Arts Management &
Technology Laboratory

Through the Looking Glass:
How Google Glass Will Change the Performing Arts

By

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INTRODUCTION

During the spring of 2013, Google released 10,000 beta test "Explorer" versions of a new augmented reality device called Google Glass. Scheduled for public release in 2014, this device will provide performing arts organizations with significant opportunities and challenges in the coming years. With this focus, the authors set out to research how this device will impact the performing arts and secured an Explorer version of Google Glass to further inform their work. The resulting paper aims to prepare performing arts leaders for the launch of Google Glass so that they can make informed decisions about augmented reality devices for their organizations.

DEFINITIONS

Real World – The physical world, further defined as anything that is not digital
Augmented Reality (AR) – A concept in which digital realities are overlaid on the real world
Wearable Computing – Computing devices made to be worn by the user
Head Mounted Display (HMD) – A computing device that the user wears on his/her head

WHAT IS GOOGLE GLASS?

Google Glass is a head mounted wearable computing device. It projects an augmented reality onto the real world via an optic prism and a mini projector that is situated just to the upper right of the user's field of vision. The resulting projection is comparable to that of a 25-inch HD television viewed from about eight feet away. Affixed to this display is a camera that allows the user to take photos at 5MP resolution and shoot 720p videos, as well as a microphone for audio recording. The projector, camera, and microphone unit are mounted to a 12 GB computer, which also houses the battery charging port.
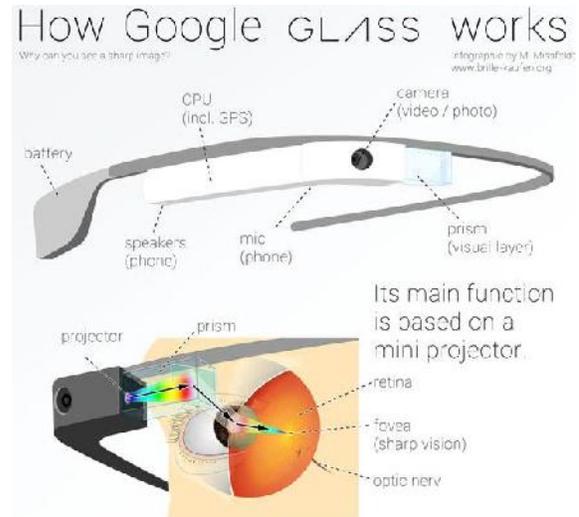
The Explorer edition of Google Glass does not have mobile functionality and depends instead on either a wireless network or bluetooth tethering to a mobile device to sync to Google's cloud, make calls, and access the Internet. Glass's battery, which is advertised to power one full day of "typical use," is suspended just behind the user's right ear. The user then hears sound in one of two ways: via mono or stereo earbuds that connect to the battery port, or through a bone conductivity transducer located on the inside of the battery section. This bone conductivity transducer conducts sound to the inner ear by directly vibrating the user's skull.

When imagining the potential ways that Google Glass and other HMDs might be used in the performing arts, and in particular how they might impact audience engagement, only the initially obvious manners in which the device might be

used to establish and build rapport can be predicted. These predictions are limited to the device's native capabilities, those software features that Google built into the device's operating system. Just as few could have predicted the concept of apps when mobile phones were first released (indeed, it took nearly three decades of development, popularization, and cultural assimilation of mobile technology before the creative and social capabilities of apps flourished), the potential of HMD technology has yet to unfold. It may be merely one app away from rewriting how patrons interact with the arts, and with each other.

FIELD TESTING GOOGLE GLASS

Against all things holy and sacred, we wore Google Glass to live arts performances to test its functionality. Most interestingly, neither ushers nor fellow audience members stopped us from wearing Glass. Our tests met with fairly positive results and surprisingly little resistance when respecting traditional theater etiquette. When active, the prism display did not emit enough residual light to distract surrounding audience members, even in a pitch black theatre. This lack of residual light is perhaps the greatest advantage that Glass has over tablet style devices, which are so bright as to grievously annoy almost everyone in a darkened theater. Nor does the video camera on Glass have the blinking red light common on other devices. Instead, the prism display is active whenever the camera function is in use.

