Viano

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Agenda

- Significance of Problem
- Effect on individuals/groups
- Requirements for project
- Design Alternatives
- Overview block diagram
- Individual block diagrams
- MDR Deliverables

What is the Problem?

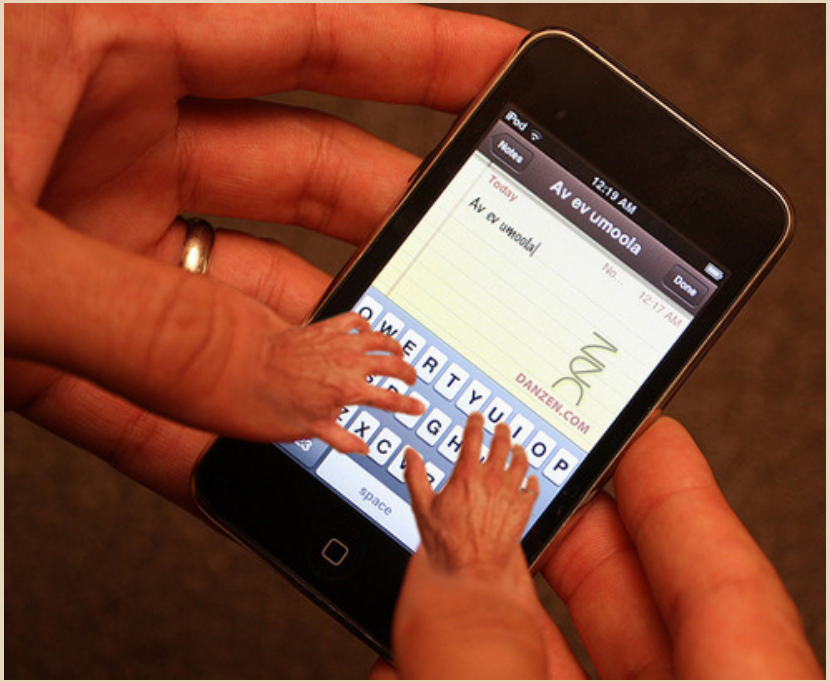
- Apple's GarageBand is a useful tool for composers, instructional aid for music teachers, and a fun hobby for the average consumer.

However...

- Playing the piano on a qwerty keyboard is difficult
- GarageBand is limited by:
  - Outdated user interface
  - Keyboard size
  - Average user experience

How Significant is the Problem?

