
The Salome Experience: Opera Live Streaming and Beyond

Peter Reichl
Christian Löw
Svenja Schröder
COSY Research Group
University of Vienna
1090 Vienna, Austria
peter.reichl@univie.ac.at
christian.loew@univie.ac.at
svenja.schroeder@univie.ac.at

Thomas Schmidt
Bernhard Schatzl
Valon Lushaj
University of Vienna
1090 Vienna, Austria
a1129297@unet.univie.ac.at
a1025166@unet.univie.ac.at
a0848448@unet.univie.ac.at

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

CHI'16 Extended Abstracts, May 07 - 12, 2016, San Jose, CA, USA
Copyright is held by the owner/author(s). Publication rights licensed to ACM. ACM 978-1-4503-4082-3/16/05...\$15.00
DOI: <http://dx.doi.org/10.1145/2851581.2851588>

Oliver Hödl
Florian Güldenpfennig
Institute for Design & Assessment
of Technology
Vienna University of Technology
1040 Vienna, Austria
oliver@igw.tuwien.ac.at
flo@igw.tuwien.ac.at

Christopher Widauer
Vienna State Opera
1010 Vienna, Austria
christopher.widauer@wiener-
staatsoper.at

Abstract

Since a couple of years, opera houses have started transmitting selected performances via live streaming over the Internet, in order to make them accessible to a broader audience. In this context, the “Salome Experience” project, carried out at the University of Vienna in collaboration with Vienna State Opera, investigates innovative approaches for further closing the gap between stage and audience via modern communication technology. This paper discusses the prototypical realization of some of these ideas in the framework of a dedicated live streaming transmission of the opera “Salome” by Richard Strauss during a symposium celebrating the 25th anniversary of the Internet in Austria. Moreover we present a novel smartphone app which has evolved from this initiative and aims at providing the audience with “smart subtitles” to make stage performances more accessible, with a specific focus on the audiences of large open air events or streaming transmissions.

Author Keywords

Live broadcast; mobile app; UHD; audience interaction

ACM Classification Keywords

J.5. Computer Applications: ARTS AND HUMANITIES:
Performing arts (e.g. dance, music)



Figure 3: Autodafé scene (with fake TV transmission) from Peter Konwitschny's production of "Don Carlos" by Giuseppe Verdi (photo: Wiener Staatsoper). Cf. beginning of the trailer [7].

Remark 1: In this context, observe that, according to Rupert Christiansen [8], "until the custom of dimming the house-lights and sitting in numbered chairs became the norm in the late Victorian period, a degree of informality was always an element of any performance, whether it was the comings and goings of posh folk in the boxes or wanton cat-calling from the gods.... The idea that a theatre should resemble a church in its etiquette – a place of darkness, meditative silence and concentration – has prevailed for only a century and perhaps doesn't reflect the primitive reality that it's up to the performers to mesmerise us and that a performance which doesn't command attention doesn't deserve our reverence."

Of course, this is not the first attempt to include the audience into the theatric action happening on stage, however, in opera this is quite rare [3-6]. A notable example is maybe Peter Konwitschny's controversial production of Verdi's "Don Carlos", with an autodafé scene taking place right amongst the audience who is still enjoying the interval and sipping champagne while observing the arrival of the royal family (King Philipp, Queen Elizabeth and the entire court) at the opera house [7]. Indeed, in this production the royal couple arrives in the grand staircase of the opera house and solemnly proceeds to the auditorium, while at the same time the heretics are chased through the building and finally burnt on stage (Fig. 3). All these events are transmitted to the (regular) opera audience via a couple of big TV screens spread all over the opera house, in the format of a (fake) TV live transmission [7], which includes commentaries, interviews, photographers, security guards, camera-men etc.

