FPGA Rock Band Player

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Project Summary

Our Project goal is to design a device that beats any Rock Band 2 song with high accuracy for players seeking high scores and unlockable content. The device can play all four instruments without ruining their original functionality. Wireless radios are used to communicate with the instruments. Over 97% accuracy is achievable by the guitars and drums, while the vocals can achieve over 85%.

We implemented the device on an Altera Cyclone II FPGA on the Terasic DE2 development board. The Xbox 360 video output is decoded and fed into separate instrument modules on the FPGA for note detection. Notes are played by outputting from the FPGA to modified instruments via wireless radios and microcontroller receivers. The vocals are handled by outputting tones that are detected by the Xbox Microphone.
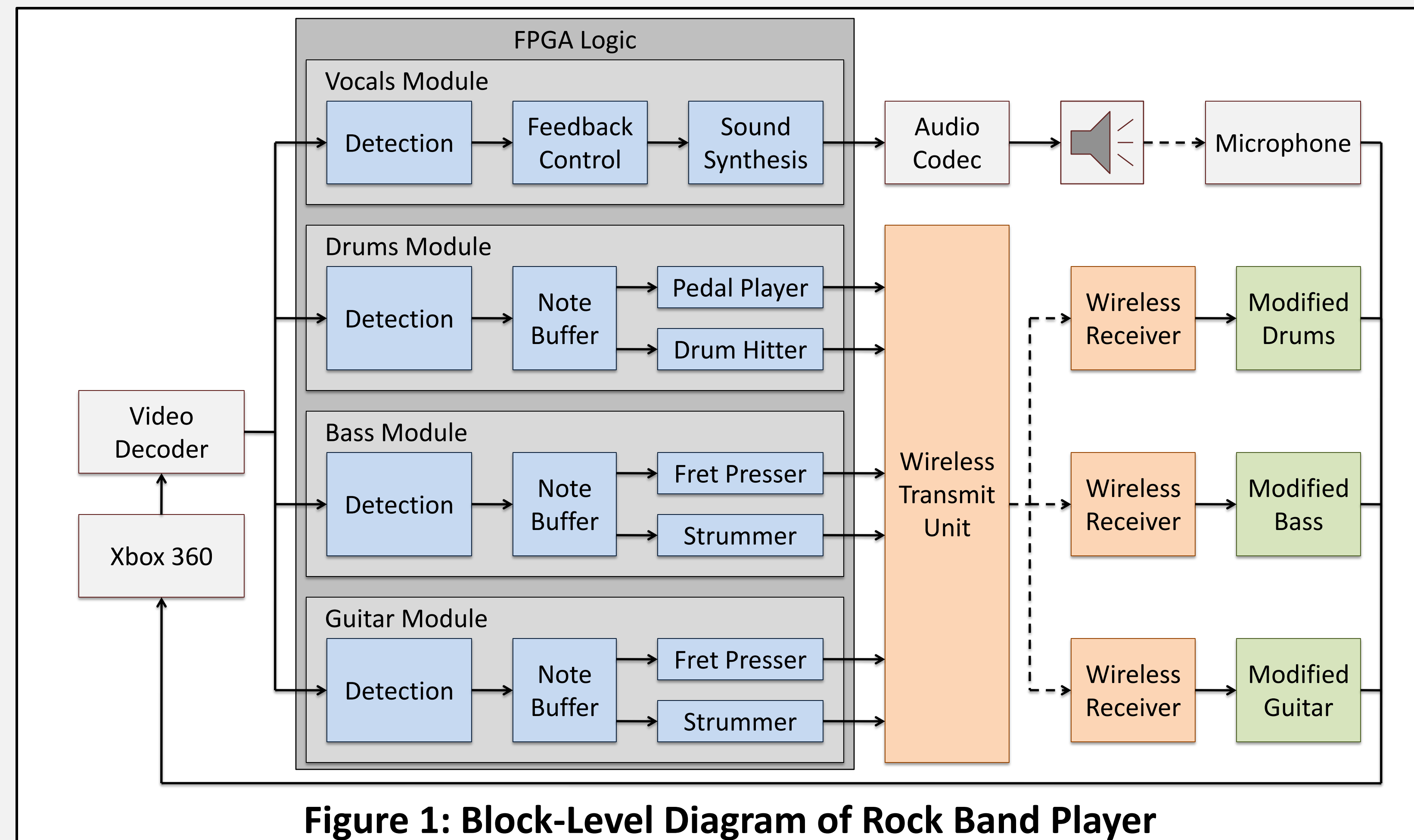

