Aalto University

TU Delft

SPOT

SOCIETAL PERSPECTIVES TO INNOVATION OPPORTUNITIES IN TECHNOLOGY

EXPLORING H3D-VISIONAIR ENGINEERING CASES: PART 1

ATTRACT

Report:

AUGMENTED VISION: OPPORTUNITIES IN ENGINEERING FIELDS & APPLICATIONS

A student perspective

Prepared for:

H3D-VISIOnAiR

Projects completed within the course:
PROTOTYPING FOR INNOVATION
January – February 2024

The *Prototyping for Innovation* course offers a combination of theory, company case explorations and hands-on practice in purpose driven prototyping for innovation. After completion participants will be familiar with key principles in purpose-driven experimentation and will recognize a range of prototypes of different forms and different levels of fidelity. Key to the programme is the development of students' ability to plan and execute meaningful experiments to develop ideas further in innovation projects.

Students were introduced to the H3D-VISIOnAiR consortium and technology through the ATTRACT technology card.

Students were asked to focus on the combination of portability and the application of augmented reality to assist in the completion of high-detailed tasks. The focus was on finding alternative application, no matter how abstract or the technology state needed.

This compilation of student insights represents a curated selection from 70 anonymous individual submissions. The theme for this compilation was possible applications in engineering fields and technical applications, relating to safety, assembly lines and repair support.

Comments presented in this compilation are those of students, and to retain their voice, their comments have not been edited.

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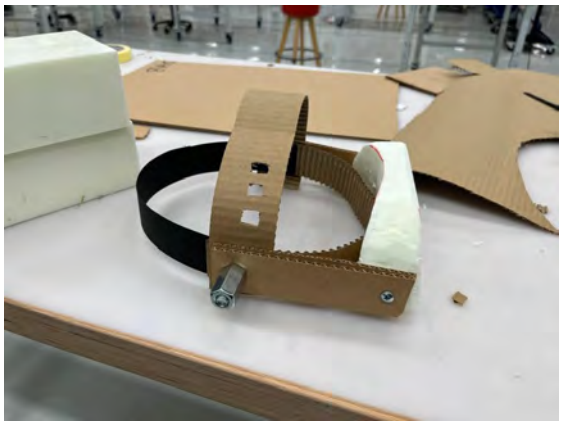
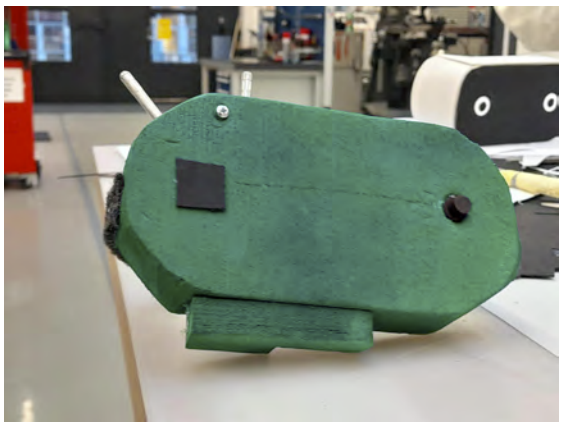
Repairs and maintenance:
Examples from the automobile and mechanical sectors

Example 1: Seeing inside service objects or environments



The purpose is to assist in seeing inside a serviced object, but without the glasses you can't actually see anything. The glasses should be easily adjustable in terms of size and the glasses can be turned to the forehead, so that when you do, for example, maintenance work, you always have good visibility.

Example 2: Welding support

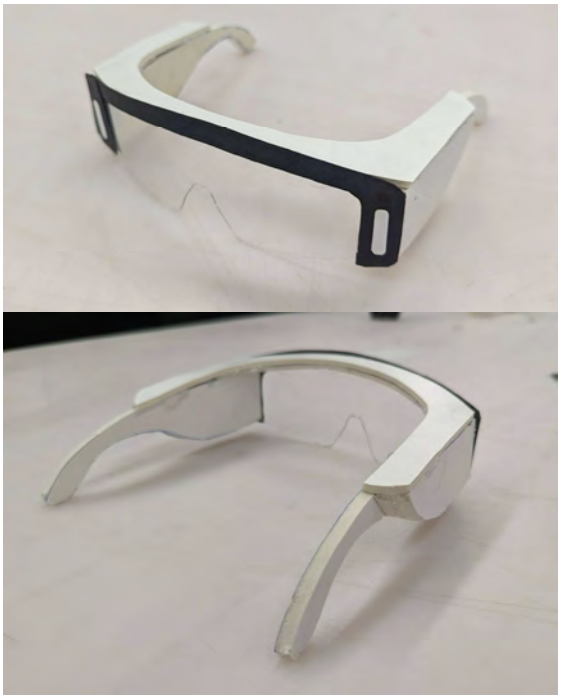


The intended use case of this prototype is to give critical welding training to personnel working in maintenance.

