ERASMUS+ Project "Online Choirs: How to carry out virtual choir rehearsals with the help of digital tools"

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R3.1: Conceptualisation and refinement of technology solution(s) facilitating online choir rehearsals

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Abstract

This document R3.1 is part of Work Package (WP) 3 (Design and refinement of technology solutions and principles to carry out online choir rehearsals) of the ERASMUS+ Project “Online Choirs: How to carry out virtual choir rehearsals with the help of digital tools”.

The activities in WP3 developed principles for conducting online choral rehearsals by considering technological, choral pedagogical and socio-technical aspects. The results of WP3, e.g. the identified best practices and challenges as well as the requirement profiles of choirs interested in online rehearsals, guided the development of the technological solution and the principles in this WP.

This document R3.1 describes how different software solutions can be used for online choir rehearsals and what hardware and equipment is needed to use different software solutions. The last part of this document describes which technology solutions are suitable for choirs with different needs.

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1 Employed software for online group singing (R3.1.1)

Digital innovations are increasingly influencing and revolutionizing different areas of life. While some areas of life have moved online in recent years (communication, media consumption, shopping, etc.), making music together has been slow to reach digital channels. During the pandemic, when face-to-face meetings were no longer possible, technical solutions got a boost.

Online choir rehearsals are now possible thanks to software platforms and can be used with almost no latency. Well-known software solutions have established themselves in recent years and have found an increasing number of users in both amateur and professional musician circles. Jamulus, Soundjack, JamKazam or Jacktrip are well-known versions of these software solutions, which are often supplemented with videoconferencing systems for communication among each other.

In the research project, the Soundjack software was complemented with Zoom. Both pieces of software offer pragmatic solutions for collaborative singing over the Internet.

Low-latency software as a solution for collaborative music-making over the Internet

Low-latency audio software is designed specifically for musicians working together over the Internet, enabling them to perform and rehearse together in advance. The software is designed to reduce the time delay - the latency - so that it is barely noticeable when musicians play together. With the right equipment, musicians can play together as if they were in the same room. In terms of quality, the solutions offer high-resolution audio to preserve the natural sound that is essential for detailed musical work.

Using Low-latency software for online choir rehearsals

The software solutions also work for collaborative choir rehearsals, providing low-latency, synchronized opportunities for the choir to sound the same as if the singers were performing together in person. Even if there are sociological or choral pedagogical differences, the low-latency software solutions offer the possibility of rehearsing together over physical distance, provided that basic technical equipment is available. Group dynamics, tonal variations, and vocal qualities can be conveyed with good technical equipment and supplemented by metronomes or instrumental accompaniment.

Videoconferencing systems

In recent years, video conferencing systems have become an integral part of the business world. With these software solutions, video and audio meetings, conferences, and workshops can be held regardless of location. They are easy to use with a wide range of tools (such as breakout rooms, recording options, and more), have low basic technical requirements, and could easily be adapted for musical purposes during the pandemic. Latency is less noticeable in a purely linguistic context, but this software is neither intended nor practical for vocal and musical harmony and togetherness.

Videoconferencing systems for online choir rehearsals

Zoom is one of the most popular video conferencing systems and is a widely used and functional software that allows participants in choir rehearsals to see each other. Document and screen sharing is also useful for distributing sheet music and making arrangements. It is not possible to produce consonance, but one-sided use of musical instructions (music, beat, conducting) can be used to reach participants.

Breakout rooms for smaller group exercises make it possible to focus on vocal groups, for example.

Last but not least, most videoconferencing systems have the advantage of being able to record sessions and allow absent participants to join in or watch and practice later.

The virtual background settings in the video function can be used to make vocal groups visible, or uniform backgrounds can be used to hide the rooms at home for a uniform presentation of the choir members. This is especially useful for recordings and adds a professional touch to the presentation of the choir members during a performance.

Combining low-latency software and videoconferencing systems for online choir rehearsals

Standard videoconferencing systems and low-latency software complement each other in terms of their respective strengths: while low-latency software solutions focus on low-latency transmission of music and voice, the videoconferencing system can transmit visual images and video with significantly higher latency. Nevertheless, the combination of the two solutions can provide a productive environment for rehearsals and choir members, as the additional video latency does not negatively impact the musical performance.

Audiovisual communication is essential for the socio-cultural structure of a choir. Even when conducting is not possible due to video delay, the transmission of videos of the participants and the conductor is of immense importance for the feeling of the choir. Gestures, facial expressions and visual cues from the conductor are also fundamental to a choir.

Combining the strengths of the two specific software solutions results in a structure similar to live choirs. The sound is in the same space, the focus is on the choir's own singing and notes, the environment with images, facial expressions and gestures complements the situation to create a fully synchronized rehearsal.

2 Employed hardware and equipment for online group singing (R3.1.2, R3.1.4)

Distributed rehearsals at the professional level require professional hardware to complement the software solutions used. While low-latency software and videoconferencing systems ensure the transmission of audio and video, professional hardware enables the software to reach its full potential: While professional microphones and headphones ensure proper sound quality, a sufficiently good Internet connection ensures low-latency data transmission. In addition to a computer, an external USB audio interface with appropriate quality requirements must be used.

