The current state of AI-music generation services

Can non-music professionals and music students correctly identify what music is human made respective AI-generated?

John-Paul Connor
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Namn (alla författares namn)

1 oktober 1988..............................................................................................................

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Metadata och uppladdade filer överförs i sådana fall till det nya systemet.
Table of Contents

Publiceringsvillkor .................................................................................................................. 3
Abstract ...................................................................................................................................... 7
Keywords ................................................................................................................................. 7

1 Introduction ............................................................................................................................ 8
  1.1 Background ......................................................................................................................... 8
  1.2 Research questions ............................................................................................................ 8
  1.3 Hypotheses ......................................................................................................................... 9
  1.4 Delimitation ......................................................................................................................... 10
  1.5 Theory .................................................................................................................................. 10
  1.6 Previous research ............................................................................................................... 11

2 Method ..................................................................................................................................... 12
  2.1 Literature study ................................................................................................................... 12
  2.2 Music Production and online survey .................................................................................. 12

3 Production ............................................................................................................................. 13
  3.1 Human made song ............................................................................................................ 13
  3.2 AI-generated song ............................................................................................................. 15

4 Result ....................................................................................................................................... 16
  4.1 Current music generation services .................................................................................... 16
    4.1.1 What is available? ........................................................................................................... 16
    4.1.2 What do they cost? ......................................................................................................... 16
    4.1.3 What do they require to make use of songs? ................................................................. 17
    4.1.4 What can or cannot be done with them? ....................................................................... 17
    4.1.5 How do the services work? ............................................................................................ 18
    4.1.6 How much input from a human is required to generate music? ................................... 19
    4.1.7 How can the music be used post-generation? ............................................................... 19
  4.2 Online survey ..................................................................................................................... 24
    4.2.1 Non-music professionals ............................................................................................... 25
    4.2.2 Music students/music professionals ............................................................................. 30

5 Conclusion ........................................................................................................................... 35
  5.1 Current music generation services .................................................................................... 35
  5.2 Hypotheses and online survey .......................................................................................... 36

6 Discussion ............................................................................................................................ 38

7 Ethical aspects ...................................................................................................................... 40

8 Reference list ....................................................................................................................... 41
Abstract

The primary purpose of this project is to gain a deeper insight into the current state of artificial intelligence, or AI, within the realm of music, what music generation services are currently available, what they cost, how much input is needed from a human for the service to generate a piece of music and what can be done with said musical piece post-generation.

The secondary purpose is to determine whether it is possible for non-music professionals and music students to correctly identify which of two musical pieces is AI-generated and which is human made.

The method used to research the questions surrounding the primary purpose of this study was literature study, whereby various scientific articles, AI-music generation service’s home pages and textbooks among other things, are used to gain a deeper understanding of the current state of AI-music generation services and AI in general.

The method used to research the question regarding the secondary purpose of this project was the gathering of data from an online survey filled out by both non-music professionals and music students.

The research revealed that there is currently a wide range of AI-music generation services available, each with different pricing tiers. The research has also shown that with the higher paid tiers, there are more benefits than the lower paid tiers, or the free tiers. The seven researched services have similar ways of generating music and they all require the user to choose criteria such as genre, mood, tempo, and key to generate music.

The survey results revealed that the majority of respondents were able to identify which song was AI-generated, and that the majority of respondents preferred the human made song over the AI-generated song.

Keywords

Aiva  Artificial intelligence  Composition  Generation  Production
1 Introduction

1.1 Background
The use of artificial intelligence, or AI for short, is becoming more common in many different aspects of life. Major businesses and companies, students, those simply interested in emerging technology and musicians are now using AI daily for various reasons.

AI has already surpassed human performance in various areas such as “image recognition, speech transcription and direct translation” (De Spiegeleire, Maas, and Sweij, 2017, pp. 44), but has AI surpassed humans when it comes to the creation of music?

The creation of music is an inherently creative, emotional and ‘human’ activity. An activity which, right now, is beyond the capabilities of AI to partake in as a human would, that is, emotionally, creatively and with awareness (Hagendorff & Wezel, 2020). Currently, music generated by AI is “nothing more than artificial, and slightly deformed re-configurations, of existing art works whose characteristics have been learned by a computer” (Hagendorff & Wezel, 2020).

While AI cannot create a piece of music based on emotions, a burst of creativity or because it is inspired to, it can generate a piece of music, nonetheless. But what is the current state of commercially available AI-music generation services? How do they work? How much input from a human do these services need to generate a piece of music? How closely can it approximate music made by a human? Will people be able to tell whether a specific piece of music is generated using AI or if it is human made? These are some of the questions that this research seeks to answer.

1.2 Research questions
There are two main areas of focus within this project. The first is research surrounding the current state of AI-music generation services, what is available, how much they cost and what can be done with the music post-generation. The second area of focus is on online surveys sent to non-music professionals and
music students, to find out if it is possible for these respondent groups to identify what music is AI-generated and what is human made.

The two research questions that were formulated are:

1. What is the current state of commercially available AI-music generation services?

2. Is it possible for non-music professionals and music students to correctly identify which of two musical pieces is AI-generated and which is human made.

1.3 Hypotheses

Once it was decided to incorporate surveys into the project, five hypotheses were formed:

1. The majority of non-music professionals included in this survey will not be able to identify which music is AI-generated and which music is human made.

2. Over 50% of non-music professionals in this survey will be able to correctly identify the general genre or style of Song A (AI-generated song).

3. 100% of music students in this survey will be able to identify which music is AI-generated and which music is human made.

4. Over 80% of music students in this survey will be able to correctly identify the general genre or style of Song A (AI-generated song).

5. The majority of both non-music professionals and music students in this survey will prefer what they believe to be human made music over what they believe to be AI-generated.
1.4 Delimitation

Research on current AI-music generation services has been limited to seven services to make the research feasible within the scope of this project.

