The scope of Artificial Intelligence in mankind: A detailed review

Sukanta Ghosh *, Amar Singh

School of Computer Applications, Lovely Professional University, Phagwara, Punjab, India-144411
Corresponding Address: E-mail: sukantaghoshmca@hotmail.com (*S Ghosh)
amar.23318@lpu.co.in (A Singh)

Abstract

Artificial Intelligence (AI) is everywhere from media coverage to general discussion, it is almost impossible to get away from AI. Its application varies from health care, education, defence services, game development, smart homes, smart medicines, automation industry and many more. AI in health care is carried out by both structured AI and unstructured AI. Many machine-learning models are used in the diagnostic field and medical recommendation. Lots of bio-inspired algorithms are making their impact in AI research field. Modern warfare now includes AI-enabled weapons and GPS guided missiles. Self-driving cars are one of the best examples of the implementation of Artificial Intelligence. Face recognition is already a commodity used by many customers, business, and government applications such as organizing your photos according to people, automatic tagging on social media etc. Similar techniques can be used to recognize other cars and obstacles around an autonomous car or to estimate wildlife populations in a forest. In this paper, we are going to discuss how AI applications are changing the life of an average human being by going into the depth of AI applications.

Keywords: artificial intelligence, fuzzy logic, learning management, simulations, neural networks, genetic algorithm

1. Introduction

Before going into the details of AI applications, we should first get familiar with the concept of AI by looking into the definition and some examples. AI means different things to different people. For some AI is any data processing technology and for some, it is about artificial life forms that can surpass human intelligence.

There is no exact official definition of AI; even AI researchers also do not have an exact definition. Almost 50 years ago, the meaning of AI was just merely some automatic methods, which does not need any human intervention. Now such methods are part of everyday life and it nullify the concept of AI. It is very difficult to separate out what is AI and what is not. From a long time, we have been shown a different side of AI in science fiction movies. Robot hood is not the only thing which comprises the AI. It is just one of the application of Artificial Intelligence. (Source: https://course.elementsofai.com/1/1)

As a researcher here is a quoted definition of − “AI = A + A” (A-Autonomy, A-Adaptivity). Autonomy means the ability to perform tasks in complex environments without constant guidance by a human. Adaptivity means the ability to improve performance by learning from experience. The definition of AI lies in these two words. Any application of AI should possess at least these two
properties that is it should be able to perform its defined tasks in complex environment by learning the environment and its actions and minimize the chances of failure. (Source: https://course.elementsofai.com/1/1)

The advancement of AI in health care has created active discussion weather AI doctors will replace human physicians in the future. It is still very difficult to replace human physicians but yes, we need the AI doctors for assistance in major surgeries. Hence, better clinical decisions or even replacement of human decision making in certain areas. A lot of data is also being produced in health care field which can been used to train various machine learning models to make them work in better health care facilities. Definitely powerful AI techniques will result in better functionality [1].

The future of teaching and education lies in the hands of AI researchers as education had evolved a lot and still need to evolve and in this evolution AI plays a vital role. In this field, progress in artificial intelligence open to new possibilities and challenges for teaching in higher education, with the potential to fundamentally change governance and the internal architecture of institutions. Universities are already using supercomputers like IBM Watson, which provides support for repetitive and predictable tasks. Online MOOC’s courses are being made effective using various machine learning tools and neural networks techniques. Grading system of universities are using AI techniques for effective grading of students. Plagiarism detection algorithms are using data from wide range and applying various techniques to find effective plagiarism in a research paper. It is very important to focus further research on the new roles of educators for enhancing learning by focusing on imagination, creativity and innovation.

2. AI-assisted emerging engineering domains

Several AI-assisted application domains are emerging in a continuous manner. It is almost impossible to cover all the application areas in a single paper. There are some key performing areas of AI which is changing the routine life of a human being. Such applications are responsible for making the human life easier. The important areas are identified and reviewed in this paper. Some thrust application areas are as follows:

2.1 Smart agriculture

Almost 30 percent of world population is depended on agriculture for their living. On land there are various issues faced by the agriculture depended population. These issues are related to crop productivity, pest control, weed control, yield prediction, irrigation and many more. There are different approaches, which are suggested to solve the issues related to agriculture. Out of so many approaches, applying AI have been found to be most promising and result oriented. AI strengthen the decision making process in lands and its activities.

