of atrial fibrillation using digital ECG monitoring equipment. These remote device applications made it possible to identify arrhythmias. Apple's wristwatch capable of detecting atrial fibrillation has been cleared by the FDA. However, despite this, there are some limitations to this approach, such as the false positive rate that is shown to the public[9]. Through AI-based techniques like deep learning and neural network, machines are able to detect a risk of cardiovascular disease in people with high accuracy.[10]

4.2. Pulmonology

In pulmonary function testing, AI plays a critical role by allowing software specialists to more accurately interpret the test results and proceed with subsequent treatment procedures.[11]

4.3. Endocrinology

Numerous businesses have obtained FDA permission to produce a smart monitoring gadget for diabetes patients that enables frequent monitoring of blood glucose levels.[12]

4.4. Nephrology

AI also helps in the treatment of kidney disease by detecting the rate of filtration in the patient and also predicts the risk of mortality related to nephrology.[13]

4.5. Gastroenterology

Deep learning and neural network approaches of AI system help in the endoscopy and ultrasound procedure by aiding in the diagnosis of precancerous and cancerous lesions so as to facilitate the patient's treatment by earlier detection of problematic lesions.[14.]

4.6. Neurology

Electroencephalography that use AI to identify epileptic episodes in patients. This gadget utilizes the most advanced technology available for improving seizure therapy via reliable monitoring. Gadgets like BIS, NIRS etc. powered by AI are critical for objectively detecting problems in neurological patients.[15]

4.7. Histopathology

There is a big challenge for a healthcare professional to recognize cancer cells in patients. By the implementation of an AI-based algorithm, the professionals are able to find the cancerous tissue with a high accuracy rate and successfully remove the tumor margin.[16]

4.8. Radiology

Radiologists used a deep learning approach in imaged-based diagnosis. Studies are done on making appropriate models through CT scanner, MRI, and x-ray for next-generation radiologist tool development.[17]

5. Role of AI in anesthesia

The term "Anesthesiology" refers to all measures that are concerned before, after, and also during the patient surgical operations. In its perioperative preparations includes giving anesthesia, critical care medicine, emergency treatment, and pain management. In today's advanced technological period, when many areas profit from AI-based solutions, AI computers can oversee the job of anesthesiologist autonomously.[18] There are different areas of anesthesiology where AI techniques are utilized.

5.1. Measurement of depth of anesthesia

Several studies have shown improvement in the measurement of depth of anesthesia by using AI. Especially in electroencephalography testing, it shows brain activity when the brain cells communicate through electrical impulses to find out the depth of anesthesia at the time of BIS monitoring. The use of machine learning AI helps to analyze a complex range of

electroencephalography signals to evaluate the effects of certain drugs in patients.[19]

5.2. Standard control over anesthesia delivery

AI helps to construct a standard closed-loop anesthesia delivery system with real-time monitoring. According to this, the anesthesiologist used an automated medication administration strategy to ensure the patient's safety by maximizing clinical indicators or markers that indicate the level of anesthesia. Apart from blood pressure as a vital indicator, BIS measurement using AI is being used to establish control over anesthetic administration. To facilitate the endotracheal intubation a deep machine learning approach is used to deliver the neuromuscular blockade automatically.[20-22]

5.3. Complication event prediction

There are many approaches based on AI, such as machine learning, neural networks, and fuzzy logic that are being used to assess the possibility of danger occurrence through hypnotic effect assessment. Throughout surgery, a fuzzy neural network can automatically assess the patient's awareness after general anesthetic, assisting in decision-making and adjusting anesthetic during the procedure. There are two locations where one must identify event occurrences: the intensive care unit (ICU) and the operating room.[21] Here, machine learning is used to evaluate a vast database in order to forecast any event, such as morbidity, mortality, or sepsis.

5.4. Assist ultrasound-based practice

The neural network approach from an AI-based network is most commonly used to assist the ultrasound-based practice by its accurate imaging features.[22] By using this technique professionals easily distinguish between the two images' differences. Additionally, these approaches aid in identifying anatomical levels for the administration of anesthetic from the spinal cord insertion in ultrasound imaging.

5.5. Pain management services

AI specialists control discomfort during preoperative measurements in order to aid patients. By using a deep learning method, professionals were able to evaluate MRI data in order to distinguish between painful and non-painful stimuli.[23] Machine learning is also used to analyze the photoplethysmography and skin conductance wave data of patients. Machine learning also applies for detecting the patient who responds to acute pain for therapy.[23]

5.6. Management of operating room

AI also plays a role in evaluating the aspects affecting operating room logistics, such as time management in OT or sensing an anesthesiologist's activities. This technique used large amounts of electronic data and a trained neural network method to forecast the overall duration of the surgical operation, as well as the kind of surgery procedure[24]. Tags were examined using machine learning to monitor anesthesiologists' interactions with operating room equipment.

6. Current status of AI in Pakistan

Numerous industries use AI in their operations on a worldwide scale. Pakistan is also developing into a significant market for AI-based solutions. Pakistan uses AI technology in a variety of industries to provide better answers to existing and emerging challenges and to boost demand in the new age.[25] Pakistan enhanced its self-security systems as a result of this, including missiles powered by AI, cyber security, and very effective cameras. There has been a noticeable increase in the spectrum of AI applications in Pakistan during the last several years.

7. PIAIC project in Pakistan

To involve the youth generation the Pakistan government initiated the PIAIC project for the development and progress of the country's economy. The government develops national-level AI centers around the country.[26] Currently, commercial companies in Pakistan are using AI in their operations by engaging top AI professionals. The following AI laboratories are located in Pakistan:

- The National University of Sciences & Technology (NUST) – National Center of AI, Islamabad.
- Artificial intelligence research lab (AIRL) Alkhawarizmi Institute of Computer Science (KICS), University of Engineering & Technology (UET), Lahore.
- The Center of Intelligent Systems and Network Research (CISNR) University of Engineering & Technology (UET), Peshawar.
- The Artificial Intelligence Lab, The Institute of Business Administration IBA (The AI Lab), Karachi

Pakistan has to restructure its faculty in the area of medicine to include AI-based learning and also take initiatives to improve the appeal of new students to high-technology learning approaches aimed at transforming the medical sector via technological services. Implementation of these approaches would catapult Pakistan's economy to new heights.[26]

8. The Future of AI in Pakistan

AI has a significant influence on the economic growth of several nations worldwide. Pakistan, on the other hand, is making relatively modest progress in implementing AI applications in a variety of disciplines, including medical. Several educational institutions and corporate companies, for example, NUST University, have introduced this AI course and department in order to compete in the market. Pakistan's agricultural department also employs a machine learning strategy to deal with natural disasters in the country.[27]

9. Conclusion

In conclusion, the deployment of AI-based approaches improves the precision of executing diverse tasks. AI assists healthcare providers by transforming the field of medicine with its accurate prediction capabilities. In clinical medicine, AI-based approaches are applied in a variety of fields, including anesthesiology. This article discussed numerous areas of anesthesiology in which AI-based solutions are being used to improve patient outcomes. Finally, we noted that Pakistan is a long way from reaping the benefits of this industry. Pakistan's healthcare industry is unlikely to benefit from this breakthrough in the future without further developing an expertise in AI.

10. Conflict of interest

The author declares no conflict of interest.

11. Authors contribution

All authors took part in literature search and drafting and review of this manuscript.

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