

Having studied classical music for the best part of 16 years I have come across a variety of different theories and techniques for composing music, from the decadence and ornateness of the Baroque era in the 1600's, to the pure expression of the Romantic era in the 19th century, an era, I believe, that still hasn't ended. Throughout all these periods there has been a conventional set of musical instruments, and although they have been treated differently by every individual composer, the basic construct of the musical instrument has not altered. That is until the 21st century. The two world wars lead people to look for new means of expression as they believed that 'classical' music no longer represented, or could represent, the ordinary person. In other words it was outdated. The apparent answer to this lay in found sound. This movement began in the 1940's and it began with a man called Luigi Russolo who was one of the first to present the idea of using sounds that already existed in the world to create music as opposed to a 'formation of tunes from sounds created by instruments'.¹ I will explain this movement in more detail later on in the essay and how it developed into 'musique concrète', however, in order to describe the instrument I have created, the failure of this movement must be established. Music exists to be expressive. In the music of Mozart, Beethoven and Wagner we find expressions of fear, love and sorrow,² we find awe and wonder, we find beauty and we find the sublime. In other words we find what it is that makes us human. In my view this was lost by the sea of experimentation that was the found sound movement. The turning away from music theory to the belief that all sound is music meant that basic expression was replaced by an academic pursuit. The found sound movement should have only ever been a means by which to create new ways of expression, and it is to that end that I have created my instrument, a lego, microbit controlled ferris wheel, an instrument designed to teach children, or any beginner to music, the circle of fifths; the basic building blocks of Western musical harmony.

Music is not born out of a laboratory but out of ourselves. My instrument aims to get children to understand the basics by which a melody and harmony can be built from so that they can go away and create music themselves. In my opinion the understanding of music theory is a crucial skill to have in studying and more importantly, composing music. The instrument is designed to have twelve lego spokes, each spoke representing a note of the scale, starting from the top on C and moving in 5th's all the way around until we get to the last note F - C, G, D, A, E, B, F sharp, C sharp, G sharp, E flat, B flat, F. (a flat is the enharmonic equivalent of a sharp). In the centre of this wheel will be a microbit controller which all the spokes will feed into. Connected to this will be a speaker so that when each note is triggered it has somewhere to play out from. The position of the wheel will determine which sound is played at a given moment. This is done via the accelerometer feature on the microbit. The accelerometer detects motion on three axis (XYZ for height, depth and width) so it can be used to measure the rotation of the spokes when mounted on the axis of rotation. This is why the microbit has to be placed in the centre of the wheel. The sound and indeed, overall concept of the instrument, could also be achieved by using the LED sensor, something which will be explained in the 'future developments' section of the essay. However, the reason why I have elected to use the accelerometer is that there are fewer external factors to take into consideration. In

¹ Cliff, A. (2012). The Dummy guide to found sound. *Dummy*, [online]. Available at: <https://www.dummymag.com/features/dummy-guide-found-sound/> [Accessed 5 Apr. 2020]

² Hoffmann, ETA. (1810). Recension: Sinfonie pour 2 Violons, 2 Violes, Violoncelle e Contre-Violon, 2 Flûtes, petite Flûte, 2 Hautbois, 2 Clarinettes, 2 Bassons, Contrabasson, 2 Cors, 2 Trompettes, Timbales et 3 Trompes, composée et dédiée etc. par Louis van Beethoven. à Leipsic, chez Breitkopf et Härtel, Oeuvre 67. No. 5. des Sinfonies. (Pr. 4 Rthlr. 12 Gr.). *Allgemeine musikalische Zeitung* 12(40) cols. 630–42 [Der Beschluss folgt.]; 12(41) cols. 652–59.

fact all that has to be accounted for is the surface the instrument is sitting on as one would need to recalibrate it accordingly so no false readings are caused. The microbit/accelerometer can do 360 degrees and so technically can do 360 notes provided each note is exactly one degree of rotation and that all spokes are attached to the central degree of this rotation. This would obviously make for a very complex wheel, and an even more complex line of code to program. Fortunately for the circle of fifths we only need twelve spokes meaning, therefore, that each spoke needs to be placed thirty degrees away from each other.

