Future of Manufacturing Industries using AI (Artificial Intelligence) – A Review

P.Sivasankaran

Associate professor, Department of Mechanical Engineering, Manakula Vinayagar Institute of Technology, Pondicherry – 605 107, INDIA

Abstract:

Today's manufacturing companies is considered to be more competitive, highly dynamic and productive in terms of technological advancements. There are much recent advancement like machine learning, Deep learning and Artificial Intelligence. Future manufacturing industries are moving towards the modernization of facilities in terms of advanced gadgets, machineries and tools etc. In this paper detailed comprehensive review is done to collect much information related to advancements of AI (Artificial Intelligence) in manufacturing industries. Future manufacturing companies are going the follow the concept of virtualization using modern technology like augment reality in modeling the product designs and process system in specific. All the process will be carried out by means of smart automation procedures. Artificial Intelligence improves the accuracy of working methods and procedural guidelines. Hence in this paper attempt has been made to collect several applications of AI (Artificial intelligence) for demonstrating the future manufacturing industries.

Keywords: Artificial Intelligence, Virtual Manufacturing, Machine learning, Deep learning

1. Introduction :

Traditional Manufacturing is forced to adopt modern approach of technological methods namely artificial intelligence. Industry 4.0 is said to be the new modern concepts in manufacturing systems. Industry 4.0 monitors every process through integration of cyber physical system. Artificial Intelligence helps to connect the real time communication between physical assets within the organization, smart decision making and virtual man- machine interface in manufacturing

enterprises. It is trusted that industry 4.0 technologies have made high degree of excellence by sustainable manufacturing in order to improve the efficiency.

The next generation Industry technology like industry 4.0 fully focus about big data, cloud computing and IOT with which the whole process can be modeled using supply chain network.

Robotics and automation have become a new modern opportunity for manufacturing industries in the current recent scenario. The role of AI in manufacturing functions will show the significant importance in terms of growth and also revenue attained through advanced use of technological appliances.

AI has also proven to be promising technology in every walks of human life both in personal as well as professional life. In addition to that today's manufacturing industry has become totally multidisciplinary in nature namely integration of neighboring domain field applications like computer science, Robotics, Electrical and Electronics fields.

Today's manufacturing methods has entirely changed from mass production to customized production methods according to the needs of specific customer. Before going for modernization of facilities we have to see whether the facility suits the need of company also measure the accuracy and efficiency. This clearly states that the control is not only focused on machines but also human personals. In addition another trend in modern manufacturing is total integration of plant control.
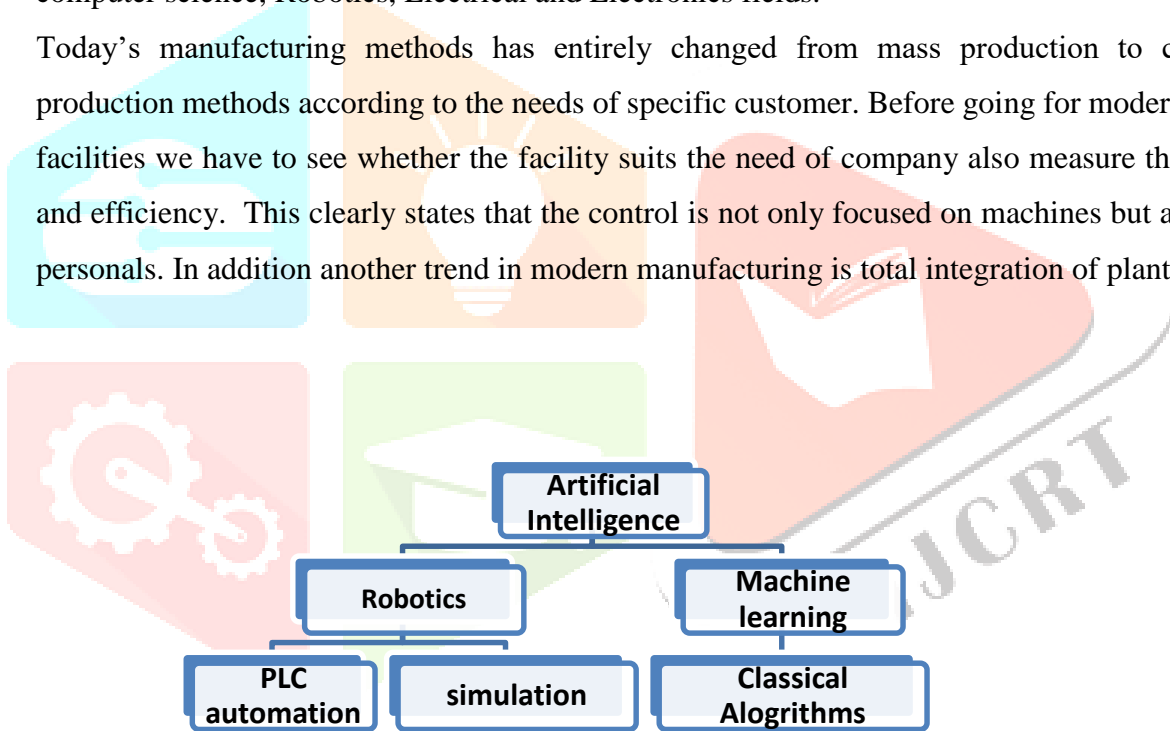
Fig 1. Framework of AI (Artificial Intelligence)

