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Artificial Intelligence and Its Associated Applications

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ABSTRACT: In the Future, Artificial Intelligence has the potential to replace or enhance human capabilities in several areas. Artificial Intelligence is basically the intelligence exhibited by machines to reduce human efforts. Artificial Intelligence is the way through which a machine/ computer can think and function like human. It helps to take technology to a new level altogether. Artificial intelligence allows machines to perform tasks which require human intelligence such as visual perception, decision making as well as speech recognition. Artificial Intelligence has several applications like certain medical applications as well as in some gaming applications. Application areas of Artificial Intelligence is having a huge impact on various fields of life and is widely used these days to solve the complex problems in various areas as science, engineering, business, medicine as well as weather forecasting. The areas concerning with and employing the technology of Artificial Intelligence have seen a steady and vast increase in the efficiency and quality. This paper deals with understanding Artificial Intelligence and its associated applications in Engineering and several other fields.

KEYWORDS: Artificial Intelligence, Intrusion Detection Systems, Neural Networks and Fuzzy Logics, Power System Stabilizer (PSS).

I. INTRODUCTION

Artificial Intelligence plays a vital and increasing role in research of management science and operational research areas. Basically, intelligence is considered as the ability to collect knowledge and information and aims to solve complex problems with proper reasoning. In the near future intelligent machines will replace human efforts and capabilities in many areas. Artificial intelligence is the study and developments of intelligent machines and software that can reason, learn, gather knowledge, communicate, manipulate and perceive the objects. It all started when John McCarthy coined the term in 1956 as a branch of computer science which was basically concerned with making computers which have the capability to behave like humans. It is the study of the computation that makes it possible to perceive reason and act accordingly. Artificial intelligence is different from psychology because it emphasis on computation and is different from computer science because of its emphasis on perception, reasoning and its corresponding actions. Its aims and helps to make machines more powerful, smarter and useful. It works with the help of artificial neurons and scientific theorems. Major areas of Artificial Intelligence are Expert Systems, Natural



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Language Processing, Speech Understanding, Robotics and Sensory Systems, Computer Vision and Scene Recognition, Intelligent Computer Aided Instruction, Neural Computing. The various techniques applied in artificial intelligence are Neural Networks, Fuzzy Logic, Evolutionary Computing, and also Hybrid Artificial Intelligence. Artificial intelligence is more consistent, permanent and less expensive. Also, it has the ease of duplication and dissemination. Its helps perform the tasks relatively faster and all this factors provides it an edge over natural human intelligence.

II. CONCERNED AREAS OF ARTIFICIAL INTELLIGENCE

2.1 LANGUAGE UNDERSTANDING

Language understanding basically deals with understanding and responding to natural language. It involves translation on spoken language in to written form and also translation from one natural language to another natural language.

2.2 LEARNING AND ADAPTIVE SYSTEM

It deals with ability to adapt behavior based on previous experiences and to develop general rules based on such experiences. Cybernetics and concept formation are example of such systems.

2.3 PROBLEM SOLVING

It involves ability to formulate a problem in a suitable representation, to plan for its solution and also to know when new information is needed and how to obtain it. Inference, interactive problem solving, automatic program writing, heuristic search are some of the steps related to problem solving.

2.4 PERCEPTION

Perception is the ability to analyze a sensed scene by relating it to an internal model which represents the perceiving organism's "knowledge of the world." The result of this analysis is a structured set of relationships between entities in the scene. Scene Analysis and pattern recognition are included in perception.

2.5 MODELING

Modeling is basically the ability to develop an internal representation and set of transformation rules which can be used to predict the behavior and relationship between some set of real-world objects or entities.

2.6 ROBOTS

It basically involves the application of Artificial intelligence in robots which is a combination of most of the above abilities with the ability to move and manipulate objects.

2.7 GAMING

Artificial Intelligence can also be used in gaming. It will help to control the activities involved in the gaming by using our thinking capability. This will in turn make the movements in the game much smarter and easier.

