

# **Element 2b: The Essay**

by Bhawjot Amrit Singh

Module: Development (ADAD7005\_LON)

Tutors: Ciaran Robinson, Helen Leigh

# TABLE OF CONTENTS

|                                         |    |
|-----------------------------------------|----|
| <b>1. Introduction</b>                  | 1  |
| <b>2. Inspiration and Influences</b>    | 1  |
| <b>3. Implementation</b>                | 5  |
| 3.1. Concept                            | 5  |
| 3.2. Components                         | 6  |
| 3.3. Capacitive Touch                   | 7  |
| <b>4. Construction</b>                  | 8  |
| 4.1. Mark I                             | 8  |
| 4.2. Mark II                            | 9  |
| 4.3. Setting Up the Touch Board         | 10 |
| 4.4. Sample Selection                   | 11 |
| 4.5. Midi Interface Mode                | 11 |
| 4.6. Summary                            | 13 |
| <b>5. Commercial Viability</b>          | 14 |
| 5.1. Assessing The Market               | 14 |
| 5.2. Survey                             | 15 |
| 5.3. Analysis and Production Cost       | 17 |
| 5.4. Marketing and Improvements         | 19 |
| <b>6. Conclusion</b>                    | 22 |
| <b>7. Bibliography and References</b>   | 23 |
| <b>8. Images</b>                        | 25 |
| <b>9. Appendix</b>                      | 26 |
| 9.1. Curated Sample Sets and Demo Track | 26 |
| 9.2. Survey                             | 26 |

# 1. Introduction

The purpose of this essay is the documentation, explanation and analysis of a conductive touch based sampler and midi controller. As part of the “Development” module a creative electronic instrument had to be constructed from scratch. This essay will explain the inspiration, creation and development of the idea and analyse the execution and its usefulness for artists and potential in the commercial market.

## 2. Inspiration and Influences

*This chapter will explain the inspiration that lead to the idea of the conductive touch plant instrument.*

Music producers, composers and songwriters in the pop industry are regularly competing to get a cut with a big artist or developing their own artist career. A big problem faced daily is trying to come up with new ideas for songs and not falling into the same pattern and repeating what has already been done. It is very easy to copy genres, sounds and melodies that are already proven to be successful but that usually culminates in generic outcomes. Copying previously lucrative formulas can fail to impress A&Rs and the consumer. Pitching a song successfully often entails finding something new that seems exciting and fresh. Though many critics argue that success in the charts is based on copying previously successful songs, a study by Columbia Business School has found that the songs that tend to be most successful in the Billboard Top 100 charts over the last 60 years are usually less similar to their predecessors (Askin and Mauskapf, 2017).

Therefore, some musicians try to find techniques to help them be more creative. One of those is to limit or guide oneself away from falling into the same workflow and purposely staying away from certain practices, sounds and samples that one uses regularly to conceive unique ideas (Computer Music, 2018). To some extent, music creation is derivative but by applying methods such as only using foley sounds or operating a new plugin/instrument can help cultivate original concepts. Hence, one of the goals of this assignment is the creation of an instrument that could provide musicians with an unusual workflow to aid them in being more creative. This goal became the main focus in the process of brainstorming and researching ideas.

A week prior to starting this module a writing camp for British pop artist and producer 'Sigala' took place at Tileyard Studios.



IMG 1: Sigala's Studio, 2018

Researching his sound for the writing camp led to finding a picture of his studio, which contains several plants. His style of music is referred to as “Tropical”, which was coined by Australian DJ “Thomas Jack” and popularised by the Norwegian DJ and record producer “Kygo” (Shannon, 2016). One of its key characteristics is the inclusion of instruments such as marimbas, mbiras, kalimbas, flutes, djembes etc. (Shah, 2015).

As the name suggests, the imagery used to visualise “Tropical” music is often connected to tropical landscapes and plants as visible in the cover art below.



IMG 2: Thomas Jack Cover Art, 2014



IMG 3: Singular Sounds Cover Art, 2015

Looking at the aforementioned studio picture resulted in the idea of a plant that serves a musical purpose, while also being a decorative part of the studio or a home. Thus, started the development of an instrument that is based on a plant and provides a new workflow. Research of instruments that include plants resulted in the ‘Singing Tree’ by Goldsmiths, University of London. It is an artificial tree that is connected to a Raspberry Pi, using conductive touch to trigger sounds (Deline, 2018). It appeared to be an interesting approach to composition and ultimately became the main inspiration for concept of this instrument.



IMG 4 and IMG 5: Singing Tree by Goldsmith's University, 2018

Goldsmiths' essentially created an instrument that seemed to be an interesting concept, however, as visible in the picture above, the 'Singing Tree' does not fully look like a real plant, takes up a lot of space and arguably does not suit everyone's decorative preferences.

Summarising, the research concluded in the goal of creating an instrument that is based on a real plant, serves a musical purpose, creates a different workflow and looks presentable as a decorative piece inside a room.

## 3. Implementation

### 3.1 Concept

The instrument will utilise copper tape attached to a plant's leaves to trigger sounds via conductive touch. Contrary to Goldsmiths' approach, this instrument will be consisting of a real plant and provide an alternative approach to composition. The plant will do so by forcing the player to trigger sounds in a previously unknown manner. For example, opposed to a midi-keyboard the player does not know which notes are triggered by the leaves of the plant before touching them. For instance, playing the note C3 on a midi-keyboard will generally trigger the note C3. Not knowing which note is triggered by the leaves of the plant could be a playful way of generating melodies, chords and beats whilst adding an element of randomisation to the workflow, which is a common technique to boost creativity (Seydel, 2019). Midi-controllers can also be utilised in random ways, however, the novelty of touching leaves instead of pressing a drum pad or a piano key creates a new environment to trigger sounds as most musicians have arguably not been using plants to play music, whereas most musicians have probably used a piano.

Midi-controllers are able to communicate with a vast number of virtual instruments and effects. Therefore, apart from triggering sounds directly, a useful added feature would be using the plant as a midi-controller which could be paired with any virtual instrument, broadening its capabilities. Additionally, the plant itself also serves as added decoration to a room and creates oxygen during the day.

