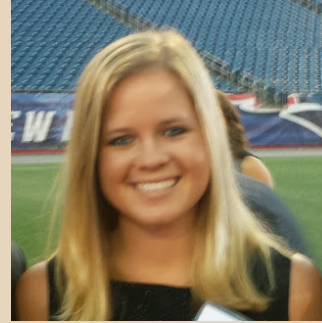# Viano

Chitula Chipimo
CSE

Christopher Cunniff
CSE

Kelly Kennedy
EE

Anna Wildman
EE

Advisor: Professor Anderson

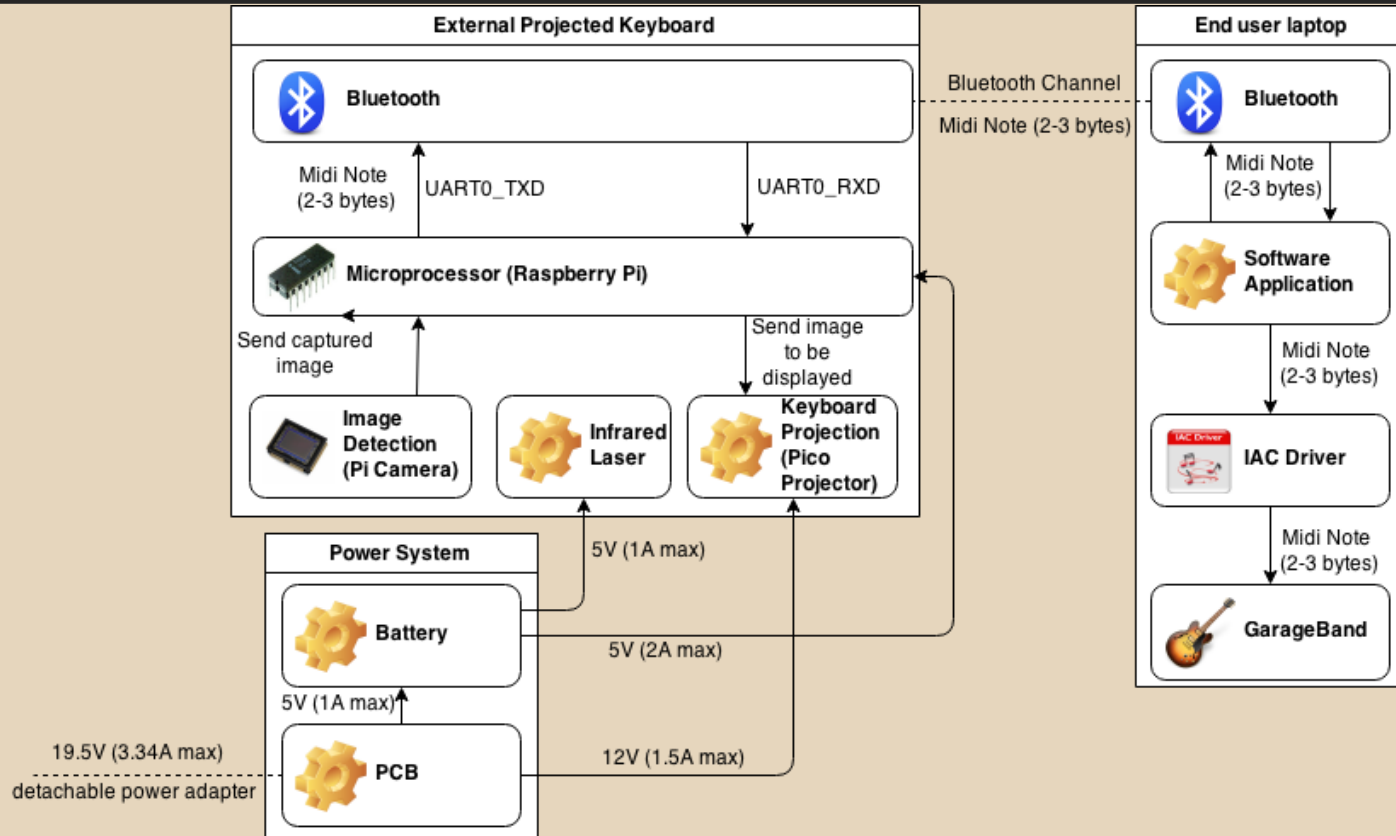# Agenda

- 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**

Block Diagram

External Projected Keyboard

Bluetooth

Midi Note (2-3 bytes) — UART0_TXD

UART0_RXD

Microprocessor (Raspberry Pi)

Send captured image

Send image to be displayed

Image Detection (Pi Camera)

Infrared Laser

Keyboard Projection (Pico Projector)

Bluetooth Channel

Midi Note (2-3 bytes)

