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Industry 4.0: Employing Industrial Robots in Manufacturing Industry of Modern Era

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ABSTRACT: The use of artificial intelligence, sophisticated robotics technology, big data processing, and their interconnectedness is known as "smart manufacturing," which uses these technologies to improve industrial performance and optimize the energy and manpower needs. Industry 4.0, often known as the fourth industrial revolution, is now all around us, but the idea is not widely accepted. Numerous facets of human existence in all spheres will be enhanced by the adoption of Industry 4.0. The adoption will lead to changes in business paradigms and production models, which will have an impact on supply chains and all stages of production processes, as well as on designers of cyber-physical systems, managers, and end users. For fourth industrial revolution and harness the potential of smart manufacturing process, industrial robots are one of the main component to be employed. Therefore, in this review, the author has provide a quick overview on the type of the robots, the fundamentals about the industrial robots as well as their application and role in different kind activities in manufacturing industries.

KEYWORDS: Automation, Industrial Robots, Manufacturing, Packaging, Warehouse.

1. INTRODUCTION

Robotics solutions are increasing production, improving safety, and offering more flexibility in a range of sectors, from meticulously harvesting crops to manufacturing cars and delivering pharmaceuticals. Forward-thinking robotics applications are helping innovative businesses achieve measurable outcomes, they say. Robotics solutions are being used in an ever-growing range of sectors and applications as producers of robotics keep introducing advancements in terms of capabilities, cost, and form factor. Human can now employ robots to serve essential objectives in a variety of ways thanks to improvements in processing power and AI capabilities[1], [2]. Today's robots may typically be divided into six types, notwithstanding the wide variety of robotics applications including delivering instructions, welding metal in hazardous locations, stocking shelves, and much more [3].

1.1. *Diverse Range of Robots being employed in Modern era*

1.1.1. *Robotic Arms*

Robotic arms and articulated robots are technologies designed to perform tasks that the human arm would normally perform. In general, they can have two to ten rotary joints. Material handling, Arc welding, machine tending, and packing all benefit from the increased range of motion that each new joint or axis enables[4].

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1.1.2. *Autonomous Mobile Robots*

AMRs travel the planet, making choices in near real time. Cameras and sensors assist them in acquiring information about their environment. Onboard processing technology assists them in analysing information and making a well-informed decision, whether this is retreating to avoid an incoming worker, choosing precisely the correct package, or choosing an ideal area to sanitize. They are mobile solutions that require little human input to function [5].

1.1.3. *Cobots*

Cobots are intended to work alongside or directly with humans. While most other types of robots conduct their jobs alone or in completely separated work locations, cobots may share workspaces with employees to assist them in accomplishing more. They are frequently utilised to reduce laborious, hazardous, or difficult chores from daily workflows. Cobots can work in some circumstances by responding to and learning from human motions.

1.1.4. *Articulated Robots*

Articulated robots (also known as robotic arms) are designed to perform functions similar to those of a human arm. These are typically made up of two to ten rotary joints. With each new joint or shaft, the range of motion increases, making them suitable for arc welding, handling of materials, machinery tending, and packing.

1.1.5. *Hybrids*

Robots of various sorts are frequently joined to produce hybrid systems capable of performing more complicated tasks. An AMR, for example, may be paired with a robotic arm to produce a robot capable of handling items within a warehouse. As even more complexity is condensed into single solutions, computational abilities are centralised as well[6].

1.2. *Understanding Industrial Robots*

Industrial robots are devices that can be programmed to carry out manufacturing-related activities for automobiles. Robots are used in many different sectors for flexible automation and high levels of output. These robots can perform intricate sequences of tasks while speeding up manufacturing.

In the early 1960s, General Motors employed UNIMATE as its first industrial robot. Manufacturing robots are capable of carrying out a variety of tasks, including packaging and material handling. They are therefore created to carry out a variety of repetitive operations and shorten the time needed for manufacturing. In reality, artificial intelligence and machine learning algorithms are built into industrial robots to assist the manufacturer react to urgent circumstances[7].

Applications for industrial robots may be found in many manufacturing industries, including factories and warehouses. Industrial robots are crucial to the automation industry in this new era of manufacturing, which has led to a huge increase in output. Manufacturers may lower manufacturing costs, increasing the production speed, and improve product quality by using industrial robots.

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The industrial robot requires a significant investment, but it also offers substantial rewards. Industrial robots are thus worthwhile investments since they operate productively in manufacturing. The handling robots are the industrial robots that move the products in a warehouse. Additionally, picking robots include those that choose products and put them in a shipping bag. An eCommerce business can benefit from using these robots. In summary, further examples of picking and handling robots are liquid handling robots, pick and place robots and material handling robots[8] (Figure 1).

