APPLICATION RESEARCH OF ARTIFICIAL INTELLIGENCE IN ELECTRICAL AUTOMATION CONTROL

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Abstract— The main aim of this paper was to review the application of artificial intelligence in electrical automation control. Artificial intelligence technology has progressively influenced most facets of people's lives as contemporary science and technology have progressed, particularly in the field of electrical automation control, which has yielded positive outcomes. Technological advancements in artificial intelligence have transformed the old method of operation and infused fresh energy into the area of electrical automated control [1]. The use of artificial intelligence in electrical automation control is a step forward from the conventional model to the intelligent mode of operation. It has taken several years to establish electrical automation control systems. Even though AI has a technological system that is very sophisticated, it still has a lot of room for progress and promise in several areas. The introduction of artificial intelligence technology may considerably increase the efficiency of electrical automation control while also broadening the range of applications for electrical automation control that are now available [1].

Keywords: Electrical automation control, automation, artificial intelligence, technological system

I. INTRODUCTION

Automation of electrical systems using artificial intelligence may be seen as an intelligent upgrade to the current industrial process. The advancement of artificial intelligence technology, which combines intelligence for numerous reasons, is critical to its use [1]. Electrical automation control technology has evolved into a rather mature technological system, and the use of artificial intelligence technology expands the field's possibilities. When artificial intelligence (AI) is used in electrical automation, it may enhance control efficiency and broaden the area of use for the system even further. As a result of the combination of big data and cloud computing technology, as well as electrical automation, the economic potential of relevant data can be stimulated to the fullest, allowing cloud computing technology to address the issue of data information while also allowing accurate and objective data analysis to be performed [2].

II. PROBLEM STATEMENT

The main problem that this paper will address is to review the significance of artificial intelligence in enhancing electrical automation control. As market rivalry heats up, businesses that wish to stay afloat must continually improve their competitiveness. Artificial intelligence is a significant tool for boosting a company's competitiveness by lowering operating costs and enhancing operational quality [2]. Intelligent assessment is mostly used in two areas: the first is to provide early warning

before a problem occurs, and the second is to provide a diagnostic once the issue occurs. The use of intelligent monitoring technologies, real-time tracking of anomalous data, and prejudging issue equipment or networks may all be signs that an electrical engineering network, whether it be hardware or circuit design, has a problem [2,3]. To fix the issue once it occurs, artificial intelligence uses neural networks, fuzzy theories, and expert databases to speed up troubleshooting, keep the system up and running, and cut down on business losses. The intelligence level of electrical automation equipment must be continually increased to achieve reliable operation and predictive operation and maintenance in electrical automation equipment.

III. LITERATURE REVIEW

A. Artificial Intelligence Technology's Value in the Real World

The implementation of artificial intelligence technology has become necessary in the knowledge-based economy due to the fast growth of social science and technology, which has had a significant impact on people's professional and personal lives. A tremendous achievement of human science and technology, artificial intelligence is built on computer and big data technologies. In a nutshell, artificial intelligence (AI) is an integral part of the human intellect, allowing us to replace humans with machines and free up labor for more complex and high-yielding jobs [3,4]. Artificial intelligence (AI) is an important area of research and development and technology because it can create new smart automation configurations that are close to human cognition, like natural language recognition encoding, image processing, by extensively interpreting the essential nature of intelligent systems. Electrical automation utilizes artificial intelligence technologies. Instead of manually operating equipment, artificial intelligence may automate it using computer technology, increasing the precision of equipment control while also reducing resources and labor expenses by a substantial margin [4].

