2006-365: NATIONAL FIRE ALARM CODE STUDIES DEVELOPMENT

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Development of National Fire Alarm Code Studies

Abstract

The purpose of this paper is to discuss the development of a unique Fire Alarm Code class. The newly developing class is formally named National Fire Alarm Code Studies and is part of the four-year Safety and Fire Engineering Technology program at the University of Houston Downtown in Houston, Texas.

Development of the fire alarm code studies includes the knowledge and application of the national fire alarm code, NFPA 72. Included in the studies class are many actual hands-on design projects that range from the initial requirements of the authorized jurisdiction to the system final design.

Many of the fire alarm code studies students are fire and safety personnel. In addition, other students work in various related professions. The class students also have varied technical experience levels and backgrounds in academics.

The students in the fire code studies become acquainted with the national fire alarm code by using newly developed handouts and reference material, national fire alarm code handbooks that contains practical explanations of the code, and many actual practical design projects.

A feature that makes these class studies unique is the heavy use of group efforts and interaction of the groups on many hands-on design projects. Also unique in the class studies is the fact that various stages of the design projects are used extensively throughout the entire course from the very beginning to the final.

These projects use software to create designs that include the very basic concepts of national fire alarm code and carry on through the more advanced concepts. In addition, there is a capstone project for the course. This capstone project requires a proficiency in both the national fire alarm code and application software.

The innovative software exercises and projects that have been developed for the national fire alarm code studies are given.

Introduction

The goal of the development of the fire code studies is to create a new National Fire Alarm Code course as part of the four-year Safety and Fire Engineering Technology program at the University of Houston Downtown in Houston, Texas. The fire code studies students learn the National Fire Alarm Code, NFPA 72, and the use of software as a design tool for fire alarm systems. The students are not necessarily required to have prerequisite knowledge of design software, in particular LabVIEW.
The approach used to teach the course is to have the students concurrently learn both the fire alarm code concepts and how to implement the practical design of fire alarm systems using software. The studies of the National Fire Alarm Code lead to code compliance, and certification and licensing by national examinations.

A virtual fire alarm systems laboratory that is used in the course in conjunction with the hardware projects, allows a variety of fire alarm systems to be designed in accordance with the fire code with a minimum cost. In addition, the design software allows the students to learn a tool that can be used outside the classroom in actual commercial, industrial, and residence design. The students in the virtual fire alarm systems lab learn both to program functional block diagrams and to apply them in the operation of the respective panels that are created for each particular fire alarm system. The object is to allow the students to both gain experience in the creation of fire alarm systems and to gain experience in the operation the operation of fire alarm systems.

**Background**

National Fire Code studies of the University of Houston – Downtown Engineering Technology department contain the basic concepts and principles of the national fire alarm code in the applications of specific designs, installations and tests for real-world fire alarm systems. The course also contains demonstrations and computer simulation of alarm systems that use software in the applications of the designs.

Even though various software is available, LabVIEW software has been chosen as the primary software for the virtual lab and projects. LabVIEW is an easy to use but powerful software for a variety of class students. It has the ability to create virtual projects with panel views and control & logic diagrams for both analog & digital.

**Methodology**

The National Fire Alarm Code studies have been in some ways modeled after the methods that are used by professional trainers. Note however, that the fire alarm code studies also definitely retain the academic rigor required in all studies that are within a four-year B.S.E.T. Safety and Fire Engineering Technology program.

The fire code studies are unique because the students work in groups for all exercises and projects in every phase of the lectures and labs. Individual testing, however, is done by formal exams that include a final exam.

Training courses that are given by professional trainers, often have sessions that last eight hours a day or more. These trainers often use much variety and an interaction of people and equipment to keep the course pace fresh and alive. The National Fire Alarm Code studies also use these techniques to keep the interest of the students. In addition, academic rigor is intersticed within the practical materials that are presented using methods that are similar to industrial training techniques. This creates even more variety in the course. Rigorous theory and formula examples are given along with the many practical applications.
The fire code studies students work in groups to make actual fire alarm systems per the fire code. The work is done in various stages for residences, warehouses, schools, hotels, apartments, office parks, and other structures. The design of the fire alarm system is done in stage-by-stage process that ranges from the courses beginning through the final design projects at the course end. This process includes the determination of the requirements required by the authorities having jurisdiction, and then the specification of the fire alarm system detectors that are required for smoke, heat, flames, chemicals, gases, and others. Furthermore, the proper location and spacing of the detectors is designed for each detector type. The final testing procedures of the fire alarm system in compliance with the fire code are created. Finally, the fire alarm system acceptance documents are written.