The respondent groups for an online survey were limited to non-music professionals and music students to make the collected data manageable within the scope and timeframe of this project.

Due to this limitation, the sample size was rather small and therefore any data, answers or claims made from the survey in this research are not meant to be indicative of a wider sample base than that of the number of respondents that responded in the survey.

I decided to limit the number of songs to be compared by respondents in the survey to one AI-generated song and one human made song, as there was only time within the scope of this project to create one human made song.

1.5 Theory

AI is a machine that can perform various “cognitive tasks” (Scharre et al, 2018). These “cognitive tasks” could, for example, be the recognition of faces, images, musical works and languages, or the sorting of various types of data, and even the generation of new images, musical works, and literature.

Two of the many branches of AI are machine learning and neural networks. Machine learning is when a large amount of data, for example, images, is fed into an algorithm which then “learns subtle patterns within the images to distinguish between categories” (Scharre et al, 2018).

Neural networks, while still using machine learning, are essentially “really large sets of bits of computers that try and mimic how the brain works” (Ling, 2021).

Machine learning and neural networks can be used for a wide range of data, and in various fields. However, within the realm of music, it is especially interesting. For example, machine learning algorithms and neural networks can create entirely new musical works by learning from the large data sets they have been fed. The algorithms can study and learn the compositional qualities, chord
progressions, instrumentation, dynamic range, or any number of other characteristics that make up a particular genre or style of music, and then on request, generate a completely new composition based on what the algorithms have learned (Moura and Maw, 2021).

1.6 Previous research

Before any work was started on this project, previous research on comparable topics was searched out to help inform on the subject area and for inspirational purposes.

Two noteworthy research papers that explore a similar area to that which this project investigates are “Artificial intelligence became Beethoven: how do listeners and music professionals perceive artificially composed music?”, written by Francisco Tigre Moura and Charlotte Maw, and “Human, I wrote a song for you: An experiment testing the influence of machines’ attributes on the AI-composed music evaluation”, written by Joo-Wha Hong, Katrin Fischer, Yul Ha and Yilei Zeng.

The purpose of Moura and Maw’s research paper is to investigate “listeners’ perceptions towards music composed by AI” (Moura and Maw, 2021). The paper written by Hong et al. investigates “how people perceive AI music generators and evaluate their songs based on different traits they have” (Hong, et al., 2022).

Both research papers have been used as inspiration for this project, especially their use of online surveys for the gathering of data.

Where the primary focus of the two research papers written by Moura and Maw, and Hong, et al. is on people’s perceptions towards AI and AI-generated music, this project aims to not only present information on what AI-music generation services are currently available, but also whether AI-music generation has recached a state where it is difficult for humans to distinguish an AI-generated piece of music from that of a human made piece of music.
2 Method

2.1 Literature study
Regarding the primary purpose of this project, which is to gain an understanding of various aspects surrounding the current state of AI-music generation services, a literature study was primarily used whereby relevant articles, books, research papers and AI-music generation websites were researched to give a clearer picture of the current state of AI-music generation services.

2.2 Music Production and online survey
In order to test the hypotheses set out at the beginning of this project, which is to help gauge the current state of AI-music generation services and whether it is possible for people to correctly identify whether a song is AI-generated or human made, an experiment was devised which entailed the production of one song that was composed, produced, mixed and mastered entirely by a human, and a second song generated in its entirety, with as little human input as possible, by an AI-music generation program called AIVA. These songs were titled Song A and Song B (Connor, 2023).

After the two songs were finished, two identical online surveys were created. One for non-music professionals and the second for music students. The questions in the surveys were identical, enabling direct comparison between the two groups, however separate links for the two surveys were created to make sure the two respondent groups were kept separate. The surveys subsequently went live. The link for the survey intended for non-music professionals was sent to family members, and subsequently shared by these family members to other non-music professionals. The link for the survey intended for music students was posted in the discord forum for the musik- och ljuddesign course shared by Mittuniversitetet, Högskolan Dalarna and Linneuniversitetet students.

The surveys contained a link to both Song A and Song B and asked that the two songs be listened to before filling out the survey. The survey contained the following questions:
1. Which song do you think was AI-created?
2. Why do you think the song you chose in question 1 was AI-created?
3. How would you describe the genre or style of Song A?
4. How would you describe the genre or style of Song B?
5. Using adjectives, for example: ‘happy, sad, dark, epic’ (as many as you feel necessary), describe your perception of Song A
6. Using adjectives, for example: ‘happy, sad, dark, epic’ (as many as you feel necessary), describe your perception of Song B
7. Which of the two songs did you prefer?
8. Why do you prefer the song you chose in question 7?

3 Production

3.1 Human made song

It was decided that the human made song should be created before the AI-generated song to not be influenced by it in any way. The human made song was created solely by me from conception, all the way through to the final master. No AI tools were used in the production of this song.

To ensure sufficient time to publish and receive responses on the survey, a time limit of ten days was given to the production of the song. On the tenth day, the song was completed and exported to a .WAV file.

The software used for the production was Ableton Live. For a full list of software instruments and effects used in the production, see appendix 1.

Two sources of valuable information that were used during the creation, mixing and mastering stages of the human made song were William Moylan’s book ‘Understanding and crafting the mix: The art of recording’ and Roey Izhaki’s book ‘Mixing audio: Concepts|Practices|Tools’.

The production began by simply playing a few chords and chord progressions on a keyboard until the chords and progressions sounded as though they worked well together. Next, a drum track, bassline, arpeggio synth, synth pad, synth organ, a synth bell sound, white noise, and a synth guitar sound were added to
the project and arranged to make a complete song. (I refer to this stage of the production of a song as the ‘Creation’. This simply means that various instruments are combined to create a song, with little to no extra effects or processes applied to the instruments and only rough gain adjusting or levelling is done).

