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A Comparative analysis of Artificial Intelligence and Deep learning process and its Impact on Human health monitoring

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ABSTRACT
Artificial Intelligence (AI) and Deep Learning (DL) approaches have taken an utmost interest in human health monitoring due to their remote and accurate patient monitoring capability. Both AI and DL are recent topics, and from them, DL has shown to win the race in terms of explainable features and large volumes of big data analysis. This research provides a comparative analysis of AI and DL in the context of health monitoring. To accomplish this research, A survey has been carried out in the UK with random healthcare professionals who have experience in both AI and DL. A total of 163 individuals have been selected, and a google survey form has been sent to them. The response data have been collected in Microsoft Excel and further analysis has been done. After that, available journal articles were analysed to validate the primary data. The results have shown that the majority (41.10%) have supported CNN as the most effective technology for healthcare monitoring. 53.37% have supported the clinical assessment of CNN for monitoring patients' health through a cyber-physical health system. 47.85% have agreed that AI technologies are more efficient in patient health monitoring. 41.10% of the surveyors have expressed their concern that the increased pressure on medical equipment might bring a future challenge for AI technologies. These results were analysed with secondary articles and it has been observed that AI technologies have a major positive role in improving the patient health monitoring system.
Keywords: *CNN, AI-technologies, DL, cyber-physical health system, survey*

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INTRODUCTION

Artificial intelligence or AI has become an interest in today's population due to its advantages in various fields. The AI has been designed inside a computer system that resembles the human brain, and it can function like the human brain. Nowadays, business, finance, human resources, healthcare and other sectors are implementing this technology for gaining competitive advantages [1]. Scientists say that they want to make the world independent and want the machines to solve certain problems quickly and accurately. These machines will then be able to make "intelligent decisions" and the entire world will become an independent place [2]. To accomplish that situation, scientists recommend Machine and Deep learning techniques (ML and DL). When someone considers AI, the first learning method for a machine is ML and then a deeper approach arrives which is called deep learning (DL). In this paper, a comparison of AI and DL approaches will be carried out for achieving the research goals.

ML (AI) can learn from both offline and internet-based datasets and the activities are autonomous. On the other hand, DL is a more advanced approach that is considered to be more efficient than ML in *learning*. Nowadays, DL approaches are becoming more popular than ML due to their higher accuracy in forecasting and better ability to learn [3]. Mobile devices, wristwatches, sensors, internet connections, virtual private networks and Wi-Fi are connected with humans through "*human-physical, physical-physical* and *human-human things*". These devices and their inter-networks are connected with humans for certain values and means. Thus, researchers are trying to develop some DL and AI techniques which by the help of the Internet of Things (IoT) will monitor the health of humans [4].

Recently, a report in China suggested that the physical condition of elderly individuals is deteriorating due to improper health monitoring. The poor conditions of older individuals are related to the 'gait

balance' and 'function of the heart' [5]. Thus, it is an urgent requirement for those elder individuals to monitor their health. Researchers are focusing on smart gadgets and remote care systems for providing effective home care. These existing devices are responsible for monitoring the health condition of patients and require a dataset for training. After proper training, the devices can predict certain health conditions and diseases.

In this research, an AI and DL-based Cyber-physical system (CPS) will be assessed to understand their efficacy [6]. The paper is organised into literature, methodology, analysis, interpretation, discussion and a final conclusion that will conclude the major findings.

LITERATURE REVIEW

Recently, "structural health monitoring" or SHM has taken another interest apart from CPS. SHM is developed by the use of AI and ML techniques. Luckey and colleagues have experimented with AI and ML to accomplish SHM. They stated that conventional ML does not provide the explanation of a decision taken by the machine. However, in the healthcare system and in providing health recommendations, an explanation of a decision is necessary to develop reliability [7]. Thus, ***Explainable-AI*** or XAI is being used to replace conventional ML and AI approaches to receive explanations on a particular decision. The authors suggested that XAI can provide certain advantages in SHM; however, it still retains some disadvantages that need to be addressed. Below figure 1 shows the functional framework of XAI.

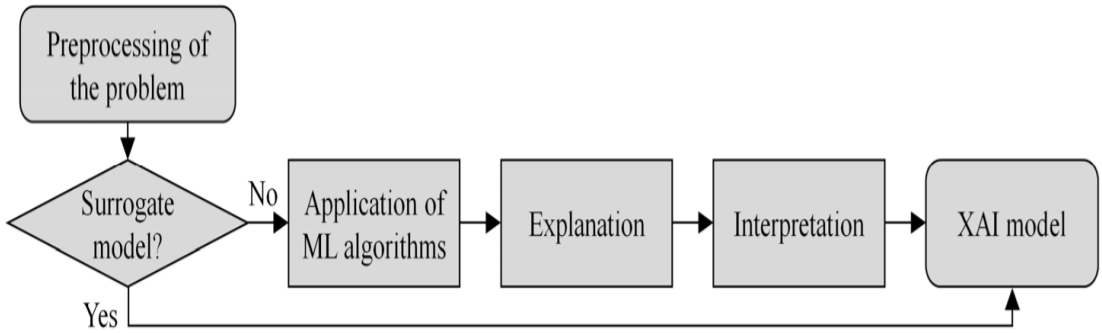

Figure 1: Functional framework of XAI[7]

