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Role of Artificial Intelligence in Extending Life Expectancy of Humans by Assisting in Early Detection of Disease

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Abstract:

AI and humans will have a symbiotic partnership, where Humans will do the thinking and lead the path, while the machines with AI will do the computing, analysing and routine work, which will prepare a way for insights and decision making, in a technical and scientific way. Earlier medical practitioners would rely on years of data for diagnosing any type of diseases based on symptoms, which due to Augmented intelligence and synthetic data is possible to analyse in shortest period. With advance computing and big data, it is possible to detect diseases ahead of time with precision, the research paper aims to analyse, how AI is assisting doctors and specialists, in extending human life expectancy.

Keywords- AI, ML, DL, augmented reality, disease, tools.

1. Introduction.

Artificial Intelligence is a study/ process enabling machines to mimic human behaviour with the help of specific algorithms, ML and DL are components of AI. ML is an AI algorithm by which systems learn from data, while DL learns from deep neural networks and analyses data providing the necessary result. In short AI increase the chances of success, while ML focusses on Accuracy while deep learning is trying to attain the highest accuracy levels. AI systems are rule based, knowledge and data driven, while ML learns by trial and error, DL network is a multiple layer of interconnected neurons which process data in a hierarchical manner, which helps in learning complex representations of data. Examples of AI applications include Googles AI powered predictions, Ridesharing apps as Uber, AI autopilot for commercial pilots, ML applications are Siri, Alexa etc, while DL applications are many specially news aggregation and Image analysis.

AI infused medical diagnosis systems analyse images and other patient data to help medical practitioners in making more accurate diagnoses and treatments.

Clinicians are being assisted by AI-enabled tools which are more empowered for medical diagnostics. Using different type of datasets, Labels of high-quality, and state-of-the-art deep learning techniques, models are developed to eventually support medical specialists in diagnosing disease.

Literature Review.

(i) AI & ML in healthcare for disease detection and medical diagnosis.

The Figure 1, below provides details on the Algorithms used in ML.

Figure 1 - Details on the Algorithms used in ML

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Different algorithms are used in Artificial Intelligence for disease detection and to arrive at results. With each having Pros and cons with regards to their performance. Diverse Algorithms suite different medical applications with varied data types. Typically, a combination of these algorithms is used to optimize depending on the diagnosis which is analysed. Few of the popular disease detection algorithms are as follows (Binariks, 2024):

a. Decision Tree:

It is a flow-chart, similar to a tree structure, with every part represented by a function, the internal nodes are for features, branch stands for decision rule, and every leaf node the conclusion.

Advantages of using decision tree is when identifying co-occurrences, it can be applied for different types of diagnosis based on medical health and body symptoms of patient. "It is easy to interpret and understand and works well with every type of data. But is prone to overlapping when the tree is deep. It is effective for proving diseases as kidney and cardiovascular conditions."

b. Support Vector Machine (SVM):

These algorithms are used in case the task requires differentiation and regression. SVM works by finding the differentiation amongst the datasets to divide into classes. SVMs are very effective in spaces with many dimensions and is robust, but the disadvantage is it is less interpretable than decision trees, "it is particularly used to differentiate medical images used in disease detection example, breast or lung cancer, as well it is very useful in case classification with regards to protein sequence is done in specific applications as genetic testing".

c. **K-nearest neighbour (KNN):**

This algorithm is instance based wherein a new instance is classified based on majority class of its "K" closest models amongst its feature space using classification and regression analysis. Disease predictions are done based on the patterns and symptoms and patients with heart disease are differentiated.

d. Logistic Regression:

It is used for classification of data. "It provides the probability if a given instance can be categorised to a particular category. This ML algorithm can be applied in predicting about diagnosing disease like diabetes basis various metrics." This regression provides probabilities apart from classifications and is easy to implement and interpret.

e. Deep Learning:

This algorithm requires large amount of data and computing power and is very effective for tasks which are complex, and can automatically extract features, it uses "neural networks with many layers for complex pattern recognition and are used in image recognition in radiology for detecting tumours, factures and other abnormalities".

f. Convolutional neural network (CNN):

This algorithm is a type of neural network used specially for image recognition. "CNN is used for analyzing medical images as X-rays, MRIs, and CT scans for various diseases. The advantage of CNN is it is very good at detecting patterns in images and can automatically learn features", but it requires big datasets for training and are difficult to interpret and considered as a Blackbox, as the healthcare professional would not understand how the algorithm reached a particular conclusion.