It is most important to note the final fire alarm system designs that are created by the students in accordance with the fire code are not just static graphics or drawings, but are dynamic operating systems interspaced within graphics. This design is easily accomplished by use of the virtual lab LabVIEW software. Again, the LabVIEW software has also been chosen as the main software for the fire alarm code course because it is easily programmed by a variety of students from various two-years schools, high schools, and time frames, for a variety of class projects.

**Examples of Student Work**

As previously mentioned, LabVIEW software has the ability to create a virtual project control panel that is used with a broad spectrum of functional blocks for logic control of both analog and digital. It has color-coded lines and functions and is very user friendly. This use of Labview is also distributed within the fire code studies.

Examples of the fire alarm systems student project work that follow are an Office Park (figures 1, 2, and 3), Electronics Warehouse (figures 4 and 5), and Automatic Lighting Design System (figures 6 & 7). Project descriptions are given below and figures of the student work then follow.

**Office Park Fire Alarm System student project using LabVIEW software**

The office park is a series of offices in a quadrangle with a center conference area and cafeteria. It has an extensive fire alarm protection system. This includes initiating devices that include automatic smoke detectors and manual pull boxes, and alarm notification appliances.

**Electronics Supply Warehouse Fire Alarm System student project using LabVIEW software**

The electronics warehouse is a more complex project and uses a zone fire alarm system with automatic initiating devices that include smoke and heat detectors, alarm notification appliances, and annunciation control panel.

**High-Rise Hotel Fire Alarm System student project using LabVIEW software**

The high-rise hotel system is an even more complex project with smoke and heat detectors, notification appliances, and a fire suppression system.
Figure 1 LabVIEW panel view from a student project for an OFFICE PARK fire alarm system in NORMAL MODE.

Figure 2 LabVIEW panel view from a student project for an OFFICE PARK fire alarm system in ALARM MODE.
Examples of Student Work (continued)

Figure 3  LabVIEW diagram partial view of student project for an OFFICE PARK that shows detectors, control logic, and notification
Examples of Student Work (continued)

Figure 4  LabVIEW panel view from a student project for an ELECTRONICS SUPPLY WAREHOUSE fire alarm system in NORMAL MODE (with tools menu)

Figure 5  LabVIEW panel view from a student project for an ELECTRONICS SUPPLY WAREHOUSE fire alarm system in ALARM MODE (with tools menu)
Examples of Student Work (continued)

Figure 6  LabVIEW panel view from a student project for a HIGH-RISE HOTEL
Fire alarm system in NORMAL MODE

Figure 7  LabVIEW panel view from a student project for a HIGH-RISE HOTEL
Fire alarm system in an ALARM MODE
Discussion of Student Work

The students work in groups from two to a maximum of four, which depends on class size, to design the projects in the stages as mentioned. The projects again include office parks, warehouses, and high-rises, all which are shown in the previous figures. Additional projects include schools, residences, and other structures. The students in the National Fire Alarm Code studies class consider the documents and codes required to design a proper fire alarm system. This ultimately includes the fire alarm code NFPA 72.

The students first use the Life safety Code, NFPA 101, and other higher authorities having jurisdiction to determine what is required for the particular fire alarm system. Next, NFPA 72 the National Fire Alarm Code is used to determine how the fire alarm system is to be designed which includes the required components and the general location of the components. The students then determine the number and exact spacing of the components. The components again may include smoke detectors, heat detectors, flame detectors, gas detectors, and the notification appliances, which include visual and audible alarms. The detector and notification placement spacing is per the fire code. The electrical wiring for the fire alarm system is per the National Electrical Code (NEC), NFPA 70. After the final detailed design is completed, the design is translated into an active software panel that uses functional blocks. The software panel is tested and checked.

Summary and Conclusions

The students in the fire code studies use the National Fire Alarm Code and related codes. This is done in conjunction with use of the “National Fire Alarm Code Handbook” and by many making many active practical design projects. These fire code studies are unique due to the heavy use of group efforts and interaction of the groups at almost every stage of the studies. The many hands-on projects that are used extensively at every phase also enhance the studies. These include designs for the very basic concepts of national fire alarm code through more advanced alarm system concepts that use software to create designs. Finally, a capstone project requires a proficiency in both the national fire alarm code and application software.

The use of software for development of the National Fire Alarm Code course has allowed teaching of a variety of design methods and assignment of exercises and projects that would not have been possible otherwise. This approach has allowed the student to learn both the National Fire Alarm Code and the use of valuable fire alarm logic tools.

Bibliography:

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