One of the challenges faced in creating this instrument is getting the microbit to create a sound. To do this we need to write a block of code using the microbit website. Firstly we need to tell it which pin to send it to (P0) and then tell it the frequency of the note to play and how long to play it for. For this we use the 'analog set pitch pin' block to tell the microbit to send the signal to the P0 pin. The frequency of the sound wave is the number of cycles per second so in the 'play tone' block we can enter the frequency as either a number or just select the letter (C-B) from the mini keyboard provided. The last thing we need to do is set the tempo, otherwise the pitch could last for too short a time or too long a time. This is very simply done via the 'set tempo' block. We can then do this for all twelve notes required for the instrument and set up a block of code for the rotational part of the instrument making sure that each note is played when the wheel is rotated every thirty degrees. In conceptualising this instrument I came across Dr. Godfried William Raes' article on 'Acceleration Sensing', where he uses a slightly more advanced set of equipment and codes to create a gesture control for one of his 'first player pianos'.³ The idea behind this is to use accelerometer chips to produce a midi data stream so that the pianos can be controlled by gestures from the hands. He uses a boxing glove for an example. Though this is a far more complex project than mine, the idea for using accelerometers to create rotation based sound triggering showed me that my project might be possible on the smaller scale that it is.

The idea to create an educational device so that children can learn the basics of music theory is something that has often appealed to me due to my feelings on the importance of learning theory from a young age. This project has been especially rewarding to conceptualise as it's not making learning a drab experience, as it so often can be given the enthusiasm and knowledge levels of a lot of teachers, but rather a fun one. Self learning is always a more beneficial process as knowledge you have acquired yourself is more likely to stay with you and stimulate you further than knowledge that has been lectured to you. However, there is more to the concept behind my instrument than just educating theory basics. In an article I recently read by Mark Oppenheimer, he explains how he believes that learning a musical instrument is not a vital skill to have and that parents should stop pushing it on their children; 'it is only necessary that the most eager and gifted students persist in their studies'.⁴ As I am someone who has had music pushed on them their entire life by both parents and teachers alike, I am in a good position to evaluate this comment, and though I do admit that it is not a necessary skill to have, I don't agree that it is not beneficial as I have come to love music through compulsory exposure to it. Though my playing of the piano is a large reason for this I believe that it is the study of music itself that is most beneficial. Too many producers and

³ Raes, G-W. (2007). Acceleration Sensing; devices for acceleration sensing usefull as gestures controllers for robotic musical instruments. *Logos foundation*, [online]. Available at: https://www.logosfoundation.org/ii/acceleration_sensing.html [Accessed 2 Apr. 2020].

⁴ Oppenheimer, M. (2013). Stop Forcing Your Kids to Learn a Musical Instrument. *The New Republic*, [online]. Available at: <https://newrepublic.com/article/114733/stop-forcing-your-kids-learn-musical-instrument> [Accessed 6 Apr. 2020].

composers alike don't have that theoretical knowledge needed in order to create complex, expressive music, and rely on chord generators and arpeggiators to essentially write music for them. Electronics have made writing music too easy and in turn have debased the emotional value of said music.