Our approach has two major effects: On the one hand, it takes advantage of these rare cases of confluence between theatre, life, social media and ICT, and as such might even have the potential to transform a simple live streaming transmission into an art form of its own right. On the other hand, it brings back a certain degree of informality while watching this performance which we expected to lower the entrance barrier for people who are not regular opera goers but are open for such an experience, and thus to make opera more accessible and maybe even more enjoyable than usual (see also Remark 1 on the evolution of opera etiquette from a historic perspective).

In order to achieve this, the "Salome Experience" project has developed several features which are presented and discussed in the following sections.

Main Features of "The Salome Experience"

First of all, we will start with briefly describing the setup of the various features or "stations" which – in addition to the main live streaming transmission on two big screens in the "Grosser Festsaal" – were open to the participants of the symposium during the social event (see Fig. 2 for a floor plan with all rooms involved).

Android App „Don't Miss the Buffet"

In order to give to interested participants the freedom of changing rooms during the performance without losing track of the performance, e.g. for going to the toilet, organizing food from the buffet, talking to colleagues or other forms of networking typical for such social events (Fig. 4), we have developed a localization-based Android app which notices the moment when people left the Grosser Festsaal as well as the moment of their return, which allowed sending to their smartphones a brief individual description of what has happened on stage during their absence (see Fig. 5).

Second Screen

While the Live Streaming Project of Vienna State Opera (*StaatsoperLive*) [9] regularly accompanies the live broadcasting with a two-channel *Second Screen App* offering subtitles and further content like archival scores, we have used this app to provide a continuous update of the story happening on stage, offering two levels of granularity (the first one summarizing a rough survey about the plot, the second one describing current actions in higher detail). In addition, some "preview" information was offered as well, for instance pointing the audience towards upcoming suicides, murders etc., as well as e.g. the impending begin of Salome's notorious "Dance of the Seven Veils".



Figure 4: Evening buffet during the "Salome Experience" in the Kleiner Festsaal. Here, the opera broadcast was replacing usual background music, but was only visible on a small TV screen in the back (photo: University of Vienna/Gerard Spee).



Figure 5: Back from buffet and updating oneself with the help of the Android app.



Figure 6: *ZoomPad* control screen

Note: due to the nature of the evening event, some of the photos slightly lack brightness.

ZoomPad

Broadcast transmissions from Vienna State Opera are realized using a total of nine cameras: while the first camera provides a long shot perspective all the time, together with the other eight cameras it is used for producing an appealing cut version with different views, creating a cinematic look and experience. For the "Salome Experience" project, we provided participants with a remote access to the control of the long shot camera, and enabled them to redirect and zoom the long shot with the help of a special *ZoomPad* interface, thus becoming co-producers of the broadcast (Fig. 6).

3D Stage View

Originally, it was planned to additionally install an experimental 360° panorama camera based on developments within the project "Beyond" run by Samsung, Vienna State Opera's technology partner [10]. Depending on the placement of this camera (there were several options under discussion), this would have allowed stunning 3D views of the running performance. Unfortunately, due to logistic reasons, this station could not be realized – instead, interested visitors were offered a 3D demo video featuring Cirque du Soleil (Fig. 7).

How Good to See the Moon

The moon plays an important role in „Salome“ – in fact, the title of this subsection is a direct quotation from Oscar Wilde's screenplay. However, in the production the moon does not appear visually on stage at any point. This motivated us to augment the live stream at the remote location with an interactive visualization of the moon. As, by a sheer coincidence, there was full moon on the evening of the performance, we developed an installation compiling four sensor-equipped deck chairs in front of an additional large screen, where

people could sit and relax (and even have a freshly tapped glass of beer, see Fig. 8) and at the same time activating an artistic installation of a simulated full moon rising above the screen (Fig. 9). Later in the evening, after it became dark enough, this installation was replaced by a live streaming transmission of the full moon rising over Vienna downtown (Fig. 10).

The transmission itself was offered by the live streaming project of Vienna State Opera [9], see Remark 2 for an overview and some further detailed information about the different services and the technical setup of this project which has been awarded the "IBC 2014 Special Award" of the International Broadcasting Convention in Amsterdam [12].