The authors stated that XAI is a great approach; however, due to its complex reasoning, ML can be used to replace XAI, because ML provides an easy explanation of a problem. On the other hand, ML decisions are not traceable. Thus, XAI plays a key role in enhancing the performance of ML in SHM applications. On the contrary, Ghassemi and co-workers argued that XAI can establish bias, has a lack of transparency in decision making and many other non-useful properties. Therefore, it will ultimately bring false hope to the future generation in the context of a patient-level decision [8]. The authors have explained the negative side of XAI where it has been observed that transparency in XAI can bring "sizable model errors". Other problems include managing the high volume of complex data using an individual relationship. The input data and output results still do not bring meaningful information in many cases. For example, the below figure 2 shows the input and output image of a chest X-ray which determines pneumonia.

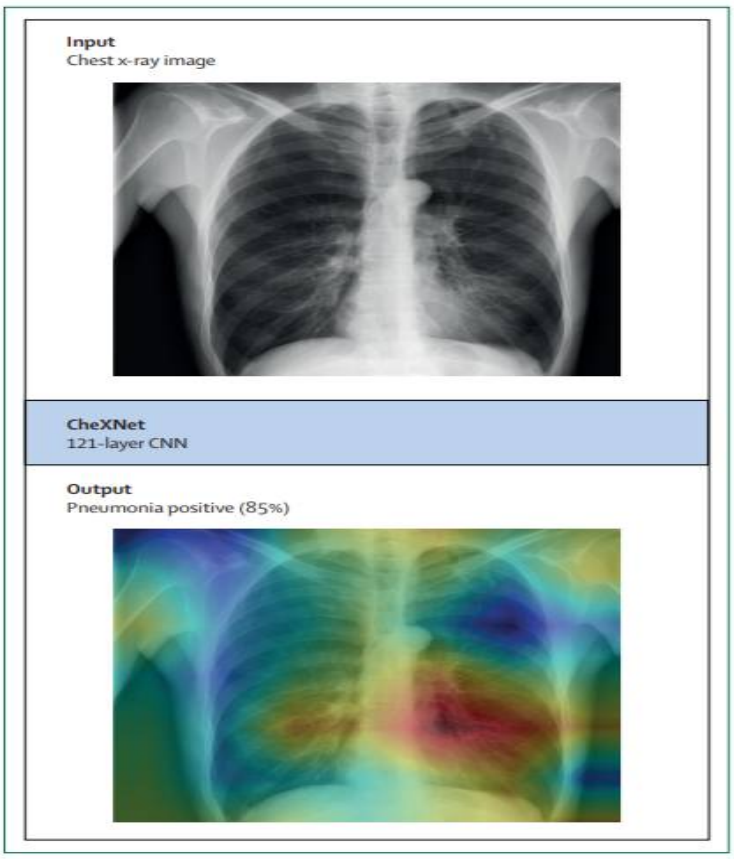

Figure 2: Heat Map of chest X-ray by DL technique where the red region is of more importance and blue region is of least importance[8]

The figure depicts that AI has predicted the risk of pneumonia where the red region is the most important part of the disease detection. However, the machine is detecting the blue regions as well which are not essential for this detection. Therefore, the healthcare professionals will not know whether the AI detected the disease correctly or not. On the other hand, humans are prone to *confirmation bias* which suggests that when a clinician observes that a machine has predicted a disease with its own explanation, the clinician will start to rely on that explanation instead of his own judgments over it [9]. Therefore, it will bring a more complex model for disease identification and will develop a cognitive error [10].

AI technology has a wider advantage nowadays in promoting effective and sustainable healthcare systems. Different AI technologies such as DL and ML help in large patient data analysis. According to Porumb and other researchers, continuous health monitoring in diabetic patients is essential as it lowers the risk of "hyperglycaemia". Their studies have stated that AI technologies can be used to track "Electrocardiogram based hyperglycaemia" in patients with nocturnal diabetes. AI technologies can effectively detect irregularities through abnormal ECG signals and can save the patient from hyperglycaemia [11]. Different DL technologies are used for clinical pathogenesis, diagnosis and effective treatment of covid-19 [12]. Technologies such as "Generative Adversarial Networks (GANs)", "Extreme Learning Machine (ELM)", "Long /Short Term Memory (LSTM)" etcetera are used to analyse "Electronic Health Record or EHR'' of patients. This allows researchers and physicians to effectively treat patients. According to the studies of Muehlematter and other researchers, DL and ML based medical devices have been extensively used in different medical sectors of the UK and USA [13]. These medical devices have been extensively used to monitor patient health. AI technologies are useful in analysing patient health conditions and monitoring treatment protocol. Decision-based AI technologies help doctors and healthcare professionals in analysing the best treatment method for patients. According to Zhou and other colleagues, "structural health monitoring" is an effective advantage of AI technologies [14]. Their studies have shown that "Deep Q Network '' and LSTM effectively monitor patients' health conditions.

