THEORETICAL STUDY ON INDUSTRIAL MANUFACTURING WITH COMPUTERIZED ROBOTIC TECHNOLOGY

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Abstract- In the next years, robotics in the industrial sector will continue to grow in popularity. They are having a big influence across the board, especially in the automobile sector. Human workers may then focus on more skill-intensive tasks while robots take care of the mundane tasks, increasing productivity and making workplaces safer. Industrial robots, on the other hand, has shown to save a significant amount of money. Industrial robots, on the other hand, has proved to save a significant amount of money in the long term, despite its high starting expenditures. Robots are capable of handling parts that are too small for human fingers and eyes to manage, and they never make mistakes. This is one of the reasons why more and more goods are being designed from the start to be robotically assembled.

Keyword- Sensor, IOT, Smart Machine, Robot

1. INTRODUCTION

The Industrial robots are computer-controlled and programmable machines used to manufacture products and can replace humans for repetitive and dangerous tasks that are difficult to accomplish with humans. Industrial robots can move in at least three or more axes while automating the processes [1]. It was George Devol who patented the first industrial robot in 1954. He enabled his robot to transfer objects within 12 feet or less. He later founded a company called Universal Automation to build the robots. Welding, painting, ironing, assembly, picking and placing, palletizing, product testing, and inspection are all common uses for industrial robots [2]. All these jobs need a lot of stamina, quickness, and precision. They also lower the danger of human injury, reduce errors, and boost production.

Because of the numerous advantages they give, industrial robots are becoming increasingly popular. Many robots can work for long periods of time and performing the same task for years on end.

The balance between human and automation is the key difficulty and constraint in all instances. Industry 4.0 will usher in a new era of manufacturing and distribution through automation, artificial intelligence, and novel sensors. Processes are digitised, robots perform work (or collaborate), and humans oversee overseeing manufacturing and other quality assurance processes. Smart factories are places where this type of production is carried out. These are intelligent in the sense that their production machines are always in sync with one another and self-regulate to ensure maximum efficiency (smart manufacturing) [3].

Smart manufacturing is described as an intelligent manufacturing process (e.g., CNC machine production or industrial robot. The digital thread enables the physical environment to interact with and exchange information with its virtual representation (through sensors and actuators). With expert knowledge, the digital twin can forecast, evaluate, and support the production process.) that consists of a physical representation linked to its digital counterpart through a digital thread [4].

2. TYPES AND WORKING OF INDUSTRIAL ROBOTS

There are many different types of industrial robotics, there are few main types that are used by most of the manufacturers [5]. Robots are integrated with sensors in smart factories to enable for human-robot collaboration in a safe work environment. When compared to typical industrial robots, collaborative robots (co-bots) offer numerous advantages. These robots are human-safe and can free up area that regular robots demand, such as a protecting fence [6].

The safety features can be a mix of technology, such as proximity sensors to slow the robot down when humans approach; force restrictions to reduce hazards to humans or the environment; and detecting human intent and manoeuvring appropriately. Different levels of human-robot collaboration can be established in addition to these safety features. Humans do jobs that require the most skill, whereas robots undertake repetitive, heavy, and boring ones [7].

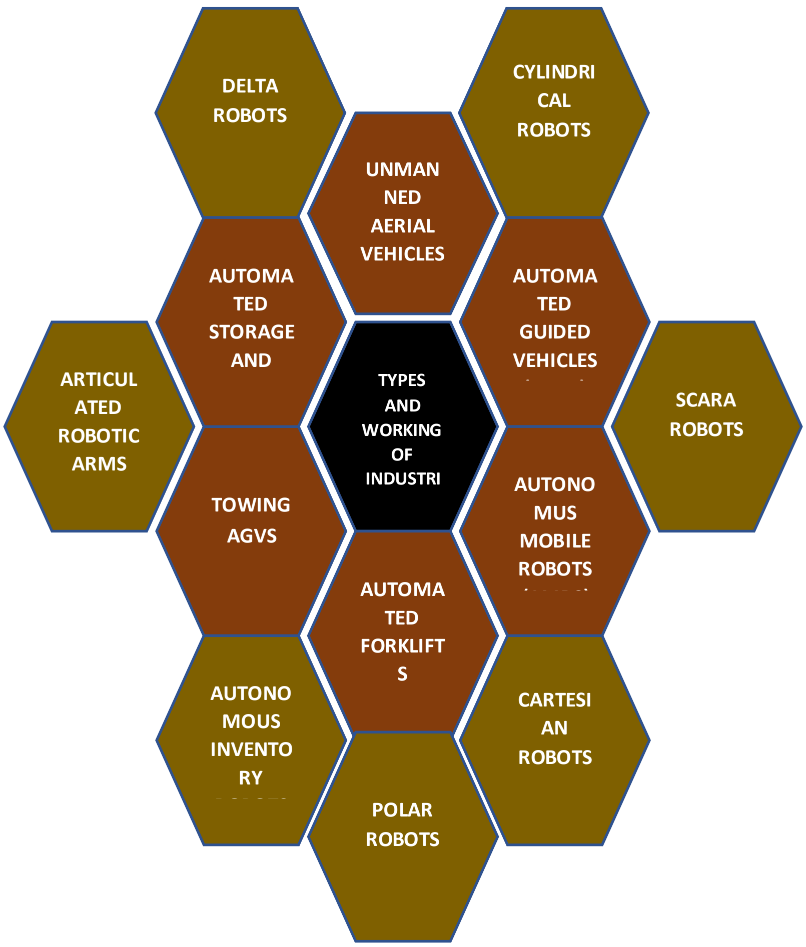

Fig (1): Representation of industrial robotics in Honeycomb structure

UNMANNED AERIAL VEHICLES (UAV)

UAVs (drones) combine the capabilities of airborne aircraft with logistics functions. The UAVs equipped with cameras and RFID scanners can scan stock levels, check inventory and check barcodes faster than manual scanning methods [8]. Lightweight goods can also be moved and lifted by them. For short-distance deliveries, this can be especially useful, allowing local drops near a warehouse to be made [9].

