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APPLICABILITY OF ARTIFICIAL INTELLIGENCE IN DIFFERENT FIELDS OF LIFE

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ABSTRACT

In the future, intelligent machines will replace or enhance human capabilities in many areas. Artificial intelligence is the intelligence exhibited by machines or software. It is the subfield of computer science. Artificial Intelligence is becoming a popular field in computer science as it has enhanced the human life in many areas. Artificial intelligence in the last two decades has greatly improved performance of the manufacturing and service systems. Study in the area of artificial intelligence has given rise to the rapidly growing technology known as expert system. Application areas of Artificial Intelligence is having a huge impact on various fields of life as expert system is widely used these days to solve the complex problems in various areas as science, engineering, business, medicine, weather forecasting. The areas employing the technology of Artificial Intelligence have seen an increase in the quality and efficiency. This paper gives an overview of this technology and the application areas of this technology. This paper will also explore the current use of Artificial Intelligence technologies in the PSS design to damp the power system oscillations caused by interruptions, in Network Intrusion for protecting computer and communication networks from intruders, in the medical area medicine, to improve hospital inpatient care, for medical image classification, in the accounting databases to mitigate the problems of it and in the computer games.

Keywords:Artificial Intelligence, Intrusion Detection Systems, Neural Networks (computer), Power System Stabilizer, Computer Vision.

I. INTRODUCTION

It is claimed that artificial intelligence is playing an increasing role in the research of management science and operational research areas. Intelligence is commonly considered as the ability to collect knowledge and reason about knowledge to solve complex problems. In the near Future intelligent machines will replace human 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. John McCarthy coined the term in 1956 as branch of computer science concerned with making computers behave like humans. It is the study of the computation that makes it possible to perceive reason and act. 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 action. It makes machines smarter and more useful. It works with the help of artificial neurons (artificial neural network) and scientific theorems (if then statements and logics). AI technologies have matured to the point in offering real practical benefits in many of their applications. Major Artificial Intelligence areas are Expert Systems, Natural Language Processing, Speech Understanding, Robotics and Sensory Systems, Computer Vision and Scene Recognition, Intelligent Computer Aided Instruction, Neural Computing. From these Expert System is a rapidly growing technology which is having a huge impact on various fields of life. The various techniques applied in artificial intelligence are Neural Network, Fuzzy Logic, Evolutionary Computing, and Hybrid Artificial Intelligence.

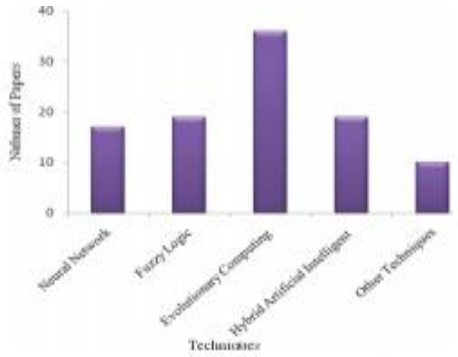

Fig.1: Paper Published on Different Artificial Intelligence Techniques Used [10]

Artificial intelligence has the advantages over the natural intelligence as it is more permanent, consistent, less expensive, has the ease of duplication and dissemination, can be documented and can perform certain tasks much faster and better than the human.

The Turing Test Approach: The Turing test was proposed Alan Turing (1950) .This test was designed to test that whether a particular machine can think or not. The test involves a human interrogator who interacts with a human and with a machine and has to tell who is human and which one is machine. The computer passes the test if an interrogator after posing some written questions, cannot tell whether the written response is coming from human or from the machine.

II. DEVELOPMENT OF ARTIFICIAL INTELLIGENCE

The field of artificial intelligence is relatively young. The creation of Artificial Intelligence as an academic discipline can be traced to the 1950s, when scientists and researchers began to consider the possibility of machines processing intellectual capabilities similar to those of human beings. Alan Turing, a British mathematician, first proposed a test to determine whether or not a machine is intelligent. The test later became known as the Turing Test, in which a machine tries to disguise itself as a human being in an imitation game by giving human-like responses to a series of questions. Turing believed that if a machine could make a human being believe that he or she is communicating with another human being, then the machine can be considered as intelligent as a human being. The term "artificial intelligence" itself was created in 1956 by a professor of

Massachusetts Institute of Technology, John McCarthy. McCarthy created the term for a conference he was organizing that year. The conference, which was later called the Dartmouth Conference by AI researchers, established AI as a distinct discipline. The conference also defined the major goals of AI: to understand and model the thought processes of humans and to design machines that mimic this behaviour. Much of the AI research in the period between 1956 and 1966 was theoretical in nature. The very first AI program, the Logic Theorist (presented at the Dartmouth Conference) was able to prove mathematical theorems. Several other programs were later on developed by taking the advantage of AI such as "Sad Sam,"(written by Robert K. Lindsay in 1960) that understood simple English sentences and was capable of drawing conclusions from facts learned in a conversation . The conclusions drawn depend on the data which is called knowledge Base (KB) in AI.

