Sonus

The Art of Hearing Places

Master's Degree Program
DIGITAL HUMANITIES AND DIGITAL KNOWLEDGE

Course Examination
MUSEOLOGY, MUSEOGRAPHY AND VIRTUAL ENVIRONMENTS

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1 Blind Travellers

People with normal sight travel to places “worth seeing” and “seeing the world” has become the ultimate goal for many. The concept of exploring visual beauty is so deeply rooted in society that the activity is referred to as “sightseeing” (sight = “thing seen; vision”)[1] and actors are called “visitors” (lat. visitare = “to go to see, come to inspect”).[2] Even though our language is not inclusive, people with vision impairment are equally fascinated by travelling to new and unfamiliar places. The experience is a combination of what the available senses perceive; one of the most defining – by people with good sight completely underrated – are ambient sounds.[3] The mixture of sounds can define a space to the extent that humans can recognise a location based on ambient sound. Some visually impaired, like Ben Underwood, can use a combination of existing and self-created sounds for echolocation, which allows moving more freely.[4]

An inspiring example for blind travellers is Tony Giles.[5] Even though he is fully blind, he has been travelling alone for around two decades. Travelling for him is about experiencing the new culture with all the available senses. During a TED Talk in Vienna, he recalled one representative example: Markets in Jerusalem have a unique combination of smells and sounds which are entirely different to any other market he has experienced during his many travels. Giles already travelled through 132 countries and has been in all seven continents.[6] His goal is to experience every country, culture, and to have been to all major “sightseeing” attractions. Some years ago, he met his girlfriend – who happens to be blind as well – which is now supporting and accompanying him on his mission.[7]

However, not everybody has the capabilities to travel and expose themselves to new experiences. Around 15% of the world’s population lives with disabilities of some forms[8] and might have limited mobility, or even just financial constraints which prevent from travelling. Empowering more people to experience new places is the goal of Sonus. The platform is designed to spread “The Art of Hearing Places,” in thus the auditory experience of travelling. Sonus is specialised in translating the acoustic atmosphere into audio recordings and provides those recordings in an accessible format online. The following describes in which way ambient audio recordings are a complex task and in which sense accessibility is an important feature of Sonus. The paper also provides an in-depth analysis of the possible organisational structure of Sonus as an institute and the technical implementation of the webpage.

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[1] Definition of “sight“: https://www.merriam-webster.com/dictionary/sight (14.06.2019).
[2] Origin of “to visit”: https://www.etymonline.com/word/visit (14.06.2019).
[3] Pallasma, Juhani. 2005. *The Eyes of the Skin – Architecture and the Senses.* Chichester: Wiley-Academy.
[4] Ben Underwood (*1992 – †2009): http://www.benunderwood.com (14.06.2019).
[5] Tony Giles documents his experience on his webpage: https://www.tonythetraveller.com (14.06.2019).
[6] Tony Giles talks about his life at TEDx Vienna: https://www.youtube.com/watch?v=Bgq_CRGSJGM (14.06.2019).
[7] An autobiographic text by Tony Giles: https://www.tonythetraveller.com/biography/ (14.06.2019).
[8] World report on disability: https://www.who.int/disabilities/world_report/2011/report/en/ (14.06.2019).

2 Sonus

2.1 Theory

Sonus is an implementable concept of a virtual museum (VM) which enables visitors to experience the acoustic atmosphere of historically significant places and famous travel destinations. In 1996, the term “virtual museum” was defined by Geoffrey Lewis as a collection of digital data of historical, scientific, or cultural interest, like images, sound files or text documents, which are accessible through electronic media. The VM domain has been provided with a common terminology by the glossary *Terminology, Definitions and Types for Virtual Museums* written by the *Virtual Museum Transnational Project*.[9] The following describes aspects of the Sonus project followed by the standardised terminology in brackets. In this way, consulting the glossary can serve for disambiguation.

Sonus classifies as a VM because the museum is solely available online. The exhibition offers audio recordings which represent the acoustic atmosphere of a place. [Distributed Virtual Museum, Transmedia, On-line Virtual Museum, Digital Object] Sonus is intended to become a full-featured institution which maintains and continuously advances the service. [Permanent Virtual Museum] Besides the primary intention to spread “The Art of Hearing Places,” the data can also serve to analyse the difference and the development of sound backdrops in respect to a zeitgeist and a location. [Research Virtual Museum] For example, the electrification of the car fleet will drastically transform the sound of cities and how they are perceived. Besides the main intention to become a full-featured virtual museum, the webpage may inspire people to visit the location. As looking at photos evokes a desire to travel, hearing the atmosphere of a location might also trigger the wish to experience the actual place. Hence, Sonus can serve as promotion for travel destinations. [Promotional Virtual Museum]

The audio recordings, if listened to with adequate headphones, create an immersion experience. The platform itself, however, given that it is a regular webpage, is a non-immersive experience. [Immersion, Interaction]

The users can contribute their audio recordings in order to enrich the collection. The high standards of Sonus, however, require to formerly hand in the audio files and additional information for revision. The contribution is likely only accepted from professionals who want to be philanthropes of the museum, or from advanced amateurs with proper equipment.

Theoretically, given that the audio recordings are not born digital but are recordings of real sound sources, the VM could be referred to as a virtual exhibition with a digital representation of real elements. Beltramini and Gaiani called this a “virtual with real” museum. However, given

[9] *Virtual Museum Transnational Project*, network for virtual museum community: www.v-must.net (19/05/2019).

the transitoriness of the unique mixture of sounds plus the circumstance that the sound sources might over time vanish, as discussed with the electrification of the car fleet, the digital files will in the future have no reference point. In the long term, the audio recordings might even undergo resampling and reformatting, which creates a further abstract distance from the source. Hence, the VM will, in some sense, become a so-called “virtual with virtual”: A virtual space which represents objects which do not exist in the real world.

