All Aboard:

A Method to Improve Model Train Control Accessibility

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Introduction

John Blase is a train enthusiast. He enjoys riding in trains. He enjoys looking at trains. He visits museums and reads books to learn about their history. And around his house lie train pictures, pillows, and sculptures. When people come to visit, he ushers them to his basement to show them his model trains. He has an elevated layout where trains travel between city and country, over bridges and through mountains. He can run up to four trains at a time, controlling them individually using a Märklin digital control unit. He also has interfaces that allow him to control the switches and signals on the track.

However, John has not been able to independently control his model trains in many years. He was born with polio and lived his life with one arm shorter than the other. About 8 years ago, he suffered three strokes resulting in loss of motor control in his longer arm and very limited control in his shorter arm. Since then, his wife and guests are the ones that have been controlling his trains.

All Aboard is a proposed interface that takes advantage of John's existing motor capabilities. It uses control interfaces manipulated by John's feet and a software interface that can connect with his current digital control unit. If the interface proves successful, it will allow John to get back into the conductor's seat.

Current System

The heart of the current system is a Märklin Digital 6021 Control Unit (Image 1). Each train engine has a decoder which is assigned a number. The decoder listens for commands from the control unit. To send a command, users first select a train by entering the corresponding number on the keypad. All commands are sent to this train until a different number is entered. A dial is used to specify the direction and speed the train is run. There exist specific buttons to control the train's sound, bell, and lights. Generic buttons can be programmed to control additional functions that trains might have such as whistles, smoke, recorded announcements, or movement within the train.

Keyboard units connect to the 6021 Control Unit to manipulate signals and switches. An Interface unit can connect between the Control Unit and a computer allowing users to program and save detailed scenarios to be played out on the layout.

These interfaces have small buttons and dial switches that are designed to be manipulated by users' hands and fingers. While evaluating the current system, I found the interfaces to be confusing to novice users. Labels next to buttons are minimally labeled, usually displaying only a single letter. Most buttons' functions change based on the last entered engine number, yet the interface lacks the ability to display

Image 1: Märklin Digital 6021 Control Unit Interface

this information. Having to memorize what all the buttons do for each individual train may be taxing on the user. Sometimes immediate action must be taken to avoid collisions. For example, when a new engine number is entered, the speed control is not initialized or set to the current speed of the new train. There is a two second delay before the train is given commands from the unit. During this time, the user must adjust the speed dial to the current speed of the train to maintain that speed, otherwise it will take on the speed of the last train.

While the main goal of All Aboard is to allow John to control his model trains with his feet, a secondary goal is to make the interface easy to learn and use by clearly labeling buttons and showing the current states of functions.

All Aboard

There are two parts to the All Aboard interface. First is the input device the user will use to control the trains. Second is the software display in which the user will interact and which will show current states of the system.

Input Devices

The user will use the foot-operated NoHands Mouse to interact with the software (Image 2). The mouse consists of two interchangeable pedals: one is a 360-degree pressure sensitive pedal that allows control of cursor speed and direction with one foot. The other pedal is a clicking device. The NoHands Mouse allows the user to control the position of the cursor, point and click, and drag and drop. In addition to the mouse, an additional foot-switch will be added as a Stop Switch (Image 2). George Masak of Toy Trains ‘N Things, Inc. explained a Stop Switch is a button that suspends all power to the

Image 2: NoHands Mouse (left) and Foot-Switch (right)

layout. It is used to avoid train collisions or other damage when the user does not have enough time to change the settings. This foot-switch will be located next to the NoHands Mouse such that the user can quickly activate it.

Input devices controlled by the feet were chosen over an eye-tracking system and a voice activated system for a few reasons. If the user wishes to expand his model train digital command center, a mouse interface would allow him to launch programmed scenarios from existing model train software. Although an eye-tracker is a similar mouse interface, when running model trains, the action is on the layout, not on the computer screen. The foot-controlled mouse will allow him to watch his trains most of the time and the computer screen a minimal amount of time. A voice activated control interface was not chosen because the trains can be loud. Running the trains is also a social activity. If people are talking about the trains as they run, they might accidentally alter the settings.

Software

Users will interact with software run on a computer that is connected to the Märklin Control Unit. The computer will interpret the user interface controls they select into commands understood by the unit. Requiring a computer to run model trains may seem extreme, however a minimal computer would suffice. Additionally, many people are connecting computers up to their train control units and programming entire scenarios that move the trains and manipulate the switches. Users may take advantage of having a connected computer to run their trains.