It was decided that the form of the song should be simple, with an intro, verses, choruses, a bridge and ending with a final chorus/outro. Moylan states that “introductions most often foreshadow material from the verse or chorus” (Moylan, 2015. pp. 408), Therefore it was decided that the intro should use some of the same instruments as the verses for cohesion.

(See appendix 2 for images of the Ableton pre-mix ‘Creation’ project).

Once all the instruments and sounds were arranged to make a complete song, all the individual stems (parts that make up the song) were rendered down to .WAV files and subsequently imported back into a blank set in Ableton where various processes such as compression, EQ, limiters and reverb etc. could be applied to the stems and then the whole song could be mixed appropriately. (I refer to this stage of the production of a song as the ‘Mix’).

To help with decisions surrounding when, where, and why to EQ a particular instrument, the entirety of chapter 15 of Izhaki’s book ‘Mixing audio: Concepts|Practices|Tools’ was consulted. However, a diagram containing “subjective terms we associate various frequency ranges with” (Izhaki, 2018. pp. 219) was of the greatest help.

(See appendix 3 for images of the Ableton ‘Mix’ project).

When the mixing stage was finished, the song was rendered down to a stereo .WAV file and subsequently imported back into a blank set in Ableton, where the mastering of the song would take place. Processes such as compression, EQ, limiters, stereo wideners, and harmonic exciters etc. were used to master the song. (I refer to this part of the production of a song as the ‘Master’).

(See appendix 4 for images of the Ableton ‘Master’ project).

The genres or styles appointed to the human made song by me, the creator, are:
1. 80's pop
2. Synthpop
3. Synthwave/vaporwave
4. Electro/Electronic

### 3.2 AI-generated song

The AI-music generation service AIVA was chosen for the generation of a song. The decision to choose AIVA for the generation of a song was based on the following items.

1. A paid tier is not needed to download songs
2. More varied genres/styles than other services
3. Ability to choose tempo and key
4. Ease of use

It was decided that the generated song should have the least amount of human input possible both pre, and post-generation. Therefore, the only human input pre-generation was choosing the style, key, tempo, and length. The only human input post-generation was the addition of iZotope’s Ozone Maximizer to bring the loudness of the song up to that of the human made song.

Within the AIVA desktop application, a new composition was made by clicking:

Create Track > From a Style > 80’s Tokyo Night Pop > Create > G Major > 2’30 – 3’00 > Create Tracks.

*(see appendix 5 for an image that shows the AIVA user interface)*

The reason that this genre was chosen was that, after several song generations in various genres and styles, ‘80’s Tokyo Night Pop’ was the most similar to the human made song’s genre or style.

The key of G Major was chosen as this is the key that the human made song is in.

Once the song was generated, iZotope’s Ozone Maximizer was used to bring the level of the song up to that of the human made song and was subsequently exported to a .WAV file.
The genre or style appointed to the AI-generated song by the AI-music generation program is:

1. 80's Tokyo Night Pop

4 Result

4.1 Current music generation services

4.1.1 What is available?
While there are many AI-music generation tools currently available I have limited my findings to seven of the most popular services. The definition given here of ‘the most popular services’ is based on the top seven results from a Google search on 18/12/2023.

The AI-music generation services included in this research are:

1. AIVA (AIVA, n.d.)
2. SOUNDRAW (SOUNDRAW, n.d.)
3. Soundful (Soundful, n.d.)
4. ecrett Music (ecrett music, n.d.)
5. Boomy (Boomy, n.d.)
6. Loudly (Loudly, n.d.)
7. Wavtool (Wavtool, n.d.)

4.1.2 What do they cost?
The table below details what costs are involved for each of the seven AI-music generation services and the various price tiers.

<table>
<thead>
<tr>
<th>Service</th>
<th>Price Tier 1</th>
<th>Price Tier 2</th>
<th>Price Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIVA</td>
<td>€0</td>
<td>€15 per month</td>
<td>€49 per month</td>
</tr>
</tbody>
</table>
4.1.3 What do they require to make use of songs?
The table below details what is needed to download, and therefore make use of AI-generated songs.

<table>
<thead>
<tr>
<th>Service</th>
<th>Sign up required to download songs</th>
<th>Paid tier required to download songs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIVA</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>SOUNDRAW</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Soundful</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Ecrett Music</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Boomy</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Loudly</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Wavtool</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

4.1.4 What can or cannot be done with them?
The table below contains four of the most common criteria regarding AI-music generation and whether a particular service includes this option or not.
4.1.5 How do the services work?

The majority of the seven chosen services require the user to choose a series of attributes such as genre, mood, theme, duration, tempo, and key. Once all the desired attributes have been chosen, the service will generate one or a series of songs automatically, or the user will be prompted to click a button to generate the song(s).

The only service researched that has a different way of generating music is Wavtool. This service presents itself in the style of a Digital Audio Workstation and has two options for generating music. The first is by adding instrument tracks oneself, choosing the instrument and then clicking a button called “COMPOSE WITH AI”. This then generates a clip containing several notes in a piano roll (the area within a Digital Audio Workstation where MIDI note editing takes place) that can be previewed by hovering over them. If the user likes the generated melody, chord progression or drum pattern, then the user can click it, followed by the “DONE” button to create the clip in the session timeline. However, if the user would like another pattern, the user simply clicks the “RE-GENERATE” button to generate another pattern.
The second way to generate music is by using the app’s built-in AI Chatbot. This enables the user to type in questions and statements whereby the Chatbot will reply accordingly, for example, offering help with the app itself, advice on which instruments, tempos or keys are appropriate for a certain genre or style and suggesting chords. The AI Chatbot will guide the user through the various stages of generating a song.