B. A Study of Artificial Intelligence's Applications in Electrical Automation

i. Use in Electrical Equipment

Electrical automation control makes use of artificial intelligence technologies. When it comes to electrical equipment design, the procedure is quite complex, and the skills needed for specialists are extremely stringent [4,5]. Technical professionals must not only be knowledgeable about circuits, electromagnetic fields, motors, and other electrical appliances on a professional level, but they must also possess extensive design experience. If they are confronted with a crisis, they will need better judgment to deal with an unexpected circumstance quickly [6]. Designing electrical equipment traditionally involves a lot of manual preparation, which results in an overly active

electrical automation design that falls short of expectations. To make things better, in the long run, electrical equipment programmers will be able to use artificial intelligence technologies to fix this issue.

ii. Using AI in Normal Operation

The constant advancement of civilization has resulted in a significant improvement in people's living conditions. There is no shortage of electrical equipment in any situation, whether it is personal, professional, or academic [6]. Electrical equipment operating stability is critical for the safety of people's lives and livelihoods. Electrical equipment must be operated and used following the manufacturer's specifications and operating guidelines. Because of the tight operation processes, faults in a single connection may lead to major operational problems and catastrophic repercussions, which adds complexity to typical operation techniques [7]. As artificial intelligence improves, these issues will become less of a concern, as it will simplify equipment operating procedures, increase efficiency, and identify incorrect operations intelligently, allowing the system to make corrections and even eliminate errors. When artificial intelligence technology is used, electrical equipment's safety and stability are improved dramatically [8]. This has a significant impact on electrical equipment's overall functioning, as well as its overall use.

iii. Accident and Fault Diagnosis Applications

Accident and fault diagnostics are done while electrical equipment is in use to evaluate and identify the state of the equipment's functioning. Detecting anomalies is simple; once they are discovered, the problem area, type of problem, and remedy plan are all easily determined [8,9]. Electrical equipment is inherently susceptible to a variety of malfunctions and mishaps, and this is particularly true while it is in use. Because of this, even a tiny failure may escalate to big failures and safety mishaps, putting the interests of the firm's workers and electrical system at risk, as well as having highly severe public ramifications. Using artificial intelligence technologies is critical for quickly and accurately identifying defects in electrical machinery [9].

iv. Use in Electrical Control Work

Keeping the control equipment in a good working state is critical in the electrical automation control system since it has a direct impact on the system's overall performance. Automation equipment that uses artificial intelligence has recently emerged as the most popular choice. Artificial intelligence (AI) technology has the potential to increase system performance while simultaneously lowering manufacturing and operating costs. Intelligent electrical automation may be achieved via the use of new control technologies including fuzzy logic, Shenjing networks, and expert systems in artificial intelligence [10]. A good example is the fuzzy control technology which primarily governs the operation speed of the equipment. It is an important communication control technology that significantly enhances the work performance and reliability of electrical equipment [10,11].

v. Artificial Intelligence Technology for Product Design

A team of designers is mostly responsible for designing the classic electrical automation systems. Because of the absence of technology and the high degree of subjectivity, this design technique falls short in various respects [12]. A rise in national economic status, along with advances in science and technology, prompted the appropriate departments to increase funding and resource allocation to enhance the design of electronic equipment. More and more study outcomes have been accomplished in advanced countries. These fields have benefited substantially from artificial intelligence technologies being used in their development and use. Overall automation productivity of product manufacturing has been substantially increased by using artificial intelligence techniques in electrical automation systems, and artificial intelligence features have been incorporated into product design to assure maximum product quality [13].