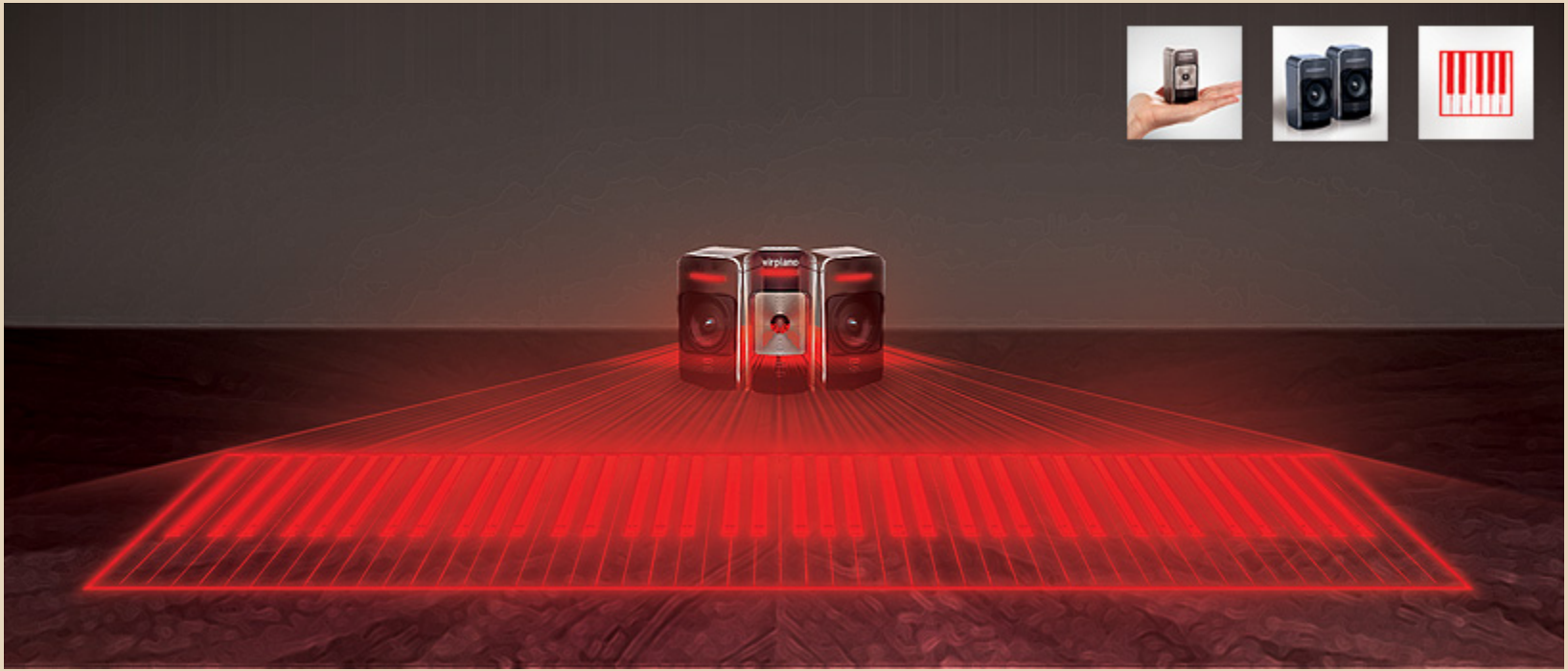
- 2012 study found that 40% of mobile ad clicks were accidental or even fraudulent
- ‘Fat Finger’ problem



Context: Effect on Individuals/Groups

- Small keyboard leads to erroneous recordings (iPhone, iPad)
- Limited Portability (MacBook)
- Missing out on prospective new musical creations

Our Solution: Laser Projected Midi Controller



Requirement Analysis: Specifications

- Portable (pocket-sized, lightweight)
- Dimensionally-correct keyboard
  - Immediate goal: 2-Octaves
  - Long-term goal: 4-Octaves
- Seamless integration with GarageBand

Requirements Analysis: Inputs and Outputs

Inputs:

- $500
- Laser Diode
- Focusing Lenses
- Computer Generated Hologram (CGH)
- Infrared Transmitter
- CMOS Image Sensor
- Microprocessor
- Bluetooth Surface Mount
- MacBook/iPad
- App user

Outputs:

- 2-Octave Virtual Keyboard
- Macbook/iPad audio via GarageBand
- Happy composers, students, and customers!

