
Interactions and Applications for See-Through interfaces: Industrial application examples

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Abstract

Could See-through technologies be useful and have benefits in industrial applications? Possible scenarios could range through a full product lifecycle; from production line operators, through machine operators to service engineers. There are also challenges involved in using new technology in critical applications; such as user attention, data availability and efficient ways of interaction for the specific task at hand. This workshop submission aims to present a number of usage scenarios together with a discussion on related risk and technical aspects.

Author Keywords

Interaction design; See-through technologies; industrial applications examples; HCI

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

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Introduction

Consumer and mobile communication applications provides possibilities to use see-through technology using mobile displays, be it smart phone with augmented applications using see through technologies, such as Nokia's Here City Lens [10] or mobile devices such as Google's Google glass [11]. These applications enhance user's ways of acquiring information and/or communicating while being connected to the reality of the world around them. From studies made on augmented reality browsers they have the possibility to both enhance the users experience and create negative experiences in acquiring information[7].

See through interfaces also provides means of providing information, communication and user support in industrial applications [3]. In this paper some brief examples will be presented and discussed based on the lifetime of an industrial machine, from manufacturing through operation and service. We will see that during all these stages there are different possible usage of see-through interfaces and that there are also different considerations together with each scenario.

The benefits of using see-through interfaces within industrial application could be many, such as better service levels, reduced time spent on administrative tasks (such as having information in sight of view instead of finding information in separate logging databases or documentation sources) giving more efficient usage of working hours etc.

Manufacturing

During manufacturing augmented reality and see-through interfaces can be used to optimize production by giving more efficient information about the part or machine being produced [12]. In production lines with high degree of customization an efficient way of displaying which parts to assemble can both reduce time and chances for errors rather than having to scan bar codes and looking at separate displays.

For this type of applications head-mounted displays (HMDs) would let user work with both hands while at the same time observing information. Interaction with the application could be done via methods such as voice control, eye-gaze or body touch interfaces [9]. As with all scenarios presented surrounding noise might be an obstacle for good voice command interpretation and Midas touch problems needs to be avoided.

Operation

While operating a machine it can be beneficial to see information without having to look down at instrument clusters or dash board mounted displays. Cars equipped with head-up displays presents information such as speed, warnings and navigational guidance. In industrial application additional information could also be valuable to present to the user while he or she still have the eyes on the task at hand. A few examples:

- The proximity of machine to surrounding objects or boundaries.
- For digging machines it could be if digging is made in the correct place, correct depth and level.
- For spraying or pumping machines it could be the volume that is distributed at each time.

- For lifting machines it could be what weights that are lifted or for precision moving machines if the machine is following its path or not.

Putting hands and focus on and through a mobile phone could be directly hazardous in a moving machine and in some countries also illegal. Instead head-up displays (HUDs) or Head-worn displays (HWDs) can be used. These types of displays both have their pros and cons. HUDs have the advantage that it does not require any additional things to wear and that information is always on the same place, user knows where to look for information. HUDs though have the limitation that the size of the “display” is rather small in size, resulting in limitations in amount and placement of information.

HWDs on the other hand provides freedom of movement and information can be presented augmented with the surrounding reality. This also make it possible to present information that could otherwise be missed using dashboard mounted indicators or displays, such as warning indications and critical information. It also provides more ways to indicate urgency in critical warnings, thus providing faster reaction from the operator[8]. When working in operational environment the presentation of information is an important consideration, visual markers and clear presentation of data is important to design carefully [5], information should enhance productivity and safety and not produce information overload nor focus shift from the primary activity.

Regardless of the type of technology used to present information when using a machine it is part of the total machine system and its system for interaction. This in relation to the other examples presented means that no

additional methods or technologies for input interaction is directly necessary to for interacting with an integrated HUD or HWD. However, new ways of presenting information can also enable opportunities for different ways to interact with the machine. For example, one can by presenting virtual "keyboard" in the driver's vision make it possible to feed the system with information without taking eyes off the road [6].

