The future of technology, how can augmented reality be implemented in flight inspection?

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ABSTRACT

Authorities in aviation (FAA, ICAO and national authorities) have over the years, defined unified procedures and tolerances on how to perform flight inspection. This has resulted further into advanced automated Flight Inspection Systems to progressed efficiency to cover a large scale of advanced procedures. Further, the development in flight inspection systems contributed to more cost-efficient operations for the operator organizations and better work environment for the flight inspections.

Within Flight Inspection, FI systems is gradually changing with newer technology such as autonomous solutions and higher demand of presentation of data to the operators. On Flight Inspection Missions, there is a continuously mission to present relevant data on a limited computer space that will be changed related to what type of procedure being flown, tolerances used and requirements from Aviation Authority.

Augmented reality is a technology that uses real-world environment combined with computer-generated information. The technology is still in the beginning of development, but more industries are starting to take in use of this technology for manufacturing, industrial design, flight training and more.

The purpose of this paper is to take a deeper look into AR technology and how this can be implemented on different areas in the world of flight inspection. We will look into how it can be used to present live data and calculations for the personnel operating a FI system in limited space, how it can be adapted for use with UAV, for training purpose or post reviewing after missions.

Introduction

Augmented reality is found under the term extended reality. This term covers Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR). While VR is a technology where the user is in a simulated experience, AR and MR is often used together as a term. AR is an interactive experience of a real-world environment; MR is a mix between real and virtual worlds.

Augmented reality (AR) is a technology that uses interactive experience in a real-world environment. The technology is not only a cool new technology for people with special interests in technology, it also on its way into several industries, for example different manufactures, in construction, for training and observation in health care, for use with drones – the opportunities is many.
The AR technology is for sure getting better and better every year, as several companies are in the competition of making AR glasses, like Google, Microsoft and Apple, but also companies that specializes for AR/XR glasses for industrial use like Iristick.

There are several diverse ways to enable AR technology in aviation and flight inspection, the most known existing use is HUD. Head Up Display (HUD) is a version of augmented reality that is a technology that exists with use case withing aviation. This functionality is to project the desired data, information, images to the person in their line of sight instead of looking down on the instruments. One example is to view simple flight data into pilots' line of sight and keep the "heads up".

Existing products for smart glasses in marked specifically for AR:

For use in flight inspection, this paper focuses on the technology developed for AR glasses with the key point will surround use for operators in air and on ground, use with drones and use in training. There are several contributors in the marked and it still get further developed. Many of the products when searching for AR or MR glasses are usually smart glasses with limited functions or devices that should be connected to a stationary computer. The two products that are most investigated to be used per technology suitable for this day, is the Microsoft HoloLens or Magic Leap for flight inspection and Iristick for maintenance.

HoloLens, a Microsoft product, is considered to be a mixed reality smart glasses. This product is head-mounted display, the unit is adaptable to the users' head and have built-in speakers and cameras. It is using a tracking function to map the area the user is found and is running a Windows operating system. From the developer edition to the newest release of HoloLens 2, the use cases increased, and the lenses comes in different options from office use to industrial use where it demands certification (example ISO certification).

Figure 1 Microsoft HoloLens 1 (Microsoft, n.d)

Figure 2 Microsoft HoloLens 2 (CNet, 2019)

Figure 3 Magic Leap One, with its computing unit and controller (Magic Leap, n.d)

For a company that delivers solutions in flight inspection, there are several different areas where the AR technology can be implemented. This can be divided into four different primary areas: Marketing, Operation/Customer, Support and Training.