The main component of the Sonus database are the audio recordings enriched with information material about the location. [Repository] The items of the database are described, classified, categorised, and annotated – with this metadata, a user can easily retrieve data from the database. [Digital Library, Metadata] This database is continuously backed up and transformed into the newest state-of-the-art data format to guarantee compatibility (unaffected from technological evolutions) and to prevent system malfunctioning. [Digital Archiving, Digital Preservation] The main focus during development must be maintainability to guarantee a long lifespan, this applies to the source code and file formats. [Long Term, Maintainability]

Besides the maintenance, the development has to consider accessibility criteria. Besides the intention to develop a resource for disabled people, as a public service, the design of the platform has to consider every type of user. The variety of target users includes people with different educational background, varying ages, or also limited capabilities. [Accessibility, Design for All] The design process of the user experience and user interface respects all users’ needs by hiring experts specialised in accessibility and in user experience. The standards of WCAG do herby determine the accessibility features of Sonus, like increasable text size, choice of colours and text-to-speech. [Usability, User Experience, User Interface Design]

The users have full control over how they prefer to explore the virtual collection of audio recordings and the information material. The virtual space has an open pattern: users do not have to follow any path. The search allows selection and, thus, omission of virtual objects. The possibility to omit creates a personalised experience.

The reusability of components is an important criterion, especially for projects like Sonus, which is founded by public money. The audio recording must have an open source licence and should be available as a download for the public. The high-quality audio material can be used, for example, for movie, music or any other kind of art project. The infrastructure of Sonus is likely very highly specific and reusing might be difficult. Nonetheless, the source code should be open source because it undoubtedly serves as a case study. [Ex-changeability]

2.2 Concept

The following describes the two Sonus principles and the three main features. The principles are guidelines for the design. The features are services provided for the visitors.

Warm Welcome

The Warm Welcome is a principle which guides, for instance, the way the front page has to receive the visitors. Emphasising the Warm Welcome is necessary given the many real museums and virtual museums which manifest the barriers to high culture. Barriers are, for example, the missing understanding of the topic or the different habitus of people who traditionally are further away from high culture.[10] These barriers might lead to feeling out of place and lead to a decline in interest. The Warm Welcome reassures every visitor that Sonus offers an enlightening experience for everybody, completely independent from their background. On the front page, testimonials from all kind of backgrounds will welcome visitors. On the following pages, the principle consequently shapes the communication style. Textual explanations exist as a beginner, intermediate and an expert version, and technical jargon can be hovered to open an easily comprehensible definition.

Barrier Free

The second principle for Sonus is Barrier Free. While Warm Welcome focuses on possible cognitive barriers, Barrier Free is the elimination of physical barriers like illegibility of texts due to partial blindness or no visual access to the content due to complete loss of vision. Hence, the possibility to increase the font size and the careful selection of colours for the colour palette is as relevant as is the support of screen readers. For the colour palette, it is essential to

Fig. 1 – Colour Palette of Piet Mondrian's Geometric Paintings

choose colours which are distinguishable for every kind of colour perception.[11] The proposed colours for Sonus are a reference to Piet Mondrian's geometric paintings, which overshadow the artist's legacy. His distinct tones of yellow, blue and red combined with white and black deliver a set of colours, which are distinguishable no matter what colour blindness may be present. A subtle side effect is that the colour palette is somewhat known and appreciated by the art scene, and the palette is associated with a chair of Gerrit Rietveld.[12] The appendix *a. Mondrian Colour Palette* contains approximated illustrations of how eight types of colour blindness distort the perception of those colours respectively. A famous example of accessibility

[10] Reuband, Karl-Heinz. 2017. *Oper, Publikum und Gesellschaft.* Wiesbaden: Springer VS.
[11] Jenny, Bernhard, and Nathaniel Vaugh Kelso. 2007. "Color Design for the Color Vision Impaired." *Cartographic Perspectives* (58): 61-67.
[12] Rietveld, Gerrit. 1918-1923. *Red Blue Chair.* https://www.moma.org/collection/works/4044 (20/06/2019).

based on primary colours is Google and their signature colours. Besides colours, text-to-speech is an important accessibility feature present on Sonus. For people with complete loss of vision technology has become very accessible since screen readers were invented. Sonus has text-to-speech build in, so that under all circumstances the accessibility is guaranteed.

Listen Now

The core of Sonus is the feature Listen Now. Visitors can listen to the recordings of aural atmospheres and to text-to-speech for textual information. Ambisonic audio recordings are the foundation for Sonus audio material. Ambisonic recordings require multi-channel microphones which pick up sounds 360 degrees around the device while maintaining the information about from which direction the individual frequency derived. The extra information about from which direction frequencies entered the microphone serves to model the binaural perception of human hearing. On the contrary, standard audio recordings contain only enough information about the frequency but not about the direction. So, the information is just enough to either output the same frequency over all speakers or to use an artificial recreation of the movement of sound sources by playing the same frequency in varying loudness on several speakers, for example as done in movies for recreating the movement of cars. In conclusion, ambisonic recordings allow an authentic digital representation of a real-world phenomenon.