Technological Aspects

In this section, we will discuss the different features of the project from a detailed technical perspective.

Android App "Don't miss the buffet"

The *Android app* station aimed at providing a location-based service providing content summaries depending on the user context. More specifically, the idea was to provide short textual summaries of those parts of the performance that had already occurred, or that had been missed by the user due to short-term absences. To this end, we conceptualized two different levels of content granularity. The less detailed perspective (we called them "partitions") are summarizing about 15-20 mins of the plot in average and correspond roughly to a typical opera scene. In addition, we provided a second granularity layer, the "chunks", corresponding to a certain small number of libretto verses (e.g. a recitative, or half an aria, etc.). On average, each partition consists of 10-15 chunks. Because the user should be able



Figure 7: Experimenting with Samsung's 3D VR Gear.



Figure 8: "Chilling" and watching.



Figure 9: "How good to see the moon" (above the TV screen).



Figure 10: Finally, live streaming of the full moon rising over Vienna downtown (next to the screen: an illuminated new-gothic church).

to join the event at any given time but also get up to date very quickly, the app combines the advantages of partitions and chunks: a priori, chunks are released one after the other, and as soon as all chunks belonging to a partition are visible, they are merged into the associated partition. This guarantees that the actual parts of the plot are described in detail, but over time become less fine granular.

To deliver these contents, the basic architecture of the project consists of three components (Fig. 11): The *queuing interface* with an embedded web service, a *client* to access the interface, and the *smartphone* of the user. The core part of the architecture is an *application server* offering the queuing interface as well as the web service for the app to load the already active contents. When the opera proceeds and reaches a certain spot (e.g. study figure) in the score, the queuing client has to release the corresponding chunk, which activates the data record for the app on the users' device.

Another app feature was allowing users to briefly leave the room and receiving a summary of missed content upon return. While developed independently, this feature provides sort of a reversed version of the *RunPee* [13] functionality (basically, *RunPee* indicates visitors in a cinema the optimal point in time to visit the toilet during a running movie). To realize this location-based feature, we have relied on iBeacons, i.e. small, cheap and energy-saving Bluetooth senders based on the Bluetooth Low Energy technology with a range of several meters [14]. The signal transmitted by the iBeacon doesn't contain any data given by the programmer but only the configurable values UUID, for identifying the signal in the users' app. To cover the area where the performance was streamed, we used two iBeacons (see Fig. 12). When the user enters or

leaves the area, the app installed on the users' smart-phone reaches or loses the connection to the iBeacons, thus allowing to identify and provide the precise part of content which the user has missed during her absence.

Second Screen

For the *Second Screen* station, the smart-phone app *StaatsoperLive* [9], provided by Vienna State Opera, has been used without specific technical modifications – our focus was put strictly on the enhanced content to be provided. *StaatsoperLive* is available to users of iOS and Android devices for free; see Remark 2 for further details. As with the Android App *Don't Miss the Buffet*, a queuing operator situated at Vienna State Opera publishes the enhanced content in sync with the performance according to the study figures of the opera score. Note that *StaatsoperLive's* Second Screen capability was mostly designed for displaying content like scans of old opera scores taken from the archive of Vienna State Opera, to home-cinema users with an utmost of precision of synchronization. To this end, the app relies on detecting queueing signals that are watermarked into the audio-stream of the performance. This proved to be efficient and quite robust even in the lively surroundings of the symposium.

ZoomPad

The *ZoomPad* station allowed users to control one of the cameras operated at Vienna State Opera's main hall. Benefiting from the advantage that the opera's streaming architecture operates on an IP-network, we accessed the camera directly over a web browser. Via this channel, the camera delivered a medium quality video-feed with almost no delay as well as a control interface to influence its direction and zoom level. This interface was made available to our participants via a

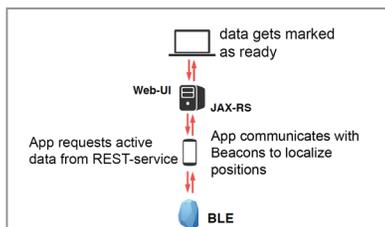


Figure 11: App architecture.