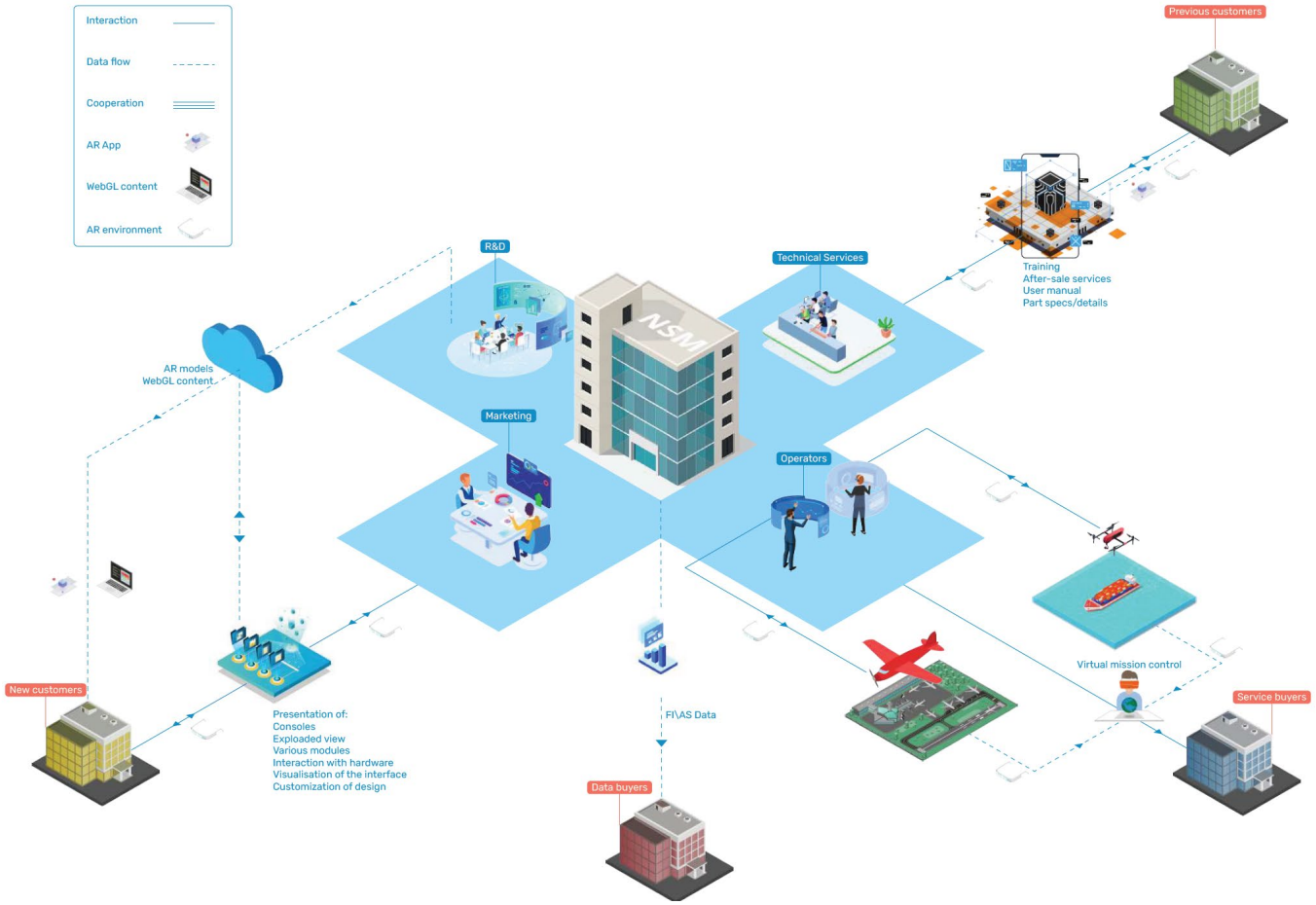

Figure 4 Possibilities for using AR Technology in the company

AR use for operators in flight inspection

For using AR and smart glasses for operators in flight inspection, it is divided into two main focus areas, use in air and on ground.

In Air

Today technology usually exist of a large console consisting with sensors, one or two screens mounted and small desk with a keyboard. Due to the space and requirements inside an aircraft, there is limitation to how large the screens can be and because of safety some seats are removed. Since most operators has limited space for screen solution and variation of information that needs to be available at the same time, the AR solution will follow operating with several screens in limited space.

There is a primary factor to consider when investigating the possibility of smart glasses in flight. The most important key factor is the aviation safety regulations that say the eyesight of the people in the aircraft should not be blocked and they can quickly get off the aircraft in an emergency. With smart glasses such as HoloLens, the operator will have a clear view through the glass and be able to see augmented objects on real surfaces. Since the glasses have a computer in the headset, there is no need for additional wiring and the communication to the flight inspection system can be wireless.

