

Assignment Three

The Cricket Locator - Part 3

Set: 4th of January 2019

Due: 11th of January 2019 @ 23:55 CEST

Synopsis:

Implement a detector array on an FPGA with physical sensors attached.

Introduction

This is the third of three assignments in the *Concurrent and Distributed Systems* course. The assignments are practical in nature, and will give you hands-on experience with the topics of the course.

In this third assignment you will be designing a real version of the detector array you made in the first assignment, and implement it on actual hardware. We will assume you have a setup similar to the distributed system in assignment two, and now need to develop the actual detector array.

To complete this assignment, you need to figure out a way to interpret the sensor signal, detect a sound (an impulse), and handle inputs from multiple sensors. After this, you can build the hardware design for the solution, run it through the vendor tools to provide an FPGA design, and finally test it on actual hardware.

Implementation

In this assignment you *MUST* implement a circuit for reading data from a physical microphone. Since the microphone is an analog device, the signal is an analog value (typically a voltage from 0v to 3v). On the microphone PMOD boards there is an analog to digital, ADC, converter that reads the voltage and returns a 12-bit number indicating the voltage. The number is unsigned, where silence is approximately the value 2048. As sound waves move the detector, the value can go down to zero and up to 4095.

The interface to the detector is described in detail in the microphone reference manual listed under the resources at the end of this document. The most important information is contained in the timing diagram, which is also shown here as figure .

In SME, the clock is implicit, so you do not need to wire the clock. You need to set the CS signal high (true), and once you set it to low (false), the output will send four leading zeroes on the data pin, and then the 12 data bits (in a total of $12+4=16$ clock cycles). After you have read the 12 data bits you must again set the CS signal high (true), wait for a clock cycle, and then you can set the signal low (false) again to have a new value read out.

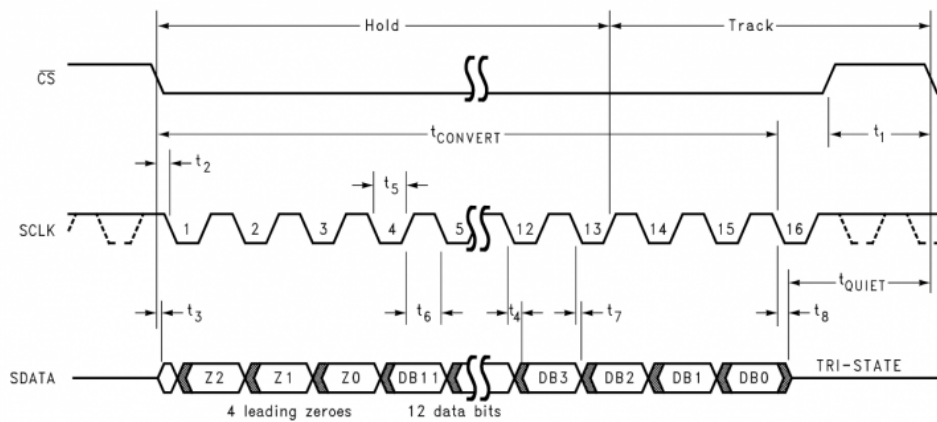


Figure 1: Timing diagram for the ADC converter

You then need to design an implement a method for detecting an edge in the signal. Given that there is no built-in support for floating point numbers, you might want to implement something simpler for this part than what you did in assignment 1.

Once you have a process for detecting an edge, you need to design a process that can read at least two such edge signals and output a value indicating that you have detected an edge and which detector came first.

- Implement a process that reads the microphone input
- Design and implement an edge detection based on the microphone output
- Design and implement a process that determines which microphone detected an edge first

Your Report

The implementation and report that you hand in must be **your own individual work**.

Your report *MUST* be written in ACM format. An ACM template for \LaTeX and Microsoft Word is available for download via Absalon.

Your reports should contain:

- An abstract describing the contents of your report
- A description of your microphone reader
- A description of your edge detection algorithm
- A description of your order detection algorithm
- A description of what tests you have performed and their outcomes

Deliverables for This Assignment

You should submit the following items:

- A single PDF file, A4 size, no more than 3 pages, in ACM format, describing each item from report section above
- A single ZIP/tbz2/tgz file with all code relevant to the implementation

Handing In Your Assignment

You will be handing this assignment in using Absalon. Try not to hand in your files at the very last-minute, in case the rest of the students stage a DDoS attack on Absalon at the exact moment you are trying to submit. **Do not email us your assignments.**

Assessment

Each assignment must be accepted in order to qualify for the exam. Should your assignment be rejected, you will be given a chance to resubmit, but please bear in mind that due to the tight schedule for assignments, you will need to complete the resubmission in the same period as another assignment.

Resources

- Locate the cricket: <https://m.imdb.com/title/tt1213275/>
- GHDL: <https://github.com/ghdl/ghdl>
- Vivado WebPACK: <https://www.xilinx.com/support/download.html>
- Pynq: <http://www.pynq.io/>
- Microphone: <https://reference.digilentinc.com/reference/pmod/pmodmic3/reference-manual>