Healthcare In Artificial Intelligence

Mayuresh Bhagwan Nehe
Date:- 19, April 2022

Abstract:

Artificial intelligence (AI) is an area of science and engineering concerned with the computational understanding of what is often referred to as intelligent behaviour, as well as the design of intelligent systems. Objects that behave in this way It's a branch of computer science. AI is becoming a well-known term. Computer science is a field that has improved human existence in numerous ways. Recently, AI has surpassed Human performance in a variety of fields and is improving, and there is reason to believe that this trend will continue in healthcare. AI could pave the way for improved disease prevention, detection, diagnosis, and treatment The use of AI in major disease areas Cancer, neurology, cardiology, and diabetes are only a few examples. AI may also be used to detect problems and threats to patient safety with high accuracy and speed, such as patterns of sub-optimal treatment or outbreaks of hospital-acquired illness. A few ongoing studies on AI applications in healthcare that paint a picture of a future in which healthcare delivery is more cohesive and human-like.

Problem Statement:

Artificial intelligence (AI) is progressively being used in healthcare, as it becomes more prevalent in modern business and everyday life. Artificial intelligence in healthcare has the potential to aid healthcare practitioners with a variety of patient care and administrative operations, allowing them to improve on current solutions and overcome obstacles more quickly. Although most AI and healthcare technologies are useful in the healthcare area, the strategies that they support can differ greatly between hospitals and other healthcare organisations. While some publications on artificial intelligence in healthcare claim that AI can perform just as well as or better than humans at specific tasks, such as diagnosing sickness, it will be a long time before AI in healthcare becomes mainstream.

Artificial intelligence has shown to be successful in a range of industries and continues to pique industry interest. Despite multiple examples of AI offering benefits to a variety of industries, it appears that AI is still feared in healthcare. On the one hand, there's a dread of machine error, as well as concerns about data privacy. Furthermore, clinicians can obtain processed patient history with the help of AI. This means they won't have to go through the full history to figure out what's going on; instead, they'll be able to access well-organised patient data whenever they need it.

Market / Customer/ Business Need Assessment:

The kind and scale of the professional and organisational changes required for AI adoption should be considered in a global assessment of its added value . The FDA, for example, has approved an AI application for diabetic retinopathy screening that might be utilised in primary care clinics . Because the screening method is carried out by an ophthalmologist (expert) in some countries, some questions arise: What role will this technology play in the future of patient care and services? How will it be integrated into organisations' and the health system's clinical-administrative processes? Will general practitioners, nurses, or optometrists be able to monitor AI if it is employed in primary care?If so, under what circumstances? What effect will it have on professional jurisdictions (regulated activity, compensation, and education)? What will change in terms of service organisation and clinical-administrative workflows (waiting times in primary care, primary care, and specialisation services relationships)?

As a result, AI may cause work to be redistributed among multiple professional scopes of practice, highlighting the need for more clinical, administrative, and technical skills and knowledge. This will necessitate clarifying new rules and processes (clinical and administrative), negotiating and reframing professional jurisdictions, responsibilities, and privileges, and reassessing the number of positions required, as well as the new skills needed to work (with) and/or perform other tasks that accompany its use. This will have to evaluate how new responsibilities in terms of informatics and data science capabilities, as well as the capacity to communicate, may be incorporated within clinical teams.

Finally, most AI systems currently are designed to do a particular task or a limited collection of functions (for example, identifying just diabetic retinopathy and macular edema). They are ineffective for diagnoses for which they have not been trained (e.g., nondiabetic retinopathy lesions and ocular melanoma) and cannot, at least for the time being, substitute a thorough clinical examination. Payers will be challenged with determining if AI adds enough value in comparison to the nature and scale of clinical, cognitive, professional, and organisational changes it may bring about.

Target Specifications and Characterization:

- Medical device firms and healthcare providers make the best use of AI hardware. One of the primary categories in healthcare with a high acceptance rate is robotic surgery. MedTech firms specialise in the design, development, and manufacture of medical equipment that can be used in a variety of healthcare settings.

- To discover the underlying cause of symptoms, clinical labour is required, and diagnostic AI solutions may assist by boosting accuracy or saving time. We observe a range of diagnostic test applications throughout the different diagnostic sectors, ranging from simple to more sophisticated diagnostic applications like OLO, an AI-enhanced blood testing gadget that counts blood cells at the point of care.

