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Artificial Intelligence in Chemical Industry

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ABSTRACT: Artificial intelligence (AI) is the ability of computers to perform activities that require human intelligence. It refers to a collection of techniques that enables computer systems to perform tasks that would otherwise require human intelligence. Those techniques include expert systems, fuzzy logic, and artificial neural networks. AI has had substantial impact on the practice of chemistry and chemical engineering. The paper provides a brief introduction to the use of AI in chemical industry.

KEY WORDS: Artificial Intelligence, Chemical Industry, Expert Systems.

I. INTRODUCTION

Artificial intelligence (AI) is the branch of computer science that deals with designing intelligent computer systems that mimic human intelligence. The ability of machines to process natural language, to learn, to plan makes it possible for new tasks to be performed by intelligent systems [1].

Artificial intelligence has also received increased attention in recent years due to its applications in industrial real-time systems and investments in AI have grown over the years. An important feature of AI technology is that is can be added to existing technologies. AI has benefited many areas such chemistry and medicine, where routine diagnoses can initiated by AI-aided computers. It embraces a wide range of disciplines such as computer science, engineering, machine learning, chemistry, biology, physics, astronomy, neuroscience, and social sciences.

The chemical industry had gone through rapid growth in the United States and all over the world. Success has so emboldened the chemical industry that it regards itself as capable of solving any problems [2].

The major disciplines in AI include expert systems, fuzzy logic, and artificial neural networks (ANNs). Each AI discipline has its own advantages. An expert system (ES) (or knowledge-based system) enables computers to make decisions by interpreting data and selecting between alternatives just as a human expert would do. It uses a technique known as rule-based inference in which rules are used to process data. The fuzzy model is robust to parameter changes and tolerant to impression. ANNs are parallel distributed systems consisting of processing units (neurons) that calculate some mathematical functions. The ANN model represents nonlinear relationships which are directly learned from the data being modeled. Using a combination of these models, rather than a single model, is recommended. The adoption of these AI disciplines in solving practical problems in chemistry is very promising [3,4].

II. APPLICATIONS

Chemistry is a fertile ground for applying and developing AI technology. Areas of applications of AI and expert systems include [5]:

- Process control: several industries
- Chemical synthesis and analysis
- Manufacturing: planning and configuration
- Waste minimization
- Signal processing: several industries

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- Mineral exploration
- Intelligent CAD
- Instrumentation: monitoring and data analysis
- Medical diagnosis and treatment
- Chemometrics

In the petroleum and chemical industry, AI technology can effectively control the production process, optimize the process technology, improve production efficiency, and reduce energy consumption.

Artificial intelligence-driven discovery of chemical synthesis could have a wide-ranging impact on the chemical or pharmaceutical industry, food, chemical, and materials industries. By using AI-driven automation, alongside using AI technologies in new emerging areas, artificial intelligence could vastly boost productivity and economic growth in chemical industry.

The process control systems and chemical plants usually require the systematic coordination of several tasks which may require data, numerical algorithms, decision-making, and human intervention. AI can use computers to automate many of these tasks [6]. AI algorithms such as ANN and ES can be developed using MATLAB and LabView and implemented on a specific process [7].

III. CHALLENGES

Just like other technologies, AI comes with challenges, such as accountability, security, technological mistrust, and the displacement of human workers. These are clear challenges that must be addressed to support AI technology's future. The stakeholders must ensure that AI's impact is a positive one by proactively tackling the challenges, while ensuring the opportunities remain available.

Artificial intelligences are computer systems and do not share human values. We tend to anthromorphinze AI and attribute them with moral values and personal traits such as "good," "evil," "friendly," and "unfriendly." AIs will not share these human traits unless we program them to do so. In the same way, lawmakers should be careful not to make strict rules because such rules may prevent progress of AIs [8].

IV. CONCLUSION AND FUTURE WORK

Artificial intelligence technology can change the world for the better. Its scope in chemistry and chemical engineering is wide. It can make chemical procedures safer, increase productivity, and boost the economy. Advances in knowledge in general and AI in particular will benefit chemical industry.

Regardless of the challenges, AI is posed to affect the world's economies, citizens, and the Internet. More information about AI in chemical industry can be found in the book by Quantrille and Liu [9]. The book is a comprehensive, readable, exposition of the emerging science of artificial intelligence as it relates to the practice of chemical engineering or the chemical process industries.

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