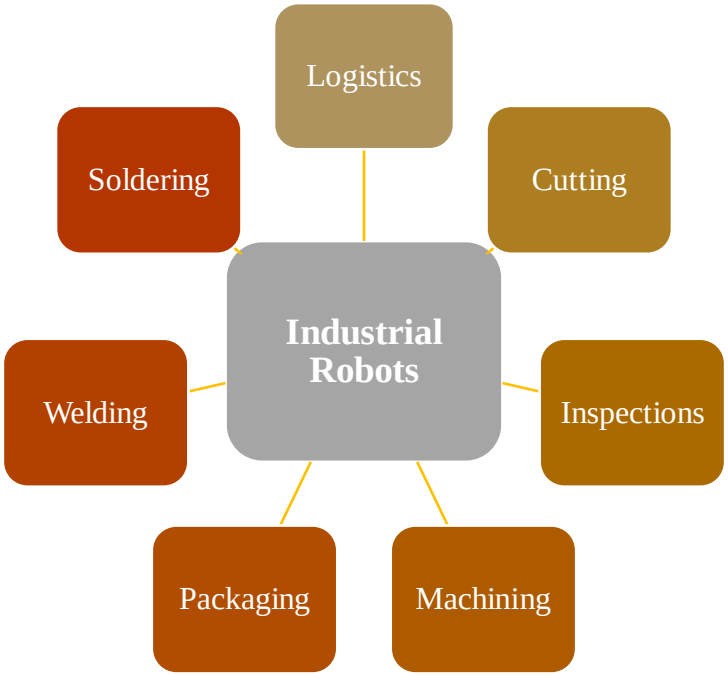

Figure 1: Illustrating the Different Applications of Industrial Robots in Manufacturing Process.

1.2.1. *Cutting, Machining, Soldering and Welding of Material*

Repetitive actions are necessary in any industrial setting or field of manufacturing. Robots are therefore the only way to automate the procedure. Similar to how different robots are needed in the machine and cutting industries of the industrial industry, including milling robots, lesser cutting robots, machine tending and loading robots, plasma cutting robots, drilling robots, and waterjet cutting robots[9].

Arc welding is a technique used in industry to join metal parts using electricity. Metal parts can link and become permanently bonded as they cool thanks to the heat. Arc welding robots, on the other hand, streamline the procedure by automating it. Following that, this automated procedure is currently expanding[10].

Undoubtedly, melted filling material is needed to strengthen the junction during the soldering. Therefore, this material's melting point is lower than the workspace's. Most notably, the soldering robots contribute to the automation and speed of this procedure.

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1.2.2. Packaging, palletizing, Logistics and Storage

Packaging and palletizing techniques are used in a variety of sectors, including manufacturing, distribution, and warehousing environments. Robots are also required for packaging smaller packages because it is a tedious procedure. Two robots, for instance Palletizing and packaging robots are needed for this procedure.

To move the items or any workpiece, as the name implies, certain logistics are required. Therefore, delivery robots are needed at the warehouse to do this task. Automation is also required for things like labelling, packing, and shipping. In conclusion, two examples of industrial robots are warehouse and delivery robots.

1.2.3. Inspection, Quality Control and Harvesting

There are several serious and life-or-death inspection and quality control challenges. In the same way, if we don't put that component in, something terrible may happen that could endanger our lives. So we need robots to get 100% accuracy. So far as inspection and quality control applications go, vision robots are the finest example.

Harvesting fruits and vegetables on schedule is crucial, but it comes first. On the other hand, timely harvesting is necessary to guarantee a high-quality product. Since they require timely harvesting, grains are a time-sensitive crop. So we need a Harvesting robot to complete this duty.

2. DISCUSSION

The fusion of human and robot talents will become increasingly more crucial in the future to preserve human health, environment, and safety and sustainable conditions for workers while also increasing quality and productivity. This will undoubtedly inspire manufacturing scenarios in which people and industrial automation equipment operate together in the same workspace to mutually benefit from each other's skills.

Due to its great working capacity and versatility, the industrial robot has amply proven over the last few decades that it is capable of serving as the central element in industrial automation.

To establish an open robot system that transitions automatically between various safety modes, smart factories will need creative solutions. This provides a setting in which the robot system is able to adjust effortlessly, i.e., move from complete automation to secure task sharing and direct cooperation inside working area of the robot.

Future smart factories have recognised the following key accomplishments:

- An open workspace where both humans and robots may exercise autonomy, cooperate together on choices, and take the necessary measures to maximise their abilities to complete a task.
- A collaborative robot that shares its control in multiple degrees of freedom with a person operates best in a workspace where tasks are allocated between the human and robot.

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- Increased productivity, adaptability, and health, environment and safety conditions for human workers.

3. CONCLUSION

In conclusion, there are many prospects and applications for industrial robots in the manufacturing industry. The examples given above show how using robots results in improved quality, cheaper costs, and fewer workplace accidents. For clarity, it should be noted that industrial robots are currently commonplace in a variety of sectors.

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