Remote Lamp Dimmer using DCC Signals

Mechatronics Projects — 3c

Jonathan Scott, 2020

1 Introduction

This project involves building a microcontroller-based device to receive, decode, and respond to data packets using the NMRA DCC signalling standard[1] while powered from the same source.

The task presents good intellectual challenges: The microcontroller must achieve timing constraints to handle incoming serial data; the program design demands that the programmer read, understand and adhere to a well-documented engineering standard; and The project is due on or before the last Friday of study week.

2 The Specification

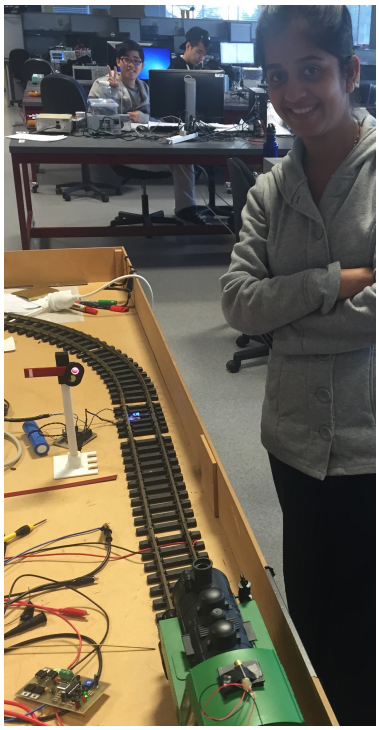
You are to construct two circuits. The first circuit can run off your power supply. It will use a PIC16F684. It will have a potentiometer. It will transmit instructions along a pair of wires to other circuits, to instruct them to set the brightness levels of lights. The other boards will have addresses in the range 1-99.

The second circuit is to be connected to the first circuit by 2, and only 2, wires. The second circuit board will have a 12V lamp. It will also use a PIC16F684. The task is to arrange for the second circuit board to make the 12V lamp brighter and dimmer as the pot on the first circuit board is adjusted. Thus, both the required power, and the instructions, must to be sent down the single pair of wires joining the boards. You may choose any address for this second circuit. When a push button on the second circuit is pressed, the lamp must be turned up to full brightness.

Additional diagnostic functions can be added to the second board for additional marks. An LED that indicates the presence of a data stream would make an electrician's job of wiring this up easier. An LED that indicates packet errors would also be helpful; pressing a button on the first board that deliberately corrupts data will let you demonstrate this. An LED that indicates detection of a valid packet with an incorrect address will also help setup. This can be tested by having the transmit circuit change the address to which it sends instructions when a button is pressed.

[1] It happens that the NMRA's DCC standard represents a small version of the kinds of standards used in serious engineering, TCP/IP, VISA, WCDMA, etc. This project is thus is a perfect model of the process often used in the development of a new product or of bringing a new employee up to speed on a technology central to a manufacturer, yet it is brief enough for inclusion in an undergraduate course. For these reasons it is a highly instructive exercise.

3 Hints and Ideas



The hardware is not important, it can be built in any way you like. You may care to build a new PCB to show that you can make the electronics very neat. You may wish simply to put a few parts into a spider-board, but robust construction is healthy.
If you briefly dissect the OO-scale models sometimes demonstrated in the lab you will discover that one uses a PIC12F675 (as was used in the ultrasonic lab) and another uses a PIC16F684 (as many students use in the motor control lab). This suggests that the task need not be very demanding in terms of the size of the code.

4 Assessment

The live assessment will consist of a demonstration and verbal "defence" of your design. Be prepared to explain how you do timing.
This time there is no report, but a circuit diagram and code listing is required documentation. Details on the Moodle submission entry.
Be sure to comment your code informatively.
The management part will be assessed as usual.