Trends in Smart Glasses 2016

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Executive summary

This report investigates the field of smart glass technology, providing both an overview of existing products and their application and providing a forecast of the future use of smart glass technology. Based on both academic and mainstream literature and interviews with experts in the field, the report illuminates a range of trends within the emerging market of smart glass technology and proposes a range of new areas to study.

The report finds that there is a lot of activity on the smart glass market, with new products being announced continuously, and augmented reality headsets thought to hit the consumer market in 2017. However, smart glasses are still not mainstream consumer products. Rather, they are specialised tools mainly adopted by the industry for various tasks. The report predicts that smart glasses might become mainstream consumer products within the next 5 years, as products become more fashionable, socially acceptable and functional.

Based on the findings of the report, we recommend that:

- the smart glass market is monitored continuously, and that a new report is commissioned in the second quarter of 2017.
- research is put into the actual use of smart glasses in different, real life settings
- the information in this report is disseminated to stakeholders and interested parties.
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1. Introduction

In 2014, smart glasses were on everybody’s lips, as Google launched the Google Glass Explorer edition to the consumer market in May. Since then, a range of new products have been introduced, Google has stopped producing Glass, and the fields of virtual and augmented reality have moved significantly closer to becoming mainstream, as they are increasingly used for various tasks in different industries. The aim of this report is giving a status on the field of smart glasses: where is it now, and where is it moving in the future? The report is an update and extension on some of the themes covered by the report “The Future of Smart Glasses” (Due 2014), which was also commissioned and funded by the Synoptik Foundation. Therefore, this report will not cover topics covered in the previous report, such as giving a historic overview of the evolution of smart glass technology or a thorough introduction to the different optical technologies.

1.1. Disposition of trend report

The disposition of this report is motivated by the two main aims: giving a status of the field now, and formulate plausible scenarios and questions that could be researched in the future. First we begin with sketching the field as it is today with a brief market survey and introduction to the growing range of products and technologies in the field. After the initial introduction to the market and technologies, the report moves on to focus on trends in use of different smart glasses. First we describe 5 general trends in the use of smart glasses and augmented reality (AR), before moving on to describing the trends in three specific industry areas. After the description of the trends in smart glasses, we introduce 5 areas for future research in smart glasses. The outline of the report is graphically represented below:
2. Status on technology and smart glass products

In this section we define the term ‘smart glasses’ and provide a terminology for the different types of glasses covered in the report. The intention is to create terminological clarity and consistence throughout the report.

2.1 Definition of smart glasses

The term ‘smart glasses’ is used as a cover term for a range of different products and a specification of the use of the word in this report is therefore in place. Generally, the term refers to a wearable computer that adds information to what the wearer sees. This information can be projected in various ways that are described in more detail in section 2.2. The term ‘smart glasses’ could therefore cover anything from virtual reality (where the wearer is fully submerged in a virtual environment known as VR) and augmented reality headsets (where graphic information is projected “on top” of the physical world known as AR) to smaller wearable devices with similar functions to smart phones. In this report, we will therefore not use ‘smart glasses’ as cover term. Instead we have placed the different products covered in three categories, that will be explained in detail in the next section. One delimitation of the scope of the report that can be made from the beginning though, is that the report will not focus on virtual reality headsets (such as Google Cardboard, Oculus Rift or other VR headsets) even though some may also call such headsets ‘smart glasses’.

2.2 Three types of smart glasses covered in the report

Different types of smart glasses have different technical specifications as they are made for different purposes, but generally incorporate wireless technologies such as WiFi, Bluetooth and GPS, a camera and any number of sensors (e.g. gyroscope, accelerometer, ambient light sensor, etc.). Devices can be either tethered to a stationary computer or smaller device, or stand on their own, which is a trade-off between computing power and how intrusive, fashionable and socially acceptable the device is. In general, the tethered devices are relatively big, binocular AR headsets with big fields of vision (FOVs), whereas the un-tethered ones are relatively small smart glasses with smaller FOVs and thus limited AR-usability and fewer sensors. In order to get a quick overview of the smart glasses covered in this report,
we have placed the products in the smart glass market into three categories: *connected glasses*, *smart glasses* and *AR HMDs*:

![Figure 1](image.png) An overview of smart glass products from connected glasses to AR HMDs

**Connected glasses** are display-less glasses that have Bluetooth or WiFi connectivity. They may have a camera and the capability to notify the wearer of certain situations, e.g. through a single light emitting diode (LED).

**Smart glasses** are glasses with a small displays and small FOV (from $10^\circ$ - $20^\circ$ diagonally). The glasses may include prescription lenses, but the lenses are not part of the optical display. The smart glasses can be divided into two groups on the basis of their displays: the rear mirror and monocular smart glasses. The rear mirror glasses have a display discretely positioned at the edge of the wearer’s field of view (and thus function like the rear view mirror in a car). The monocular smart glasses have an optical engine positioned in front of one of the wearer’s eyes, allowing the wearer to see reality through the display while projecting digital information directly in the field of view.

**AR HMDs** are headsets (HMD is an acronym for Head Mounted Device) with binocular see-through displays that have a relatively large FOV (e.g. $90^\circ$ for the Meta 2) that can provide true AR and usually have more bulky optics than regular smart glasses. For a quick overview, we have compiled a number of smart glasses in the different categories on a continuum in figure 1 above (which has been inspired by Barfield 2015: 92 and Friedman 2016).
There are a few points we would like to make in relation to figure 1. First, we have included the category connected glasses in our overview, though it is debatable whether they actually qualify as being smart glasses, since they have no display. The reason for doing this is to offer the reader a quick overview of the entire market of head mounted devices that contain more technology than regular glasses. The category of connected glasses will surely become more and more mainstream in the years to come, and offer customers recording and self-tracking abilities without compromising concerns about looking fashionable while wearing the glasses. In addition to this, connected glasses can be connected to computers, e.g. a smart phone, and therefore end up functioning like real smart glasses. Therefore, it will be very interesting to monitor the evolution and impact on the traditional eyewear market in the years to come. However, connected glasses will not be covered in this report, where the focus will be on “real” smart glasses, i.e. smart glasses and AR HMDs. Another point in relation to figure 1 is, that since 2014, the field of smart glasses has moved rapidly. Today, there are at least 55 smart glasses projects (see Appendix 1) with new products being announced continually. It is beside the scope of this report to give a full overview of the market, but a short description of the market is in place. In figure 2, the leading monocular and rear view mirror smart glasses are presented:

<table>
<thead>
<tr>
<th>Product name</th>
<th>Next model launch</th>
<th>Primary use</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vuzix m100</td>
<td>2016</td>
<td>Industry</td>
<td>1080 € / 7258 DKK</td>
</tr>
<tr>
<td>ODG R-7 Smart Glasses</td>
<td>2016</td>
<td>Industry</td>
<td>2,750 $ / 18481 DKK</td>
</tr>
<tr>
<td>Recon Jet</td>
<td>?</td>
<td>Sports tracking</td>
<td>499 $ / 3354 DKK</td>
</tr>
<tr>
<td>Google Glass</td>
<td>?</td>
<td>Industry</td>
<td>N/A</td>
</tr>
<tr>
<td>Ora-S</td>
<td>2016 (DE)</td>
<td>Industry</td>
<td>699 € / 5200 DKK</td>
</tr>
<tr>
<td>Lums DK 40</td>
<td>2016</td>
<td>Industry</td>
<td>400 $ / 2662 DKK</td>
</tr>
</tbody>
</table>