Design Alternatives

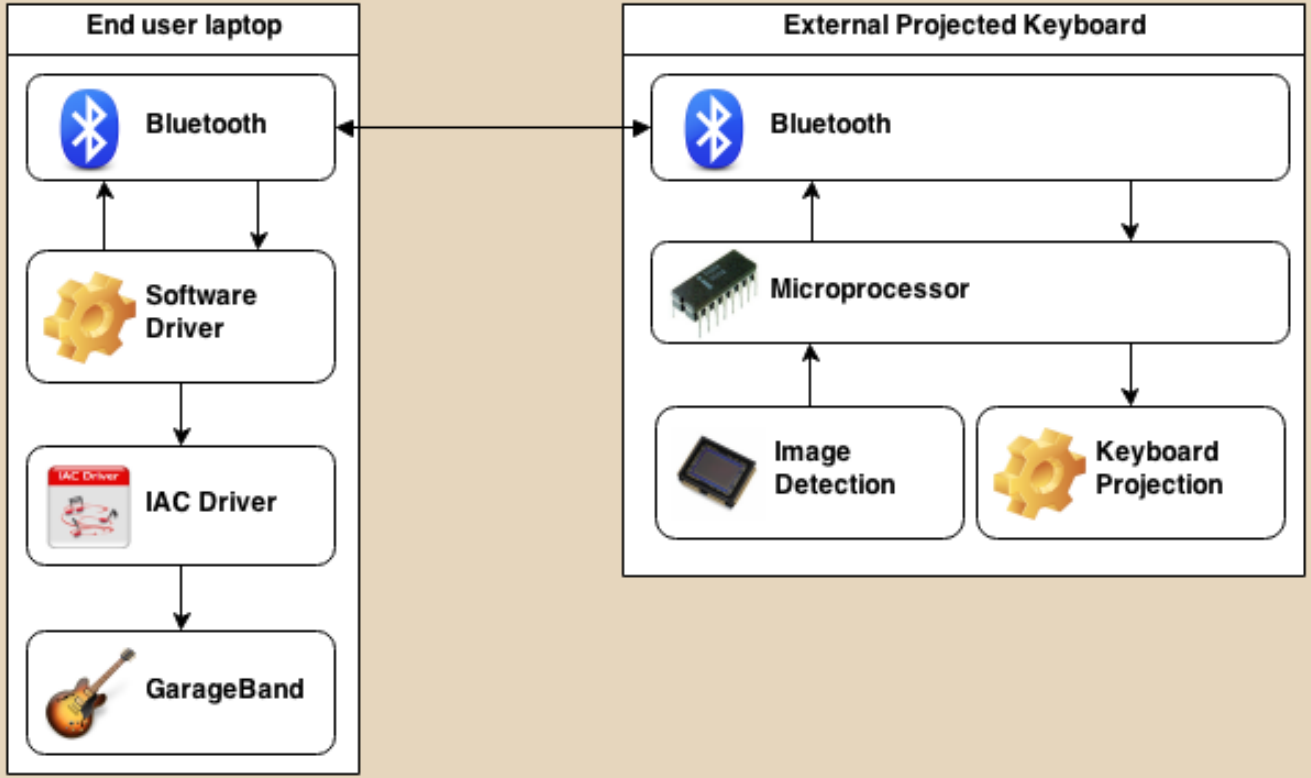
- Midi controller keyboard, connected to computer/iPad via USB.

What Already Exists

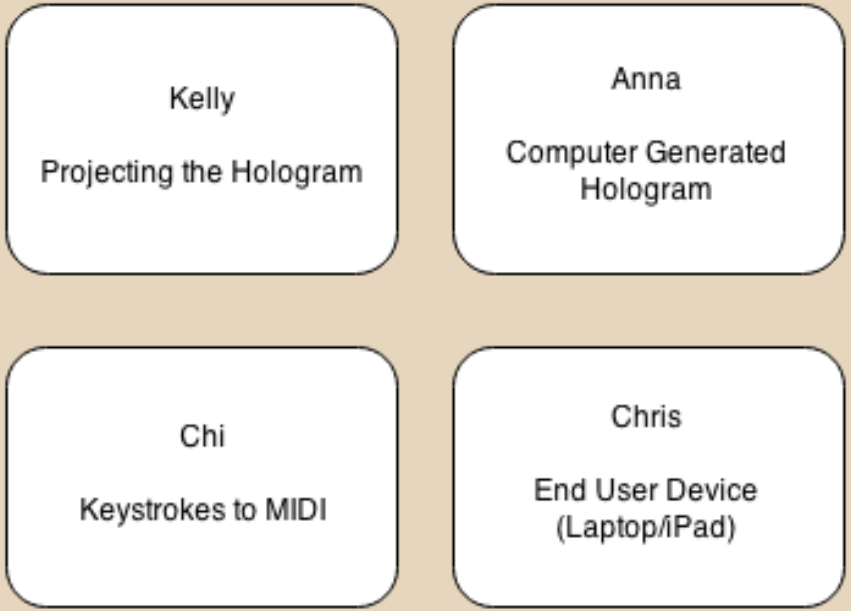
- laser-projected QWERTY keyboards
  - bluetooth
  - lithium ion battery
  - Available on market for $100-150

