Music Curation and Analytics Project Report

Within the field of music curation and analytics the data can be defined by three categories, descriptive data, notated music and acoustic data. Notated music can be described as printed and computerised scores, manuscripts and encoded notation. Descriptive data includes text based file formats which tend to use schemas and controlled vocabularies. Acoustic data comprises of live, recorded and wave visualisations of music. All types of data were included in the project which primarily focused on the music of Bastille. The three types of data used different standard methodology for curation and analysis but there were some similarities. This report will examine the methods used and to what extent they were successful as well as highlighting the failures and bias they introduce. Additionally it will look at potential ways to improve the failures found.

Firstly, as part of the project, a computerised score which can be described as notated data was created using a programme called Musescore. Musescore is a programme which allows the user to transcribe or compose music to create a computerised score. To create the pieces of music the user firstly had to choose to create a new score which then took the user to new score wizard. This allowed the user to input information describing the title, subtitle, composer, lyricist and copyright. Then the user was taken to a page which allowed the user to either choose to create a new type of score in which the instruments, pitch etc could be chosen by the user or Musescore gave the option of scores which were specifically for genres or instruments for example in Jazz there was the option for Big Band. After specifying the instruments the key signature and tempo could be chosen then the time signature ad number of bars. Once the sheet music had been created then the notes could be inputted into the sheet. This could be done by pressing n on the computers keyboard and placing the type of note onto the line corresponding to the note. Additionally it could also be done by going to notes on the toolbar and adding them by letter. Musescore gave the user an insight into the correlation of notes to what they actually sounded like when played. This gave the user insights into what popular pieces by Bastille sounded like with different instruments and stripped back to just a piano piece. Musescore was throughout the project one of the simplest programmes to use even for users who couldn’t read music. Although the programme has many specialised features it was presented in a way which made choices clear and inputting notes was easy. Maxwell Shinn wrote “Musescore supports many features that are only found in some of the most expensive music composition packages”[[1]](#footnote-1) That was also a benefit of Musescore it is free to use and accessible for everyone. Additionally Musescore is Libre software which means that developments can be contributed from anyone therefore if the user doesn’t have a feature that they needed they could help get it developed.[[2]](#footnote-2) Although this could be detrimental and limit the software as the development would need to be one of value and this provides the risk of adding or developing detrimental changes. Also a limitation of the software was that to begin with at least inputting notes was a slow and laborious as unless you searched for keyboard shortcuts you had to input the notes one by one. Furthermore the copy and paste feature only allowed for the full bar to be copied and not a selection of notes within the bar. This could be developed to allow the copying of more than just the whole bar.

Another form of notated music that was created during the project was MEI files. MEI stands for the Music Encoding Initiative which aims to provide a system or standard for encoding musical documents in a structure which is machine readable. The structure contains “a core set of rules for recording physical and intellectual characteristics of music notation documents expressed as an eXtensible Markup Language (XML) schema.”[[3]](#footnote-3) To create the MEI files a programme called Verovio was used to convert the MusicXML files created in Musescore into MEI files. Although this should have been relatively simple to do as there was a clear well structure convertor on Verovio the programme had its limitations. On multiple occasions after selecting the MusicXML file and pressing the convert button the programme failed to convert the files to MEI. This limitation was likely a fault of Verovio and did seem to be corrected after some time. After successfully completing the conversion the MEI file could then be examined in Oxygen an XML editor. Oxygen allowed the user to simply open the new MEI file and edit parts of the code. Within the code in the <note> elements the code oct, pname, stem.dir, accid.ges was displayed. Oct stands for octave, pname is pitchname, stem.dir is stem direction and accid.ges records the performed pitch inflection. The four elements are either described as a number or up/down or letter. These elements were changed using oxygen and then saved as an alternative version. This version would sound different to the original as the changes for example of oct equalling 4 changing to 7 will alter the octave by 3. This allowed the MEI file to be edited easily and allows the user to transform the piece without having to change the original which is beneficial. The changes made to the piece Pompeii in the project were done in order to completely change the sound of the piece as the numbers were doubled and the directions were changed to be the opposite. However, there were limitations to using oxygen to edit the MEI files. Firstly the programme is not free and in order to use it for more than 30days you have to pay. To address this limitation the user would just have to simply use another XML editing software. Secondly, after editing the code it was very important to add comments in order to keep track of which notes were edited and without the comments it would be very easy to forget what changes have been made. Lastly, the code itself was difficult to understand for non-music readers. For example when changing the octave only after some research was the user able to determine what changes it would make to the sound of the piece of music. Although as the code was standardised by letters, numbers and up/down it was simple enough to change as the range of choice was quite clear and structured.