(ii) Various disease where Artificial Intelligence and machine learning algorithms can be applied.

AI and ML algorithms for disease detection are different algorithmic models used to analyze patients' medical data and checks signs of diseases before it becomes severe. Future of AI is going to assist medical diagnosis to an extent that it will predict common conditions which leads to mortality and treat them on time.

AI and ML in disease detection "is being used in imaging analysis, signal processing, and identifying multiple diagnosis. AI and ML in disease detection can analyse genetic markers for mutations and as well biomarkers."

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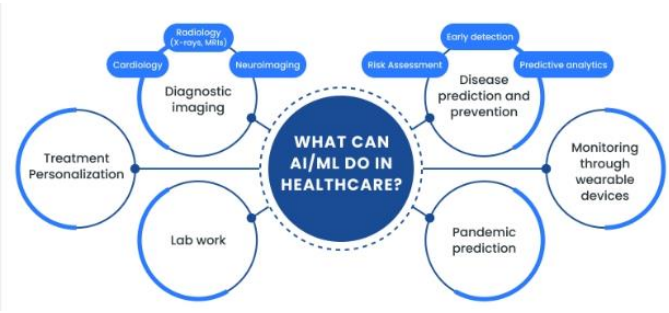

Figure 2 – What can AI/ML do in Healthcare?

List of diseases below are the ones which can be detected early with the help of AI & ML (Binariks, 2024):

a. **Cancer**:

Early detection is a game changer in treating cancer. "ML assists in AI analysis of medical imaging to help in the early detection of cancer." As an example, in Melanoma a malignant skin cancer, the survival rate of 5 years is possible in 99% cases in case of localized cancer, and 32% for distant cancers. (CDC,2024) "AI can analyse medical imaging and can also analyze blood to suggest the best course of treatment for a patient. Some disease types in cancer, where AI &ML algorithms can be applied are as follows":

a. **Breast Cancer**: Mammogram images can be analysed using algorithms detecting tumors or abnormal patterns with 94% accuracy.
b. **Lung Cancer**: CT scans can be analysed using AI tools to detect early-stage tumors, according to (Binariks, 2024) "early stage of lung cancer was detected with 94% accuracy".
c. **Skin Cancer**: After analyzing skin images, "AI algorithms can differentiate between benign moles and malignant melanomas" and early signs of skin cancers can be detected.
d. **Prostate Cancer**: AI can detect cancerous patterns by analyzing MRI images and tissue biopsies.

b. **Cardiovascular diseases**:

Machine learning applied to preventive health assessment can help in preventing this disease by detecting arrhythmias from ECG data, "patients health records and test results can be used to predict heart failures, arterial images can be studied for identifying atherosclerotic plaques, with the help of wearable devices vital signs can be monitored predicting the immediate and long-term risk of stroke and heart attacks". (Binariks, 2024)

c. **Neurological Diseases**:

AI & ML if used in medical diagnosis, can help "in early detection of diseases like Alzheimer's and Parkinson's, early detection can help in preparing and organizing for the patient." In case of Alzheimer's brain imaging data can be used for early detection, while in Parkinsons, voice data and hand movements can be analyzed using AI. (Binariks, 2024)

d. **Diabetes**:

Basis patient's records, "genetic data, and lifestyle factors, disease detection systems based on AI can predict onset as well as complications." (Binariks, 2024)

e. **Eye diseases**:

Analysing eye scans for disease detection using AI can help for condition as Glaucoma and retinal images can help in detecting macular degeneration.

f. **Infectious Diseases**:

ML based medical diagnosis and AI based disease detection can potentially identify outbreak of disease and predict the spread of disease based on the data from various sources. Consequently, "genetic sequences of Virus can also be studied to predict virulence or resistance patterns" for example in case of Covid-19.

g. **Liver Diseases**:

Early detection of this disease can lead to its cure, AI algorithms can be used to "detect fibrosis or fatty liver from MRI or ultrasound images. It can also reduce the risk of severe liver disease."

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h. **Respiratory diseases**:

Spirometry data or audio breathing analysis which is used for medical diagnosis for conditions like asthma or chronic pulmonary disease can be analysed using AI & ML for pattern detection.

i. **Bone and Joint Diseases:**

AI & ML algorithms can "identify early signs in Osteoporosis and Arthritis by analysing X-ray or MRI images," as well it can help in detecting mutations leading to disease by analyzing genetic sequences, as well as it can monitor vital signs in patients and alert clinicians of adversities. (Binariks, 2024)

(iii) Step by Step guide to build an "AI based disease detection system":

To build an AI based ML disease detection system, multi-step process involving technical and domain expertise is needed, the steps to follow are as below,

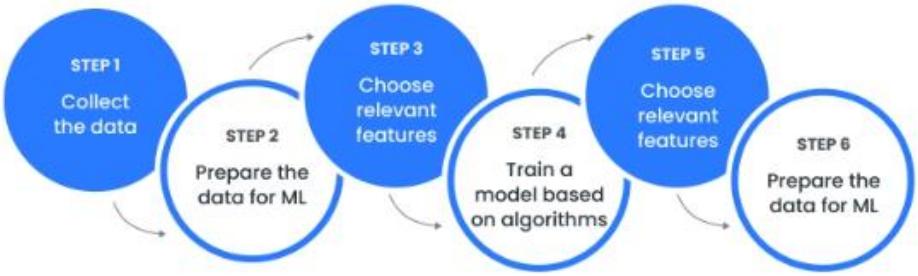

Figure 3 – Steps to build an "AI based disease detection system"

Step 1: Data Collection:

At this point, "reliable sources of data collection have to be identified such as hospitals and research institutions," these data need to be integrated as Electronic Health Records. Which needs to comply with regulations as Health Insurance Portability and Accountability act as well as general data protection regulation.

Step 2: Data Preparation:

Next step is to prepare the data, this can be considered as data cleaning or "removing the inconsistencies and errors in data and converting the data into a format suitable for machine learning."

Step 3: Feature Selection:

At this point, "select features most relevant to the disease in focus," and the medical domain experts need to be consulted, and AI tools need to be selected accordingly.

Step 4: Model Training:

At this step, "a suitable machine learning algorithm or combination of algorithms needs to be chosen," and complex machine learning models needs to be trained and automated.

Step 5: Model Evaluation:

At this stage, "appropriate metrics must be chosen to evaluate the model, such as accuracy, precision, recall etc, cross-validation techniques can be used to access the results for generalization by using independent datasets and evaluating the model using the validation set and metrics in real time." Techniques as SHAP (Shapley Additive Explanations) can be applied.

Step 6: Model Deployment:

Test the model before deploying it real time, use smaller data sets to assess the performance, after which "deploy the model in the desired environment, and cloud-based platforms can be chosen as well for performance checks" (Binariks, 2024).

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2. Methodology:

The Research Paper is based on Secondary study by Systematically searching articles published between year 2000 until 2024, reviewing the conclusions and context systematically in the databases as Web of science, PubMed, and Scopus etc. Only the articles "comparing the medical performance between advanced AI and subject matter experts "were considered.

3. Discussion & Finding:

RQ: **AI will assist the medical professionals for early detection, diagnosis and prediction of diseases eventually improving the life expectancy for humans**.