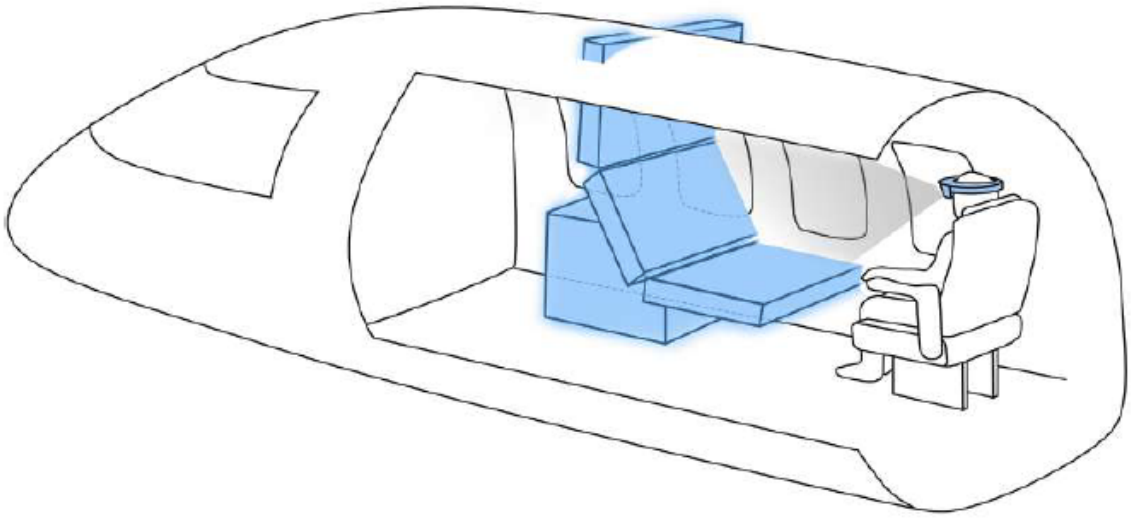

Figure 5 Inside aircraft with console projected trough smart glasses.

On Ground

One crucial factor for flight inspection is to confirm the data collected and compare to expected values. Usually, the team will work with desktop computers with a small monitor to compare and confirm the collected data. With changing over to using AR glasses, one example is HoloLens, the operators can work together with glasses that are linked together to view the same information.

Figure 6 Microsoft HoloLens, flight validation on ground (Microsoft, n.d)

In the figure above, it is visualized that the operators can be in an office space without furniture to be able to walk around. From here it can be two options, having their own virtual workspace or create a large workspace they can look at together. When the computers are linked together and having one large workspace, the operators can then discuss the data together, creating simulated model on how the aircraft was flying while looking at the information that is presented typically in plotters and calculation results diagram. This can be adaptable related to the necessary needs for the specific company.

In the following figures gives out examples on how to adapt the use of smart glasses on both inside an aircraft, but also can be used on ground by a desk. There is a large number of innovative ideas on how to set up a system with the use of smart glasses. The following will present two options, one more traditional to existing system today and one with more holograms.

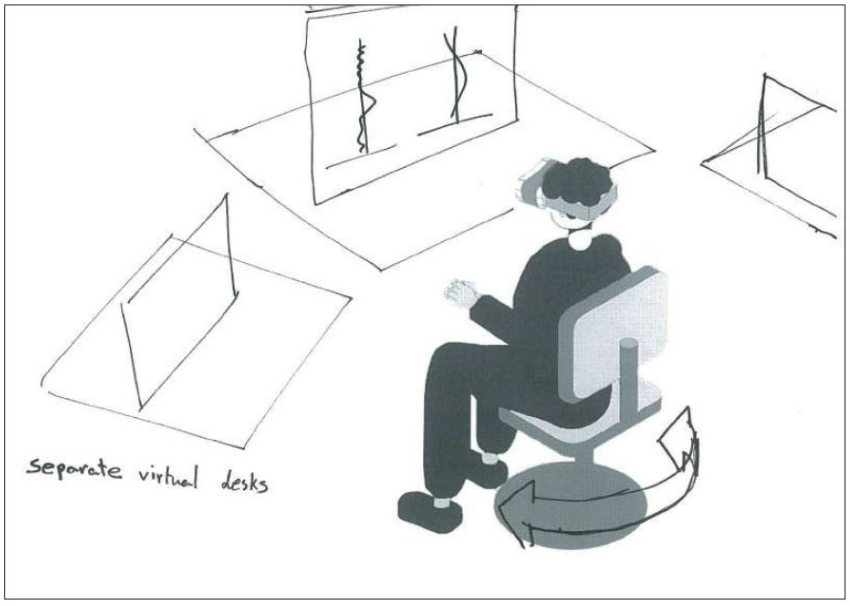

Figure 7. With this setup, the glasses will project multiple different screens for the operator to choose from. Here the operator is able to setup the screens to view the desired information.