III. EVOLUTION OF SUB DISCIPLINES OF ARTIFICIAL INTELLIGENCE

The following Fig.2 shows the attachment of AI with other disciplines of Science. It shows how the AI is attached and important for other disciplines.

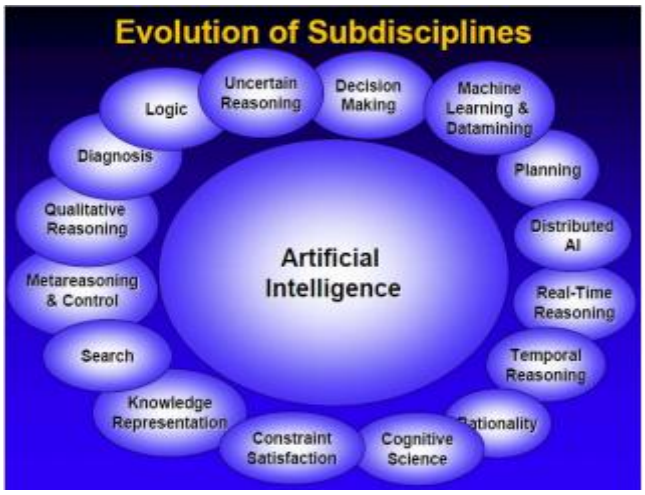

Fig.2: Attachment of AI with other Disciplines of Science

IV.AREAS OF ARTIFICIAL INTELLIGENCE

4.1 Language Understanding

The ability to "understand" and respond to the natural language. To translate from spoken language to a written form and to translate from one natural language to another natural language.

4.1.1 Speech Understanding

4.1.2 Semantic Information Processing (Computational Linguistics)

4.1.3 Question Answering

4.1.4 Information Retrieval

4.1.5 Language Translation

4.2 Learning and Adaptive Systems

The ability to adapt behaviour based on previous experience, and to develop general rules concerning the world based on such experience.

4.2.1 Cybernetics

4.2.2 Concept Formation

4.3 Problem Solving

Ability to formulate a problem in a suitable representation, to plan for its solution and to know when new information is needed and how to obtain it.

4.3.1 Inference (Resolution-Based Theorem Proving, Plausible Inference and Inductive Inference)

4.3.2 Interactive Problem Solving

4.3.3 Automatic Program Writing

4.3.4 Heuristic Search

4.4 Perception (Visual)

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.

4.4.1 Pattern Recognition

4.4.2 Scene Analysis

4.5 Modeling

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

4.5.1 The Representation Problem for Problem Solving Systems

4.5.2 Modeling Natural Systems (Economic, Sociological, Ecological, Biological etc.)

4.5.3 Hobot World Modeling (Perceptual and Functional Representations)

4.6 Robots

A combination of most or all of the above abilities with the ability to move over terrain and manipulate objects.

4.6.1 Exploration

4.6.2 Transportation/Navigation

4.6.3 Industrial Automation (e.g., Process Control, Assembly Tasks, Executive Tasks)

4.6.4 Security

4.6.5 Other (Agriculture, Fishing, Mining, Sanitation, Construction, etc.)

4.6.6 Military

4.6.7 Household

4.7 Games

The ability to accept a formal set of rules for games such as Chess, Go, Kalah, Checkers, etc., and to translate these rules into a representation or structure which allows problem-solving and learning abilities to be used in reaching an adequate level of performance.

4.7.1 Particular Games (Chess, Go, Bridge, etc.) [11]

V.APPLICATIONS OF ARTIFICIAL INTELLIGENCE

5.1 Application of Artificial Intelligent Techniques in Power System Stabilizers (PSSs) Design

Since the 1960s, PSSs have been used to add damping to electromechanical oscillations. The PSS is an additional control system, which is often applied as a part of an excitation control system. The basic function of the PSS is to apply a signal to the excitation system, producing electrical torques to the rotor in phase with speed differences that damp out power oscillations. They perform within the generator's excitation system to create a part of electrical torque, called damping torque, proportional to speed change. A CPSS can be modeled by a two stage (identical), lead-lag network which is represented by a gain K and two time constants T1 and T2. This network is connected with a washout circuit of a time constant Tw. The signal washout block acts as a high-pass filter with the time constant Tw that allows the signal associated with the oscillations in rotor speed to pass unchanged. Furthermore, it does not allow the steady state changes to modify the terminal voltages. The phase compensation blocks with time constants T1i – T4i supply the suitable phase-lead characteristics to compensate the phase lag between the input and the output signals.

