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APPLICATION OF AUGMENTED REALITY IN INDUSTRIAL MAINTENANCE

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Abstract - *The performance of industrial maintenance operations is considerably reliant on the intelligence and exercise of the technicians engaged. This paper demonstrates a simple approach to enhance the production by adapting Augmented Reality (AR) in the maintenance field. It is a technique that adapts with available data and the skill level of the technicians and without the need for previous working knowledge of AR. The AR system can be dynamically adapted employing non-programmer maintenance technicians to enhance efficiency further.*

Key Words: Unity Hub, Augmented Reality, Industry 4.0, Downtime, Maintenance, 3D view, Equipment failure.

1. INTRODUCTION

The Industrial Internet of things (IIOT) otherwise known as Industry 4.0 focuses heavily on interconnectivity, automation, machine learning and real-time data. Industry 4.0 refers to digitized and connected industrial value creation and it is assumed to yield extensive industry-spamming opportunities like increasing quality and flexibility. Thus, Industry 4.0 relies on advances in automation and digital technology to accumulate, examine, and offer beneficial records in real-time to the manufacturing systems. The advances in automation and communication technologies such as the Internet of Things (IoT), cloud computing, big data and analytics made this integration possible through cyber-physical systems (CPS). A comprehensive definition 'Industry 4.0 refers to the integration of Internet of Things technologies into industrial value creation enabling manufacturers to harness entirely digitized, connected, smart and decentralized value chains able to deliver greater flexibility and robustness to firm competitiveness and enable them to build flexible and adaptable business structures, [acquiring] the permanent ability for internal evolutionary developments to cope with a changing business environment as the result of a purposely formulated strategy implemented over time'. Therefore, there is a need for a study that collates and analysis the pros and cons for the implementation of Industry 4.0 in organizations from an academic perspective, so that the stakeholders are well informed. Besides, the understanding of the pros and cons will help the organizations to successfully determine its implementation. [20]

2. AUGMENTED REALITY

When someone talks about AR, they are referring to technology that paves information and virtual objects on real-world scenes in real-time. It uses the existing environment and adds information to it to make a new artificial environment. Augmented reality (AR) is one of the biggest technology developments right now, and it's most effective going to get larger as AR ready smartphones and different devices become more accessible around the world. AR let us see the real-life environment proper in front of us—trees swaying within the park, puppies chasing balls, children gambling football—with a digital augmentation overlaid on it. For example, a pterodactyl might be seen landing in the trees and the children might be visible kicking past an alien spacecraft on their way to score a goal. With advances in AR generation, these examples are not that different from what might already be available for your smartphone. Augmented truth is, in fact, effectively available and being utilized in a myriad of approaches which include Snapchat lenses, apps that help you discover your vehicle in a crowded car parking zone, and in variety of shopping apps that let you try on clothes without even leaving home. Perhaps the maximum well-known instance of AR generation is the cellular app Pokémon Go, which was released in 2016 and quickly has become an inescapable sensation. In the game, players locate and seize Pokémon characters that pop up in the actual world—to your sidewalk, in a fountain, even to your very own restroom.

2.1 Augmented Reality for Automation

Nowadays the engineering labs have the necessary physical devices to perform experiments that reinforce the theoretical knowledge of the course. However, there aren't enough elements that could generate an normal applied system that usually includes technology beyond the course, leaving tons to the imagination. Augmented Reality Automation (ARA) is an innovation that includes augmented fact era to the classical experiments, allowing the integration and interaction of numerous technologies, growing mixed experiments, both real and virtual, this is visualized through a mobile phone, together with a tablet, to create the deeper and clearer vision of knowledge. This paper especially makes a speciality of dragging AR into automation.

