

Use of Augmented Reality in manufacturing industry

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Abstract:

These days process and manufacturing industries have more focus on industry 4.0. Industry 4.0 involves Internet of things, predictive analytics, digitalization, remote maintenance, augmented reality, predictive quality. And the concept was introduced back in 2015. Multiple researched have been done on this topic in past.

Here in this research augmented reality which is part of industry 4.0 has been implemented and tested at different factories. In this research proper research and development was done. Proper augmented reality device is used in this research. This device was Epson Moverio bt-2000. Its android based wearable glass device. Two parts were involved in this application. Client was totally glass based application. This is which manufacturing process or recipe is in process, what are underlying process variables like temperature, pressures etc. At one factory it helped senior

hands free device where user wear it just like normal glasses and then display is available in glass. Application developed has navigation available based on head gestures, voice command and hands gestures through camera using deep learning.

At server side an application server was developed using python. This server application had a connected database, scheduler and planner. Through client server architecture client is communicating with server application. Server application was connected with plant floor instruments and sensors. Server application was getting data in real time from sensors. At client application when user enters plant floor area and points to a machine then user will see inner details of machine. Like production manager to minimize temperature increase while monitoring real time, thus saved cost.

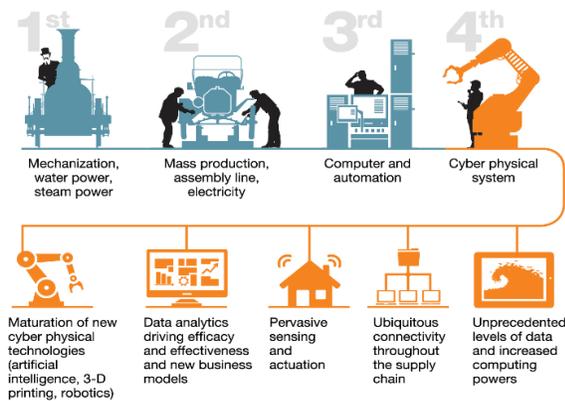
Similarly, another feature is for plant maintenance. It helps real time remote maintenance through video call. So, it follows concept of see what other resource see. Simply user at plant wears glass and starts working while being hands free hands free and support guy at another can easily guide him. Using augmented reality-based drawing support user can easily do drawing and point out exact part of the equipment for maintenance. Similarly, few other features like digital manuals are also available in this application. It helps in knowledge management to decrease knowledge transfer cost. It can be achieved using video recording feature. Whenever senior resource will do critical task, he will wear glass and video will be recorded. And in future any junior technician will use glass for guidance to perform those tasks. All these features were tested at different plants and we found it a lot helpful in minimizing cost, time to repair and increased knowledge. And most important factor was to decrease paper usage and its step towards a digital platform which helpful in maintaining green and paper less environment.

Keywords: industry 4.0, Augmented reality, remote maintenance, digital twin, AR, VR

Introduction:

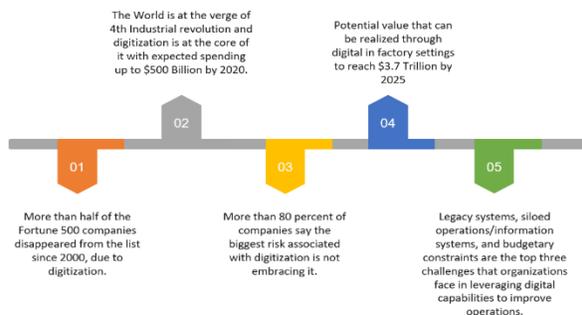
These days manufacturing industries are following industry 4.0. in industry 4.0 standard factories are aiming to digitize all processes. These processes include procurement, planning, procurement, production process, utilities consumption analysis and prediction. Using digitalization, they can easily digitize their supply chain network. Thus, it improves productivity, transparency, quality, production time, plant reliability and cost. Regarding cost, utilities is important factor to minimize overall production cost.

Different industrial revolutions came to improve process. These revolutions helped to minimize production time, cost and increase plant reliability. Here different industrial revolutions are shown in below picture. Each industry revolution has taken manufacturing processes forward and towards good quality.



Industry 4.0 is all about digitalization and paper less environment. In below picture a picture will demonstrate how digitalization helped different companies to grow. Also, it shows how much amount companies will invest on digitalization and industry 4.0. Then we can see how top companies collapsed in past which did not adopt digitalization. Big example is Nokia. Also, another part which related to hurdles in digitalization is explained in below image.

Digitalization – An Unavoidable Change



1) Literature analysis.

Industry is investing in industry 4.0 and specially for use or AR. A lot of manufacturing units have allocated budgets for it. Multiple researched have worked on AR, VR and mixed reality. These researched have been carried out based on different use cases. A.Y.C. Nee¹, S.K. Ong² have published a research paper with name virtual and augmented reality applications in manufacturing. In this research it was demonstrated using virtual reality how to perform a task at plant floor. It was completely 3D modeling and steps. Also, standard maintenance procedures were explained in this research. So research done by A.Y.C was mostly 3d simulation and training. Then another research by J. Novak-Marcincin with title Augmented reality aided manufacturing. It was related to CAM and CAD. Instead of

using computer user will use AR glasses to carry on manufacturing process and will visualize whole process and assembly in 3D environment.

