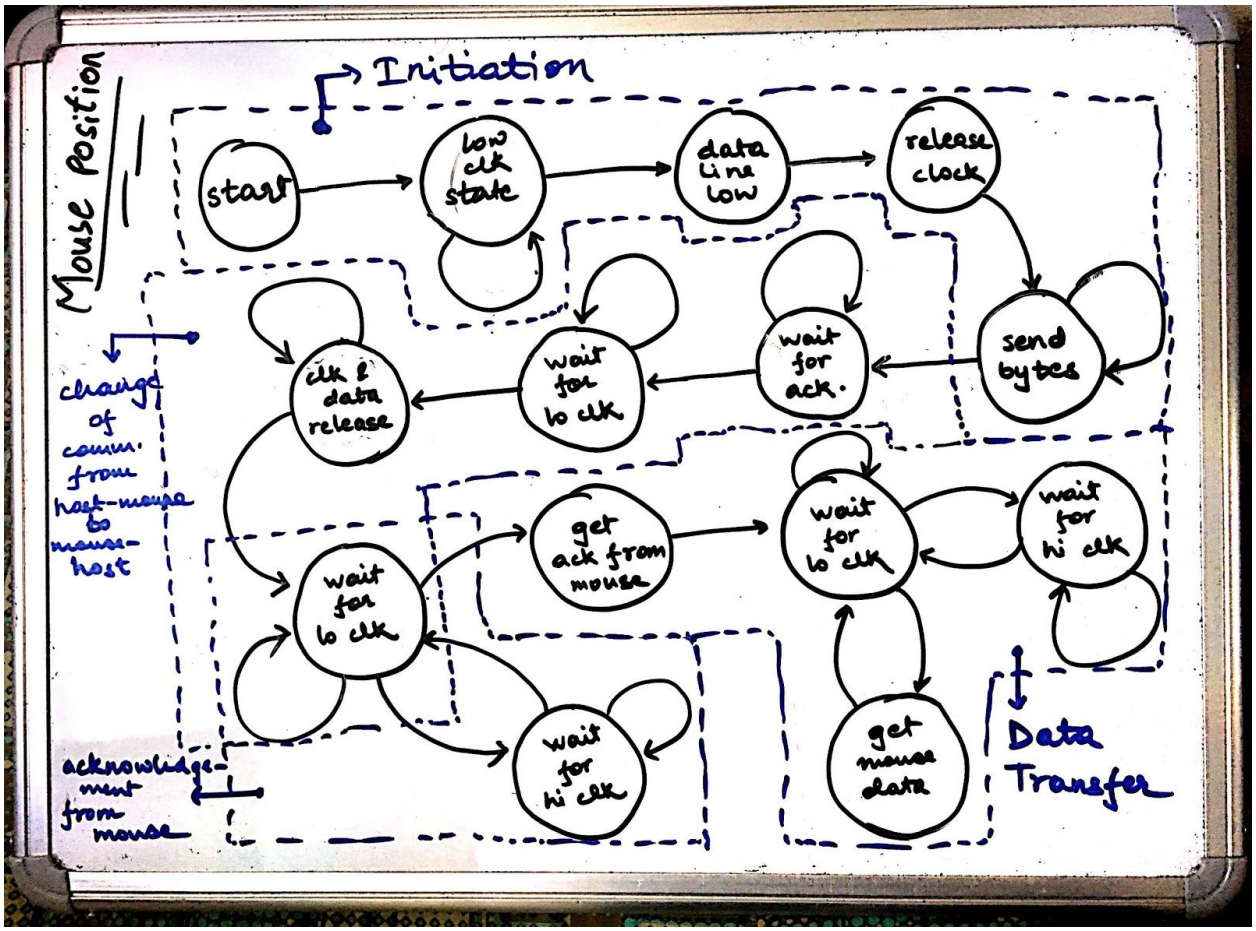
MINI-PROJECT

Mouse-Positioning using VHDL

COL215, Fall of 2017 Mini Project



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INTRODUCTION

The problem statement was:

Using the available IP for interfacing with the mouse, write a VHDL code to interact with the mouse in a way that a horizontal scroll in the mouse makes different LEDs to glow. If this is implemented quickly, you can add functionality using clicks. This involves using readymade libraries for USB communication for communicated to USB Device with FPGA Board as host.

Hence, we have to establish the connection between host,i.e., fpga and device,i.e., mouse and then display the x-movement in the form of led display on fpga (basys3 board).

HYPOTHESIS

The USB HID port on the FPGA board converts the usb input from the mouse to ps/2 output. These ps/2 signal are parsed and given to Mouse Controller which consists of many states which does:

1. Establishing the handshake between host and device.
2. Acknowledging the mouse connection and transfer of data.
3. Conversion of data in the form of bytes to x-position.
4. Displaying the x-position in the form of leds on board.

The whole functioning is also depicted pictorially in the last page.

PROCEDURE

1. Initially, we were thinking of making an indirect usb communication from the mouse to the fpga by the use of the PC as an intermediary. However, we did not know that the port converts the USB input to the PS\2 form for the FPGA automatically.
2. Moreover, we realised that to transfer data from the PC to the FPGA, we'll have to use the UART RX-TX module as well and this would not be consistent with the desired output.
3. Therefore, we came to the conclusion that we shall use the PS/2 port on the board. For this, we defined the various states that were to be used and then, following the

FSM, we implemented our code.

4. Presently, based on the states, the clock and data lines of the host and the device are changed and communication is established.

VALIDATION METHOD

For validation method, we resorted to creating the simulation and then forcing the constant to get the gist of the changes caused.

Since the mouse input would be very much dynamic and would be changing drastically with every clock cycle, it was quite cumbersome task to create the testbench for every change of the current state, we resorted to testing on the basys3 board directly instead.

Hence,we were able to successfully check for the various states but the actual input/output to and from the mouse could not be simulated by us on the testbench. We verified the states through the leds which were lit at that time.

RESULTS

We were able to achieve the motive of problem statement by establishing the connection and going through the handshake mechanism. We converted the signed data from mouse to x-position. Following this, we converted the x-position to led output and thus showing the mouse input on fpga.

CONCLUSION

We learnt about the ps/2 protocol of mouse. We also exercised our skills on FSM states. At last we have learnt about the transfer protocol between devices and its subparts like handshakes, acknowledgment, termination, etc.

REFERENCES

1. Digilent official document on Ps/2 protocol. Here.

→ Reset Mode → Initialization and self test
→ Stream Mode → Default Mode: Transfer of 3 bytes of data
→ Remote Mode → Initiation: Host transfers 0xF4 bit.
→ Wrap Mode → Host requests movement data packets
↓ (1) count → count_wait 100us.
Diagnostic Mode. bit_count → count_send 0xF4.
i → count_receive ack
(2) count → count_get bytes.

Host-to-device communication.

Data is read on the falling edge of the device clock.