III. APPLICATION OF ARTIFICIAL INTELLIGENCE

3.1 APPLICATION OF ARTIFICIAL INTELLIGENCE IN NETWORK INTRUSION DETECTION

Various Artificial Intelligence techniques are used in Intrusion Detection Systems for the protection of computers and communication network from Intruders. It is basically the process of monitoring the events occurring in network and detecting the signs of intrusion.

3.1.1 ARTIFICIAL NEURAL NETWORK IN INTRUSION DETECTION SYSTEM

Artificial Neural Network in an mathematical model and consists of an interconnected group of artificial neurons which processes the required information. In Intrusion detection system, Artificial Neural Network is used to model complex relationships between inputs and outputs or to find patterns in data. In this process a neuron calculates the sum by multiplying input by weight and applies a threshold. Furthermore the result is transmitted to subsequent neurons.



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3.1.2 FUZZY INFERENCE SYSTEM IN INTRUSION DETECTION SYSTEM

The proposal of two machine learning paradigms is given and they are Artificial Neural Networks and Fuzzy Inference System. SNORT was used to perform real time traffic analysis and packet logging on IP network during the training phase of the system. Furthermore they constructed a signature pattern database using Protocol Analysis and Neuro-Fuzzy learning method. Also testing and validation of the model was carried out using 1998 DARPA Intrusion Detection Evaluation Data and TCP dumb raw data.

3.2 APPLICATION OF ARTIFICIAL INTELLIGENCE IN MEDICAL AREAS

Artificial intelligence techniques have the potential to be applied in almost every field of medical area. Its application can be used in medicine and also its associated application in evolutionary computation of medicine.

3.2.1 FUZZY EXPERT SYSTEMS IN MEDICINE

Fuzzy logic is a data handling methodology that permits ambiguity and hence is particularly suited to medical applications. It captures and uses the concept of fuzziness in a computationally effective manner. The most likely area of application for this theory lies in medical diagnostics and, to a lesser extent, in the description of biological systems. The techniques of fuzzy logic have been explored in many medical applications. Fuzzy logic is preferred over the multiple logistic regression analysis in diagnosing lung cancer using tumour marker profiles. Fuzzy logic is also used in the diagnosis of acute leukaemia and breast and pancreatic cancer and also predict patients' survival with breast cancer. It is also possible to use it to characterize MRI images of brain tumours, ultrasound images of the breast, ultrasound. Fuzzy logic controllers have been designed for the administration of vasodilators in the peri-operative period to control blood pressure.

3.2.2 EVOLUTIONARY COMPUTATION IN MEDICINE

Evolutionary computation is basically a general term for several computational techniques based on natural evolution process that imitates the mechanism of natural selection and survival of the fittest in solving real-world problems. The most widely used form of evolutionary computation for medical applications are Genetic Algorithms. The principles of Genetic algorithms have been used to predict outcome in critically ill patients. Evolutionary computation is also used to obtain MRI segmentation of brain tumours which is used to measure the efficacy of treatment strategies. They have also been used in computerized analysis of mammographic micro calcification.

3.3 IMPROVEMENT OF HOSPITAL INPATIENT CARE USING ARTIFICIAL INTELLIGENCE

Mycin a rule-based expert system which is used for identifying bacteria causing infections and recommending antibiotics to treat these infections was developed in 1970 under the work of CDSS for medical diagnosis. Pathfinder, which used Bayesian networks to help pathologists more accurately diagnose lymph-node diseases. AI has also been useful for computer-aided detection of tumors in medical images. Such approaches help in the diagnosis of various forms of cancer, and congenital heart defects.

3.3.1 ARTIFICIAL NEURAL NETWORK APPROACH ON DIAGNOSTIC SCIENCE

The subsections given below will discuss how ANN is utilized for image classification over generations..

