A Modern Approach of Artificial Intelligence Application In Applied Mechanics & Materials

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Abstract. With the development of computer technology, the application of artificial intelligence technology is more and more extensive. This paper summarizes the artificial intelligence technology, including its development process, composition. What's more, the concept of mechanical and electronic engineering is introduced and the relationship between mechanical and electronic engineering and artificial intelligence technology is analyzed. Finally, the development of artificial intelligence in mechanical fault diagnosis is summarized. Taking the fault diagnosis of hot forging press as an example to illustrate the specific application of artificial intelligence in mechanical engineering

Keywords: artificial intelligence, mechanical and electrical engineering, machine learning, neural network, fault diagnosis.

I. INTRODUCTION

Man-made consciousness is an arising innovation science that reviews and builds up the hypothesis, innovation and application frameworks for recreating and broadening human knowledge, including teaches like brain research, intellectual science, thinking science, data science, frameworks science and bioscience. The Artificial insight is indeed the recreation of the cycle of information connection of human intuition, wanting to comprehend the embodiment of human insight and afterward produce a brilliant machine, this insightful machine can be equivalent to human intuition to react and manage the issue [1]. With the nonstop advancement of science and innovation, mechanical designing is likewise continually developing and changing, from the customary mechanical designing to the electronic mechanical designing. What's more, its degree of computerization and intellectualization has a consistent improvement, it went into another phase of advancement, accordingly, the mix of man-made consciousness innovation and mechanical and electronic designing has become an area of interest. Man-made consciousness innovation is applied under the reason of the advancement of PC innovation, which improved the PC innovation through its examination to accomplish the acknowledgment of canny innovation. At the point when Intelligent innovation being applied in mechanical and electrical designing, it mostly accomplished the robotization control of mechanical designing, the utilizations of computerized reasoning in mechanical and electrical designing isn't just the utilization of PC innovation, yet additionally joined with data innovation, brain science, etymology and other information [2]. The motivation behind this paper is to report the piece and advancement of man-made reasoning, as well as the connection between man-made brainpower and mechanical and electronic designing.Above all, it expects to concentrate how computerized reasoning is applied in the field of mechanical and electrical signing.

II. THE RESEARCH DIRECTION OF ARTIFICIAL INTELLIGENCE

2.1 Machine Learning

Machine Learning (ML), which mainly focuses on how the computer simulates human learning behavior, reorganizes the existing knowledge structure with the knowledge and skills learned, and continuously improves its performance. Machine learning is the core of artificial intelligence and it is the only way for computers to have its own intelligence. At present, the machine learning is used in all areas of artificial intelligence, but cannot be used for deductive reasoning [3].

2.2 Expert System

Master framework (ES) is another significant part of man-made consciousness research [4]. It will investigate the overall perspective into the utilization of particular information to take care of explicit

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issues. ES will make the hypothetical exploration of the man-made brainpower into down to earth application; master framework can be viewed as a sort of specific information on PC insightful program framework, it can use aptitude and experience given by specialists in explicit zones and the utilization of thinking methods

in man-made brainpower to take care of and recreate complex issues that can regularly be addressed by specialists. An essential master framework comprises of information base, data set, thinking machine, translation instrument, information securing and UI, as demonstrated in Figure 1.
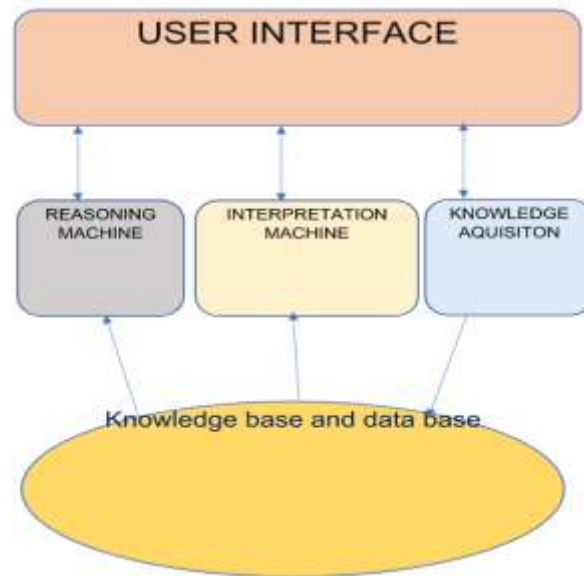

Fig. 1 The basic structure of the expert system

2.3 Pattern Recognition

Example acknowledgment research predominantly incorporates two viewpoints: one is the strategy for impression of the object, which has a place with the comprehension of logical classification; the other one is to accomplish design acknowledgment with the PC under the state of the assignment of the case is resolved. The previous is the exploration substance of physiologists, analysts, scholars and neurophysiologists. The last has been deliberately explored by the endeavors of mathematicians, informatics specialists and PC science laborers, and has been applied in text acknowledgment, voice acknowledgment, finger impression ID, far off detecting and clinical finding, and so forth, it has significantly encouraged individuals' lives.