The recording capacity of the camera in a performance setting resulted in poor quality recordings due to user head movement and

camera quality (yes, we know it is wrong, but we destroyed the recordings immediately). This function poses the most significant difficulty for the performing arts sector, as performance recording restrictions and audience capabilities continue to evolve in conflicting directions—a topic requiring further research.

The bone conductivity transducer that transmits audio to the user's ear does emit significant sound bleed, about equal to the sound bleed from a mobile phone. Both mono and stereo earbuds decrease the sound bleed significantly, but at top volume these small speakers can be highly distracting. With very few audio tests, it was clear from the beginning that Google Glass will face less resistance in a performing arts setting when used as a visual display only, as opposed to an audio or recording device. Distraction to non-users sitting next to a Glass user was significantly decreased when refraining from using audio.

Voice and gesture activation are perhaps the second most distracting feature of the device, although one can be discreet when using gestures. We hope that Google will integrate a non-illuminated handheld keypad/control for the device that operates much like a remote control. Otherwise, when Glass is in use, the physiological distraction to a non-user can range from mild interest to annoyance and even fanatical fascination. In one instance, a young child was hopelessly mesmerized by the device while his parents showed equal portions of polite disregard and resentment. These reactions will most likely decrease as society adapts to the device. However, when the user is wearing the device in

standby mode, running applications such as incoming phone calls or emails can disrupt the performance experience.

Google Glass Is Banned On These Premises

stopthecyborgs.org

Image courtesy of stopthecyborgs.org

In the future, each performing arts venue will have to decide whether to allow Google Glass and other head mounted displays (HMDs), or actively to discourage their use. Good reasons exist for either choice. The purpose of this paper is not to advocate a specific position, but rather to examine issues on both sides. To that end, performing arts professionals should consider the following factors when making decisions on whether to adopt or reject these devices.

At the moment, the Explorer version of Glass is exceptionally easy to identify as an HMD. Ban signs, like the one above, have already been created, making it possible to train ushers and volunteers to spot users that are wearing Glass and ask them to remove the device. However, Glass is compact enough that it can easily be concealed in a pocket or purse, making it easy for

audience members to sneak the device into the theater and slip it once the hall is darkened.

One of the greatest design flaws Google Glass currently has is that people with prescription glasses cannot use their glasses and the device at the same time. If only this could not change, it would make the differentiation between HMDs and corrective lenses much easier. But those lines are already beginning to blur with prototype designs of prescription Glass and recent reports from the *New York Times* that Google has started talks with eyewear designer Warby Parker in creating prescription glasses with Glass technology. The ultimate result could look very much like this mock-up design from Sourcebits.

GLASS

Image courtesy of Sourcebits

When wearable computing gets to this point, it will be difficult to determine whose glasses contain Google Glass and whose are only prescriptions. This will make it nearly impossible for venues to screen patrons for HMDs and even if they could, raises another, more complex issue: can venues insist that users not wear the device if it is inseparable from their prescription eyewear? This conundrum becomes even more difficult when considering the rapid miniaturization of this type of technology. HMDs will only continue to be designed more and more discreetly, to the point

that in the not-too-distant future we may well have AR contacts, ocular implants, and possibly neural implants--a frightening but not impossible notion, given the rate at which other technologies have been miniaturized.