Figure 2. Overview of leading monocular and rear view mirror smart glasses. (DE = Developer edition)

Most of the smart glasses in this category are not tethered to computers. They are already in the market, and have largely been adopted by the industry for various tasks (though other uses are also
present e.g. Recon Jet for sports tracking). They are generally in same price range as smartphones – except R-7 (due to a range of sensors, robustness and design). The next generation of the showcased products is coming up with Epson, Vuzix and Lumus launching later in 2016. Whether Google will attempt to revive Google Glass in the future is a matter of dispute, with rumours of a new patent circulating. Compared to rear view mirror and monocular smart glasses, the binocular smart glasses (i.e. AR HMDs) are more expensive due to better specifications, more sensors and a more augmented experience. In figure 3 below the leading AR HMD products on the market are showcased:

<table>
<thead>
<tr>
<th>Product name</th>
<th>Launch</th>
<th>Primary use</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atheer Air</td>
<td>Q3 2016 (CE)</td>
<td>Industry</td>
<td>3950 $ / 25803 DKR</td>
</tr>
<tr>
<td>Microsoft Hololens</td>
<td>Shipping in US</td>
<td>Industry</td>
<td>3000 $ / 19597 DKR</td>
</tr>
<tr>
<td>Meta 2</td>
<td>Q3 2016 (DE)</td>
<td>Industry</td>
<td>949 $ / 6199 DKR</td>
</tr>
<tr>
<td>Cast AR</td>
<td>2017 (CE)</td>
<td>Gaming</td>
<td>400 $ / 2613 DKR</td>
</tr>
<tr>
<td>Epson Moverio BT-200</td>
<td>2016</td>
<td>Industry</td>
<td>700 $ / 4704 DKR</td>
</tr>
<tr>
<td>Sony SmartEyeGlass</td>
<td>2016</td>
<td>Industry</td>
<td>861 € / 6407 DKR</td>
</tr>
<tr>
<td>Magic Leap</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Figure 3. Overview of leading AR HMDs. (DE = developer edition, CE = Consumer edition)

Most showcased products are tethered (with exceptions of Hololens and Cast AR). Not all products are yet available, and Atheer and Meta are shipping in Q3 2016. There are a few unknowns in the market with products such as the Daqri smart helmet and the Google backed start up Magic Leap, that despite being very secretive is a dark horse due to $1bn in funding.

2.3 Basic technology and functionalities

The basic function of smart glasses is to add information to what the wearer sees. This information is given through computer-generated images (CGIs). Some devices can superimpose these images on to a
real world view (known as augmented reality, (AR), or mixed reality), some can show images on a heads up display (HUD), and others yet offer a fully immersed experience where the viewer only sees the CGIs (known as virtual reality). There are two main technologies used to achieve this: either a head mounted display (HMD) or an optical head mounted display (OHMD).

![Figure 4. Head mounted device, HMD (left), and an optical head mounted device, OHMD (right).](image)

Both HMD and OHMD refer to devices that are worn somehow on the head (as a part of a helmet, like glasses, visors or the like) and that have displays in front of one or both eyes (monocular or binocular displays). The difference between the types is that in the OHMD the wearable display reflects projected images through a lens. Popularly speaking OHMD’s are sometimes referred to as “see-through HMDs”. There have been several techniques for projecting CGIs in see-through HMDs. Today, the most used techniques are known as either waveguide-based¹ or curved mirror-based (Due 2014). In the waveguide based technology, the CGI is projected out in a space in front of the eyes, whereas in the curved mirror solution, the CGI is projected on to a particular small field.

3.2 The next frontier: smart contact lenses

Even though this report is focused on smart glasses, there are a number of new technologies in the making that might become relevant for the vision industry in the future. We have chosen to include a short description of the trends in smart contact lenses, as they may render wearables like smart glasses useless in the future.

¹ Sometimes also referred to as light-guide based
While the technology still is too crude to predict when smart contact lenses will actually become mainstream, consumer products, it is clear that a number of computer technology companies are already developing different contact lenses. A number of patents have been applied for by frontrunners like Google, Sony and Samsung:

- Google is currently developing and testing contact lenses that aim to assist diabetics constantly measure their glucose levels in their tears. The development is carried out by Verily and is currently testing prototypes (Wikipedia 2016a).
- Sony has filed a patent for a contact lens that is also a tiny camera, allowing the wearer to record and store anything he or she sees (Tech Insider 2016).
- Samsung has been granted a patent in Korea for a smart contact lens that allows for augmented reality content (Futurism 2016)

The potential of smart contact lenses is considerable. Basically, they could have the same functions as other wearables only in a quite unobtrusive and unnoticed way, and those features are potentially revolutionary. One of the main problems that consumers have with adopting wearables is how acceptable they are aesthetically, that is, how fashionable they are in the eyes of society. Smart contact lenses could make such considerations a thing of the past. It is important to bear in mind that computer technology companies file patents for various products, and that a patent does not entail that a corresponding commercial release necessarily follows. Even so, the potential of smart contact lenses is so great – and therefore, it is of great interest for stakeholders in the vision industry to monitor the development of smart contact lenses.
2.4 Summary and recommendations

To sum up, smart glasses can be divided into at least three categories (connected glasses, smart glasses and AR HMDs). Whereas the basic technologies are still the same as two years ago, there has been a rapid development of different products in the field. The different products differ significantly in design, application and price.

On the basis of the review of the different products, we recommend that:

- The market is monitored continuously for the next years to stay ahead of new developments
- From an optician’s perspective, that special attention is given to connected glasses and rear view mirror glasses, as they are most likely to be compatible with prescription optics.
- Products like smart contact lenses (and further down the road visual prostheses) is looked more into in order to stay on top of the developments in the field

3. Market survey and sales of smart glasses

In this section, we present an overview of the smart glass market, and look into how it might evolve in the years to come.

