Projecting Finger Placement onto the Fretboard

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Demo
Outline

- Related Work
- Architecture
- Finding the Fretboard
- Projection
- Results
- Outlook
Related Work

- LEDs embedded in piano keys [Casio] or in fretboard [Optek Fretlight]
- Miniature data projectors as versatile HCI devices [Raskar]
- Tracking the fingering for training or transcription [Burns, Wang, Paleari, etc.]
  - markers attached
  - or camera mounted on neck
  - or not real-time
System Architecture 1/3

Miniature data projector

- On close distance bright enough and sharp
- Camera placement close → low parallax error
System Architecture 2/3

MIDI Playback → Splitter → Other MIDI Channels → GM Sound Generator

Bass Line → Mute

Web Camera

Fretboard

Data Projector

Image Processing → Tracking → Image Generation
System Architecture 3/3

- No attached optical markers
- Interactive speed
- Robustness: do not literally “track” the fretboard
- Smooth the projected image’s motion from frame to frame
Finding the Fretboard 1/3

Input

Finding the Fretboard 1/3

Finding the Strings

Directional Filter

Constrained Line Detector
Finding the Fretboard 2/3

Input

Directional Erosion

Extracting the Frets

Difference

Directional Derivative
Finding the Fretboard 3/3

Input

Finding the Frets

Rectification:
200 x 3 Pixels

Template Matching
Projection

- Calibration

- Homography: Projector and camera may point in different directions if optical centers remain close.
Results

- 10 fps with low-end PC
- 100 lumens are perfect
- Image processing issues
  - No striped shirts allowed
  - No glossy reflections allowed
- Problems with standard webcams
  - Low sensitivity $\rightarrow$ long shutter time $\rightarrow$ motion blur
  - Large latency effectively limits spatial resolution
- Project notes not on time but in advance?
Outlook

• Karaoke-style projection?
• Experiments with learners
• Adapt to “expensive” musical instruments such as cello and harp; benefit: no damage to instrument
• Mobile version with built-in camera of mobile phone
Questions?