- Small laser-projected piano keyboards
  - None implemented as midi controller
  - None communicate with GarageBand
  - No bluetooth connectivity
  - Available on market for $130

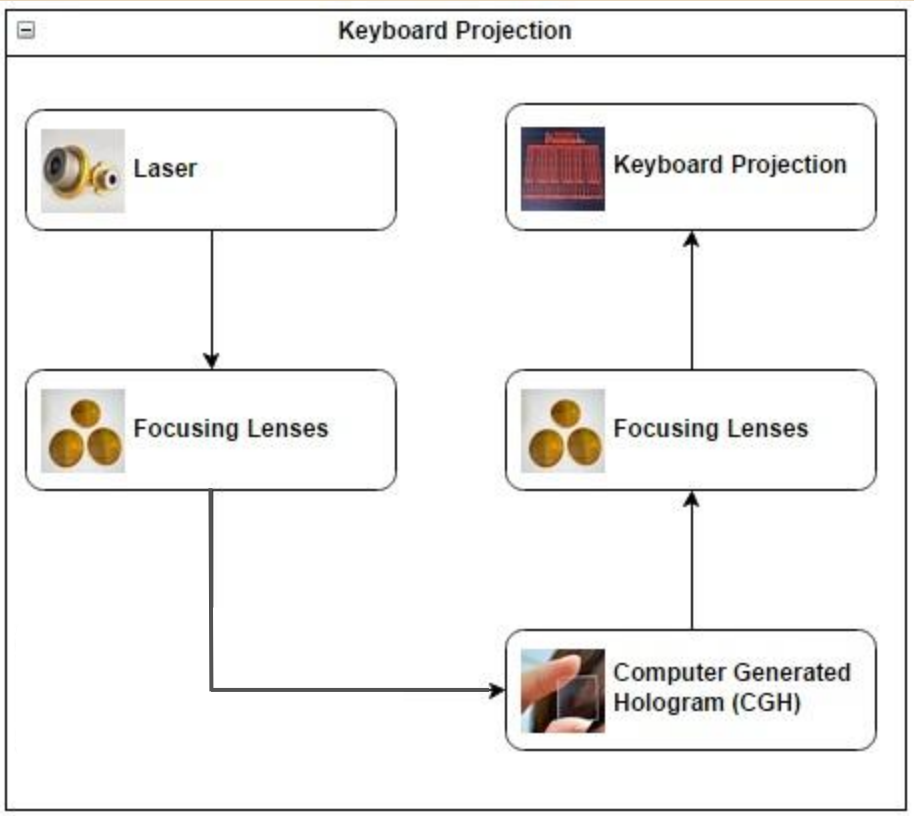
Our Solution: Block Diagram



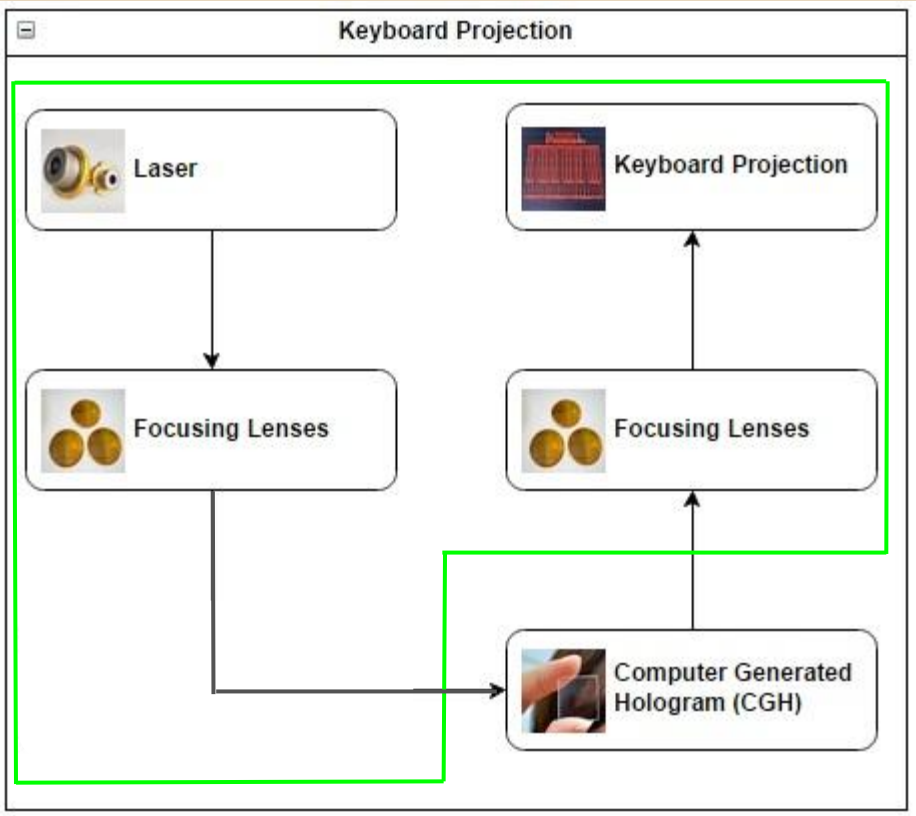
