Viano

Chitula Chipimo
CSE

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CSE

Kelly Kennedy
EE

Anna Wildman
EE

Advisor: Professor Anderson
Agenda

- Review of Project
- CDR Deliverables
- Demo
- FDR Deliverables
Pico-Projected Midi Controller

Specifications:

- **Portable** (fit in small bag, lightweight)
- Dimensionally-correct keyboard
  - Immediate goal: 2-Octaves
- Seamless integration with GarageBand
- Not pressure sensitive**
Promised CDR Deliverables

Kelly
Design housing unit and wide-angle solution for projecting image

Anna
Design and Test a Power Circuit

Chi
Implement Virtual Coordinate Keyboard and Touch Calibration

Chris
Gui application on laptop and sending information from Raspberry Pi
Design Challenges:

- Have 3 devices that need power
  - 2 - 5V (Raspberry Pi (5W), Linear Laser (25mW))
  - 1 - 12V (Pico Projector (18W))
- For portability, need batteries with a charging circuit
- Only want one charging cord for simplicity on user end
### Charging Circuit for Rechargeable Batteries

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Cost per Item</th>
<th>Cost per Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laptop Charger</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>UBEC 5V, 3A</td>
<td>2</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>UBEC 12V, 3A</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Rechargeable AA Batteries</td>
<td>18</td>
<td>2.75</td>
<td>49.5</td>
</tr>
<tr>
<td>PCB Charging Circuit</td>
<td>1</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>23</td>
<td></td>
<td><strong>129.5</strong></td>
</tr>
</tbody>
</table>

### Manually Recharging/Replacing Batteries

<table>
<thead>
<tr>
<th>Item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>UBEC 5V, 3A</td>
<td>2</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>UBEC 12V, 3A</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Rechargeable AA Batteries</td>
<td>18</td>
<td>2.75</td>
<td>49.5</td>
</tr>
<tr>
<td>Battery Recharger</td>
<td>5</td>
<td>16.99</td>
<td>84.95</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>26</td>
<td></td>
<td><strong>164.45</strong></td>
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</table>

### Battery Pack

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Cost per Item</th>
<th>Cost per Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laptop Charger</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>USB Battery Pack</td>
<td>1</td>
<td>49.95</td>
<td>49.95</td>
</tr>
<tr>
<td>PCB Charging Circuit</td>
<td>1</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3</td>
<td></td>
<td><strong>99.95</strong></td>
</tr>
</tbody>
</table>
Viano Charging & Power Circuit: Schematic
Viano Charging Circuit: Testing

FEATURES
- Specified 1% Output Voltage Tolerance (LM317A)
- Specified max. 0.01%/V Line Regulation (LM317A)
- Specified max. 0.3% Load Regulation (LM117)
- Specified 1.5A Output Current
- Adjustable Output Down to 1.2V
- Current Limit Constant with Temperature
- P* Product Enhancement tested
- 80 dB Ripple Rejection
- Output is Short-Circuit Protected

R2calculated = 2.06 (kohm)
R2measured = 2.02 (kohm)

R2calculated = 720 (ohm)
R2measured = 707 (ohm)
Projecting the Piano Image

Design Challenges:

- Projecting bright enough image
- Keeping Viano overall size as compact as possible
- Finding a wide-angle solution that gave us the right magnification without distorting image
- Perspective Transformation Distortion

Solution:

- New Pico Projector (DLP technology + 100 lumens vs 6 lumens)
- High Definition .43x Wide Angle Lens
- Graphic Program for re-imaging
Projecting Piano Image

New Projector + Wide-Angle Lens + Perspective Transformation

Before perspective transformation

After perspective transformation
Housing for the Viano

- Built via SolidWorks (CAD program)
- 6in x 6in x 12in
- Hollow, 4 individually piece design that will snap in with one another
  - allows for flexibility in design

(View in SolidWorks)
Finger Tracking

1. Linear IR Laser Beam ~790nm
2. A finger breaks IR beam
3. Camera with IR filter sees finger reflection

- Add keyboard and touch calibration
Keyboard

- Defines a keyboard in 2D Euclidean space
- Input is finger coordinates
- Identifies key presses and releases
  - Uses a KeyStateManager, KeyEventHandler, and MidiHandler to receive, interpret, and pass on data
- Output is MIDI messages
- Contains a simulator for visual testing
Touch Calibration

Camera & projector placement:

- **Either rigid**
  - Once-off coordinate mappings
  - Errors introduced by camera or projector moving
  - Hard-code (this may be tedious to update)

- **Or flexible**
  - Parts may move/tilt/vary
  - Arbitrary placement of camera and projector
  - User calibration at startup
Bluetooth Communication

- **Transmission (Raspberry Pi)**
  - Slave bluetooth adapter via UART on Pi’s GPIO
  - Code to transmit MIDI notes over channel
  - Current transfer rate approx. 300 notes/s

- **Receiving (Desktop)**
  - Java App to receive/process transmitted data
  - Play notes on garageband
  - Allows for user definition of note velocity
<table>
<thead>
<tr>
<th>CDR Deliverable</th>
<th>Who is Responsible</th>
<th>Has it Been Achieved?</th>
<th>What is Left?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Housing Unit</td>
<td>Kelly</td>
<td>Yes - Overall Design</td>
<td>Final Dimensions and 3D Printing</td>
</tr>
<tr>
<td>Find Wide-Angle Solution for Projecting Image</td>
<td>Kelly</td>
<td>Yes - Accurate Width/Length of 2 Octaves</td>
<td>Sync Key Width with Software</td>
</tr>
<tr>
<td>Design and Test a Power Circuit</td>
<td>Anna</td>
<td>Yes - USB Battery Pack</td>
<td>Charging PCB</td>
</tr>
<tr>
<td>Implement Keyboard and KeyEventProcessor classes</td>
<td>Chi</td>
<td>Yes</td>
<td>Adjust Individual Key Dimensions</td>
</tr>
<tr>
<td>Implement Touch Calibration at Startup</td>
<td>Chi</td>
<td>Yes</td>
<td>Improve Separation of Fingers</td>
</tr>
<tr>
<td>Gui Application on Laptop</td>
<td>Chris</td>
<td>Yes</td>
<td>Improve UI</td>
</tr>
<tr>
<td>Sending Information from Raspberry Pi</td>
<td>Chris</td>
<td>Yes</td>
<td>Nothing</td>
</tr>
</tbody>
</table>
Final Design Review Deliverables

**Kelly**
Have Housing printed and implemented for Viano.
Correct dimensions of piano keyboard that will sync with the software

**Chi**
Add control keys to keyboard for changing instrument.
Discuss efficient image-processing improvements with Prof. Erik Learned-Miller.

**Anna**
Design and Order a Charging PCB using Cadsoft Eagle Software

**Chris**
Integrate pthreads into code base to utilize quad core on Raspberry Pi 2.
To maintain frame rate when increase image resolution.