Figure 1: Block-Level Diagram of Rock Band Player
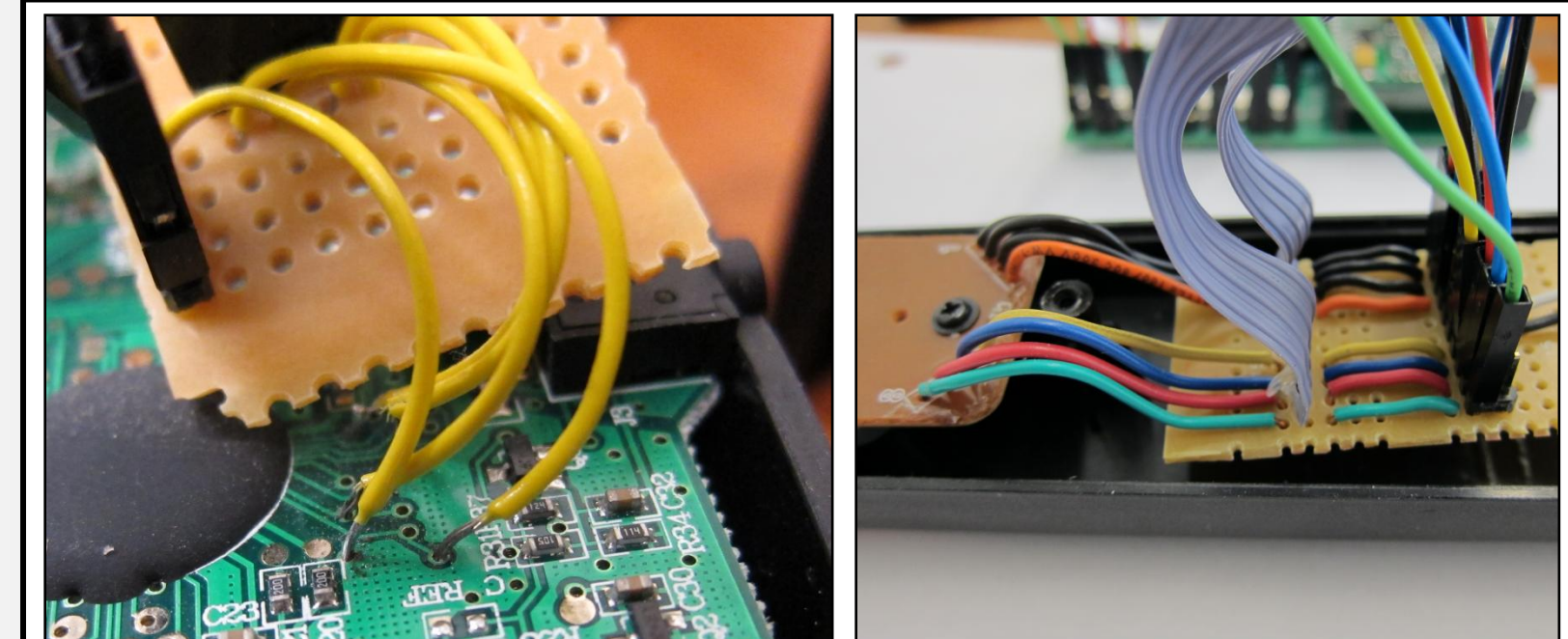
Controller Modification

Figure 5: Tapping into existing circuitry of drums (left) and guitars (right)