## 3.2 Components

The concept of the plant instrument required the following elements for construction:

- Calathea Plant
- Bare Conductive Touch Board
- Micro SD Card
- Power Supply
- Copper Tape
- Crocodile Wire
- Carton
- Speaker
- Micro USB Cable
- Mini Jack Cable

The calathea is a popular indoor plant that can be found in many offices (Ambius, 2019). The leaves are large, it does not take up a lot of space, it only requires indirect sunlight and limited water (approximately two times a week). All these factors, alongside its preferred temperature between 18-23°C, make it a great plant to keep indoors, for instance a recording studio.

The brain of the instrument will be the touch board by 'Bare Conductive'. It is a programmable board with 12 electrodes that can be used to trigger sounds as an MP3 player, a proximity sensor and a MIDI piano (Bare Conductive, 2019). The board works with crocodile clips, copper tape, electric paint, solder and e-textiles.

The leaves will be equipped with copper tape, which will be connected to the electrodes of the touch board. The board will be connected to a power supply and a speaker. Curated samples will be added to the Micro SD card and then plugged into the touch board.

### 3.3 Capacitive Touch

The touch board triggers a sound when one of the electrodes is touched. In this case the board reacts when the copper tape, which is connected to the electrodes, is touched. The technology is called capacitive touch and is commonly used in modern touch screens of smartphones and tablets.

The human body has a natural capacitance, which means it is able to conduct electrical current and store an electrical charge (Aranda, 2016). The electrodes of the touch board create an electrostatic field. The introduction of the electrical charge of skin affects the electrostatic field and causes it to redistribute accordingly. This is registered by the touch board, which then triggers a sound.

## 4. Construction

*This part of the essay will document the construction process of the plant instrument.*

### 4.1 Mark I

The first challenge of the construction process proved to be the application of the copper tape to the leaves of the plant. The copper tape is slightly fragile and tears easily, therefore a smooth application was difficult to achieve.

Fortunately, the copper tape can be peeled off the plant easily, so multiple tries were possible. One of the biggest challenges of this instrument was the connection between the copper tape and the touch board. As previously mentioned, the copper tape is delicate and to prevent tearing it needs to be attached to a surface, such as paper, carton or in this case the plant. Since the plant is not directly connected to the touch board there is large a gap between the stem of the plant and the touch board, leading to a high risk of the copper tape tearing. A solution could have been attaching the tape to a piece of carton or the pot of the plant, however, this would have led to a second issue, which would have been the ability to water the plant. Adding 11 pieces of copper tape heavily reduces the space for water to enter the soil of the plant and also water is conductive and therefore must not be involved. Additionally, it would have increased the risk of damaging the touch board's components which are not waterproof. Further, moving the instrument without breaking the copper tape would have become very difficult with this arrangement.

Although the tape could have been arranged in a pattern that would have taken up the least amount of space to simplify the process of watering the plant, the risk of damaging the touch board would have persisted while also remaining very fragile. Hence, a better solution was required.



IMG 6: Mark II Plant Instrument, 2019

## 4.2 Mark II

The main concern with the first approach was the copper tape. Instead of directly connecting the copper tape to the touch board a more stable connection was required and crocodile wires proved to be a viable solution.

The copper tape was attached onto the middle of the leaf following down the stem and then attached to a little piece of cardboard, which made it easy to connect to the crocodile wires.

With this approach the copper tape is always attached to a surface, reducing the possibility of tearing, providing it with more stability.

The copper tape does not go to the bottom of the stem which also saves material, instead it was attached to a small piece of cardboard higher up the stem meaning the plant can be watered easily, even with the crocodile wires attached. Additionally, the clips of the wire are easily detachable, reducing the risk of accidentally damaging the touch board while watering the plant and also making the instrument conveniently portable. In case one of the wires is broken it can also be exchanged very easily.

Summarising, this concept proved to be a suitable solution. With all the parts attached and the touch board reacting accordingly it was time to program the touch board.

### 4.3 Setting Up the Touch Board

After attaching the crocodile wires to the touch board, connecting it to a power supply via the micro USB port and attaching a speaker through the mini jack port the instrument was set up. The board turns on with a simple switch and includes a recalibration button which has to be pressed every time the board is in use so the electrodes work accordingly.

It came preloaded with the code to trigger samples by touching the electrodes and had 11 preloaded samples that each included a short explanation of the board's features. The samples were easily exchangeable with any audio in a mp3 format and just had to be renamed accordingly, specifically "TRACK000.mp3" to "TRACK011.mp3".

The included micro SD card is limited to 125 MB, which should be enough storage space for most samples in a MP3 format, needing less space than lossless formats like WAV but also reducing the sound quality.

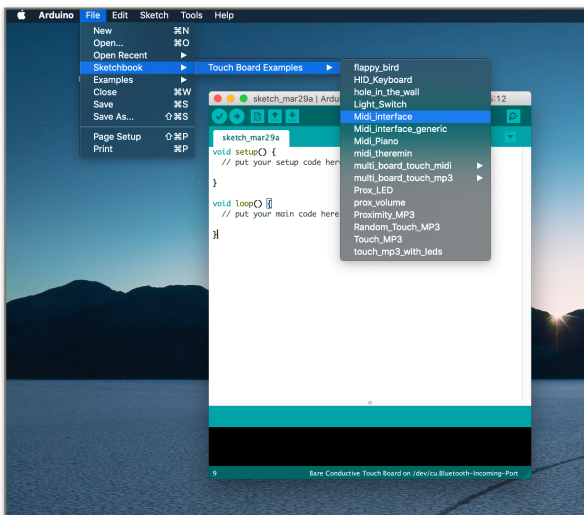
## 4.4 Sample Selection

To find the right sounds for the instrument many different samples, such as drums, pianos, guitars and marimbas were tried. As the touch board has a slight latency, drum samples did not suit the instrument perfectly. The leaf does not provide a lot of resistance to a finger pressing the copper wire on it. Coupled with the slight latency, it made playing a drum beat very difficult. Pianos and guitars suited the instrument better but going with the aforementioned 'Tropical' theme that inspired the creation of this instrument, harmonic pluck instruments like marimbas, kalimbas and mbiras seemed more appropriate. Apart from the chosen sounds, different scales and chords were considered as well. Triggering chords in the same key seemed to work extremely well and ended up becoming the main choice for the latest iteration of the instrument, which triggers chords in A minor (further curated sample packs for the instrument are available in the appendix).

