

Piano with Dexmo

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Students

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Description

- Goal: Learning to play an easy piano task with haptic guidance
- Each hand is strapped to an exoskeleton glove (Dexmo)
- Dexmo can
 - track each finger's position (extension and flexion)
 - provide passive force feedback
- The piano/keyboard (connected via MIDI) and Dexmo are used to measure the user's performance
- Dexmo provides haptic feedback (for demonstration or practicing)



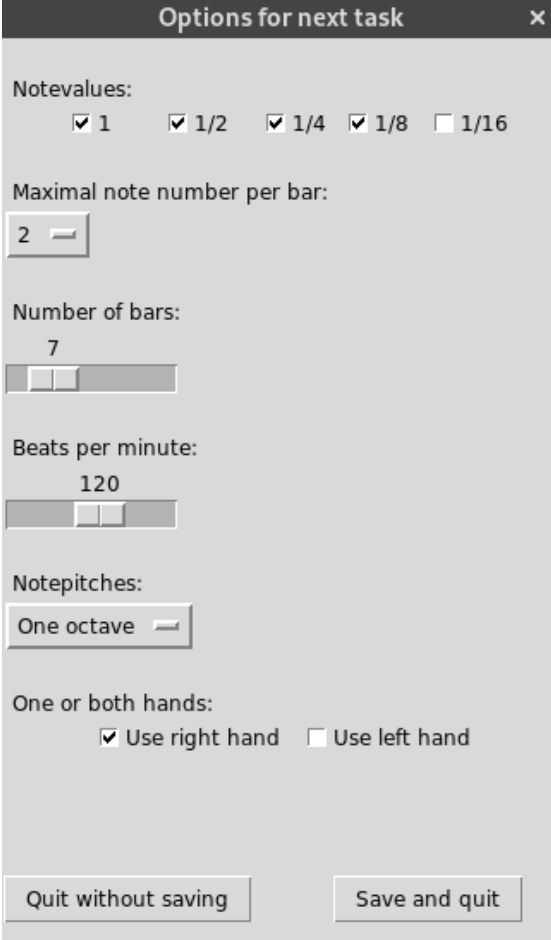
Video recorded and provided by Guillaume Walck

Practice Task

- The task's sheet music is displayed to the user
- The task can be played back (demo mode), optionally combined with the Dexmo "pressing" the right keys
- While practicing, a metronome is played and the user has to play the piece correctly
- If desired, Dexmo can provide haptic feedback for that
- The error per task is directly visible (represented as a graph)

Task Generation

- Each task (i.e. piece of music) is generated randomly
- Various options to adjust difficulty:
 - Tempo (bpm)
 - Amount of notes and bars
 - Feasible note pitches and durations
- Choice of hands (left, right or both)
- Custom MIDI files can be used as well
- In each case, a metronome track is added



The image shows a dialog box titled "Options for next task" with a close button (X) in the top right corner. The dialog contains several settings for generating a music task:

- Notevalues:** A row of five checkboxes: 1, 1/2, 1/4, 1/8, and 1/16.
- Maximal note number per bar:** A text input field containing the number "2".
- Number of bars:** A text input field containing the number "7" above a horizontal slider.
- Beats per minute:** A text input field containing the number "120" above a horizontal slider.
- Notepitches:** A text input field containing "One octave" above a horizontal slider.
- One or both hands:** Two checkboxes: Use right hand and Use left hand.

At the bottom of the dialog are two buttons: "Quit without saving" on the left and "Save and quit" on the right.

Finding piano fingering

- A finger-note mapping is required
 - to provide feedback to the user (right finger at the right time)
 - to evaluate the user's performance (right/wrong finger, timings)
- An optimal fingering is determined automatically (external library) and added to the task (generated or chosen)

Devices

- For full functionality, 3 devices (MIDI connection) are used:
 1. Note input: MIDI keyboard or emulator (e.g. *VMPK*)
 2. Sound output: MIDI synthesizer (e.g. *Qsynth*)
 3. Dexmo: Virtual MIDI port, input and output
 - Communication with Dexmo happens via MIDI messages
 - Mockup device (made of LEGO) was used due to Corona
- The respective MIDI ports can be selected individually by the user



Start first task

Quit

Dexmo output port:

:XMO_R:DEXMO_R MIDI 1 20:

Sound output port:

ynth1):Synth input port (Qs_{ynth}):

Piano input port:

VMPK Output:out 154:0

Further development

- Implementation of different error measures
- Automatic adjustment of the task's difficulty depending on the user's performance
- Machine learning-based approaches
- Improve visual feedback (e.g. real-time note display)