3.1 Developments since 2014: Glass is dead, smart glasses live

In 2014, Google Glass was an extremely hyped gadget and the poster boy for the emerging smart glass market. There were great expectations to the impact and scope of smart glasses in general and Google Glass in particular in the years to come. Predictions had it that Google Glass would sell approximately 22 million units in 2018 (Danova 2013). A few notable things have happened since then. Whereas the smart glass and wearables market has not died, Google Glass as a consumer product was abandoned by Google on January 15th, 2015. Since then Google has gradually offered less and less support for their consumer products, and have focused on use in the industry, the so-called “Glass at Work”-programme (Glass at work 2016). Google Glass for consumers was probably not adopted by consumers for a number of reasons. First, they were not aesthetically fit for the mainstream market: whereas first movers might not mind a geeky look, the general consumer will. Secondly, they posed several social and interactional problems (users were dubbed “Glassholes” by commentators (Due 2015a). Thirdly
privacy concerns connected to Glass were considerable (Streitfield 2013), and a general scepticism in the public even sparked alleged attacks on glass-wearers in public space (e.g. Bloomekatz 2014). Fourthly, the device turned out to be unreliable (it shut down easily due to overheating) and had battery problems. In light of these shortcomings, one might think that releasing Google Glass to the consumer market was a premature decision by Google. However, one could also see it as a marketing strategy to bring focus and momentum to the smart glass market. Google Glass certainly received enormous media attention, which was in part due to the exclusivity of the product: early adopters paid $1500 for the Glass Explorer Edition be first movers (and be labelled Glass Explorers by Google). Another way of seeing the Glass Explorer edition, then, is that the release was a large scale beta test of an unfinished product. In this way, Google got to test the gadget on real life people in real life situations and boost the hype around smart glasses and thus be an indirect factor in the rapid increase of smart glass projects (see section 2).

3.2. Market survey and future sales of smart glasses

Every year, the analytics agency Gartner publishes an authoritative overview of the hype associated with different emerging technologies, known as “the Hype Cycle”. The cycle is a good departure point when trying to understand what might happen with a certain technology in the course of the next decade. The model predicts how a technology emerges: from an innovation trigger to becoming a mainstream consumer product. The process consists of 5 phases and the hype cycle gives an estimate of how far a specific technology is in this process. The logic of the hype cycle is that after the hype peaks, there will be a period of disillusionment before products can gradually be improved until they are adopted by the mainstream.
Looking at the latest hype cycle (Gartner 2015, figure 6) the most interesting technologies for our purposes are wearables and augmented reality. Wearables are still near the top of the hype, with an expected 5 - 10-year period until the technology is adopted by mainstream consumers. Compared to 2014, wearables are coming ever closer to the disillusionment phase. Augmented reality on the other hand, is nearly at the bottom of the disillusionment phase. This means that in the foreseeable future, the movement downwards on the model will be replaced by upward momentum, carrying the technology out of disillusionment towards an integration with mainstream products. The upward momentum may very well have already been sparked by the release of the augmented reality game “Pokémon Go” on July 6, 2016. The app became the most downloaded of any app on the App Store in their first week, and hit 100 million downloads by July 31 (Wikipedia 2016b). At the moment, though, the leading manufacturers of AR HMDs (i.e. Atheer, Microsoft, Meta) have only released developer editions of their headsets. When one of the leading companies launch a regular consumer product, the public focus will turn to augmented reality, boosting the development of software and hardware in the field. Commentators state this will happen in 2017, with rumours of Meta releasing consumer a product and CastAR said to release their glasses for augmented reality board games in 2017 (Plante 2016). The growing market for smart glasses is backed up by research from Gartner, that estimates that the
1 The number of HMDs sold will rise from 1.43 in 2016 to 6.31 million in 2017 (figure 7, Gartner 2015), projecting a projected increase of 441% in global sales.

<table>
<thead>
<tr>
<th>Table 1: Forecast for Wearable Devices Worldwide (Millions of Units)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Smartwatch</td>
</tr>
<tr>
<td>Head-mounted display</td>
</tr>
<tr>
<td>Body-worn camera</td>
</tr>
<tr>
<td>Bluetooth headset</td>
</tr>
<tr>
<td>Wristband</td>
</tr>
<tr>
<td>Smart garment</td>
</tr>
<tr>
<td>Chest strap</td>
</tr>
<tr>
<td>Sports watch</td>
</tr>
<tr>
<td>Other fitness monitor</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Figure 7. Forecast for wearable Devices Worldwide (Millions of units). Source: Gartner 2015

Arguably, quite a bit of the increase of HMD sales reflect that 2016 was “the year of virtual reality”, as products such as Oculus Rift, HTC Vive, Sony PlayStation VR were all introduced to the consumer markets. Even so, the figures also reflect an increase in the sales of other augmented reality HMDs and OHMDs. It is not clear how big the fraction of AR headsets is, but commentators predict that while 2016 has been the year of virtual reality, the focus will gradually move to augmented reality as well. At the start of 2015, it looked like consumer AR could launch in 2016, but AR has been largely focused on the enterprise market in 2016, with consumer AR now expected to launch in 2017. Other analyses suggest that the total revenue for AR and VR will be 120 billion $ in 2020, with AR standing for 90 billion $ of the total revenue, the tipping point for AR passing VR from 2018 to 2019 (Digi-Capital 2016). According to the same analysis, around 45% (approx. 40.5 billion $) of the total AR revenue in 2020 will originate from sales of hardware, i.e. AR HMDs. Other forecasts are less optimistic, suggesting that the revenue from hardware sales of AR and VR glasses together will only rise from 1.7 billion $ in 2016 to 14.5 billion in 2020 (CCS Insight 2016). The latter analysis is based on the expectation that the number of VR and AR HMDs will rise from 15 million sold in 2016 to 96 million units sold in 2020.

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2 A dark horse on the AR consumer market, though, is the the well funded and secretive start up Magic Leap.
3.3 Summary and recommendations

To sum up, we will see more and more head worn devices in the next 5 years. Although Google Glass was taken off the consumer market, it created a hype around smart glasses that has brought attention to the field, with more and more products being launched. In the years to come it is expected the VR and AR headsets will be adapted by both consumer and industry users.

On the basis of the survey of the smart glass market, we recommend that:

- the market is followed closely, and taking stock of actual sales numbers of smart glasses for 2016 and 2017 when they become available
- opticians’ shops and chains evaluate how they will respond to the emerging technologies, as the market may become large in a few years
- that the possible health effects VR and AR headsets are researched, as they may have an impact on the future customers of vision enhancing products and services

4. General trends in smart glasses and AR

In this section we will present some overall trends before moving on uses in different industry areas and more specific cases in section 5. The different trends in this section are highlighted on the basis of monitoring the smart glass products and commentators, and talking to experts in the field (e.g. Friborg 2016).

4.1 Smart glasses mostly used for industry; consumer market coming up

There are generally three types of applications for smart glasses: 1) specific work-related applications; 2) task-related contextual applications; and 3) lifestyle applications for so-called self-trackers. While 1) is in a professional work-setting, 2) and 3) are situated in the personal sphere. Eventually, smart glasses probably will become widely used in all three areas, but as described in the survey of the smart glass market in section 3, the focus of the majority of smart glass and AR HMD producers is currently on industry use, i.e. specific work-related applications. In 2014, when Google launched Google Glass to the consumer market, it looked like that might open up the consumer market, and become more used for task-related and contextual and lifestyle applications, but Google stopped selling Glass to individual customers in January 2015, probably due to different factors like short battery life, price in relation to...
functionality, the “glasshole-effect” and concerns about privacy (Due 2014). Since stepping away from the consumer market, Google has continued to support Glass at Work, a program aimed at enterprise solutions for Glass (Glass for Work 2016). While there are applications and smart glasses aimed at the personal sphere for quantified selfers and lifelogging applications (e.g. Recon Jet, Garmin’s “VariaVision” and Kopins micro displays) or gaming (e.g. CastAR glasses launching in 2017) smart glasses and AR HMDs are still not mainstream products.