4.1.6 How much input from a human is required to generate music?
Overall, across all seven of the researched services, very little human input is required to generate music.

Wavtool requires the most human input upfront to generate a complete song as the user is required to either add individual instruments and tracks themselves, and then generate melodies, chords and drum patterns for each instrument or track, or to use the AI Chatbot to guide the user through all these steps. However, even when using the AI Chatbot, the steps are still the same, only it guides the user step-by-step.

For the other six services, generating a complete song can be as simple as choosing a genre, mood or style and clicking a generate button.

While a minimal amount of human input is needed to generate music with these seven services, two of these services have robust post-generation manipulation tools. These two services are AIVA and Wavtool. Due to both AIVA and Wavtool presenting themselves as a Digital Audio Workstation (AIVA: in “editor” mode), the option for editing the generated music is far greater than the other researched services.

4.1.7 How can the music be used post-generation?
How the music can be used post-generation is dependent on which service is used to generate music, which tier is chosen and the service’s terms and conditions.
The following seven tables detail how the AI-generated music can be used post-generation for the respective AI-music generation services’ price tiers.

### AIVA

<table>
<thead>
<tr>
<th>Price Tier 1 (€0)</th>
<th>Price Tier 2 (€15/month)</th>
<th>Price Tier 3 (€49/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyright owned by AIVA</td>
<td>Copyright owned by AIVA</td>
<td>Copyright owned by YOU</td>
</tr>
<tr>
<td>No monetization</td>
<td>Limited monetization</td>
<td>Full monetization</td>
</tr>
<tr>
<td>Credit must be given to AIVA</td>
<td>No need to credit AIVA</td>
<td>No need to credit AIVA</td>
</tr>
<tr>
<td>3 downloads per month</td>
<td>15 downloads per month</td>
<td>300 downloads per month</td>
</tr>
<tr>
<td>Track durations up to 3 minutes</td>
<td>Track durations up to 5 minutes</td>
<td>Durations up to 5 minutes 30 secs</td>
</tr>
<tr>
<td>Download MP3 &amp; MIDI formats</td>
<td>Download MP3 &amp; MIDI formats</td>
<td>Download ALL file formats</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Export high quality WAV files</td>
</tr>
</tbody>
</table>

### SOUNDRAW

<table>
<thead>
<tr>
<th>Price Tier 1 (€0)</th>
<th>Price Tier 2 ($19.99/month)</th>
<th>Price Tier 3 ($39.99/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate unlimited songs</td>
<td>Background music for your content: Videos, podcasts, games &amp; other Social media</td>
<td>Add vocals to our beats and make songs Distribute to Spotify, Apple music, etc Unlimited audio streams</td>
</tr>
<tr>
<td>Bookmark songs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV, Radio, etc</td>
<td>You keep the royalties</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------</td>
<td></td>
</tr>
<tr>
<td>Unlimited downloads</td>
<td>Up to 30 downloads per month</td>
<td></td>
</tr>
<tr>
<td>Royalty-free</td>
<td>Simple, transparent license</td>
<td></td>
</tr>
<tr>
<td>No copyright strikes</td>
<td>No copyright strikes</td>
<td></td>
</tr>
<tr>
<td>Commercial and personal use</td>
<td>Keep the license forever</td>
<td></td>
</tr>
</tbody>
</table>

### Soundful

<table>
<thead>
<tr>
<th><strong>Price Tier 1 (€0)</strong></th>
<th><strong>Price Tier 2 (€59.99/year)</strong></th>
<th><strong>Price Tier 3 (€59.99/year (sale))</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to 25+ free styles</td>
<td>Access to premium content</td>
<td>Access to premium content</td>
</tr>
<tr>
<td>3 downloads/month</td>
<td>Unlock 150+ styles</td>
<td>Unlock 150+ styles</td>
</tr>
<tr>
<td>1 STEM pack/month</td>
<td>100 downloads/month</td>
<td>300 downloads/month</td>
</tr>
<tr>
<td>For non-profit and personal use only</td>
<td>1 STEM pack/month</td>
<td>10 STEM pack/month</td>
</tr>
<tr>
<td>Non-exclusive license for tracks you create</td>
<td>Non-exclusive license for tracks you create</td>
<td>Exclusive license for tracks you create</td>
</tr>
<tr>
<td>Publish content for business and digital adds</td>
<td>Publish content for business and digital adds</td>
<td>Copyright available for purchase</td>
</tr>
<tr>
<td>Covered for social media, online platforms and websites</td>
<td>Covered for social media, online platforms and websites</td>
<td>Unlimited monetization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEM pack included with purchase</td>
</tr>
</tbody>
</table>
### Ecrett music