Block Distribution



Blocks 1&2: External Projected Keyboard

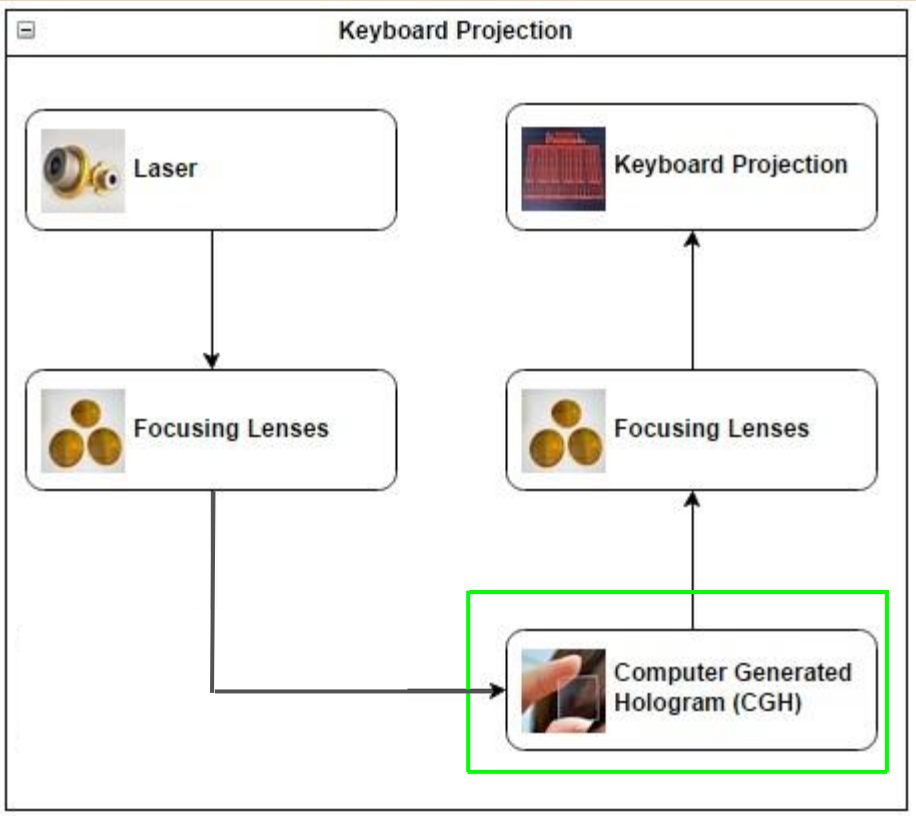


Block 1: Projecting the Hologram



- Laser Diode
- Ideal (Pinpoint) Source Laser
- Focusing Lens
- Simple Test CGH
- Angled Focusing Lens
- Keyboard Projection