2) Problem statement.

How Augmented reality can help manufacturing industry to reduce cost and improve process. How AR can help manufacturing industry to improve plant health by enabling remote maintenance.

3) Research Questions.

In past different industry revolution have helped manufacturing units to improve production quantity within less time and with same cost. Third industry revolution which was linked with PLCs and computer did process automation. Now its time for 4th industry revolution where concepts of big data, IOT, machine learning is introduced and augmented reality is major part of this revolution. In this research we will do research how AR can help to improve process and reduce cost.

Methodology.

This paper is based on research and development methodology. Initially research was carried on to finalized hardware and software tools &

technologies. For hardware glass wear Epson Moverio BT-2000 was selected. And at software was completely based on client server architecture.

Client application will be installed in glass. And server application will be hosted at any computer in local premises or in cloud. Communication can be established over WIFI or internet.



Figure 1: Moverio BT-2000

4) Tool Used

AR glass has android based custom operating system. Client application was completely developed in android and server application was developed using python and its libraries.

5) Features included in client application.

Real time process visualization: Server application was enabled to communicate with installed DCS and PLCs. Server application has power for data acquisition in real time. Any user

who wears glass and enter factory then he can easily visualize machine's data in real time in glass. Glass scans machines and using image analysis glass app sends image to server and in response real time values will be sent back to glass. These can be machine speed, temperatures and important pressures.

Digitized plant maintenance

To record and digitize maintenance activities, this solution is based on AugAR module and will be developed using client server architecture. Server application will host and store database with details of equipment and manuals. Server will also host data for client application along with historian of all recorded videos. Client application (AR glass application) will communicate with server. So, both client (AR glass) and server (PC/server machine) will be connected to same network for smooth data flow.

With remote video call feature, A technician on plant floor can connect remotely with a supervisor, other experienced colleagues or OEM support for quick, at-the-spot hands-free troubleshooting. WhatsApp can be used as well.

Any critical maintenance activities can be video recorded for quality compliance or any future troubleshooting reference. Also, maintenance videos can be recorded by experienced technicians for different equipment. These videos will be available with at-spot access to AugAR users whenever required during maintenance jobs. This is an excellent feature for knowledge & skill management.

It is a very useful tool for assessing and analyzing workforce performance. It truly digitizes maintenance activities and keeps track of time spent on each job. These reports and analytics can be used by management to assess performance to appraise or arrange training etc accordingly. On any given day, maintenance activities status can monitor in real-time using Live feature.

SMP tool converts SMPs into smart glass readable files which guide the AugAR user step by step for any maintenance, inspection, operational or safety activities. This is a great feature to ensure company standards compliance as well as great support for new/semi-skilled technicians to carry out any job with much ease.

AugAR project will work towards fulfilling following use cases:

1. Efficiency Improvement
2. Knowledge Management
3. Real-Time Jobs Status
4. Technical Resource Management
5. Maintenance Reporting and Analysis
6. SMPs Conversion tool

Features included in current solution are:

1. Availability of equipment specific help manual
2. Step by Step procedure (SMPs) with pics and Text
3. Availability of equipment specific video manual
4. Availability of equipment specific videos historian
5. Availability of remote video call support with video call and WhatsApp
6. AR glasses navigation through Voice commands
7. AR glasses navigation through AR Glass controller
8. Barcode reading for equipment double verification

9. Ambient light adjustments in AR glasses
10. Stop/Pause feature of Videos and simultaneous recording while watching other existing videos/manuals
11. Diagnostics at desktop application including battery level, active status, technician details etc.
12. Volume increase/adjustment
13. Video window size adjustment in AR glasses
14. Video call resolution improvement
15. Naming Videos with time/date

Testing at multiple plants

Plant 1: At plant 1 real time visualization features were tested and it was found real time has helped to do corrective maintenance. Also, it reduced maintenance cost and prevented breakdowns

Plant 2: At this factory complete AR features were tested. It was found that remote maintenance feature helped them to minimize cost by not visiting vendor's engineer physically.

Conclusions: multiple leading plants in Pakistan used this AR based solution at respective factories. As this solution has

remote video calling, real time process visualization and integration with plant's sensors, PLCs and DCS. User at plant find it helpful to improve over all process with minimized cost. Real time alarms and events module helped user to do corrective measures to fix issues at factories before any breakdown occurs. Similarly, digitized maintenance module helped user to achieve following goals.

- Efficiency Improvement
- Knowledge Management
- Real-Time Jobs Status
- Technical Resource Management
- Maintenance Reporting and Analysis
- Smart Access

References:

[1] J. Novak-Marcincin, Augmented Reality Aided Manufacturing:2013

[2] A.Y.C. Nee¹ , S.K. Ong² "Virtual and Augmented Reality Applications in Manufacturing:2013