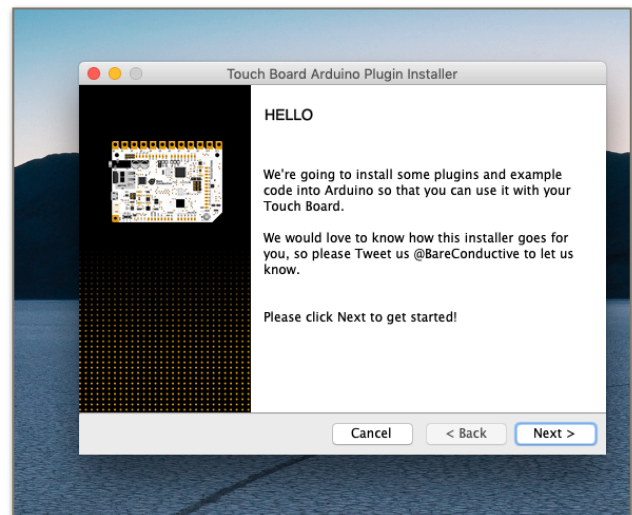
## 4.5 Midi Interface Mode

As previously mentioned one goal for the instrument was the potential of using it as a midi-controller with a computer. The touch board had to be reprogrammed to do so.

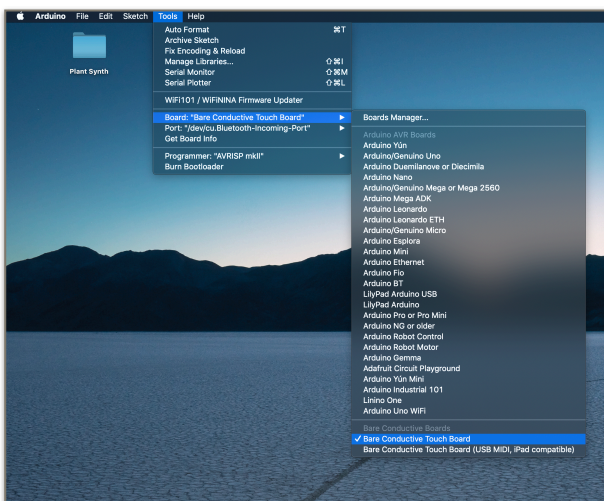
First, the “Arduino IDE (Integrated Development Environment)” software was installed on a computer. Additionally, the “Touch Board Arduino Plugin Installer” from Bare Conductive, which connects the touch board to the Arduino software was installed as well. After plugging in the touch board to the computer and completing the set-up, the code “Midi\_interface” was uploaded via the Arduino software (screenshots below).



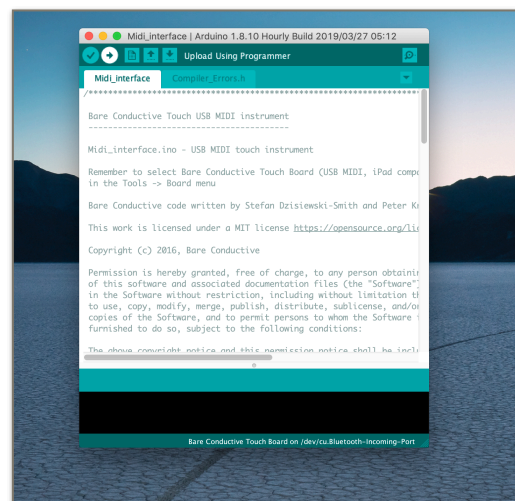
IMG 7: Arduino File Window, 2019



IMG 8: Touch Board Installer Window, 2019



IMG 9: Arduino Tools Window, 2019



IMG 10: Arduino Upload Window, 2019

It was accessed via the following path: File→Sketchbook→Touch Board Examples→Midi interface. Once the upload is complete, the board can be connected to any DAW and be used as a midi-controller. However, to be able to trigger samples in initial mode, the “MP3 playback mode” has to be re-uploaded, meaning the board can only function in one mode. Being able to quickly switch between both modes would have been a great feature.

## 4.5 Summary

The construction process proved to be successful and managed to realise the goals of the initial idea. The instrument functions and is easily portable. Once the copper tape was attached to the plant, the touch board could be connected and disconnected easily via the crocodile wires, simplifying taking care of the plant without needing too much space or risking the damage of certain components. Choosing the calathea plant has been an appropriate choice so far as it does not require a lot of care. Using the touch board in MP3 playback mode is straight forward and easy to learn. One caveat, however, is switching between MP3 playback mode and MIDI interface mode. Uploading the code through the Arduino IDE is pretty simple but time consuming, this could be very inconvenient for certain users. Including an added switch on the touch board would be the perfect solution to shift between the modes. Further, the MP3 playback mode can only trigger 11 samples. Switching samples is also a simple process but once again time consuming.

Another useful feature would be a button or flip switch on the touch board that could switch between two or three different sample banks. Additionally, the use of lossless formats for playback would also be an improvement.

## 5. Commercial Viability

*After constructing, developing and analysing the instrument this chapter will look at the instrument as a product in the commercial market and assess its potential for it.*

### 5.1 Assessing The Market

The plant instrument is geared towards the creative professional industry, specifically the music industry as it is intended to provide musicians with a new workflow. Within this industry, Native Instruments and Avid are two major music hardware and software manufacturers. They have a combined estimated annual revenue of over \$500 million (Owler, 2019). According to a report from the "Creative Industries Federation", the creative industry's growth is double the rate of the average job growth in the UK (Chung, Yang and Cauldwell-French, 2018). Hence, there evidently is a market for music related hardware and software and it seems to be growing as well, but this data does not provide enough information to claim potential financial success for the instrument.

To find out more, a survey was drawn up to get an overview on how much people spend on music hardware and plants and also to assess the general interest level for a plant that generates sounds in and outside the music industry.

