**Laboratory 5-6**

**Project**

**Post-Lab**

**Team Number 5**

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**LAB 5-6 – Project**

In this laboratory we designed and implemented a timer using the keypad, the digital to analog converter, PB2, Dip Switch 0, and the 7-Segment multiplexed display. We aimed for the 90pt task and believe we succeeded in successfully implementing a design that qualifies for the 90 pt category.

A time is entered by the user via the keypad. If the user enters an invalid time, they can use PB2 to reset the entered values and try again. The user will then flip the 0th DIP switch to begin the timer's countdown. As it runs, the display will display a countdown in hexidecimal. When the specified amount of time has passed, the timer will output audio via the ADUC's Digital to Analog Converter to signal to the user that the timer has indeed finished. The user may then press switch the 0th DIP switch to the off position, which will stop the alarm.

This satisfies the criteria for the 90 point category. We use a keypad that interrupts the CPU, offloading as much processing power as possible. We also be use analog output by using the Digital to Analog Converter to output audio. GPIO is not used, and instead we use memory interfaced input and output.

This project created a challenge for us, and tested and demonstrated our skills as honed in this class. We now know far more about the programming and implementation of physical hardware in connection with the ARM processor.

**Attached You Will Find:**

1. **Main.s** – this file contains the main section of code
2. **Exceptions.s** - this file is included as I modified it and placed IRQ\_Handler and FIQ\_Handler in separate files.
3. **FIQ\_Handler.s** – this contains the IRQ\_Handler, which handles the 7-segment display and second counting
4. **IRQ\_Handler.s** – this contains the FIQ\_Handler, which handles keypress events.
5. **timerAlarm.s** – this file contains the subroutine timerAlarm. This subroutine is used to output sound to the audio output using the DAC.
6. **Quartus FPGA Schmatic** – This file shows the FPGA configuration as used for this project.
7. **Waitcounter.v** – this file shows the hardware counter we implemented for key press interrupt events.