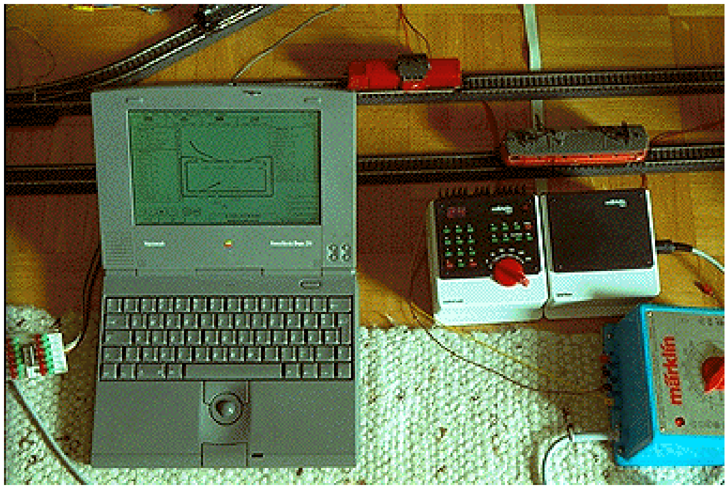

Image 3: Laptop connected to the control unit and controlling the trains.

Because the interesting action taking place is on the layout, the interface was designed to be simplistic. The screens are uncluttered and items are large and easy to find. According to Fitt's law, the larger size buttons allow for faster selection by the user.

There are three tabbed sections that organize the controls: Train Control, Track Control, and My Programs. This organization is consistent with the current system's control units. Train Control allows selection of a train and provides buttons to control its functions (Image 3). Image buttons displaying the trains are displayed down the left side of the screen allowing for faster recognition of the desired target. If there are more trains than can be displayed on the screen, scrollbars will appear. To select a train, the user presses the image button. The panel to the right of the buttons updates with the selected train's controls.

Every train has a slider that controls the speed and direction of the train. To adjust the speed, the user would click down on the slider and hold with one foot. The user would tilt their other foot forward to go forward or tilt it backward to go in reverse. The more extreme the tilt, the faster the train will travel. This action was designed to map with the idea of forward and reverse, and would not require the user to look at the screen.

All controls are clearly labeled to allow ease of use. Effects that would be consistent, such as the engine sound or head light, can be powered on or off by pressing a check box. More transient effects, such as a bell or whistle, are enabled by pressing a button. Every train also has a Stop button.

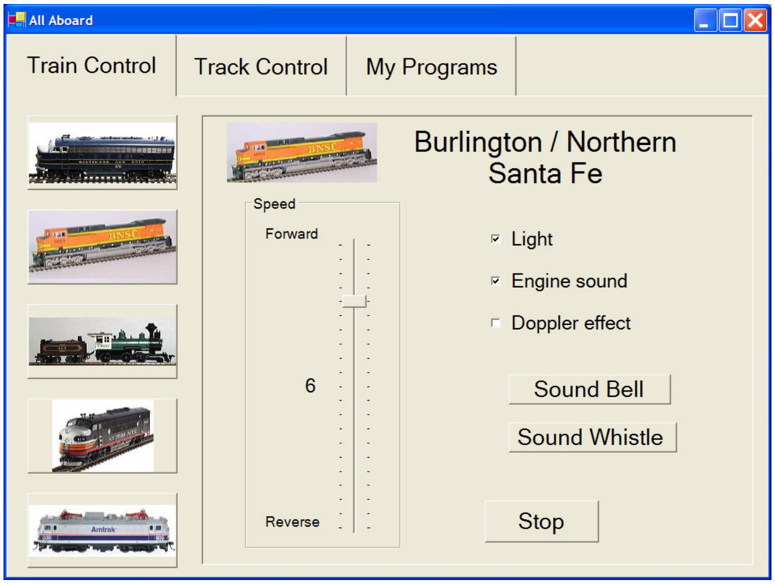

Image 4: Train Control Screen

Track Control lists the signals and switches which toggle between two states (Image 5). When setting up the system, these states can be given meaningful labels. For example, instead of referring to a switch by a memory address, the user may call it