Studies have shown that AI technologies are used for the treatment of covid-19 in patients. This is done through monitoring patient health and analysing effective treatment methods through patient EHR [15].

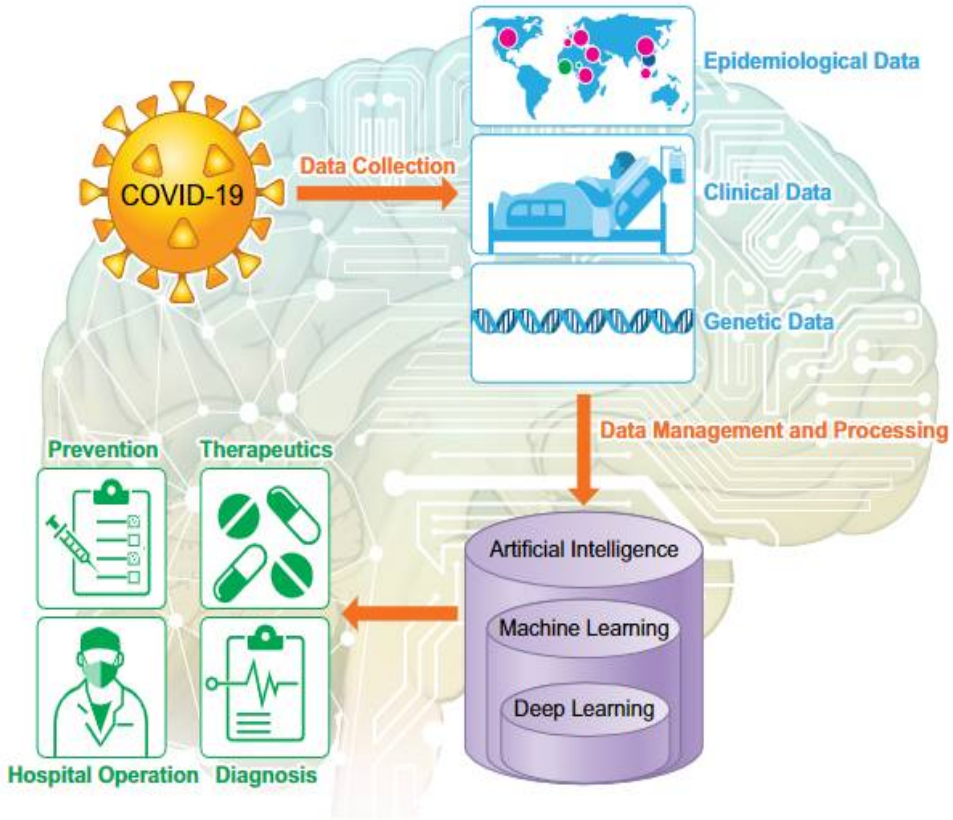

Figure 3: Diagnosis and treatment of covid-19 through AI technologies[15]

The above figure explains the treatment procedure of covid-19 using patient data. The data is collected through patient EHR data, epidemiological data and "genetic data of patients". These collected data are processed through AI, ML and DL technologies and provide adequate treatment prediction. This method is also effective in monitoring a patient's health conditions and effective disease diagnosis. Proper monitoring of patient health is the key to effective treatment protocol which can be done through AI and DL technologies.

MATERIAL AND METHODS

Initially, the research has performed a primary survey to research on the UK healthcare professionals who have experiences on both AI and DL. The research will uphold the practical knowledge, challenges and opportunities of both AI and DL. Moreover, the primary survey will obtain practical data on the comparison between the AI and DL. A Google survey form was developed by the researchers that contain the survey questions and their respective options. The options that will receive the maximum votes will be justified as the demanded options. The survey contains questions related to AI, DL, their applications and comparisons. Previously, the researchers have posted on social media; such as Facebook and Twitter, regarding the survey on healthcare professionals who have experience on both AI and DL. A total of 221 responses have been obtained and from those, the researchers have selected 163 individuals who have experiences in both DL and AI. The individuals were asked to provide their email addresses. After that, the google survey form has been sent via email address.

In this case, a *random sampling technique* has been used to collect data from random healthcare professionals from the UK. Usually, some selected healthcare sectors will not provide the judgements from a wide range of experience and knowledge. Thus, random sampling has been considered to be more diverse in knowledge.

