

HARMONIC SPLIT - WEB APPLICATION FOR AUDIO PROCESSING

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Abstract:

We utilized artificial intelligence to generate high-quality music resources like acapella and backing tracks for artists. Additionally, we developed a precise guitar tuner algorithm using advanced frequency sorting and FFT analysis. Our innovations promise to transform the music industry by providing musicians with the tools to create and perform their art more effectively.

Am utilizat inteligența artificială pentru a genera resurse muzicale de înaltă calitate, precum acapella și piese de acompaniament, prin intermediul unor algoritmi avansați de învățare automată. În plus, am dezvoltat un algoritm precis de acordaj pentru chitare, bazat pe sortarea avansată a frecvențelor și analiza FFT a semnalelor audio. Aceste inovații reprezintă o contribuție semnificativă în domeniul tehnologiei muzicale, oferind instrumente deosebit de utile pentru muzicieni în crearea și interpretarea operei lor.

Keywords: Artificial Intelligence, Tuner, Audio, Processing, Music

1. Introduction

As more and more people are starting to see the benefit of AI in places like text generation - OpenAI's ChatGPT, image generation – DALL-E, Stable Diffusion and even sound – Lyrebird and DeepZen, Harmonic Split comes in utilizing the power of AI and mathematics to become the one-stop shop for audio processing.

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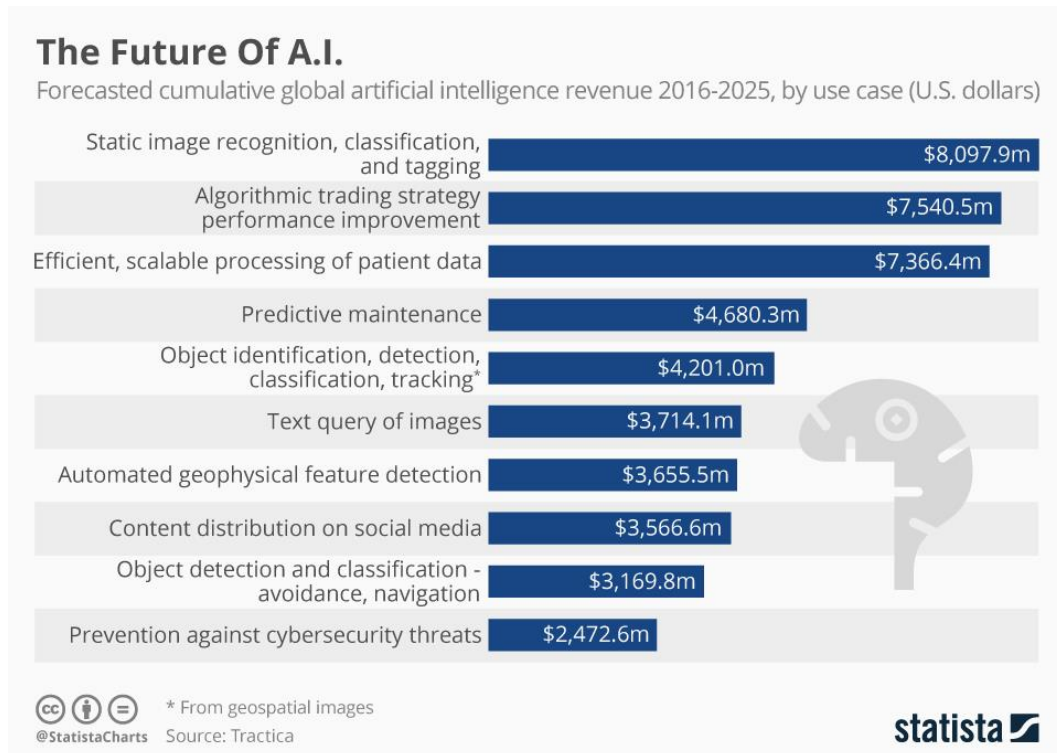


Fig. 1. Source: Armstrong, Martin. "The Future Of A.I.." Digital image. November 18, 2016. Accessed May 04, 2023.

<https://www.statista.com/chart/6810/the-future-of-ai/>

2. Paper contents

1. Audio Splitter

Using the power of AI, more accurately of the Spleeter's pretrained model – 5 stems version, successfully integrated into a web application running on a windows machine, any user can split various formats of songs (mp3, wav, aiff, flac, m4a, ogg)

2. Guitar Tuner

With the help of mathematical formulas, we implemented a real time, super accurate guitar tuner using JavaScript, making tuning a guitar as easy as just going to the Web Application and simply using the guitar.