THE SECOND SCREEN EXPERIENCE

To better understand how audiences might use Google Glass at live performances, it is helpful to examine how consumers currently use mobile tablet devices. One of the most impressive trends in recent years has been the growth of the second screen industry. A second screen is any screened device that is used while consuming another type of entertainment—referred to as the first screen. Second screen use can be unrelated to the content of the first screen (i.e. email, apps, games, etc.) or directly synchronized with first screen content to enhance the user/viewer experience. Although using a second screen is highly discouraged in today's theaters and concert halls, according to Ericsson Consumerlab, 1 in 4 people use a second screen while watching TV. Corraborating this trend, *Business Insider Intelligence* released a report in October 2013 showing that nearly half of all smartphone owners simultaneously watch TV and use their smartphones.

Second screen experiences are also spreading to other entertainment industries. In April 2013, the Dutch thriller *APP the Movie* became the first motion picture to create a second screen experience for moviegoers, providing additional plot points and twists to mobile users. As audiences continue to adopt the practice of using a second screen while consuming other

entertainment, should performing arts venues consider accommodating this trend?

The performing arts first encountered the issue of second screen experiences thirty years ago, when when the Canadian Opera Company introduced supertitles for the first time, in 1983. Supertitles, similar to subtitles for movies, consist of brief translations of an opera's text that are usually projected above the proscenium onto a screen. Supertitles were widely adopted and changed very little until 1995, when the Metropolitan Opera introduced its seatback titling system—overcoming the famous declaration of its artistic director, James Levine, who ten years earlier proclaimed of supertitles, "Over my dead body will they show those things at this house."

Wanting to surpass this obstacle and also provide closed-captioning for patrons with disabilities, Patrick Markle of the Santa Fe Opera and Geoff Webb and Ron Erkman of the Metropolitan Opera gathered around a dinner table to discuss the problem. Their conversation resulted in the creation of the seatback titling system, still in use at the Met and in many opera houses around the world. The system allows audience members to view the titles on a screen that is fixed to the seat in front of them. Audience members can choose to have the device either on or off and, once on, they can select the language to be displayed. For the first time in the history of the art form, the opera house uniquely empowered its audience to personalize the individual user experience.

The recent adoption of tablet devices has brought with it another opportunity to personalize the

visitor experience. Although many theaters actively discourage the use of smartphones and tablets to prevent the distraction of other patrons, there has been some exploration of second screen experiences for these platforms. "Tweet Seats," designated seating sections for patrons wishing to tweet during a performance, were introduced by the Lyric Opera of Kansas in 2009. The idea subsequently spread widely across multiple venues in the United States. One reason why this practice has been accepted is that Tweet Seats, by definition, segregates second screen users from non-users in the auditorium. The issue of distraction from residual light is mitigated with an "out-of-sight, out-of-mind" philosophy, although many venues rejected the concept outright.

In a non-auditorium setting, the collaboration between U.S.-based Figaro Systems, Vienna-based PocketScience, and the Wiener Staatsoper resulted in the invention of the Wiener Staatsoper 2nd Screen App, which debuted in December 2013. This app allows individuals to use a second screen to view titles, scores, and commentary while watching live transmissions from the Wiener Staatsoper. Or in other words, "Turn your living room into your personal box at Vienna State Opera!" Similar to second screen experiences with many TV programs, the app is possibly the least intrusive example of using mobile devices to complement a first screen transmission, as one does not have to worry about non-users in the privacy of one's home.

Perhaps the most aggressive approach to second screen experiences in the performing arts comes from the Italian-based firm OperaVoice, which is experimenting with second screen titling systems in multiple languages in collaboration with the Teatro Comunale of Florence. However, the system still suffers from "the distracting effect of the illuminated projection of captions," suggesting that no matter how far tablet style devices progress, light pollution continues to detract from the experience of non-users.