3.3.1.1 ENDOSCOPIC IMAGES

Image classification is an important step in CAD. In classification of endoscopic images a hybrid implementation by advanced fuzzy inference neural network which combines fuzzy systems and Radial Basis Function (RBF) was proposed. The concept of fusion of multiple classifiers dedicated to specific feature parameters with an accuracy of 94.28 percentage but RBF was characterized by a very fast training rate than fuzzy. It extracted both texture and statistical features



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3.4 APPLICATION OF ARTIFICIAL INTELLIGENCE IN ACCOUNTING DATABASE

The use of artificial intelligence is investigated as the basis to mitigate the problems of accounting databases. The following are some difficulties with existing accounting database systems. The needs of decision makers are not met by accounting information. Humans do not understand or cannot process the computerized accounting databases. Systems are not easy to use. There is focus on the numeric data. Integrating intelligent systems with accounting databases can assist in the investigation of large volumes of data with or without direct participation of the decision maker. Thus, the systems can analyze the data and assist the users understanding or interpreting transactions to determine what accounting events are captured by the system. With the artificial intelligence we store and retrieve knowledge in natural language. There are some artificial intelligence tools or techniques that help in the broader understanding of events captured by the accounting system. There is more emphasis on symbolic or text data rather than just numeric data to capture context. The artificial intelligence and expert system builds intelligence into the database to assist users. Without users direct participation such models help the users by sorting through large quantities of data. Such models also assist the decision makers under time constraints; suggest alternatives in the searching and evaluation of data.

3.5 APPLICATION OF ARTIFICIAL INTELLIGENCE IN GAMING.

Specifically Artificial Intelligence can be used in gaming for the purpose of controlling the commands in the game. Currently motion sensor games are available which detects the motion of the player and run associated commands in to action in a specific game. However Artificial Intelligence can be used to control commands which will help the player to make the required commands just by using their thinking capability. Some of the applications of Artificial Intelligence is given below with its required and associated algorithm. Artificial intelligence solves the three common problems: non-playing character (NPC) movement, NPC decision making, and NPC learning. The four artificial intelligence techniques used are Path Finding, Bayesian Networks, Fuzzy Logic, and Genetic Algorithms which help a computer game provide non-playing character path finding and decision making as well as learning.

3.5.1 NPC MOVEMENT USING PATH FINDING

Artificial intelligence computer game must provide a way for a non-playing character to move throughout the game world. For example if person A is the main character and person B have to reach person A then from which path the person B will reach the main player will be decided by Artificial Intelligence. This is the NPC movement problem.. In order to find path in games, the search methods of Artificial Intelligence are used. A* Algorithm is very flexible and also it provides the shortest path possible between two points. Hence it is widely used for path negotiation. This algorithm mainly has 3 major attributes and they are fitness, goals and heuristic or we can also denote this as f, g and h respectively. g is basically the cost to travel from start node to some node between the goals while h is the estimated cost to get from this node to the goal and f is the sum of g and h.

The pseudo code for A* Algorithm is given below.

1. Let P = the starting point.
2. Assign f, g, and h values to P.
3. Add P to the Open list. At this point P is the only node on the Open list.
4. Let B = the best node from the Open list (best node has the lowest f-value).
 - a. If B is the goal node, then quit. A path has been found.
 - b. If the Open list is empty, then quit. A path has been found.
5. Let C = a valid node connected to B.
 - a. Assign f, g, and h values to C.
 - b. Check whether C is on the Open and Closed list.
 - i. If so, check whether the new path is more efficient (lower f-value). 1. If so, update path.
 - ii. Else, add C to open list.
 - c. Repeat step 5 for all valid children of B.
6. Move B from the Open list to the closed list and repeat.