3. DOWNTIME

Since industries are moving towards the next level of production, there are still some major cons that lie in a way that decreases the speed of production. One of the major cons is Equipment failure. Some of the major causes of equipment failure are Improper operation, too much preventive maintenance and failure to monitor equipment which results

in significant downtime, they hold the risk of becoming a normalized part of the production process, reducing overall effectiveness and efficiency. This paper explains an accessible way to sort out the downtime by adopting Augmented Reality. Capabilities such as mobiles, wearables and IoT connected devices can help to improve visibility, operational compliance and productivity on the shop floor. When integrated into a single platform, they can enable manufacturers to monitor, measure and improve operational standards on the shop floor in real-time. Downtime is often caused by workers not being aware of it in time to prepare the right tools and materials or of what the target time for the changeover is. So, this paper implements an easy spare replacement technique to reduce the downtime drastically.[20]

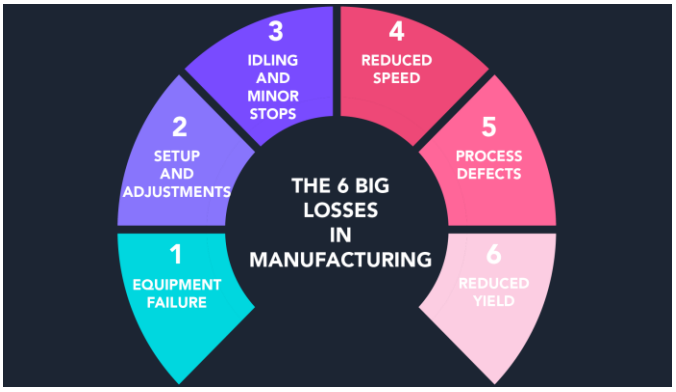

Fig -1 Cause of Downtime [20]

4. UNITY HUB

Unity is a cross-platform game engine evolved through Unity Technologies, first introduced and launched in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. A study on the year 2018 says, the engine was prolonged to support more than 25 platforms. It can also be used to create 3-dimensional, two-dimensional, virtual reality and augmented reality games in addition to simulations and other experiences. Unity hub has been adopted by industries outside gaming such as film, engineering and construction. The Unity Hub is a management tool that you may use to administrate all your Unity Projects and installations. Use the Hub to manage more than one installations of the Unity Editor along with their associated components. Unity Hub is not only a launcher in your projects however also it permits you to replace team spirit and get multiple variations of it. [21]

4.1 Unity Hub for Automation

As everyone knows that downtime plays a major role in reducing production speed. Hence, this paper came up with a solution to reduce the downtime. Since unity has been adopted by automotive industries, it can greatly help people around the industry in many ways. The advantages of using unity hub in the industry include 1) Enable/disable 3D parts to see the parts which exactly you want to view. 2) It provides Information about each 3D model and allows you to explore the mechanism and exploded view of the component. 3) It contributes to the Animations + Dictation of information related to the model. 4) Rotation, Pan and Scale Sensitivity of the 3D model can be controlled. 5) Download 3D Models from Online Library and visualize them anytime.

Fig-2 3D view using AR [17]

Fig-3 Name of Components & bill of materials [18]

The above-mentioned features of the unity hub greatly help a worker to examine the skeletal view of a component in case of an equipment failure. It can create three-dimensional, two-dimensional views of an object and it can be further used to stimulate and view the working and exploded view of a component.

Fig-4 Stimulation using AR [19]

So, it can be used for replacing flawed components with refurbished components in an equipment. As soon as, the damaged component is removed and replaced, the equipment can be back to work as quick as possible which

leads to a drastic decrease of downtime. Unity hub further assists the user by providing step by step instructions to assemble, disassemble, clean and repair the required part of the equipment. Adding to the above, Unity Hub has the benefit of permitting the user to stimulate individual components of an equipment. Since unity hub is aimed towards common people, it can be said that it is a feasible solution for maintenance experts with no experience in AR. Hence, this is a simple solution for replacing damaged components in an equipment and to reduce the downtime along with reduced cost and reduced manpower. This is a must-have app for students who are interested in learning/visualizing different structures in 3D animations.