- Machine learning (ML) is a subset of artificial intelligence that allows software applications to more precisely predict outcomes. In order to forecast new outputs, machine learning algorithms use historical data as input. It is at the heart of many major firms today since it can provide insight into customer behaviour trends and speed up business processes for new product development.

External Search

Skin Disease Detection using Machine Learning:

Skin illnesses are the fourth leading cause of skin disease worldwide. To alleviate this load and assist patients in doing an early assessment of their skin lesions, robust and automated technologies have been developed. The majority of the systems available in the literature simply classify skin cancer. Skin treatments are more effective and less disfiguring when detected early, however research is difficult due to the similar characteristics of skin illnesses. We are attempting to detect skin disorders in this experiment. In this study, an unique system for diagnosing the most frequent skin lesions is described (Melanocytic nevi, Melanoma, Benign keratosis-like lesions, Basal cell carcinoma, Actinic keratoses, Vascular lesion, Dermatofibroma). The suggested method includes pre-processing, a deep learning algorithm, model training, validation, and classification. Experiments on 10010 photos revealed that utilising Convolution Neural Networks (CNN) and the Keras Application API, 93 percent accuracy was obtained for seven-class classification.

DATASET:

1. Sample Data

The dataset is labelled into 7 different categories:

1. MelanocyticNevi
2. Melanoma
3. Benign keratosis-like lesions
4. Basal cell carcinoma
5. ActinicKeratoses
6. Vascular lesions
7. Dermatofibroma

To develop any ML-AI based system,

1. **Data Gathering.**

   The proposed system has been assessed on dermatoscopic images which are collected from publicly available dataset based on Skin-Cancer-MNIST (Modified National Institute of Standards and Technology Database)-HAM10000. The number of options is

endless. To save time and effort one can use publicly available data.

2. **<u>Data Preprocessing & Enhancement.</u>**
   Trash In- Good Out is the basic motto in this step [6]. Validating your dataset with some basic profiling procedure will help speeding up the process, by slip-ups and grimy information [4]. AI algorithms don't give great outcomes when working with such information.
3. **<u>Data Cleaning.</u>**
   Dirty data can cause confusion and results in unreliable and poor output. Hence the first step in Data Pre-processing is Data Cleaning. Cleaning of data is done by filling in missing values, smoothing noisy data by identifying and/or removing outliers, and removing inconsistencies.
   1. Data Transformation.
      Data Transformation involves converting data from one format into another. It involves transforming actual values from one representation to the target representation.
   2. Exploratory Data Analysis (EDA).
      In this we explore different features of the dataset, their distributions and actual counts.
   3. Label Encoding.

Machine learning is the future of skin diseases prediction:

Despite the fact that skin diseases are the fourth most common cause of human sickness, many people still do not seek medical help. We demonstrated a reliable and automated method for detecting dermatological disorders. When skin problems are detected early, treatments are more successful and less disfiguring. It's important to note that it's intended to replace doctors because no machine can yet replace human analysis and intuition. For the first time, research published in the European Society of Medical Oncology has proven that AI or machine learning can outperform skilled dermatologists. He gives a quick overview of the system as well as the installation process.

Benchmarking alternate products (comparison with existing products/services):

Benchmarking is used in healthcare to increase efficiency, quality of care, patient safety, and satisfaction. Examining standards, best practices, and evidence-based processes, as well as identifying potential areas for improvement, is part of the process. AI-assisted analysis of hospital data sets, which often include information of relevance to both consumers and clinicians, enables faster and more granular analysis. When it comes to competitive benchmarking, this is very useful.

Applicable Regulations (Government and Environmental):

- Beef up the Specification in new applications
- Craft claims to avoid the “abstract idea” groupings.
- Craft claims to qualify under one of the “integration” examples provided in the Guidance.
- Keep patent families open.
- Pursue multiple avenues to overcome Examiner rejections.

- Don’t rely on the Guidance alone.

Applicable Constraints
Expertise:

- Mergers, Acquisitions, & Collaborations with Life Science & Medical Device Companies
- Influx/Emergence of Many Startups in the Healthcare AI Industry
- Increase in Patient Volume & Complexities Associated with Data
- Technological Advancements & Innovations in AI