End user laptop

Bluetooth

Midi Note (2-3 bytes)

Software Application

Midi Note (2-3 bytes)

IAC Driver

Midi Note (2-3 bytes)

GarageBand

Power System

Battery

5V (1A max)

5V (2A max)

5V (1A max)

19.5V (3.34A max)

detachable power adapter

PCB

12V (1.5A max)

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

Viano Power Circuit: Description

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

Viano Power Circuit: Design Ideas

Charging Circuit for Rechargeable Batteries			
Item	Qty	Cost per Item	Cost per Order
Laptop Charger	1	0	0
UBEC 5V,3A	2	10	20
UBEC 12V, 3A	1	10	10
Rechargeable AA Batteries	18	2.75	49.5
PCB Charging Circuit	1	50	50
Total	23		129.5

Manually Recharging/Replacing Batteries			
Item	Qty	Cost per Item	Cost per Order
UBEC 5V, 3A	2	10	20
UBEC 12V, 3A	1	10	10
Rechargeable AA Batteries	18	2.75	49.5
Battery Recharger	5	16.99	84.95
Total	26		164.45

Battery Pack			
Item	Qty	Cost per Item	Cost per Order
Laptop Charger	1	0	0
USB Battery Pack	1	49.95	49.95
PCB Charging Circuit	1	50	50
Total	3		99.95

