UNC Charlotte, ECGR 4892/6090/8090, Spring 2004: Lab 3

Building an IR Communications Device and Sending Packet data

Learning Objectives

This lab will extend lab 2 (interfacing two MSV30262-SKP boards via an Infrared (IR) Link or wired link) by making the link run faster, operate in duplex, and send data more efficiently using packets.

General Information

The general steps for this lab are:

1. Create a new folder for lab 3. Copy your files from lab 2 into the new folder.
2. Generate a new project using the files you just copied. Name your new project Lab3.
3. Open and edit your main.c file to perform the lab functions.
4. Program the lab. Don't forget the necessary include files to get the correct functionality.
5. Compile the code into an .x30 file, and load onto the board.
6. Test the program and repeat steps 4, 5, and 6 until the program works as required.
7. Write your lab report.
8. Demonstrate for the professor and turn in your report.

Prelab Activity

What is the efficiency of a packet with 1 data byte? 40 data bytes? 80 data bytes? Don't forget about the ACK message returned.

Laboratory Assignments

You may use the PCs in Smith 347 or your own PC to do this lab experiment. The machines in Smith 347 already have the software tools loaded. In this lab you will be utilizing onboard timers, serial UARTs, and I/O ports of the starter kit to create an IR communications device. The main objective is to create a board which can attach to a PC and transmit/receive data via an IR link or wired link. Two boards should be programmed with the same code and have the same IR hardware (if they use IR parts). IR hardware has been provided. You will need two serial cables and one PC with two serial ports.

Lab 1 and 2 required users to send data one byte at a time, with a large number of overhead bits (3 start, 1 parity, and 2 stop bits). If you consider the ACK/NAK response to a sent byte, you would need to send 28 bits for every 8 bits of useful data (29% of bits sent are useful data). In the world of computer data communications, we often "pack" together many bytes of data into a "packet". Each packet must have a starting byte for synchronization and must carry other information to indicate packet details. Specifically, the pack for this lab should contain:

- Byte 1: Sync byte (xA5)
- Byte 2: Source board identifier – Board sending this packet (each group was given two identifiers, one for each board)
- Byte 3: Destination board identifier – board which should receive the packet (each group was given two identifiers, one for each board)

- Byte 4: Size – size, in bytes, of the DATA of the packet (do not count header or tail info)
- Byte 5 to n+4: The n bytes of data (maximum of 80 bytes of data)
- Byte n+5: Checksum – add all of the header and data bytes together (not the checksum byte), send only the lowest 8 bits of the sum (perform an unsigned add, discard all of the carry bits each addition)

Steps

1. Modify the main.c file and include the appropriate files. Include commenting along the way.
2. Build your program slowly, testing along the way. Perform compiles and solve each requirement one at a time. Make sure comments are written as you progress.
3. Continue to build and test the program until all of the requirements have been met. Did we mention you should write your comments as you progress, not at the end?
4. If you run into problems, use the break point functionality of KD30 to step through the code until you find the problem.
5. Once all the requirements have been met, ensure that everything works.
6. Finish lab write-up and demonstrate for the professor.
7. Submit your C code (*.c) and .map files on a floppy disk, CD ROM, or email.

Requirements

Changes to the Requirements (from lab 2) are in **bold lettering.** **Further changes are in red.**

Req. 1 – The code generated is written in C for the MSV30262-SKP

Req. 2 – The code is well commented and easy to follow

Req. 3 – Your lab report should include the final build output from the builder

Req. 4 – Both boards should run the same code

Req. 5 – The serial communications with the PC should operate at 19200 baud 8,N,1

Req. 6 – HyperTerm will be used to transmit and receive characters (you can run it on one PC with two serial ports, but with two HyperTerm applications open).

Req. 7 – The general operation will be that a character will be typed in a HyperTerm window, transmitted via RS-232 link to one board, transmitted via IR or wired link to another board, then transmitted via RS-232 link to another HyperTerm window. This transmission is bi-directional.

Req. 8 – Transmit via IR or wired link with **four header bytes, up to 80 data bytes, and one checksum byte is a single transmission.**

Req. 9 – Transmit via IR or wired link all values between 0x00 and 0xFF, including ACK and NAK

Req. 10 – Each IR or wired link transmitted **packet** should be acknowledged. The receiving board should acknowledge a valid transmission with a NAK **data** character (0x06). If the transmission is invalid, acknowledge with a NAK (0x15). **ACK and NAK packets also need the 4 byte header and checksum bytes (and will be 1 data byte).**

Req. 11 – A valid IR or wired link transmission will be characterized by the correct **packet information (correct sync byte, correct source, correct number of data bytes compared to what should have been sent) and checksum.**

Req. 12 – A valid IR or wired link transmission will have the correct parity.

Req. 13 – Each byte transmitted via IR or wired link should be acknowledged within 0.01 seconds.

Req. 14 – The LCD does not need to show characters, but can be used during debug.

Req. 15 – Use the IR hardware provided by the professor (if IR is used).

Req. 16 – The minimum transmission distance is 1.5 meters ~~. (Extra credit for transmission over greater distances).~~

Req. 17 – The IR hardware should be powered by the Renesas boards.
Req. 18 – The PC will send one character every 0.01 seconds (you will need queues to buffer the input). Send the buffered data to the other board when the CR or LF byte is sent from the PC (x0D or x0A)
Req. 19 – Ignore all packets where you are not the destination packet. If the source was not your "paired" board, send a NAK.
Req. 20 – Ignore all "garbage" messages (cannot determine correct header information).
Req 21 – The same code should be used on both boards. Determine the board number (between the two provided to your group) based on a SW2/SW3 button press.
Req. 22 – Extra credit for getting IR to work.

Lab Report

Include in your lab report observations and procedure like the following:
The general learning objectives of this lab were . . .
Pre-lab question answers
The general steps needed to complete this lab were . . .
Some detailed steps to complete this lab were . . . .

1. *Step one*
2. *Step two*
3. *. . . .*

Code generated for this lab…
Some important observations while completing/testing this lab were . . .
In this lab we learned . . . .

Send the code the .map file, and the report to Dr. Conrad via email. Turn in a hard copy of the report, but not the code.

Board Codes
Rai/Kurnella: x10/x11
Levine: x20/x21
McClain/McKain: x30/x31
Tchang/Ansari: x40/x41
Ford: x50/x51
Ngo/Johnson/Frierson: x60/x61
Lasassmeh/Snyder: x70/x71