Respondents provided their responses along with the demographic data. However, the demographic data have been excluded from this study as the data seemed to be irrelevant for this purpose. Therefore, the data related to AI, DL, human health monitoring and future challenges have been selected for further analysis. The data were recorded in Microsoft Excel and percentile values have been calculated. Apart from this, graphical representations have been generated for easier observation. The graphs and percentile table have been analysed and interpreted in the following section.

The survey questions were close-ended and thus, in-depth explanations were not possible to obtain from the healthcare professionals. Therefore, the researchers have chosen a *deductive research approach* to compare the primary research data with the results of available online journal articles (secondary research). The available research articles will provide findings from the past research on this particular topic. Ultimately, it will help the researchers to justify the validity of primary research data. To accomplish the secondary research, journal articles belonging to the past five years (2018-2022) have been selected for ensuring that the information is up-to-date. Thereafter, the entire discussion of this research has been developed with the help of primary data, secondary data and judgments of the researchers.

Research Questions

What are the most used algorithms in human health monitoring?

What are the opportunities and challenges of the new technical approaches?

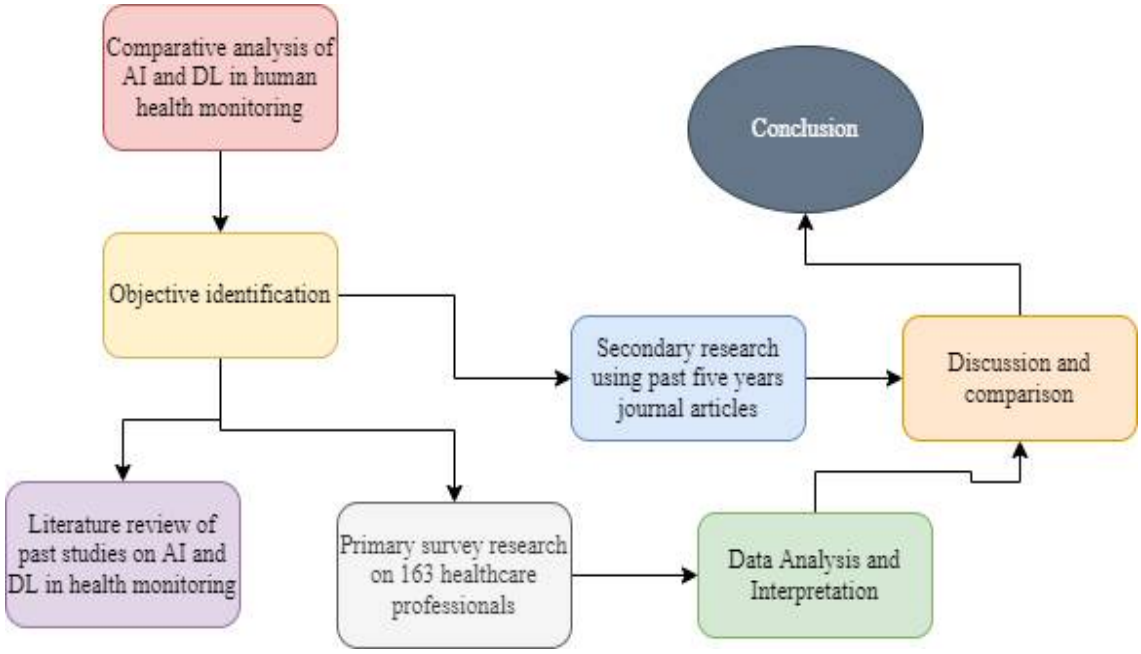

Figure 4: Research framework

RESULTS

Primary data analysis

A survey-based analysis has been done to analyse the role of AI technologies in patient care monitoring. The survey has been conducted with 163 individuals who are taken from different healthcare sectors of the United Kingdom.

Important survey questions:

Q1. What do you think is the most important technology for healthcare monitoring?

TABLE I: MOST IMPORTANT TECHNOLOGY FOR HEALTHCARE MONITORING

Options	Total participants	Response collected	Percentage
Convolutional Neural Network	163	67	41.10429
Deep Learning	163	58	35.58282
Artificial Neural Network	163	20	12.26994
Machine Learning	163	18	11.04294
Total		163	

