

LART-CS08

Acceptance Test Plan – D005



Senior Design - Spring 2008

Lafayette College

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ACCEPTANCE TEST PLAN

Technical Requirements

R001: Rail Switch Control

The LART-CS08 will provide interface electronics and software to allow the independent programmed control of all electromechanical rail switches in the CFE track layout. This requirement will be tested by visual inspection. The rail switch must go the majority of the way across the track when it is thrown by our controller software. The train must also be able to successfully ride over the switch when it is thrown in either direction and not go off of the tracks.

R002: Engine Power Control

This requirement will be tested in a variety of ways. The interface and electronics software that allows the independent programmed control of all of the track segments will be tested by visual inspection. We will use the GUI to activate various rail segments and see if the trains move in the direction and at the speed they are supposed to according to those chosen by the user on the GUI. We will test all of the 16 different train speeds by measuring their velocity on the tracks and we will test the train direction by visual inspection. We will also test that the speed of the train does not vary when crossing different sections of the track by visual inspection. Lastly, we will test the circuit which prevents over current conditions if a short circuit is created over two track segments by visual inspection. We will use visual inspection to see if a fuse blows properly if a short circuit is present instead of sending the infinite current back into our circuit boards.

R003: Train Proximity Monitoring

The interface electronics and software that allows the independent programmed monitoring of the train proximity sensors will be tested by visual inspection and analysis. We will use the maintenance mode to run trains over various sensors and inspect that the software handles that information properly.

R004: Expandability and Adaptability

This requirement will be tested by visual inspection and analysis. We will make sure that our GUI can support multiple trains operating simultaneously. We will test the maintenance mode by operating multiple trains on the track and visually inspect that they run smoothly and we will run the demo mode which uses multiple trains as well and visually inspect that it operates appropriately. We will test that our system is expandable by adding more trains to the existing track and visually inspecting that the system still functions properly. We will not be able to physically test the expandability of our track layout since we are limited by the CFE track layout. Therefore, we will visually inspect the XML document that was created describes how to modify the program if more tracks are added.

R005: Control and Monitoring Speed

We will test this requirement by measurement and analysis. We will test to make sure the delay throughout the hardware and over the cables does not adversely affect the performance of our control system.

R006: Applications Programming Interface

The LART-CS08 shall provide fully documented software Applications Programming Interface (API). This will enable an applications programmer to write software applications using the methods and classes defined in the API documentation. These applications should be able to control and monitor all CDE track layout and engine power interfaces supported by the LART-CS08. We will test this requirement by visual inspection. Well commented code should exist to assist a programmer in debugging.

R007: Maintenance User Interface

The Maintenance UI must allow a highly trained human technician to manually control and visually monitor all interfaced components on the CFE track layout, including track-switches, train proximity sensors, and engine speed control at each track segment. This will be tested by an external qualified user who should be able to navigate the maintenance GUI to control and monitor the components of the train system.

R008: Demonstration Application

The LART-CS08 shall provide a fully documented, user friendly, easy to use, Demonstration Application. A fully documented easy to follow user manual should be in place. This requirement will be tested by having a non-technical user successfully run an automatic demonstration of the capabilities of the LART-CS08 and CFE track layout. Simultaneous automatic motion of multiple trains and informative end user train arrival displays should be demonstrated.

R009: Modifications of the CFE Layout

Modifying the basic CFE train layout is not permitted. A visual inspection of the LART-CS08 will determine that no modifications have been made to the tracks, track-switches, train sensors, and the trams themselves.

R010: Power Input

The LART-CS08 shall operate on the standard 120VAC, 60Hz power available from a single outlet in AEC room 419. A multi-outlet power strip and extension cords will be used. All other voltages will be generated by the ac-dc converter. A visual inspection of the LART-CS08 will verify that this requirement has been made.

Ethical Requirements

ER001: Trams must not crash

This requirement will be tested by visual inspection and analysis. The software has many fail-safes to prevent the trains from crashing so we will inspect that this is working properly when the system is complete.

