Computerized Train Control System

Functional Description

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**Project Overview:**

The Computerized Train Control System will allow control of a model train layout from a remote java based client application. This system will consist of a remote client, server, PC based controller, one or more track control-sensor units, and encoder units. The client software and server will give the user control of the model train layout through a java applet running on the client machine that communicates with the server. Pictures of the train layout will be sent to the client from a webcam. The PC based controller will take commands from the server application and communicate with the Local Controller units. Due to the inability for real time control to be established over the internet, the Controller Application will have the ability to monitor the layout status and send out commands to the Local Controllers to prevent crashes or train derailments due to intentional or unintentional user/client error. The control-sensor units will be networkable microprocessor based units that will receive instructions from the controller unit and send back information about the layout. These units will transmit commands to the Digital Command Control encoder which will be responsible for converting the information into a serial transmission which complies with National Model Railroad Association (NMRA) standards for Digital Command Control (DCC). The DCC signal will be received by a decoder card in the locomotive which will then execute the commands.
Overall Block Diagram:

Client – Server

The client and server applications provide a means of control over the internet using standard protocols.

Client

The client side will be implemented using a java applet running on the remote terminal and will allow the user to monitor and view the train layout. While multiple client sessions can be opened for viewing, only one of the clients will be able to have full control of the layout at any time. This control connection will be able to be switched between clients so that control can be shared between users that are logged on.
Server

The Server will handle the connections between client terminals and the Controller Application. Commands will be forwarded to the Controller Application and feedback on the status of the system is returned to the client application.

Controller Application

![Controller Application Diagram]

The Controller Application is a PC application that acts as the brains of the entire system. It receives commands from the server and polls the Local Controller network for sensor information. It then calculates the current state of the layout and uses this information to keep the trains from being derailed or crashed. It is also responsible for sending commands to the Local Controllers. Thus commands from the server that may result in a crash are not sent through to the Local Controllers.

→ Commands from Server

The Server will give commands to the Controller Application.

← System Status

System errors and layout status sent to the Server.
→ Output to Local Controller

Commands sent out to control the trains on the Local Controller’s segment of the layout. These will be sent over a serial network.

→ Status from Local Controller

A protocol will be used so that the Command Application can poll the Local Controllers to check the current state of the sensors.

↔ System Definition Files

Text files which store information about the train layout, trains and system setup.

Local Controller

Controller Application Commands ➔ Local Controller

Status ➔ Data to Encoder

➡ Sensors

➡ Switch control

The Local Controller will receive commands from the Controller Application. It will then handle the control of its track section by sending commands to locomotives using the DCC protocols. It will also control switches or other accessories using a parallel interface. The Controller will receive data from sensors. Sensor data will be sent to the Controller Application when it is polled.

→ Controller Application Commands

← Status
Data to encoder

Data is sent to the encoder module though a parallel connection.

Sensors

Block sensors to tell if there is an operating locomotive on a particular section of track.

Switch Control

Ports which can be turned on or off by the Local Controller to control switches or other accessories.

Encoder

Data from Local Controller \(\rightarrow\) Encoder \(\rightarrow\) DCC signal to tracks

Handshaking \(\leftrightarrow\)

The Encoder takes the commands from the Local Controller, converts the information into the NMRA standard packet, and puts this signal onto the tracks so that it can be received by the locomotives.

Data from Local Controller

Handshaking \(\leftrightarrow\)

DCC signal to tracks

Packets of information compliant with the NMRA standards for DCC are continuously sent to the tracks.