<table>
<thead>
<tr>
<th>Price Tier 1 (€0)</th>
<th>Price Tier 2 (€7.99/month)</th>
<th>Price Tier 3 (€24.99/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Download preview music for free</td>
<td>Download unlimited royalty free music</td>
<td>Download unlimited royalty free music</td>
</tr>
<tr>
<td>Save and manage music you created</td>
<td>Use music for commercial projects</td>
<td>Use music for commercial projects</td>
</tr>
<tr>
<td>Receive updates, promos and more!</td>
<td>Use music for YouTube monetization</td>
<td>Use music for YouTube monetization</td>
</tr>
<tr>
<td></td>
<td>License applies to the individual</td>
<td>License applies to the company</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boomy</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Price Tier 1 (€0)</th>
<th>Price Tier 2 (€9.99/month (sale))</th>
<th>Price Tier 3 (€29.99/month (sale))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create and edit songs</td>
<td>Create and edit songs</td>
<td>Create and edit songs</td>
</tr>
<tr>
<td>Access to basic song editing tools</td>
<td>Access to advanced song editing tools</td>
<td>Access to advanced song editing tools</td>
</tr>
<tr>
<td>25 song saves</td>
<td>500 song saves</td>
<td>Unlimited song saves</td>
</tr>
<tr>
<td>3 releases</td>
<td>5 releases per month (up to 15 total)</td>
<td>Expediated release review</td>
</tr>
<tr>
<td>Up to 12 songs per release</td>
<td>Up to 25 songs per release</td>
<td>10 releases per month</td>
</tr>
<tr>
<td>No downloads</td>
<td>Expediated release review</td>
<td>Up to 25 songs per release</td>
</tr>
<tr>
<td>No commercial use</td>
<td>MP3 downloads (10 per month)</td>
<td>25 MP3 &amp; WAV downloads per month</td>
</tr>
<tr>
<td>Price Tier 1 (€0)</td>
<td>Price Tier 2 (€14.99/month)</td>
<td>Price Tier 3 (€39.99/month)</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>25 AI song generations per month</td>
<td>Everything in Free plus: 300 AI song generations per month maximum 210 second songs 300 downloads per month High quality WAV 5 stem packs per month License covers all social media, livestreams, podcasts Monetize all your channels including YouTube Certified music license PDF</td>
<td>Everything in Personal plus: Generate unlimited tracks per month maximum 420 second songs 500 downloads per month 20 stem packs per month Full license coverage includes: Paid digital advertising media Client work Mobile apps and websites</td>
</tr>
<tr>
<td>Access to the full song catalog</td>
<td>Corporate &amp; branded Media</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combine with visual NFTs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indie games</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wavtool</th>
<th>Price Tier 1 (€0)</th>
<th>Price Tier 2 (€10/month)</th>
<th>Price Tier 3 (€20/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core DAW features</td>
<td>Core DAW features</td>
<td>Core DAW features</td>
<td>Core DAW features</td>
</tr>
<tr>
<td>Conductor Chatbot</td>
<td>Conductor Chatbot</td>
<td>Conductor Chatbot</td>
<td>Conductor Chatbot</td>
</tr>
<tr>
<td>Cloud saves</td>
<td>Cloud saves</td>
<td>Cloud saves</td>
<td>Cloud saves</td>
</tr>
<tr>
<td>Basic skills</td>
<td>Basic skills</td>
<td>Basic skills</td>
<td>Basic skills</td>
</tr>
<tr>
<td>Composer AI</td>
<td>Composer AI</td>
<td>Composer AI</td>
<td>Composer AI</td>
</tr>
<tr>
<td>Stem split</td>
<td>Stem split</td>
<td>Stem split</td>
<td>Stem split</td>
</tr>
<tr>
<td>Audio generation</td>
<td>Audio generation</td>
<td>Audio generation</td>
<td>Audio generation</td>
</tr>
<tr>
<td>Prototype execution</td>
<td>Prototype execution</td>
<td>Prototype execution</td>
<td>Prototype execution</td>
</tr>
</tbody>
</table>

4.2 Online survey

Two identical surveys containing the same questions were sent to non-music professionals and music students.

See appendix 6 for an image of the survey and questions.
4.2.1 Non-music professionals

The survey that was sent out to non-music professionals received a total of sixteen responses. Of the sixteen responses, 87.5% (fourteen individuals) correctly identified that Song A was AI-generated, while 12.5% (two individuals) identified Song B as AI-generated.

These results do not support hypothesis 1.

With regards to question 2 of the survey (why do you think the song you chose in question 1 was AI-created?), there were recurring themes among the responses of those that correctly identified Song A as the AI-generated song.

The table below shows fourteen respondent’s answers as to why they thought Song A was AI-generated.

<table>
<thead>
<tr>
<th>Question 2</th>
<th>Why do you think the song you chose in question 1 was AI-created?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(non-music professionals)</td>
<td></td>
</tr>
<tr>
<td>Respondent</td>
<td>Reason/Answer (summarised)</td>
</tr>
<tr>
<td>Respondent 1 (chose Song A as AI-generated)</td>
<td>Disjointed</td>
</tr>
<tr>
<td>Respondent 2 (chose Song A as AI-generated)</td>
<td>Less variation (than Song B)</td>
</tr>
<tr>
<td>Respondent 3 (chose Song A as AI-generated)</td>
<td>Missing a plot</td>
</tr>
<tr>
<td>Respondent 5 (chose Song A as AI-generated)</td>
<td>Simpler (than Song B)</td>
</tr>
<tr>
<td>Respondent 6 (chose Song A as AI-generated)</td>
<td>More unmelodic (Than Song B)</td>
</tr>
<tr>
<td>Respondent 7 (chose Song A as AI-generated)</td>
<td>Randomness/jarred sounds/ lazy and random/abrupt ending</td>
</tr>
<tr>
<td>Respondent 8 (chose Song A as AI-generated)</td>
<td>Lack of direction</td>
</tr>
<tr>
<td>Respondent 9 (chose Song A as AI-generated)</td>
<td>Very technical</td>
</tr>
<tr>
<td>Respondent 10 (chose Song A as AI-generated)</td>
<td>Sounded bad</td>
</tr>
<tr>
<td>Respondent 11 (chose Song A as AI-generated)</td>
<td>Irregular</td>
</tr>
<tr>
<td>Respondent 13 (chose Song A as AI-generated)</td>
<td>More random/less thought-out structure (Than Song B)</td>
</tr>
<tr>
<td>Respondent 14 (chose Song A as AI-generated)</td>
<td>More generic (Than Song B)</td>
</tr>
</tbody>
</table>
One can see that some of the respondents that correctly identified Song A as AI-generated had similar answers explaining why they thought Song A was AI-generated. For example, respondents 7 and 13 both mention randomness and respondent 3 mentions that the song is missing a plot while respondent 8 mentions that the song has a lack of direction.