ER002: The trains must not accelerate or decelerate too abruptly

This will be tested by measurement and visual inspection. We will calculate the acceleration of the train and compare it to that of a modern day car or train. We will try to scale our results and create a smooth acceleration and deceleration accordingly. Once the proper amount of acceleration and deceleration has been determined we will visually inspect to see that the trains are running smoothly.

General Project Requirements

GPR001: Documentation

We will test to make sure we have met this general project requirement by visual inspection and analysis. We will test to make sure that all of our project documents are accumulated in electronic form, uploaded to our project website and properly indexed. We will make sure all final system level documentation has been created and that all of the schematics for our sub systems follow the proper drawing format. All software will be inspected to make sure they are in the proper format. Also, we will make sure our user's manual and maintenance manual follow the appropriate requirements.

GPR002: Environmental

This requirement will be tested by visual inspection and analysis. We will test to make sure that all of the components that were purchased meet the specifications in this requirement. This will be done by analyzing the documentation for these parts and visually inspecting their performance when the system is running to make sure they do not over heat or condense.

GPR003: EMI/EMC

This requirement will be tested by analysis. We will make sure any unintentional electromagnetic radiation emitted from our system meets US CFR Title 47 Part 15 subpart B regulations for Class A digital equipment. This will be tested by analyzing the documentation of our parts and making sure they follow the specifications in the CFR document.

GPR004: Hazmats

This requirement will be tested by analysis and visual inspection. We will analyze all of the documentation of our system components to make sure they do not contain hazardous materials and that all of the materials used meet the 2002/95/EC RoHS directives. We will also make sure that when it comes time to discard any components, that they be discarded according to the Lafayette College Chemical Hygiene plan. This will be tested by visual inspection.

GPR005: Safety and Good Practice

This requirement will be tested by visual inspection throughout our project design process. We will make sure that we construct all of our electronic components with good industry practice to enhance reliability and maintainability. We will also make sure that the project activities adhere to the general Lafayette College safety policy and ECE Laboratory safety rules. We will inspect all power supplies to make sure their outputs do

not exceed 30 Volts. Throughout the design of our system we will consistently refer back to this requirement if we choose to add something to our project that might be a concern.

GPR006: Reliability

We will test this requirement by analyzing our reliability requirements. We will test those requirements by visual inspection, measurement and analysis. We will review the documentation of our parts to make sure they have the proper lifetime warranty that satisfies the requirement which states the expected lifetime of our system. We also will calculate the MTBF of our system to make sure it meets the requirement in GPR006.

GPR007: Maintainability

At minimum, the system MTTR (Mean Time To Repair) should be less than 1 week. In order to provide for this all components must be able to be obtained from at least two suppliers. A fully documented API would also help in repairing the system incase some code or hardware got corrupted. Fully documented sub-system diagrams would also help reduce the MTTR making it easier to order replacements or fix a particular sub-system. For minor complications the user's manual should be a sufficient resource.

GPR008: Sourcing Sustainability

All production designs must be built from components and subassemblies that have a sustainable source of supply over the system lifetime. This will be satisfied by ensuring each component is available from at least two suppliers.

GPR009: Global Sustainability

All production designs should be synthesized with consideration to techniques that maximize global sustainability. A thorough life cycle assessment of the components in the design will have to be considered. The life time of each component as well as its proper disposal shall be investigated. Also all components should be RoHS compliant in order to cause minimal harm to the environment.

GPR010: Ethics Report

This will be addressed by a fully documented Ethics Report

GPR011: Project Demonstration

A completed project must be demonstrated for review by ECE faculty. This will be verified visually ensuring that the trams are controlled and monitored as per project requirements.

GPR012: Final Disposal of Projects

Projects may be stored for future work, placed on display, or discarded. Separate parts must be properly labeled so their association with the stored project is obvious. Any hidden portions should be enclosed in a sealed container, locked cabinet or secured room. This will be verified visually.