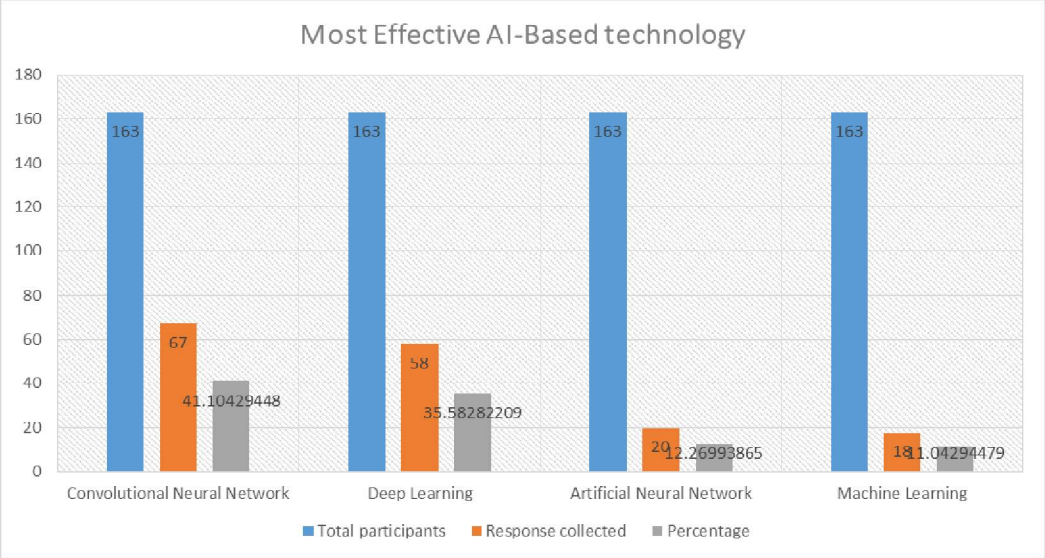

Figure 5: Effective AI-based technology

According to table I and figure 5, among the 163 surveyed individuals, 67 individuals have supported CNN as the most effective AI-based technology. 58 individuals have supported DL and 20 individuals have supported "Artificial Neural network" or ANN. Only 18 individuals have supported machine learning to be the most effective technology for healthcare monitoring. Therefore, it can be stated that the majority of the individuals have supported CNN for effective monitoring of patients' healthcare.

Q2. How do you think CNN helps in patient care monitoring?

TABLE II: CNN IN PATIENT CARE MONITORING

Options	Total participants	Response	Percentage
By analysing the patient data	163	31	19.0184
By analysing disease progression rate	163	33	20.2454
By predicting treatment method	163	12	7.361963
By implementing a cyber-physical health system	163	87	53.37423
Total		163	

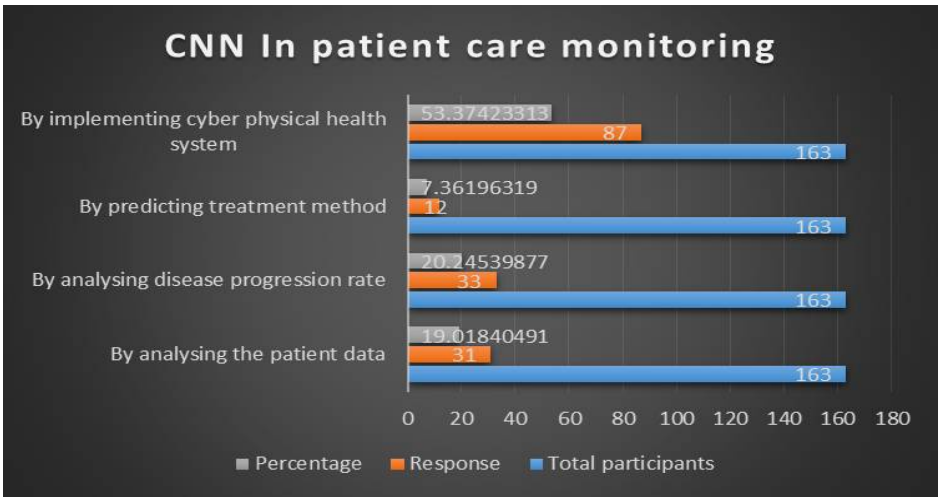

Figure 6: CNN in patient-care monitoring

According to Table II and figure 6, 31 respondents have stated that AI technologies analyse patient data to monitor patient health. 33 respondents have stated that these technologies analyse the disease progression rate to serve the purpose of patient health monitoring. 12 individuals have stated that AI

technologies predict the treatment method and 87 individuals have supported the implementation of a cyber-physical health system for patient health monitoring.

Q3. Do you think AI technologies are more effective than traditional methods of patient monitoring?

TABLE III: EFFECTIVENESS OF AI TECHNOLOGIES THAN TRADITIONAL METHODS

Options	Total participants	Response	Percentage
Strongly Agree	163	78	47.85276
Agree	163	63	38.65031
Neutral	163	20	12.26994
Disagree	163	1	0.613497
Strongly Disagree	163	1	0.613497
Total		163	