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3.5.2 NPC DECISION MAKING USING BAYESIAN TECHNIQUE

Before negotiating a path there is a different problem that is supposed to be taken in to consideration. To understand the problem let us consider an example. The problem is that if in a building person A is present and how will another computer player B in the game will even come to know or not about the presence of player A in the building. This is the major problem which should be first taken in to consideration and solved before deciding and negotiating the path as explained in previous section. This is an example of NPC Decision making. In this case using this algorithm the computer player is made to think and act like a human and make decisions accordingly. If player A i.e. the active player enters a specific building with creating some noise or disturbance then the player B i.e. the computer will sense the presence of player A by the noise created by player A henceforth giving a human like quality to the computer. After sensing the player A, the player B will start negotiating the shortest path as discussed in the NPC movement using path finding. One possible AI technique to implement this is to use Bayesian Network. It helps NPC to perform complex reasoning in a human like fashion. The computer calculates the probability that player B will sense the presence of player A and it is given by following equation:

$$P(B|A) = P(B|A) P(A) / P(B)$$

Where $P(B|A)$ denotes the probability that player B will sense player A if player A had actually tripped, $P(A)$ denotes that player B will sense player A and $P(B)$ is the probability of player A tripping.

3.5.3 NPC LEARNING

Computer games use the Artificial Intelligence Genetic Algorithms to try and implement learning in NPC's. A genetic algorithm works in the following way:

1. Create a first generation population of random organisms.
2. Test them on the problem that is being solved and rank them according to fitness and if the best organisms reached our performance goals then stop.
3. Take the best performers and mate them by applying genetic operators such as crossover and mutation. Add a few brand-new random organisms to the population to introduce new variety and help ensure against convergence on a local maximum.
4. Loop to step 2.

Genetic Algorithms try and build the perfect specimen and are very complex. This AI technique has not found itself into many modern computer games because it takes a lot of computer resources and time to evolve a specimen or NPC into something worthwhile.

3.6 ARTIFICIAL NEURAL NETWORK IN PSS

In the power systems the most applications of the artificial neural network use a multilayer feed forward network. In the neural adaptive PSS, a feed-forward neural network with a single hidden layer is proposed which includes two sub networks: adaptive neuro-identifier, in which the dynamic characteristics of the plant are tracked and adaptive neurocontroller to damp the low frequency oscillations. Radial basis function network (RBFN) has three layers: input layers, hidden layers, and output layers. The hidden layer find centers and widths of the radial basis functions for individual pattern units and the output layer finds the weights between the pattern units and the output units using an unsupervised learning algorithm. A recurrent neural network (RNN) stabilization controller is proposed to improve the transient stability of power systems in which both the governor and AVR is used. The weight of the proposed controller is adjusted on-line. The signal output of the first RNN is added to the PSS signal output for excitation control. The signal output of the second RNN is used as a stabilizing signal for the governor system. ANNs are intelligent controllers to control nonlinear, dynamic systems through learning, which can easily accommodate the nonlinearities and time dependencies.



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3.7 FUZZY LOGIC IN PSS

In 1964, Lotfi Zadeh developed FL to address inaccuracy and uncertainty which usually exist in engineering problems [10]. A design process for a fuzzy logic based PSS (FLPSS) was proposed for a multi-machine power system. The input signal to FLPSS is the speed deviation of the synchronous generator and its derivative. For the robustness of the FLPSS, five generator power systems were used and for designing a normalized sum-squared deviation index were used. This A novel input signal based FLPSS was applied in the multi-machine environment.

IV. CONCLUSION

The field of artificial intelligence gives the ability to the machines to think analytically, using concepts. Tremendous contribution to the various areas has been made by the Artificial Intelligence techniques from the past many years. Artificial Intelligence will continue to play an increasingly important role in the various fields. This paper is based on the concept of artificial intelligence, areas of artificial intelligence and the artificial intelligence techniques used in the various fields. Artificial Intelligence has several applications like it can be used in gaming, medical application and several others. It can also be used to build smarter products which will add to the benefit of people around. For example the construction of locomotion system for ALS patients requires Artificial Intelligence and it helps ALS patients to attain mobility just by using their thinking capability. Furthermore Artificial Intelligence can replace motion sensor based games as well in future. We conclude that further research in this area can be done as there are very promising and profitable results that are obtainable from such techniques. While scientists have not yet realized the full potential and ability of artificial intelligence, this technology and its applications will likely have far-reaching effects on human life in the years to come.

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