ECE 453

Team # 4

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Air Piano

Deliverable # 3: Schematic and FPGA Block Diagrams, Test Plan, BOM, and Updated Schedule and Cost/Time Estimate

Test Plan

There are three components that need to be tested: the sensors, the LEDs, and the speakers. The sensors need to be calibrated and the input needs to be translated into notes based on voltage. The LEDs need to be wired correctly. The speakers need to receive frequencies from

the ARM and output sound. Once these individual modules are working, the modules need to be combined through software and this software needs to be tested. The test plan is broken down below.

1. Calibration of sensors:
Each of the seven sensors will have to be calibrated individually. For each sensor, we will measure the voltage that is output when an object is placed at the distances our notes will be played at. The voltage values and their corresponding distance values will be stored in a lookup table for each individual sensor.

2. Sound output by speaker:
A test program will send sine waves from the ARM to the speaker to verify that the frequencies calculated output the desired note and to ensure the speaker is in fact receiving data and outputting sound.

3. LED connections:
A test program on the PIC uController will toggle all the LEDs on and off to ensure they are wired correctly.

4. LED toggling using through FPGA:
A test program on the ARM will store all allowed combinations of LED values into the LED registers in intervals. The PIC will read the registers and toggle the correct LEDs. This will verify the ability to toggle all LEDs from the FPGA as necessary.

5. Sensor Input through FPGA:
The PIC will receive input from the sensor and place the data in the correct sensor register on the FPGA. A test program on the ARM will read the value from the FPGA register and display the note that is to be played for verification.

<u>Requirements Definition</u>
Overall Inputs: Sensor information from user
Overall Outputs: Sound, LED display

The air piano will play music based on input from the user. There will be seven infrared proximity sensors. The user will place their hand over one of the proximity sensors. The

proximity sensor outputs a voltage based on the distance from the user's hand to the sensor. This will be input into the PIC microcontroller, which triggers an interrupt. In the interrupt handler, the analog voltage is converted into a digital signal using the ADC. The output is then placed into the register on the FPGA of the specific sensor that triggered the interrupt. The ARM microcontroller will then read the register and calculate the note to be played based on the distance value. Once the note is calculated, the LED registers in the FPGA will be updated with new values (ie which LEDs to turn on/off based on note that is being played). The PIC microcontroller will read the register values and output the values on the GPIO pins to toggle the LEDs. At the same time, the ARM will send a sine wave that corresponds to the tone to be played to the speakers.