SYSTEMS TO INTELLIGENT AUTOMATION

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Abstract: This study explores the profound impact of artificial intelligence on industrial automation and focuses on the revolution of autonomous systems. A detailed literature study shows major improvements in AI technologies such as machine learning, computer vision, and natural language processing that improve the capabilities of robotic systems. Key approaches used in diverse studies include integrating AI with legacy systems, making real-time decisions, and developing intelligent robotic systems. Data quality issues, integration with current infrastructures, and the challenges of human-robot collaboration are all rigorously examined, as are the ethical considerations and security risks that come with the introduction of AI-driven technology. The findings emphasize the importance of addressing operational challenges in order to fully benefit from AI-enabled automation, paving the way for a more sustainable and efficient industrial landscape.

Keywords: Machine Learning Algorithms, Industry Problem-Solving, Smart Robots, Industrial Automation, Robotic Process Systems

Introduction

Topic Presentation Artificial Intelligence [AI] concentration on getting machines to do things that we would demand intelligent behavior [Donepudi 2018]. In the term of robotic Process automation, robot refers to a software-based solution, programmed to carry out procedures, processes or tasks on the repetitive way that are usually done by human. Automation plays a crucial role in robotics by streamlining processes, reducing human effort, improving efficiency, and increasing productivity [Sharma et al. 2022]. AI decision making serves as the future of intelligence in businesses. For

several decades, the backbone of modern business has been data. It has helped businessmen and entrepreneurs shape their decisions. Besides, it allowed them to learn in-depth about their customers. However, with all the data comes a price; the human brain cannot process it all. That is where artificial intelligence [AI] and its decision making in business intelligence come in. AI has considerable potential to speed up design and programming of robotic automation, though this is in early stages of development [Frankfurt 2022]. Background information AI is still in its infancy in real-world applications of robotics. Traditionally, automotive and electronics manufacturers - the main adopters of industrial robots – have looked for precision, speed and predictability from their robot. Achieving these characteristics does not require AI [Frankfurt 2022]. Robots have become increasingly prevalent in various industries, revolutionizing automation processes. They are utilized in manufacturing, healthcare, agriculture, transportation, and more. With advancements in artificial intelligence [AI], robots are evolving from simple automated machines to intelligent and autonomous systems, capable of perception, learning, and decision-making. Existing research on industrial automation using AI covers a wide range of applications and techniques oriented at enhancing efficiency, precision, and decision-making in industrial processes. These major areas are illustrating the significant achievements they are predictive maintenance, process optimization, Quality control, Decision-Making, Robotics and Automation. This ongoing research efforts in integrating AI with industrial automation to create smarter, more efficient and resilient industrial systems. 1.3 Research Problem In today’s industries, machines often need to make decisions quickly to keep everything running gracefully. However, many of these machines can't adapt to sudden changes in their context, which can lead to mistakes, delays, and wasted resources. This is where Artificial Intelligence [AI] comes in. AI can help machines interpret a lot of information, like data from sensors that track how equipment is working in real-time. By doing this, AI can find patterns and make smart choices on its own, like when to fix a machine before it breaks. But there are still some challenges. For example, not all data is consistence and it can be hard to combine new AI systems

with older machines. Automation involves the use of machines, including robots, to perform tasks with minimal or no human intervention [Sharma et al. 2022]. To make the most of AI in industrial settings, we need to tackle these problems. This will help industries run more efficiently, save money, and boost productivity. Industrial developments in robotics, coupled with the advancements in the research laboratories, have profoundly affected robotics in different sectors of the technical world [Kurfess 2005].

Objectives A machine that is able to make decisions on its own is said to possess AI. There is a broad spectrum of applications for AI, ranging from machine learning to robotics. By combining the current advancements in machine and deep learning, huge amounts of data from various sources are reviewed by utilizing AI to identify patterns and make intelligent predictions [Sharma et al. 2022]. As intelligence is added to robots, they will not only be able to perform more flexibly in manufacturing, but will begin to be evident in tasks outside the industrial environment. Thus, robots in firefighting, under seas exploration, mining, and construction will appear [Gevarter 1984]. To improve productivity, adaptability, and flexibility in industrial environment, intelligent robotic systems are developed [Soori et al 2024]. The main aim of using AI in robotics is to better manage variability and unpredictability in the external environment, either in real-time, or off-line. This offers benefits for manufacturers, logistics providers and retailers dealing with frequently changing products, orders and stock in so-called ‘high mix/low volume’ environments [Donepudi 2018]. Industrial automation using AI refers to the integration of artificial intelligence technologies with industrial processes to enhance efficiency, accuracy, and decision-making. This involves using AI algorithms, machine learning, and robotic process automation [RPA] to automate complex tasks, optimize operations, and improve productivity in manufacturing and other industrial sectors [Frankfurt 2022].