For the two respondents that incorrectly identified Song B as AI-generated, their answers as to why they thought Song B was AI-generated were not as similar.

The table below shows the two respondent’s answers as to why they thought Song B was AI-generated.

| Respondent 15 (chose Song A as AI-generated) | Less realistically human (Than Song B) |
| Respondent 16 (chose Song A as AI-generated) | Cold/soulless |

### Question 2

**Why do you think the song you chose in question 1 was AI-created?**

* (non-music professionals)

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Reason/Answer (summarised)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 4 (chose Song B as AI-generated)</td>
<td>AI samples from other music so Song B possibly a mix of other songs</td>
</tr>
<tr>
<td>Respondent 12 (chose Song B as AI-generated)</td>
<td>More variance (than Song A) (Respondent associates variance with AI-generated work)</td>
</tr>
</tbody>
</table>
Question 3 of the survey (how would you describe the genre or style of Song A?) was included to help gauge how well an AI-generated song could mimic or approximate a chosen genre or style, and whether respondents would be able to identify the general genre or style.

Since the AI-generated song has a very specific genre or style (80’s Tokyo Night Pop), it could not be reasonably expected for any of the respondents to correctly, word for word, identify the genre or style of the song and therefore the following general genres or styles are to be deemed correct:

1. 80’s
2. Synth pop
3. Electro/electronica
4. Synthwave/vaporwave
5. Any combination of the above

The table below shows all respondent’s answers regarding what genre or style they would give to Song A.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 1</td>
<td>Electropop</td>
</tr>
<tr>
<td>Respondent 2</td>
<td>Electronic</td>
</tr>
<tr>
<td>Respondent 3</td>
<td>Computeristic</td>
</tr>
<tr>
<td>Respondent 4</td>
<td>Robotic</td>
</tr>
<tr>
<td>Respondent 5</td>
<td>Techno/Europop</td>
</tr>
</tbody>
</table>
These results show that 31.25% of respondents correctly identified the general genre or style of Song A leaving 68.75% of respondents that did not correctly identify the general genre or style of Song A.

These results do not support *hypothesis 2*.

Regarding question 7 (which of the two songs did you prefer?) of the *survey*, of the sixteen responses, 93.8% of respondents preferred the human made song (Song B) leaving 6.3% of respondents preferring the AI-generated song (Song A).
These results support hypothesis 5.

4.2.2 Music students/music professionals

The survey that was sent out to music students received a total of thirteen responses. Of the thirteen responses, 69.2% (nine individuals) correctly identified that Song A was AI-generated, leaving 30.8% (four individuals) that incorrectly identified Song B as AI-generated.

These results do not support hypothesis 3.

With regards to question 2 of the survey (why do you think the song you chose in question 1 was AI-created?), there were some recurring themes among the responses of those that correctly identified Song A as the AI-generated song.

The table below shows the respondent’s answers as to why they thought Song A was AI-generated.
<table>
<thead>
<tr>
<th><strong>Respondent</strong></th>
<th><strong>Reason/Answer (summarised)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 1 (chose Song A as AI-generated)</td>
<td>Less emotional (than Song B), observations on overall dynamic and waveform being very even</td>
</tr>
<tr>
<td>Respondent 2 (chose Song A as AI-generated)</td>
<td>Lacks finish and finesse, flat and dry</td>
</tr>
<tr>
<td>Respondent 3 (chose Song A as AI-generated)</td>
<td>Worse sound quality (than Song B), sounds like MP3 quality, lifeless, generic chord sequences, flat</td>
</tr>
<tr>
<td>Respondent 4 (chose Song A as AI-generated)</td>
<td>Robotic sounding mix, felt auto generated</td>
</tr>
<tr>
<td>Respondent 6 (chose Song A as AI-generated)</td>
<td>Less full sounding (than Song B), too much repetition</td>
</tr>
<tr>
<td>Respondent 7 (chose Song A as AI-generated)</td>
<td>Not logical</td>
</tr>
<tr>
<td>Respondent 8 (chose Song A as AI-generated)</td>
<td>Not as engaging</td>
</tr>
<tr>
<td>Respondent 9 (chose Song A as AI-generated)</td>
<td>Generic, lack of consistent melodies and structure</td>
</tr>
</tbody>
</table>
One can see that some of the respondents that correctly identified Song A as AI-generated had similar answers explaining why they thought Song A was AI-generated. For example, respondents 1 and 10 both mention the dynamic elements of the song’s waveform and respondents 2 and 10 both mention that it sounded flat.

For the respondents that incorrectly identified Song B as AI-generated, their answers as to why they thought Song B was AI-generated were not as similar.

The table below shows the respondent’s answers as to why they thought Song B was AI-generated.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Reason/Answer (summarised)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 5 (chose Song B as AI-generated)</td>
<td>Song A has more unconventional choices in progressions etc. indicating human error/interpretation</td>
</tr>
<tr>
<td>Respondent 11 (chose Song B as AI-generated)</td>
<td>Very clear form/arrangement indicating AI-created</td>
</tr>
<tr>
<td>Respondent 12 (chose Song B as AI-generated)</td>
<td>Not Mixed as well or as thoughtful about details (as Song A)</td>
</tr>
</tbody>
</table>
Respondent 13 (chose Song B as AI-generated)  Can hear more references to other songs

Question 3 of the survey (how would you describe the genre or style of Song A?) is included in this survey also to help gauge how well an AI-generated song could mimic or approximate a chosen genre or style, and whether respondents would be able to identify the general genre or style.

Since the AI-generated song has a very specific genre or style (80’s Tokyo Night Pop), it could not be reasonably expected for any of the respondents to correctly, word for word, identify the genre or style of the song and therefore the following general genres or styles are to be deemed correct:

1. 80’s
2. Synth pop
3. Electro/electronica
4. Synthwave/vaporwave
5. Any combination of the above

The table below shows all respondent’s answers regarding what genre or style they would give both Song A and Song B.

