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Review on Artificial Intelligence and its Implementations in Digital Era

M. Duraipandian

Head of the Department, Department of Information Technology, Hindusthan Institute of Technology, Coimbatore, India

E-mail: mduraipandiandp@gmail.com

Abstract

Artificial Intelligence (AI) moderns the present society and opens the door for many applications to boom digitally. AI plays a key role in the field of agriculture to space science. The development on cloud storage and wireless communication systems are assisting the AI to reach certain goals in the digital world. Also the improvements made to the electronic processors and other chips are helping the AI to gain its computational efficiency. The design of micro electronic devices are opening the possibility of moving the sensors to keep in distinguished locations though Internet of Things (IoT) communication. The objective of the paper is to review the performances of AI methodologies in various applications for identifying the research gaps.

Keywords: Neural networks, machine learning, deep learning, internet of things, cloud computing

1. Introduction

Artificial intelligence is the process of simulating human intelligence though machine and computer peripherals. Therefore the AI algorithms are structured with neurological connection as layers. Hence the neurological layers are solving the problem same as like of human thinking [1,2]. The artificial intelligence algorithms are basically categorized into two types as-

- Machine learning and
- Deep learning

1.1 Machine learning

Machine learning approaches are solving the problem based on its own learning process without any human interruption. Hence such machine learning algorithms are acting

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like a computer programming language and give response to the given task as on its oven understanding.

1.2 Deep learning

The deep learning algorithms are trained through a huge amount of data samples as text, image and videos. In some cases the dataset is organized and in some cases the dataset information are not organized for its learning process. The deep learning algorithm also works same as like of machine learning at the time of training but a human can interrupt in such work on selecting the required parameters for the learning process.

The AI systems are also categorized as weak and strong AI models based on their application performance [3,4].

1.2.1 Weak AI models

The AI algorithms that are applied to single or limited application are represented as weak AI systems. The algorithms that are created to play chess game and act like a human assistance for simple questions are come under this category.

1.2.2 Strong AI models

Self-driving vehicle is one of the best example for strong AI models that handles multiple critical and complex problems at a time. The response speed of such AI models is also very high when comparing to the other system and its accuracy also comparatively better than the weak AI systems [5,6]. Figure 1 explores the steps that are involved in creating a successful AI approach.

Collect – Represents the data collection process. Data is an essential one for any AI algorithm. The amount of data utilized for the training process improves the accuracy of the prediction process. The configuration of data can be in text, image, voice or video format. The structure and labelled data are improving the learning accuracy of the AI model.

Organize – The raw data that are collected from different sources are having the possibility of having minor to major noise due to the environmental and interface disturbances. Hence a preprocessing step is required for organizing the collected dataset. A human manipulation is also implemented in some cases when data is of numerical information.

Analyze – Training a neural network model with the collected dataset will give the ability to analyze the testing data given to the neural network architecture.

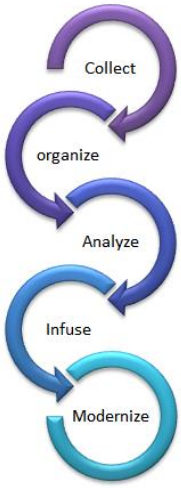

Figure 1. Ladder of AI

Infuse – Implementing the trained model into a hardware module represent the process of infuse. It allows the hardware module to get interfaced with the additional control units when needed.

Modernize – Modernize is the process of incorporating the developed AI model into the cloud infrastructure for the computing and analytic process.

2. Basic Concepts of AI

Based on the task and computational effectives the AI systems are segregated into 4 types.

2.1 Reactive AI machines

The reactive AI machines are deployed without a memory space for a specific task. Hence the reactive machines are not having the ability to learn from its experience. It can only react the coding burned into the algorithm. Chess playing super computer called Deep Blue is a best example for reactive machine that has the ability to play the chess board based on the rules included to their neural network. But the Deep Blue model doesn't have the prediction of the opponent move in the chess board. This limits the neurological capability of a machine to not overcome the smartness of a human being. Similarly the complexities of reactive machines are very low and its reliability is very high as it is implemented over the repeated tasks [7].

2.2 Limited memory AI machines

The limited memory models are presented with a dedicated memory storage unit for storing their previous experiences. Therefore the learning capability of such AI machines are comparatively better than the reactive machines. The capability of learning process is directly related to the memory space allocated in such machines [8]. Following are the basic AI methodologies enforced with limited memory access.

Reinforcement Learning – It trains the model from its experiences on the basis of trial and error method.

Long Short Term Memory – It is also defined as LSTM and it observes its recent experiences on taking complex decisions. In most cases it avoid the experiences that got before a very long period.

Evolutionary Generative Adversarial Networks – It is represented as E-GAN and that improves the algorithm with respect to its previous decisions. There is also a slight change in the decisions of E-GAN when it does even a repeated work.