PUTTING THE "SUPER" IN SUPERTITLES

Google Glass has the potential to bridge the existing gap between live arts performances and the second screen experience. These devices are small, covert, and relatively innocuous to the non-user, as they only project a fraction of residual light compared to tablet and smartphone devices. The art form that might be best positioned to leverage Glass to enhance the audience experience is opera, given its history with supertitles. The vast majority of audiences and venues have already adopted the use of titling during live performance. Google developers now only need to find a way to deliver titling to Glass via a website or hardware access point and, voilà!, users would be able to select a title channel from a handful of languages to enhance their opera experience. Certainly, such development will require time and testing before a final product can be released. Once that product is created, the remaining hurdle will be to convince opera companies and non-users of HMDs that such devices—Glass or otherwise—can be both non-disruptive and non-threatening, lest Glass users be segregated to Tweet Seats.
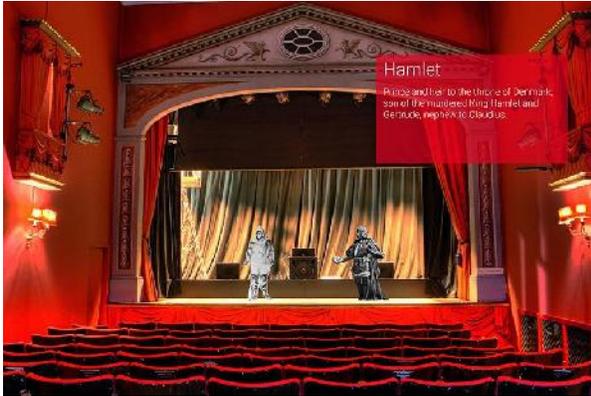
"Theater with Google Glass View Mockup," Samuel Allen, a derivative of "Theater" by Alan Cleaver, used under CC BY.

In fact, Google Glass has already found advocates in the opera industry who want to develop the device for titling use. According to Geoff Webb, president of Figaro Systems, "Glass is the future for titles. It is no surprise that the major established companies are not welcoming of such a new and radical solution given the typical audience who is only now coming to terms with smart phones. This resistance is expected and will quickly fade away when used by the audience. It will, I believe, be embraced as projected titles were when first introduced and again when our seatback titles debuted in 1995."

Such a bold endorsement from a leading manufacturer of titling systems suggests that this device will at least enjoy experimentation and, hopefully, implementation in an operatic setting. Webb also notes that larger companies will probably be less welcoming of this new technology, leaving much of the initial experimentation to smaller companies with less organizational red tape. For opera companies that perform in found spaces or that hold site-specific performances, it is often impractical to employ projected or seatback titles. At one such

company, On Site Opera, founder and artistic director Eric Einhorn is already searching out partnerships to develop a Google Glass app that will enable the desired titling technology:

By wearing Glass, audience members have the opportunity to engage in a performance like never before. Historically, audiences have been forced to disengage and look away from the performance space in order to read titles – either above the stage or on the seat back in front of them. By reading translations in one's peripheral vision on Google Glass, one can remain focused directly on the action and, in On Site Opera's case, follow the action wherever it may happen within the venue. (Eric Einhorn)

In such settings, Glass would enhance an immersive theatrical experience, allowing audience members to not only understand the text of the opera, but also move along freely with the performance as it unfolds. When this is achieved, the surtitle experience that one normally receives within an opera house could be enjoyed almost anywhere and, more importantly, on the go, giving new meaning to Shakespeare's famous proposition, "All the world's a stage."

PERFORMANCE ANNOTATION

Having explored opera titling as the easiest point of entry for Google Glass into the realm of the performing arts, other opportunities exist for the device to enhance the audience experience. Any performing art form can take the titling example and simply provide other content. Much like one reads a book with annotation for additional depth and information, audience members could select

a Glass channel that displays director commentary, dramaturgical notes, additional plot information, or explanations of musical elements. Glass has the ability to educate and engage audiences in the manner that most suits them as the performance unfolds. Although the playbill or concert program offers some illumination, when the house lights dim and the curtain rises, Google Glass and other HMDs offer new potential for exposition, explanation, and interaction.