Learn More

With the feature Learn More users have the opportunity to not only listen to the places but also to learn about the context. For historical buildings, the text contains the history of the architecture, for nature or any other non-historical place the information provides context about the location's role in the community. The resources are drafted in collaboration with – if available – the administrating institutions. In this way, the texts can be formulated in the institutes' interests and serve as promotion material, which motivate users to discover more about the places. Sonus must be based on serious research and with reliable content; with the goal being to achieve attractivity without losing credibility.

Share Yours

The Share Yours feature allows the visitors to upload their audio recordings. As mentioned in chapter *2.1 Theory*, the uploaded files are reviewed to enforce the quality standards of Sonus. An extensive manual describes the requirements in order to facilitate the recording process and to increase the quality of the submissions. If the recording is sufficient, metadata is added, and the textual information for the contextualisation of the audio recording is, as stated, drafted in collaboration with relevant institutes. The webpage indicates the contributor alongside the recording. The target user for this feature are professionals, skilled amateurs, and students of sound engineering. The preferred group must be officially communicated,

concerning the complexity of ambisonic recordings, to avoid submission of low-quality recordings. Given the reputation of Sonus for high-quality standards, the limitation is justifiable and explainable without upsetting the user base. Targeted campaigns and contests help to motivate the preferred users. Those contests follow the Sonus' slogan "The Art of Hearing Places" and challenge to find the most beautiful places in respect to their aural appearance. With Share Yours, the repository continuously grows, and the community feels connected with Sonus.

2.3 Implementation

The implementation of Sonus including its features and principles requires a broad set of skills, a variety of software and hardware which enables the staff to contribute their best and allows for the deployment of Sonus. Sonus, as an institution, can have three states: Setup State, Daily State, and Maintenance State. Each step requires a particular set of employees to perform all state-specific jobs. See appendix *b.* for a diagram of the hierarchical structure, appendix *c.* for a diagram indicating when which role is active and appendix *d.* for extensive descriptions of every role. By default, the three states contain the following tasks:

Setup State	**Daily State**	**Maintenance State**
• Team building • Hardware acquisition • Server infrastructure setup • Basic structure of webpage • Initial set of audio recordings • Corporate identity design • Relationships with institutes	• Accounting • Marketing campaigns • Contributor hunting • Customer service • Incremental improvements • UX enhancement • Relationships with institutes	• Software updates • Hardware upgrades • Framework changes • Code refactoring • File format conversion

Given that Sonus is an entirely new initiative, the Setup State requires disproportionally more work than a Daily State because this state includes all the prerequisites like information or decisions necessary to start the business. The Setup State is, hence, carried out by consulting companies, which are specialised in kickstarting digital projects. In this way, highly trained professionals can establish a good foundation and structure in which the permanent employees can then operate. A Setup State is revocable for an evolution in the functionality or organisation of Sonus. Revoking a Setup State requires first to define the desired actions and then to select external employees. The differences between Setup, Daily and Maintenance States are the higher concentration of new implementations and the required input from external experts. In general, Sonus avoids employing an expensive expert for infrequent tasks. For instance, in a regular Maintenance State, the maintenance of more advanced infrastructure components is carried out by a consulting firm as well.

In detail, in the fourteen weeks long Setup State consultants are in place as director, content strategist, marketer, accountant, sound engineer, UX designer, graphic designer, web accessibility specialist, IT technician, full-stack developer and back-end developer. The length of the employment varies for each role and depends on the complexity of establishing this position. The director has to supervise all processes performed by the consultants and has to find permanent employees for the Daily State. Hence, this person starts at the beginning of the project. Consultants who have to start their work immediately after the director are content strategist, UX designer, web accessibility specialist and IT technician. The content strategist, which ideally is a historian specialised in architecture, has two main tasks: creating a selection of locations for which the sound engineer is then going to create audio recordings, and contacting the responsible institutes to gather information about the particular location. The UX designer and the web accessibility specialist are partnering to design an interface and a user experience which meet the principles of Sonus. Their draft is then passed on to the full-stack and the back-end developer for implementation. The IT technician starts early to set up all the computer for the in-house employees who start in the Daily State and to configure the server for the deployment of Sonus. The marketer and the accountant follow in the end. The marketer creates an initial campaign to advertise the launch of Sonus and the accountant establishes a system in which the part-time in-house accountant can later perform the job efficiently.

In the Daily State, the team persists of director, content strategist, marketer, customer service as full-time positions, and accountant, UX designer and full-stack developer in part-time positions. The in-house employees either work from home or meet in coworking spaces. During daily business, Sonus focuses on the acquisition of content with the feature Share Yours, as described in the chapter *2.2 Concept*. The institutions, companies and users are motivated to contribute through competitions and altruistic motivations. The strategic communication and establishment of relationships are responsibilities of the director, the content strategist and the marketer. The customer service can assist with communication and assists already existing users. In a Daily State, the improvement of Sonus will only see minor updates which are designed by the UX designer and implemented by the full-stack developer.

The Maintenance State involves all permanent in-house employees and external consultants as graphic designer, web accessibility specialist, IT technician, back-end developer and another part-time full-stack developer. All tasks, which in the preceding eleven weeks long Daily State remained undone, are approached in the two weeks long sprint. During the presence of the external experts, in-house employees can be trained how to perform minor expert tasks themselves; for example, the marketer can learn how to adjust the graphic design. The combination of Daily and Maintenance State repeats each quarter.

2.4 Cost Estimation

The difference between the three states requires to separate the cost calculation for each state. The costs are calculated based on the average hourly pay a professional receives in their field. This data was retrieved from the internet, for example, from salary comparison platforms, or the HAYS Salary Guide 2018.[13] For the Setup State, as described, consultants are commissioned to fulfil the roles initially and to implement a structure in which regular employees can operate more efficiently. Hence, the final cost per position includes taxes, wage costs and profit, which the companies are adding to the bill. The New York University lists the average profit a industry normally expects from a bill. The Daily State costs do not include side costs, except wage costs, because the people are employed in-house. Initialising Sonus and employing everybody for the Setup State with a duration of approximately 14 weeks costs around 86,594.43 € without cost for hardware, data or software licences.