Infectious disease is a global concern contributing to high mortality rates, and in the domain of public health "identification and diagnosis of microbial diseases are consistently seen as a priority." (Seventer & Hochberg, 2017) has stated that" identification of patterns in transmission of infectious agents is achieved by examining variables, roots, or pathways, by which early diagnosis is achieved". According to the paper (Ogidi, 2024), the World Health Organization which designated Covid -19 as a pandemic and global concern, "advanced Artificial Intelligence tools were used to control, and properly manage and attempt to eradicate the pandemic".

AI uses computational methodology to "develop systems with ability to acquire knowledge of "patterns." Over past few decades, AI has experienced significant growth, leading to notable advancements in the healthcare sector. In the diagnostic approach for microbial infectious disease system-based assessments are followed by thorough identifications of pathogens" (Agrebi & Larbi, 2020), As stated in (Turaiki,2021; Hrizi,2022, Taie&Ghonaim,2021)."Utilization of AI methods have demonstrated superior performance compared to traditional diagnostic approaches in the detection and diagnosis of diseases. Advancements in technology has made it possible to utilize sophisticated analytical methods to examine extensive collections of health records, as well as large databases with photographs or genomic data, for the purpose of illness detection. AI driven diagnostic system used for infectious diseases accesses data regarding patients' symptoms, medical history, and profile, while eventually a model is constructed by implementing machine learning algorithm," The derived model facilitates, "the diagnostic process for physicians, leading to improvements in diagnostic speed, accuracy, and reliability. As well it supports as an additional tool for students and non-specialist physicians, guiding them in identifying patients with specific diagnostic challenges." (Ogidi, 2024) "the study also contributes to identifying concealed patterns harbouring undisclosed information about the potential occurrence of diseases which would have remained unknown".

Deep Learning has outperformed all previous algorithms in several visual recognition tasks, and its performance has improved significantly. "A DL algorithm is a deep artificial neural network (ANN) inspired by human brain cells that consist of several simple processing units that combine to form a more complex architecture. ML enables computers to perform the tasks of medical professionals. It has a widely used subfield in medical image recognition called deep learning (DL). DL is a method for designing the ML algorithm in which simple concepts are built on top of each other to form a deep structure with numerous processing layers, which means DL is a development of ML for analysing huge amount of data" (XiX, 2019 & Rizk, 2019 & Bhatt, 2021). (Kumar Sharma, 2022) " Deep learning (DL) is a subset of AI developed to mimic the human brain. It is a way for a computer to perform actions that come naturally to humans. It is a tool extensively used to organize unsupervised or unlabeled data and find patterns in them. DL has had a major impact on the field of medical science owing to its applications in medical drug discovery, medical imaging, genome synthesis, disease diagnosis, and much more. The growth of DL in this field has increased significantly owing to the processing and type of data used in the models. Focusing on the type of data, preexisting or curated, can drastically affect the success rate of a DL model. DL is used to diagnose diseases such as skin lesions, brain disease, and chronic disease." According to (Sameer, 2024) "pulmonary disease identification and characterization are among the most sought-after research topic in recent years as it requires an accurate and better diagnosis. Pulmonary Radiography has helped in lung disease diagnosis, the interpretation of these radiographic image has always been a main concern for doctors and radiologists to reduce diagnosis errors. Cutting edge Artificial Intelligence techniques like Machine Learning (ML) and Deep Learning (DL) are widely encouraged due to its success in image classification and segmentation tasks and are applied in the field of diagnosing lung disorders and identifying them using medical radiographic images". Many countries have raised the questions of ethics over the concern of patient's data being used analysis by AI & ML, "hence the use of synthetic data will be on the rise. Going forward, blockchain technology paired with deep learning and machine learning might be a promising study for diagnostic systems," (Zhang,2018 & Engelhardt, 2017). Practically, "practitioners understand the extent to which AI

