1 Abstract

In this paper I present a system for encoding music centered on the specific and individual needs of vocalists. The system hopes to present a system that is simple for new vocalists to pick up on, as well as one that is useful and adaptable for experienced vocalists. It is focused on the idea of encoding spatial relationships between notes, rather than absolute note value. This focus is built off of the specific needs of vocalists that I discovered by interviewing several vocalists. The system proposed here, when tested on vocalists untrained in reading music, led to them making approximately a third as many mistakes as were made when reading traditional music. These results are encouraging, and there are many future ways this research could be taken.

2 Literature Review

Since the beginning of western written musical notation, there has been extensive research and exploration done about appropriate and useful ways of encoding music. Traditional music notation itself, as we know it, is the product of iteration, addition and improvement over many, many centuries. For example, the four-line staff is said to have been created about 1000 A.D., but ways of encoding tempo were likely not added until about 1300 A.D.. In addition to the natural development of traditionally written music, there have also been a myriad of experimental systems of encoding music outside the realm of traditional notation. Some have

I discuss a few of these alternative systems here, focusing on those intended specifically for vocalists. It is important to note that these systems do not necessarily start from scratch in how they represent music, but rather build off traditional musical notation in various ways.

2.1 Shape Notes

One system, developed in 1801, focuses on the use of shapes to encode pitch within a given key–each note in the scale is given a certain shape to (at least theoretically) help the singer more easily identify what notes to sing.

This is a creative system, but in the end it does not stray far from the traditional model of musical notation, and may indeed be even more overcomplicated than the traditional model due to the excessive plethora of ways the music is being encoded. In other words, traditional notation is already cluttered with encodings, and the shapes may only serve to clutter it more.

![Figure 1: Scales composed using shape notes](image-url)
2.2 Chromatic Scale

The chromatic staff is a system that plays with the spacing of notes on a staff. In traditional musical notation, only seven notes have their own line or space, with sharps or flats (which can be thought of as the "black keys" in an extreme simplification for those unaccustomed to reading music) being encoded with specific symbols. In comparison, the chromatic staff has a line or space for every key. Below is a scale on the traditional (aka diatonic) staff and the same scale on a chromatic staff.

Figure 2: Scales on the diatonic and chromatic staffs, respectively

The chromatic staff is an intuitive and useful tool, and it is easy to see why it would make a good system for writing music. My musical notation system borrows from the chromatic staff in ways I will enumerate on later in this paper.

3 Methodology

I began my needfinding process by taking a limited survey of four vocalists who regularly read and perform music. These vocalists were recruited from a high school choir that performs on a regular basis. I classified them as "experienced" vocalists who were capable of providing more insight on what precisely is important in reading music than more amateur vocalists. As my aim during this step was to gain a few "expert opinions," their level of experience was appropriate for my purposes.

Following an open-ended needfinding pattern, I composed questions to these vocalists in order to define what, exactly, they find most important in reading music effectively in a vocal context. I allowed them to shape and guide the conversation in such a way that I was not prompting answers, but rather passively receiving them as they chose to provide them. There were a few interesting findings, which I enumerate in the following sections.

3.1 Important Elements In Reading Vocal Music

Of the elements involved in reading music, two of the four indicated rhythm (or tempo) as one of the most important elements of reading music, and one of the four identified key signature as a highly important element (notably, this participant ranked key signature as more important than note value.) Three of the four participants indicated note value, in some form, as the most important element of reading music.

Lastly, and perhaps most notably, two of the three participants indicated that they pay far more attention to the spatial distance between the notes, rather than the absolute values of the notes, and that spatial distance is the most important element of reading music in a vocal context, in their opinion. This makes sense, as perfect pitch is rare among vocalists.

3.2 Core Idea Of The System

Though many elements of written music are antiquated, I kept a few of them in this system prototype. Notably, I kept the convention of using lines to help denote pitch (though I worked with a chromatic scale as opposed to a traditional one) and the idea of reading music from left to right, as that is a broader convention within the written English language as a whole and is not specific to music.

From these initial conclusions, I decided that the most valuable path to embark on within this project was one that emphasized relative distances between notes, both in solo and group singing situations. The basis of my music visualization is built around the idea of the "start note," i.e. the note that the singer begins on (and is assumed to know or have been given...
beforehand.) This is indicated by a thicker, darker line, as opposed to other notes, which are indicated by less distinctive lines. Thus, all notes are defined in relationship to the first note, rather than on any kind of absolute scale.