	Position	Hours	€ / Hour	Wage Cost[14]	IVA[15]	Profit[16]	Gross € / Hour	Pay
Setup State	*Director*	560	13.30 €[17]	27%	22%	2%	21.09 €	11,807.80 €
	Content Strategist	480	13.70 €[18]	27%	22%	2%	21.72 €	10,425.36 €
	Marketer	160	12.30 €[19]	27%	22%	8%	20.65 €	3,303.53 €
	Accountant	160	13.30 €[20]	27%	22%	3%	21.29 €	3,406.73 €
	Sound Engineer	300	13.90 €[21]	27%	22%	2%	24.41 €	7,323.92 €
	UX Designer	480	13.70 €[22]	27%	22%	2%	21.72 €	10,425.36 €
	Graphic Designer	400	10.40 €[23]	27%	22%	6%	17.13 €	6,853.75 €
	Web Accessibility	480	13.00 €[24]	27%	22%	2%	20.61 €	9,892.68 €
	IT Technician	160	11.80 €[25]	27%	22%	4%	19.07 €	3,051.86 €
	Full-Stack Dev.	400	17.50 €[26]	27%	22%	2%	27.74 €	11,097.56 €
	Back-End Dev.	400	14.20 €[27]	27%	22%	2%	22.51 €	9,004.88 €
							Total	**86,594.43 €**

After the successful implementation, a team of permanent employees manages Sonus, while receiving support from consultants, which implement or optimise more complex aspects, on a regular basis. As explained, each quarter starts with a Daily State of around 11 weeks,

[13] HAYS Salary Guide 2018: https://www.hays.it/salary-guide/sg-2018-web-2179788 (18/05/2019).
[14] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Wages_and_labour_costs/it (18/05/2019).
[15] https://gestionaleamica.com/ebook-guida-pratica-fatture/parcella.html (18/05/2019).
[16] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/margin.html (18/05/2019).
[17] Based on 28,000€ HAYS (Figure Digitale, Bologna, Servizi, Product Manager).
[18] Based on 29,000€ https://www.studentville.it/lavorare/stipendio-professore-universitario-quale/ (18/05/2019).
[19] Based on 26,000€ https://neuvoo.it/stipendio/?job=Marketer (18/05/2019).
[20] Based on 28,000€ HAYS (Finance, Consulenza Fiscale, Bologna, Accountant).
[21] Based on 29,400€ https://www.jobbydoo.it/stipendio/tecnico-suono (19/06/2019).
[22] Based on 29,000€ https://crebs.it/salari/ux-designer/#.XQn1cy2Q3zI (19/06/2019).
[23] Based on 22,000€ https://neuvoo.it/stipendio/?job=Graphic+Designer (18/05/2019).
[24] Based on 27,400€ https://www.jobbydoo.it/stipendio/web-designer (19/06/2019).
[25] Based on 25,000€ HAYS (Information Technology, Figure Junior, Bologna, HW Solutions, Hardware Techn.).
[26] Based on 37,000€ for Programmer (Information Technology, Bologna, Development, Senior Programmer).
[27] Based on 30,000€ for Programmer (Information Technology, Bologna, Development, Programmer).

which is followed by a two weeks long Maintenance State. The regular staff for the Daily State costs more or less 16,245.03 € per month. The additional costs for the supporting consultants during a Maintenance State sum up to an estimate of 7,456.04 €, which includes four full-time and three part-time employees for the duration of two weeks. If the cost for consultants are redistributed monthly over the course of a quarter, the monthly costs for employees add up to 18,730.38 € without the cost for any of their equipment.

	Position	Full- vs. Part-Time	€ / Hour	Wage Cost	Gross € / Hour	Pay
Daily State	*Director*	Full-Time	13.30 €	27%	16.94 €	2,982.18 €
	Content Strategist	Full-Time	13.70 €	27%	17.45 €	3,071.87 €
	Marketer	Full-Time	12.30 €	27%	15.67 €	2,757.96 €
	Accountant	Part-Time	13.30 €	27%	16.94 €	1,491.09 €
	Customer Service	Full-Time	10.90 €[28]	27%	13.89 €	2,444.04 €
	UX Designer	Part-Time	13.70 €	27%	17.45 €	1,535.93 €
	Full-Stack Dev.	Part-Time	17.50 €	27%	22.30 €	1,961.96 €
					Total	**16,245.03 €**

	Position	Hours	€ / Hour	Wage Cost	IVA	Profit	Gross € / Hour	Pay
Maintenance State	*Graphic Designer*	80	10.40 €	27%	22%	6%	17.13 €	1,370.75 €
	Web Accessibility	80	13.00 €	27%	22%	2%	20.61 €	1,648.78 €
	IT Technician	80	11.80 €	27%	22%	4%	19.07 €	1,525.93 €
	Full-Stack Dev.	40	17.50 €	27%	22%	2%	27.74 €	1,109.60 €
	Back-End Dev.	80	14.20 €	27%	22%	2%	22.51 €	1,800.98 €
							Total	**7,456.04 €**

The acquisition cost for computer hardware used by the in-house employees sums up to 13,743.00 €. The order is a mix of MacBook Pros (for more advanced tasks like programming, bookkeeping, photo editing) and Google Pixelbooks (for easy tasks like customer support and text editing). The monthly redistribution of hardware costs is a common practice. The assumed lifespan is often three years. Hence, the monthly expense for the devices is 381.75 €.