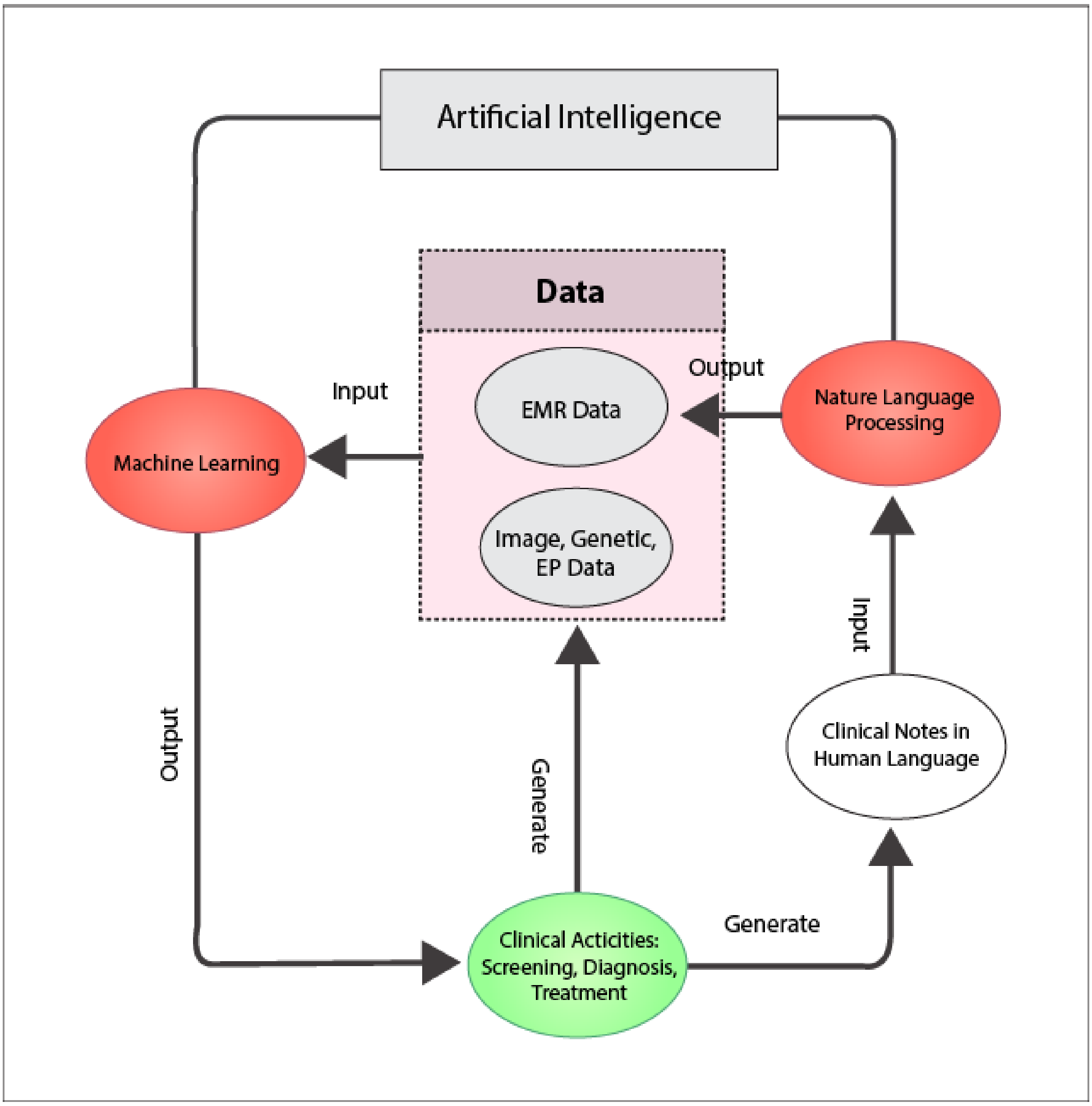
Business Opportunity:

The business opportunities for AI in healthcare are significant, from enhancing the quality and efficiency of care to digitising charts and test results. However, there are many challenges standing in the way for a successful digital transformation that are unique to the healthcare system.
From improving the quality and efficiency of service to digitising documents and test findings, AI in healthcare offers huge business prospects. However, there are other hurdles specific to the healthcare system that stand in the way of a successful digital transformation.

Concept Generation (process of coming up with Idea):

Artificial intelligence in drug discovery and clinical decision-making has paved the way for a new era of pharmaceutical medication and dose management workflow efficiency. This new method in drug discovery is extensively adopted because it is both cost and time effective. As AI in-hospital workflow management has grown in popularity, healthcare facilities have been able to provide more streamlined and efficient patient care. In 2020, hospital workflow management accounted for 38.41% of the healthcare AI market, and it is likely to maintain its dominance in the years ahead. Market vendors are increasing their investments in healthcare-related digital solutions. A number of agreements between IT businesses and healthcare providers have been established in recent years in order to adopt new technology and incorporate them into better outcomes. Because of its algorithmic more accurate findings, machine learning is increasingly employed and adopted in healthcare. Machine learning held a significant part of the healthcare AI market in 2020, accounting for 41.16 percent.