- Optocouplers are wired across button contacts by tapping directly into existing circuitry.
- Wiring in parallel with physical buttons maintains existing functionality of instruments.
- Microcontrollers are used to control optocouplers to simulate button presses.
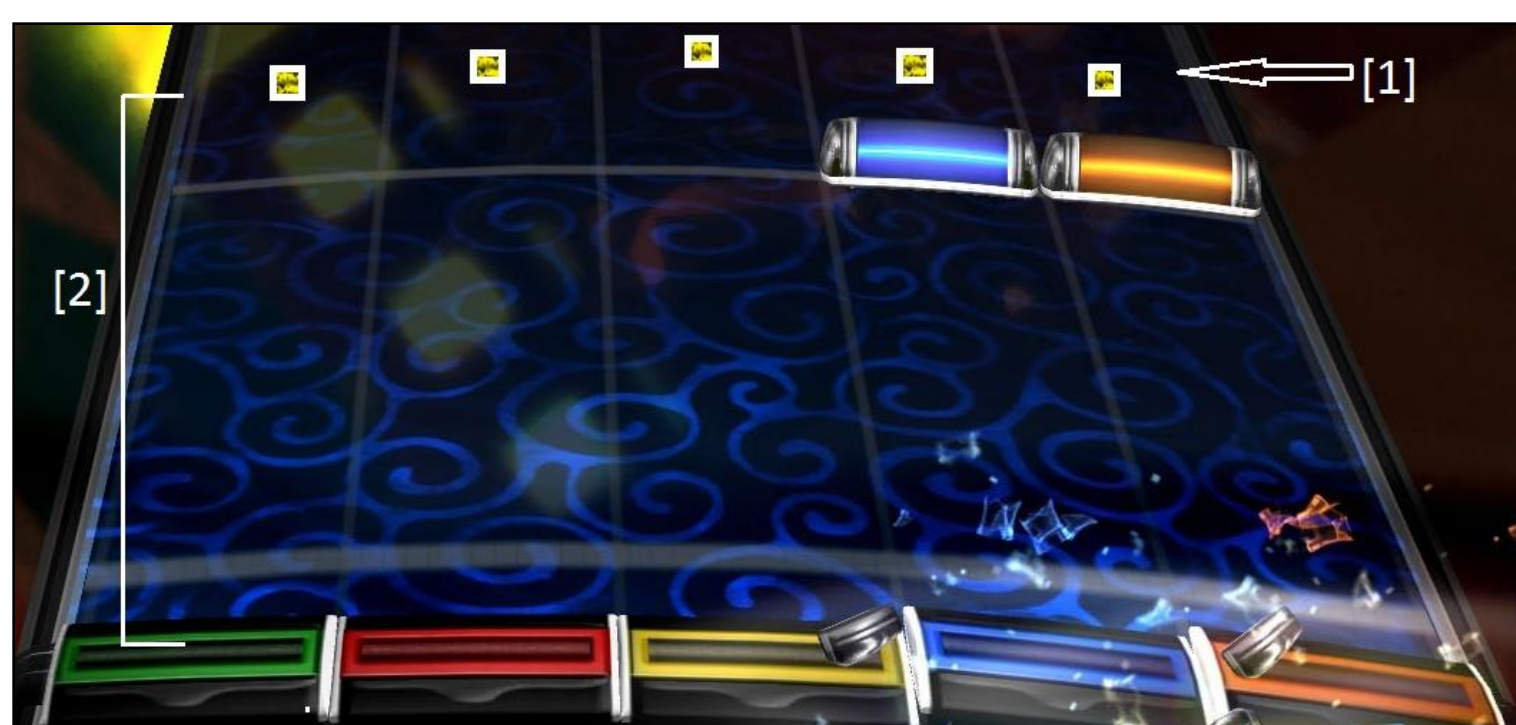
Note Detection and Control Algorithms