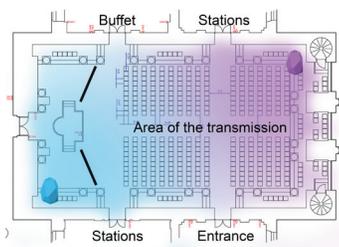


Figure 12: iBeacon coverage in Grosser Festsaal, cf Fig. 2.



Figure 13: Deck chair with infra-red sensor (arm handle) recognizing if somebody is sitting down. The bigger box holds the Arduino and a power-battery.

touchpad. Apart from the display of the medium quality feed, the *ZoomPad* station also offered a high-quality stream of this camera, which exhibited a delay of about 20 seconds. After having taken over control of this camera and used it to capture details individually important to them, the participants could witness the result of their camera work as it got incorporated into the State Opera’s main high quality streams.

3D Stage View

Initially, the *3D Stage View* station was set out to visualize a live 360° view, recorded and transmitted from Samsung’s “Project Beyond” panorama-camera [10] within the opera. This proved to be a challenging task to prepare technically, as Project Beyond’s multiple source cameras produce over a gigapixel of video-data every second. Due to logistical problems, a change of plans was necessary, which resulted in the final version of *3D Stage View*: Instead of a live feed from the opera, we used a pre-recorded 360° video in which the watcher takes on the place of an audience member of a Cirque du Soleil performance. We presented this video to the “net:25”-symposium guests via a *Samsung Gear VR* virtual reality device as shown in Fig. 7.

How Good to See the Moon

At this station, as already mentioned earlier, audience members have been invited to have a seat in one of four sensor-equipped deck chairs in front of a large canvas with an approximate 6m x 4.5m projection of a night sky view full of glimmering stars (cf Figure 9). Depending on which of the seats were taken, and in which particular order, the moon appeared in the projection and was alternated (i.e., the moon moved into the direction of the last seat that was occupied by a person). Technically, this was implemented by distance

sensors (IR sensors) monitoring the surface of the chairs, which then wirelessly transmitted “seat events” (occupied/free) to a control server. This information was then rendered into the projection of the moon and stars using a corresponding processing environment together with a high performance projector.

Questionnaire Results and Lessons Learned

In order to get some feedback and ideas on how the opera experience can be enhanced, we asked the participants to fill out brief, station specific questionnaires after visiting each station. We have used standardized scales (like, e.g., the “hedonic quality” scale [11]) and included questions regarding the visited station plus a demographic part that was identical over all stations and only had to be filled out once. All in all, 58 visitors participated in our study and returned one or more questionnaires. Most of the visitors only experienced one station while twelve participants visited two or more stations; detailed participation numbers are summarized in the following table.

Station	Participants
App “Don’t Miss the Buffet”	7
Second Screen	2
ZoomPad	12
3D Stage View	34
How good to see the moon	18

The mean age was 37.4 years with a SD of 12.7. The majority of the participants have been 20 to 30 years old (supposedly students at the University of Vienna), a noticeable amount of visitors has been between 40 and 55 years old. Out of the participants, 22 were female and 31 male, while 5 didn’t specify their gender.

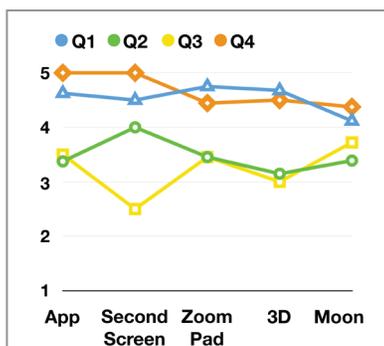


Figure 14: Summary of feedback from questionnaires (Q1 - Q4).

