MECHOSOFT
An Article on Industry with Augmented Reality (AR), a New Generation Manufacturing Concept

Susheel kumar Bijapure [1]
[1] Faculty of Engineering and technology Co.Ed.
Department of Mechanical Engineering
Sharnbasva University Kalaburagi

ABSTRACT

With the emergence of Industry 4.0, the manufacturing sector is witnessing a radical shift, especially in digitisation. The future mechanical engineer will collaborate with intelligent machines to design and develop automated systems that enhance productivity, precision, and safety across industries like manufacturing, logistics, and healthcare, this article is targeted on the study about the intelligence used in to manufacturing and other various options to meet the desired industry needs. This article is collected information about how Augmented Reality (AR) is transforming manufacturing by enabling companies to improve productivity, optimize workflows, and reduce operational costs.

Keywords: Augmented Reality, Industry 4.0, Manufacturing, Virtual reality.

A. INTRODUCTION

Mechanical engineering has evolved from simple mechanical systems predating the Industrial Revolution to steam-powered engines which powered locomotives and factories, to combustion engines which powered automobiles and airplanes, and to today, where computer-aided design tools assist in novel technologies and designs, . Everything we use, from cars to electronic devices, is manufactured in a factory. This makes manufacturing a key building block of our society. Data shows the global manufacturing industry's growth to be at a rate of 18.2%.The future mechanical engineer will collaborate with intelligent machines to design and develop automated systems that enhance productivity, precision, and safety across industries like manufacturing, logistics, and healthcare the rise of 5G and 6G networks will enable faster processing speeds resulting in enhanced user experiences with reduced latency.

B. Integration of Mechanical and Software a reality:

Virtual reality (VR): is a simulated experience that employs 3D near-eye displays and pose tracking to give the user an immersive feel of a virtual world. Applications of virtual reality include entertainment (particularly video games), education (such as medical, safety or military training) and business (such as virtual meetings). VR is one of the key technologies in the reality-virtuality continuum.

Augmented Reality (AR): Augmented reality is a bilateral experience that develops the real world with computer-generated perceptual information. Using apps software, and hardware such as AR glasses, augmented reality brings digital content onto real-life environments and objects. This enhances the user experience and turns surroundings into an interactive learning environment which is mostly valuable in manufacturing and Industry 4.0 processes. Augmented Reality works by superimposing digital information onto real-world objects to create a 3D experience that allows users to interact with both the physical and digital worlds. But AR does not and cannot exist in a solo; its true value is in being part of a cloud-connected Industry 4.0 ecosystem that incorporates everything from big data to automated robots.

C. Overview of the augmented reality process:

- An AR-enabled device with a camera such as smart glasses, a tablet, or a smart phone parses a video feed to identify a physical object or the environment around the user, such as a piece of machinery or the layout of a warehouse.
- A digital twin – a 3D digital replica of the object in the cloud – connects the real and virtual environments. It collects information from the physical object and digital

- The augmented reality device then downloads information about the object from the cloud. It superimposes digital information over the object using markers or trackers like GPS, accelerometers, orientation and barometric sensors, and more. This creates a part-real, part-digital 3D interface.

- Thanks to real-time data flowing from products, the user can interact with the object or environment by moving around and sending commands to the cloud through a touch screen, by voice, or with gestures.

Fig1: Augmented reality in modelling section

D. ***How is augmented reality differ from Virtual reality***

Virtual Reality: Virtual reality, or VR, removes people from the real world and fully immerses them in a virtual world using a head-mounted display or headset. In that virtual world of imagery and sounds, users can move around in all directions, manipulate objects, and more. VR is often used in healthcare, architecture, and education.

Augmented Reality: AR enhances, or augments, the real world with digital information. While augmented reality apps work through mobile devices such as smart phones or tablets, in manufacturing and industrial settings where it benefits the user to have their hands free, glasses or headsets are the best gateways to the AR experience.

Mixed Reality: MR blends imagination and reality so that users can both see and interact with the real world and the virtual environment simultaneously. Think of playing a virtual video game while drinking real coffee and offering an imaginary character some of your coffee in your game.

E. ***Industry with AR*****:**

AR can be used for everything from asset identification to knowledge transfer in the field to training section. By incorporating the physical with the virtual to augment the way people work, augmented reality gives workers more information and context about the product or machines they're working on and the world around them, Augmented Reality (AR) is transforming manufacturing by enabling companies to improve productivity, optimize workflows, and reduce operational costs. According to a recent report by ABI Research, the number of AR smart glasses shipments in the manufacturing sector is expected to reach 27 million by 2025.