Figure 8. In this setup, the setup is configured with small holograms and virtual screens. Here the operator is designed to use a tablet to control the system.

The safety aspect with Augmented Reality.

As you all know safety is a big aspect of the modern aviation industry – both on the ground and in flight.
When we first started looking into the possibility to use Augmented reality and Virtual reality in flight inspection one of our initial thoughts was, is it safe to use VR and AR equipment inside an aircraft or on an airfield?

Situational awareness is key to keep the safety at the desired level. Both when using AR inside the aircraft to be able to obtain more information, and when standing on an airfield as a drone operator.
We will take a quick look into the safety aspects when used inside an aircraft, and when used on an airfield by a drone operator.

We will start with inside the aircraft

The AR equipment is light weighted and easy to take with you in and out of the aircraft, just the same as a headset is. It will therefor in the event of an emergency be quick, safe and easy to take of the AR glasses of your head, so you can leave the aircraft as quick and smooth as without the headset.

One of the big advantages with AR instead of VR is that you are still able to see what's happening outside of the augmented world, so your perception of what's happening around you, will still be good. Therefore, if a situation is to appear when using the AR technology, you will be able to see and react to this in the same time amount as without the AR glasses.

There is an important key factor to consider for operation in flight for personnel, nausea and motion-sickness for sensitive people. Since it occurs with vibration and movement inside an aircraft that is in flight, the screen on a console will follow the movement of the aircraft and the operator might get nausea from trying to keep their focus on the screen. Here will AR technology have an advantage to be more flexible. The general way to use AR screens through the glasses is to mount the screen on a specific point in the space, but it can also be placed according to a specific point according to the glass. So, when the aircraft experience vibration, the operators screen will follow the motion of the operator and the screen will be on a stable point.

Safety when using AR technology with drones

AR Technology with drones

Now a days – with modern technology you can control the drone from near, but also further away.

A drone can be controlled in several ways – to control a drone you always need to know where it is, visually, from position systems or a combination of these – on bigger drones, for example the ones we in the future might use in flight inspection we have the great advantage of autopilot. However, these drones will in some cases need to be controlled manually.

We have looked into how we can combine AR technology with drones.

As some of you might already know – Norwegian Special Mission and Primoco UAV have already co-operated together to start testing of drones for flight inspection. The drone used in these tests are fully equipped with autopilot, and is controlled from ground. The autopilot is mostly used, but in heavy weather or in precisions flights the drone pilot does manually control the drone.

One use can be during PAPI approach when 'hunting' down the lights, then in the AR glasses the drone pilot could be able to see live camera data so he would have the view of an airplane pilot, and at the same time be able to see flight data received from the drone. While the pilot is watching this, he or she will also be able to see the surroundings of the drones from 'real' view.

Negative sides of AR and drones

We cannot only talk about the smart solutions and the possibilities – we also must look into the less fortunate parts of the technology. Drones do not have too much space; with the AR technology you would have to add more equipment inside already tight space. Some drone pilots would maybe prefer to be able to use AR glasses and stand outside of their normally control environment, to see the drone visually and also see the data transmitted from the drone. But other drone pilots will prefer to sit in front of the normal displays and control the drone from there. As for someone the AR glasses might be disturbing to wear for several hours.

It has also been reported that some people might be sensitive to augmented reality or virtual reality – as they can experience dizziness and nausea while using the glasses.

Training purpose

With AR technology, it is possible to create a new foundation of training where it can be used simulated objects instead of real-life objects. With this, the crew can get more familiar with the systems without the risk of damaging components, take systems out of operation due to need for equipment to train on, get higher experience on the systems that is delivered to the customer.

Operator focused training

Training is a key point for all personnel in flight inspection and it is a high importance to have high quality training provided. Today, a typical training involves either personnel or instructor/instructors travelling to a place and supply a training course normally involving materials such as PowerPoint-slides and laptops where people work together. In many cases these courses can be help without having the actual product be available for the attendees to practice on. Therefore, the training can feel abstract and hard to understand if limited experience on the actual product.