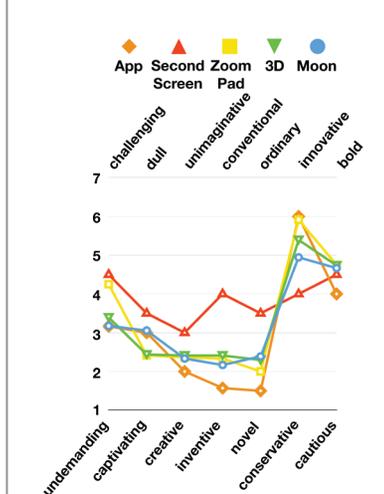


Figure 15: Results from AttrakDiff questionnaire [11] (undemanding ↔ challenging, captivating ↔ dull, creative ↔ unimaginative, inventive ↔ conventional, novel ↔ ordinary, conservative ↔ innovative, cautious ↔ bold).

Regarding their prior experience with opera visits, it turned out that most of the participants (40 out of 58) only seldomly went to see an opera (i.e. once a year or less often). Yet the general interest in classical music seemed to be high: 39 visitors stated a high interest in classical music (rating 4 or 5 on a scale of 1-5 where 5 meant a high interest). Overall, most of the participants expressed a positive attitude towards the stations of “The Salome Experience”, and a high majority would have recommended the stations to friends.

In the qualitative part of the questionnaire, participants were asked to provide information about what they personally liked or disliked about opera visits. According to their answers, most notable benefits of attending the opera contain the special atmosphere, as well as emotions and ambience, followed by the music, combination of art forms and the varying unique productions. Negative aspects most importantly included the high prices for tickets, but also the elitist community, negative side aspects of attending an event in person (e.g. long waiting lines and coughing guests), and aversion against specific musical aspects (e.g. length of the pieces, long boring musical sequences).

In general, this indicates a high potential of remote opera streaming since most of the participants expressed a high interest in opera as an art form while disliking negative aspects of a physical opera visit. While experiencing the opera remotely attendants could walk around freely, chose a new seat while still enjoying the music and the production through the opera stream. Multimedia installations and specific applications could further enhance these remote opera experiences. Finally, novel smartphone applications like the ones described in this paper have the potential of providing additional content which can be highly tailored to the indivi-

dual opera visitor (e.g. guiding him through the plot in his/her mother tongue, reacting to change of location etc.), not to speak of the fancy aspects such applications have e.g. for early adopters.

Finally, we asked the visitors of each station some more specific questions, i.e. whether they liked that station (Q1), whether that station increased their interest in opera (Q2), whether activities like these might increase their frequency of opera visits (Q3), and last not least whether they would recommend that station to friends (Q4). For Q1-Q3, we used a Likert-type scale ranging from 1 (“not at all”) up to 5 (“fully agree”), while Q4 is binary and has been evaluated in terms of the percentage of “yes” answers (Fig. 14).

The station-related questions asked participants also to rate stations according to qualities specific to the respective station content, e.g. whether they’d describe experiencing *How Good to See the Moon* sitting in the deck chair as “comfortable”, or they’d get dizzy from using the *3D Stage View* station’s VR headset. Furthermore, participants were asked to situate their experiences in several impression fields (Fig. 15). Here, most notably it turned out that, except for the *Second Screen*, all features of the “Salome Experience”) were judged to be highly innovative, rather courageous and – at least to some extent – creative, inventive and novel, while not being particularly challenging or exciting. Regarding the representativeness of our study, there are certain limitations. First of all the smartphone apps had a low quantity of returned questionnaires due to the distributed nature of these stations (App “Don’t Miss The Buffet” with 7 visitors and the “Second Screen” App with 2 visitors). Also the demo of the Cirque du Soleil at the 3D station only approximately resembled a real opera experience.