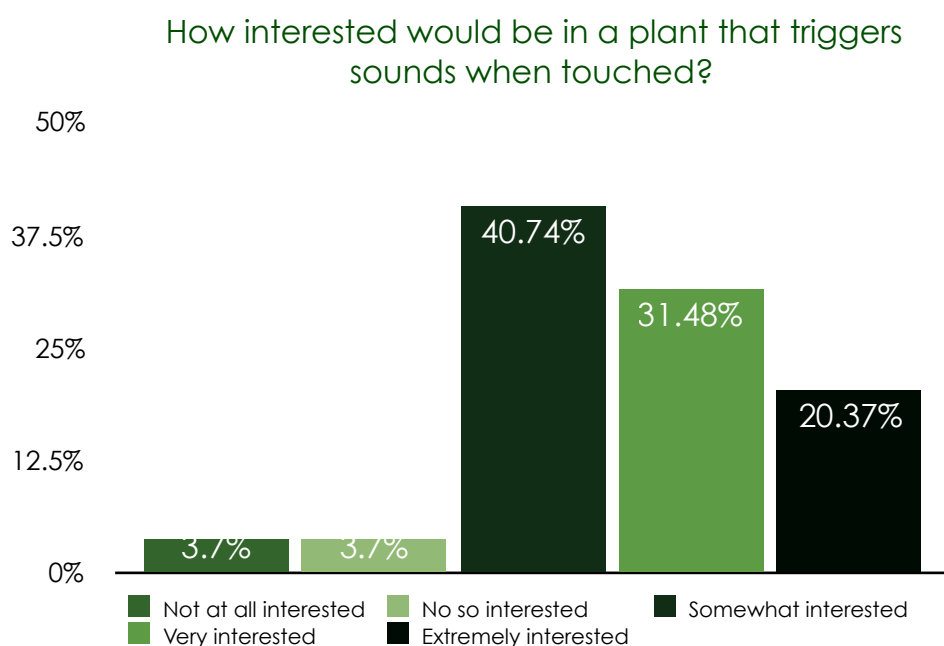
If interest exists, finding out how much could potentially be charged for such a product is highly relevant.

## 5.2 Survey

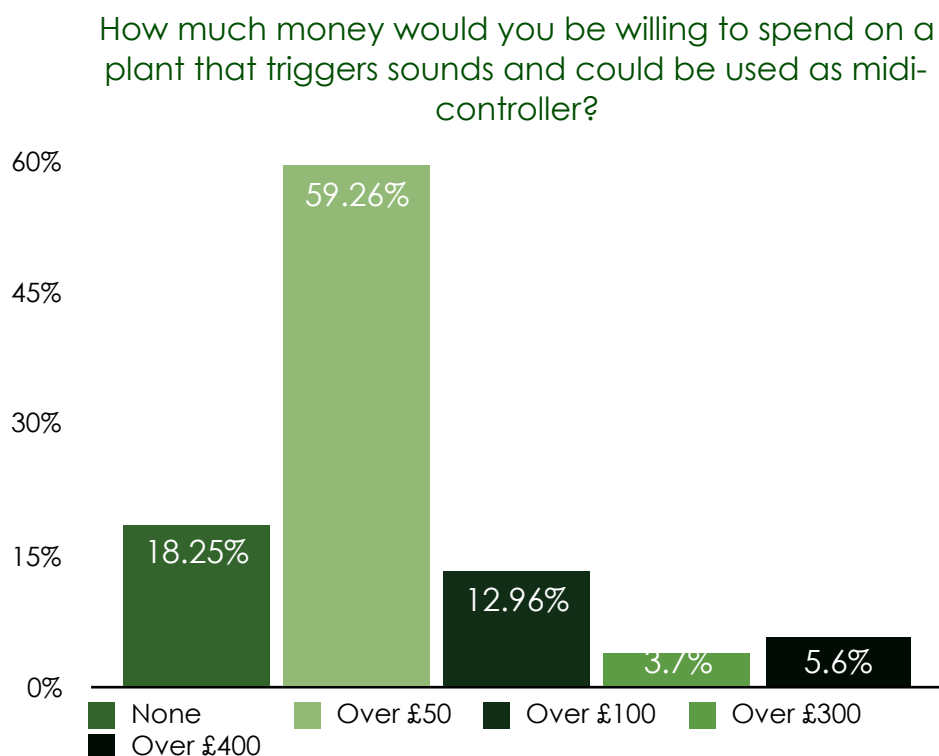
The survey included 54 people, which is a small number, however it still revealed several interesting points (full survey in appendix):

60% of the people who took the survey work in the music industry, the rest does not, giving it some outsider perspective.

In regards to the annual spending of money on music related software, hardware and sample packs, £0 to £200 was the most common answer, with 13.21% willing to spend over £400. Considering that 40% of the people who took part in this survey are not in the music industry and presumably would not spend money on music related tools reveals £100-£200 as the most common answer. This number has to be put in context as well since a large part of the survey is based on students with relatively limited budgets.



Looking at the annual budget for plants, 48.15% are not willing to spend more than £100 while 37.04% spend no money at all on plants, leaving only a small amount who are willing to pay £100 or more for them.



When asked about their interest in a plant that could trigger sounds 51.77% were “very” to “extremely interested”, 40.74% “somewhat interested” and only 7.4% were “not so” to “not at all interested”.

The ultimate question asked how much money they would be willing to spend on a plant instrument. 59.26% are willing to spend over £50, whereas 22.22% would spend £100 or more. Interestingly, only 18.52% would not spend any money at all. Given the fact that 40% who took part are not within the music industry, this conveys positive potential in that non-musicians might also be interested in the instrument and would even pay for it.

### 5.3 Analysis and Production Cost

Despite the fact that this survey is very limited due to the small number of participants and considering that most responses came from students and relatively young professionals, some interesting conclusions can be drawn.

The reaction to the idea of a plant that makes sounds is clearly positive with only 7.4% being “not so” to “not at all interested”. Furthermore, 81.75% are willing to pay at least £50 or more for it, which can also be seen as positive feedback to some extent.

| Product                                             | Cost (Including Shipping) |
|-----------------------------------------------------|---------------------------|
| Calathea Plant                                      | £8                        |
| Touch Board (SD Card, Power Supply Included)        | £62.02                    |
| Copper Tape (20m)                                   | £6.99                     |
| Crocodile Wire (10 pieces)                          | £4.99                     |
| Carton (5cm <sup>2</sup> )                          | £1                        |
| Speaker (Micro USB Cable, Mini Jack Cable Included) | £6.80                     |
| <b>TOTAL</b>                                        | <b>£89.80</b>             |

Not accounting for labour, the cost of the instrument is currently at approximately £85 considering that 20m of copper wire could be used for multiple instruments and adding a net profit margin of 10%-20% (e.g PepsiCo, Inc. 10.2 % or Apple Inc. 22.2%), the product would retail between £93.5 to £102 (Statista, 2014). Albeit, nearly 60% would be willing to pay over £50 for it, only 12.96% would be willing to pay over £100 for it, which seems to be the price range the plant instrument would retail in.