3. Tuner

A couple mathematical equations used to find the pitch of the sounds captured by the microphone:

$$f = f_0 \cdot 2^{i/12}$$

$$12 \cdot \log_2 \left(\frac{f_i}{f_o} \right) = i$$

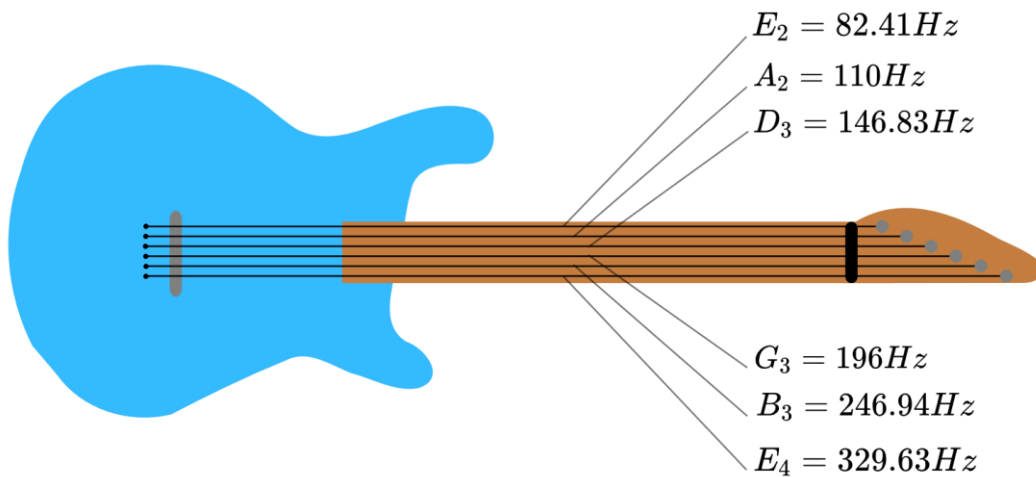


Fig. 2. Source: Programming a Guitar Tuner with Python by chciken on GitHub

4. AI Model

The AI model is the 5-stem model trained by Deezer^[1] and implemented using Spleeter^[2] a library made for Python by the same company. This has been used in multiple projects before:

- [iZotope](#) – Music Rebalance feature within **RX 8**
- [Acon Digital](#) – in **Acoustica 7**
- [VirtualDJ](#) – in their stem isolation feature
- [Algoriddim](#) – in their **NeuralMix** and **djayPRO** app suite

5. Creation of the Web Application

The backend of the Harmonic Split is made using Python and JavaScript.

```
from flask import Flask, render_template, flash, redirect,
url_for, request, send_file, jsonify
from werkzeug.utils import secure_filename
import os
import queue
import split_song
from pathlib import Path

q = queue.Queue()
UPLOAD_FOLDER = 'D:/Uni/Uploads'
ALLOWED_EXTENSIONS = {'mp3', 'wav', 'aiff', 'flac', 'm4a', 'ogg'}
key = os.urandom(12).hex()
app = Flask(__name__)
app.config['UPLOAD_FOLDER'] = UPLOAD_FOLDER
app.config.update(
    TESTING=True,
    SECRET_KEY=key
)

def allowed_file(filename):
    return '.' in filename and \
        filename.rsplit('.', 1)[1].lower() in ALLOWED_EXTENSIONS

@app.route("/")
def home():
    return render_template('main.html')
```