4.2 AR HMDs and gesture control will replace monitor and mouse

We start off with a trend that could drastically change office and home infrastructure in the future. The potential of AR HMDs is a true paradigm shift, leaving old operating systems and monitors unnecessary. As explained above, AR HMDs and monocular smart glasses allow the user to see a layer of digital information on the real world. In the history of computers, such digital information has been presented via monitors, i.e. physical, electronic displays that we know from our PCs, tablets and smart phones today. With the emergence AR, monitors will become less and less important, or as Meron Gribetz, CEO of Meta, proclaims: “we’re all going to be throwing away our external monitors.” (TED Vancouver 2016). Meta have proclaimed that they have started to replace regular computer monitors in their head offices with Meta 2 headsets (Futurism 2016b).

How far along the replacement is has not been reported, but an engineer from Meta said in an interview that he has replaced his four desktop monitors with the Meta 2 headset (Futurism 2016c). Using the Meta glasses in this way, the engineer codes for the glasses through the glasses. Technologies
such as gesture control and natural-language question answering will affect the future workspace in interplay with augmented reality. Gesture control is of specific interest in this report, as it allows a user to control and use the features of a computer through natural hand gestures. Together with augmented reality, gesture control could completely change the future workspace, as physical technologies like keyboard, mouse and monitor could all be things of the past. The aforementioned engineer from Meta did use a regular keyboard for writing his code, but as Meta glasses also allows its users to manipulate virtual projections by their hands, a physical keyboard could become redundant in the future. Speaking in terms of hype, the field of gesture control should be adopted by the mainstream in 2 – 5 years, according to Gartner (see figure 6).

4.3 Collaboration across geographical space

Practically all smart glasses have a camera and wireless access to the internet, and thereby the possibility to broadcast photos or video streams to other people located anywhere on the globe. This functionality has been utilized in a range of smart glass products in a multitude of industries such as health care, construction, security and sales to name but a few. A common application in the industry is remote support and observation of professionals in the field. This allows for quicker resolution of problems and fewer mistakes, as professionals can display what they are facing in the field, not having to rely solely on spoken or written language.

![Figure 9. Remote assistance for an engineer in the field](image)

This use of smart glasses functions is not new, but will surely increase and enter the private sphere as smart glasses become mainstream, facilitating and optimizing collaboration across geographical locations. The result of the technology is that geographical space becomes less important, as the office can truly be anywhere. One related trend that is yet to be adopted in business settings, though, is that
with the introduction of AR HMDs comes the possibility to have holograms of other people in the wearer’s field of vision which can revolutionize video conferences and meetings. The idea has been around for some time (one might recall the same use of holograms in movies like Star Wars from the 1970s and 80s), but with the recent advances in AR, being present in a meeting as a naturalistic hologram has come even closer. Future meetings may very well benefit from this technology, improving video meetings by providing more communicational cues for the participants. Today, video meetings are limited by the 2D-dimensionality afforded by screens, and a lot of communicational cues (such as body language and gaze) go missing. AR HMDs may provide the answer to this problem and therefore may replace the meeting rooms and video conference rooms of today (Maldow 2012.)

4.3 Use of smart glasses in special populations

A third trend that can be observed in the smart glass market is utilizing smart glass technology and computer software to meet the needs of special populations, e.g. people with cognitive impairments such as autism or blindness. As an example, different researchers are working on projects that seek to aid autists with tasks that are notoriously difficult for them, e.g. recognizing emotions from facial expressions (Zengin 2015, Chea 2016). The disabled group of people that has possibly received the most attention is the blind and visually impaired community. A number of research groups (e.g. Eli Peli at Harvard Medical School, Stephen Hicks at the University of Oxford (VA-ST 2016, Metz 2015b) and Nicolla Belotto at the University of Lincoln), manufacturers of assistive aids (e.g. Orcam and Esight) and big corporations (e.g. Microsoft’s collaboration with Pivothead (Microsoft 2016) and Toyota’s Project BLAID (BLAID 2016)) have set out to make wearable computers that can assist blind and/or visually impaired individuals with everyday tasks such as navigation, reading, facial recognition, etc. The trend can be divided into at least two areas. First there are the applications for regular smart glasses such as Google Glass. These applications (apps) are relatively simple computer programs that can assist visually impaired people with different tasks, mainly reading, navigation, object recognition or digital magnification. Secondly, there are headsets designed especially for visually impaired people like the gesture controlled smart glasses from Orcam, or the AR HMDs VA-ST Smart Specs and Esight glasses. While Orcam offers the same types of functions as the apps for Glass, VA-ST and Esight glasses empower the wearers to make better use of their remaining sight by augmenting certain features in the field of vision, such as contrast (see figure 8).
As smart glasses and AR HMDs become mainstream, the trend of using them as assistive aids will increase. The blind and visually impaired community has already adopted smart phones as accessibility features such as voice over (the ability of the phone to read menus aloud) has been introduced, and it is undoubtable the same will happen for smart glasses. Specially designed headsets like the VA-ST Smart specs and Esight glasses will soon be available on the European consumer market (e.g. Esight in Q4 2016, VA-ST sometime in 2017).

4.4 AR in exhibitions and theme parks

Smart glasses and AR has great potential to change existing exhibitions, theme parks, show rooms and the way people present a message to an audience. Taking exhibitions as the starting point, the trend to use AR in connection with more classical exhibitions at museums has been around for a few years. The basic functionality is that a device, for example a smart phone, is triggered by an AR marker to display certain content to the viewer. The AR marker can be anything in the exhibition that the smart device can recognise, for example a 2D image such as a painting. The AR marker triggers or displays certain media content; it could be videos, photos, animations or whatever the curators of the exhibit might find relevant to the visitor. This works in a similar way to QR codes that the visitors scan, the only — but crucial – difference being that the AR markers do not necessarily stand out like the black and white QR-codes and are therefore not aesthetically problematic in exhibitions. An example of using AR in a Danish context could be National Gallery of Denmark’s exhibition of Vilhelm Hammershøi where an AR app was created for smart phones (see figure 11). When a visitor (having downloaded the app)
pointed his smart phone towards the poster, a nude woman would walk into the painting, simulating the actual situation when the painting was created.

![Figure 11. Poster from exhibition at National Gallery of Denmark using AR to make the painting by Hammershoi come alive.](image)

With smart glasses or AR HMDs such AR material could play a bigger part of an exhibition, as the visitor would not have to actively hold the device towards an AR marker. When the device is mounted on the head of the visitor, AR content could be triggered anywhere the visitor is looking, and thereby become the main attraction. The same thing holds for theme parks. Today, VR theme parks are beginning to pop up (e.g. The Void in the US (Metz 2015) and Landmark in China (Gaudiosi 2015), and it is a question of time before AR theme parks will be a reality. Google Glass has already been used to augment the experience in a museum (e.g. the de Young Museum in San Francisco in collaboration with GuidiGo and Google (McGee 2014), but as Glass does not offer true AR, the true AR theme parks and museums are yet to come. Commentators expect this will happen over the next few years.