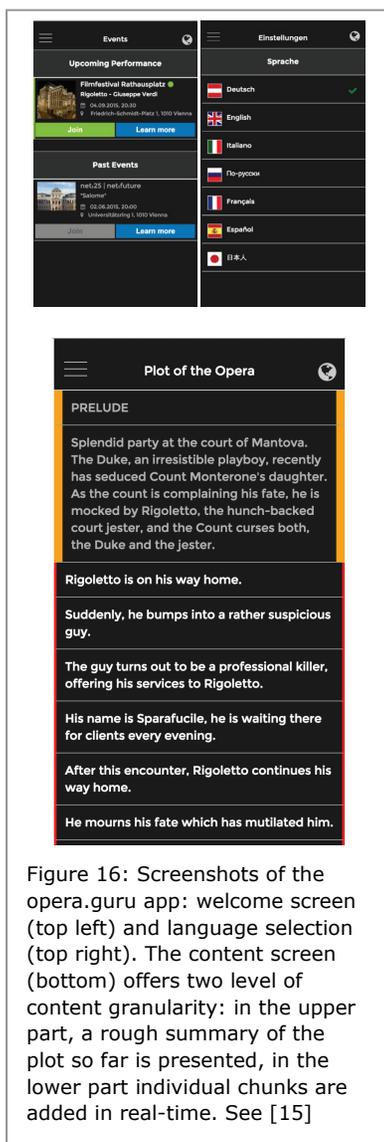


Figure 16: Screenshots of the opera.guru app: welcome screen (top left) and language selection (top right). The content screen (bottom) offers two level of content granularity: in the upper part, a rough summary of the plot so far is presented, in the lower part individual chunks are added in real-time. See [15]

Keeping this in mind, the average results depicted in Fig. 14 allow at least deriving some general trends and indications. Most notably, it seems that visitors liked very much being offered additional content on their smartphones (*Don't Miss the Buffet app, Second Screen*) and recommend this further (Q3/4), while these offers do not necessarily increase their general interest in opera (Q1/2). Visitors also liked the other three feature stations, and it seems they felt specifically comfortable with the relaxed environment offered by the *Moon* station for enjoying the performance. The *3D Stage View* station was by far the most popular one (34 visitors), but did not produce noteworthy trends with respect to Q1-4 (however, as already mentioned, provided only a demo version of a potential very innovative opera-related feature).

Hence, despite of all of its limitations, already this preliminary study reveals some insights into how physical and remote opera visits are perceived and can be enhanced through modern multimedia and communication technology. For instance, it was interesting to observe that among the participants using the smartphone app, there were apparently several couples who were sharing a device, which eventually led to far more interaction (whispering, mutual calling of attention etc.) between the two than this is usually the case e.g. during the consumption of TV/screen content. We also observed cases of people using the smartphone app who did not really go for the location-based service aspects but just used the app as a subtitle replacement.

As an immediate consequence, this observation has led us to further develop on this particular aspect, resulting in the "smart subtitles" approach discussed in the following section.

Towards an App for Smart Subtitles

Smart Subtitles

As discussed above in detail, the *Don't Miss the Buffet* Android app yielded a concept of dynamic summarization of live content. Based on the encouraging experience feedback which we received from participants of "The Salome Experience", who for instance labeled this idea consistently being a rather novel and creative approach, we decided to develop and explore this concept further, last not least triggered by the observation that this app – to our surprise – was used also as subtitle replacement by some users.

In shape and form, we stuck with the *Don't Miss the Buffet* concept of a twofold content granularity, consisting of a set of fine-grained information particles (i.e. chunks), which would be listed over time, subsequently vanishing and being incorporated into a condensed, less fine-grained summary particle (partitions). Such "Smart Subtitles" stand for a novel modality of content, as they are situated in between fine-grained, classical subtitles, demanding of the user a constant level of attention, and over-arching summaries, which usually are consumed before or after a cultural experience and thus are disconnected from its live character.