Fig. 3. The beginning of the Flask Application in the “flask_main.py” file

And the frontend is made using HTML, CSS, and JavaScript

```
<!DOCTYPE html>
<html>
  <head>
    <title>Harmonic Split</title>
    <!-- Add Bootstrap CSS -->
    <link rel="stylesheet"
```

```

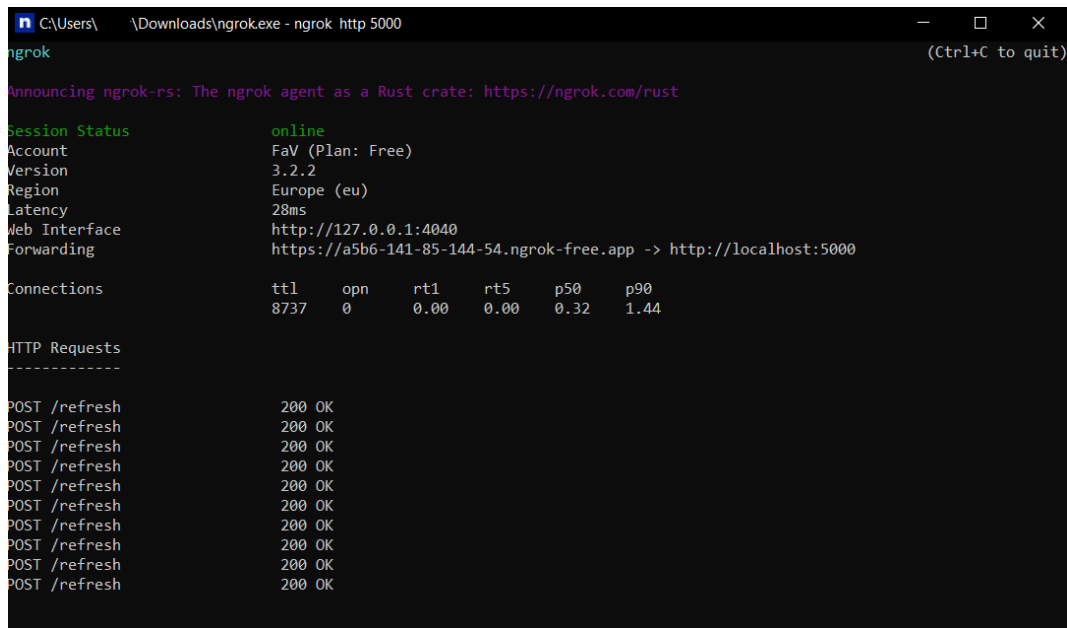
href="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/css/boots
trap.min.css">
</head>
<body>
  <!-- Navbar -->
  <nav class="navbar navbar-expand-lg navbar-light bg-light">
    <a class="navbar-brand" href="#">Harmonic Split</a>
    <button class="navbar-toggler" type="button" data-
toggle="collapse" data-target="#navbarNav" aria-
controls="navbarNav" aria-expanded="false" aria-label="Toggle
navigation">
      <span class="navbar-toggler-icon"></span>
    </button>
    <div class="collapse navbar-collapse" id="navbarNav">
      <ul class="navbar-nav mr-auto">
        <li class="nav-item">
          <a class="nav-link"
href="{{url_for('home')}}">Home</a>
        </li>
        <li class="nav-item">
          <a class="nav-link"
href="{{url_for('splitter')}}">Splitter</a>
        </li>
        <li class="nav-item">
          <a class="nav-link"
href="{{url_for('tuner')}}">Tuner</a>
        </li>
      </ul>
    </div>
  </nav>

  <!-- Add Bootstrap JS and jQuery -->
  <script src="https://code.jquery.com/jquery-
3.3.1.slim.min.js"></script>
  <script
src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.14.7/umd/p
opper.min.js"></script>
  <script
src="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/js/bootstr
ap.min.js"></script>
</body>
</html>

```

Fig. 4. The Base HTML file for the frontend

The Web Application is hosted on a Windows computer and is made publicly available using Ngrok's ^[3] free tier which forwards all traffic sent through a link created by them to the localhost



```
C:\Users\ \Downloads\ngrok.exe - ngrok http 5000
ngrok
Announcing ngrok-rs: The ngrok agent as a Rust crate: https://ngrok.com/rust

Session Status      online
Account             FaV (Plan: Free)
Version             3.2.2
Region              Europe (eu)
Latency              28ms
Web Interface        http://127.0.0.1:4040
Forwarding           https://a5b6-141-85-144-54.ngrok-free.app -> http://localhost:5000

Connections          ttl    opn    rt1    rt5    p50    p90
                    8737   0      0.00   0.00   0.32   1.44

HTTP Requests
-----
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
POST /refresh        200 OK
```

Fig. 5. The CLI of Ngrok while it's active.