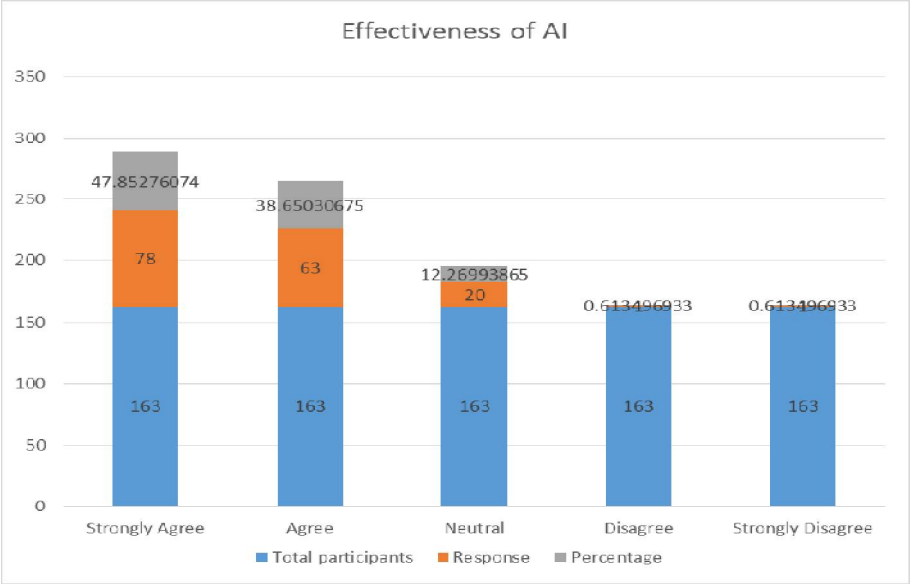

Figure 7: Effectiveness of AI technology

According to Table III and figure 7, 78 respondents strongly agree that AI technologies have more effectiveness than traditional methods in patient health monitoring. 63 respondents agree with the statement and 20 individuals have given a neutral response. Only 1 individual has disagreed and strongly disagrees with the statement.

Q4. What can be the future challenges of healthcare monitoring through AI technologies?

TABLE IV: FUTURE OF AI TECHNOLOGIES
(SOURCE: CREATED BY THE RESEARCHER)

Options	Total participants	Response collected	Percentage
increasing pressure on clinical equipment	163	67	41.10429
Exponentially increasing healthcare data	163	36	22.08589
Augmented intelligence	163	24	14.72393
Legal issues	163	36	14.11043
Total		163	

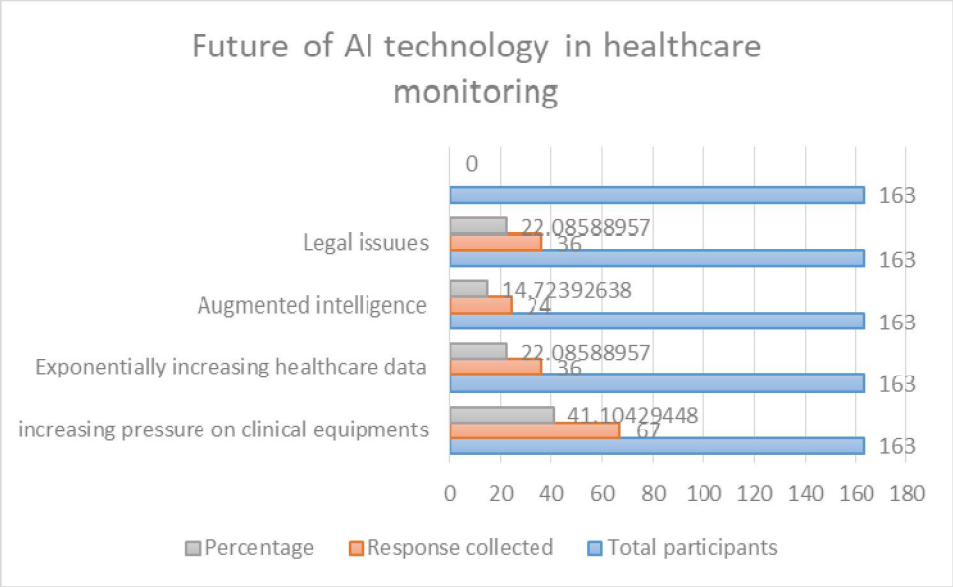

Figure 8: Future of AI-technology

According to table IV and figure 8, 67 respondents have stated that the major future challenge of AI technology is the increasing pressure on medical equipment. 36 individuals have stated that the "exponential" increase of healthcare data is the primary concern. 24 respondents have supported augmented intelligence and 36 individuals have stated that legal issues are the biggest future challenge held by AI technologies.

DISCUSSION

The analysis and interpretation section has shown that the respondents agreed with the use of "*Convolutional Neural Network*" or CNN in human health monitoring (41.1%). 35% of the respondents have agreed that they used DL for health monitoring. In this scenario, AI approaches, such as Machine Learning (ML), received the least votes. This suggests that DL and CNN are more accurate in health monitoring than ML [16]. According to Zhao and co-workers, DL can access huge amounts of big data which cannot be possible for ML algorithms to process and extract meaningful information [17]. Other authors. Such as Alzubaidi and colleagues stated that CNN is an algorithm of DL. Therefore, it can be suggested that DL (Figure 9) is the most used algorithm in health monitoring due to its capability of analysing large volumes of big data [18].

