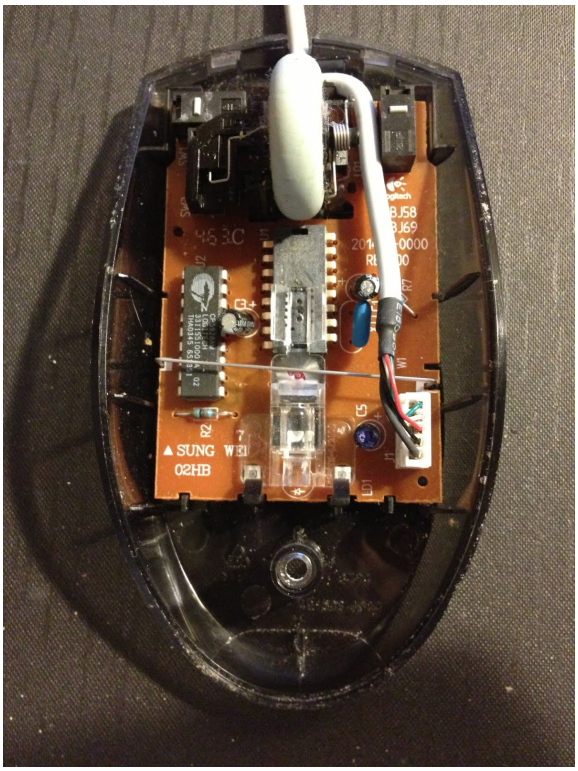
Optical Mouse Scanner



Embedded System Design - Prof. Stephen Edwards
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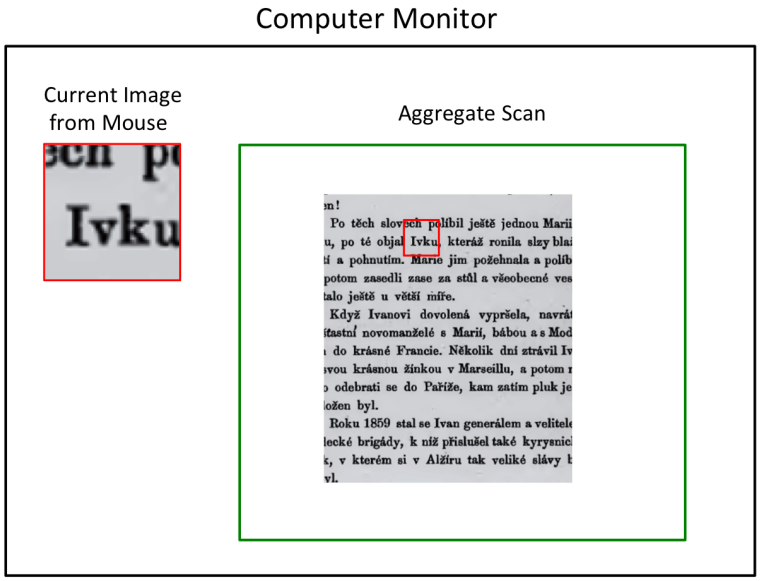
I. Overview

In our project, “Optical Mouse Scanner,” we will be implementing a system in which a user can create low resolution scan of a document using an ordinary optical mouse. The mouse is operated in a normal configuration, with the user running it over the portion of the document he is interested in scanning. The aggregated results of the current scan will be displayed on a computer monitor. By observing the aggregated scan on the monitor, the user can note which areas of the scan are missing or erroneous, and rescan the document at those locations.

The user will be able to use the left-click and right-click functionality of the mouse to scan and reset the scan, respectively. The current image being read by the optical mouse will always be displayed in a small inset box on the monitor display, next to the larger image of the aggregate scan up to that point. The position of the mouse will also be indicated on the aggregate scan. The figure below depicts the described visual output.



II. Description

To implement our low-resolution scanner, we will be interfacing with two main peripherals: the optical mouse and the VGA monitor.

Input - Optical Mouse

A standard optical mouse transmits information about the location of the mouse in a serial, packetized format. This information can be acquired using the USB, PS/2, and other similar serial interfaces—for the purposes of this project, the USB interface will be used. We will acquire image data from the optical mouse via the ADNS-2051 optical processor, which is one of a

series of common optical processors distributed by Agilent for use in optical mice. This processor includes an 18x18 pixel CCD; the image data is acquired via a synchronous, half-duplex serial port on the processor. By soldering connections to the optical processor's clock, serial I/O, and power status pins, we can communicate with and exchange data with the optical processor. The ADNS-2051 data sheet outlines communication/request protocols that we must establish to access CCD and other information. All connections to the optical processor will require soldering ribbon cables to the optical processor to establish custom GPIO (to connect to the Altera DE2).

Output - VGA Monitor

The output will be an image on a VGA monitor as described in the figure on the previous page.

Hardware

Hardware components will consist of the USB interface of the optical mouse, a GPIO connection to ADNS-2051 pins, and the interface of the VGA monitor. The parallel inputs and video processing (VGA) capabilities of the FPGA will be leveraged.

Software & Algorithms

There are several aspects of this project that require hardware and software functionality. We will map the serialized coordinate data to image data acquired from the mouse using our own custom "sorting" algorithm. This algorithm will spatially position the scanned image onto an external VGA monitor based on the coordinate data. Our first approach to this algorithm will be centering image data based on the change of X and Y coordinates received over USB.

Other software will consist of additional bookkeeping and image processing needed to compose the scan from the images retrieved from the optical mouse. The bookkeeping consists of making sure that the coordinates of the moving mouse correspond with the coordinates on the monitor to generate a cohesive image. Image processing will provide further refinement of the image, as necessary, from the raw data. This can be done using simple filtering techniques, such as a low-order moving average filter, or a small median filter. Such filters correspond to attenuation of high-frequency image noise and removal of arbitrary incorrect pixels.