Realistically, the cost of production could potentially be cut down by using cheaper materials, utilising economies of scale and bringing production in house (Long, 2017).

The main cost is the touch board from Bare Conductive. For instance, replacing it with a Raspberry Pi and a capacitive touch sensor could reduce the cost. Buying in bulk and building long-term relationships with providers could lower the production cost as well (Ajami, 2006). Bringing production of materials such as the plant, touch board and speaker in house could reduce cost but could be challenging for a start-up business. It would be rather expensive to start cultivating plants and an engineering division as they require different skills and assets.

However, if a company like Bare Conductive who is already building touch boards in house would start making a product like the plant instrument, the manufacturing cost would probably be much cheaper. Adding the hypothetical cost of labour and marketing, it seems likely that only an established company like Bare Conductive, Native Instruments or Avid could manufacture and sell such a product for profit.

## 5.4 Marketing and Improvements

The analysis of the survey and the production cost has revealed that the plant instrument could realistically only be lucrative if produced by an established company. To be commercially viable, the product's design, features and benefits have to be assessed in order to discover which improvements need to be made to hypothetically market this product. Looking at the design of the current iteration of the instrument it could definitely be improved. As of now it resembles a DIY-project more than an actual product.



IMG 11: Mark III of the Plant Instrument, 2019

The copper tape seems to suit the green colour of the plant, anyhow, the crocodile wires all have different colours. Having a uniform colour for all wires, such as green or potentially copper would most certainly improve the overall look.

The touch board, speaker and power supply are currently positioned next to the plant. It is relatively portable but there are still several components that have to be move. To get the best out of the product all the electronics would have to be part of the pot.

The touch board could and power supply potentially be buried inside the soil in a dirt and waterproof box, next to the plant pot with cut-outs for the SD card slot, mini jack port and a charging port.

The speakers could be incorporated into the pot of the plant as well. Additionally, a wire could be developed that is connected directly to the touch board inside the soil that runs along the stem of the leaves. Upon reaching the leaf the wire would open up and expand into a copper surface, similar to the copper tape on the current version of the plant. Completing all these improvements would require a serious level of engineering and trials, which are out of the scope of this assignment. Nonetheless, to be commercially viable the design and engineering would absolutely have to improved, because in essence the current version is just a DIY-project. Lastly looking at the features, the current version works quite well. It can be loaded up with samples and reprogrammed to be used as midi-controller. Switching between the two modes could definitely be improved and to make the product even better, the board could be programmed to sense proximity similar to a theremin.

Finally, the instrument being based on a plant means that has to be taken care of. Although the calathea does not require much care it could be a dealbreaker for some people.

On the other hand, plants have lot of benefits such as cleaning, make the workplace more attractive and according to studies even boost creativity and reduces stress (Chignell, 2018).

The plant could definitely be a focus of a hypothetical marketing campaign the makes the instrument stand out.

Summarising, the instrument works properly and seems to be perceived as an interesting idea. The decision to add chords in the same key makes the creation of chord progressions very simple. An example of a simple track made with the instrument is featured in the appendix.

The plant could be a unique selling point however, looking at the analysis of cost it does not seem commercially viable at this point.

It would need investment, development and engineering to make into a fully polished product as it would enter a highly saturated market. Looking at it as toy or a decorative accessory for the home it could gain some traction if it were sold by the right brand at an affordable price the consumer is willing to pay. The instrument could potentially be sold as a DIY-kit. Bare Conductive, the manufacturer of the touch board sells electric paint kits for example. They could create a new kit including all the electrical components needed for the plant instrument as they already sell most of them. Interested consumers could use it on plants they already own or buy one they like. Additionally, they could create a new version of the touch board that makes switching between playback and midi mode easier.

Even though the plant would be the unique selling point of this instrument, it also causes a lot of potential issues. Taking care of the plant could be an inconvenience to some consumers. From a corporate perspective, setting up customer service for a living organism that includes electronics could be very challenging.

The plant could be successful as part of an interactive art installation as it is easy to use.

## 6. Conclusion

The plant instrument is a simple DIY-project that can be replicated easily if one is willing to invest the time and money. This essay has shown that it requires some development to be successful in the commercial market, despite the novelty factor and even then, it would be difficult to make it commercially viable. It appears to be more suitable as a DIY project or as part of an interactive art installation. Bare Conductive, the manufacturer of the touch board, could potentially sell the featured components as a kit. They already sell electric paint kits on their website and ship most of the components.

Ultimately, the goal of creating an instrument that is based on a plant and provides a new approach to composition has been achieved successfully. It could definitely be improved in several ways, especially regarding the use of different modes and samples, however in conclusion, it is an interesting DIY-project to create and use and it is certainly at least somewhat interesting to most people.

## 7. Bibliography and References

Ajami, R. (2006). *International Business: Theory and Practice*. 2nd ed. Armonk, N.Y.: M.E. Sharpe, p. 12.

Ambius. (2019). All you need to know about Calathea plants | Ambius. [online] Available at: <https://www.ambius.com/learn/online/plant-doctor/all-you-need-to-know-about-calathea-plants/> [Accessed 28 Mar. 2019].

Ambius. (2019). Benefits of Indoor Plants - Health Benefits of Plants to Humans | Ambius. [online] Available at: <https://www.ambius.com/learn/benefits-of-our-services/> [Accessed 28 Mar. 2019].

Aranda, M. (2016). How Do Touchscreens Work? - SciShow. [online] YouTube. Available at: <https://www.youtube.com/watch?v=wKuqNuzM1oM> [Accessed 28 Mar. 2019].

Askin, N. and Mauskopf, M. (2017). What Makes Popular Culture Popular? Product Features and Optimal Differentiation in Music. *American Sociological Review*, 82(5), pp.910-944.

Bare Conductive. (2019). How to make a MIDI piano Interface - Bare Conductive. [online] Available at: <https://www.bareconductive.com/make/midi-interface/> [Accessed 28 Mar. 2019].

Bare Conductive. (2019). Setting up your Touch Board with the Arduino Installer - Bare Conductive. [online] Available at: <https://www.bareconductive.com/make/setting-up-arduino-with-your-touch-board/> [Accessed 28 Mar. 2019].

Bare Conductive. (2019). Touch Board - Bare Conductive. [online] Available at: <https://www.bareconductive.com/shop/touch-board/> [Accessed 28 Mar. 2019].