Though this started with the found sound movement, the progression to *musique concrète*, developed by Pierre Schaeffer, only added to this problem. The idea he had was 'electroacoustic music derived not only from sounds made by instruments and voices, but also sounds recorded from the environment', he 'wanted to "point out an opposition with the way musical work usually goes"'.⁵ Anything could be used for this new style from kitchen utensils to bathroom products, in other words, anything that can make sound is music. Peter Zinovieff's invention of the first portable synthesiser made this idea possible as one was now able to remove sounds from their natural environment and manipulate them to use in a piece of 'music'. John Cage took *musique concrète* to the extreme when he 'composed' '4:33'. The piece is in essence 4 minutes and 33 seconds of complete silence, the idea being that the sound around you is the music. Musicologists have commented that the clever thing about this piece is that it doesn't require a concert hall to be performed as it is just every day life. No two performances will ever be the same and therefore the piece ultimately represents the ever changing nature of the world around us and it is our job to listen. Levinson concludes, 'It should be apparent that there are no longer any intrinsic properties of sound that are required for something possibly to be music'.⁶ Here he is stating that the developments in musical language lead to a need for a brand new definition of music. Jean-Jacques Nattiez takes this further as he discusses how music and non-music becomes difficult to distinguish when the context goes beyond the Western world. 'More and more frequently, ethnomusicological literature stresses that other cultures do not in general have a term for music as a global phenomenon'.⁷ 'The border between music and noise is always culturally defined - which implies that even within a single society, this border does not always pass through the same place; in short, there is rarely a consensus...By all accounts there is no *single and intercultural* universal concept defining what music might be'.⁸ There is therefore no intercultural universal concept that we can all agree defines music. However, music, and art as a whole, is an expressive tool. Though there will never be an umbrella term that defines all music, all cultures use music to express emotion, whether that be tribal music or gregorian chant, and thus I must differ from Nattiez and say that music and non-music is distinguishable via its intention to express. In order to explain this point I will return briefly to Levinson who, in his definition of music, makes intention the primary concern. Music is 'humanly organi[z]ed sound *for the purpose* of aesthetic appreciation'.⁹ This is very similar to the Romantic philosopher Jean-Jacques Rousseau's definition of music; '*art de combiner les sons d'une manière agréable à l'oreille*' - music is the 'art of combining sounds in a way that is pleasing to the ear'. This idea of intention to create aesthetic pleasure is key in creating any music. Rousseau in his

⁵ Cliff, A. (2012). The Dummy guide to found sound. *Dummy*, [online]. Available at: <https://www.dummymag.com/features/dummy-guide-found-sound/> [Accessed 5 Apr. 2020]

⁶ Levinson, Jerrold. (2011). *Music, Art and Metaphysics*. Oxford University Press. pp.271.

⁷ Nattiez, Jean-Jacques. (1990). *Music and Discourse: Toward a Semiology of Music*. Princeton University Press. pp.54.

⁸ Ibid. pp.47-48.

⁹ http://www.deconstruction-in-music.com/proefschrift/300_john_cage/310_what_is_music/what_is_music.htm

many writings on the subject explains the aesthetic importance of music as being without any reference to an outside world where it departs from that which it is meant for. ‘He understood music in relation to *that which it requires of us as human beings*’.¹⁰ Rousseau basically wanted to establish the principle that music is to be understood in its relation to human life and experience. He believed that it is man’s (in the gender neutral sense of the word) most difficult achievement to be human. It is not an automatic rite of passage when we are born, we have to earn it. Music is the embodiment of this as we have to work at the meaning. It takes us on a journey of expression and each person listens in different ways. How we relate a piece of music to ourselves, that’s what makes us human.

“For music to become interesting, for her to bring to the soul the feelings that she is able to call up, all parts of it must come together to reinforce the expression of the subject into question. Harmony must only intensify this, the accompaniment must make the subject matter more attractive without submerging or disfiguring it; the bass line must march, must, so to speak, guide the person who sings and the person who listens, without being perceived as doing such. In a word, the whole must transmit at the same time a melody to the ear and an idea to the soul.”¹¹