As shown in illustration (fig .1) it clearly says that artificial intelligence has many broad dimensions namely Robotics and Machine learning. In Recent Technological advancements robotics and machine learning has made lot of opportunities in manufacturing as well as other allied areas. Nowadays artificial intelligence applications are done by using numerous algorithms for manufacturing operations.

Future manufacturing industries are totally tuned towards interdisciplinary in nature that is overall integration of several operations combined together in a synchronous manner.
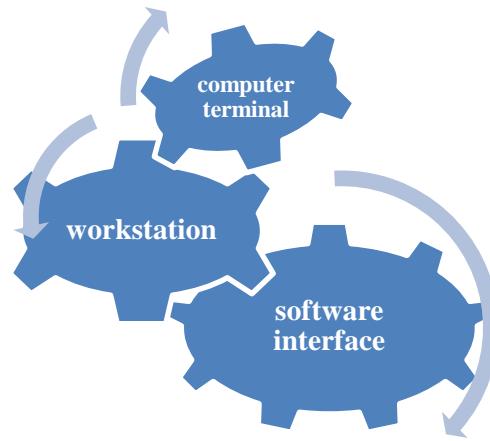
Fig 2. Process of AI in shop floor manufacturing system

As illustrated in fig 2, AI (Artificial Intelligence) applications in shop floor plays a important role right from processing of materials from inventory , loading of materials in workstations for production and dispatching of finished commodities from machineries etc everything can be done virtually through software interface connectivity within the shop floor system .

There has been lot of tools available to solve problems related to manufacturing one such tool is artificial intelligence. The traditional tools like OR (Operation Research) optimization approach is fully focused.

Since manufacturing is the main focused sector in a country for economic development care has to be taken to modernize the system efficiency of machines as well as operation efficiency of plant maintenance. In this paper attempt has been made to review the recent advancements in artificial intelligence and its significant features in manufacturing industries.

2. **Review of Literature :**

The present section discusses about the various key aspects of Artificial Intelligence applications in manufacturing system. The following are the various subsections illustrated below as shown here:

2.1. **AI in manufacturing and Logistics**

2.2. **Purchase and Supply Chain Management**

2.3. **Monitoring and supervisory control system**

These are the three broad areas of literature focused in this work.

