Synesthesia for All – Crafting a Colour Model of Schubert's "Erlkönig"

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Abstract

This paper describes the crafting of a colour model of Schubert's "Erlkönig" composition using an Empirical Modelling approach. First of all, different methods for associating music and colours are discussed followed by an explanation of the model itself. The main interests of this study are to examine the relationship between visual cues and musical experience, and also the extent to which Empirical Modelling provides a means for non-theory based analysis of musical compositions. I am also interested in the creative process of Empirical Modelling and its usefulness in regards to human computing, as discussed in [6].

1 Introduction

Synesthesia, the neurological condition to which the title of this paper refers, is the phenomenon in which human senses become coupled such that, for example, a synesthete might observe a written letter 'C' and experience the colour blue. The brand of Synesthesia that is relevant to this study, however, is that of colour-music Synesthesia. This may involve a visualisation of music by an automatic association of specific colour to different chords or key signatures. For example, the Russian composer Nikolai Andreyevich Rimsky-Korsakov 'saw' key signatures by colour association, with C Major being white and D Major being yellow. While it is certain that this condition is not commonplace, it seems to be widely accepted by music lovers that our experience of a musical performance is generally affected by the atmosphere in which that experience takes place. A sad song, consisting of minor keys and sombre lyrics, might have a more emotional effect on the listener during a cold grey day, while a fast tempo song in mostly major keys might be enhanced by a beautiful green summer's day. One of the interests of this study, therefore, is to examine the effect of visual cues on musical experience and how these may vary from person to person.

The piece of music upon which this analysis will be based is Franz Schubert's "Erlkönig". This composition is based on a poem which tells the story of a father carrying his son on horseback to the doctor. However, by the time he arrives his son has died in his arms. This piece of music has been modelled with these methods before, in relation to harmony and chord structures, by Meurig Beynon as described in [5] and [6].

The idea is to create a model of this song through a series of blended colours, with each colour representing the state of the song at a specific moment. In order to do this, thought must be given to possible methods for mapping a piece of music to a colour scheme.

2 Colour-Music Representation

Several different methods for representing music with colour have been suggested by third parties and will be discussed here.

2.1 Using Wave Properties

Caivano, 1994, as referenced in [2], suggests associating sound wave properties with those of light. Using this approach, pitch is mapped to the hue of a colour since both of these properties rely on wavelength.

Similarly, volume is mapped to brightness in association with amplitude. The saturation of the colour, which refers to its purity (with greys having low levels of saturation), is further associated with purity of tone and levels of noise. While this theory-based approach provides a useful method for directly mapping individual notes to specific levels of hue, saturation and brightness, it is perhaps not appropriate for this study for the following reasons:

1. The complex chord structures and harmonies in "Erlkönig" present problems when using a one-to-one note-to-colour mapping.
2. Caivano's method ignores the connections between certain colours and emotions and also between key signatures and emotions.

2.2 Assigning Colours to Key Signatures

It is widely agreed that different key signatures provoke different emotional reactions. At the highest level, minor keys provoke more negative reactions while major keys are more positive. As mentioned in [1], dark and light colours are generally associated with negative and positive emotions respectively. Through this, a transitive relationship can be developed where major keys are mapped to light colours while minor keys are mapped to darker ones. This can be made more detailed by examining the common emotions reflected by specific key signatures and colours. Since we wish to model the emotional effect of a song through colour, this approach is highly relevant and an attempt will be made to implement it.

In [4], Lavignac describes what he believes to be a paradigm for the association of keys to emotions. By examining this alongside the music-colour relationships proposed by [1], and the colour-emotion relationships proposed by [3] and various internet sources, we can develop a reasonable starting point for key-colour mappings. Table 1.1 illustrates the scheme to be used for the key signatures present in "Erlkönig".

Key Signature	**Colour**
F Major	Purple
B Major	Yellow
E Major	Orange
A Major	Cyan
D Major	Green
G Major	Green
C Major	White
F# Major	Blue
E Minor	Violet
A Minor	Grey
A Flat Minor	Grey
C# Minor	Dark Red
F# Minor	Dark Blue
B Minor	Red
B Flat Minor	Black/Blue
C Minor	Black

Table 1: Key Signature – Colour relationships

2.3 Colouring the Story

The "Erlkönig" composition is delicately crafted around the poem on which it is based. The mood of the song is reflected by key signatures, methods of accentuation and other performance-related factors. When the Erlking is speaking, the music changes to a major key with staccato expression in order to give the impression of deception while the figure of death tries to beckon the child into his grasp. In strong contrast, the music transfers to minor keys and comes louder and harsher when the son cries to his father in fear and pain.