4.5 AR in show rooms and as in-home marketing

Apart from changing exhibitions and theme parks, smart glasses and AR HMDs also have the potential to change the way people present products. There are many examples of using augmented reality in show rooms, and we have chosen two examples from different industries; Ferrari and IKEA. As an example, the car company Ferrari has developed an app for their showroom, that allows the customer to see different setups of the cars in the show room (Ferrari 2015, figure 12). This allows the potential customers of the cars to experience what a given car will look like with their favourite colour, wheel rims and interior.
IKEA, the world’s largest furniture retailer, has used AR in a similar way. As part of a free app catalogue in 2014, IKEA included a feature that could give a virtual preview of furniture in any room (Ridden 2014). This feature of course potentially helps customers that have not taken measurements (IKEA has found that 14 percent of customers end up buying furniture that does fit the intended location), but really provides a new kind of information to all customers, i.e. the experience of seeing furniture in their local context. This feature could potentially mean the end of the physical showroom, as the app lets the customer see what a sofa or chair might look like in their living room, without ever having to take measurements or leave their home.

4.6 Summary and recommendations

To sum up the preceding section, the following 5 trends have been identified:

- smart glasses are still mostly used by the industry
- AR HMDs will in time replace monitor and mouse
- smart glasses are used to facilitate collaboration across locations
- smart glasses are increasingly used for special populations
- AR is used by museums and theme parks, show rooms and in-home marketing

On the basis of the described trends, we recommend that:

- further research is carried out on the potentials of smart glass in special populations, especially the blind and visually impaired
- research on the consequences of using screens so close to the face
- opticians evaluate how AR might become part of new show rooms and in home-marketing efforts
- professional organisations look into the new technologies’ possible advantages in terms of work space design and enhancing collaboration
5. Trends in industry areas

In this section we present cases from 3 industry areas. While the overview is not exhaustive, the areas are intended to be illustrative of the potentials of smart glasses in the industry. As a reminder to the reader, smart glass products can be placed into at least three categories (connected glasses, regular smart glasses, AR HMDs). In the overviews below the focus will be on smart glasses (rear mirror view and monocular smart glasses) and AR HMDs (binocular smart glasses).

5.1 Healthcare

Ever since the advent of smart glasses, commentators have pointed to the technology’s potential within healthcare (e.g. Monroy, Shemonski, Shelton, Nolan, & Boppart, 2014) and the emerging field of telemedicine. Being one of the largest industries in the world, health care is still nimble at adopting new technology in workflows. There are several reasons why smart glasses are especially suited for use in the health sector. An obvious reason is that hands-and-touch-free interfaces will minimize the spread of bacteria and therefore health care-associated infections, that despite being very undesirable and costly still are frequent and well documented in the literature (Collins 2008). Another promising feature of see through HMDs in health care is the possibility for health care personnel to interact with patients face to face. Technologies used in the sector now, such as PDAs and mobile phones, dictate that the doctor or nurse shift their attention and gaze away from the patient in order to use the device. Even though smart glasses have been shown to trigger certain interactional difficulties (Due 2015a, 2015b), the fact that see through HMDs allow a user to still face their interlocutor may well prove to be a very valuable feature. Eye contact and gaze direction has great significance in human communication and in health care interaction where displays of empathy are important (Heritage & Maynard 2006).

![Figure 13. A doctors using smart glasses for data entry and patient consultation.](image)

Apart from these possible benefits, smart glasses also have the promise of optimizing key areas in health care such as reducing errors, making documentation easier, enhancing collaboration and
enabling better education (Wired 2015). We will sketch the possible benefits of smart glasses in the different areas below:

1. Smart glasses have a potential to reduce errors and ensure best practices
2. Smart glasses have a potential to facilitate documentation

1) Smart glasses can reduce errors and ensure best practices in at least two ways. First, primary health care personnel will be able access digital information (such as checklists) in their visual field at all times, enabling personnel to follow updated and standardized procedures easily. Secondly, the use of e.g. checklists can be remotely monitored and verified in real time, reducing risk of errors and allowing for quicker implementation of new procedures.

2) Documentation is a crucial task in the health care industry, and 30 – 40 % of an average physician’s day is spent on entering data manually (Wired 2015). By entering data on the go through voice recognition software, this time could be lowered significantly. In addition to entering of linguistic data, smart glasses could enable personnel to add pictures and videos to a patient’s journal. The use of visual documentation could overcome problems that arise from subjective descriptions of symptoms, e.g. “red” versus “irritated”. Instead, doctors can accompany their descriptions with visual documentation that will help avoid possible miscommunication. In terms of education, smart glasses can enable health care professionals to get access to recordings or live streams of the leading practitioners performing medical procedures such as operations. The transfer of hands-on knowledge can happen regardless of where the student or health care professional is located in the world, and thus gives the promise of making education and internships more time efficient and reducing travel costs. The possibility of remote interaction through smart glass platforms can greatly impact the possibilities of collaboration between professionals. Through video streaming, remote professionals can assist and guide care providers, ensuring the best possible care for patients. Quite a few projects are implementing smart glasses in health care settings, such as Google’s “Glass at Work”-programme (Glass at work 2016). In a Danish context, a project in 2014 showed the potential of Google Glass in emergency medical services at Falck (Andersen & Andreasen 2015) in applications such as medicine scanning, protocol support and video calls. AR HMDs are still waiting to be adopted broadly in health care, but when they do, they will offer even more radical rethinking of the daily routines in a healthcare institution like a hospital. One might imagine various augmented reality visualization of data on human bodies, e.g. intra-operative x-ray dose (Rodas & Padoy 2014).
6.2 Heavy industries

Commentators suggest smart glasses and robust AR HMDs will have quite an impact on the heavy industries such as manufacturing, construction and gas and oil. Examples of tasks that have been optimized by the use of AR HMDs are training personnel, repairing and maintenance, upholding work site safety standards and documentation. We will give a few examples of possible uses in the different industries. The oil and gas industry is often associated with high risk off shore work in remote locations, making security and long distance collaboration crucial terms in the industry. AR glasses enable experts to train and guide their workers on-the-job (for example repairing equipment or other tasks) from a remote location anywhere in the world. This allows for faster repairs and may lower labour and travel expenses, as experts do not necessarily need to fly in to fix things. Apart from the access to centralised knowledge, AR HMDs allow for real time monitoring of systems and give evacuation alerts and safety reminders to oil rig personnel, heightening the work safety. In construction, the video streams from AR HMDs may also serve as documentation for later use; both for settling disputes with customers of whether something was correctly constructed or making sure that safety instructions are followed. This sort of documentation is valuable for construction inspectors, but also for professional roles in lighter industries, such as insurance adjusters, real estate appraisers and couriers as evidence that something was delivered correctly. In manufacturing and maintenance support, AR has been used to as instructional tools. As an example, car companies like BMW and Volkswagen have introduced AR HMDs for their mechanics (Woolastone 2014).

Figure 14. Screen shot of mechanic’s view. When mechanic looks at the engine, the relevant engine part is highlighted in green with instructions of how to fix it. Instructions appear at top of view and can be read out loud.