Recent developments in industrial automation have led to the implementation of advanced techniques that enhance decision-making and process optimization. Figure 1 depicts how all the LLM models are connected to cloud services.

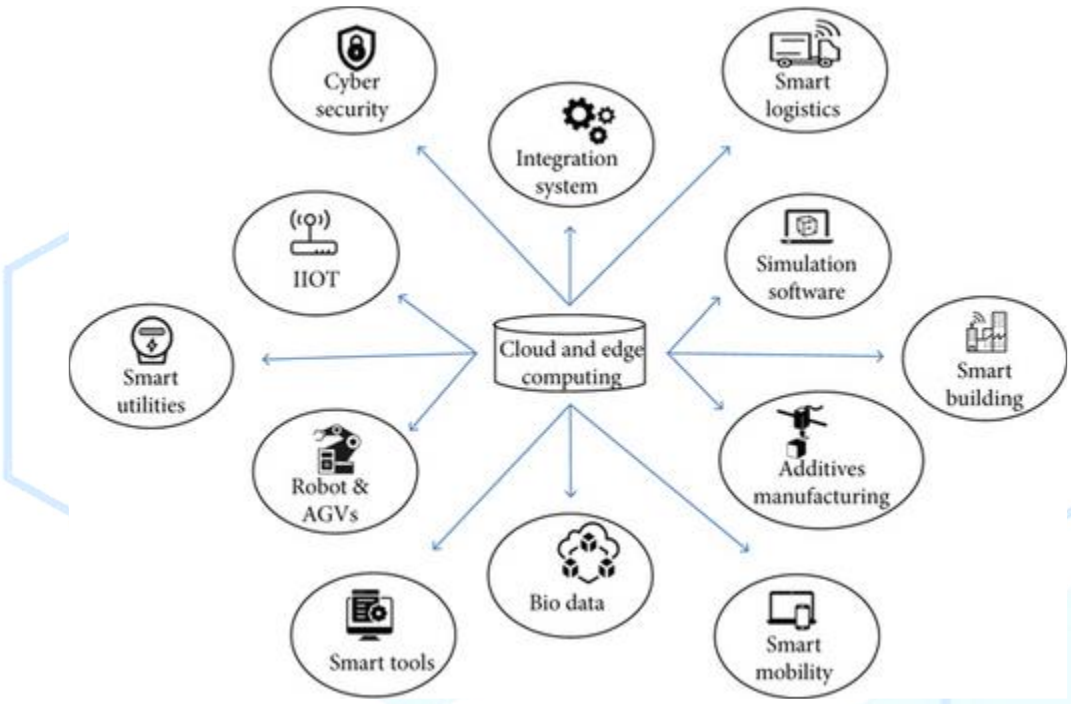

Figure 1. Depiction of all the sources being connected to cloud services

Precision and recall are the fundamental metrics in assessing AI decision-making accuracy, particularly in industrial automation systems like predictive maintenance, quality control, and fault detection. Precision measures the proportion of true positives among the predicted positives, reflects how accurately the AI system makes correct decisions.

Recall on the other side evaluates the ability of the AI system to capture all relevant outcomes, determining how well it identifies all the defective products or process issues.

Sharma et al. [2021] documented a study in a manufacturing plant where AI-driven quality control systems exhibited high precision [95%] but slightly lower recall [85%], indicating the system was highly accurate in its detections but missed some faults.

Conclusion

Applying the concepts of Artificial Intelligence [AI] in industrial automation is a major technological advancement in decision making. Real-time analysis of extensive data as well as adaptability when it comes to the conditions has made AI an essential part of present industries such as predictive maintenance, process

improvement, and robotics. However, there are critical issues that converge with the use of an AI system for industrial automation; for instance, compatibility issues when automating different systems, data quality and preparing the AI system for decision-making complexities, high costs and energy of real-time operational automation. Further, the ethical issue and security concerns are also some of the issues that should warrant handling before the implementation of the technology can take place.

However, using the study, it becomes clear that AI and more specifically machine learning, neural networks, and reinforcement learning models present the required tools to improve operational performance, minimize the interference of human elements and make best decisions in a contexted environment. Currently, industries are shifting toward more intelligent and self-optimizing systems due to improvements of AI technologies including the IoT and edge computation. For AI to be efficiently utilized in industrial automation there are a number of challenges that have been pointed out and below will be advisable to avoid them; Adequate policies and faculties will be required to support the use of AI.

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