# Viano Charging & Power Circuit: Schematic
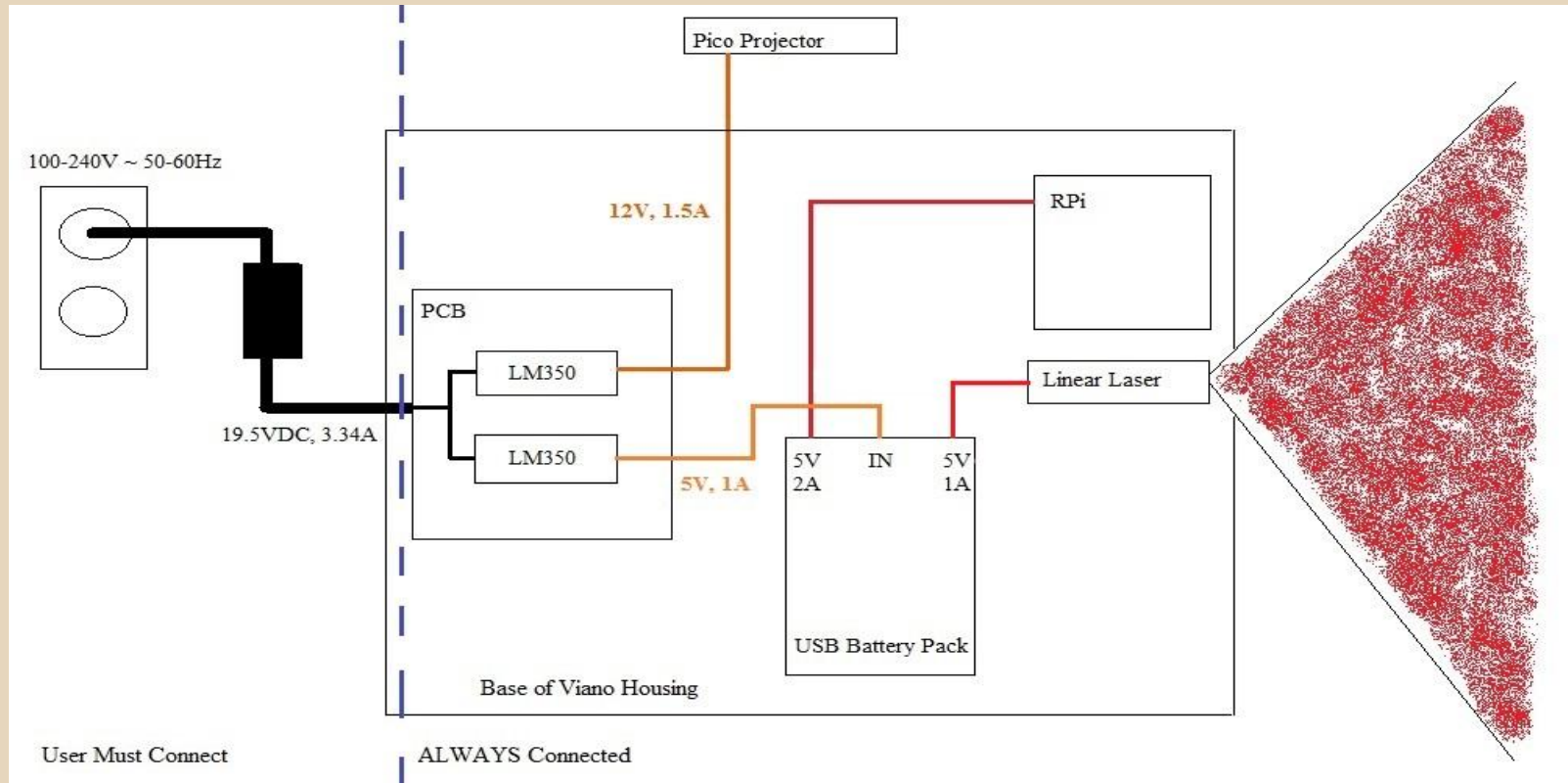
Viano Charging Circuit: Testing

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
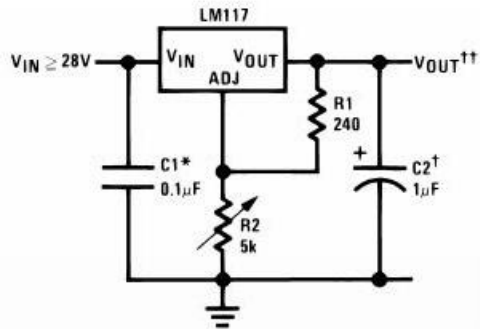
R2calculated = 2.06 (kohm)
R2measured = 2.02 (kohm)
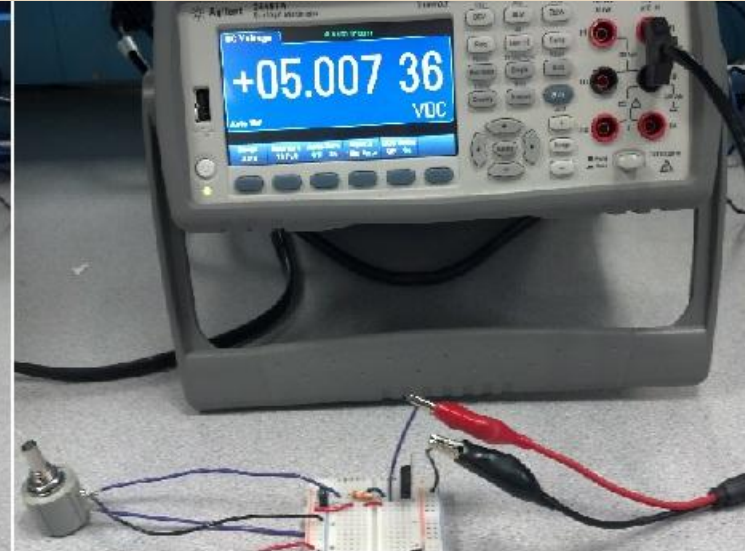
R2calculated = 720 (ohm)
R2measured = 707(ohm)

# 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
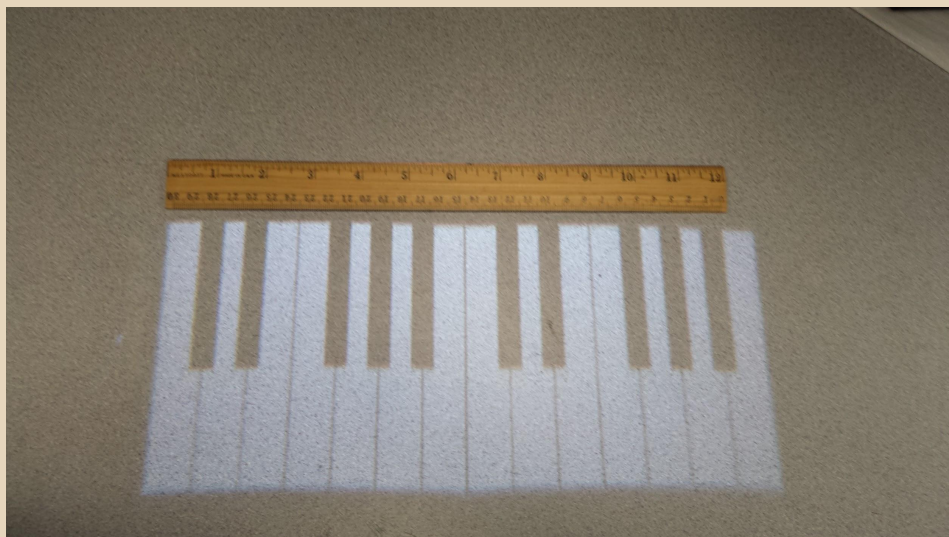- Perspective Transformation Distortion