2.1. AI in Manufacturing and Logistics:

Today manufacturing systems and logistics have become more powerful computing network systems in terms of processing data or information as well as handling multiple sets of data's . In addition there are many sensors come to track the information that are processed daily in shop floor operations as well as in logistics application system. Advanced computing systems have find lot of ways to detect part dimensions through automated inspection, faulty inspection and quality check etc. All manufacturing and logistics industries have turn out to actionable decision making environment through artificial intelligence applications. AI has bought change in semiconductor manufacturing industries, packaging and material handling systems. As a whole artificial intelligence is tool which is used for many functional areas to do lot of things in faster and quick responsive way without affecting the time and cost .
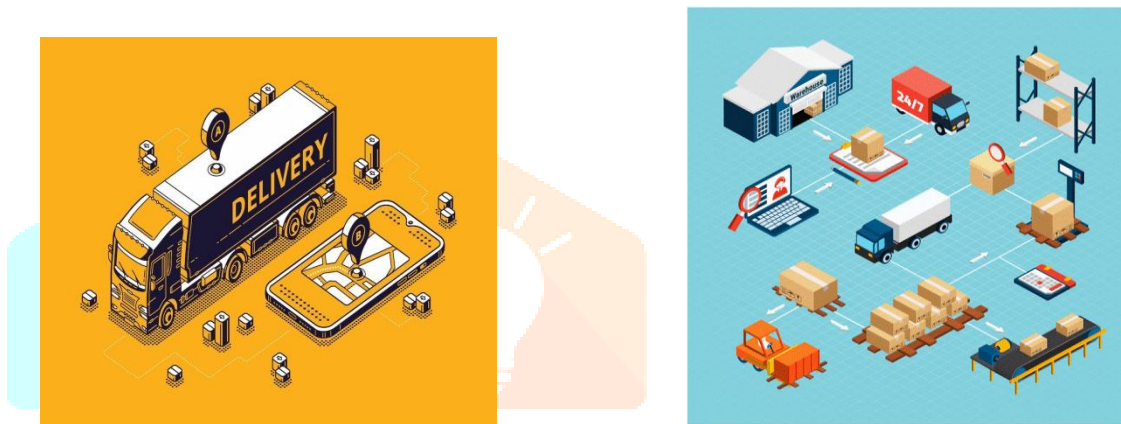

Fig2.1.1. Framework of manufacturing and logistics in AI system

As shown in fig 2.1.1 the logical operation sequence of logistics and manufacturing systems are clearly explained in the illustration.

2.2. Purchase and Supply Chain Management

Due to the complexity in the present manufacturing and supply chain functions has transformed more advanced way by equipping with AI interface system in business operations. Use of AI in manufacturing has increased more safety in planning the materials as well as production using modern tools like data science, numerical algorithms etc . In supply chain management virtual test market can be constructed to analyze the customer taste towards the products this can be achieved using machine learning techniques.

2.3. Monitoring and supervisory control system

In conventional or Traditional systems the operators have faced lot of issues in physical monitoring and inspection of parts and also in process control systems. Intelligent systems for effective monitoring and controlling using machine learning and simulation approaches. Present research efforts taken to improve the effectiveness of monitoring and control system in manufacturing applications.

Summary of literature:

At the outset the researchers have contributed their vision towards modernization of manufacturing enterprise using AI in several segments such as logistics planning and scheduling, manufacturing process optimization, ordering and purchase, supply chain function, process control and monitoring system.

3.Case study of AI in manufacturing:

Robot simulation in manufacturing:

In this case study the application of AI in manufacturing is discussed using simulation experiments from the literature survey it is evident that AI used in logistics, Inspection and manufacturing. Hence in this paper attempt has been made to develop simulated work environment for welding using robot in simulation practice. The experiment is carried out in ROBODK solver model version 5. In actual method of welding there is lot of hurdles in doing process start from fixing the electrode in holder till finishing the job by joining using welding operation this is regarding with respect to human welder challenges are present. But in case of automation robot is equipped to solve such problem in more flexible way method with zero risk in operation .
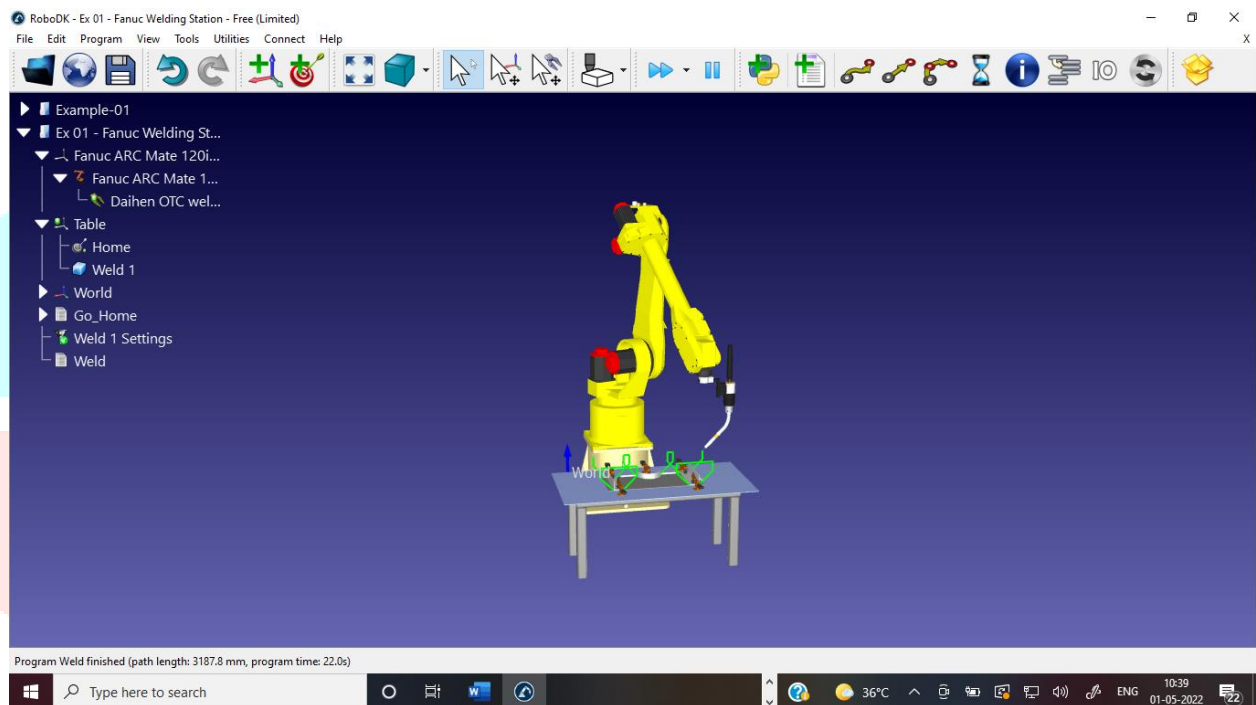

