Web Development: A Method For Remote Collaboration of Bands and Choirs

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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ABSTRACT

Following the development of the coronavirus pandemic, several bands, choirs, and other music groups at UVA were forced to attempt to collaborate remotely for an extended period, which presented many challenges. COMPOSER was a website that a fellow project group member and I created in response to these challenges. Our goal was to assist musical groups by providing them a way to remotely record, organize, and edit musical projects through the use of an online website. We designed the website using a combination of JavaScript, PHP, HTML/CSS, and Python. Ultimately, we were able to produce a website that allowed users to remotely create projects, record music, combine tracks, and lightly edit the composition in order to combat common remote recording problems. At least one music group at UVA has expressed interest in our project, though it is still in need of some polish. Future work needed on the project includes expanding its editing and organizational tools.

1 INTRODUCTION

This project came about as a result of the coronavirus pandemic. Due to the spread of the virus and the subsequent global quarantine starting in March 2020, many institutions were forced to handle their operations in an entirely new way. With the option of meeting others face to face removed, institutions like schools, bands, and choirs all had to shift their activities to take place via the internet. This transition affected different groups and organizations to different degrees. Certain musical groups especially struggled in this transition. While choirs, bands, and other music groups might normally record and practice songs and other music together in person, the coronavirus pandemic made this impossible, making it difficult to collaborate on projects.

My roommate was himself in the University Singers at UVA during the height of the pandemic, and found the process of recording music with others remotely exceedingly difficult. Tools like video conferencing apps or other live solutions proved useless for the task, as the delay they introduced between systems made it impossible for singers to sing in time, and the audio compression involved in these applications also worsened the quality of recordings. Following these challenges, the University Singers switched to having each participant record their audio separately and send it to the directors, who would then stitch the audio together in an audio software tool. Unfortunately, this solution had its own problems. Participants struggled to remain on-beat and in tune with one another without the other singers to use as reference, and the logistical task of organizing and combining many disparate audio files became a nightmare for the composers involved. A Computer Science major in the college of Arts and Sciences, my roommate had the idea of creating a desktop app that would take recordings of students, send them to a server, and then have that server stitch the audio together automatically. After implementing the idea, however, that solution also ran into problems, as students struggled with compatibility issues on their machines, maintained some timing issues, and were reluctant to download the application in the first place. Ultimately, the software was tested but not found viable for the University Singers due to these issues, though it certainly made a good attempt at a seriously in-demand solution.

The next year, my roommate and I found ourselves to be in a group project together in CS 4640: Programming Languages for Web Development. For our project, I pitched the idea of designing a website that would replace his desktop app. I argued that a website application would be uniquely situated to solve the issues that bands had with organizing, timing, and combining music tracks, while avoiding issues with the previous software, like compatibility problems or download issues.

2 RELATED WORKS

This project was not the first piece of software designed to aid in the remote collaboration of music groups. Koszolko (2017) documented his experiences using remote music collaboration software, and mentioned that using such tools led to "changes in production workflow, facilitated learning, generated new creative learning relationships, and, ultimately, helped to achieve the desired outcomes" [1] Our goal with the project was to similarly change production workflows of remote musical groups to aid them in learning, improving, and creating. Additionally, Barbosa (2003) described how the introduction of such tools "has led to new methods of musical composition and improvisation" [2] While our original intention was to simply allow musical groups to function remotely, we did make a process that would somewhat

change how these groups would create their music, as we also found that built-in online tools did provide helpful functionality.