Hardware	Price	Quantity	Total
MacBook Pro 13" [29]	2,349.00 €	5	11,745.00 €
Google Pixelbook [30]	999.00 €	2	1,998.00 €
		Total Cost	**13,743.00 €**

[28] Based on 23.000€ https://neuvoo.it/stipendio/?job=Customer+Service (19/06/2019).
[29] MacBook Pro 13": https://www.apple.com/it/shop/buy-mac/macbook-pro/13-pollici-grigio-siderale-processore-quad-core-a-2,4ghz-(turbo-boost-fino-a-4,1ghz)-512gb# (19/06/2019).
[30] Pixelbook: https://www.amazon.it/dp/B0776WCLHL/ref=cm_sw_r_tw_dp_U_x_HRLcDbGX9RS0Y (19/06/2019).

Software for office work (Office 365), photo editing (Adobe Cloud), UX design (Sketch, Adobe Cloud), and customer service (Freshdesk) is purchased with a monthly subscription. The service charges for hosting the webpage (Bluehost) and for the IT support hotline (Smart Service Desk) are paid monthly as well. Those fees sum up to a monthly total of 440.94 €. The total monthly cost for running Sonus, based on the considerations outlined in this report and with various aspects to be evaluated, sum up to 19,553.07 € per month.

Software / Services	Price / Month	Quantity	Total / Month
Office 365 [31]	10.50 €	7	73.50 €
Adobe Cloud [32]	91.49 €	2	182.98 €
Sketch [33]	8.25 €	1	8.25 €
Freshdesk [34]	15.00 €	2	30.00 €
Bluehost [35]	107.21 €	1	107.21 €
Smart Service Desk [36]	39.00 €	1	39.00 €
		Total Cost / Month	**440.94 €**

3 Outlook

In conclusion, the goal of Sonus to spread “The Art of Hearing Places” is ambitious and comes with a price tag. However, as this report has shown, not only the community of people with disabilities but also the cultural sector would benefit from Sonus: People with disabilities are provided access to cultural experiences which are otherwise inaccessible, and the cultural sector has a new channel to promote their cultural good and to educate citizens.

The final implementation of Sonus requires to explore the feasibility further. While various aspects are present in this report, the mentioned consultants are fictious, and the salary cost calculations use online resources only. Hence, contacting relevant companies to clarify their availability and their pricing schemes is required to determine the actual cost and the realistic timeline for a project of this scale. At last, the availability of consultants is crucial for the success of the Setup State. Also, some professions like the web accessibility specialist might not even exist in Italy, because of the novelty of this profession.

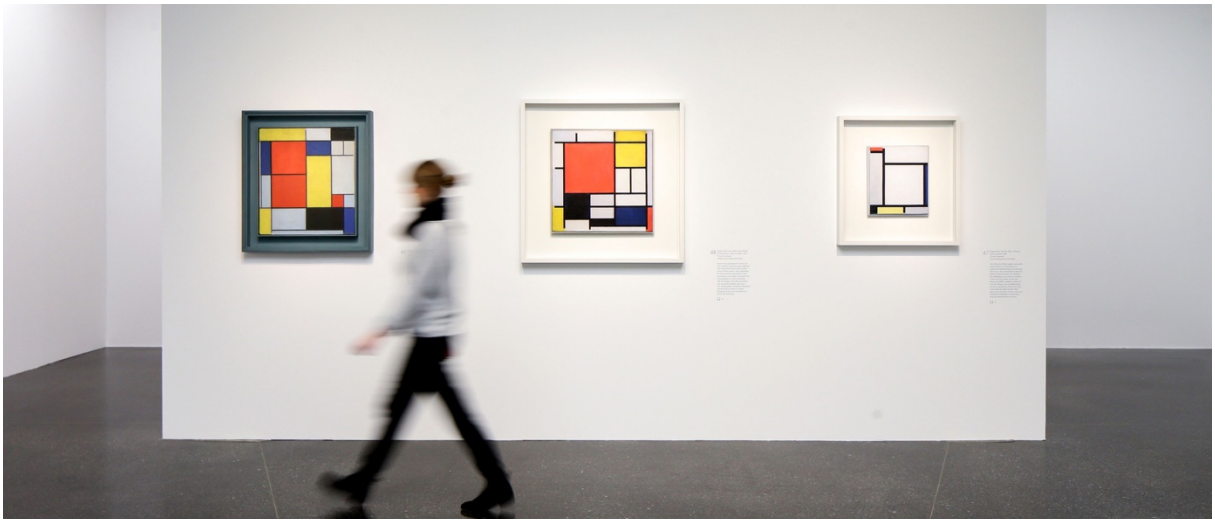
Ultimately, designing for accessibility is – against the common belief – by no means designing for a minority. Designing for accessibility is designing for the heterogenic mass of people which have many varying needs and a broad spectrum of different capabilities. Often, an accessibility feature become a mainstream tool like captions in videos.

[31] Office 365: https://www.microsoft.com/it-it/microsoft-365/business#pmg-cmp-desktop (19/06/2019).
[32] Adobe Cloud: https://www.adobe.com/it/creativecloud/plans.html (19/06/2019).
[33] Sketch: https://www.sketch.com/ (20/06/2019).
[34] Freshdesk: https://freshdesk.com/pricing (20/06/2019).
[35] Bluehost: https://www.bluehost.com/hosting/dedicated (20/06/2019).
[36] Smart Service Desk: https://www.smartservicedesk.it (18/05/2019).

