

Individual Project Plan

Title

Does abstracting control reduce the complexity of a railway control system?

Introduction

This project focuses on control of model trains along an undefined route. Traditional automated train control has relied on a preset route and timings which can cause a headache to plan and any changes are time consuming to implement. The project describes how using abstraction in hardware the trains can be routed in a more intelligent way. The microcontroller based control architecture will be designed to be scalable for large and complex model railways layouts. The project is targeted at any model railway hobbyist who requires to automate their railway layout.

I have no great interest in model railways but I am more interested in computer control. There are few things that can be easily controlled by a computer so a model railway seems the easiest to control. This solves a real problem with model train control and has great scope to be taken further when I graduate. The principal of routing a train has a number of links with computing principals which makes my job easier as theories and solutions have already been created which I can recreate. Control had a big part of my placement year and again I can use a lot of what I learnt on this project for example state machines in control routines.

Background

For a model railway hobbyist, creating a railway layout that looks and acts as close to the real thing as possible is their main aim. The expense of the hobby can put off children who you would expect it to be targeted at. The main audience for this hobby is generally the older generation who have the disposable income that is required. With the aid of lots of money creating a layout with realistic scenery is very achievable however control of the trains themselves is a more specialist area. Both Hornby and Peco, the market leaders in model railway products, don't offer any kind of automation control products apart from their power controllers which are manually controlled. The lack of control products has meant that the average layout uses an unrealistic circular design. This not only causes repetitive movements of the trains which can be dull to watch but the layouts themselves can take up most of the room that they are housed in. Without any sort of automation it is currently not possible for example to have a layout run down only one side of a room. This type of layout would

be far more convenient for most people as it doesn't mean reserving a whole room for the layout.

The project is focused around the control of an OO gauge model railway. OO has a scale ratio of 1:176.2 and runs on a 12V DC supply. There are two rails which depending which one is live, controls the direction of the trains travel.

Project Objectives

- A modularised control system will be created to control a model railway.
- Routing of the trains should be done intelligently with no interaction from an operator.
- Ideally it should be easy to add a new block if the layout expands and the complete system should be made aware of the change in a short time.

Priority 1: Movement of a train from one block to another. Scheduling is done via a Personal Computer with a basic Set-and-Depart interface. No advance scheduling can be achieved.

Priority 2: The PC's interface should be more advanced with scheduling being achieved along time in advance of the train departing.

Priority 3: Changes to the system, for example addition of new blocks and destinations can be downloaded from the PC to the block-controllers on initialisation.

Constraints

- The trains run on a 12V DC track.
- The signals use 1.2V LEDs.
- The point motors operate using a 'burst' of a 12V DC current. If the current is left on the motors will overheat.
- The system has to be safe.

Method

The problem that I am trying to solve has already been solved on the full scale rail network. We don't have a central control centre that controls the whole of the UK's railways. Instead we have much smaller control centres traditionally called signal boxes. These control only a small section of track that can be easily managed by an signal man or control system. I am therefore going to take the same solution by

breaking any model railway layout into blocks. Each block will be controlled by a microcontroller based block-controller that I will also build. All the block-controllers will be able to communicate with each other via a serial connection. Communication is required in the event that a train has to cross the boundary of its associated block-controller. With full scale railways the signal box doesn't actually control the train as the train driver does, however I intend the block-controller to also act as the train driver by setting the speed and power of the train.

Over the summer I have created a demo layout consisting of 2 blocks. The blocks are mirrors of each other and are made up of a basic layout with 3 points, 5 sensors and 2 signals.

Deliverables

- Requirements Specification
- User Guide

Design Documentation

- High Level System
- Block-Controller
- PC Scheduler Interface

Products

- Block-Controller Hardware
- PIC18F2550 Firmware (Firmware / C)
- Windows Scheduling Software (Windows / C#)

Activities

See Individual Project Plan Timeline

Resources

- MPLAB IDE: This is Microchip's own Integrated Development Environment for developing firmware for any PIC microcontroller.
- MPLAB C18 compiler: This is the compiler used to compile C code into a hex format that can be loaded onto a PIC microcontroller. The student edition is free, however after 60 days the advance features for optimising performance are disabled.

- Visual Studio: This is used to create and compile the Windows scheduler application that will run on the desktop computer. This is available free for students from MSDNAA.

Risk Analysis

Risk	Risk Probability	Risk Impact	Risk Factor
Unavailability of resources	2	8	16
Unavailability of key personnel	4	5	20
Technical problems	6	6	36
Other tasks demanding my time	6	5	30

Unavailability of resources: All the resources I need for this project I currently have and it is very unlikely that these will be taken away from me and as such I have no contingency measures in place if this would occur.

Unavailability of key personnel: The main issue in this area is if my supervisor or reader would be made to resign. In the event I would be allocated another lecturer to fill the gap but my project is likely to suffer as a result.

Technical problems: This is very likely as I am not only dealing with software but also hardware. When something smokes an all-nighter will not fix the problem. As with all fixable problems I intend to work at it until I have solved the problem. This will delay my progress but I have to manage my progress and alter my plan to guide me back onto track. To try to prevent this I have done lots of research in the areas that I intend to use which should help me when I come around to using it.

Other tasks demanding my time: This is a little unknown as I am not yet at a stage where I can plan for this as not all the assignments have been issued. When I can, to prevent too much time being taken away from this project I intend to plan my time wisely and any changes will be consulted with the plan and it revised.

Ethical Review

There are no ethical considerations that I can think of.