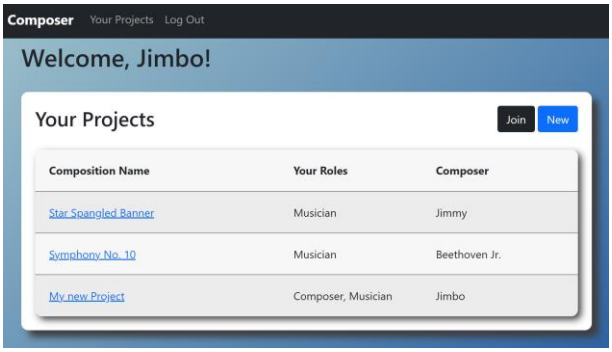

Figure 1: The "Your Projects" Page

3 PROJECT DESIGN

Our overarching goal for this project was to create a website that would make remote collaboration easy for bands and other music groups. We kept a number of design goals in mind throughout the project in order to ensure that this core idea was kept. Our first design goal was to make the website as easy as possible to use, as our entire goal with the project was to make the process of recording, sharing, and combining pieces of music as easy as possible. We did not want anyone to get stuck learning our software for any length of time, and instead aimed for it to be a quick and simple method of collaboration. Our second design goal was to ensure that our software would attempt to alleviate any possible difficulties that the musicians would have staying in time with one another. Finally, we wanted to offer some light editing tools for composers while they combined music, because we knew that such tools could do a lot to help composers manually offset any problems that might arise when trying to combine many recordings.

We made the website using a combination of JavaScript, PHP, HTML/CSS, and Python. It ran on a UVA CS department server (as that was a requirement for the project), though we developed it on our own machines. Ultimately the website had a number of pages, and served as a very adequate way to record and compose musical projects over the internet.

When users first visit the website, they are greeted by a sign-in page, in which they are encouraged to log in with their email and password, or to make an account if they do not have one already. After signing in, they are redirected to their Projects page, which is depicted in Figure 1. This page lists every project that the user has joined or made themselves. The user can make or join new projects by clicking on buttons for those functions on this page.

If they click the Join button, they will be redirected to the join page, depicted in Figure 2. This page lists all of the projects made by other users of the website. They can join these projects by clicking on them here, which will add the project to their projects page and allow them to record tracks for that project.

If they click the "new" button on the projects page, they will be taken to the new project page, which is depicted in Figure 3. This

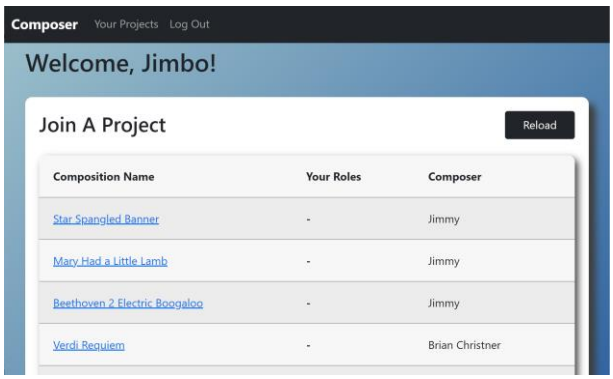

Figure 2: The Join Page

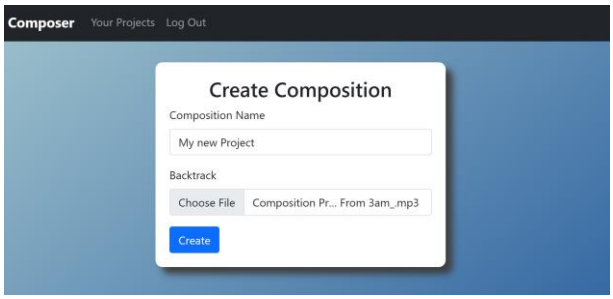

Figure 3: The New Project Page

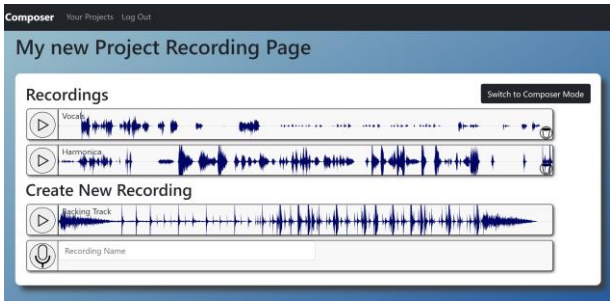

Figure 4: The Recording Page

is the page where composers can make new music projects for their band members to join and contribute to. To make a project, the composer must enter the name of the project and a backing track. Backing tracks are our solution for the timing issue that is common for musicians trying to record remotely. Essentially, the composer can enter some sort of backing music- it might be a metronome, or a part of the piece that can help guide their musicians- and then all of the musicians will hear this piece while they are recording. This way, all musicians can stay in time with each other by staying in time with the backing track.

