pianAI: Research Document Draft

Notes: Add further to project benefits section, as well as more detail to technologies used section once more information is available.

Overview:

pianAI is a digital piano learning tool that uses a devices camera and microphone to provide feedback to users learning the fundamentals of the instrument. It leverages OpenCV to monitor hand and wrist position of the user, as well as tracks incoming MIDI and audio data that can be compared against existing MIDI Data to check for correct playing and dynamics (changes of volume used in music). It is currently implemented as a web application to allow for a wide range of devices to use it.

Existing Solutions:

Prior to the inception of pianAI, piano teaching tools were primarily mobile apps or in person lessons. Mobile apps relied on the device microphone and comparison between what a user plays and what the music states. They also often had a fundamentals-based approach, teaching users the basics of the piano and sheet music and instructing basic pieces. In person lessons on the other hand offer a much more in-depth experience as you are able to converse with an expert and gain real time feedback on more than just the notes – other valuable information such as hand positioning, correct use of fingers, and artistic decisions. The main barrier to in-person lessons is distance and cost – lessons are expensive, and teachers may not be available in close proximity to your home or school.

Project Benefits:

The problem pianAI looks to solve is the gap in between in person lessons and current digital solutions. It gives users more feedback than traditional solutions and allows them to become more familiar and skilled prior to deciding to pay for in-person lessons. This is especially important for people who may not be nearby to music education facilities or live in remote communities, as digital solutions may be all that is available to them.

Technologies Used:

As mentioned earlier, the primary artificial intelligence integration within this project is the use of OpenCV to track user hand and wrist position. This program maps points to each digit of the hand and is able to check whether the hand is playing in a curved position (ideal for piano playing) and provide feedback to the user in real time. For audio processing, the project uses Mido, a Python MIDI (Musical Instrument Data Interface), as well as MediaPipe.

To interact with users, the frontend is a React.JS web application and TailwidnCSS for styling, that streams a live feed from the webcam, as well as a feedback window to provide information to users.

User Benefits:

With various studies demonstrating a clear link between music education and benefits to childhood development, it is important that people of any age are able to easily incorporate music into their lives. pianAI achieves this at a higher level than other digital solutions, and gives users the fundamental knowledge of music and piano technique to become proficient at the beginner levels of the instrument. They can then take this knowledge to further levels with the piano or easily transition to another instrument, as the piano serves a solid basis of knowledge for learning any musical instrument. It also lowers the barrier of entry to music education, allowing people who are considering lessons to test out the basics and understand the fundamentals prior to starting paid lessons with a teacher. Essentially, the goal was to make music education more affordable and accessible by harnessing the power of artificial intelligence.