The mechanics are shown 3D animated objects on top of their view of the engine, and receive instructions and animations step by step in the process. The animations can show what parts are needed, which tool to use, which direction to screw or how something should be assembled. In short,
the AR HMDs offer access to task lists and check lists (and assist with text, pictures and video) that can help standardise procedures, lower mistakes and even diagnose problems, letting untrained mechanics perform complicated procedures that would otherwise need expert mechanics.

6.3 Light industries

Lighter industries such as design, retail and entertainment are also incorporating smart glasses and AR HMDs into their workflows. We have already sketched the potential of augmented reality in retail and theme parks in section 4.4 and 4.5, so focus in this section will be on the use of AR HMDs for design. As mentioned in section 4.2, Meta has announced that their designers use their AR HMDs for design purposes. As another example of a design project where AR HMDs are used, NASA (the National Aeronautics and Space Administration), are using Microsoft Hololens for designing the next Mars Rover, an unmanned vehicle that will be sent on a mission to Mars in 2020 (NASA 2016). The project involves engineers, designers and experts from around the world.

![Designers collaborating on designing through “hands on” interaction with hologram](image)

As illustrated in figure 13, the 3D object is only visible to the headset wearers and the designers can interact with the object intuitively using natural gestures. Furthermore, the designers are able to inspect different layers of the object; the outer layer disappears when the designers move close to the object, allowing them to inspect the interior parts of the 3D model. This allows designers not only to visualise their designs as 3D objects but also pinpoint potentially problematic areas that could affect the overall function of the rover.

6.4 Summary and recommendations

To sum up, smart glasses have already been utilised for different purposes in different industries. This tendency is predicted to continue, and different types of smart glasses will be adopted for different
tasks in health care and light and heavy industries, respectively. At the moment, especially AR HMDs are only available as development kits in Europe.

On the basis of these predictions, we recommend that:

- the emerging trends are evaluated more thoroughly in terms of potential when AR HMDs are released as regular consumer products in 2017

6. Future research questions

On the basis of the overview given in the preceding sections, this section formulates research questions that could be interesting to pursue. To organise the different research questions, we have chosen to describe them thematically from 5 different perspectives. The perspectives can be visualised as follows:

![Figure 16. The five different areas of study.](image)

The rest of this section is dispositioned after the 5 different perspectives on smart glasses.

6.1. The optician’s perspective

Since the last trend report, the much hyped Google Glass have been taken off the consumer market, and smart glasses are yet to become adopted by the mainstream. However, the adoption is moving ever closer, and it will be relevant for opticians to stay ahead of the evolution. A crucial question for
opticians in the time to come is what kinds of products might influence their business. Obviously, the product category connected glasses will have an impact on the market, as they look much like regular glasses and contain prescription lenses. Also, rear view mirror and monocular smart glasses might have an impact as they often come with the possibility to add prescription lenses or be added to regular spectacle frames. On top of that, optics companies like Carl Zeiss are working on producing subtle smart glass lenses that will make the smart glasses look like regular glasses (Carl Zeiss 2016), making them obvious candidates in any optician’s stock. While most binocular smart glasses are probably too bulky and computerized to be considered in the same category as regular glasses, some might be interesting in an optician’s perspective. As examples, the binocular smart glasses designed specifically for the visually impaired (i.e. eSight glasses and VA-ST Smart Specs) may be interesting to opticians, as it takes optical expertise to adjust the glasses to different individuals’ needs (for instance measuring the space between the pupils and making specially designed prescription lenses). At the moment, it is unclear who will sell smart glasses for the visually impaired when they arrive on the Danish market in late 2016 or 2017. According to the report “The Future Customers of Vision Enhancing Products and Services - a global 5-10-year perspective” (Nielsen & Trærup 2016), more people will be in need of visual correction in the future, due to an increase in both elderly adults, myopia, and diabetics. This situation will in itself cause an expansion of the customer base for opticians, but it might also serve as a catalyst for incorporating new products. As an example, the increase in diabetic customers will increase the demand for eyewear that can track certain values for the wearer, such as Google’s smart contact lenses that can measure glucose levels in the wearer’s tears.

Key research questions

- How large will the market for connected glasses and rear view mirror smart glasses, respectively, be in the next 3 to 5 years?
- Would it take training and skills development for the employees at opticians’ stores to include connected glasses and rear view mirror smart glasses in the inventory?
- Who is going to control the emerging market of smart glasses for the visually impaired in Europe and specifically in Denmark?
- What are the status of smart contact lenses, and how will they affect opticians?
- How are the different opticians responding to smart glasses? What are the possibilities in the market?
Proposed methodological approaches

The research questions could be investigated by doing further market surveys into the specific product niches in a Danish context, interviews with leading trend spotters and innovators, focus groups with professionals and potential customers and more thorough surveys of different target groups.

6.2. The ophthalmological and cognitive perspective

With the introduction of new technologies comes the question of how they may affect the human vision and brain. Smart glasses arouse valid concerns about Computer Vision Syndrome (CVS), and monocular smart glasses may cause a range of conditions such as phoria and binocular rivalry. At the moment, researchers are uncovering the effects of working conditions and lifestyle on vision, and especially the use of smart phones, tablets and computers (Nielsen & Trærup 2016). As noted above, the use of such screens may very well be replaced by smart glasses in the future, and therefore more research into the effects of smart eyewear on human vision and cognition is crucial, as the changes in technology may result in a new ophthalmological landscape.

Key research questions

- How will the different kinds of head mounted technology affect the wearer’s vision?
- More specifically; how does connected glasses, rear view mirror smart glasses, monocular smart glasses and binocular smart glasses affect the wearer’s vision, and how do the eyes adjust to new routines?
- What kind of visual or cognitive disorders might result from the use of different types of smart glasses?
- How and at what rate are the new technologies being adopted by the industry, and what effect will the new working conditions have on vision and cognition?

Proposed methodological approaches

A starting point for researching the effects of the different smart glass technologies could be a thorough review of ophthalmological literature. Furthermore, a range of experimental setups could be developed – both short and long term to measure the effects on the eyes and cognition of subjects.
6.3 The sociological and interactional perspective

Smart glasses are interesting phenomena from a sociological and interactional perspective in a number of ways. Since smart glasses are yet to be adopted by mainstream consumers, common norms and etiquette for wearing the new devices have still not emerged. Experience has it that new norms will not emerge until a new technology, i.e. smart glasses, are actually used by people in real life situations. We can predict that the first movers will probably experience similar reactions as the pioneers of Google Glass did in American cities like San Francisco; from excited interest from technology welcoming peers to negative, anxious and even aggressive reactions from people concerned about privacy. While the norms and etiquette for using the new visible technologies emerge in public, it will also be interesting to monitor the introduction of less obvious, potentially unnoticeable technology with the same capabilities as smart glasses (such as smart contact lenses or smart glass optics in regular looking glasses, e.g. the Carl Zeiss lenses described in section 6.1) and what concerns they raise about privacy.