There are various subdivisions of agriculture where AI has been used extensively, namely,

1. General Crop management system
2. Pest management
3. Disease management
4. Agriculture product controlling management
5. Soil and irrigation management
6. Weed management
7. Yield prediction
In 1985, McKinion and Lemmon [3] in their paper “Expert Systems for Agriculture” first proposed the use of AI techniques in Crop Management. Roach et al. [4] proposed an expert system POMME for apple plantation management in 1987. In year 1997, Robinson and Mort [5] in Italy came up with a multi-layered feed forward artificial neural network based system to protect the citrus crops from frost damage. In Jalandhar, Punjab, Prakash C. et al. [6] proposed a fuzzy logic based soybean crop management which provides instructions regarding crop selection, fertilizer applications and pest related problems.

Each year a lot of crop is heavily damaged due to pest related problem which results in heavy economic back fall. To tackle with this several logics based fuzzy system were proposed and developed by Saini et al. [7], IPEST by Hayo et al. [8], Roussel et al. [9], Jesus et al. [10]. TEAPEST is an object oriented approach expert system for pest management in tea proposed by Ghosh et al. [11]. Later Samanta and Ghosh [12] redesign the system using multi-layer back propagation neural network.

Most of the farmers in India and rest of the world have the concern with the crop destruction due to crop disease. It is very important to detect the disease and find out the relevant cure for the same as early as possible. It is possible to detect disease on the basis of wetness of leaf in a plant. Tilva et al. [13], find out this method and proposed a fuzzy logic based model which forecast the diseases. Image processing plays a vital role in disease detection in plants because the appearance of plant tells a lot about the health of that plant. In year 2007, Huang [14] came up with an image processing model coupled with ANN to catalogue phalanopsis seedling diseases. Al-Hiary et al. [15] and Bashish et al. [16] developed a system using k-mean segmentation algorithm to detect diseases in plant in their early stage. Khan et al. [17] developed a web based expert system for detecting diseases in wheat plant.

Storage, drying, sorting of harvested crops are also very important phases of agriculture. There are various food monitoring and quality control mechanism that utilizes the concept of Artificial Intelligence. Kavdir et al. [18] in his paper “Apple Grading Using Fuzzy Logic” has proposed a fuzzy logic based method which is used in a decision support system to grade the apples. Gottschalk et al. [19] has proposed a fuzzy logic based controller to control the climate of potatoes cold storages. M. Taki, et al. [20] proposed a ANN based method to predict roof air temperature, air humidity, soil temperature and soil humidity in semi-solar green house.

Soil and irrigation plays important role in crop productivity and yield. Improper soil and irrigation management led to crop loses and poor quality. Brats et al. [21] developed a rule based expert system for estimation of the design and performance of micro irrigation systems. Sicat et al. [22] proposed a fuzzy based recommendation system to decide which crop should be grown on a particular type of soil using farmer’s knowledge. Arif et al. [23] designed an ANN based system for estimation of soil moisture during paddy sowing season. Rain is a important factor for crop production and Manek and Singh [24] compared several neural network architectures for prediction of rainfall.

Removing weeds from agriculture land is very important for crop quality and productivity. AI applications are used for proper weed management. Pasqual [25] intended a rule based expert system for recognizing and removing weed in crops like oats, barley, triticale and wheat. Shi et al. [26] proposed and developed an approach by using image analysis and neural networks to identify weeds in real time.

2.2 AI-assisted intelligent education and learning

S. Gross et al. has reviewed tutoring approach for learning programming related subjects. There are three learning from this paper. There are number of AI-support tutoring system available but most of them uses feedback based deployment. In addition, these feedback-based approaches is capable of
identifying the intention of the student. Most of tutoring approaches support individual learning. These were the gaps, the author tried to solve by using the approach of pair learning. In this approach, two students can sit together to solve similar type of programming problem [27].

Virtual Reality plays a vital role in enhancing the quality and pedagogy of education in the current scenario. According to Wong et al. [28], VR could help to improve the performance in conceptual understanding of the subject. There are lot of subjects where demonstration does not work and the facilitator need to provide simulation based learning environment. In such cases, VR can be very effective and provide greater impact than traditional way of teaching. For example, VRML-based 3-D object is used to teach geometry in high schools. By using this method, the performance of students has increased drastically. Similarly, VR Physic Simulation (VPRS) is used to teach physics concepts such as ray optics, relative velocity etc. to high school and university students.