Human health may contain a wide variety of illnesses, different features of a disease, different types of symptoms that need to be analysed accurately to reduce cognitive errors. Thus, when large volumes of big data will be analysed, the output information will be more accurate [19]. On the other hand, ANN (ML approach) is not used in health monitoring due to its lack of explanation capability. However, DL is ***explainable*** which provides the explanation on why the machine has chosen a decision/recommendation [20].

According to Table II and figure 6, 53.37% of the respondents have stated that CNN helps in patient care monitoring by implementing a cyber-physical health system. 20.24% of the surveyors have stated that CNN helps in analysing disease progression rates. 19.01% have supported that CNN helps in patient care monitoring by analysing patients' EHR and EMR data. 7.36% have stated that CNN monitors patient health by predicting an appropriate treatment method [21]. Thus, from survey data, it is observed that the majority of the respondents have supported the implementation of a cyber-physical health system [22]. This data can be supported by the research of Gatouillat and other colleagues [23]. Their research has proved that implementation of a "cyber-physical health system" has improved the overall patient monitoring system as it improves the "robustness", "security", "efficiency" and effectiveness of healthcare monitoring [24].

According to Table III and figure 7, 47.85% of surveyors have strongly agreed that AI technologies have better effectiveness than traditional methods in patient health monitoring. 38.65% of the respondents agreed with the statement and 12.26% gave a neutral response. However, 0.61% of the respondents have disagreed with the statement which is a very low response [25]. Thus, the majority of the surveyors have agreed with the statement. This statement can be proved by the studies of Fouad and other researchers [26]. Their studies have proven that traditional methods do not provide accurate patient information

which is required for proper patient health monitoring. On the other side, AI technologies effectively provide these data that are used in effective patient health monitoring. The data includes patient BMI, "fitness tracker", past medical records, "temperature" etcetera.

According to table IV and figure 8, 41.10% of the surveyors have stated that the major future challenge of AI technologies is the "increased pressure" on medical equipment. 22.085% of the individuals have supported the "exponentially increasing healthcare data" as the future challenge. 14.73% have supported augmented intelligence and 22.08% have stated that legal issues associated with AI technologies are the biggest future challenge. According to the studies of Jones and Kerber, AI technologies have a wide range of applications in detecting and treating complicated diseases including neurosurgery [27]. However, the over-dependency of doctors and medical care professionals on AI technologies have enhanced immense pressure on medical equipment. This challenge can be reduced by promoting hybrid technologies such as ECG and CNN algorithms for stroke detection and CT scan and DL algorithm for medical image processing. Therefore, from the primary survey data and secondary supportive articles, it can be stated that CNN is the most effective AI algorithm for healthcare monitoring. This algorithm monitors a patient's health by implementing a "cyber-physical health system". It has been proved from the survey that AI technologies are more effective in patient's health monitoring than traditional methods. Moreover, the major challenge of AI is the increasing pressure on medical equipment.

CONCLUSION

AI technologies are nowadays the most effective and reliable technology in healthcare. Proper detection of the patient condition is done in less time and with more accuracy with the help of AI technologies. Rapid analysis of a patient's heart condition, temperature, BMI, and fitness level is done effectively through different AI technologies. Moreover, these technologies are efficient in continuous monitoring of blood pressure, heart rate and organ function in critical patients. This accurate detection is not possible in traditional methods and due to this reason, doctors and medical care professionals are relying on AL technologies. Patient care monitoring should be done with optimal accuracy and effectiveness which is offered by AI technologies. Effective monitoring of a patient's health alleviates the speedy recovery of a patient.