The commonly used structure of the PSS is shown in Fig 3.

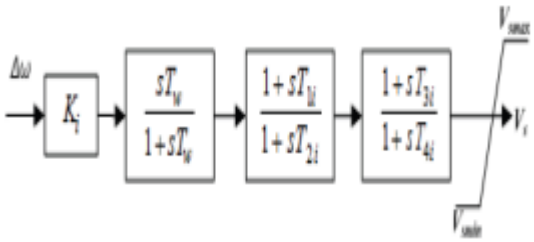

Fig.3: Structure of PSS [10]

In the field of power system operation computer programs are executed and modified frequently according to any variations. Artificial intelligence (AI) has the ability to deal with the high non-linearity of practical Systems. The various technologies that are used in PSSs optimization problems are ANN, FL, ES etc.

5.1.1 Artificial Neural Network (ANN) 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.

5.2 Fuzzy Logic (FL) 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.

5.3 Application of Artificial Intelligence Techniques in Network Intrusion Detection

Intrusion Detection Systems (IDS) uses the various Artificial Intelligence techniques for protecting computer and communication networks from intruders. Intrusion Detection System (IDS) is the process of monitoring the events occurring in network and detecting the signs of intrusion.

5.3.1. Artificial Neural Network in IDS

ANN is a mathematical model that consists of an interconnected group of artificial neurons which processes the information. In IDS ANN are used to model complex relationships between inputs and outputs or to find patterns in data. In this a neuron calculates the sum by multiplying input by weight and applies a threshold. The result is transmitted to subsequent neurons. Basically, the ANN has been generalized to: [6]

$$y_i = f\left(\sum_k w_{ik} x_{k+} \mu_i\right) \qquad (1)$$

Where wik are weights attached to the inputs, xk are inputs to the neuron i, μi is a threshold, f (•) is a transfer function and yi is the output of the neuron.

5.3.2. Fuzzy Inference System (FIS) in IDS

Sampada et al [12] proposed two machine learning paradigms: Artificial Neural Networks and Fuzzy Inference System, for the design of an Intrusion Detection System. They used SNORT to perform real time traffic analysis and packet logging on IP network during the training phase of the system. They constructed a signature pattern database using Protocol Analysis and Neuro-Fuzzy learning method. They then tested and validated the models using the 1998 DARPA Intrusion Detection Evaluation Data and TCP dump raw data. The data set contains 24 attack types. The attacks fall into four main categories viz. Denial of Service (DOS), Remote to User (R2L),

User to Root (U2R), and Probing. From the results, it was shown that the Fuzzy Inference System was faster in training, taking few seconds, than the Artificial Neural Networks which took few minutes to converge. Generally, both techniques proved to be good, but with the Fuzzy Inference System having an edge over Artificial Neural Networks with its higher classification accuracies. Their experiment also showed the importance of variable selection, as the two techniques performed worse when all the variables were used without selection of the variables. Good results were recorded when a subset (about 40%) of the variables were used [12].

5.4 Application of Artificial Intelligence Techniques in Medical Area

Artificial intelligence techniques have the potential to be applied in almost every field of medical area.

5.4.1. Artificial Intelligence in Medicine

5.4.1.1. Fuzzy Expert System 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 [14].Fuzzy expert systems use the structure of a series of if – then rules for modeling.

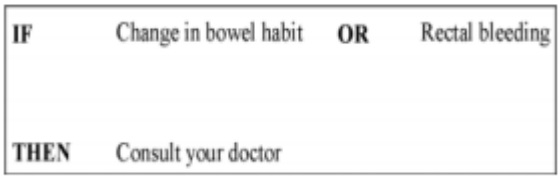

Fig.4: A typical Fuzzy Rule System [1]

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. They can also 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.

5.4.1.2 Evolutionary Computation in Medicine

Evolutionary computation is the 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 [8]. Genetic Algorithms based on the natural biological evolution are the most widely used form of evolutionary computation for medical applications. The principles of Genetic algorithms have been used to predict outcome in critically ill patients. MRI segmentation of brain tumours to measure the efficacy of treatment strategies is also done through evolutionary computation. They have also been used in computerized analysis of mammographic micro calcification.

5.4.1.3 Using Artificial Intelligence to Improve Hospital Inpatient Care: Clinical decision support systems (CDSS) were one of the first successful applications of AI, focusing

Primarily on the diagnosis of a patient‟ s condition given his symptoms and demographic information [4].Mycin a rule-based expert system 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.