2.4 Neural Network

Fake Neural Network (ANN) is a number juggling model acquired by abstracting the human neural network from the point of view of data preparing. It is made out of countless neurons associated with one another. Every neuron addresses a particular yield work, called an excitation work. The association between every one of the two neurons addresses a weighting through the associated signal, called the weight. At the point when the neural organization association mode, weight and impetus work changes, the organization yield additionally will change [5].

2.5 Deep Learning

The concept of deep learning comes from artificial neural network research, belonging to a new field of machine learning [6]. Depth learning refers to artificial intelligence beginning to learn, train it, self-master concepts, and recognize sounds, images and other data from untagged data. This approach is closer to the human brain. Deep learning is mainly to build a deep structure to learn multi-level representation, not specifically refers to a machine learning algorithm or model, but a technology.

III. THE CONCEPT OF MECHANICAL AND ELECTRONIC ENGINEERING

Mechanical and electrical designing is a science and innovation covering a wide range of science, the center of which is mechanical hardware, joined with related information on data innovation and keen organization. The hypothesis of these orders has been broadly utilized in mechanical and electrical designing. In the plan of mechanical and electrical esigning, it is important to incorporate the PC innovation, network innovation and mechanical-related innovation, joining the distinctive mechanical segments to improve the plan. Albeit the information is unpredictable in the plan of the mechanical and electronic designing, the plan is generally basic, the construction isn't convoluted, and has great execution. Mechanical and electronic designing has high proficiency, little size when it went to creation, which supplanted the conventional apparatus [7].

IV. THE RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE AND MECHANICAL AND ELECTRONIC

Engineering With the rapid development of electronic information, mechanical and electronic engineering as a basic discipline has been widely used in our life. But the mechanical and electronic engineering also has shortcomings, such as the unstable system, the reason of the problem is the imperfect factor of the electronic information system. Artificial intelligence itself can quickly transfer the information and timely process it, which can effectively make up for this shortcoming. In the process of input and output in mechanical and electronic engineering, the electronic information system will face a lot of difficulties and resistance, if the input information is too complex, electronic information system is likely to make a mistake, then you need to manually solve the problem. If you can combine the two features, you can solve the problems and shortcomings of mechanical and electrical engineering.

V. APPLICATION OF ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING

At present, artificial intelligence technology is often used in the diagnosis of mechanical engineering failure [8-10]. In general, artificial intelligence-based fault diagnosis techniques include rule-based reasoning (RBR), case-based reasoning (CBR), and fault-based tree fault diagnosis. Based on the basic composition and basic principle of the traditional expert system, a mechanical fault diagnosis expert system based on RBR and CBR reasoning is constructed. The overall structure is shown in Figure 2. The system includes maneuver case database, fault diagnosis rule database, fault diagnosis database, fault reasoning machine, knowledge processing, fault diagnosis process interpreter, learning system and expert system man-machine interface.
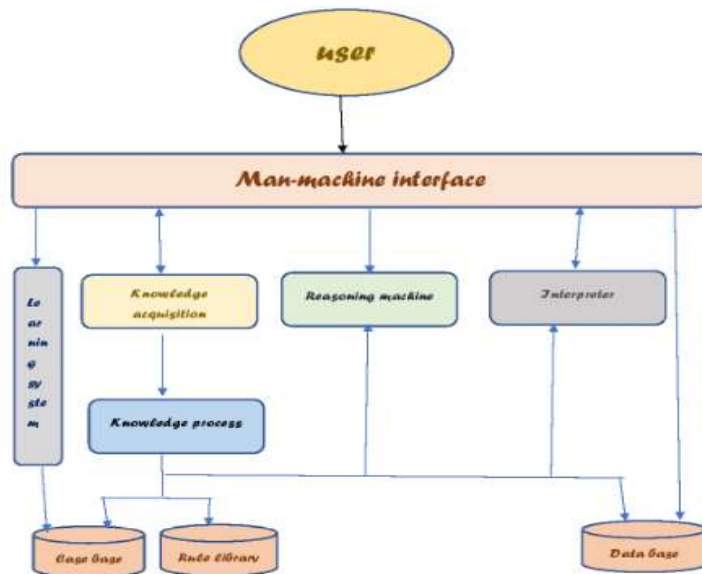
Fig. 2 The overall structure of the system

The basic working process of the diagnosis system is: Firstly, the user input the online data monitored by the machine through the man-machine interface. Secondly, reasoning machine activate the corresponding rules to obtain diagnostic results according to the positive reasoning mechanism, it will provide diagnostic expert advice, and then retrieve the case in the database through a certain algorithm, subsequently, get the most similar case, calculate the similarity according to the historical case, and complete the mechanical fault diagnosis with high efficiency. Finally, it will further improve the expert diagnosis system by adding new cases. 5.1 Intelligent Diagnostic System for Rotating Machinery From the situation of fault diagnosis of mechanical equipment, during the development of several years, the theory and method of fault diagnosis technology of rotating machinery has been improved day by day. In the practical application, it has achieved great economic benefits. In this paper, the fan diagnosis system is used as an example, in fact, it is the universal integrated neural network diagnosis system in the fan fault diagnosis application. The system is composed of two parts: fan and motor. According to the type of monitoring parameters, the main system can be divided into five subsystems: vibration, temperature, noise, oil and performance, in which the fault diagnosis and decision system is core of the whole intelligent system.

