Computer Controlled Railroad Simulator

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The Computer Controlled Railroad (CCR) is an HO scale model railroad that is controlled by a PC using robotic techniques. It is currently used in computer science classes like Operating Systems and Machine Organization to help students visualize concepts like multi-tasking, racing conditions and interrupt processing. Several student projects have used the CCR to learn about robotics, client-server processing and real-time processing. Unfortunately, there are only two physical railroad layouts for students to test their designs and algorithms. Development is also slowed by issues like trains derailing, damaged track and power loss. A CCR simulator would allow several students to be *working on the railroad* at the same time and whenever and wherever they want. The CCR Simulator could also be used at Boys and Girls Clubs and elementary schools as STEM projects for kids to run trains remotely and to develop fun programming applications using a simple meta language.

Project Description: Develop an application that simulates a CCR allowing applications to plug into the actual CCR without major modifications.

General Requirements:
1. Design a track definition protocol so that users can define their own layouts.
2. Develop a track editor that allows users to design their own layouts.
3. Layout designs can be saved, loaded, and modified.
4. A layout supports turnout switches and train detection sensors.
5. Users can adjust a train's speed, direction, lights, horn, etc. as well as switching the direction of the turnouts.
6. Detect collision and derailment.
7. Support multiple trains.
8. Develop an API that allows application programs to send and receive information to the simulator.
9. Develop a graphical interface that dynamically shows the current state of the CCR.
10. Simulate error conditions such as broken trains and hardware failure.
11. Develop a simple interactive user interface that can run the simulator.
12. Allow multiple train engineers to remotely control trains on the same layout.
13. Consider a simple meta-programming language to develop programs that control trains in a batch mode.