The proposition here, therefore, is to use colours based on the state of the story at any given point. For example, the poem's opening line contains visual keywords "night" and "wind", which can be translated to black or grey colours associated with night and bad weather respectively. For this method, each line of the lyrics will be translated into a colour based on associations with keywords.

Using this method, each stanza of the poem develops its own colour scheme as listed in Table 2.

Stanza	Colour Scheme
First – Narrator sets the scene	Energetic and warm colours – Green, yellow, orange
Second – Anxiety from the Son with reassurance from the Father	Dark and foreboding colours – Purple, black, gold, grey
Third – Deception from the Erlking.	Bright colours reflect deception – yellow, green, pink, gold
Fourth – More anxiety from the Son.	Blue, black and green.
Fifth – Further deception from the Erlking, now with mention of his daughters.	Bright and upbeat colour to reflect the nature of the music – yellow, pink, red, purple
Sixth – Son is more afraid. Scene described as 'gloomy'	Sombre and depressing colours – Dark blue, greys
Seventh – The Erlking now uses force	Violent – Dark red, black
Eighth – The father arrives but his son is dead	Colour relating first to the child, then to death – yellow, black

Table 2: Colours to reflect the mood of the story

3 Crafting the Model

3.1 The Display

The display template for this model consists of 3 methods for displaying the state of the song at a given time. The first of these is a progress bar at the top of the window. This is largely used for modelling purposes, in order to infer the points at which certain lyrics or colours are displayed. The second display device is an area showing the lyrics of the song that are currently being sung. Finally, the whole screen background changes for the colour display.

3.2 Observables and Dependencies

The nature of Empirical Modelling allows for the definition of dependencies between observables similar to those of the real world where, for example, the position of a candle is dependent on the position of the table upon which it sits. Should the table move, the candle will move with it in real time. This is in contrast to a traditional programming method that requires a set of instructions to be laid out before execution, in a very distinct and formal manner. This feature of Empirical Modelling is extremely useful for this application since we can develop dependencies between the current position in the song and the current key signature, lyrics, and associated colour mapping.

Since the model involves an .mp3 performance of the composition, markers had to be placed on each beat. These markers came in the form of C notes in MIDI format which were inserted using Adobe Audition. These were sent, through a virtual MIDI device, to Bome's MIDI translator (http://www.bome.com) which in turn outputs a 'c' keystroke for every note it receives. Therefore, the TKEden modelling software receives a 'c' keystroke on every beat of the song. The progress meter at the top of the window moves for every 2 beats via dependency.

The beat, or bar numbers, then had to be associated with the various key changes and lyric positions. The analysis required to make these associations was time-consuming and involved a detailed analysis of the song's score and timing. As explained in [5], "In many respects, such model making resembles a craft activity rather than conventional programming, and demands external support by way of rudimentary musical analysis and pencil-and-paper documentation". During these phases, a great deal of this pencil-and-paper documentation took place and such methods can certainly be likened to the crafting of a piece of music itself. The same trial and error methods take place as well as the creative aspect involved in assigning colours and associating blending times.

The two methods for colour interpretation require two different modes for display. When the observable 'mode' is equal to 0, the colours change based on key signature. When the observable is set to 1, the colours change based on the lyrics.

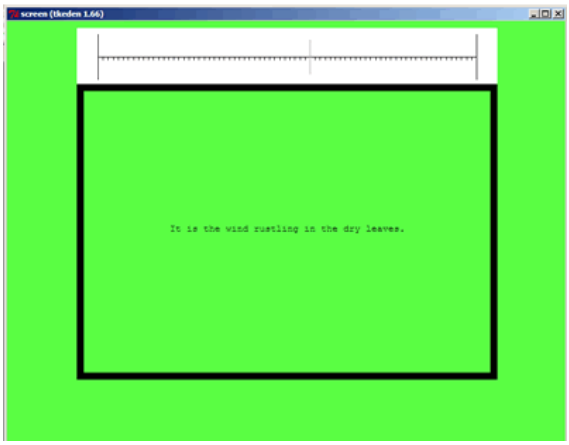

Figure 1: The model in mode 1 displaying the lyrics "It is the wind rustling in the dry leaves" and the corresponding green colour associated with the line.