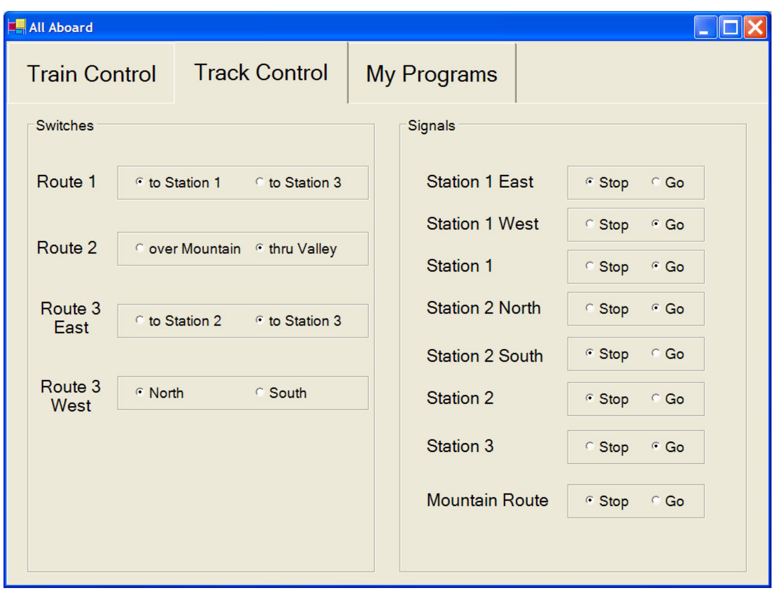

Image 5: Track Control Screen

Route 1 and describe its states as "to Station 1" and "to Station 3". If there are more switches or signals than can fit on one screen, scrollbars will appear.

My Programs displays buttons that launch programmed scenarios created using other model train software on the computer (Image 6). The software display is flexible enough to interface with the other software and allow one button execution of the scenarios. Comments to the right of the button describe the scenario in more detail.

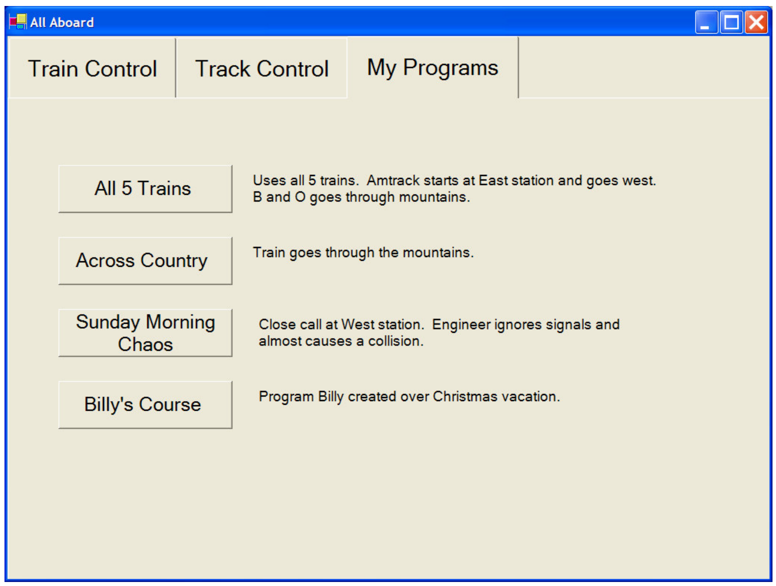

Image 6: My Programs Screen

Future Work

The proposed design should be shown to John and other train enthusiasts with similar need for this technology to see if it allows them to accomplish all tasks in this domain. Their input would be valuable toward future iterations of the design. More research should be done on how to interface All Aboard with existing model train software. Better graphics should be created to make the information displayed more quickly and easily understood and to provide an enjoyable atmosphere when using All Aboard. Finally, a usability study should be completed using the proposed hardware, a prototype of the software, and a real train set. Train enthusiasts with similar disabilities as John should participate and provide feedback to be used in the creation of a real system.

Conclusion

All Aboard is a proposed interface for model train enthusiasts lacking motor control of their arms. It uses a foot-controlled mouse interacting with a software interface to give commands to train and track controls on a digital command control layout. The interface was designed to make it easy to access and manipulate items on the screen using a mouse and to quickly ascertain the state of the controls at a glance, limiting the amount of time the user must take his or her eyes off of the train layout. This is an initial design which should be evaluated by potential users as well as HCI students and professionals. Based on the results of the evaluation, the design may be improved and modified, resulting in an anticipated product.

References

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