Project Proposal

Optical Mouse Hand Scanner

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Project Abstract

This is a project to turn an optical computer mouse into a hand scanner. Optical mice operate by using a digital signal processor to determine distance vectors in a rapid stream of small, greyscale images. This hardware configuration on the PCB inside the mouse can be modified to bypass the digital signal processor, and allow the optical sensor to connect directly to the USB or PS/2 interface. Therefore, the optical sensor can be driven directly by the host controller (in this project: the Zilog ZNEO microcontroller) to capture the stream of images and buffer them for later use. In this project, the microcontroller will package the image frames into ZigBee packets and sent them to a remote location for reassembly.

Strategy

Hardware

The hardware will involve an optical mouse that is equipped with either an SDNS-2083 or ADNS-2610 optical sensor. These sensors are capable of capturing 18 x 18 pixel images of the surface underneath the mouse with 5 bit color depth. The DSP chip in all cases will have to be removed, and jumper cabled will have to be soldered between the PS/2 or USB interface and the appropriate pins on the optical sensor.

It is important to node that while the optical mouse sensor will be connected directly to a USB or PS/2 interace, the optical sensor does not operate over these prococols. Therefore, the USB or PS/2 connecter at the far end of the cable must be removed and the individual wires must be connected to particular SPI or GPIO pins.

Software

The software modules will include an SPI interface in order to exchange bit streams with the optical sensor. The microcontroller must produce a clock signal and synchronize all inbound and outbound bits with that clock. The clock frequency can be as high at 18MHz (approx.), but no lower than 18000KHz or else the optical sensor will force a reset. The module will provide an interface that allows arbitrary byte streams of unbounded length to be written in or out.

The second major software component is responsible for assembling the queries to the optical mouse sensor to start it up, set it in the proper modes, and request the current image frame. Most optical mouse sensors return one byte of the current image at a time, so several hundred requests must be made in order to reconstruct the current image on the sensor. Following the successful capture of the image, the sensor must be told to clear its buffer and capture a new image of the underlying surface.

The final, major, component of the system is responsible for packaging the reconstructed image into a Zigbee packet, after which it will be broadcasted wirelessly to the receiving station. Additional features could include appending message authentication codes or confidentiality features. This component will also be set to up receive instructions from a remote host to cease capturing images from the mouse stream, or to alter its sampling frequency.

The final component of the project is not on the Zilog board itself, rather it will be written in a high-level language on the host controller and will be used to assemble the small sampled images to stitch them together into a larger image.

Unknowns

The optical mouse sensors only have one GPIO pin that is used for all inbound and outbound connections. This may present a challenging hardware and software dilemma to force the appropriate pins into the high-impedance state in order to direct the traffic flow properly.

Implementation Plan

1. Implement an SPI controller and interface with sample application.
2. Test the SPI controller with the optical mouse sensor (query for device ID)
3. Develop the Zigbee controller.
4. Confirm transmission and reception of Zigbee packets.
5. Develop controller to implement protocol for interacting with the optical mouse sensor.
6. Sample for one image from the optical mouse sensor.
7. Develop embedded application to query optical sensor for image, pack with timestamp and transmit over Zigbee.
8. Develop application on the end-controller to stitch image together to enable hand scanning.

Resources

1. Zilog ZNEO, personal.
2. ADNS-2610 or SDNS-2083 optical mouse sensor and mouse, personal.
3. Solder and Solder Gun, from friend.
4. Zigbee transceiver chips, to order, personal (quantity 2).

Total budget should come in at under $100.