4 Appendices

a. Mondrian Colour Palette

The geometrical paintings of Piet Mondrian inspire the colour palette for Sonus. His famous modernism defining paintings use colours which can be identified by colour blind people as separate colours. The following demonstrates the possible perceptions.



Exhibition View of Piet Mondrian Artworks. (Bucerius Kunst Forum)[37]

In the eye, rods and three types of cones are responsible for the perception. Rods serve for vision in dim light and can only detect variation in light. Cones are active in bright light and detect either short, middle or long wavelength (blue, green and red respectively).[38]

Normal

Achromatopsia

This type of colour blindness is the most severe but also rarest kind. None of the cones in the eyes function correctly. Only the rods, which normally are for low light vision, have functionality. Affected persons see black, white and shades of grey.[39]

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[37] https://www.buceriuskunstforum.de/en/exhibitions/mondrian-colour/ (19/06/2019).
[38] https://medical-dictionary.thefreedictionary.com/vision (19/06/2019).
[39] https://medical-dictionary.thefreedictionary.com/achromatopsia (19/06/2019).

Deuteranomaly

The green cone photopigment is abnormal. The sensitivity of the cones has decreased. The condition usually does not affect the quality of life. (5% of male)[40]

Deuteranopia

Insensitivity to the middle wavelengths (green) because of an absence of green cones.[41]

Protanomaly

The red-sensitive pigment of the cones has decreased.[42]

Protanopia

No working red cones present. The perception of long wavelengths is disturbed.[43]

Tritanomaly

The blue-sensitive cones are defective and function poorly.[44]

Tritanopia

The blue-sensitive cones are absent.[45]

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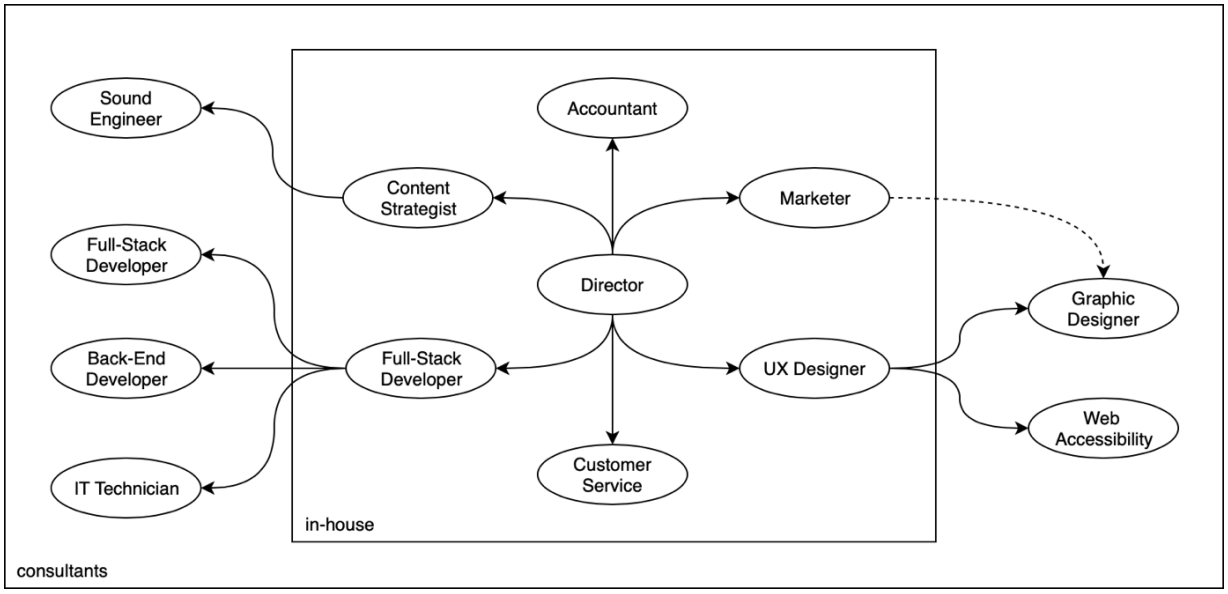
[40] https://medical-dictionary.thefreedictionary.com/Deuteranomaly (19/06/2019).
[41] https://medical-dictionary.thefreedictionary.com/deuteranopia (19/06/2019).
[42] https://medical-dictionary.thefreedictionary.com/protanomaly (19/06/2019).
[43] https://medical-dictionary.thefreedictionary.com/protanopia (19/06/2019).
[44] https://medical-dictionary.thefreedictionary.com/tritanomaly (19/06/2019).
[45] https://medical-dictionary.thefreedictionary.com/Tritanopia (19/06/2019).