Melody underpins all of this and it is melody that expresses what we are. In the article by Aimee Cliff explaining the history and value of found sound/musique concrète,¹² she mentions how modern day artists such as Kendrick Lamar and Kanye West use this technology in their music, as if this somehow shows that music has moved on and evolved. In fact this is not the case. In the song Cliff references, ‘Blame Game’ by Kanye West featuring Chris Rock, the outgoing samples are only effective because of the accompanying music. The way the melody is played and the chord progression chosen gives the samples the desired musical effect. By itself it is not music, because it was not designed to be so, music is not just sound, but the intention to express, and therefore not all sound is music. I am not saying that experimentation is a bad thing, for example, the composer Benjamin Britten managed to create highly expressive music by combining atonality with the Romantic theory of Wagner. This was only possible, and effective, because of his deep understanding of both types of musical theory. Even in other art forms, for instance, the poet Geoffrey Hill wrote a sonnet about how we can express love after the horrors of the 2nd World War. Though this is a clear departure from what a sonnet is, it is still expression. Returning to music, departure from the norm can be very effective but it has to be underpinned by melody and harmony, something that can only be done via the understanding of theory. My instrument is made to aid this understanding and to give children the stimulation to go away and play music on their own accord as opposed to having it forced upon them.

¹⁰ Strong, Tracy. (2013). Rousseau: Music, Language and Politics. *Speaking of Music: Addressing the Sonorous*. Fordham University Press. pp.86-100

¹¹ Ibid.

¹² Cliff, A. (2012). The Dummy guide to found sound. *Dummy*, [online]. Available at: <https://www.dummymag.com/features/dummy-guide-found-sound/> [Accessed 5 Apr. 2020]

There are many ways in which this instrument can be developed. As only the first attempt at creating such an educational device it is fairly limited in what it can do in that it only teaches the circle of fifths. There are of course many different aspects of music theory and I am hoping that with more experimentation this product could be used to address a few more educational needs. From a technological point of view there are some developments that can be initiated given more time to perfect. For example, at the moment the instrument uses absolute readings in order to collect its data to make a sound. This means that it is currently dependent on the location of one spoke and therefore every time it is used has to be reset to the first position. A better and more user friendly way of doing this would be to use relative readings¹³ where regardless of the position the wheel is in it will effectively reset automatically and just measure from the current reading, adding 30 degrees from that point to make the circle of fifths. The most important thing here is to make sure the angle of the spokes is still the same as what the microbit is expecting to see. The benefit of using relative readings is that the one variable we need to worry about, as explained earlier, the surface it is on, is made redundant, as in it doesn't matter which surface it is on as the microbit can calculate the start position and go from that point. This improves the reliability of the device and makes testing and debugging easier as you don't have to constantly reset the position. As is the same with the product as it is now, any addition or removal of spokes would mean the code needs adjusting. Due to the fact the product is primarily for children there could be one or two additional design features added to it in order to make it more 'fun' as it were. For example, as opposed to using the accelerometer we could use the light sensor in order to trigger sounds and that way connect it to an LED display so that the spoke 'lights up' every time it plays a note. The actual idea of using the light sensor to control the instrument comes from the light sensor guitar on the microbit website. The code for this is as follows:

1. light level detector - forever loop - drag a plot bar graph into the forever loop- drag a light level block into 'plot bar graph of' - set plot bar graph value up to 255
2. Test the light required to move the bar graph height - 255 the maximum light input reading so try numbers smaller than 255 and find a value that allows the graph to show 1-5 bars
3. Multiply frequency using math blocks - create play tone block and drag into it a multiplication block to set the tone - add b button block that multiplies the tone by a number other than 2 to set the tone
4. Control the frequency with the light input - create forever loop containing a play tone block - set tone using the multiplication block that multiplies light level input by 25 or experiment with multipliers larger and smaller than 25¹⁴

The issue with using this sensor as opposed to the accelerometer is that for every location the instrument is taken to the ambient light would need to be taken into consideration and therefore would make coding the instrument a lot more complicated. Perhaps the solution to this is to combine the two methods of controlling so that the sound is generated by the accelerometer and the LED display is generated by the light sensor and therefore would need to be coded appropriately.