Chignell, B. (2018). Seven benefits of having plants in your office. [online] CIPHR. Available at: <https://www.ciphr.com/advice/plants-in-the-office/> [Accessed 28 Mar. 2019].

Chung, C., Yang, L. and Cauldwell-French, E. (2018). Growing the UK's Creative Industries. [online] Creativeindustriesfederation.

Available at: <https://www.creativeindustriesfederation.com/sites/default/files/2018-12/Creative%20Industries%20Federation%20-%20Growing%20the%20UK's%20Creative%20Industries.pdf> [Accessed 28 Mar. 2019].

Computer Music. (2018). 10 ways to increase your creativity by restricting yourself. [online] MusicRadar. Available at: <https://www.musicradar.com/how-to/10-ways-to-increase-your-creativity-by-restricting-yourself> [Accessed 28 Mar. 2019].

Deline, M. (2018). Singing Tree Built with Raspberry Pi. [online] YouTube. Available at: <https://www.youtube.com/watch?v=-BT9fs3D0Oc> [Accessed 12 Mar. 2019].

Long, L. (2017). Three Ways To Lower Your Manufacturing Costs. [online] Forbes. Available at: <https://www.forbes.com/sites/lizlong/2017/09/26/three-ways-to-lower-your-manufacturing-costs/#63bc7f927d97> [Accessed 28 Mar. 2019].

Owler. (2019). Avid's Competitors, Revenue, Number of Employees, Funding and Acquisitions. [online] Available at: <https://www.owler.com/company/avid> [Accessed 28 Mar. 2019].

Owler. (2019). Native Instruments's Competitors, Revenue, Number of Employees, Funding and Acquisitions. [online] Available at: <https://www.owler.com/company/native-instruments> [Accessed 28 Mar. 2019].

Seydel, R. (2019). 7 Uncommon Ways To Make Your Tracks Better With Randomization | LANDR Blog. [online] LANDR Blog. Available at: <https://blog.landr.com/how-to-make-music-random/> [Accessed 28 Mar. 2019].

Shah, N. (2015). A Beginner's Guide to Tropical House, the Breakout Music Genre of 2015. [online] The Wall Street Journal. Available at: <https://blogs.wsj.com/speakeasy/2015/12/08/a-beginners-guide-to-tropical-house-the-breakout-music-genre-of-2015/> [Accessed 12 Mar. 2019].

Shannon, P. (2014). Before He Invented Tropical House, Thomas Jack Sold Magic Mushroom Shakes. [online] L.A. Weekly. Available at: <https://www.laweekly.com/music/before-he-invented-tropical-house-thomas-jack-sold-magic-mushroom-shakes-7578899> [Accessed 12 Mar. 2019].

Statista. (2014). Net profit margin of leading U.S. consumer products companies, 2013 | Statistic. [online] Available at: <https://www.statista.com/statistics/242166/net-profit-margin-of-leading-us-consumer-products-companies/> [Accessed 28 Mar. 2019].

## 8. Images:

**IMG 1:** PM Studio. (2018). Sigala Studio. [online] Available at: <http://www.pmstudio.com/music/music.html?page=20180907-7836> [Accessed 28 Mar. 2019]

**IMG 2:** Playlists.net. (2014). Thomas Jack presents Tropical House Spotify Playlist. [online] Available at: <http://playlists.net/tropical-house-1> [Accessed 28 Mar. 2019]

**IMG 3:** Thissongslaps. (2015). Become the Next Tropical House Star with Singular Sounds' Newest Sample Pack - thissongslaps.com - Electronic Dance Music & Hip-Hop Media. [online] Available at: <http://www.thissongslaps.com/2015/12/become-next-tropical-house-star-singular-sounds-newest-sample-pack/> [Accessed 28 Mar. 2019]

**IMG 4:** Deline, M. (2018). Singing Tree. [online] Mdphysicalcomputing.tumblr.com. Available at: <https://mdphysicalcomputing.tumblr.com/page/3> [Accessed 28 Mar. 2019]

**IMG 5:** Deline, M. (2018). Singing Tree. [online] Mdphysicalcomputing.tumblr.com. Available at: <https://mdphysicalcomputing.tumblr.com/page/3> [Accessed 28 Mar. 2019]