2.3 Theory of mind machines

Such machines are developed to observe the intention of the opposite human by reading their face and other emotions. These kind of AI machines are employed to take decisions based on the characteristics learned from the opposite people and decisions taken by such machines are not same on people to people [9].

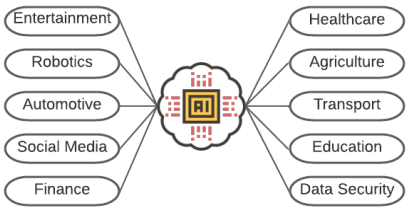

Figure 2. Applications of AI

2.4 Self-awareness machines

Self-awareness machines are not completely structured for any application. Such models are under the theoretical concept only and that leads the machine to take decision by analyzing its location, state and other parameters. The proof of concept is developed so far as

separate application and that has not yet clubbed to form a complete self-awareness system [10]. Table 1 explores the application and limitation constraints of the various AI models.

Table 1. AI Models and Its Attainments

AI Type	Comments
Reactive AI	1. Suitable for repeated classification and prediction applications 2. Works better when it knows all of its attributes 3. Accuracy lags when some attributes are missing during the testing phase
Limited Memory AI	1. Has the power to attend complex problems even when the source information is not available 2. Can estimate the predictions from past experience 3. Present AI model that is available in self-driving cars and machines 4. Open to attacks and vulnerability
Theory of Mind	1. Can take decision by considering multiple parameters 2. Has the ability to learn with minimum training data 3. Motive and intention based prediction system
Self-aware AI	1. Human level intelligence and that can overrule human on certain problems

The AI models are implemented to several applications based upon their task and operational requirements. Figure 2 explores the list of applications where the AI systems are directly implemented in the present scenario. The primary requirement of implementing an AI system into a new field is training data. A huge amount of data is needed for enforcing a neural network algorithm to some specific application for the first time. Similarly the hardware capability of handling such a big amount of data is also playing a huge role in terms of computational speed. A reliable hardware model with feasible structure always improves the performances of the AI systems. In the present trend many AI architectures are implemented with the help of cloud computing environments to reduce the computational burden to the local system and that improves the performances of the AI system to certain extent.

3. Review on AI in Various Segments

Table 2 represents the achievements of AI in various applications. It is projected to identify the data samples considered in the work for training and testing process and explores the list of basic methodologies involved in the steps of designing the algorithm. Table 2 is also categorized to project the attainments of AI in an even manner on various applications.

Table 2. Survey on AI Models in Different Applications

Citation	Year	Broad Area	Application	Methodology	Dataset	Observations
Monteiro et al. [11]	2022	Healthcare	White blood cell classification	Artificial Neural Network	BCCD Dataset	Accuracy = 84.19%
Lahoud et al. [12]	2022	Healthcare	Mandibular canal segmentation	Coarse and fine segmentation using 3D-UNet CNN	M3BE database	Mean accuracy = 0.999 Mean precision = 0.782 Mean IoU = 0.636
Kong et al. [13]	2022	Agriculture	Pest and disease recognition	Feature-enhanced attention neural network	CropDP-181 Dataset	Accuracy = 85.29% Average recognition time = 71ms
Petrakis et al. [14]	2022	Agriculture	Greenhouse climate prediction	Multilayer perceptron neural network	Self-made dataset of 62 days climate changes	Max error temperature = 0.877K Max error relative humidity = 2.838%
Huang et al. [15]	2022	Transport	Tourist spot prediction	RBF neural network algorithm with particle swarm optimization	Self-made dataset by normalizing the influencing factor values	Proposed RBF accuracy = 94.04% BPNN = 91.53% Cluster analysis = 88.02%
Zhai et al. [16]	2021	Transport	Traffic prediction	Spatiotemporal Part-Whole Convolutional Neural Network	BeijingTaxi, NYC bike and taxi datasets	BeijingTaxi MAPE = 1.17% NYC bike MAPE = 3.25% NYC taxi MAPE = 9.49%
Joseph et al. [17]	2022	Education	Anti-spoofing attendance system	Convolutional Neural Networks	Self-made dataset	Accuracy = 98% Precision = 96% Recall = 0.96
Yousafzai et al. [18]	2021	Education	Student performance assessment	Attention based bidirectional long short-term memory	UCI Machine Learning Repository	Prediction accuracy = 90.16%
Mandru et al. [19]	2022	Data Security	Network intrusion detection	Deep Neural Network level 4	KDDCup-'99	Accuracy = 0.929 Precision = 0.998 Recall = 0.912 F1 score = 0.955
Kimmel et al. [20]	2021	Data Security	Malware detection in cloud	Long Short Term Memory and bidirectional RNN	Self-made dataset of 40,680 malicious and benign samples	LSTM accuracy = 99.65% Bidirectional RNN accuracy = 99.51%
Wang et al. [21]	2021	Entertainment	Emotion aware music recommendation system	Deep Neural Network	myPersonality dataset	Accuracy = 97.46%
Song et al.[22]	2021	Entertainment	Fake news detection	Temporal propagation-based graph neural network	Sina Weibo dataset	Accuracy = 0.968 Fake news precision = 0.962 Real new precision = 0.974
Hua et al. [23]	2021	Robotics	Multi-scene recognition	PM-NASNet	Multi-scene aerial image dataset	F1 score improved over Mem-N2N-VGGNet by 1.03%
Anagnostis et al. [24]	2021	Robotics	Human activity recognition	Recurrent Neural Networks	iBO open dataset	Average accuracy = 85.6%
Zaghari et al. [25]	2021	Automotive	Driving behavior module	Deep Neural Network	KITTI dataset	Accuracy = 92.93%
Tseng et al. [26]	2021	Automotive	Fast instance segmentation	One-stage multi-task neural network	COCO and CityScapes datasets	Frames per second handle capability = 24
Umer et al. [27]	2021	Social Media	Sentiment analysis	Unified convolutional neural network–long short-	US airline sentiments	Accuracy = 0.820