The colours are stored in HSL (hue, saturation, and luminance) format as these attributes are generally agreed to be easier to translate by humans than RGB. Since TK-Eden defines colours in terms of RGB by default, a function was created for conversion.

Dependencies were created for each key signature and line of lyrics present within the song such that individual components can be altered by the observer on the fly. For example, the observable FMajor_luminance can be altered to change the brightness of the colour that is displayed during any section in F Major. An interesting application of this might be to lower the luminance of all major keys and raise that luminance of the minor keys, inverting the minor- dark, major- light relationships described earlier. Similarly, line1_hue describes the hue of the colour displayed while the first line of lyrics are being sung.

4 Analysis and Conclusions

4.1 The Creative Process

When examining the "Erlkönig" composition, it can be seen that Schubert created dependencies of his own in a very natural and 'human' way. For example, the Erlking's attempts to entice and deceive the child are enacted with major keys and staccato. Schubert thus gives a voice to the characters in the song through the style of music, as well as the words of the poem. In an Empirical Modelling context, this can be viewed as a net of dependencies relating characters with keys, tempo and certain performance factors, all of which add to the experience of the story. In simple terms, Schubert took a powerful piece of literature and added a musical context in order to enhance its emotive power. The model presented in this paper, which further adds a visual context to the work, can be viewed as a less sophisticated version of this creative activity.

4.2 Human Computing – A Collaboration?

According to [6], "The term 'humanities computing' evokes two images of relationship: one in which computing is the servant, the other in which it is a partner." The development of the model discussed in this paper was based not only on a desire to understand how experience can be altered by a visual display during a piece of music, but also to examine the reason behind this phenomenon. The provocation of emotions by different colours, chords and other stimuli is, however, very subjective. By beginning with a set of colour mappings based on third party research and tinkering with them to conform to my own feelings, I quickly realised that I was not creating a model of the musical composition performance in colours, as I initially believed, but a model of my own emotional reactions to that music. In doing this, I found that my experience of the music was not only partially enhanced by the colour visualisation of the model, but by the experience of creating the model itself.

In terms of human computing, I believe that this model serves as a good example in showing the steps that Empirical Modelling takes towards achieving a partnership

between computer and modeller. Rather than constructing a set of rules and procedures which would become inaccessible during runtime, this approach meant that I could attach my own experiences to the dependencies within the model and experiment with different effects. Indeed, the lessons that emerged from this model did not do so until the artefacts within it were 'experienced, explored and developed' ([6]).

4.3 Colour-Based Conclusions

In crafting this model to my own experience of the music, some conclusions can be drawn as to which colours can perhaps be associated with different emotions, or at least events within this particular composition. The stark contrast between the light colours and dark colours in representing major and minor keys worked well in emphasising the change in mood from the Erlking's soft persuasive techniques and the terror of the son. I certainly felt that these darker colours enhanced the feelings of fear and anxiety.

In addition to this, the colour yellow was often used when the father is trying to comfort the son. I felt this gave a good representation of the caring father with the warm yellow colour corresponding to the father keeping his son "safe and warm".

However, I feel that creating a basic colour representation of this song is inadequate in terms of enhancing the entire piece. For example, some colours will never provoke an emotional response, regardless of their emotional context and, in fact, only a select few may have any effect at all.

It must therefore be emphasised that this model is extremely limited in regards to enhancing musical experience. Whilst we may listen to a certain piece of music at twilight during winter and be affected in a totally different way than we might have been on a hot summer's day, it is our associations with environment that have this effect and colours are only a small part of this.

3 Further Work

Given the limited nature of this model, there is certainly room for development. In keeping with the themes presented at the outset, it would be ideal to generate a virtual world corresponding to the composition and the listener's past experiences in order to enhance their experience. However, there is perhaps more scope for personalised music videos or animations that show an individual perception of a song's meaning.

However, there might be an interest in reversing the procedure and attempting to create an environment in which a user can compose a piece of music using only colours. By analysing an individual's preferences for colour-music mapping in their experience with the model described in this paper, it may be possible to generate a colour scheme for developing music.

Despite its limitations, the development of this model has illustrated the power of Empirical Modelling as a tool in human computing. By using my own experiences and reactions to music, I was able to craft a colour model of my state of mind during a piece of music.

References

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