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improves the diagnostic process and how the overall healthcare system benefits from it. Medical professionals understand how AI can be applied to diagnosing diseases, which could result in having suitable suggestions for further developing AI-Based approaches. In addition, healthcare experts comprehend which challenge still need to be tackled before disease is diagnosed in collaboration with AI. In terms of implications for society, readers realize that AI is likely to be used in healthcare to diagnose diseases or atleast assist during the process." (Milad & Nicholas, 2021). Based on research, its identified that "AI performs at par with human experts in terms of image analysis. Image analysis involves a number of object-identification tasks whose outputs rely exclusively on the detection and interpretation of concrete features such as shapes and colors. The nonfatigue characteristic of advanced artificial networking enables constant training and learning until achieving satisfactory accuracy." (Jiayi Shen & Casper Jhang, 2019), AI is having the edge in terms of Image evaluation or disease diagnosis as compared to human medical experts, as biologically it is not possible for humans to evaluate so much of data as reviewed from the articles, "Achievements of AI is based on the diagnosis outcomes, which eventually need to yield meaningful implications. The diagnostic criteria are developed based on long standing and recursive processes of real -world practice apprised by clinicians," (Rajpurkar,2018) "the self-learning abilities of AI will lead to additional prospects." (Schrittwieser, 2017), "The viability of diagnostic processes is inarguably determined by human experts through cumulative clinical experience" (Gulshan,2017 & Amato, 2013), Which means "clinical experts are the ones to inform AI of what the desired outcomes should be, as AI is still not capable of interpreting what is obtained from data and providing compelling results, hence the final success of AI is conditionally restricted by medical experts who can evaluate the diagnostic performance in real time, hence humans will be one step ahead in human dominated medical environment". The relationship between AI and human users is complementary, that the symbiotic relationship between advanced AI with clinical significance cannot be ignored. "The AI technology will improve further and would provide an encouraging outlook on medicine applications, and it will bloom continuously, finally the human engagement with the machine is needed as to have the real-world implications. Each milestone achieved by AI regardless of database driven or by self-learning needs to improve the patient's health, the learning abilities of AI have to complement with the declining task performance of humans." (Rajpurkar, 2018) It will improve clinical efficiency, AI's performance will be comparable to that of experts, and will save time, reduce stress, and provide accuracy and as well predict the right outcome.

4. Impact on society:

Innovative technologies have often been adopted by health care systems as an early adopter, and with the recent developments in AI & ML along with deep learning are on the path to becoming the backbone of healthcare system, from creating new health check actions to accessing the patients records, the maximum burden on the medical practitioners will be reduced by implementation of AI & ML in medical diagnostics and allowing them to do their best and spend more time with patients.

Alternatively, "AI & ML techniques help the patients as well, help the medical practitioners to save the patient's life by treating them as early as possible." (Yogesh kumar, 2022 & Luo, 2019)

5. Conclusion:

The recent developments in AI have achieved the performance levels to support the medical experts in specific fields. Predictive performance of AI along with streamlined efficiency and accuracy with regards to disease diagnosis particularly in imaging tasks is supporting the clinicians because of their tireless and meticulous evolution in accessing huge amount of data and transcending to a tireless and stable characteristic. Further studies can be focussed on other medical imaging practices. With the continued development of AI & ML assisted technologies, patient centred approach will be the way forward in technology based medical research. The research papers analysed revealed that AI & ML will make tremendous strides in disease detection, it is also capable of correctly diagnosing early, which is the "most crucial step to reduce mortality and improve outcomes for most common diseases, including cancers, cardiologic conditions and diabetes." As a way forward in health care, "disease detection driven by AI will expand to involve more conditions and will focus even more on personalized treatments." Given the progress it will help in extending the life expectancy of humans by accurately diagnosing and providing the early cues, to support in diagnosing the dreadful disease in patients, and effectively helping healthcare professionals in treatment of patients.

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