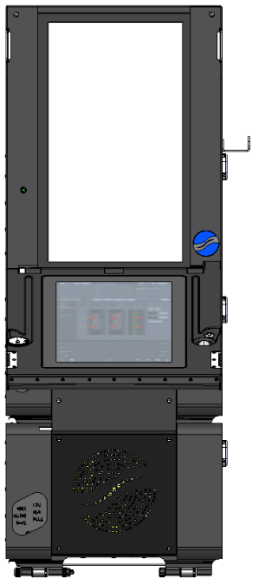

Figure 9 3D mechanical drawing of a console. This can be viewed as a true size hologram to be projected through smart glasses. With this the operator can get firsthand practice on the console without the necessity of the physical equipment.

With using AR or smart glasses, it opens innovative ideas and way to conduct training. When in advanced, the manufacturer can provide smart glasses to the client with the proper software programs installed. From here, the trainer can remotely Holoport to the training course without the necessity to physical travel. The glasses can also be used to present AR model of the product with all its features and software. This way the trainees will get experience on a virtual model of the product, the teacher can interact directly with each student and provide higher quality of information then what it will be possible to do with only a laptop.

Maintenance focused training

With augmented reality, the idea is to be able to teach maintenance training with a full-scale module created from 3D drawings without the need for a physical console. This way, each trainee can get familiar with the console and equipment without the need to dismantle the entire system but can dismantle and rebuild every section and sensor as pleased to get firsthand experience. With this way, several members of the training can take part at once with each set of exp. HoloLens and work one and one or in small groups

to get familiar with the console in a simulated reality. Since AR technology also can be adapted to tablets, it is possible to use 3D drawings and walk around a “simulated” console next to the real one during troubleshooting.

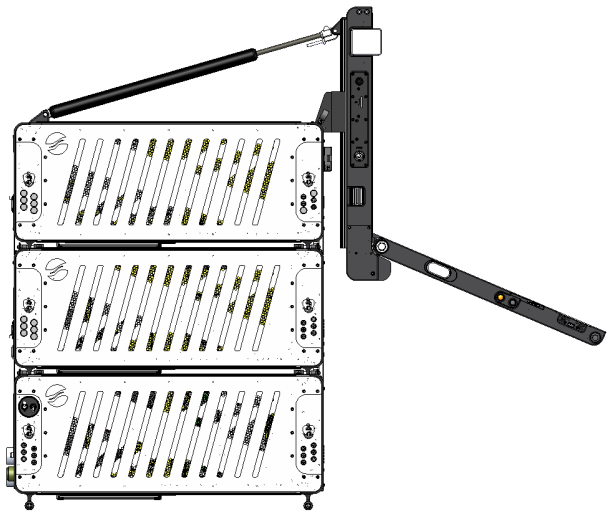

Figure 10. Mechanical drawing of console to be presented with the smart glasses or a tablet with AR software.

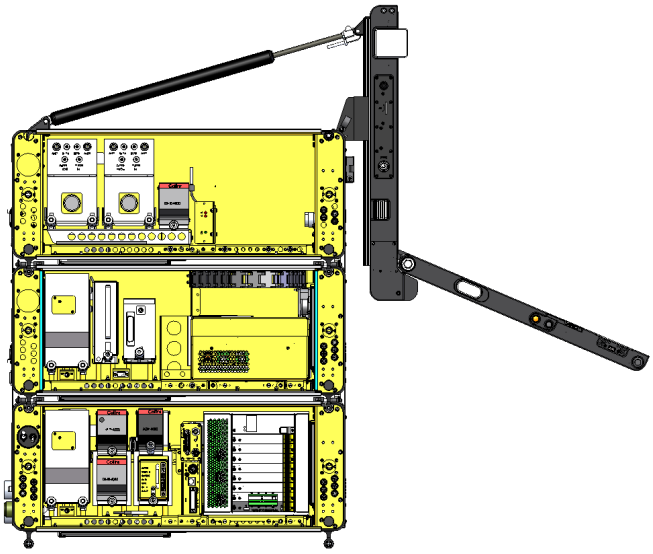

Figure 11. Mechanical drawing of a console where the cover on the side is removed. This gives the possibility to mount and disassemble equipment without the physical items.

When using devices such as smart glasses, the devices usually have integrated camera in the front. With the camera, the personnel using the device can connect to a remote support (exp. Manufacturer) and being able to show exactly what the person at the site is looking at. For the person that provides support, it can then take a screenshot to show what to look at, create a virtual screen to the personnel with drawings for troubleshoot or similar. There is also a possibility to create an AR user manual. This can provide a detailed instruction manual, with the glasses detecting a selected item, then creating a bon to the information about the physical object.

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