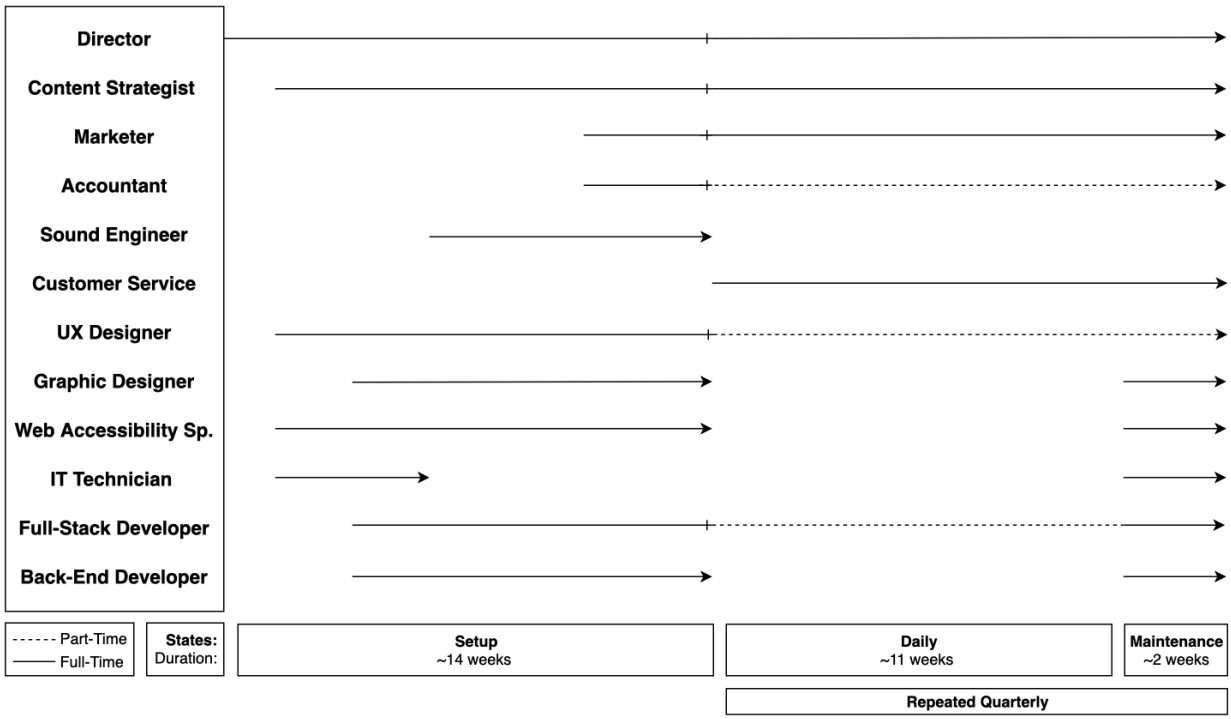
b. Team Structure

The diagram shows the relationships on the in-house employees working permanently for Sonus in the Daily State and the consultants who are joining for the Maintenance State. All roles, except the customer service, are present in the Setup State in this constellation.



c. Sequential Order of Jobs

The figure shows the sequential order in which the consultants fill their roles during the Setup State. Further, the visualisation shows which roles are active in the Daily and Maintenance State. The lengths of the arrows are approximately responding to the duration.



d. Description of Roles

The following appendix defines twelve roles which are needed for Sonus. The requirement for and the function of the position is explained in each definition. The four key aspects are tasks, technical knowledge, soft skills, and the experience a candidate has to have.

	Director
Tasks	The director is the manager of the museum. The person supervises all administrative processes, the development of the platform, the production of the content, and the long-term maintenance, and the customer service. The job is mainly about handling people (7-11) and guiding the project towards a successful future.
Technical Knowledge	The person needs a basic understanding of WCAG guidelines, server-client architecture, web development, and audio recordings, computer literacy (Microsoft Office, management software, etc.).
Soft Skills	The skillset of the person should include public speaking, empathy, managing people, and excellent skills in maintaining relationships with sponsorship partners etc.
Experience	This position requires previous experience in a management position. It is suggested that this previous employment was in a company developing products for people with disabilities. Experience in a company unrelated to assisted living products but a personal interest or relation to the matter could be sufficient as well. The ideal candidate also has (amateur) experience in a recording studio, but this is optional.

	Content Strategist
Tasks	This job is about the structural design of the content. The person defines the taxonomies, metadata, and manages the content provided by other people like recordings handed in by supporters or content provided by writers, copywriters, editors, or the representatives of represented places.
Technical Knowledge	The person has to have functional computer literacy, profound knowledge of the content, and how users usually search for content on a platform.
Soft Skills	The position requires excellent communication skills to cooperate with partners and to be able to communicate the content to the users in an easily comprehensible manner.
Experience	For this job, experience as a historian is ideal. A historian has the competences to evaluate whether the buildings or locations are historically relevant. Further, the person can check whether the information provided by the institutions is accurate.

	Marketer
Tasks	The marketer develops a campaign for advertising the project. Given that the museum exists only online, marketing campaigns are mainly online as well. Hence, the tasks involve writing PR articles for online newspapers, creating representative material for advertisement, managing contracts with advertising platforms like Google Adwords, a throughout search engine optimisation and tracking the statistics with tools like Google Analytics. Given the target group of visually impaired people, the task involves creating audio material (like podcasts, or radio jingles) as well.
Technical Knowledge	The employee has to know about online marketing, the planning of an advertisement campaign, and the writing of public relation articles. Further, computer literacy and understanding of online tracking tools (basic HTML) is needed.
Soft Skills	This person has to be an open-minded, fast learner to adapt to communication trends.
Experience	Given that the person singly manages the marketing department, prior senior experience in a marketing department is required. It is always suggested to hire somebody with an understanding of the requirements of visually impaired users.

	Accountant
Tasks	This essential position is required to ensure liquidity. The tasks involve mainly accounting, organising contracts, and transferring salaries.
Technical Knowledge	The employee has to know the local tax system, the standard knowledge about accounting, and needs to be fluent with Office.
Soft Skills	The person has to be self-driven and well organised, given the few working hours.
Experience	The position requires senior experience as an accountant because the task will only be carried out by this one person.