Service and repair

Following a time of operation a vehicle often needs some kind of service or repair. See-through technology have great opportunities to support users also in this stage of the machine life cycle. Documentation and service manuals have already moved from papers and binders into digital media that can be displayed on the machine's built-in display or via service computers. With hand-held and head-up display devices this can be improved even further, the needed information for the task at hand can be displayed in the line of sight while working, instead of having to shift focus or move where the information is. By using rich media overlaid over the part or machine being in service the user can also get direct guidance during the service process.

See-through technology can also make communication between operators and remote specialists or support personnel more effective. For example; using see-through interface via a mobile phone, operator and specialist know that they are looking at the same thing. The specialist can also effectively show things for the operator, for example by adding visual markers shown via the see-through interface.

By opening up communication with the vehicle, one can also display relevant information, error messages or

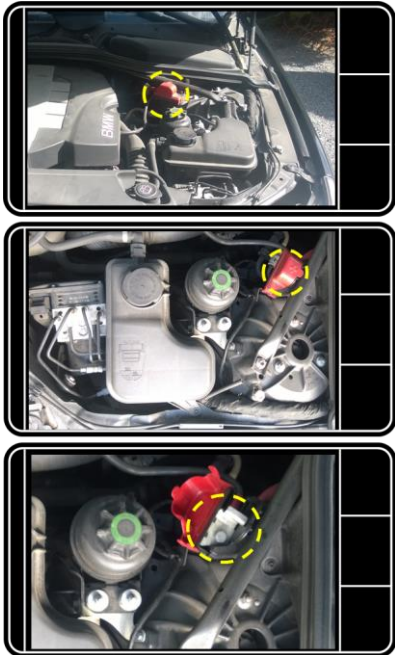


Figure 1. Showcasing an augmented mobile see-through interface where the content of the screen is shared with the remote support person. The support person adds visual cues (dashed circles) to direct user to the right place in the engine compartment, open a cover and find the place to attach cabling.

other values from the machine directly when you look at the machine or parts of the machine. As an example, the running hours and general error messages are shown when looking at the whole machine, and when you look at the engine the oil level and engine fault codes are displayed.

As in manufacturing, it is an advantage if users in these contexts have both hands free to work with the task at hand. Additionally, the environment may in many service and repair situations be dirty and tight, so means to interact should as far as possible not require much space, like touching screens or using other surfaces such as on-body touch.

Choice of technology can also be determined by availability, a service app that runs on the mobile phone can be a simple and effective solution since most users have some form of smartphone, but at least at the time of writing, HWD units are less common. While the increased freedom of having both hands free could justify the investment in HWDs for professional users.

Discussion and future work

See-through and augmented reality interfaces could have many potential benefits in industrial applications. They could be used to present information in the line of sight and make the information easier and faster to obtain, increase accuracy, efficiency in operations and contribute to higher safety and security.

The above examples illustrates potential applications for using see-through interfaces in industrial applications. Further work in user centered design is suggested to find out what information displayed gives most benefits for users. Using the result of these

studies prototypes would be created to measure and evaluate gains, acceptability and also risks with practical usage.

For see through applications like Augmented reality browsers it has been argued that one limiting factor is the availability of content[4][3]. This is perhaps also applicable for industrial application, though depending on the application its appropriate content may be created as a part of realizing the application, like in the factory scenario. Or that the application itself produces the content, like in the scenario for the machine operator.

To become successful there are several other usability challenges that need to be considered and evaluated further. Information should be presented in a clear way for safe and efficient interpretation and should not overload the user, instead it should clearly highlight the important information in each situation [8]. It probably also require different ways of interacting with the interface depending on the situation and task at hand.

Additionally, the technology needs to be on par with the usability requirements. Different kind of technical solution (Handheld Device, HUD, HWD, etc.) for presenting information are more or less appropriate for different usage. This will among other range from the availability of visualization systems that matches the necessary quality and cost [2], how they enable interaction and ergonomic factors [1].

Although see through interfaces has been around for some time already we might still have some of the most useful applications yet to find.

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