<table>
<thead>
<tr>
<th>Question 3</th>
<th>How would you describe the genre or style of Song A? (Music students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent</td>
<td>Answer</td>
</tr>
<tr>
<td>Respondent 1</td>
<td>80’s action movie music</td>
</tr>
<tr>
<td>Respondent 2</td>
<td>Club music/house</td>
</tr>
</tbody>
</table>
This result shows that 61.5% of respondents correctly identified the general genre or style of Song A leaving 38.5% of respondents that did not correctly identify the general genre or style of Song A.

These results do not support hypothesis 4.

Regarding question 7 (which of the two songs did you prefer?) of the survey, of the thirteen responses, 92.3% of respondents preferred the human made song (Song B) leaving 7.7% of respondents preferring the AI-generated song (Song A).
These results support hypothesis 5.

5 Conclusion

5.1 Current music generation services

There is currently an extensive range of AI-music generation services available, and all with a wide variety of pricing tiers. These tiers can range from completely free, all the way up to forty-nine Euros per month. Out of the seven services researched, five of these services require either the creation of an account, or a subscription to one of the paid tiers to download any generated music. However, for two of the services (Loudly and Wavtool), this is not the case. With these two services, it is possible to both generate music, and to download the generated music without any sign up, account creation or subscription to a paid tier.

The wide variety of pricing tiers and whether one needs to sign up, create an account or subscribe to a paid tier does not, from the description of the benefits, seem to correlate directly to the quality of the generated music. When looking at the differences between the pricing tiers for each of the services, it does not mention that with a paid tier, the generated music will for example be of a better quality, more realistic sounding or be any different to the music generated with a free tier. This is the same for the differences between the paid tiers. Again, there is no mention that with the highest paid tier, the generated music will be any different than that generated with a mid-range tier for example.
This indicates that there is no difference in the quality or complexity of generated music between pricing tiers and that the differences between tiers are more to do with, among other things, monetization opportunities, copyright ownership, how many songs can be downloaded, quality of audio formats, song length and whether credit to the company or service needs to be given.

When choosing the criteria for the generated music, the four most common criteria that the majority of the seven services shared was:

- Generation based on chosen genre/style
- Generation based on chosen mood/theme
- The choice of tempo
- The choice of key – major/minor

This shows that currently, while minimal, at least some human input is required to generate music using these seven services.

### 5.2 Hypotheses and online survey

Considering *hypothesis 1* was not supported, this could allude to several conclusions. Firstly, the result shows that the majority of non-music professionals who responded were able to correctly identify which music was generated by AI and which was made by a human. Secondly, the result could indicate that I have underestimated the knowledge, analytical abilities, and awareness that non-music professionals possess regarding music. And finally, that non-music professionals may have had more exposure to AI-generated music than previously expected.

Genres and styles of music have become increasingly difficult to determine in recent years due to the amount of sub genres and the combination of various genres and styles. The AI-generated song was generated using a very specific genre or style as a prompt (80’s Tokyo Night Pop), therefore, as *hypothesis 2* was not supported, one conclusion that can be drawn based on this result is that, at least with the service used, the AI-generated song was able to approximate a very niche genre and style, making it difficult for most of the non-music professionals to identify.
Regarding *hypothesis 3*, as 69.2% of respondents correctly identified the AI-generated song as opposed to the 100% that I hypothesised, this could indicate many things. Firstly, that I could have overestimated my preconceptions regarding music student’s knowledge, analytical abilities, and awareness of AI-generated music. Secondly, that currently, at least with the music students that responded in this research, AI-generated music is far better at approximating human made music than previously expected. And finally, that potentially less music students may have been previously exposed to AI-generated music than non-music professionals in this research and this is why the results show that a higher percentage of non-music professionals were able to identify the AI-generated song compared with music students (87.5 for non-music professionals and 69.2% for music students).

The result that *hypothesis 4* was not supported, and the conclusions based on this result, can be viewed in a similar way to the result and conclusions for *hypothesis 2*. That is to say that at least with the service used, the AI-generated song was able to approximate a very niche genre and style, making it difficult for some music students to identify. However, a notable difference between the results of the music students and non-music professionals regarding the identification of the AI-generated song’s genre or style is that the majority of music students (around 61.5%) were able to identify the general genre or style of the AI-generated song, while the majority of non-music professionals (around 68.7%) were unable to identify the general genre or style of the AI-generated song. A conclusion based on these results could certainly be that, within this research and compared to the non-music professionals, the music students have a better understanding of genres and styles within music. However, because of this factor, it is more difficult to draw conclusions about how good or bad the AI-music generation service is at approximating genres or styles.

Lastly, since *hypothesis 5* was supported, the conclusion that can be drawn from this result is that within the scope of this research, human made music is still preferred over AI-generated music by the majority of both non-music professionals and music students.
6 Discussion

The results from the literature-based research on the current state of AI-music generation services gives a deeper insight into, and a better understanding of what AI-music generation services are currently available, including what they cost, what is required of the user to make use of the generated music, what can be done with the generated music post-generation and how the music generation works in practice. By researching these AI-music generation services, I feel that the first research question regarding this project has partly been answered satisfactorily. The word ‘partly’ is used here as, while seven AI-music generation services were researched, only one song from one service was generated and tested by way of a survey and this makes it difficult to draw definitive conclusions regarding the current state of all AI-music generation services. However, the research has given a better understanding of the seven AI-music generation services researched. As these seven services were the most popular at the time of the Google search, I feel that they made a good sample to test as a starting point.