Block 2: Computer Generated Hologram



- Etching Machine
- Thin Substrate
- Rectangular Hologram

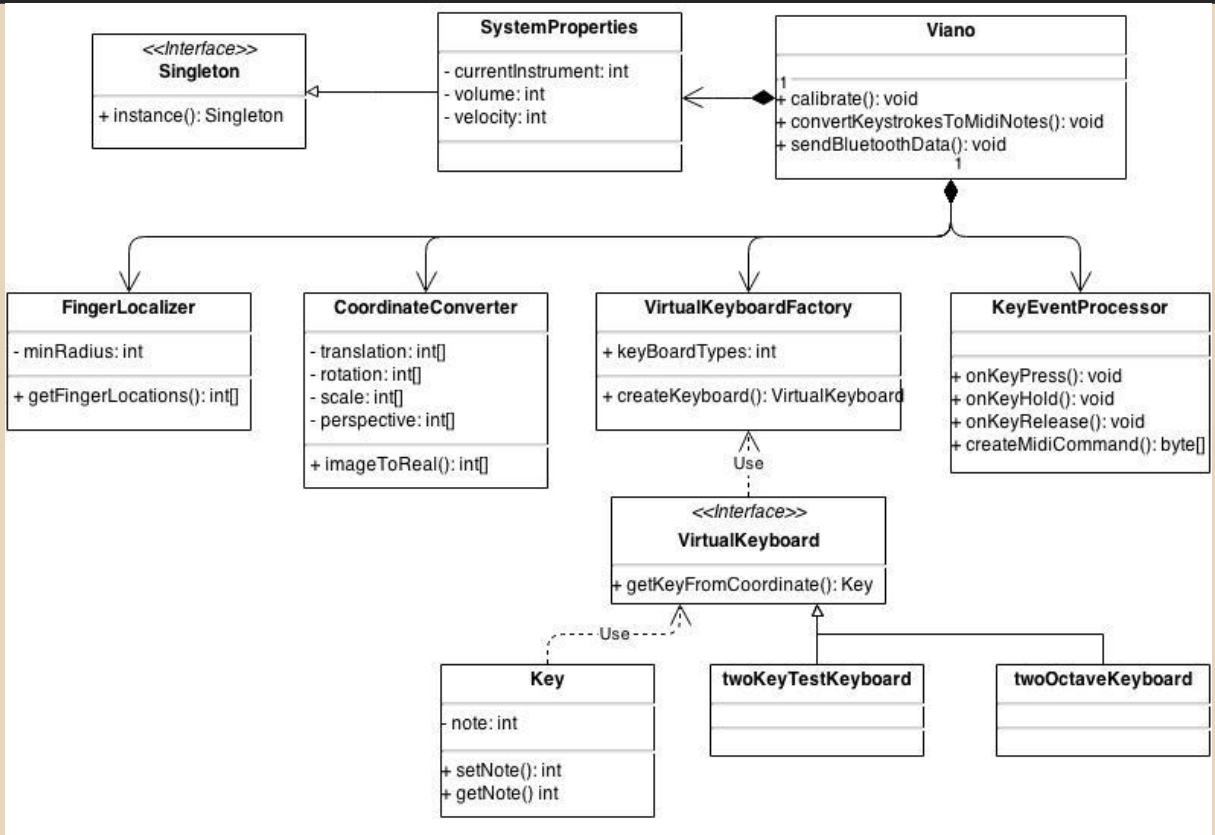
Block 3: Keystrokes to Midi Notes

IR Camera → Microprocessor → Bluetooth Module

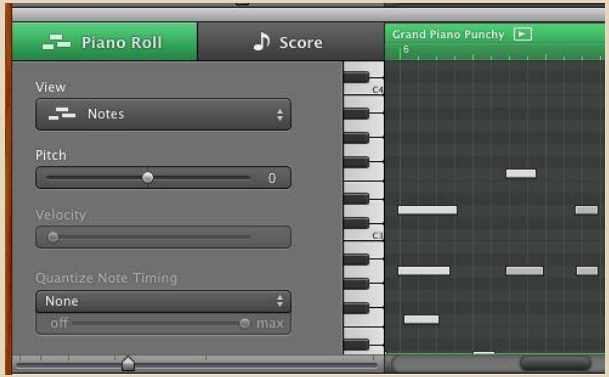
Requirements:

- Finger localization
- Coordinate transformation
- Key identification
- Event handling

Block 3: Class Diagram



Block 4: End User Laptop

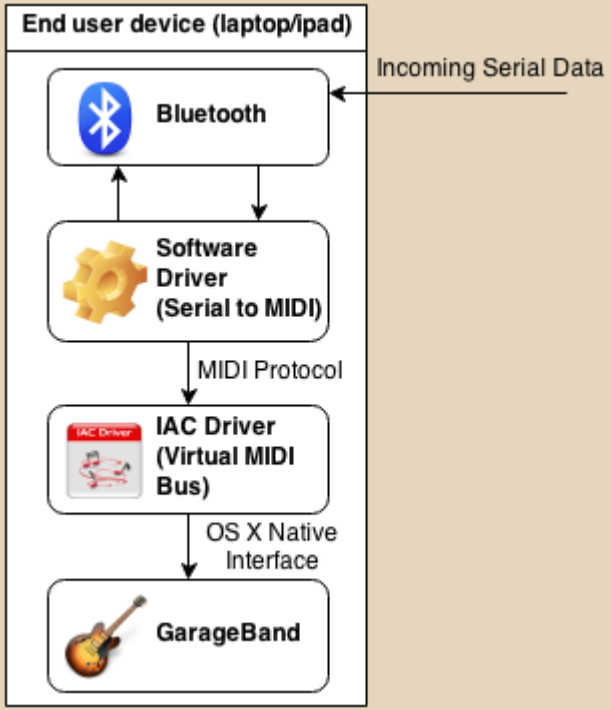


End Goal: External piano plays notes through Apple's GarageBand

Requirements:

- Accept serial Com from external keyboard
- Create Device Driver to virtualize external keyboard as MIDI port within OS X (iOS later)
- GarageBand integration

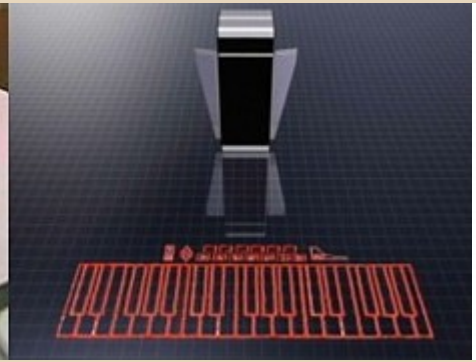
Block 4: End User Laptop



Software Requirements:

- OS X Device Driver will be created to...
  - Translate incoming serial Com to MIDI protocol
  - Use OS X API to virtualize MIDI port using Apple's native IAC (Inter Application Communications) Driver
- GarageBand natively supports IAC Driver
- Preliminary tests have shown this implementation to be successful

MDR Deliverables



- Computer Generated Hologram
  - Designed and in the process of fabrication
- Single finger localization
  - Track and display finger coordinates over image
- Coordinate conversion
  - Given P(x’,y’) in image, convert to P(x,y) in projection
- Device driver for OS-X to allow for GarageBand Integration with keyboard
- Functioning Bluetooth connectivity