5.4.1.4 Artificial Intelligence Approaches for Medical Image Classification

Artificial intelligence techniques are used for diagnostic sciences in biomedical image classification. Model-based intelligent analysis and decision-support tools are important in medical imaging for computer-assisted diagnosis and evaluation. CAD helps radiologist who uses the output from a computerized analysis of medical images as a second opinion in detecting lesions, assessing extent of disease, and improving the accuracy and consistency of radiological diagnosis to reduce the rate of false negative cases [12].

5.4.1.5 Artificial Neural Networks Approach on Diagnostic Science

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

5.4.1.6 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% but RBF was characterized by a very fast training rate than fuzzy. It extracted both texture and statistical features [13].

5.4.1.7 MRI Brain Tumour Analysis

For the MRI brain tumour images a general regression neural network (GRNN) based automatic three dimensional classification method was proposed. This method had good time consuming rate and classification accuracy. Another intelligent classification technique proposed was Least Squares Support Vector Machines (LS-SVM). It identifies normal and abnormal slices of brain MRI data. This technique had a higher accuracy of classification over other classifiers as the false negative in LS-SVM was very low compared. Due to automatic defects detection in MR images of brain, extensive research is being performed.

5.5 Application of Artificial Intelligence in Accounting Databases

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 (either with the decision maker or independent of decision maker) 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 [5].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.

5.6 Application of Artificial Intelligence Techniques in the Computer Games

Playing games is one of the most popular uses for computer technology. In the evolution of computer games, they have grown from modest text based to the three dimensional graphical games with complex and large worlds. The systems as graphics rendering, playing audio, user input and game artificial intelligence (AI) when put together provide the expected entertainment and make a worthwhile computer game. Artificial intelligence is the most important part of every computer game and playing the game without artificial intelligence would not be any fun. If we remove artificial intelligence from computer games, the games will be so simple that nobody will be interested in playing the computer games anymore! Without the game AI, the winning would not be difficult at all. Artificial intelligence is used to solve common problems in the computer games and provide the features to the games. Specifically, non-playing character (NPC) path finding, decision making and learning are examined. There are several ways that AI contributes to modern computer games. Most notably are unit movement, simulated perception, situation analysis, spatial reasoning, learning, group coordination, resource allocation, steering, flocking, target selection, and so many more. Even context dependent animation and audio use AI [2].

Computer Games Problem Solved With AI

Artificial intelligence solves the three common problems: nonplaying 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.

5.6.1 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, When then player is on one side of the building and the monster is on the other, through which path through the building the monster will reach the player? This is the NPC movement problem.AI Search Methods are used to find the path in computer games. A* algorithm is the most widely used for path negotiation because of its flexibility and also because it determine the shortest path between two points. Typical A* algorithms have three main attributes, fitness, goal, and heuristic or f, g, and h respectively. g is the cost to travel from the start node to some node between the goal. h is the heuristic or estimated cost to get from this node to the goal. f is the sum of g and h, or the total estimated cost of a path going through this node. The A* algorithm also maintains an Open list of the nodes that have not been explored yet and a Closed list of nodes that have been explored. The following is pseudo code for the A* algorithm [9].

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 from step 4. [9]

5.6.2 NPC Decision Making Using Bayesian Networks

In the previous example of the monster negotiating a path to the player, a different problem must be solved first before negotiating the path. The problem is does the monster even know the player is present in the building? If the game designers give the full information of the game world to the non-playing character then there would be no fun in playing the game. This is an example of NPC Decision making. In this AI is needed to make the nonplaying character to act in a human like way. When the player enters the building from the other side, the monster will be unaware of the presence of the player because of the wall between them. If the player enters causing a noise disturbance, then the monster will sense the player and will start negotiating the shortest path as discussed in the NPC movement using path finding. One AI technique that is used to implement this is a Bayesian Network. It helps NPC to perform complex reasoning in a human like fashion. In this the computer calculates the probability of the monster sensing the player if the player has entered the building. This expression can be written as;

$$P(B|A) = P(B|A)\,P(A) / P(B) \quad (2)$$

Where P (B|A) is the probability that the monster would sense the player if the player had actually tripped and P (A) is the probability of the monster sensing the player and P (B) is the probability of the player tripping (2).

5.6.3 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 [7].

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. If the best organisms have 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.

VI. 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 last 2 decades. This paper is based on the concept of artificial intelligence, areas of artificial intelligence and the artificial intelligence techniques used in the field of Power System Stabilizers (PSS) to maintain system stability and damping of oscillation and provide highquality performance, in the Network Intrusion Detection to protect the network from intruders, in the medical area in the field of medicine, for medical image classification, in the accounting databases, and described how these AI techniques are used in computer games to solve the common problems and to provide features to the games so as to have fun. There is bright future in the analysis of Network Intrusion Detection and there is also definite future in the area of Power System Stabilizers. 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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