Fig 3.1. Simulated view of robot in welding station

In this case study how, simulation is helpful for industrial robots to plan the task in sequential way is discussed here. Simulation is a set of preprogrammed instructions for any operation which has to be performed in real time. using simulator, we can analyze the path motion of robot arm for performing welding operation within the work cell. While performing the welding operation care should be taken to note that arm manipulator should not hot any nearest object in work cell. So, another experiment also done using simulation with the help of motion planning collision exercise.
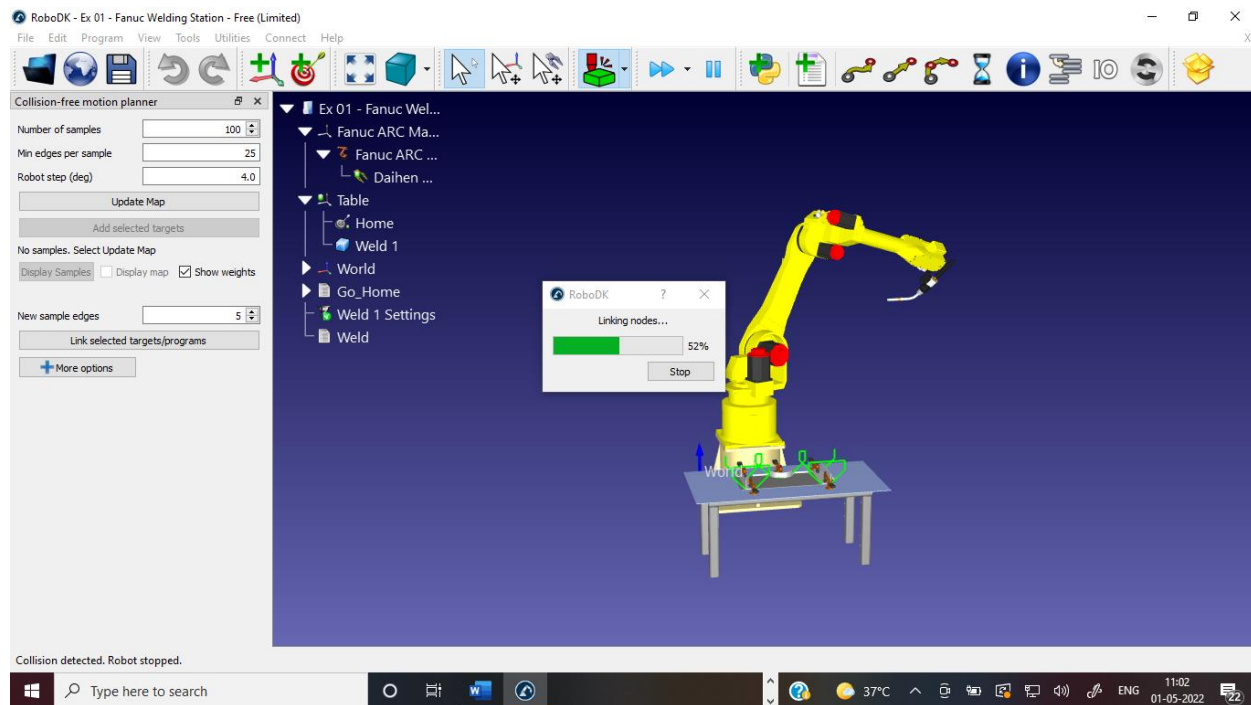
Fig 3.2 . motion path planning using Collison solver

In this experiment the arm manipulator is simulated for various iterations such that collision barrier analysis is estimated within the work cell area based on that we can simplify the path positions of arm within the limited area. Therefore in this case study two exercises are illustrated in the above figures that shows how simulation plays a vital role in AI systems for manufacturing industries in future .

Conclusion:

In this paper the importance of AI (Artificial Intelligence) applications has focused in many several dimensions like manufacturing and logistics, intelligent process control systems etc. use of AI in manufacturing has gained increased importance nowadays due to fast changing business environment. The modernization in manufacturing enterprise has brought more safety and flexible way of operating every business transaction in less time. In addition to that case study also discussed here using ROBODK SOLVER model for robot welding and its features .

Acknowledgement:

We sincerely acknowledge this work to all leading manufacturing companies around the globe staying more competitive and fit in tough business environment.

References:

1. Chen-Fu Chien et al, Artificial intelligence in manufacturing and logistics systems: algorithms, applications, and case studies, International Journal of Production Research, Vol: 58, NO: 9, 2020, pp.no:2730-2731.

2. Mito Kehayov et al, Application of Artificial Intelligence Technology in the Manufacturing Process and Purchasing and Supply chain Management, Procedia Computer Science 200 (2022) 1209–1217.

3. Varanon Uraikul et al , Artificial intelligence for monitoring and supervisory control of process systems , Engineering Applications of Artificial Intelligence 20 (2007) 115–131