				term memory network	dataset	
Salamat et al. [28]	2021	Social Media	Recommender system	Graph-based neural networks	Ciao, Douban, and Epinions	RMSE of Ciao = 0.9980 RMSE of Douban = 1.006 RMSE of Epinions = 1.0755
Akyildirim et al. [29]	2021	Finance	Cryptocurrency price prediction	SVM, ANN, RF and logistic regression	Self-made dataset with open, high, low, and close prices	Prediction accuracy varies between 55 to 65% on various algorithms
Wang et al. [30]	2021	Finance	Stock index forecasting	Elman neural network with direct input-to-output connections	Global stock indices SSE, KOSPI, Nikkei and SPX	RMSE and MAE are improved over 44.2% and 41.1% than the traditional Elman neural network

4. Discussion

The review observations shown in the previous section are exploring that the AI models are having the ability to solve classification, segmentation, prediction, estimation and forecasting kind of problems. The literature analysis also found that the problems that need most attention and immediate response are handled with complex neural network algorithms like Deep Neural Networks and the applications that are repeated are employed with Shallow kind of neural networks.

4.1 Shallow Neural Networks

The shallow neural networks are developed to attend less complex problems with limited number of neural network connections. In many cases the shallow networks are limited with one or two hidden layers to operate. Therefore the number of input parameters considered for the analysis is also very less [31].

4.2 Deep Neural Networks

The deep neural network designs are having more than two hidden layer for its operation. The number of layer count increase will allow the neural network design to learn and store more complex observations gathered from the given input. The values that are extracted from the given input data are generally termed as features and attributes. The user can also limit the count of features and attributes extracted from a given input sample. This will allow the neural network algorithm to concentrate only on the area that are specifically given by the user. In some modern neural network algorithms there will be a tuning parameter for adjusting the performances of the neural network. However, the number of hidden layer count included in a neural network algorithm will not going to improve the

accuracy all the time. At the same time it will also improve the computational complexity of the prediction algorithm [32].

5. Conclusion and Future Scope

Artificial intelligence moves all sectoral applications to move forward to certain extent. The implementation of AI algorithm is not limited to any application. The review work performed in the paper tries to analyze the attainments of the AI algorithms in various segments of operations in the past two years. The literature study indicates that the strong neural network algorithms are implemented over the complex problems and the weak neural network algorithms are employed to the regular and repeated applications. It has also been observed that the accuracy attainments of many applications are not still reached their mark due to computational burden and poor attribute selection.

Still there is a need for an accurate prediction and estimation with minimum computational cost. Hence the concepts on theory of mind algorithm are moving their step towards achieving such goal. The hypothetic statement of theory of mind states that prediction rate of the neural network algorithms can be improved when the expected outcome is already feed into the neural network architecture. Similarly the research on capsule network based algorithms are also moving in a rapid manner to limit the requirement of learning samples for a deep learning based approaches. The developments of capsule network based techniques are avoiding the requirement of data augmentation step for a classification and prediction kind of problems. The assistance of cloud processing environment are also opens the door for handling more complex problems with neural network architectures.

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Author’s biography

M. Duraipandian is presently working as a professor in the Department of Information and Technology, at Hindusthan Institute of Technology, Coimbatore, India. His interested area of research includes Artificial Intelligence, Data Management and Data Mining, Computer Architecture, Computer Networks, Robotics, Pattern Recognition, Computer Vision, Software Systems, Distributed Computing, quantum computers, Computer Graphics.