A comparable example of the potential for these devices can be found in HBO's streaming service, [HBO Go](), which offers additional content to the viewer that runs concurrently with the program. For instance, assume that you want to watch an episode of the network's popular fantasy epic, Game of Thrones. With dozens of characters, intersecting plot lines, and a plethora of names and phrases, it is easy even for dedicated viewers to lose track of the significance of the events on screen. To remedy this, HBO GO offers viewers the option to have occasional [pop-up reminders]() that offer explanations and brief summaries of prior plot developments.

Consider the myriad twists and turns of a Shakespearean comedy, or the intricate symphonic motifs of the Romantic era. Without diverting the user's gaze from the action onstage, HMDs could offer a guide, minute-by-minute, over the course of a performance. That these devices are entirely optional further aids performing arts organization by providing an option with which to offer information to the audience without coming across as condescending. Those viewers who want to interpret the artistic action on stage

themselves are able to do so, while those who may not be as familiar with the works of the medium, or who simply desire further interaction, can receive further exposition.

ASSISTIVE TECHNOLOGY

For audience members with visual or hearing impairments, Google Glass also represents a new frontier for assistive technology. Both iOS and Android tablet devices already have [built-in assistive options]() to make their respective devices more accessible to all users. Although the current version of the Glass firmware (XE12) does not earmark any functions for the purpose of increasing accessibility, some users have already found applications for the hands-free capabilities of the device. *USA Today* recently profiled a [quadriplegic user]() who uses the audio command function of Glass to enable picture-taking and email dictation. [OpenShades](), a startup, has experimented with using the external camera to help the [visually impaired]() identify objects. Many other developers are interested in Glass as an assistive technology because of the possibilities of using either vocal or gestural commands to access audio or visual assistance.

Using a similar Google Glass channel concept, audience members could access assistive channels for those with visual or hearing impairments. For the hearing impaired, a [closed captioning]() channel could be created so that an audience member could read the text of a play. For audience members with visual impairments, audio channels could be created that describe the intricacies of a set and the action taking place onstage.

Furthermore, Google Glass could potentially offer accessibility solutions that are not only effective, but personal. In an ideal scenario, Glass could provide organizations with a way to custom-tailor their accessibility efforts. As opposed to having to rely on projectors or headset systems, theaters might implement their accessibility offerings directly into devices that are owned and maintained by the patrons. Patrons could then configure their devices to render the captions or audio transcriptions at the font size or volume level that preferable to them.

Numerous infrastructure obstacles currently challenge the implementation of existing assistive technology in performing arts venues. In addition to expense, it can be difficult to find an assistive solution that is reliable, easily implemented, and usable by a wide range of patrons. Glass has the potential to provide performing arts organizations with a solution that would assist multiple users at a relatively low cost to the company.

WHERE TO NOW?

Google Glass shows tremendous potential in to change the audience experience throughout the performing arts. It now falls to those arts managers who are willing to invest in and experiment with Glass for the benefit of the industry. Utilizing Glass as a second screen that provides complementary channels to audience members will enhance the overall audience experience by providing optional, customizable interaction. Both small and large performing arts organizations should explore the possibilities the device presents, including potential collaboration

across the industry to develop the technology desired to meet its needs.

Experimentation and collaboration will require a certain amount of investment from interested partners and/or outside sources. Service organizations should encourage developers like Figaro Systems, performing arts organizations, and tech gurus to work together to fully understand the potential of HMDs like Google Glass. Such gatherings could begin with adapting existing second screen titling software to Glass, using this as a launching point for other uses and art forms. Issues surrounding bandwidth support, hardware infrastructure, application design, and tech support will likewise need to be addressed.

As stewards of the arts, it is our responsibility to move the industry forward. We must probe the possibilities of these devices before they hit the marketplace, lest HMD users pour into our venues and find us unprepared. The Google Glass Explorer program has given us a rare opportunity to prepare for the future before it arrives. We should take that opportunity and run with it.

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