On the topic of recording, our website lets both composers and musicians that have joined a project record audio for that project. If the user clicks on a project in their Projects page, they will be taken to the recording page for that project, as depicted in Figure 4. Here they can press the record button in order to record themselves playing music for the project. While they record, the backing track that the composer selected will play to help them with timing. The website uses whatever microphone the musician has on their computer to record at the press of a button, making this a very easy process. Musicians can record as many tracks as they would like for the project as well.

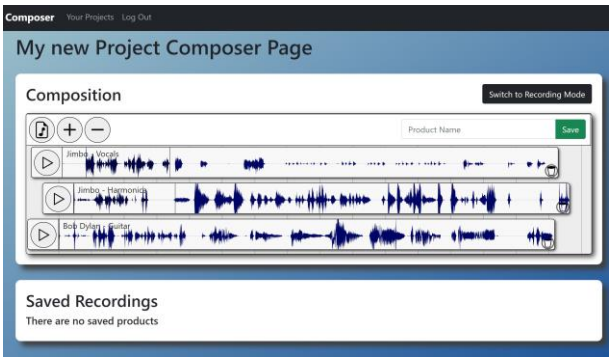

Figure 5: The Composer Page

After recordings have been made, the composer of a project can then edit and stitch together the project by visiting the composer page for a project, which is reached by clicking a button in the recording page. The composer page is shown in Figure 5. Here, the composer can see the recordings of every person that has recorded music for the projects, as well as play them individually or delete them. The composer can drag these waveforms left or right to edit when that recording will play relative to the others once combined. The composer can also zoom in or out with the plus and minus buttons. Finally, the composer can press the preview button (with the music note on a file icon) in order to combine the recordings into one file, with their edits applied. If they like the sound, they can name and save that recording to the right of the editing buttons. Finally, once a recording is saved it will show up at the bottom of the composer page, where it can be listened to or downloaded as an mp4 file. We implemented this small editing step in order to further fix issues of timing and desynchronization common to remote recording. Ideally, this page gives composers an extra bit of control over how their recordings combine without being too overwhelming to new users.

4 RESULTS

Ultimately, we were able to make a website that was very easy to use, and served as an effective method of remote collaboration, though it still has some flaws. The project was overall a success. The project won the award of "most usable" among the projects submitted in CS 4640, reinforcing the idea that one of main design goals- making product that would be easy for musical groups to use- was met. The addition of a backing track and some light editing tools also made it easier to stay in time when we tested the project, though no thorough examination has taken place. Perhaps most importantly, after being told of the new project by my roommate, the director of the University Singers expressed interest in using it for a future project.

5 CONCLUSION

The coronavirus pandemic showed in stark relief the importance of online tools for communication and collaboration. Even as in-person events have returned following the pandemic, it is important to have these resources available, and to learn from the tools and problems we had during the pandemic. COMPOSER, and tools like it, have the potential to connect people and provide new avenues for art and music. Even without a global pandemic forcing music groups apart, simply having the option to collaborate remotely could revolutionize the way music is recorded, produced, and shared. When unfortunate events of any kind force people apart, tools like COMPOSER could be vital to help people stay connected and creative. This project represents an excellent first step towards that goal, and tools like it could continue to help people for years to come.

6 FUTURE WORK

In the future, COMPOSER could be expanded to do its job even better. To begin, the project's editing tools could be expanded to allow composers more control over the final recording's sound. While we did implement the ability for composers to change the timing of tracks, other tools that would be very useful for composers might include the ability to cut or splice tracks, to speed up or slow down tracks, or to repeat tracks. We did want to make the editor lightweight and easy to learn, so we never planned on implementing a very large number of features for composers, but a greater number of optional editing tools would likely be very helpful for combining music, and so would be welcome in future work done on the project. Another area that would likely help future iterations of this project would be the addition of private musical compositions- as of right now, all compositions can be joined by any user of the website, which might not be ideal for some groups that would rather not have unknown people trying to record for their compositions. In order to facilitate these private compositions, an invitation or friend system would likely work well. Ultimately, while the project is certainly usable in its current state, future work done on the project could do a lot to enhance its set of features.

7 ACKNOWLEDGMENTS

I would like to express my gratitude to Brian Christner, my roommate and project group member that features heavily in this paper. His work was vital in the project's success and it could not have been done without him.

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