3.3 Other Encoded Elements

3.3.1 Tempo

Another piece that must be encoded is tempo. For this, I considered dashing the “start note” line, and having each dash represent a beat, but realized that for notes further away from the “start note” line it would be hard to connect the dashing of the line to the position of the note. Since tempo was indicated as a highly important element, I decided that a more obvious way of marking tempo was important. Thus, I decided to stick with another convention of traditional music notation, and create vertical bars to denote tempo. The concept of “measures” was one that I considered doing away with, but I eventually decided that the way music is generally structured makes including some notion of “measures” necessary. Thus, measures were encoded by being divided by dark, thick lines, and other beats in the tempo are encoded using thinner, lighter lines.

3.3.2 Note Duration

The next piece of this system that is important to encode is note duration. Traditional musical notation uses a variety of symbols to encode this, but I decided on a more intuitive system of using bars of various lengths to denote note length.

3.3.3 Volume

Volume must also be encoded. I considered encoding volume by making louder notes larger than softer ones, but when I tried to implement that system, it looked too cluttered and irregular. I decided to change my strategy, and instead to encode volume through darkness/lightness. I made louder notes darker, and quieter ones lighter. Since volume is somewhat subjective, rather than distinct, this is an appropriate scale.

4 Results

4.1 Testing Materials

To test the value of this system, I used it to notate a ten-note-long piece of original music, and then notated a similar, but not identical piece of music using traditional notation. Figure 1 and Figure 2 show these short pieces of music.

Figure 3: Music composed using traditional notation

Figure 4: Music composed using original notation

4.2 Evaluation

I evaluated my system using three different test subjects, each of which was unfamiliar with reading music in any form but had some minor experience with vocal performance. As opposed to my initial interviews, these were far more structured.

To evaluate, I asked them to read both pieces of music I composed (one using each system) giving them the first note in each case. I also explained the basics of each system to the users so they had some baseline knowledge of what they were attempting to read. I evaluated accuracy in understanding by counting the number of notes sung wrong (out of ten total notes) in each case. If a test subject “jumped up” or “jumped down” too many notes but continued correctly other than the fact that the piece of music became as a whole too high or too low, I counted that as only one error, instead of many.
4.3 Numerical Results

I found that using my original system, the participants made on average 1.67 errors, and using traditional notation, the participants made on average 3.34 errors. Again, these numbers are out of ten, so participants had a 16.7% error rate using my original system of musical notation and a 33.4% error rate using the traditional system of musical notation.

5 Discussion

5.1 Encouraging Elements

The results of my evaluation were encouraging insofar as they showed that my system certainly had an impact on the ease of entry for new readers learning to read music; the simplicity and intuitiveness of my system seemed to help them read with greater accuracy right off the bat. This was clear in the disparity of accuracy between new music-readers reading traditional notation versus my original notation.

5.2 Further Testing

However, my metric for testing the usefulness of this system was perhaps somewhat simplistic insofar as it targeted one subsection of the singing community (novice singers) and one specific element of reading music (accuracy.) It is possible, and indeed probable, that more advanced singers have different needs as opposed to novice ones, and thus to truly evaluate the system I would likely need to extend my test subjects to

6 Future Work

6.1 Further Iteration

As with all design-oriented projects, it would be highly beneficial to go through many more rounds of revision, testing, and iteration in order to find the most ideal system of musical representation. This solution is a valuable start, but could certainly be improved upon. In addition, musical notation as it exists today incorporates a massive variety of complex rules and symbols to specifically portray all the different forms music can take. (For example, staccato, legato, etc.) The system I have developed is optimized for simplicity and does not contain that level of nuance, and an interesting way to take this problem in the future would be deciding how to incorporate that nuance without sacrificing too much simplicity.

6.2 Isolating Usefulness

It would also be an interesting exercise to pin down exactly what elements of this system were the most useful, perhaps by eliminating some and determining what makes the most difference when removed. For example, I might remove bar lengths in favor of traditional note-length notation, but keep everything else, in order to determine if the bars are critical to understanding how this music is read.

6.3 Conclusion

This project has a promising start, but there is certainly more than can be done here. Written music is a highly complex and extremely commonly used system of data encoding, and as such, much attention should be paid to it in order to find the most perfect system possible. This rich beginning opens up a myriad of new possibilities for design, implementation, evaluation, and improvement.