Final Product Prototype (abstract) with Schematic Diagram:



Abbreviations:

AI Artificial Intelligence
CIHR Canadian Institutes of Health Research
EHR Electronic Health Record
FDA Food and Drug Administration
HTA Health Technology Assessment

Product details:

How does it work?

We used the Keras Sequential API, which requires just that you add one layer at a time, beginning with the input. Conv2D layer is a set of features that can be learned. There are thirty-two filters used in this example. Using the kernel filter, each filter transforms a portion of the image defined by the kernel size. The filter maps are transformed images. The pooling layer, which essentially acts as a downsampling filter, is the next significant layer. We have Max pooling, where MaxPool() selects the most valuable of two adjacent pixels. This layer is used to reduce overfitting and to scale back (cut back) machine value. CNN can easily mix local features and learn global features by combining both of the above layers. To add non-linearity to the network, the Activation Function backpropagation is used. We employ the Dropout function, which uses a normalisation strategy in which a proportion of nodes in the layer are randomly disregarded (their weights are set to zero) for each training sample. This enhances the network's generalisation. Now we need to flatten the final feature maps into a single 1D vector, therefore will utilise the Flatten Layer. This flattening phase is required so that fully connected layers can be used after some of the previous levels. It incorporates all of the previous convolutional layers' identified native choices. Dense() is used in the last layer, which returns the net output distribution of likelihood for each category. We'll need to build up a score function, a loss function, and a good optimization method once the layers have been introduced. Binary cross entropy is the loss function that will be used to calculate the error rate between observed and anticipated labels. The optimizer is the next most critical component. Adam Optimizer has the advantage of incorporating features from other optimizers. In the realm of learning models, Adam is a well-known and often used algorithm.

Data Sources:

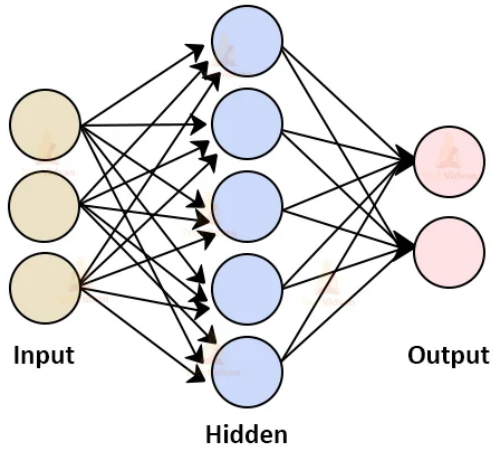
- Healthcare Providers
- Pharma-biotech and medical devices companies
- Payers
- Others

Algorithms:

Artificial Neural Network(ANN):

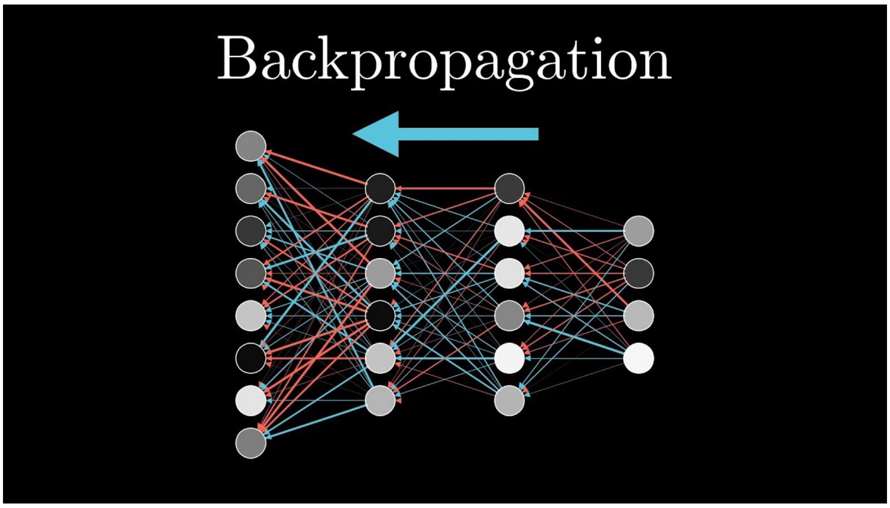
An artificial neuron network (ANN) is a statistical nonlinear predictive modelling method which is used to learn the complex relationships between input and output. The structure of ANN is inspired by the biological pattern of our brain neurons . An ANN has three types of computation nodes. ANNs learn computation at each node through back-propagation. There are two sorts of data set trained and untrained data set which produces the accuracy by employing a supervised and unsupervised learning approach with different sorts of neural network architectures like feed forward, back propagation method which uses the info set in a special manner. Using Artificial Neural Network, accuracy obtained in various researches is 80% which isn't optimum . Also, ANNs require processors with parallel processing power. ANN produces a probing solution that does not give a clue as to why and how it takes

place which reduces trust in the network.