Features

1. It has two accessory sticks for use as welding torches.
2. It has cameras and sensors for communicating with CPU and torches.
3. Detachable battery and strap are added features.

Example 3: Electronics repair

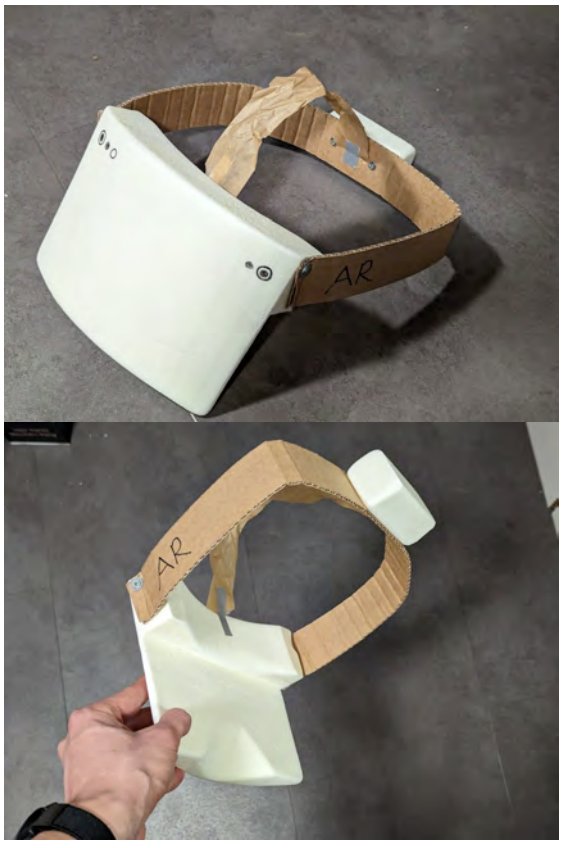


The AR glasses are meant to assist in repair work (electronics and other fine mechanical work) by highlighting the next steps in (dis)assembly.

The main criteria are to be:

Lightweight and comfortable as they would be worn for long periods at a time, protective as they would also replace the protective glasses often required for the repair jobs (Li-Ion batteries etc), as well as simple and convenient to use as they should assist the job, not complicate it. The glasses feature work lights and cameras on both sides, and touch control surfaces integrated the temples, which also house the electronics.

Example 4: Automotive fault detection

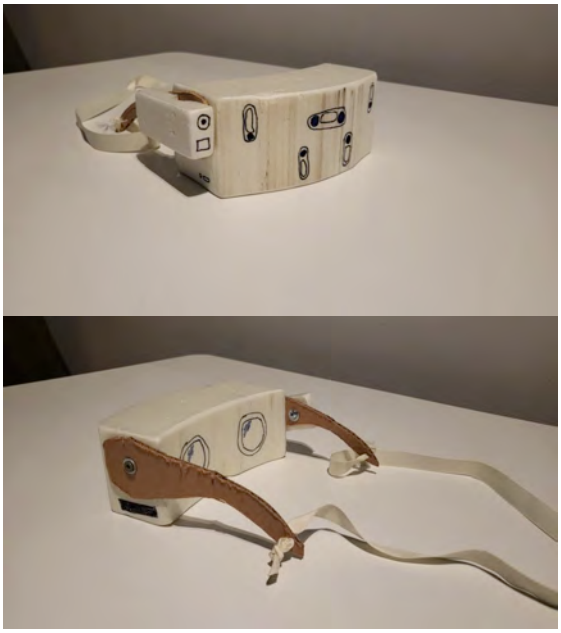


This headset is intended to be used in for example a car repair shop. Ideally, an OBD adapter is connected to the car to diagnose possible faults, and the headset then displays the faulty parts of the car in the AR view. Can be also used to map structures by using an IR proximity sensor, and can also produce a thermal image with a FLIR camera.

Critical features:

1. Ergonomic design of the visor and headband, comfortable fit on the head.
2. Hinges that allow the operator to lift the visor without removing the headset.
3. Exchangeable battery, enabling continuous use.
4. Multiple sensors: 2 cameras, IR sensors, FLIR camera.

