Near Real-Time Online Reporting System for The Model Railroad System Located in The Real-Time Computing Laboratory

Graduate Project Report

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Submitted by

Maruthi H. Dantu

To the

Department of Computing and Mathematical Sciences
Texas A&M University – Corpus Christi

COMMITTEE MEMBERS

R. Stephen Dannelly, PhD
Chairperson

Holly Patterson-McNeill, PhD
Member

Dulal Chandra Kar, PhD
Member

[Signatures]

[Signatures]

[Signatures]
Abstract

This project is the development of a World Wide Web (WWW) based system for monitoring the Model Railroad component of the Real-Time Computing Laboratory in the Computing and Mathematical Sciences Department at Texas A&M University-Corpus Christi. The reporting system will allow faculty and students to view the actions, status, direction and speed of all the five model locomotives and also status of switches and occupied blocks on the track. Both the control server and the control server simulator for the model train system provide clients and users with real-time reporting and allows them to test their software modules through the WWW irrespective of the user’s physical location.
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1. Introduction

1.1 Background

The computer science program offered by the Department of Computing and Mathematical Sciences at Texas A&M University-Corpus Christi, produces graduates who are highly proficient at designing, developing and writing software to solve real problems in a range of areas. The department began building a real-time laboratory in the summer of 2000 that is composed of a Model Railroad system. This laboratory is used to teach a wide variety of computer science and mathematics subjects. The laboratory provides students with experience in real-time programming, client/server programming, designing solutions to challenging problems and also the ability to effectively implement and test those solutions.

The Laboratory consists of five networked Linux-based control computers. One of the computers is equipped with an electronic signaling device that controls the components of track system. This main control computer, conductor.tamucc.edu, will also be equipped with the A/D card that supplies location sensor data. In addition to the computer-controlled track system, two cameras have been installed, and each camera is fixed in place to provide different views of the system via the Internet. These cameras provide an overview of the entire track-bed. The track bed is composed of approximately 100 linear feet of track with 34 electronically controlled track switches called turnouts. Faculty can use this model railroad as a tool to provide students with real examples. For example, a challenging problem for an Artificial Intelligence course will be to have an application automatically move a single train from one point on the track to another point with the minimum number of changes to turnouts. Such realistic model problems will
stimulate interest and enthusiasm in students about a course that will teach them to use
the computer to control a Model Railroad.

Since the real-time computing lab is in its initial stages of development, the current focus
is to develop the essential low-level software modules to control and monitor the
operations of the model railroad. The primary objective of this online reporting system
project is to provide status information about the model locomotive and surrounding area
that helps users to monitor and test their software via Internet. In addition, the reporting
system will be used as a part of tours for prospective students, to demonstrate the type of
work being done in the department.

1.2 Project Overview

This project, titled "Near Real-Time Online Reporting System For The Model Railroad
System Located In The Real-Time Computing Laboratory" was the development of the
Web-based system for monitoring the Model Railroad in the Real-time Computing
Laboratory. This system is a communication interface that provides a detailed display of
the Model Railroad with dynamic data analysis of the real-time data stream (i.e., data
transmitted during the operation of the railroad system). It will include live reporting of
the railroad locomotive status, block-occupancy status (i.e. presence of a physical object
on a particular segment of track).

Providing Web pages for frequently asked questions (FAQ) about the Model Railroad
and online help for navigating through the system was also part of the project. These
pages include a brief description of history of the Model Railroad and a description of the
layout of the track bed.
This project was designed to interact with and be integrated with related projects. Image processing and analysis of the Model Railroad is a parallel project that has been developed by Pamela Cristina Castro, a graduate student of the Department of Computing and Mathematical Sciences. Her project provides a library function that captures and processes the live images and determines where the model trains are located by looking for certain characteristics of the model trains (such as color or shape).

The Model-Railroad-Control Interface is another parallel project that has been developed by Oscar M. Benavides, a graduate student of the Department of Computing and Mathematical Sciences. This provides a Web-based graphical user interface to allow users to control the motion, speed, and direction of the locomotives on the track. It also provides a controlling feature for track switches, allowing a locomotive to run on different sections of the track.

1.3 This document

This document is organized to describe the project in different chapters. Chapter 1 gives a brief background and overview of the problem describing the need for its implementation. Chapter 2 describes the project development environment and a detailed description of the train components, system resources and software components. Chapter 3 describes how the system is used from the user point of view with several example screens. Chapter 4 presents the chronological steps taken to accomplish the project. Chapter 5 concentrates on describing the system design providing details about software components and data flow diagrams. Chapter 6 describes the system implementation, inputs and outputs of the system and complex elements source code.
Chapter 7 gives the current state of the project and ways in which it could be expanded for problems such as locomotive collision control. The appendix contains CD with the source code and project report.