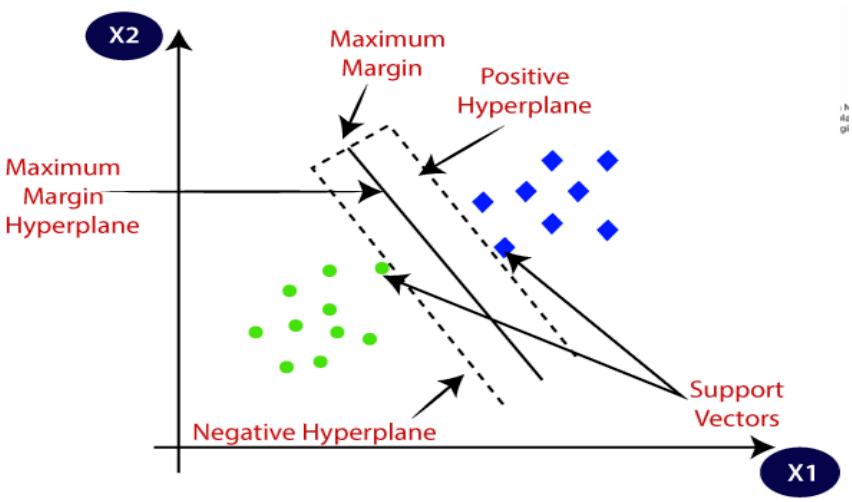
Back Propagation Network(BPN):

After a cluster of information (in image recognition, several images) is processed, back propagation is a mechanism used in Artificial Neural Networks to find out the error contribution of each neuron. Back Propagation is extremely sensitive to data that is noisy or raucous. The accuracy of the BNN classifier is between 75 and 80 percent. BNN has advantages in prediction and classification, although it is slower to process than other learning algorithms.



Support Vector Machine(SVM):

SVM is a non-linear supervised classifier that creates an optimum n-dimensional hyperplane to divide all data points into two groups. Choosing an honest kernel function in SVM is difficult. For large datasets, it necessitates a lengthy training period. We can't make modest calibrations to the model because it's not straightforward to use, and tuning the parameters utilised in SVMs becomes complicated. When compared to ANNs, SVMs consistently produce better result



Team required to develop:

- Machine Learning engineer
- Querying Method
- Natural Language Processing

Conclusion:

Artificial intelligence is a rapidly developing discipline with applications in a variety of fields, including the medical services framework. According to studies, AI is a rapidly growing market in the healthcare industry. In this discipline, it has a wide range of applications, including data management, drug research, diabetic care, digital consulting, and so on. There is some indication that medical AI can assist doctors and patients deliver healthcare in the twenty-first century in a much more professional manner.

References:

1. Kirch D.G., Petelle K. Addressing the physician shortage: the peril of ignoring demography. *JAMA.* 2017;317(19):1947–1948. [PubMed] [Google Scholar]
2. King D, DeepMind's health team, joins Google Health.
3. Bresnick J. Artificial intelligence in the healthcare market to see 40% CAGR surge; 2017.
4. L.G. Pee, S.L. Pan, L. Cui Artificial intelligence in healthcare robots: a social informatics study of knowledge embodiment J Assoc Inf Sci Technol, 70 (2019), pp. 351-369, 10.1002/asi.24145

5. S. Hamid The opportunities and risks of artificial intelligence in medicine and healthcare(2016).
6. Esteva A , Kuprel B , Novoa RA , *et al* Dermatologist-level classification of skin Cancer with deep neural networks. *Nature* 2017;542:115–8.doi:10.1038/nature21056 CrossRefGoogle Scholar
7. Goodfellow I , Bengio Y , Courville A *Deep Learning*. First Edition: The MIT Press, 2016.
8. Bishop CM , ed. *Pattern recognition and machine Learning (Information Science and Statistics*, 2007.