Regarding the second area of focus for this research, whether non-music professionals and music students can correctly identify what music is AI-generated and what is human made, I feel that the data collected from the online survey has satisfactorily answered this question. However, since the sample bases for both non-music professionals and music students were so small, I feel that the data gathered, the results found, and the conclusions drawn are only of worth within the scope of this project.

To generalise on a wider scale, much larger sample bases would be needed, with a wider range of people and a wider selection of both AI-generated music and human made music. This wider selection of both AI-generated music and human made music should be selected from several different AI-music generation services, from several different human musicians/artists and in several different genres or styles. Only then would the results be more indicative of ‘people in general’ or ‘AI-music generation services in general’.

If the research were to be conducted again, much greater emphasis would be placed on collecting data from a larger and wider sample base. This would
enable the research to generalise much more than it can currently and perhaps even be used statistically.

In the future, further research on the topics discussed in this project is certainly of worth as there are already many different AI-music generation services available and more can be expected to appear in the future. It is reasonable to assume that AI-music generation services in general will become much more robust and better at generating quality music, and that there will be more services available than there are currently.

It is to be expected that AI-generated music will be of a much higher quality going forward and much better at approximating human made music, which will make it even more difficult for people to correctly identify what music is AI-generated and what music is human made. One can also expect AI-generated music to be used in a variety of new ways, both privately and commercially, making further research almost mandatory, especially within the realm of ethics.

It is entirely reasonable to believe that the very minimal human input that is required to generate music using these seven services would appeal to a wide range of people, businesses, or other services. For example, people that wish to create their own music, but have little practical knowhow or knowledge on the subject would be able to generate their own song in a matter of seconds. A company that would like to use music for an advertisement or similar can generate a song, use the song however they wish and own the rights to the song for a fraction of the price it would cost to use a song owned by another creator. A musician, struggling with writer’s block or finding it difficult to be creative, can use a generated song as a source of inspiration or to induce creativity. There are many uses for music generated with these services.

As it stands currently, the quality of music that can be generated using these services can vary widely depending on which service is used. However, while all the music generated by these services is serviceable, that is to say that they are highly usable in a number of situations, the majority of them still ‘sound’ AI-generated and somewhat robotic, and it would take some human input and manipulation post-generation to make the music sound more ‘human’.
7 Ethical aspects

Since this project contains interaction with the public by way of online surveys, it is important to keep in mind ethical considerations. For reasons regarding the managing and collation of data collected from the answered online surveys, it was felt necessary that a first name and surname be required to submit the answered survey. The respondent could by all means create a pseudonym or even type in their initials, however, to belay any fears, anxieties or apprehension, it was stated in the surveys quite clearly that any names will not be published and are only for informational purposes when collating data.

Not only was the decision made to keep names or any other personal information out of publication, the decision was also made that all data from the surveys, and the surveys themselves, be deleted in entirety upon full completion of the project.
8 Reference list

ARTICLES


Ling, T. (2021) AI is about to shake up music forever – but not in the way you think. BBC Science Focus. https://www.sciencefocus.com/science/ai-music-future


BOOKS


WEBPAGES

AIVA. (n.d.). https://www.aiva.ai/ [14/01/2024]


## 9 Appendix

### Appendix 1.

Full list of instruments and effects used in the human made song (Song B)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Compressor/Limiter</th>
<th>EQ</th>
<th>Reverb/Delay</th>
<th>Other Effects</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Instruments Massive</td>
<td>Softube VC 76</td>
<td>iZotope Neutron 2 Equalizer</td>
<td>Softube RC 24</td>
<td>Ableton Live Arpeggiator</td>
<td>Youlean Loudness Meter 2</td>
</tr>
<tr>
<td>Linn drum samples/ Roland TR-707 samples</td>
<td>Ableton Live Compressor</td>
<td>Ableton Live EQ8</td>
<td>Valhalla Supermassive</td>
<td>Native Instruments FM8 FX</td>
<td>Blue Cat Audio FeqAnalyst</td>
</tr>
<tr>
<td>Native Instruments FM8</td>
<td>iZotope Neutron 2 Transient Shaper</td>
<td>iZotope Ozone 8 Equalizer</td>
<td>Ableton Live Delay</td>
<td>iZotope Neutron 2 Exciter</td>
<td>Sonarworks SoundID Reference</td>
</tr>
<tr>
<td>Vital Audio Vital</td>
<td>Softube Vari Comp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dirty LA</td>
<td></td>
<td></td>
<td></td>
<td>iZotope Ozone 8 Imager</td>
</tr>
<tr>
<td></td>
<td>Thrillseeker LA mk II</td>
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Appendix 2. (Ableton ‘Creation’ Project)

Appendix 3. (Ableton ‘Mix’ Project and example of effects)
Appendix 4. (Ableton ‘Master’ Project and effects chain)
Appendix 4. (Continued)

Appendix 5. (AIVA’s user interface for song generation)
Appendix 6. (Survey)

Please use the following link to listen to Song A and Song B before filling out the survey: https://on.soundcloud.com/VuHwb

You have listened to two songs. One was created by a human and the other was generated in its entirety using AI. Please answer the following questions.

1. Which song do you think was AI-created?
   - [ ] Song A
   - [ ] Song B

2. Why do you think the song you chose in question 1 was AI-created?
   Long answer text

3. How would you describe the genre or style of Song A?
   Long answer text

4. How would you describe the genre or style of Song B?
   Long answer text

5. Using adjectives, for example: happy, sad, dark, epic (as many as you feel necessary), describe your perception of Song A.
   Long answer text

6. Using adjectives, for example: happy, sad, dark, epic (as many as you feel necessary), describe your perception of Song B.
   Long answer text

7. Which of the two songs did you prefer?
   - [ ] Song A
   - [ ] Song B

8. Why do you prefer the song you chose in question 7?
   Long answer text