As a side remark, note that our concept significantly differs from other forms of "smart subtitles" as recently proposed in related work, e.g. in the context of vocabulary learning via subtitles of TV series [16]. To the best of our knowledge, our *opera.guru* app is the first to address specifically the field of opera and theatre live broadcasting, while *wolfgangapp.nl* [17], released by the Dutch cultural consultant J. Idema about a week before "The Salome Experience", focuses on concert scenarios only and lacks all other *opera.guru* features.

Remark 2: “Opera live wherever you are” [9] - under this motto, Vienna State Opera offers a live streaming service for around 45 live performances per season. Taking into account both the democratization request that publicly subsidized cultural events should be made accessible to the public under reasonable conditions, and the willingness of consumers to pay for cultural content, this service has been implemented as a premium product, providing a live stream from within the opera house together with additional value-added services, including (a) the option to switch between a long shot channel and a second channel with a cut version of the performance (from a total of 9 cameras), (b) a second screen app offering rare content like scores from the opera’s archive, giving insight into the interpretation of eminent conductors of the past, (c) a digital program, (d) a concierge service for continuous user support, etc. Most notably, this award-winning initiative has become the first project worldwide to realize live broadcast over IP in Ultra-High Definition (UHD), even well ahead of FIFA’s soccer world cup in 2014 [16].

Offering a dynamic channel of textual and visual content created complementary to and delivered in sync with an opera performance, in theory holds the opportunity to augment cultural content and empower its consumers in various ways. A set of contextual remarks, for example, can enrich the experience of a classical concert for an audience less familiar with its content, by highlighting or describing important plot developments and recurring or otherwise relevant musical motives. Furthermore providing such content in a number of languages can help with making cultural content more accessible and might be valuable to cultural institutions catering to an international audience.

opera.guru

To capture user feedback on this idea, we chose several events of open air opera live screening known to be visited by international tourists for a set of user trials alongside the app’s redesign. More specifically, in collaboration with Vienna State Opera and the City of Vienna, we had the opportunity to offer our app for free at five live screenings of Giuseppe Verdi’s “Rigoletto” in the course of June and September 2015 on Herbert-von-Karajan-Platz Vienna, and on Sept 4, 2015 at the FilmFestival Vienna. The latter one was opening the 2015/16 season of Vienna State Opera and was transmitted to a 300 sqm screen on Rathausplatz Vienna with more than 2,000 seats available. To get an impression from these events, please refer to Fig. 17.

In addition to equipping our app with several content language options, we applied a subtle, dark interface design (Fig. 16) in order to reduce possible disturbances for other audience members – a potential problem which has been repeatedly mentioned as *conditio sine qua non* for introducing such an app into the (rather

traditional) opera or concert hall context, see e.g. the lively discussion our app triggered in the forum of “Der Neue Merker”, one of the most influential opera-related online platform in the German speaking regions [19]. Finally, we chose *opera.guru* [15] as an appealing and likeable app name. *opera.guru* was made available for users of iOS, Android and Windows Phone for free.

On all mentioned occasions, the language options (currently available: English, German, French, Italian, Spanish, Russian, Japanese) were well-received; for instance, one third of the 193 unique users recorded at the “Rigoletto” screening at the FilmFestival chose other languages than German. Observations revealed users checking *opera.guru’s Smart Subtitles* intermittently as the prevalent usage pattern, while some users also followed them continuously. While intermittent use would be consistent with the intent of *Smart Subtitles*, this can only be taken as a first glimpse at the usage practice and will be examined further in subsequent user research.