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
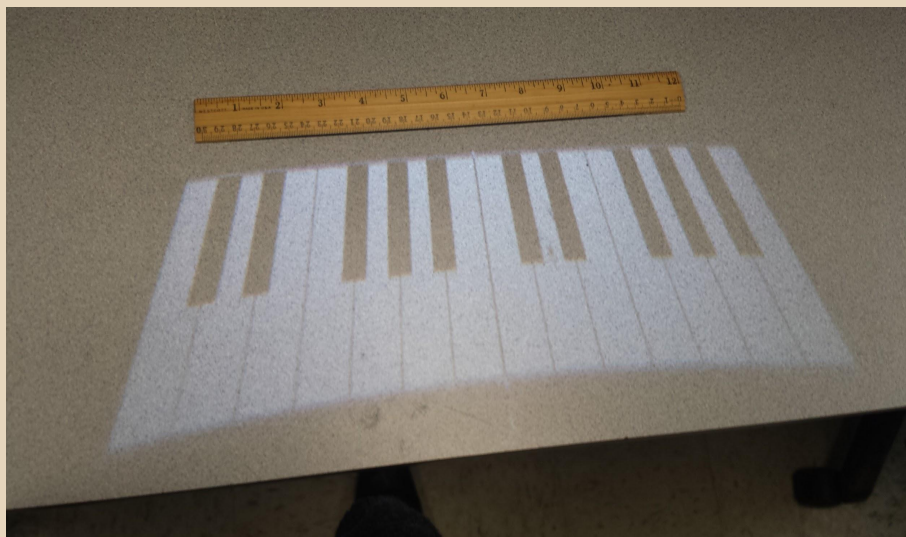
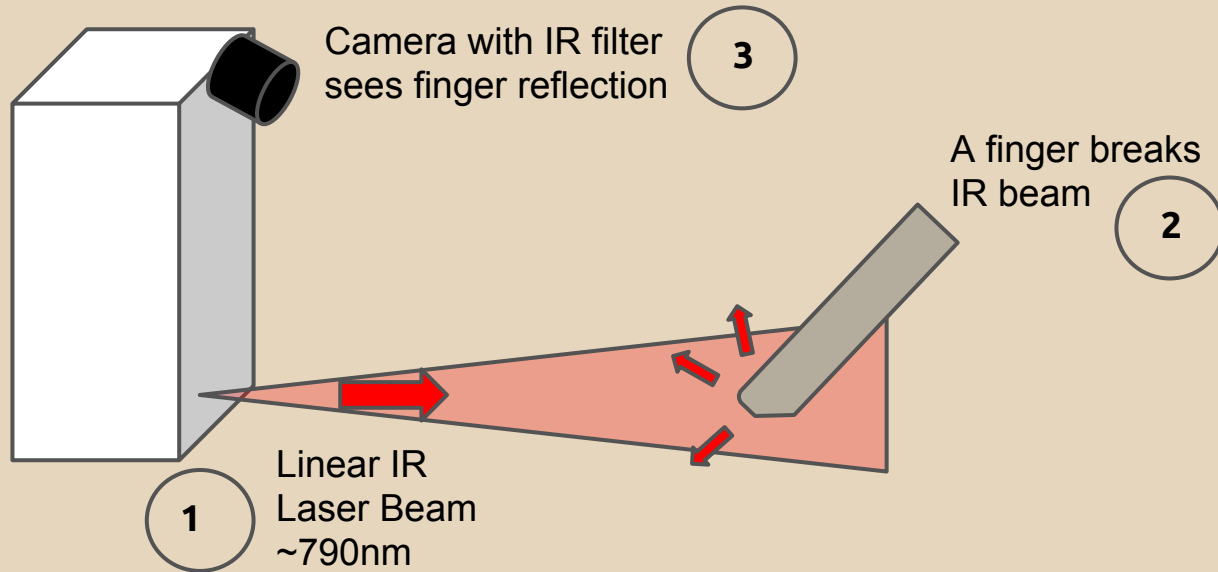Before perspective transformation

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

Camera with IR filter sees finger reflection ③

A finger breaks IR beam ②

Linear IR Laser Beam ~790nm ①

- 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

Demonstration

CDR Deliverable	Who is Responsible?	Has it Been Achieved?	What is Left?
Design Housing Unit	Kelly	Yes - Overall Design	Final Dimensions and 3D Printing
Find Wide-Angle Solution for Projecting Image	Kelly	Yes - Accurate Width/Length of 2 Octaves	Sync Key Width with Software
Design and Test a Power Circuit	Anna	Yes - USB Battery Pack	Charging PCB
Implement Keyboard and KeyEventProcessor classes	Chi	Yes	Adjust Individual Key Dimensions
Implement Touch Calibration at Startup	Chi	Yes	Improve Separation of Fingers
Gui Application on Laptop	Chris	Yes	Improve UI
Sending Information from Raspberry Pi	Chris	Yes	Nothing

Final Design Review Deliverables

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

Anna

Design and Order a Charging PCB using Cadsoft Eagle Software

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

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