5.1 Intelligent Diagnosis System for Reciprocating Machinery Because the reciprocating machinery has a set of high-speed reciprocating motion quality, its kinematics and dynamic morphology is much more complex than the rotating machinery, fault diagnosis is more difficult. The research about failure mechanism and diagnostic methods of research is not enough. Diesel engine is a typical reciprocating machine; integrated neural network diagnosis system is actually a universal integrated neural network diagnostic system in the applications of diesel engine fault diagnosis. Diesel engine failure can be divided into performance failure and mechanical failure. The diagnosis of performance faults can be achieved using a sub-neural network, with performance parameters as input, such as power, speed, cylinder pressure, water temperature and so on. The mechanical fault is diagnosed by two sub-neural networks, and the integrated neural network diagnosis system is formed by using the commonly used vibro acoustic (VA) signal and oil analysis information as input.

5.2 Application of Fault Diagnosis to Hot Film Forging Press In the process of production of hot forging presses, it will produce some common serious problems, such as the slider stopped outside the location of the top dead centre, stuffy car, the main motor current is too high, lubrication failure. There are many reasons for these failures, and the fault diagnosis method of hot forging press can be combined with rule reasoning and case reasoning [11]. The fault diagnosis of the production process of the hot forging press is based on the rule reasoning and the case reasoning. The system carries out the relevant rule reasoning and case reasoning according to the case in the case library and establishes the number of failures. And the nearest neighbour algorithm is used to analyze the similarity of case matching.

The algorithm is as follows:

$$sim(X, A) = \sum_{i=1}^{n} w_i sim_i \left(f_i^X, f_i^A \right) / \sum_{i=1}^{n} w_i , \qquad \text{----(1)}$$

Where, w_i is the weight of the ith attribute, f_i^X represents the value of the ith attribute of the fault X, f_i^A represents the value of the ith attribute of the case A, $sim_i \left(f_i^X, f_i^A \right)$ is the similarity of the fault X and the retrieval case A, $\sum_{i=1}^{n} w_i = 1$. Different types of attribute values, the calculation method of $sim_i \left(f_i^X, f_i^A \right)$ is not the same:

(1) The value of the attribute of the string type is calculated by the TF-IDF method. The similarity is expressed by the cosine of the angle of the weight vector, which is shown in Equations (2) and (3):

$$w_i = f_i \times \lg \left(\frac{N}{N_j + 1} \right), \qquad \text{------(2)}$$

$$sim(X, A) = \frac{\sum_{j=1}^{t} \left[f_{Xj} \times \lg \left(\frac{N_X}{N_{Xj} + 1} \right) \right] \left[f_{Aj} \times \lg \left(\frac{N_A}{N_{Aj} + 1} \right) \right]}{\sqrt{\sum_{j=1}^{t} \left[f_{Xj} \times \lg \left(\frac{N_X}{N_{Xj} + 1} \right) \right]^2} \sqrt{\sum_{j=1}^{t} \left[f_{Aj} \times \lg \left(\frac{N_A}{N_{Aj} + 1} \right) \right]^2}}, \qquad \text{--------(3)}$$

Where, j represents the attribute of string type, $j = 1, \cdots, t$, f_j, f_{Xj} and f_{Aj} is the frequency of the fault; N, N_X and N_A represent the total number of string type attributes in the case; N_j, N_{Xj} and N_{Aj} represent the number of occurrences of a string type attribute in the case.

(2) For the value type attribute is the range of $[a,b]$, the calculation of $sim_i\left(f_i^X, f_i^A\right)$ is as follows:

$$sim_i\left(f_i^X, f_i^A\right) = 1 - \frac{\left|f_i^X, f_i^A\right|}{b-a}; f_i^X, f_i^A \in [a,b],$$

----------(4)

The consequences of case coordinating are recorded in the closeness degree from enormous to little. The plan engineer utilizes the bigger comparability shortcoming analysis to configuration plan, and sets a likeness edge δ to improve the conclusion effectiveness.

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VI. CONCLUSION

This paper reviews the composition and development of artificial intelligence, as well as the relationship between artificial intelligence and mechanical and electrical engineering. It also summarizes the relevant applications in the field of mechanical engineering. Theoretical and practical research shows that intelligent technology has been widely used in all aspects of mechanical systems, coupled with the discovery of knowledge and distributed artificial intelligence and other computer technology, which makes artificial intelligence more effective in the mechanical system and other areas. Because of the increasingly fierce competition in the machinery industry, the hybrid intelligent design, monitoring, control, diagnosis system based on fuzzy logic, neural network, expert system, will be a new research hotspot in order to improve the level of its intelligent control. These applications have very promising prospects.

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