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Smart Glasses and Augmented Reality for Maintenance 4.0

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Abstract. According to the journal (the m.a.g of economics 2021), the term "Industrial Revolution" defines many of the factors that have changed the world since the 18th century through technological innovation, new modes of production, and means of communication. Socially, the Industrial Revolution represents a transition from a society primarily based on agriculture and crafts to industrial and trading companies.
In these recent years, many things have been reported about the transformation called "Industry 4.0". Still, many managers don't know much about it. Switching to Industry 4.0 has the potential to increase productivity, significantly reduce costs, and significant improvement of product quality by introducing digital technologies
In general, technology allows for the control of production at each stage of the process, which improves the product's quality. It also helps to reduce – if not eliminate – downtime thanks to equipment data that alerts maintenance men when it's time to perform sustention checks and alerts them about potential problems.
Industry 4.0 is based on information technologies such as" big data", which is a technological domain dedicated to analyzing a large volume of computer data, IOT, or "internet of objects". In this paper, we are interested in augmented reality which designates a virtual interface, in 2D or 3D, which enriches reality by superimposing additional information.
In this project, we focus on augmenting reality by creating assistant intelligent glasses. Which has the goal of allowing the maintainer to have accurate and detailed information by recognizing the equipment in front of him keeping a clear large view, and gaining precious time All of this without the use of hands or exert much effort.

Keywords. Augmented reality, Maintenance 4.0, Bigdata, IOT, Embedded system.

INTRODUCTION

Industrial systems are becoming increasingly complex. This complexity is a cause of several incidents and faults, occasioning considerable damage to the material, the environment, and people. Maintenance optimization and the choice of maintenance strategies play an important

role in the efficient operation of any industrial system (Aissani et al., 2009), to ensure equipment availability and high production quality at minimum cost. Predictive Maintenance has emerged as a new and effective strategy, which can minimize maintenance costs by up to 30% and eliminate failures by 75% compared to conventional preventive maintenance (Stenström et al., 2016).
Implementing such approaches necessitates a well-structured architecture, which can be aided by the use of emerging ICT technologies such as the Internet of Things (IoT), cloud computing, advanced data analytics, and augmented reality. As a result, this paper describes the architecture of an intelligent and predictive maintenance system that follows the principles of Industry 4.0. It is equipment that collects data from the system and sends them to a platform that can retrieve and predict actions to be shown to the operator on site.
The paper is organized as follows: The first section and state of the art of preventive maintenance are presented, then a second section presents the architecture of the application and materials for preparing project planning and implementation, and the third section present introduces experiments.

PREVENTIVE MAINTENANCE IS A STATE OF THE ART

Preventive maintenance is maintenance that consists of intervening on an asset according to predetermined criteria or at regular intervals before it breaks down, its main objective is to reduce the probability of failure or unavailability of equipment during use. The cost analysis of preventive maintenance must have a gain greater than the failures it avoids (Stenström et al., 2016).
It can take two different forms: systematic preventive maintenance and conditional preventive maintenance.
- Systematic preventive maintenance is planned preventive maintenance on equipment according to a time-based or unit-of-use schedule.
- Conditional maintenance is preventive maintenance that is carried out only when a certain significant predetermined threshold is crossed, depending on the state of degradation of the asset.

Systematic preventive maintenance:

Most failure modes are age-independent. However, in most failure modes, you will see some warning that it is about to or will occur.
If you find evidence that something is in the early stages of failure, you can take steps to prevent a complete failure and/or the consequences of the failure. Therefore, strategic condition-based maintenance looks for physical signs that a failure is occurring or is imminent. This view of CBM points to a wide range of applications other than condition monitoring technology. This is often only relevant for rotating equipment.

Conditional maintenance:

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MAINTENANCE 4.0 TECHNOLOGIES

It is impossible to find a solution to a sustainable maintenance problem without considering technology as an integral part of development. From a maintenance perspective, the development of new technologies and end-user requirements have had a significant impact on both the subject of maintenance work (machines and systems) and the way maintenance measures are planned and implemented. Today, we use the most common term, "smart machines," when it comes to applying new technologies to machines and equipment. The term "smart machine" means a more networked, more flexible, more efficient, and safer machine. You can respond quickly to new requirements. Smart machines have three main components: physical components, intelligent components, and connectivity components. Although smart components are directly linked to services related to physical components, connectivity allows information to be exchanged between the machine and its environment, allowing services to existing outside the physical machine itself.

Intelligence and connectivity enable the features and capabilities of entirely new machines.

- Monitoring: Machines can monitor their status, operations, and external environment through sensors and external data sources to alert users and other stakeholders of changes in status and performance.
- Control: The machine can be controlled via remote commands or algorithms that are integrated into the device or located in the machining cloud.
- Optimization: Smart, connected machines can apply algorithms and analysis to current or historical data to improve performance, utilization, and efficiency.
- Autonomy: A combination of monitoring, control, and optimization capabilities that provides intelligent networked machines with a level of autonomy never before achieved. At the simplest level, autonomous machines operate in real-time using sensors and software. More sophisticated machines can learn about the environment, self-diagnose their unique service needs, and adapt to user preferences. Autonomy not only reduces the need for operators but also increases safety in hazardous environments and facilitates remote operations. (Jasiulewicz-Kaczmarek and Gola, 2019).