MEI is a file type that not only provided the user to change musical elements it also provided the user the ability to create metadata describing the piece including source information, encoding information and revision information. Sergey Bludov highlighted the importance of metadata by declaring that “Without metadata, the music industry would come to a standstill. This vital information is required in order to manage music files, allowing data to be properly created, stored, sorted and used in a wide range of applications. Truly, metadata is a centerpiece of the industry, uniting music creation, copyright, royalties, music discovery and technology.”[[4]](#footnote-4) After opening the MEI file in Oxygen the <meiHead> is what describes where the metadata would be written under various sub headings. These sub headings included file description which included the sub elements Title and responsibility, Edition data, physical information, publication and distribution, publication series information and miscellaneous information. In the original Pompeii piece the file <titleStmt> was used to describe the metadata relating to the title, composer, author, arranger, date, editor, composer, funder and lyricist. This was important metadata to include as it gives the user the basic information needed to describe the song as well as providing a more in depth description of who is responsible for creating the song. In the edition data the edition, date, and if and who revised the piece was represented. These were important to include as it provides information about who has edited the piece and when it was created. The publication metadata was important to include also as it provides the information about who publishes it where they are located. In the Pompeii metadata the corporation name and address was included. The availability was also included which details who can use the file, which is important mainly as it provides potential users with the knowledge that they can either use the file or not. The series information was also included as it links the track with others within the project as it provides metadata about the series title, editor, an identifier and what it contains. The miscellaneous information was also important to include as it provides a place for metadata that is distinct for example in the Pompeii piece the notes provided a place to state that some of the tracks in the series contain features artists not just Bastille. In addition to the original Pompeii piece metadata was important to distinguish the edited version as previously described. The Substantive metadata, defined as “data that reflects the substantive changes”[[5]](#footnote-5) provides the user with the availability to clearly distinguish between both files due to the title and the edition. Overall through the metadata a lot can be learnt about the music. A limitation to providing metadata in this way is that often it could be unstructured as for some pieces it may be important to have some information. However with other tracks there could be less or more information available as it is really dependant on the user to decide. Additionally another limitation could be that it is unclear if you have created a piece of music based on a song by another artist, who is the artist? Was it the user who created the score or the original artist? This confusion could also provide an unstructured metadata and bias as some could give credit to the original artist but others may credit themselves. This limitation however could be solved by having a clear concise set of metadata standards in the music industry which would include a clear definitive way of differentiating who the author would be.

A form of Acoustic data that was created during the project was wave visualizations. The wave visualizations were created through using sonic visualiser. The wave visualizations show the hertz and decibels correlation to time. They were useful as it gave the user a basic visualisation which was easier to understand than some of the other visualisations. As it was simple the user then had a stronger idea of what some of the other visualisations would look like. Although wave visualisations were created, Sonic Visualiser was used to create more complex visualizations of sound. Sonic Visualiser allowed the user to create spectrograms, Mel Frequency Cepstral Coefficients and chromagrams of digital audio. In order to create these the song files were opened in sonic visualiser and on the toolbar the user chose the option to add a new pane. The user then right clicked and transformed the pane to whichever visualisation was needed. A spectrogram visually represents the spectrum of frequencies in a sound as they vary with time. The spectrogram displays this information using colour with axis the y-axis represents the hertz with the louder the decibels the stronger the colour. For example the orange represents the louder decibels compared to the green in most of the spectrograms in the project. In order to provide a more standardised spectrogram the bin option was changed to log. This creates a logarithmic spectrogram which displays music better as the distance between units gets smaller further along the axis which corresponds better to sound as the human ear responds to both decibels and frequency logarithmically rather than linearly. A Mel Frequency Cepstral Coefficients transform the spectrogram and extract frame by frame. They are important as the provide insight into “tibre” or “tone quality”. Chromagrams were also created which is similar to a spectrogram but maps the notes on the y-axis. Three visualisations were created as they provide the user with insight into the songs themselves but they are also useful to compare different songs. This is because after creating the different visualisations you can compare the different songs if you use the same standards. For example when comparing the chromograms of the inventors track compared to the Ultra-Cat track there are clear differences as Ultra-Cat has quite a repeated use of notes whereas the inventors have a more varied and randomly spaced use of notes. This is beneficial as it allows people to make comparisons and gain insights for example the difference may be because of the differing genres. A limitation of the visualisations using Sonic Visualiser is that for users with little music knowledge is that the numbers on the y-axis can be quite difficult to comprehend. Additionally in order to create more complex visualisations such as the Chromogram additional transforms have to be downloaded. It may be beneficial to combine the extra features as part of the programme as the visualisations without are relatively simple and it would be good to provide more complex ones.

Another visualisation which was created as part of the project were histograms. Histograms were created using python and Jupyter notebook, after having exported the annotation layers on sonic visualiser as csv files. The csv files contains the raw data and when examined it is very difficult to extract meaning. A histogram visualises the data in a useful way representing the pitch. According to George Tzanetakis, Andrey Ermolinskyi and Perry Cook “Pitch Histograms provide valuable information for musical genre classification”. Although the final histogram can be very useful the process of creating one has many limitations. Both programs are very difficult to use as they are very case sensitive. When a mistake has been made in the code it is difficult to identify which part. Also when creating the histograms the parameters also have to be very accurate otherwise a graph will not be created and it can be difficult to know what parameters to put especially as you have multiple numbers to consider. Although difficult to use one of the most beneficial parts which provides a lot of insight into the music is that it allows you to create multiple graphs for comparison. Additionally, you can compare different songs in one graph to find similarities for example by genre.

Overall, in the project many standards and methodologies for curation and analysis were used such as musescore, Verovio, Oxygen XML editor, Python, Jupyter and Sonic Visualiser. Through using these methods many insights could be gained about the music. Many come from comparisons and transformations into different types of files. For example metadata was created providing insight into the files like the editions and titles. Additionally visualisations provided insight as they helped find patterns and show the notes through looking at time compared to hertz and decibels. Although many insights have been gained, there has been some limitations to the curatorial and analytical methodologies such as the difficulties creating a histogram and standardisation of metadata. Some of the limitations have some simple solutions such as creating a standardised list of metadata titles.

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