¹³ Essl, G and Rohs, M. (2009). Interaction for Mobile Music-Making. [online]. Available at: <https://cpb-us-w2.wpmucdn.com/sites.uwm.edu/dist/0/236/files/2016/09/os09-mobileinteractivity-2lt8a0i.pdf> [Accessed 2 Apr. 2020]

¹⁴ <https://makecode.microbit.org/projects/guitar/lightsensor>

From a conceptual point of view there are also a few things that can be done to the design as it is now. In order to teach more than just the circle of fifths the sound could be coded to play the arpeggio of the chord of the note that is playing at any given time. So for example, the first note is C, so it would play C at first and then play the arpeggio; C, E, G, C and so on and so forth. This would provide a knowledge of not only how chords relate to each other, but how the chord is structured. Furthermore, the minor keys could be added. So each note played generates its major arpeggio but also its relative minor arpeggio.

The last section of this essay is given over to the marketing of the product. The instrument itself is not so hard to build and comes to a cost of around £70 for all the parts. Therefore I would value it at about £90. Many companies make the mistake of thinking that marketing is about getting the product out there so that everyone can see. However, it is more important to get the product out in front of the right people as they can further market your product if they like it themselves. Marketing is 80% research and 20% 'getting it out there'. For the marketing research I have used part of the canvas business plan to work out my target audience and who to pitch the product to. Firstly, what job am I doing for the customer? what needs am I fulfilling? Returning to the article by Mark Oppenheimer, he states that kids shouldn't be pushed to learn a musical instrument, that the utilities of lessons are 'overblown'¹⁵ and that they should be a hobby until the child takes it upon themselves if they so wish, to learn more seriously, which they invariably don't. My instrument fulfils the vital need, in my opinion, to learn about the building blocks of music. A greater understanding of music shows how it is all linked from Bach through to Stormzy. A greater passion is born from understanding and it is my belief that with this understanding children will decide to pick up an instrument themselves. Secondly, what is unique and why do customers prefer my product to alternatives? My instrument encourages self learning by being a fun way of education. The process of building the instrument is something that will appeal to children. Obviously the microbit itself will be separate and can be easily attached at the end, but the lego aspect is something very enjoyable. The hands on approach that this instrument requires as opposed to having something lectured to you, is, as I have already stated, far more beneficial as knowledge you have gleaned yourself is more likely to stay with you and stimulate imagination. Channels are very important in marketing a product. The first thing I would do is conduct interviews with potential clients to see if and how they would use it. Though the children are the target audience it is the teachers that are the required customers so I would conduct a survey as it were to generate interest and feedback, in case there are additional things that need to be done in order for the product to be sellable. As someone who is very unfamiliar to ventures such as marketing strategies I would use what I do know and advertise it on google adwords and youtube, as an explainer and building video would be a good way of gaining attention on the product. On top of this I would place the product on pimoroni, a website that has a variety of different electronic creations such as this, as well as, perhaps most importantly of all, reach out to the school of noise. The school of noise runs workshops for children and adults encouraging, in their words, 'the exploration of music and the science of sound'. Their aim is to provide creative and imaginative activities using sound in accessible, fun and educational ways. Their workshops where they invite schoolchildren to test out products would be a fantastic way to gain exposure for the product.

¹⁵ Oppenheimer, M. (2013). Stop Forcing Your Kids to Learn a Musical Instrument. *The New Republic*, [online]. Available at: <https://newrepublic.com/article/114733/stop-forcing-your-kids-learn-musical-instrument> [Accessed 6 Apr. 2020].

All in all, my instrument is about a change in attitude. Theory is the building block of all music and I think somewhere along the way we have started to experiment for the sake of experimenting and have lost the fundamental truth of music in the first place; its power to express. That's why we listen to music and I want to educate children in the correct way to go about understanding music so that they can use their imaginations to do what they want from that point.

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Other websites:

- Pimoroni - <https://shop.pimoroni.com/products/mini-mu-glove-kit?variant=21240542560339>
- The School of Noise - <https://www.schoolofnoise.com>