C. Artificial Intelligence Application Strategy in Electrical Automation

i. Design and development of electrically automated devices

We know from experience that the electric automation system is extremely complicated, requiring highly trained and skilled personnel to operate it. This is necessary to reduce the risk of improper handling and human error, which could lead to various types of malfunctions and mishaps, and ultimately to the loss of valuable time and resources [13]. As a result, artificial intelligence technology will be critical in solving this challenge. The computer intelligent control may be accomplished by using computer theory to construct suitable electrical automation equipment software. Electrical equipment that operates on its own may eliminate the need for human intervention, which not only increases productivity but also lowers operating and design expenses [13]. Figure 1 depicts the artificial intelligence technology's electrical automation control system. Aside from that, artificial intelligence technology has the potential to enhance the scientific functioning of electrical automation equipment while also optimizing the real-world environment in which the equipment operates.
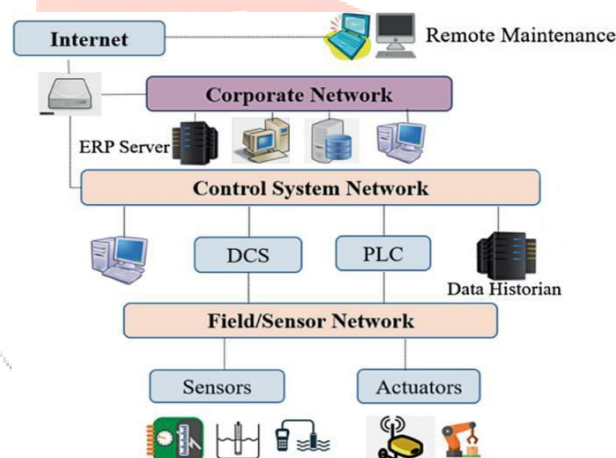

Fig.1 Electrical Automation Control System

D. Conceptualization of Electrical Process Control Design

As a critical component of the electric automation control system, the electrical control connection can enhance electronically controlled capabilities while also enhancing the productivity of electrical automation system operation [15]. This will allow for the realization of science-based production through automation while also lowering operational costs. Expert systems, neural networks, and fuzzy control are often used in the electronic control design process. For example, the fuzzy control system uses fuzzy language as a parameter, relies on logic, and leans extensively on expert knowledge while making decisions. As may be seen in Illustration in fig ii is an illustration of a fuzzy control system which is a type of self-control system, and it falls to this category. A computer-controlled closed-loop digital control system with input channel topology is built utilizing fuzzy logic decision rules [15].
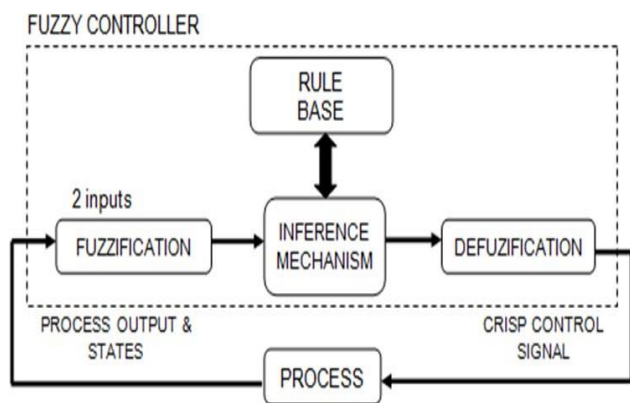
Fig ii: Composition of Fuzzy Control System

E. Conceptualization of Fault Diagnosis

Electrical automation equipment installation failures are often preceded by warning indicators such as those described above. As a result, a discrepancy between these two warning indications suggests a problem with the device itself. So, while operating electrical automation equipment, professionals often depend on their knowledge to accurately forecast these symptoms, assess the sort of equipment malfunction, and correct the problem before it becomes a larger issue. When artificial intelligence (AI) technology is used in an electrical automation system, electronic equipment problems may be correctly located, maintained, and dealt with, allowing electrical equipment to run efficiently and steadily [16]. Artificial intelligence technologies such as neural networks and fuzzy controls are now frequently employed in electrical equipment failure diagnostics. For instance, utilizing artificial intelligence techniques, transformer fault analysis, and diagnosis may examine the oil and gas in the transformers and utilize the findings of the study to determine the kind of transformer problem, allowing specific steps to be taken to resolve the issue [17,18].