If the adoption of smart glasses in general - and AR HMDs in particular - prove to trigger a paradigm shift leaving a lot of today’s IT infrastructure useless, it is interesting to investigate what the shift will mean for private and public spaces in the future. What will offices, homes, educational institutions, hospitals, museums and public spaces look like in a future dominated by augmented reality and smart eyewear? Also, what will the combination of wearable (and possibly unnoticeable) cameras combined with the growing number of possibilities of broadcasting oneself directly to large audiences (e.g. livestreaming on Facebook) mean for the society of the future?

When technology is a part of interaction, it always influences the interaction somehow. As an example, studies have shown how interaction is influenced by doctors’ use of computer monitors in interaction with patients (Nielsen 2016). Also, the use of monocular smart glasses has already been shown to have a possibly negative impact on face to face interaction in certain settings (Due 2015a, 2015b). It would be interesting to broaden the scope of such investigations and look into what kind of interaction the different types of smart glasses may afford in both professional and every day settings. Examples of questions that such investigations could look into are whether the use of Google Glass in medical settings decrease empathy between doctor and patient, if the use of AR HMDs in design processes will inhibit the face to face interaction between engineers and designers, and what effect the use of 3D holograms will have on the interaction in video mediated meetings.
Key research questions

- How will smart glasses be received by people and society? What reactions and norms will emerge?
- What impact will smart glasses have on social interaction?
- What possibilities and constraints do different types of smart glasses entail in both every day and professional interactions?
- What will the new technology mean for the design of offices, homes and public space?

Proposed methodological approaches

The methods for undertaking sociological and interactional research could be an eclectic a mix of both quantitative and qualitative methods. Surveys could unravel people’s attitudes towards smart glasses in a general sense, and micro-sociological and observational approaches (such as video ethnography, ethnomethodology and breaching experiments) could shed light on the impact of smart glasses in situated, real life interaction in different settings.

6.4 The technological and design-related perspective

At the moment, trying to keep up with the technological innovations, filed patents and upcoming products in the field of smart glasses is basically a day to day task. If the predictions about the smart glass market is right (see section 3), we will see a lot of activity and new products on the market over the next year alone. This development should be monitored closely in order to predict the future of smart glasses in a European context. The crucial questions will be where the smart glass market is headed and what the realistic timelines for consumer launches of new technologies like smart contact lenses are.

In terms of design, smart glasses (not including connected glasses) are still relatively bulky and are perceived as nerdy gadgets rather than fashionable accessories. This fact is also a big component in why smart glasses have been embraced by different industries, but not as consumer products – it is deemed bearable to look nerdy at work if the payoff is more efficiency, but not in the general public. The designs of smart glasses today come very much down to technical limitations with displays and
electronics. Predictably, there will be a tipping point in the future where the technological aspect will not overrule design considerations, and smart glasses will become stylish commodities that are status statements in themselves, like for example sunglasses are today. Following and predicting when the tipping point is arrived will be valuable for stakeholders in the vision industry.

Leaving the aesthetic angle of design aside, questions about the functionality of smart glasses may arise. Generally, people will not use new technology if it does not give something valuable back to them. In industry settings, a number of valuable functionalities have been pointed to, but it still remains unclear what the most popular applications will be for smart glasses for a mainstream audience.

**Key research questions**

- Where is the smart glass market headed? Do the technological predictions hold up?
- How fast will new technologies emerge?
- What aesthetic qualities will smart glasses need in order to be adopted by the mainstream consumers?
- What functional qualities will make the mainstream consumers adopt smart glasses?
- What technological gap will smart glasses fill?

**Proposed methodological approaches**

In order to map the technological and design developments interviews could be set up with leading experts, trendsetters and designers in the field. In order to continuously monitor the market and foresee how things will play out in the future, media intelligence surveillance could be set up, employing both quantitative and qualitative analyses of news about the field of smart glasses.

**6.5 The philosophical and psychological perspective**

As wearables like smart glasses become mainstream commodities, people will wear them more and more, and potentially end up using smart glasses all their waking hours. In the future, this situation could erase the boundaries between physical reality and the digital reality, making people truly live in an augmented reality. One way to put it is that smart glasses will then provide the operating system for life, with all the philosophical and psychological consequences that might follow from this ubiquitous
computing, that is a future where computing is made to appear anytime and everywhere. Living life inside an operating system with constant augmentation and tracking of bodily functions may have effects that are beneficial or harmful depending on the perspective.

Philosophically, one might ponder what it will mean for the future human being to live inside of an operating system, and what should we consider when developing new technologies? Are there any lessons that can be learned from the history of technology in general and the last three decades of computer science in particular? One concern is that constantly living inside an operating system may cause users to isolate themselves more, as they can constantly engage in the virtual world. Isolation leading to anxiety and depression are known psychological results of excessive use of computers, and one might fear the same effects of overuse of smart eyewear. The most dystopic future vision is that smart glasses have the potential to isolate wearers from face to face interaction and human touch with grave consequences. The lack of human touch, for example, has been shown to reduce production of oxytocin (i.e. the hormone that positively influences our bonding and nurturing behaviour), resulting in the negative psychological effects.

Questions also arise regarding the psychological effects of smart glasses and augmented reality controlled by natural gestures. AR and gesture control introduces a lack of tactile stimuli that might have a physiological effect resulting in derived psychological effects. Nerve cells in the body are specialised through use, i.e. nerves are strengthened where they are used. The lack of tactile stimuli when manipulating 3D holograms may thus have a negative effect on nerve cell development (e.g. nociceptors) and the proprioceptive sense and possibly the building of muscles. Another possible danger of augmented reality is that wearers get so focused on augmented content that they ignore the physical world. An example of this could be car accidents and body injuries attributed to people playing the extremely popular location based AR-game Pokémon Go, while not paying attention to their surroundings (Park 2016).

**Key research questions**

- What will the operating system of life look like? And what philosophical consequences will it have?
- What psychological consequences will the extended use of smart glasses have on the wearers?
- How does the merging of physical and virtual worlds affect human life?
- What ergonomic considerations should be taken when using smart glasses?
Proposed methodological approaches

The philosophical consequences of smart glasses on human life and conduct could be researched from a history of technology and philosophy perspective. The approach could start with a thorough literature review on the matter, and secondly approach the questions of the effects on smart glasses from different philosophical standpoints. As for the psychological effects, experiments (both short and long term) with subjects using smart glasses in different settings and for different tasks could be set up to monitor both behavioural and possibly neurologic effects.

7. Conclusions and recommendations

This report has investigated trends in the smart glass market in order to give a status on where it is now, and where it is headed in the future. The main findings can be boiled down to the following 5 points:

1. Smart glasses have not yet become mainstream consumer products, but this could happen in 5 years, as the products gradually become more fashionable, socially acceptable and functional.
2. There is a lot of activity on the smart glass market, with new products being announced continuously. This is especially relevant for opticians to monitor closely, as it might result in battles for the sales channels.
3. Smart glasses are used successfully in industry settings, and they could possibly alter the way work is done.
4. AR HMD’s could become mainstream in the next few years, as major companies are expected to launch consumer products in 2017.
5. The emergence of smart glasses opens up to a whole range of new research questions from different perspectives
The findings have led to a range of recommendations through the report. We see some of these recommendations as more important than others, and have gathered the main recommendations below:

1. We recommend that the smart glass market is monitored continuously. The market is moving fast, and a lot will happen in the course of the next year alone. We recommend that a new trend report is commissioned in the second quarter of 2017 in order to stay on level with the new developments and their implications for the optical market.