Example 5: Automobile repair and maintenance



The AR headset is designed for car mechanics. Just by looking at the car it can detect broken parts by using its sensors and machine vision. It automatically adds the needed parts to a shopping list. It can show the user step-by-step instructions for repair by highlighting the required part and its place in the car. It is wireless and doesn't restrict the movement of the mechanic. The removable battery can be swapped easily while in use thanks to capacitators keeping the power on for a

while without the battery. Car specific data can be uploaded to the headset wirelessly.

Critical features in the prototype:

1. The flashlight and camera module on the right side of the headset. The flashlight helps the user to see in dark places and the camera can be used to record and stream video.
2. The adjustable heads trap allows the user to hang the headset from their neck. It is also used to tighten the headset to the users head.
3. The hinge of the temples allows user to find the most comfortable setting for their head.

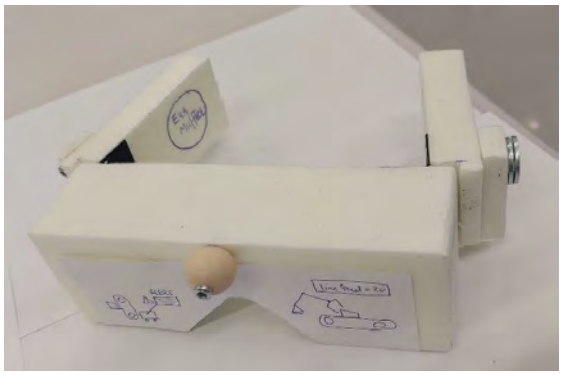
Example 5b: Automobile repair and maintenance

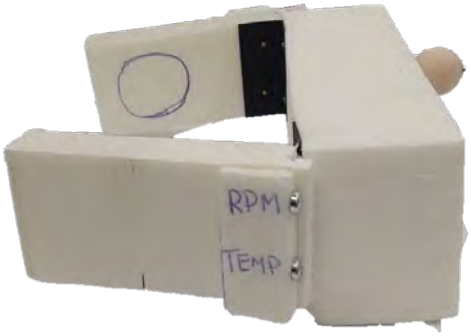
My idea is based on an idea about AR-glasses for car mechanics. Glasses are supposed to guide the mechanic through the whole repair/maintenance that needs to be done. It starts with the AR-glasses highlighting the tools and parts in a tool shelf/-box that are needed for the whole project and guides the mechanic through the wrenching by highlighting the parts that need to be removed or replaced (bolts, nuts, clips etc). I thought about comfort, smallness and product weight, and as a result, I came up with glasses that resemble safety glasses, with added lights/battery packs on both sides and a camera in the middle.

Production:

Examples from design to assembly lines and factories

Example 1: Monitoring production line and factory floor





The purpose of the AR headset is to capture the ongoing activities on the production line/ factory floor. Ongoing activities include the normal functioning of the machines installed i.e. to note the line speed of conveyors, functioning of motors, pumps etc. and alert the user if there is a fault (overheating, flowrate decrease, efficiency down etc.)

Feature 1: The camera would gather all the data and the headset is linked to the

Feature 2: Laser sensors to check RPM and temperature in real time.
Feature 3: Ear mufflers added to provide noise protection on the factory floor.
Feature 4: Finally, there is a charging port and a knob to change between different modes. i.e. reliability mode, Normal mode, Temp sensor, RPM sensor.

Example 2: Design and assembly support

This AR headset is specifically designed for mechanical designers and engineers, aiming to simplify and enhance the accuracy of their work. It's particularly effective during processes such as simulating, designing, and assembling machines. The headset is capable of displaying 3D models, component details, exploded views of assemblies, thermal effects on parts, and various types of simulations. This feature allows users to realistically visualize models and simulations before the actual parts or machines are manufactured. It aids in early detection and resolution of potential issues, thereby facilitating a deeper understanding of complex machinery.