REFERENCES

1. Amisha PM, Pathania M, Rathaur VK. (2019). Overview of artificial intelligence in medicine. Journal of family medicine and primary care. ;8(7):2328.
2. Salehi H, Das S, Biswas S, Burgueño R. (2019). Data mining methodology employing artificial intelligence and a probabilistic approach for energy-efficient structural health monitoring with noisy and delayed signals. Expert Systems with Applications. ;135:259-72.
3. Bouktif S, Fiaz A, Ouni A, Serhani MA. (2018). Optimal deep learning lstm model for electric load forecasting using feature selection and genetic algorithm: Comparison with machine learning approaches. Energies. 20;11(7):1636.
4. Sun L, Shang Z, Xia Y, Bhowmick S, Nagarajaiah S. (2020). Review of bridge structural health monitoring aided by big data and artificial intelligence: From condition assessment to damage detection. Journal of Structural Engineering. ;146(5):04020073.
5. Wu Z, Zhang H, Miao X, Li H, Pan H, Zhou D, Liu Y, Li Z, Wang J, Liu X, Zheng D. (2021). High-intensity physical activity is not associated with better cognition in the elder: evidence from the China Health and Retirement Longitudinal Study. Alzheimer's research & therapy. ;13(1):1-1.
6. Alguliyev R, Imamverdiyev Y, Sukhostat L. (2018). Cyber-physical systems and their security issues. Computers in Industry. 100:212-23.
7. Luckey D, Fritz H, Legatiuk D, Peralta Abadía JJ, Walther C, Smarsly K. (2022). Explainable Artificial Intelligence to advance structural health monitoring. InStructural Health Monitoring Based on Data Science Techniques. pp. 331-346. Springer, Cham.
8. Ghassemi M, Oakden-Rayner L, Beam AL. (2021). The false hope of current approaches to explainable artificial intelligence in health care. The Lancet Digital Health.;3(11):e745-50.
9. Rollwage M, Loosen A, Hauser TU, Moran R, Dolan RJ, Fleming SM. (2020). Confidence drives a neural confirmation bias. Nature communications. ;11(1):1-1.
10. Korenstein D. (2019). Medical overuse as a physician cognitive error: looking under the hood. JAMA Internal Medicine. ;179(1):26-7.
11. Porumb M, Stranges S, Pescapè A, Pecchia L. (2020). Precision medicine and artificial intelligence: a pilot study on deep learning for hypoglycemic events detection based on ECG. Scientific reports. 10(1):1-6.
12. Jamshidi M, Lalbakhsh A, Talla J, Peroutka Z, Hadjilooei F, Lalbakhsh P, Jamshidi M, La Spada L, Mirmozafari M, Dehghani M, Sabet A. (2020). Artificial intelligence and COVID-19: deep learning approaches for diagnosis and treatment. Ieee Access. 8:109581-95.

13. Muehlematter UJ, Daniore P, Vokinger KN. Approval of artificial intelligence and machine learning-based medical devices in the USA and Europe (2015–20): a comparative analysis. The Lancet Digital Health. 2021 Mar 1;3(3):e195-203.
14. Zhou X, Liang W, Kevin I, Wang K, Wang H, Yang LT, Jin Q. Deep-learning-enhanced human activity recognition for Internet of healthcare things. IEEE Internet of Things Journal. 2020 Apr 2;7(7):6429-38.
15. Alimadadi A, Aryal S, Manandhar I, Munroe PB, Joe B, Cheng X. Artificial intelligence and machine learning to fight COVID-19. Physiological genomics. 2020 Apr 1;52(4):200-2.
16. Geeksforgeeks.org. (2022). *Difference between machine learning and deep learning.* Available at: https://www.geeksforgeeks.org/difference-between-machine-learning-and-deep-learning/ [accessed 16 February 2022]
17. Zhao R, Yan R, Chen Z, Mao K, Wang P, Gao RX. Deep learning and its applications to machine health monitoring. Mechanical Systems and Signal Processing. 2019 Jan 15;115:213-37.
18. Alzubaidi L, Zhang J, Humaidi AJ, Al-Dujaili A, Duan Y, Al-Shamma O, Santamaría J, Fadhel MA, Al-Amidie M, Farhan L. Review of deep learning: Concepts, CNN architectures, challenges, applications, future directions. Journal of big Data. 2021 Dec;8(1):1-74.
19. Chen M, Ma Y, Song J, Lai CF, Hu B. Smart clothing: Connecting human with clouds and big data for sustainable health monitoring. Mobile Networks and Applications. 2016 Oct;21(5):825-45.
20. Xie N, Ras G, van Gerven M, Doran D. Explainable deep learning: A field guide for the uninitiated. 2020.
21. A. Jain, A. K. Yadav & Y. Shrivastava (2019), "modelling and optimization of different quality characteristics in electric discharge drilling of titanium alloy sheet" material today proceedings, 21, 1680-1684
22. A. Jain, A. k. pandey, (2019), "modeling and optimizing of different quality characteristics in electrical discharge drilling of titanium alloy (grade-5) sheet" material today proceedings, 18, 182-191
23. Gatouillat A, Badr Y, Massot B, Sejdić E. Internet of medical things: A review of recent contributions dealing with cyber-physical systems in medicine. IEEE internet of things journal. 2018 Jun 19;5(5):3810-22
24. A. Jain, A. k. Pandey, (2019), "multiple quality optimizations in electrical discharge drilling of mild steel sheet" material today proceedings, 8, 7252-7261
25. V. Panwar, D. K. Sharma, K.V.P.kumar, A. Jain & C. Thakar, (2021), "experimental investigations and optimization of surface roughness in turning of en 36 alloy steel using response surface methodology and genetic algorithm" materials today: proceedings, https://doi.org/10.1016/j.matpr.2021.03.642
26. Fouad H, Hassanein AS, Soliman AM, Al-Feel H. (2020). Analyzing patient health information based on IoT sensor with AI for improving patient assistance in the future direction. Measurement.;159:107757.
27. Jones DT, Kerber KA. (2022). Artificial Intelligence and the Practice of Neurology in 2035: The Neurology Future Forecasting Series. Neurology. ;98(6):238-45.

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