**IMG 6:** Singh, B. (2019). Mark II Plant Instrument. Shot on iPhone X

**IMG 7:** Singh, B. (2019). Arduino File Window. Screenshot

**IMG 8:** Singh, B. (2019). Touch Board Installer. Screenshot

**IMG 9:** Singh, B. (2019). Arduino Tools Window. Screenshot

**IMG 10:** Singh, B. (2019). Arduino Tools Window. Screenshot

**IMG 11:** Singh, B. (2019). Mark III Plant Instrument. Shot on iPhone X

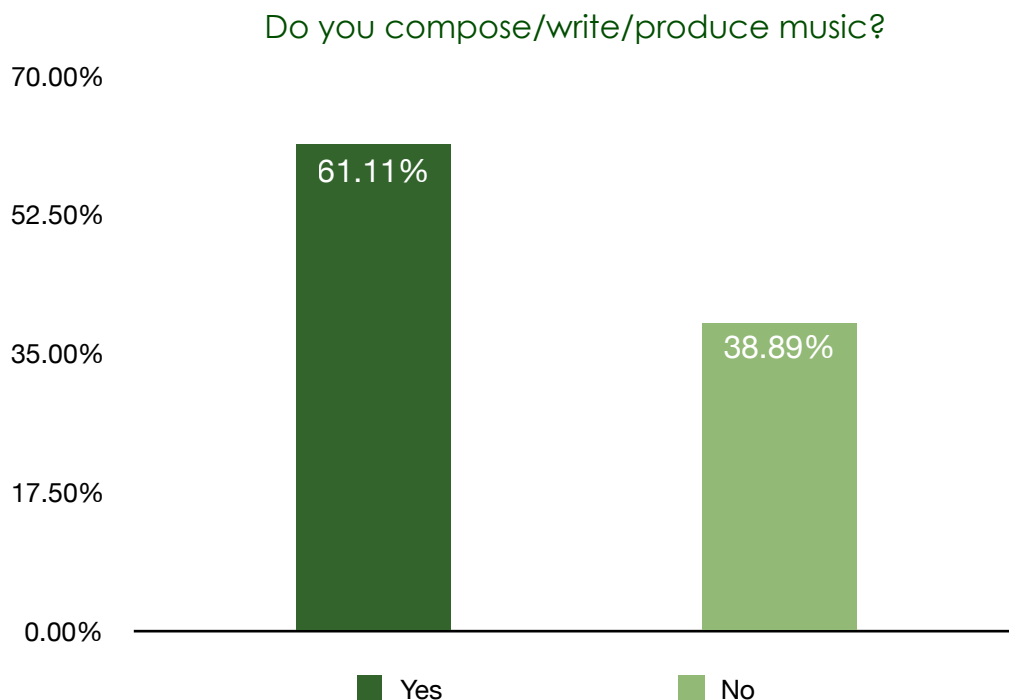
## 9. Appendix

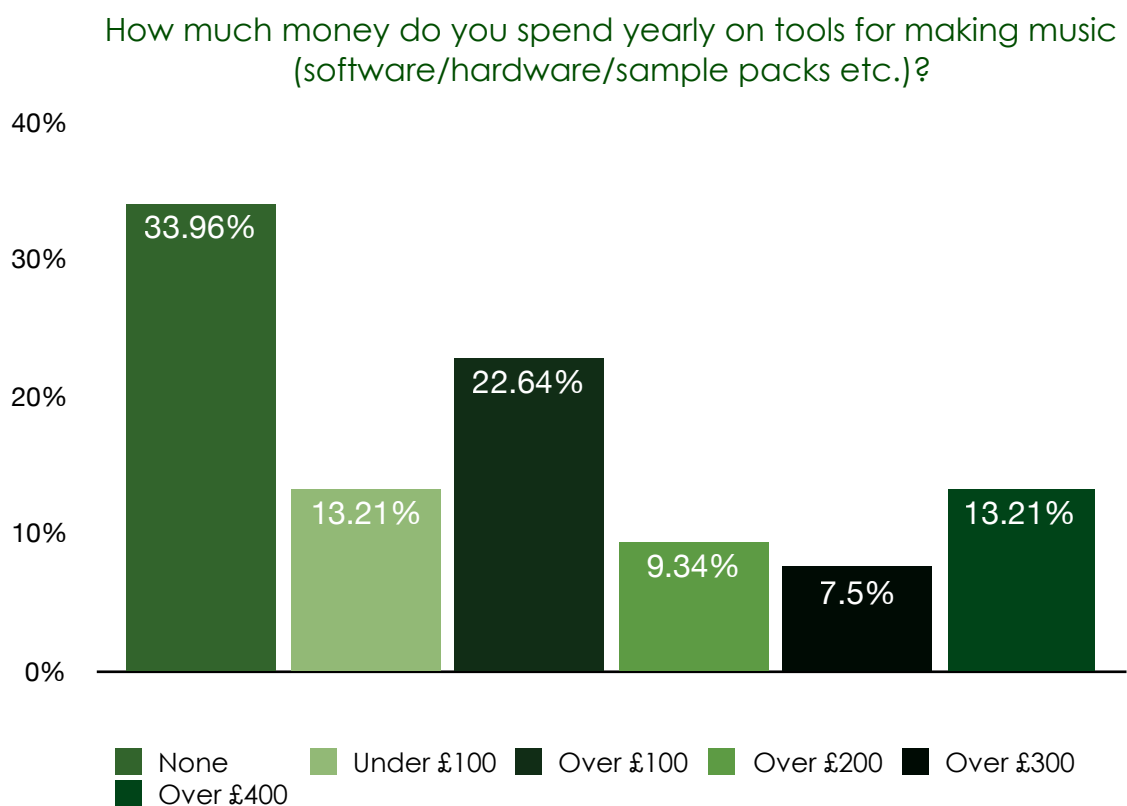
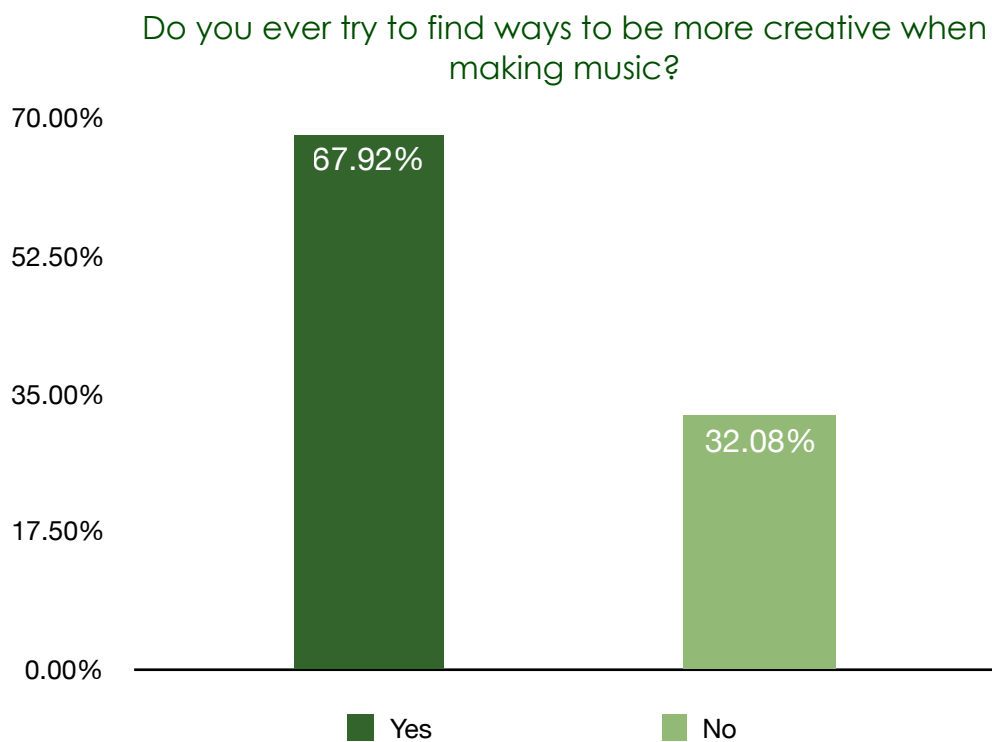
### 9.1 Curated Sample Sets and Demo Track

The curated sample pack and demo track are located in the folder "Essay Appendix", which has been submitted alongside the essay in "Singh\_B\_Element2c.zip".