Summary and Outlook

In this paper we have presented a case study around several ideas to make opera live streaming more accessible and enjoyable to an audience of non-specialists. Starting from the isolated event of the “net:25” symposium, we have experimented with several different approaches and, based on the feedback received, further developed the idea of a smartphone app offering multi-lingual “smart subtitles” especially for tourists visiting open air events. Of course, this work is considered just a starting point, and many more options for audience interaction are on our roadmap, for instance the integration of gaming aspects (see e.g. [20] for a



Figure 17: *opera.guru* in action – impressions from Karajan-Platz, Vienna, June 2015 (3 photos), and FilmFestival Rathausplatz Vienna, Sept 4, 2015, with its 300 sqm big screen (bottom).

computer game around the story of Salome and John the Baptist) or the extended use of social media, e.g. for linking artists and audience closer together.

Acknowledgements

The authors would like to thank Christian Panigl and Romana Cravos (ZID), Hannes Weisgrab (COSY) and Oliver Zenner (Vienna State Opera) for the technical and logistic support during the event. Note that the positions presented in this paper reflect not necessarily the official positions of any of the involved institutions but rather the individual opinions of the corresponding co-authors in the context of a research paper.

References

1. <https://www.net25.at>. Retrieved Sept 12, 2015.
2. R. Strauss. 1905. *Salome*. Musik-Drama in einem Aufzug nach Oscar Wildes gleichnamiger Dichtung. Musik von Richard Strauss op. 54. Vocal Score, Fürstner Musikverlag Mainz.
3. J. L. Armitage and K. Ng. 2013. Augmented Opera Performance. In: *Proc. of 2nd International Conference on Information Technologies for Performing Arts, Media Access and Entertainment (ECLAP)*, 276–287.
4. E. Jessop, P. A. Torpey and B. Bloomberg. 2011. Music and Technology in Death and the Powers. In: *Proc International Conference on New Interfaces for Musical Expression (NIME)*, 349–354.
5. T. W. Leong and P. Wright 2013. Understanding “Tingle” in Opera Performances. In: *Proceedings of OzCHI2013*, pp. 43–52.
6. A. Ersöz. 2015. Audience-Oriented Forms of Performance in the 21st Century. *Academic Journal of Interdisciplinary Studies*, 4(1), pp.31–36.
7. Wiener Staatsoper. Don Carlos (French version). Video. Retrieved Sept 12, 2015, from www.wienerstaatsoper.at/Content.Node/home/spielplan/Spielplandetail.php?eventid=1024458.
8. R. Christiansen. 2014. Why theatre seats for Twitter junkies is a #goodidea. The Telegraph, Oct 17, 2014. Retrieved Sept 12, 2015, from: <http://www.telegraph.co.uk/culture/culturenews/11169040/Why-theatre-seats-for-Twitter-junkies-is-a-goodidea.html>
9. <http://www.staatsoperlive.com/en/>, retrieved Sept 12, 2015.
10. <http://thinktankteam.info/beyond/>, retrieved Sept 12, 2015.
11. <http://attrakdiff.de/index-en.html> . Retrieved Oct 5, 2015
12. <http://www.ibc.org/page.cfm/link=829>. Retrieved Sept 12, 2015.
13. <http://runpee.com>. Retrieved Oct 5, 2015.
14. R. Faragher and R. Harle. 2014. An Analysis of the Accuracy of Bluetooth Low Energy for Indoor Positioning Applications. *Proc 27th International Technical Meeting of The Satellite Division of the Institute of Navigation (ION GNSS+ 2014)*, Tampa, Florida, September 2014, pp. 201-210.
15. <http://www.opera.guru>. Retrieved Sept 12, 2015.
16. G. Kovacs and Robert C. Miller. 2014. Smart Subtitles for Vocabulary Learning. In: *Proc. of CHI 2014*, pp. 853-862.
17. <http://wolfgangapp.nl/>. Retrieved Sept 12, 2015.
18. <http://www.gramophone.co.uk/classical-music-news/the-vienna-state-opera-goes-hd>. Retrieved Sept. 12, 2015.
19. <http://der-neue-merker.eu/forum/app> . Retrieved Oct 5, 2015.
20. <http://tale-of-tales.com/Fatale/>. Retrieved Sept 12, 2015.