Memo

To:

From: Cameron Robinson

Date: November 13, 2023

Re: Term Project Proposal

The project proposed in this memo is a system that collects data from a 2D rotating LiDAR, processes the data, and displays it on the DE10-Standard's LCD. The purpose of this project is to learn about hardware and software codesign as well as learn how to process and display data from a 2D rotating LiDAR. The components needed for this project include a DE10-Standard, an LD19 rotating LiDAR, a 5V power supply, and some wires. The peripherals needed on the DE10-Standard include the LCD, seven-segment displays, and one GPIO pin. The seven-segment displays will be used to indicate the closest obstacle detected by the LiDAR, and the GPIO pin will be used as a UART RX pin.

The system block diagram for this project is shown below in Figure 1. The system will use the hard-core processor on the DE10-Standard and will run a Linux operating system. There will be four custom hardware accelerators in this project: a UART receiver, a clock divider, a seven-segment decoder, and a CRC module. The UART receiver will receive data from the 2D LiDAR and store the data in a register, which can be read into the software program. The clock divider module is used to divide the 50MHz clock on the DE10-Standard into a clock useable by the UART receiver so it can sample the LiDAR transmit line that is running at 230400 baud. These modules will be implemented in hardware since it seems like a waste to spend CPU time counting how long a wire is high or low for.

The CRC hardware accelerator will receive the LiDAR data from the hard-core processor and will check to make sure that the data is valid. If the data is invalid, it will be discarded. The code for the CRC is already provided in software by the LD19 manufacturers, however, implementing it in hardware should still work and it will add more complexity to the project.

The seven-segment decoder module will take in hexadecimal values written by the hard-core processor and decode them into equivalent values that can be displayed on the DE10-Standard seven-segment displays. This module could have been implemented in hardware or software, but the hardware module code was basically already created, and it makes sense to give as much CPU time as possible to processing and displaying LiDAR data.

The software for this project will handle reading and writing to the LCD and custom hardware modules. It will parse the LiDAR data and store it so that it can be sent to the LCD to display any detected obstacles. The software will also analyze the data to determine where the closest obstacle is, and then send the direction to the seven-seg decoder modules. Handling and displaying the LiDAR data will be done in software because it has the most applicability to Senior Project where LiDAR data will be parsed, sent over a radio, and displayed on an LCD in a similar manner.

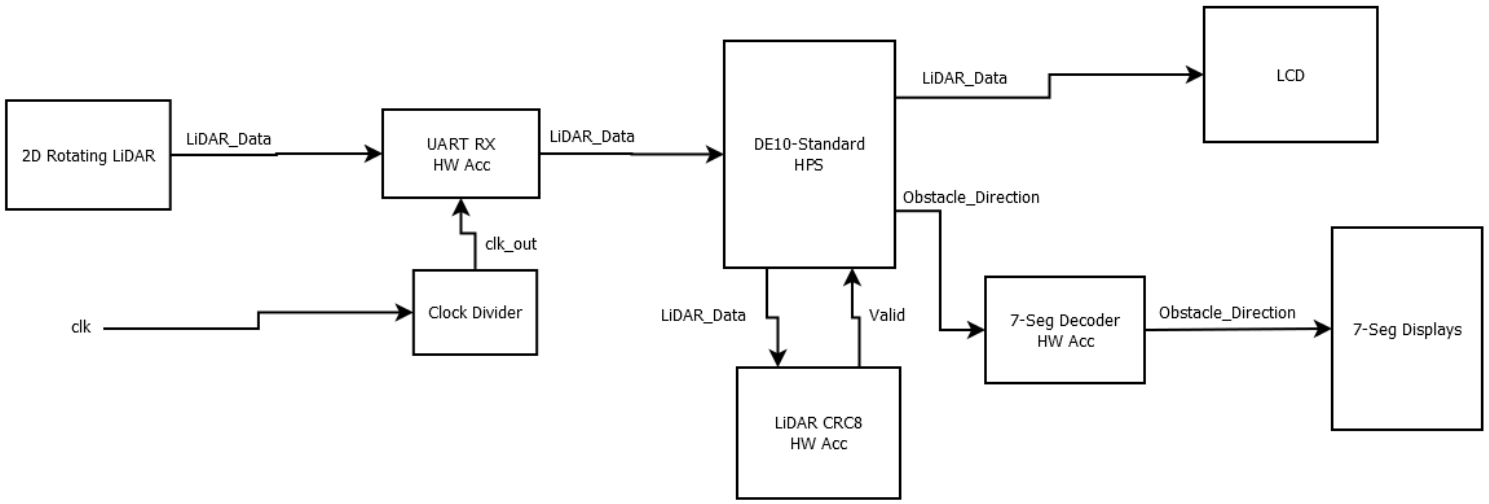

Figure 1: System Block Diagram