Manufacturing processes require precision and attention to detail, and even a small mistake can result in significant losses for the company. AR-powered smart glasses can help workers perform tasks more efficiently and accurately, reducing the risk of errors and improving quality control

F. ***AR is commonly used in the following areas***

- *Design and product development*: Imagine being able to prototype virtual objects that designers and potential users can walk around and examine from every angle? Thanks to augmented reality, digital twins, and the IoT, product designers can bring products to life, test them, and adjust them before anything physical is ever built.

- *Maintenance, operational control, and safety*: With AR, workers can gain immediate information on any machine they're interacting with. They can access the latest user manual or connect with an expert anywhere in the world to help them assess or repair an issue. This supports continuous production and non-disruptive performance.

- *Employee and operator training and learning*: Augmented reality allows employees to get trained on any machine or equipment "on demand," turning their immediate surroundings into an ongoing learning platform. It can also provide environments and scenarios that allow employees to hone their skills while increasing productivity and safety.

- *Quality control*: Incorporating AR into quality control and assurance can help prevent defects during production, optimise the production process, and reduce time to market. For example, technicians wearing AR glasses can view a product and get information from IoT sensors embedded in the product components that

generate information about each part and alert them to issues.

G. key benefits AR provides in industrial and manufacturing environments:

- Improved product development: Implementing AR during the design phase makes it possible for designers to respond to modern consumer demands for shorter product lifecycles and reduce costs associated with prototyping.

- Simplified processes: Visualised workflows offering step-by-step instructions can support predictive troubleshooting while reducing mistakes that cause rework and speeding up complex assembly tasks for workers.

- Streamlined warehouse management: AR can save time by managing inventory levels, guiding product picking, minimising downtime by making it easier for technicians to diagnose and fix problems, and enhancing employee training.

- Increased worker engagement: Because AR is a relatively new technology, the immersive quality of the 3D experience and the ability to learn by virtually doing is still novel for workers, which boosts their engagement with the task at hand.

- Reduced risk: AR doesn't just replace the work or function of real equipment and people; it also creates a safe, experiential learning environment that allows workers to practice tasks virtually without risk. This improves worker safety, inspection, training, and workflow.

Fig2: Augmented reality in quality control

H. Understanding Augmented reality with industry problems and its solution

1. ***Warehouses and Logistics***

Problem: Warehouse and logistics operations are complex. Especially when it comes to big enterprises with huge inventories, however, a logistic professional must find the correct item to deliver the product, as it consumes 50% of their time and leads to low efficiency and productivity. So how can AR help?

Solution: Logistics and warehouse specialists can use a head-mounted device (HMD for short) equipped with AR technology and get access to quick detection of products, manage inventory better, and get real-time instructions to navigate the product.

2. Product Development

Problem: Deployment of quality products is one of the crucial points in product line development. An enterprise cannot take the risk of any faulty section as it can hurt the rest of the line and can lead to damaged products, poor-quality products, or unplanned downtimes.

Solution: With AR's remote visual assistance, you allow your workforce to share information and make informed decisions to overcome hurdles. The on-site team can receive assistance from any part of the world. They can also review product line batches and conduct internal audits, remote inspections, and real-time MROs to finely tune production processes.

3. Industrial Training of the Workforce

Problem: One of the most effective ways for new technicians and engineers to learn their job is to get acquainted with experienced workers. But unfortunately, the training capabilities of many enterprises have been stretched thin. The main reason for it is the retirement of experienced and skilled technicians.

Solution: However, with AR, you can hire mentors and trainers from around the world to train your employees and make them aware of the latest industry trends and initiatives. They can also train their workforce through 3D AR Annotations of complex machines, digital manuals, step-by-step SOPs, and guides. This way, you can help to upskill and reskill your workforce.

4. Equipment Inspection and Reviews

Problem: To ensure the longevity of equipment and machinery, enterprises need to run regular inspections and reviews. With these regular inspections, businesses can run efficient operations and ensure the safety of their

frontline workers. It further helps businesses diagnose and troubleshoot issues before they escalate.

Solution: Your workforce can run comprehensive inspections and reviews of their daily operations using expert opinion and detailed manufacturing work instructions in real-time through video sessions. Equipment operators, inspectors, and safety engineers often use inspections and reviews to ensure job safety, improve maintenance scheduling, and reduce repair costs.

5. Quality Audits

Problem: Safety and quality are two essential aspects of the manufacturing industry and critical for companies to work upon. However, running these consistent safety audits with on-site professionals takes a lot of work. Also, enterprises must comply with laws and regulations and seek permission to conduct these audits.