Augmented reality (AR) :

Augmented Reality (AR) is defined as a real-time direct or indirect view of a physical real-world environment that has been enhanced/augmented by adding virtual computer-generated information to it ('Augmented reality', 2021). An Augmented reality (AR) is also referred to as a system that combines real and virtual worlds, is interactive, and registers in three dimensions (Azuma, 1997). It can be used to enhance or destroy the natural environment. Augment reality technology can make some experiences possible that otherwise seem to be very hard or impossible to implement. After decades and major advances in AR enablement thanks to the development of technologies, such as cameras, sensors, tracking algorithms, visualization technologies, and general information and communication technologies, AR is now entering the consumer market. At that time, AR was recognized as one of the main technologies of the Fourth Industrial Revolution, the so-called industry4.0 (Masoni et al., 2017).

Augmented Reality as a support for maintenance is just one example of what can be achieved by introducing AR into the industry. AR helps reduce maintenance task time and errors (Fiorentino, 2014).

In this paper, we are exploring the use of augmented reality in preventive maintenance.

APPLICATION PROTOTYPE

Functions specification

After placing the device in the field of view of the camera or glasses and defining which device it is, the information is displayed and stored in the database.

The following describes the information that is displayed:

- First, there is a technical datasheet
- Second, history.
- Third, preventive maintenance and repair maintenance.

Material specification:

The prototype is composed of glasses and equipment.

- Microcontroller.
- Camera.
- Nano Display.
- Battery.

The prototype is shown in figure 2.

EXPERIMENTATION

These glasses are tested on known equipment DVC6020 Positioner.

To compare the duration of the old intervention method with the new method (using glasses), we created this table to show the time difference between the latter.

Maintenance has time for preparation, documentation, and repairs.

Table 1. Comparative table of time

Action	Ideal time without glasses	Time with glasses
Preparation	from 7h to 8h	20min
Documentation	from 6h to 7h	20min
Repair	4h	1h

Analysis of results

Analysis of the results of a small device using the positioner example showed that maintenance times fluctuate between 1-2 working days. For comparison: With the glasses that have just been run (Fig. 2), maintenance of this equipment will be completed in less than 2 hours.

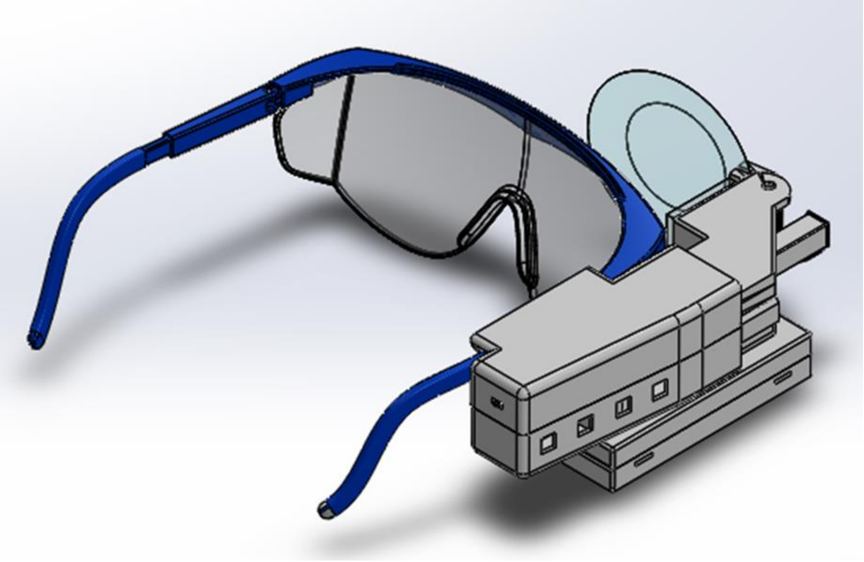

Fig.1. Prototype 3D.

Fig.2. An example of the use of glasses.

CONCLUSION AND PERSPECTIVES

Industrial engineers can optimize industrial maintenance. Augmented reality glasses give operators all the information they need to perform maintenance tasks smoothly and give them the freedom to move around. Wearing augmented reality glasses gives you the freedom to use hands. This is not always the case with tablets, phones, computers, and even paper documents. Smart glass solutions allow technicians to intervene as quickly as possible in the event of a failure, limiting downtime for sometimes long and very expensive machines. We also intervene in preventive maintenance, especially if we perform checks to avoid possible failures and delayed activity.

This prototype has been tested with good results, but it is not without problems such as creating a database, angle for display, and display of glasses.

However, there are still some areas that need improvement. Specified optimization on much lighter models, expanding the Smart glass network, expanding Smart glasses with additional options, and expanding the database.

REFERENCES

Aissani, N., Beldjilali, B., & Trentesaux, D. (2009). Dynamic scheduling of maintenance tasks in the petroleum industry: A reinforcement approach. *Engineering Applications of Artificial Intelligence, 22*(7), 1089-1103.

Azuma, R. T. (1997). A survey of augmented reality. *Presence: teleoperators & virtual environments*, *6*(4), 355-385.

Fiorentino, M., Uva, A. E., Gattullo, M., Debernardis, S., & Monno, G. (2014). Augmented reality on large screen for interactive maintenance instructions. *Computers in Industry*, *65*(2), 270-278.

Jasiulewicz-Kaczmarek, M., & Gola, A. (2019). Maintenance 4.0 technologies for sustainable manufacturing-an overview. *IFAC-PapersOnLine, 52*(10), 91-96.

Masoni, R., Ferrise, F., Bordegoni, M., Gattullo, M., Uva, A. E., Fiorentino, M., ... & Di Donato, M. (2017). Supporting remote maintenance in industry 4.0 through augmented reality. *Procedia manufacturing*, *11*, 1296-1302.

Stenström, C., Norrbin, P., Parida, A., & Kumar, U. (2016). Preventive and corrective maintenance–cost comparison and cost–benefit analysis. *Structure and Infrastructure Engineering*, *12*(5), 603-617.