Figure 2: Location of detectors for guitars

- RGB pixel values are analyzed well in advance to detect incoming notes away from flashes [1]
- Detected notes are stored in a FIFO buffer until it is time to play them [2]
- Control logic determines what notes should be held or changed and sends commands to wireless transmitter for instruments
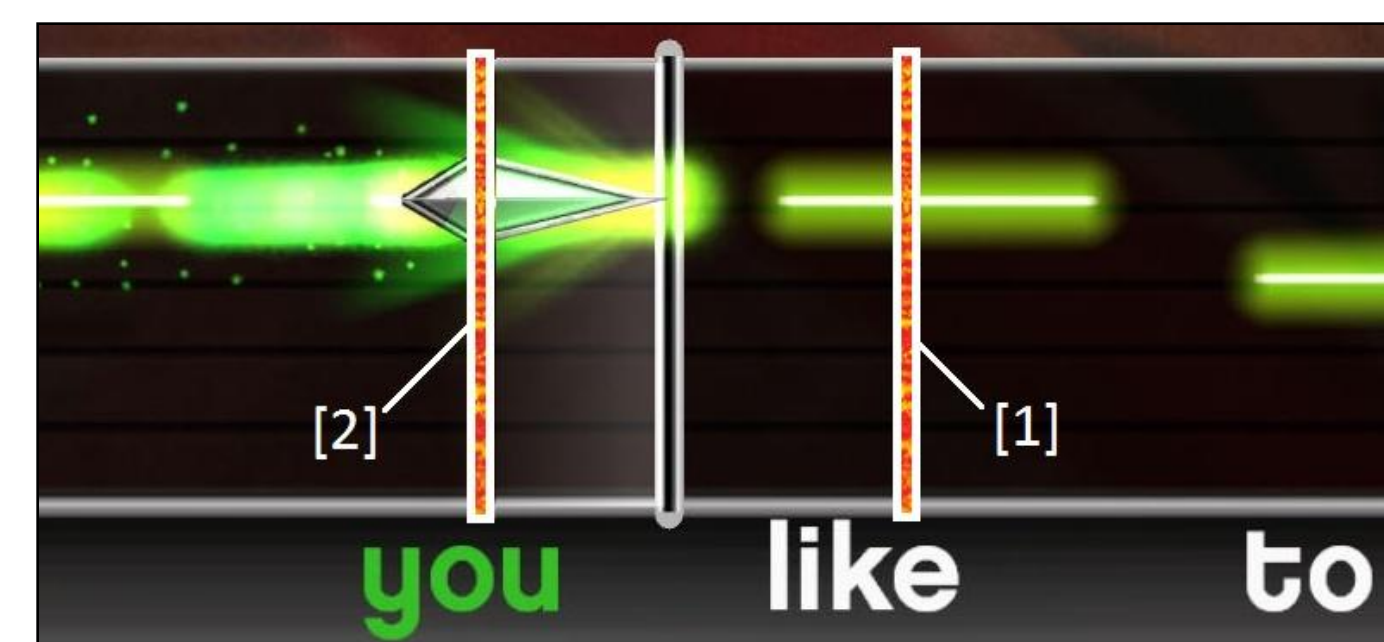