5. Results and Layout of the page

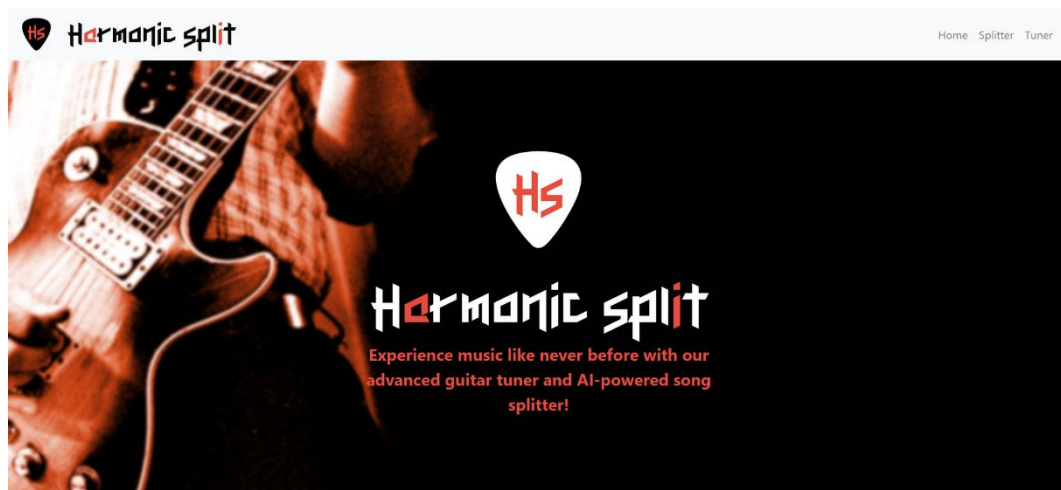


Fig. 6. The Main Landing Page

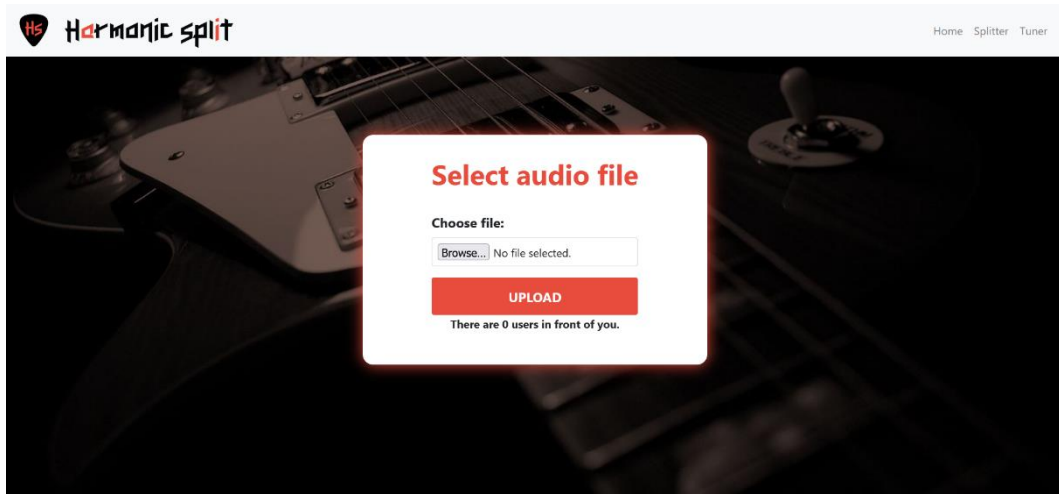


Fig. 7. The Audio Splitter Page

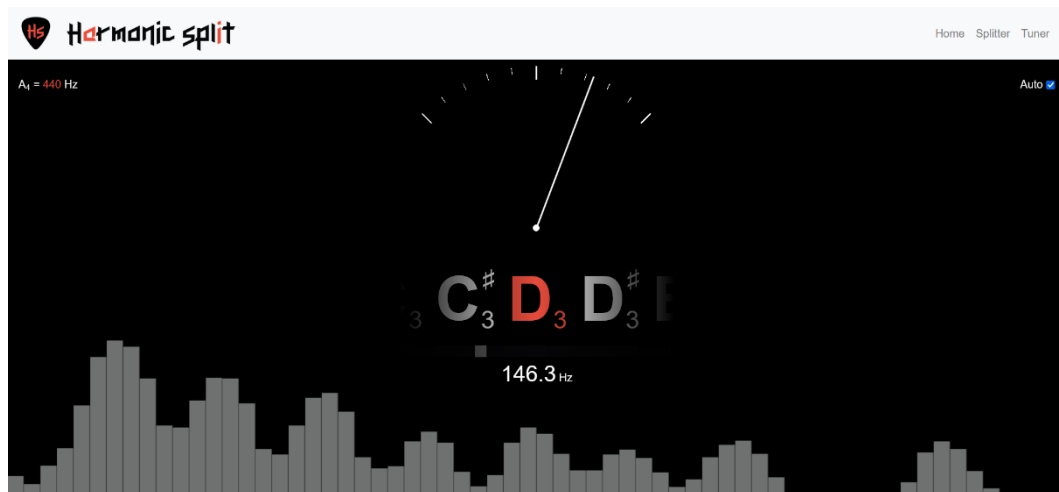


Fig. 8. The Guitar Tuner Page

6. Conclusions

The Web Application is an easy to use, AI powered song splitter and mathematically powered guitar tuner that can be easily updated to include more functionality.

REFERENCES

The multimedia content (e.g., images or video material) used for this platform is not used for commercial purposes, but for educational purposes and only for presentation during the Scientific Communication Session.

- [1]. <https://www.deezer.com> – Creators of the AI model
- [2]. <https://github.com/deezer/spleeter> – The GitHub page for the AI implementation
- [3]. <https://ngrok.com/> – Serving the Web Application publicly
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- [7]. Romain Hennequin and Anis Khelif and Felix Voituret and Manuel Moussallam, *Spleeter: a fast and efficient music source separation tool with pre-trained models*, *Journal of Open-Source Software* 2020, Volume 5, Number 50, <https://doi.org/10.21105/joss.02154> - Spleeter creators and the article it's published in
- [8]. <https://www.chciken.com/digital/signal/processing/2020/05/13/guitar-tuner.html> – The main concept for guitar tuner that's used as a base and modified, made by not-chciken – <https://github.com/not-chciken>