5. EXPERIMENT ON EFFICIENCY

In order to validate whether or not AR created content material can enhance maintenance efficiency, an assessment was conducted by [5] between a paper based manual guidance and the Unity Hub method for a specific industrial maintenance task by the usage of a gear box representation as a demonstrator. This was measured in terms of the length of time for completing the required task. In overall there had been 8 participants involved; 4 for each type of guidance. The participants have been selected to have no experience in maintenance and AR. Considering the target populace size for AR systems in maintenance the sample can be considered representative. The participants in the paper-based experiment were given a real-life, complex maintenance manual to comply with and find the relevant information from a variety of equipment and components covered. In the Unity Hub guidance, the participants were requested to identify the correct maintenance operation and to carry out the task supported by the animations overlaid directly to the demonstrator. The participants using the Unity Hub guidance were able to complete the same task almost half of the time as compared to the paper based manual procedure. During the conduction of these experiments, it was noted that what made simpler the understanding of the tasks to perform the contextualization of the information presented. Thus, the decrease in time created through the use of AR can enhance maintenance efficiency, as better understanding of the tasks to perform can also result in fewer errors, which shows it was not only the reduction in duration of maintenance that was observed, thus less time to accomplish the same maintenance tasks.

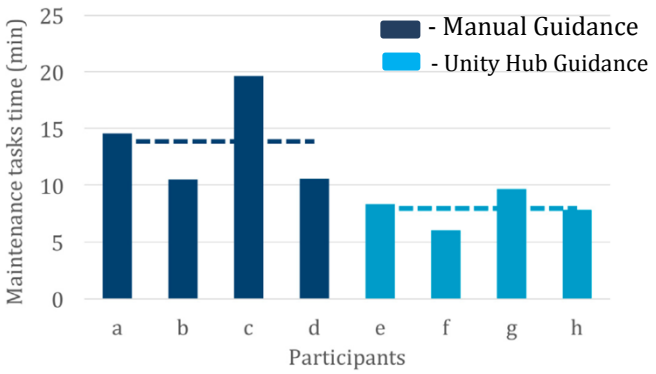

Fig-5 Efficiency of Unity Hub **[5]**

The above graph shows the result of the experiment conducted by [5]

6. WORKING

On a Machine shop floor, calibration and spare replacement are held out manually using Machine Maintenance manual. Nowadays, with the help of AR the replacement of Ball screw, Spindle bearing, Hydraulic pump, motor, etc. even calibration can be done easily with reduced labor and reduced cost using unity Hub. The installation process is as follows:

1. To work with unity hub, the 3D model required should be designed in any CAD software like AUTOCAD, solid works, CATIA etc.

2. The 3D model designed in CAD software should be defined in Vuforia engine of unity hub.

3. With the assist of this animated part, an application needs to be generated with the help of Unity Hub.

4. The application is generated in a way that it can be installed on mobile or other holdable devices.

5. By opening the application, the user should scan for the model target which is already defined.

6. Once the scanner targets the model, the user will be able to view the 3D view of the equipment, skeletal view, mechanism, guidance to dismantling, reassemble and repair the equipment.

7. CONCLUSION

It is possible to conclude that AR offers opportunities for industrial maintenance by permitting the user to Enable/disable 3D parts. But, the main contributions of the paper, related to maintenance efficiency and AR fields include improving maintainer's efficiency with adaptive data management and to make Non-programmers create AR content.

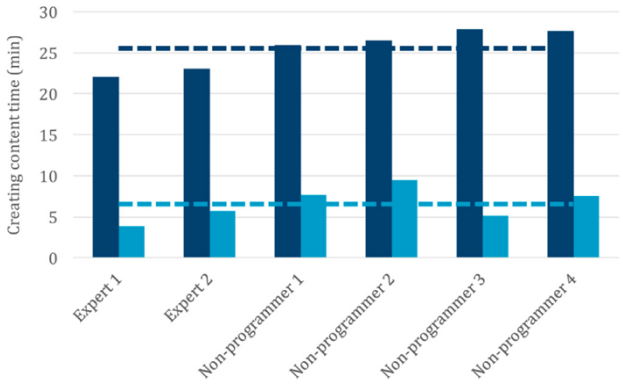

Fig 6 Programmer Vs Non-programmer **[5]**

Fig 6 shows the efficiency of Non-programmers in creating AR content. Thus, this paper concludes with "APPLICATION OF AUGMENTED REALITY IN INDUSTRIAL MAINTENANCE" is a uncomplicated technique to improve production by decreasing downtime and labor strain.

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