Figure 3: Location of column detectors for vocals

- Required pitch is detected in advance by analyzing a column of RGB pixel values [1]
- Current pitch is also detected by locating the position of the arrow [2]
- PID feedback control loop adjusts the direct digital synthesis (DDS) of output tone
- Tone is sent to audio codec and out to speakers to be picked up by Xbox microphone
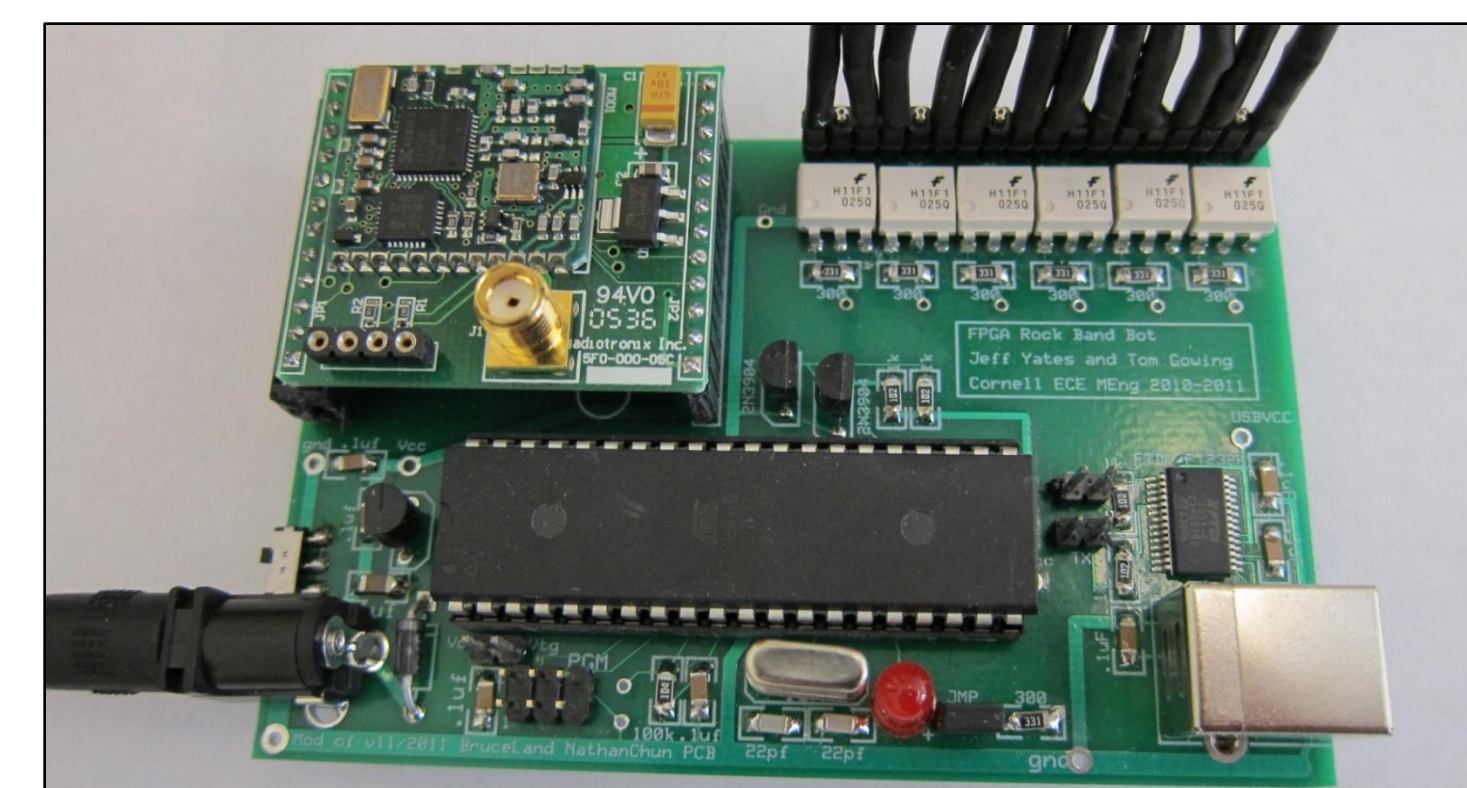
Wireless Communication

Figure 4: Custom wireless receiver circuit board

- Radiotronix wireless radios are used to send commands from the FPGA to the instruments
- Atmel Mega644 microcontrollers receive commands and control the instruments
- Custom circuit boards were printed for receiver and instrument control circuitry.

Results and Conclusions

Table 1: Instrument accuracies (%) by song

Song	Guitar	Bass	Drums	Vocals
Man in the Box	98	99	98	87
Eye of the Tiger	98	97	98	83
One Step Closer	98	98	99	84
Lump	98	99	99	85
Pretend We're Dead	98	98	98	87

Our device can successfully beat any song in Rock Band 2 on Expert with accuracies consistently above 80% for vocals and 97% for guitars and drums. Future work can be done to improve detection algorithms and device packaging.

Special thanks to:

- Atmel – for the microcontrollers
- Radiotronix – for donating the wireless radios
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- Bruce Land – for his guidance and support