F. Utilization of AI in Day-to-Day Operations

Technical professionals are required to operate an electrical automation system that has a complicated operation and tight standards for its operation. There will be a variety of issues with manual operation, and doing the task incorrectly will result in failure and monetary loss. It may increase the precision and efficiency of the operation by using artificial intelligence technologies. Aside from that, the streamlined user interface enables remote control and operation of the electrical system, which improves production efficiency and ensures the electrical system's stability while conserving money and resources efficiently.

G. Improved Electrical Automation Process Control Simplicity

If a problem occurs with an electrical automation system, the mechanical equipment might be significantly damaged. Engineers are now focused on ways to standardize electrical automation equipment control while also simplifying and programming operation to the greatest extent feasible. Electrical engineering automation can store and evaluate everyday materials more efficiently thanks to the integration of artificial intelligence technologies [18]. When machine malfunctions, appropriate action may be done right away to keep things running smoothly. With artificial intelligence, it is possible to manage electrical equipment from a distance while also improving monitoring and maintenance of electrical equipment. This will result in more operational efficiency while also

providing inspectors with more comfort during equipment inspection.

IV. FUTURE IN THE U.S

Electrical engineering in the United States now has enormous potential and scope for optimization thanks to artificial intelligence, and this will lead to significant improvements in economics, safety, and operational control. Because of the widespread use of artificial intelligence since its invention, it has had a noticeable application influence and even spelled out the path of growth for many industries, the area of electrical automation control not being an exception. Using artificial intelligence has accelerated the development of practical electrical automation and should be given top priority by businesses and employees alike. According to DOE projections, by 2030, 80 percent of the power generated will be used by devices based on power electronics, both domestically and abroad. Increasing the usage of power electronics on the grid in this way will have some advantages. Rotating equipment has traditionally been used to generate system inertia. Much of the system inertia may be replaced and even improved using power electronics. However, a growing dependence on power electronics has several drawbacks. Power electronics have specific stability and failure mechanisms that must be evaluated, investigated, and perhaps minimized.

V. ECONOMIC BENEFITS IN THE UNITED STATES

The benefits of using artificial intelligence in electrical automation control in the United States will have various economic ramifications across a wide range of industries. Automation lowers the cost of items produced by businesses. Significant economies of scale may be achieved by automation, which is critical in businesses requiring substantial up-front investment. Additionally, automation allows for higher cost savings due to the reduction in labor requirements. Because of this, a single facility can now create a wider variety of items, which is as essential to businesses as reduced labor costs per unit. There was an emphasis on low-cost manufacturing in the 1950s. Consumers now expect a higher degree of personalization from the things they buy. Instead of purchasing a conventional model off the production line, automation allows customers to customize the size, appearance, and functionality of their fridge. Automation may have a variety of positive effects on society as a whole, in addition to the advantages, it provides to businesses. More options for products and services have made life easier for customers. One basic example of automation is the use of ATM cash machines, which allow individuals to withdraw cash even when banks are closed. More discretionary money may be spent on a broader variety of goods and services due to decreased manufacturing costs. New occupations are created that are more creative and needless repetitive work, and this opens up the labor market to more flexibility. If young people don't want to work in a factory doing monotonous tasks, they may train to be software engineers who create the concepts, designs, and manufacturing procedures that robots will use.

VI.   CONCLUSION

This research paper discussed how artificial intelligence is used in electronic automation control. A review of artificial intelligence, including its use in electrical equipment, electrical control, and problem diagnostics is presented in this study. While science, technology, and the social economy continue to advance, so does the maturity of applications for artificial intelligence. Due to these benefits in operational efficiencies, reliability, and problem detection that may be achieved by integrating artificial intelligence into the electrical automation system, which can help companies save money and time. The industry's operating costs, boost the company's economic and social advantages. A major advance in electrical automation is now being spurred by artificial intelligence (AI) technologies. Artificial intelligence is now extensively applied in electrical automation control, raising the field's profile. However, there are still some issues with the application process itself. As a result, experts in the field should continue to research and develop new applications of artificial intelligence technology to spur further progress and advancement.

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