AUTOMATED GUIDED VEHICLES (AGVS)

The use of automated guided vehicles (AGVs) as material handling systems or load carriers for the transportation of stock and materials. It is one of their key characteristics that they do not require an onboard operator or human driver [10]. The recent availability of LiDAR (light detection and ranging) sensors and camera systems has further enhanced the capabilities of AGVs to avoid collisions and detect obstacles.

AUTONOMUS MOBILE ROBOTS (AMRS)

An autonomous mobile robot (AMR), in contrast to an AGV, makes its way based on maps and advanced sensors, rather than a fixed route. AMRs can understand and interpreting their environment and navigating through it autonomously with this capability. In addition to identifying products and objects, the built-in sensors and maps help sort packages [11].

AUTOMATED FORKLIFTS

It is a common type of AGV to use a forklift for transportation. With forklifts, tasks that have traditionally been carried out by humans can now be performed by machines [12].

Common types of forklifts

1. Reach fork truck.
2. Order picker
3. Walkie stacker
4. Pallet jack
5. Rough terrain
6. Industrial forklift

7. Telehandler
8. Counterbalance forklift
9. Side loader
10. Warehouse forklift

TOWING AGVS

Typically, towing vehicles transport heavier loads on pre-defined routes over long distances, stopping to drop off or pickup as needed. These Robots can locate pallet forks within their environment and transport them autonomously to their destinations [13].

AUTOMATED STORAGE AND RETRIEVAL SYSTEMS (AS/RS)

Automated storage and retrieval systems (AS/RS) are generally connected to warehouse management systems (WMS), which direct the operations. AS/RS robots are designed to work in tight spaces and are ideal for narrow aisles and high levels. As well as reducing the risk of human workers in high-risk areas, AS/RS robots can allow warehouses to make better use of their space [14].

ARTICULATED ROBOTIC ARMS

These versatile robots are equipped with multiple joints and are used to perform a variety of tasks in manufacturing facilities, including picking, repackaging, receiving, and loading vehicles.

AUTONOMOUS INVENTORY ROBOTS

By using radio frequency identification (RFID) tags, the robots can take inventory automatically and follow predetermined business processes. The automated inventory robotics approach can enable manufacturers to save operational costs by maximizing their inventories, reducing waste, and reducing labour costs.

CARTESIAN ROBOTS

The Cartesian robot is also called the linear robot. These robots move in straight lines on three axes, using the Cartesian coordinate system. Due to their flexibility, they are popular. Several of these features can be adjusted, including speed, stroke length, precision, and size [15].

SCARA ROBOTS

A SCARA robot has three axes and can also move rotary. They are typically used in assembly, palletizing, and bio-medical applications.

CYLINDRICAL ROBOTS

All cylindrical robots have rotary joints to connect the links and then prismatic joints to connect the joints. As a result of their compact design, they are often used in tight spaces for machine tending, simple assembly, and coating [16].

DELTA ROBOTS

Delta's robots or parallel robots have three arms that are attached to one base. Due to the joint of the end effector being directly controlled by all three arms, they can move precisely and delicately at high speeds.

POLAR ROBOTS

Polar robots were among the first industrial robots ever invented. They are spherical robots. They are commonly used in injection moulding, welding, die casting, as well as material handling [18].

3. INDUSTRIAL APPLICATIONS

- Manipulation (Pick-and-place, handling, machine feeding)
- Spray painting and coating (nozzles)
- Laser cutting and welding.
- Gluing and sealing
- Mechanical machining operations (milling, drilling, deburring, grinding…)
- Assembly and packaging
- Arc welding
- Spot welding
- Machine tending

The following are the major achievements highlighted for future smart factories:

- An open workplace where humans and robots may work together to make judgments and take actions that will improve their ability to complete a task.
- A collaborative workplace where tasks are arranged between the human and the robot;

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a collaborative robot sharing optimally its control in various degrees of freedom with a person are all examples of shared autonomy [19].

- Human worker flexibility, productivity, and EHS conditions have all improved.
- A robot's capacity to learn through simple, natural conversation with humans.
- A workplace without barriers that allows for a smooth and automated transition between safety modes based on the human danger of physical confrontation with the robot [20].

4. CONCLUSION

Robotics in the industrial sector will continue to gain popularity in the coming years. They are making significant impact in a range of industries, including the automotive industry. Then, human workers can concentrate on more skill-intensive jobs while robots do monotonous jobs, increase productivity, and make workplaces safer. However, industrial robotics has shown to save a substantial amount of money over the long run, even with high initial costs. Robots can handle parts too small for human fingers and eyes and never make mistakes. This is one reason why more and more products are designed for robotic assembly from the beginning [17].

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