Sani at el. [29] has provided approach of intelligent tutoring system (ITS). This software provides personalised tutoring methods to students based on their need and interest. The aim of ITS is to maximize the leaning by engaging the student in their interest. Student model and pedagogy model are the main components of ITS. Various modelling techniques are being used such as ontology, neural networks, data mining, fuzzy logics etc. for working of this approach. Modelling of these frameworks incur lot of uncertainty and fuzzy logics and Bayesian techniques are very effective in handling uncertainty.

Tarus et al. [30] had mention about the working of recommendation for e learning in education. In knowledge based recommendation system, ontology plays an important role for knowledge representation. Most of the previous papers have the gap related to ontology-based recommenders. This paper had discussed various categories recommendation system based on ontology-based recommenders. It also discussed various knowledge representation techniques used in ontology-based recommendation system.

2.3 AI-assisted smart healthcare

Artificial Intelligence is influencing the health care services by implementing various AI techniques such as deep learning, machine learning etc. in every sub field of health care. Lots of health monitoring devices are into the market doing lot of analysis and applying various techniques to monitor and early detection of health hazards. A lot of innovation has taken place in AI and ML enabled medical devices for health care services. These devices helps a lot in improving the health care services in the country.

According at Jiang et al. [1] there are lot of AI techniques used to analyse various types of diseases. The paper gives a description of majorly two categories of AI techniques, ML and NLP for developing various medical devices. SVM, neural networks and modern deep learning are very powerful tool to develop various mechanism for health care management, especially in disease diagnosis for stroke care.

According to Alvin Rajkomar [31], artificial intelligence beats conventional statistical models at foreseeing a scope of clinical results from a patient's completely raw electronic health record (EHR). The team lead by Alvin Rajkomar developed a data processing pipeline for converting EHR files into a regular format. Then they applied deep learning techniques on the data collected from 216,221 patient. Ultimately they found that their algorithm accurately predict risk of mortality, hospital readmission, prolonged hospital stay and discharge diagnosis.

ECG signal pre-processing and support vector machine-based arrhythmic beat classification are performed to classify into normal and abnormal topics. Signal processing technique is advanced for remote healthcare systems. Discrete wavelet transform is functional on the pre-processed signal for
HRV feature extraction and machine-learning techniques are used for performing arrhythmic beat classification. SVM classifier and other popular classifiers are used on noise removed feature extracted signal for beat classification. According to the results, the performance of SVM classifier is better than other machine learning classifiers [32].

2.4 AI-assisted military and security services

Artificial Intelligence, explicitly the Machine Learning and Deep Learning, has inside 10 years moved from prototyping at research centres and colleges to industry and societal application. ML and DL are used intensively to carry out military operations and surgical strikes. Bio-inspired algorithm combines with the strength of Artificial Intelligence to support national security and military operations.

According to Demertzis et al. [33], country’s national security is backed by confidentiality, integrity, and availability of Military information. In the paper, an Artificial Intelligence framework, bio-inspired hybrid artificial intelligence framework for cyber security (bioHAIFCS) is discussed. This powerful AI framework prevent any kind of cyber-attack on time and accuracy. It also provides support for malware detection, which are nottraceable by antivirus. Further, this system prevents important information from SQL injections and provides support of early detection of attack.

Sanjeev et al. [34] had proposed multi-robot area exploration method for unknown search areas, which can further be used in military operations. Exploration is mainly followed by collective effect of probabilistic and deterministic movement. It uses Clustering Based Distribution Factor for deterministic movement and nature inspired algorithms for random guidance for exploration. They have worked with various nature inspired algorithms like Particle swarm optimization (PSO), Bacteria foraging optimization (BFO), and Bat algorithm (BA). The approach has been implemented in various environment and team size and it has been found that the performance of PSO is better than other tested algorithms.

IT criminals are using cyber space to commit a large number of crimes. Cyber infrastructure are susceptible to these attacks and threats. Physical devices and human efforts are not enough for monitoring and security of these infrastructures. Selma et al. [35] has discussed and demonstrated various methods of AI techniques to combat with these attacks and threats. They demonstrated how these techniques and tools helps early detection and prevention from these cyber-attacks.