Solution: Enterprises must run timely audits to ensure workplace safety and meet industry standards. With the help of AR, enterprises can merge the video screen of auditors and safety specialists with their workforce to access complete control over inspections from anywhere. Auditors can quickly pinpoint the areas that aren't under compliance or at risk for future problems.

6. Equipment Installation

Problem: Installation of machines and equipment is a complex process. The enterprises depend on engineers' availability, which is costly and time-consuming.

Solution: With AR-powered solutions, engineers can use their expertise to guide customers and other manufacturing sites about the installation process. They can provide accurate directions to the person on installing particular machinery. Since the support is in real-time, it becomes easier for the worker to complete the task in time with proper installation.

7. Real-time Troubleshooting

Problem: In manufacturing, equipment breakdowns and malfunctions can lead to costly downtime, decreased productivity, and increased maintenance costs. Troubleshooting these issues in real time is critical to minimize production losses and reduce operational inefficiencies.

Solution: Manufacturers can use AR for troubleshooting issues in real time and enhance their daily productivity. It will also help them run seamless operations with reduced downtime. The enterprises get access to lower maintenance costs by providing timely and accurate guidance to operators and maintenance personnel, enhancing their ability to identify and resolve issues quickly.

I. Companies using AR

TATA: TATA recently co-developed an end-to-end solution with Swedish industrial tools and manufacturers in two assembly plants. The solution was created to observe transparency throughout the supply chain – inbound or outbound, this custom application solution includes integrations with ERP, shop floor control systems, and logistics. Some of the key functionalities that TATA included in its shop floor to improve the efficiency of its workforce by 30% include order management, kitting, electronic Kanban, digital work instructions, and real-time updates through dashboards. The enterprise also planned and reduced the assembly line from 3 days to 4 hours.

BMW: BMW invested in AR glasses and equipped its workers at the Munich plant to speed up the inventory identification process and reduce the error rate. The results of the adoption of AR glasses led to some astonishing results. There was a 22% decrease in inventory identification time and a 33% reduction in error rate. Thus, implementing AR industrial solutions might be expensive, but it will bring a significant ROI for your business in the long run.

Fig3: Augmented reality in modelling section

Porsche: Porsche is introducing AGV (automated guided vehicle)-based assembly process for Taycan, its electrical model. However, Porsche used AGVs to transport vehicles between assembly stations and adopted a flexible production line concept. That means if a vehicle needs installation of special interior features, it can quickly leave the main assembly line and shift to the special features needed to customize the vehicle, With this AGV-based

production line, Porsche could save 30-40% capex than the traditional main line. In addition, it includes higher efficiency in operations and shorter ramp-up times.

Samsung: Samsung is known for its technology; it now uses 3D vision scanning to tackle the growing demands and quality standards for LCD panels. The company has invested in 3D scan-based automated inspections that take less than 1 second of inspection time per screen, With these new and enhanced 3D scanner-based automated inspections, Samsung can easily replace the manual processes. The 3D scanner system identifies internal panels and surface defects. It also increases the production line output, eliminates the inspection process bottleneck, and increases customer satisfaction.

J. Augment reality becoming a reality in Sharnbasva University

Within the shadow and blessings of his holiness Mahadasohi Lord Sharanabasaveshwara and with the guidance of Vidya Bhandari Poojya Dr Sharanbasavappa appaji, and Matoshree Dr. Dhakhsayani avvaji, sharanbasva university has already started its various programs to the students to meet the actual need in the present industry, the MOUs with various companies and training institutes like Medini Technologies, CADMAXX solutions etc are the very first step towards imparting knowledge to students and faculties in digital or virtualisation in manufacturing, various training programs are undergoing with collaboration of Medini Technologies and CADMAXX solutions in association with Mechanical Engineering department of our university, days are not far away when every students dream would be a engineer from Mechanical engineering department sharnbasva university.

K. Conclusion and Future work

Despite of the many recent advances in AR, much work remains to be done. Application developments can be helped by using the available libraries; Digital revolution has already made its mark on every industry. Businesses that have adopted complete virtualisation of manufacturing are steaming ahead of businesses that have been reluctant to adopt it. Irrespective of the uptake, digitalisation is here to stay, and if businesses want to remain relevant in this ever-changing landscape, they must completely digitalise and embrace the revolution; People can interact with the system in a more natural way of human-computer interaction. In the future, augmented reality technology will change human life to a great extent, which is an inevitable trend of scientific and technological development, Furthermore, the rise of 5G and 6G networks will enable faster processing speeds resulting in enhanced user experiences with reduced latency. As AR/VR becomes more main stream across a broader range of industries worldwide; this trend is expected to continue into 2030 and beyond.

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