Audio input: microphones

Microphones are available in a wide range of qualities and standards. In addition to microphones for telephony and voice transmission, there are also high-quality microphones for professional vocal performances. USB microphones are easy to use and can be easily connected to existing computers as they are already an external audio interface. The quality is sufficient for basic requirements. More advanced requirements can be met with professional XLR microphones. Because of their analog connection, they require an additional sound card that acts as an interface between the computer and the microphone and can transmit in full professional sound quality. This sound quality has a positive effect on the overall sound of a choir. Professional directional microphones meet the highest standards.

Proper microphone placement is also important for proper sound capture. The use of a pop screen and a distance of several centimeters prevents the capture of distracting plosives and ideally captures the choir member's voice.

Audio output: headphones

Quality headphones are essential to hear the sound of the ensemble and the conductor's instructions without interference.

While over-ear headphones block out outside noise and allow the user to focus on the sound of the ensemble, open-back headphones provide a more natural sound with less isolation from outside and background noise.

It is important that the headphones are comfortable to wear for long periods of time so that there is no feeling of pressure.

Audio interfaces

Audio interfaces are used to convert the analog signal from the XLR microphone into a digital audio signal. They typically provide decent preamplification, which improves overall fidelity and allows detailed control of audio settings, including gain and monitoring level.

Internet connection

A stable broadband Internet connection is essential for a low-latency, low-interference choir rehearsal. It is generally advisable to use LAN cable for data transmission and to avoid WLAN in order not to disturb the consistency of the data transmission.

The higher the speed of the local Internet, the more reliable the low-latency transmission of images and sound via the software used. A minimum upload speed of 5 Mbps is recommended for distributed music performances.

Computer requirements

A computer with sufficient CPU power and RAM is essential to use the software solutions and to act as the main hub for the technical equipment used. While modern computers, tablets, and smartphones easily support traditional videoconferencing systems, they require audio processing and technical connections with at least a dual-core processor, 8 GB of RAM, and an up-to-date operating system.

Sufficient input sockets for the technical equipment should be available here.

As mentioned earlier, videoconferencing systems (such as Zoom) can also be used to carry out online choir rehearsals. Videoconferencing systems can be used for simple choir rehearsals, but with significant limitations. Of course, voice-based sound transmission is possible, but low-latency communication and synchronized singing cannot be achieved, nor can the voice quality compete with professional software.

However, it is possible to make arrangements and discuss sheet music, or record vocals or piano so that participants can sing along in silence. Video conferencing systems have recognized these weaknesses and are working on a latency reduction option, some of which are available in beta. So far, however, this functionality is not comparable to the combined solution of low-latency software and videoconferencing systems.

Individual voices can sing the pieces with high-quality microphones, but a choir-synchronized sound of adequate quality is not possible. Good over-ear headphones enhance the focus on the choir leader's music and reduce distractions. They should also be comfortable to wear.

A stable Internet connection is a basic requirement for any kind of real-time data transfer. Again, it is advisable to avoid WLAN transmission and connect the computer to the router with a LAN cable.

3 Combination of software and hardware for online group singing depending on the needs of different choirs (R3.1.3)

In the rapidly developing digital age, live choir sessions are now possible over the Internet. The combination of technical possibilities and software solutions can meet the needs of different choir formats. The requirements, financial resources and choir size can differ considerably and have a significant influence on the structure of the setting.

1. Small choirs and amateur choirs

For smaller choirs with very limited financial resources, free software solutions are available that require hardly any technical equipment.

- **Software**: Zoom (or other videoconferencing systems) is an excellent choice for videoconferencing because it is easy to use and has basic music sharing features. For audio quality, Soundtrap or BandLab can also be used to create recording tracks.
- **Hardware**: USB microphones and high-quality over-ear headphones ensure clear audio recording and playback. A modern laptop with a built-in webcam is sufficient for most rehearsals.

2. Semi-professional choirs

Choirs with advanced music requirements should rely on the combination of low-latency software and videoconferencing systems.

- **Software**: In addition to a videoconferencing system for visual communication, Soundjack (or other low-latency software) can be used for real-time, low-latency audio. This combination allows for synchronized rehearsals with high quality audio.
- **Hardware**: XLR microphones paired with an audio interface for improved audio fidelity. External HD webcams provide clear visual communication. A robust Ethernet connection reduces latency issues.

3. Professional choirs

For professional choirs that have to meet the highest standards, professional equipment that takes full advantage of low-latency software - such as Soundjack - is essential.

The settings can optionally be balanced according to the individual voices of the singers and can be adjusted separately. In addition, the use of high-quality condenser microphones ensures the best sound quality.

- **Software**: For professional choirs interested in real-time synchronization, Soundjack is the ideal solution. This software has been specifically designed to achieve ultra-low latency, making it perfect for demanding real-time musical rehearsals.

- **Hardware**: High-quality condenser microphones and specialized audio interfaces provide the best sound quality. Professional studio headphones and monitors are essential for audio monitoring. A powerful workstation or desktop computer with sufficient RAM and storage space will support processing large amounts of data.