	Sound Engineer
Tasks	The sound engineer has two main task fields. On the one hand, the person develops a guide which allows enthusiastic amateurs or philanthropic professionals to translate the atmosphere of places in their region into audio recordings, which they can then hand in for review and possible publication. On the other hand, the person creates a set of initial recordings with which the museum can be published.
Technical Knowledge	A profound understanding of recording spatial audio and knowledge about ambisonic microphones, and cutting and mixing equipment is required.
Soft Skills	The person has to be an excellent instructor and should have an ear for unique sounds.
Experience	This position does not require prior professional experience in a similar position. The execution of this role is best filled with a highly motivated person who is willing to systematically explore the possible ways of representing the atmosphere of spaces. The only required experience are working experience with recording equipment.

	Customer Service
Tasks	The role is about communicating with users and providing support. Usage problems or bugs are then forwarded to the internal teams to work on improvements. Generally, customer contact allows having an idea about the general feeling in the community.
Technical Knowledge	The employee has to have computer literacy to use the ticketing system for user requests and some basic understanding of web technologies to report issues.
Soft Skills	The position requires to be an excellent communicator in order to handle user requests professionally and politely.
Experience	This position does not require any working experience. The required experience is the prior interaction with a vast variety of other people, which volunteering might proof.

	UX Designer
Tasks	The person creates the user story for Sonus and has a specific focus on studying and researching how people use Sonus. Based on the results, he/she creates an agenda with necessary changes and tests the implemented changes. The UX Designer in contrast to the Web Accessibility Specialist is not a technical role with technical expertise regarding the implementation and does also not consider the feasibility, but things about the general design of the user experience.
Technical Knowledge	The employee needs to know all the conventional user research methods (quantitative and qualitative methods) and has to have profound knowledge about how to create a good user experience.
Soft Skills	Needs excellent communication skills to report the findings or necessary changes, and to interview customers for a qualitative analysis of their experience.
Experience	The employee is required to have experience in working for and with people with disabilities. An occasion might have been, for instance, voluntary work outside of the prior work as a UX Designer. The work experience can be of middle level, given that the other senior staff (like the developer) can support.

	Graphic Designer
Tasks	The Graphic Designer is responsible for designing a user interface with the highest priority being to ensure legibility for people with colour blindness or weakened sight.
Technical Knowledge	The designer has to be a fluent user of Adobe software, the web design tool of his/her choice (like Sketchup) and needs to know some basics in front-end development.
Soft Skills	The person must be able to communicate with team members constructively and to contribute effectively in meetings because collaboration with the Web Accessibility Sp. is necessary for the information about accessibility guidelines.
Experience	The Graphic Designer has to have prior experience. Given that the UX Designer and Web Accessibility Sp. support with their strategic thinking, a junior level is enough.

	Web Accessibility Specialist
Tasks	Responsible for ensuring that the platform is accessible by the target user. The Web Accessibility Specialist implements all the features which ensure high accessibility for people with disabilities, especially for people with vision impairments. The person partly functions as developer and partly as designer in order to consider accessibility from the first draft until the final deployment of Sonus.
Technical Knowledge	The person has to have in-depth knowledge of accessibility laws, guidelines, and best practices. Most of the information is provided by the World Web Consortium (WCAG 2.0) and resources like the American Disabilities Act (Section 508). Further, general knowledge about user experience, responsive web design and WAI-ARIA is required.
Soft Skills	The employee has to be able to implement the standards accurately and needs excellent communication skills to share insights with everybody else.
Experience	Given that accessibility is the defining component of Sonus, considerable experience is required for adequately fulfilling this position. The candidate has to have prior experience as a Web Accessibility Specialist. It is suggested to choose a person who has experience with managing people because the function requires instructing others to apply the accessibility standards correctly.

	IT Technician
Tasks	This hardware person sets up all the actual computers used for the employee and the servers for running the webpage. The latter involves the servers provided by a host, which require some basic prior configuration but will not be bare-metal servers.
Technical Knowledge	The person needs knowledge about the available hosting services for selecting the appropriate service and needs to know how to configure the system. Further, knowledge about the current state-of-the-art hardware is required to purchase and set up the hardware for the employees.
Soft Skills	The employee needs to be able to configure Linux, Windows, macOS and all software used for running or creating Sonus.
Experience	Given that the information technology is the backbone of every webpage, the experience is required on a senior level. The person needs to have worked as a system administrator where he/she was responsible for setting up the servers for a webpage.

	Full-Stack Developer
Tasks	The Full-Stack Developer is supervising the technical implementation of the webpage. The person codevelops the webpage, instructs the Back-End Developer and the second part-time Full-Stack Developer during the Maintenance States, and ensures that the bridge between front-end and back-end is created correctly.
Technical Knowledge	The person equally knows the current technologies for front-end and back-end, including HTML, CSS, JavaScript, and back-end languages (like Python, PHP, or Ruby). Further, the candidate has to have in-depth knowledge of agile development techniques and know how to organise an agile team.
Soft Skills	The necessary skills include managing people, writing well-structured code and detailed documentation. The person needs to demonstrate a strong ability to learn quickly in order to adjust to the requirements of the development of Sonus.
Experience	The Full-Stack Developer requires good to excellent experience but hiring a senior developer is only optional.

	Back-End Developer
Tasks	The Back-End Developer is focusing on developing the back-end of the web.
Technical Knowledge	The employee needs knowledge in the respective programming language like PHP, Ruby, or Python and skills in database/server work. An average understanding of JavaScript and HTML would help. Further, this developer needs an understanding of security and structuring the backbone of the webpage.
Soft Skills	The person has to be extremely organised, which results in a clean and readable code which is easily maintainable in the future.
Experience	The Back-End Developer is required to have prior experience, but a junior level could be enough, given that the Full-Stack Developer is instructing the task.