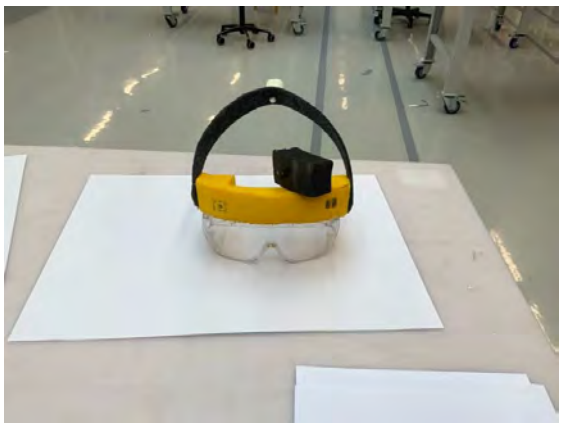
Features

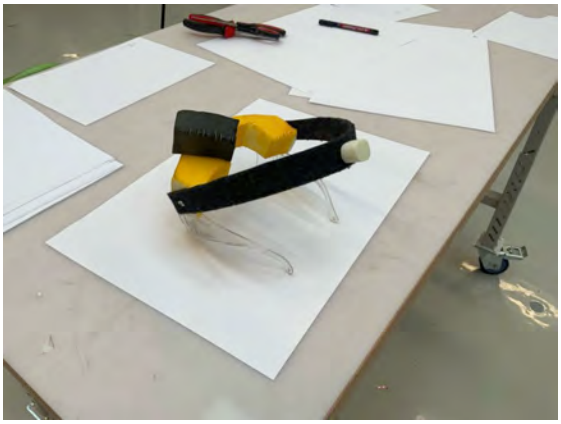
1. 3D Model Display: This feature shows detailed 3D representations, enabling users to closely inspect and interact

with machine designs in a digital setting.

2. Detailed Component Information: Provides extensive insights on machine parts, including exploded views of assemblies. This enhances understanding of the machine's structure and how it functions.
3. Thermal Impact Simulation: Demonstrates the effects of temperature changes on components, assisting in creating machines that are more durable and efficient.
4. Advanced Simulation Options: Offers a range of simulations that allow users to virtually test and improve their designs, reducing the reliance on physical prototypes.
5. Early Issue Identification and Solution: Aids in recognizing and resolving design problems at an early stage, leading to more dependable and effective machinery.
6. Improved Comprehension of Complex Systems: Facilitates a better understanding of intricate machinery, contributing to higher quality and efficiency in design.

Example 3: Quality Control and Smart Manufacturing





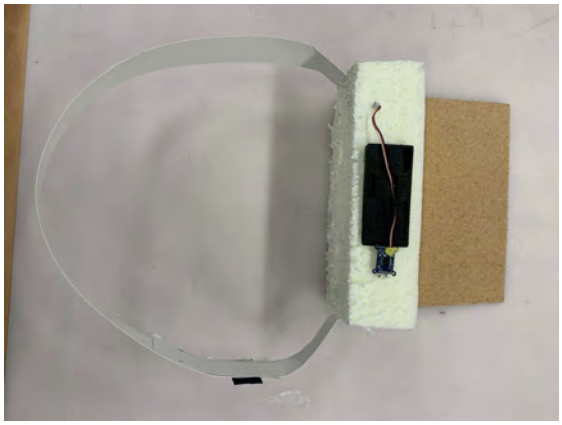
This AR headset is intended for Quality Control and Smart Manufacturing. The headset will be combined with a 3D Scanner and an iPad on an Assembly line. Using the 3D scanner, all parts will be scanned and compared to the CAD model. The results of dimensional and surface analysis will be displayed on the AR headset in real time. Apart from that, the headset can also be used for assembling and connecting different parts together. In this case the headset will guide the person what to do and he wouldn't need to see drawings.

Three critical features of the prototype are:

1. Removable Battery with a charging dock.
2. Adjustable Strap for better support.
3. Built in LEDs, Camera and Sensors.

Safety:
Examples from driving aids to mining safety

Example 1: Coal mine application



A prototype for AR glasses with an adjustable strap is made with the intended use-case of improving the safety of miners in the coal mine industry. These AR wearables will be adaptable to the complex environmental conditions of the mines.

The critical features are as follows:

1. A button to move the display to allow for full situational awareness.
2. A humidity sensor and a temperature sensor to help in meeting the requirements of the coal mine safety regulations.
3. A receiver at the bottom to receive information and a microphone to get the real-time support of mining experts from the server side.

Example 2: Safety helmet

I have modelled a safety helmet with built in smart func□ons, such as AR glasses, cameras, and sensors. This helmet would improve the safety of construc□on sites by giving the necessary instruc□ons to the workers. The helmet can show dangerous zones, highlight coworker's posi□ons, warn the user of other dangers from the surrounding through different sensors. To power everything a battery pack is built in the back part of the helmet.