2. We recommend that the information in this report is disseminated to interested parties and stakeholders on the area. One good opportunity to do this is the stakeholder conference at the University of Copenhagen, December 14, 2016, another is that it is distributed to Grandvision. Synoptik A/S is not particularly interested in keeping this reports knowledge to themselves, and we recommend that a version this report is published and disseminated to the public as a Synoptik-Fonden brand initiative.

3. We have outlined a range of possible research areas in the report. We find that an area of special interest is the actual use of smart glasses in real life settings. If the Synoptik Foundation wishes to maintain its current position as frontrunner on smart glass technologies, we recommend that it pursues some of this research. We recommend a video ethnographic study of the use of smart glasses in different industry settings and a survey among relevant companies on their use of smart glasses.

8. Acknowledgements

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Appendix 1: List of smart glasses in production

This list is made by The Optical Vision Site (Optical Vision 2015) and has been fitted to this report.

Alphabetical list of smart glass projects

1. ADAMAAS Smart Glasses– Niche Smart Glasses developed through the “Adaptive and Mobile Action Assistance in Daily Living Activities.

2. Amazon – Amazon was granted a patent for a new kind of eyewear that lets users connect to a display device, like a tablet or TV, and watch the content right through the lens of the glasses. (Business Insider)

3. APX Labs– Smart glasses for people at work

4. Asthetikon Vision – Asthetikon Glance is designed to relay the user’s incoming notifications to an unobtrusive area of his/her visual field.

5. Atheer-Combines 3D augmented reality with gesture-based interaction, released software that adds intelligent voice and head-motion input control to the Atheer Air™ smart glasses platform.

6. ATOS– Smart glasses developed to translate languages for the Stage. (The Stage)

7. AVG- launches smart glasses to thwart facial recognition technology

8. AYO– Another crowdsourced smart glass. This eyewear is prevent jet lag. (Jet Lag) http://goayo.com

9. Brain Power: Developed by Turkish scientist Nедим Sahin and working with google, he has developed smart glasses for autism. (Daily Sabah)

10. Buhel – Bluetooth Smart Glasses raised over $400,000 on Kickstarter. Buhel SGO5 features bone conduction technology that allows you to listen to calls and music with no headsets or earphones, and bi-directional microphone and more. (Optical Vision Resource)

11. CastAR: Raised over $15 Million in another round of funding for their AR Gaming Glasses (Recode)

12. Cool Glass One; Known as China’s answer to Google Glass.

13. Dispelix (Finland). developed by VTT Technical Research Centre of Finland — which brings visual information directly into the user’s field of vision, as a high-definition image on an eyeglass lens


15. Epson- BT200. Working with several other companies for Smart Phone Development. They are just launched the Moverio BT200, the next generation. Using the google approach, they are looking for their own explorers.

16. Evena Medical– Epson Technology. X-ray type of smart glasses to help nurses and the like to find veins.

17. EverySight (Video) (Sports) Smart Glasses for cyclists. – Raptor by EverySight. Raptor smartglasses pack uniquely unobtrusive display technology and powerful functions

18. Eye Control Glasses: Smart glasses for people with ALS. Head mounted infrared camera that tracks eye movements and translates them to spoken words or free text. Launched on Indiegogo, they made over their goal of $30,000.

19. Fujitsu Retissa Eyewear: Smart Glasses for poor vision (Gizmodo) - Google new patent for Smart Glasses

20. GlassUP Video, wearable display, real time information, Unfortunately we don’t know if this is shipping any longer.

21. Go In Store: Smart Glasses that allow retailers to connect better with customers. Music retailer Dawsons is using Smart Glasses to help sales associates speak to their customers.

22. Google Glass has filed new patents for a new design. They continue to work with other companies for the technology.

23. Hololens; Bought by Microsoft, gaming glasses

24. iConnect by Toxic Eyewear- Headset Sunglasses Amazon Smart Glass Patent

25. LASTER Technologies

26. Lenovo M100– launched with partner Yuzix, they are designed for the Chinese market and will make voice calls, playback video and more.

27. Magic Leap Purchased by Google- Magic Leap is an augmented reality eyewear company that creates objects in 3D that you can put in your virtual world.

28. Mad Glass – Can translate signs, send emails, basically every thing that glass could do. (Trusted Review)

29. Meta Augmented Reality Glasses

30. Mini Augmented Reality Eyewear– Launched in 2015 and developed by BMW, the smart glasses are for driving, they show appropriate information to the driver in their direct field of vision. Fujitsu Retissa; Image Ubergizmo

31. Motorola: Developing smart glasses, wearable cameras for law enforcement. (USA Today)

32. Nargis Glasses- Eyewear- which brings visual information directly into the user’s field of vision, as a high-definition image on an eyeglass lens

33. Oculus Rift- Facebook owned. Gaming Smart Glasses

34. ORA X – has been around for several years. By Optinvent, they Offers Screen, Augmented Reality, computing via Android and headphones.

35. OrCam– Smart Glass that can read to the blind and describe objects and identify people. (MSN)

36. Osterhout Design Group- Can do about anything that a tablet can do. Wi-Fi, Bluetooth, GPS. Will be used by military and NASA.

37. Pivot Head– Also around for awhile. Camera. Mini Glasses by BMW

38. PogoTec For Smart Glasses– Look and shoot eyewear.

39. Quantum Interface– Augmented Reality Eyewear

40. ReCon Jer Smart Glasses (Sports) Bought by Intel in 2015. wearable computer for sports and outdoor recreational activities. (Smart Sport Glasses)

41. Rhema: designed with google glass, the system helps people to speak in front of audiences. Provides real time feedback to the speaker. (WRVO)

42. RideOn– Augmented Reality Goggles. They raised over $113,000 on Indiegogo.

43. Samsung: Also has a patent for Smart Glasses for an AR keyboard on the arm. (Optical Vision Resources)

44. Senth IN1 Smart Cycling Glasses (China) Development of smart glasses for cyclists. Made their funding in Indiegogo
SiME Smart Glasses (Taiwan) See Toms Guide for a review
Six15 new technology Athar Labs
Smart Specs by Va ST– Smart Glasses for the visually challenged (eetimes)
Spardar Smart Glasses– Budget Smart Glasses that record video. (PC Advisor)
Sony – has several options, the latests being launched at CES16 is the Smart Glass Attach which can attach to any glasses to make them a smartphone, (Tech Times) and SmartEyeGlass
Van Lent Systems: Launched in Indiegogo, the glasses offer a LED light into the frame. (Optical Vision Resources)
Vuzix– a top leader in technology and smart glasses.
VSP’s Project Genesis; Tracks activity
WeON glasses smart glasses that connect with your phone and or tablet.
Zeal Optics (Sports) Owned by Maui Jim, using Recon technology for Smart Glasses.