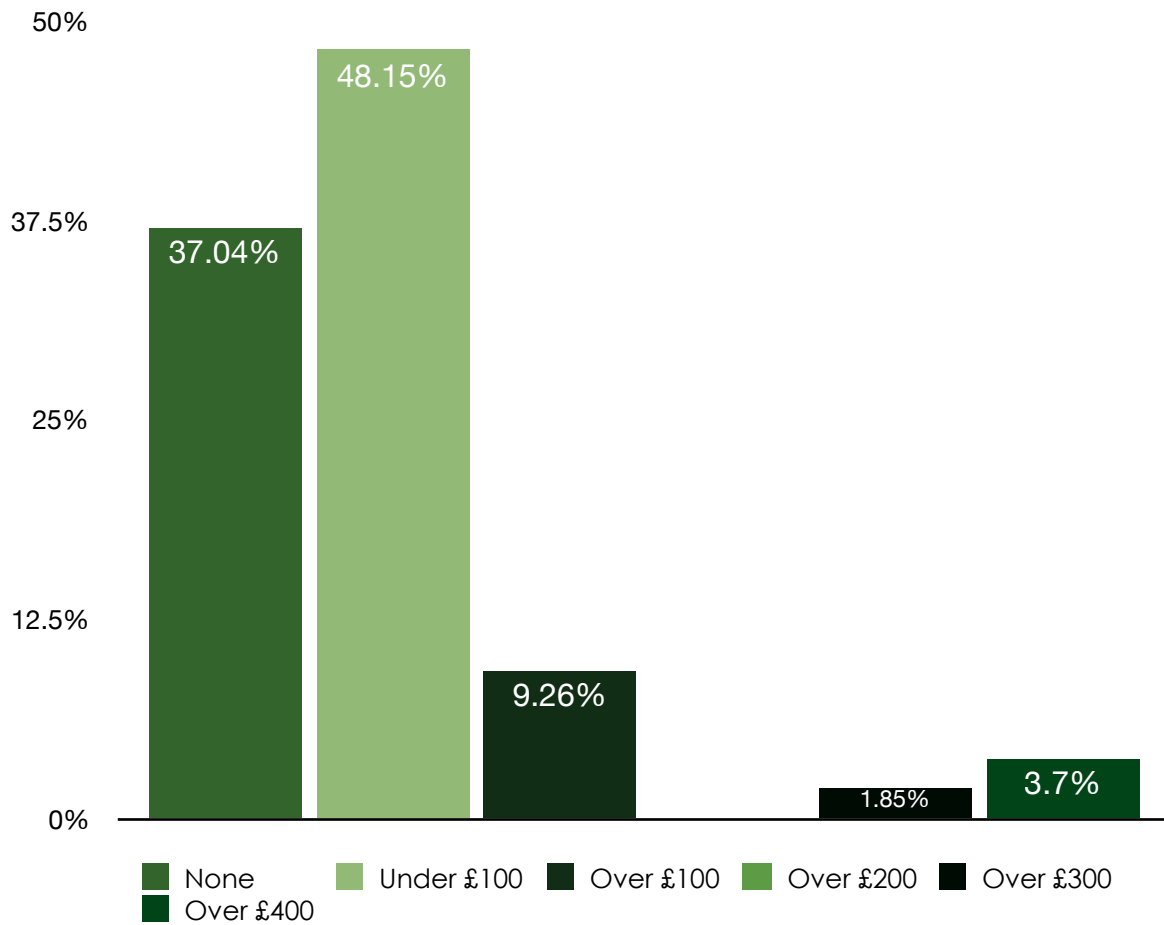
### 9.2 Survey

The following graphs are based on the conducted survey, available here: <https://www.surveymonkey.com/results/SM-QRD3M87NV/>

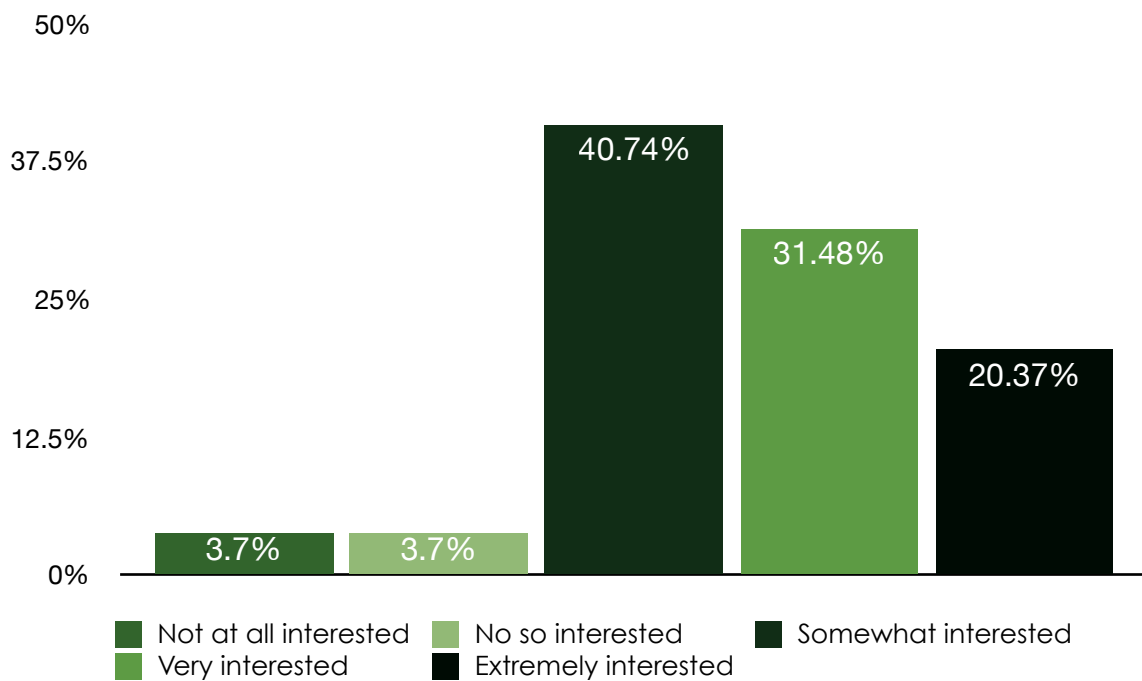




### How much do you spend on plants a year?



### How interested would be in a plant that triggers sounds when touched?



How much money would you be willing to spend on a plant that triggers sounds and could be used as midi-controller?