3. Imperative articles based on the above discussed areas

| Paper Title                                                      | Year | Citation Count |
|-----------------------------------------------------------------|------|----------------|
| Artificial intelligence in healthcare: past, present and future [1] | 2017 | 133            |
| Exploring the impact of artificial intelligence on teaching and learning in higher education [2] | 2017 | 22             |
| Expert systems for agriculture [3]                              | 1985 | 105            |
| An expert system for helping apple growers [4]                   | 1987 | 21             |
| Title                                                                 | Year | Volume |
|----------------------------------------------------------------------|------|--------|
| A neural network system for the protection of citrus crops from frost damage [5] | 1997 | 19     |
| Fuzzy based Agriculture expert system for Soyabean [6]               | 2013 | 3      |
| Web based fuzzy expert system for integrated pest management in soybean [7] | 2002 | 51     |
| An indicator of pesticide environmental impact based on a fuzzy expert system [8] | 1998 | 202    |
| Adaptation and use of a fuzzy expert system to assess the environmental effect of pesticides applied to field crops [9] | 2000 | 44     |
| Fuzzy logic and geographic information systems for pest control in olive culture [10] | 2008 | 2      |
| TEAPEST: An expert system for insect pest management in tea [11]      | 2003 | 23     |
| Tea insect pests classification based on artificial neural networks [12] | 2012 | 14     |
| Weather based plant diseases forecasting using fuzzy logic [13]       | 2013 | 5      |
| Application of artificial neural network for detecting Phalaenopsis seedling diseases using color and texture features [14] | 2007 | 135    |
| Fast and accurate detection and classification of plant diseases [15]  | 2011 | 273    |
| Detection and classification of leaf diseases using K-means-based segmentation and Neural networks-based classification [16] | 2011 | 138    |
| Dr Wheat: A Web-based expert system for diagnosis of diseases and pests in Pakistani wheat [17] | 2008 | 49     |
| Apple grading using fuzzy logic [18]                                 | 2004 | 100    |
| Improved climate control for potato stores by fuzzy controllers [19]   | 2003 | 33     |
| Title                                                                 | Year | Citation |
|----------------------------------------------------------------------|------|----------|
| Application of Neural Networks and multiple regression models in greenhouse climate estimation [20] | 2016 | 6        |
| An expert system for the hydraulic analysis of microirrigation systems [21] | 1993 | 12       |
| Fuzzy modeling of farmers' knowledge for land suitability classification [22] | 2005 | 133      |
| Estimation of soil moisture in paddy field using Artificial Neural Networks [23] | 2013 | 6        |
| Comparative study of neural network architectures for rainfall prediction [24] | 2016 | 2        |
| Development of an expert system for the identification and control of weeds in wheat, triticale, barley and oat crops [25] | 1994 | 15       |
| Analysis and Testing of Weed Real-time Identification Based on Neural Network [26] | 2017 | 1        |
| A Review of AI-Supported Tutoring Approaches for Learning Programming [27] | 2013 | 17       |
| A Review of Using Virtual Reality for Learning [28] | 2008 | 59       |
| Computational Intelligence Approaches for Student/Tutor Modelling: A Review [29] | 2015 | 10       |
| Knowledge-based recommendation: a review of ontology-based recommender systems for e-learning [30] | 2018 | 52       |
| Scalable and accurate deep learning with electronic health records [31] | 2018 | 171      |
| ECG Signal Pre-processing and SVM Classifier-Based Abnormality | 2018 | 17       |
Detection in Remote Healthcare Applications [32]

A Bio-Inspired Hybrid Artificial Intelligence Framework for Cyber Security [33] 2015 25

Multi robot area exploration using nature inspired algorithm [34] 2016 4

Applications of Artificial Intelligence Techniques to Combating Cyber Crimes: A Review [35] 2015 47

Table 1. Imperative articles based on the above discussed areas

4. Conclusion

From the above discussions, we found that Artificial Intelligence is changing the way of human living. We have discussed four major applications areas of Artificial Intelligence namely agriculture, military, education and health care. Artificial Intelligence has drastically changed above-mentioned applications areas. In context of agriculture, artificial intelligence has given new means of productivity, improved irrigation methods, better quality of products and many more. Data obtained from various devices related to agriculture lays the path of new research. Similar benefits are provided to health care management. Lot of data generated by medical equipment helps in taking better decisions. From tele operations to ease disease diagnostic mechanism, artificial intelligence is playing a major role. Lots of machine learning algorithms and nature-inspired algorithms used in health care services to provide better services to humankind.

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