The key features that are included in the prototype:

1. Attached AR glasses to the helmet.
2. Swappable battery pack in the back.
3. Sensors strategically placed to cover 360 degrees around the user.
4. Cameras facing the front to capture the workers point of view in the middle of the glasses.

Example 2b: Safety helmet

AR glasses seamlessly integrated into the engineering helmet, combining helmet and safety goggles for a unified safety product. Built-in microphones and speakers facilitate real-time communication with on-site colleagues.

Features

1. Integrated cameras allow remote colleagues to view the surroundings when needed.
2. Glasses automatically dim in outdoor environments, safeguarding the user's eyes from the sun's glare.
3. Removable battery pack on the back allows easy replacement and charging of batteries to ensures uninterrupted usage.
4. Instructions are displayed in front of the user, providing guidance for specific tasks.
5. Virtual preview capabilities allow users to visualize the final look of a product or building.
6. Depth sensor enables precise on-site measurements.
7. Integrated cameras capture images, enhancing documentation capabilities during tasks.:
8. Glasses are designed to be rotatable, allowing users to raise them up when needed for better visibility or to interact without obstruction.

Example 3: Driving Mate

The device is designed as an aid for professional drivers in winter times. The AR headset is supposed to show road signs, lanes, crossings and even pavements

covered with snow for enhanced visibility. The following features are introduced to the design for specific reasons which is unique to professional drivers in this difficult season.

Features

1. Curved shape of the glass – Helps the drivers to see the sides clearly despite wearing an AR headset.
2. Cleaner – A 'touch to clean' button is used to actuate the cleaning mechanism. It can be used to clean the fog or any alien particles while driving without having to take the AR headset off. It uses a simple rotating mechanism at the ends of the glasses and two wipes placed touching the glass. (The glass is place in between the wipes)
3. Glare resistor – Prevents the direct sunlight hitting the eyes while driving. Made out of car dashboard material to prevent reflections. This also makes space for the cleaning mechanism to work without any obstructions from the driver's forehead.
4. GPS module – Detecting the location to provide road data to project while driving.
5. Wi-Fi module – Enhance the accuracy of the location data by using Wi-Fi networks along the road.
6. Bluetooth module – Enhancing the accuracy of the direction data of the location to precisely decide the navigation.
7. ON/OFF button – Switches on and off the display when not in work or if the driver wants to see via the naked eyes for some reason.
8. Processor – Processes the camera data, location data to project an augmented reality.
9. Camera system – Consists of IR cameras and HD cameras to identify objects.
10. Light weight and slim design – The product is designed aiming drivers who has to wear them for longer period of times. Therefore, some features such as audio IP/OP are ditched. Also, in order to avoid distractions in the display, only the speed of the vehicle will be displayed apart from the aforementioned road signs.

Specific use cases:

Examples for astronauts, tour guides and to enhance communication

Example 1: City tours

This AR glasses is intended to be used in city tours. You can walk around the city and when looking at buildings it tells you some information about it. It can also guide you through the city to see the most famous sights by showing arrows. There are buttons for power and brightness on the temples. Furthermore, the temples can be changed in size, so they fit a variety of people. The main part has two cameras in the front and a charging point on the back.

Example 2: Augmented hearing

These AR glasses were designed for people who are hearing impaired. They work in a way that when one looks through them, they "see" the speech of others as text, sort of like real-time subtitles. They are quite small because they only need that one function, ideally in different

variations such as in choosing the distance, text font, text size, etc. The visuals are made through an advanced tehcnological material that works like a hologram.

The features highlighted in the prototype include

1. Size which also shows an outward bridge over the nose. This piece is made so that if one likes other shapes of glasses, they can simply place them over these AR glasses.
2. Microphones placed on the sides, so that all directions of sound could be considered.
3. Charging mechanism, which took inspiration from Apple's Airpod mechanism.

Example 3: Astronauts

This AR visor, distinct from traditional HMDs, is a detachable attachment for an astronaut's helmet, avoiding modifications to the main visor. Prioritizing safety, it can be swiftly detached in case of malfunction, residing atop the astronaut's helmet to enable wiring connections.

Features

1. The removable attachment houses essential components and more prone to malfunction, like a battery so in case of malfunction the suit is not at risk.
2. In the image a paper also illustrates the potential arm control panel for the astronaut, facilitating manipulation of the AR visor—displaying warnings or guiding directions.
3. Additionally, a small lever on the attachment allows easy toggling of the visor's power.