Original Article

Upgrading The Machine's Alert For Engine Overheating

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Abstract

The project comprises of a secondary investigation of a technology called system detection and fire alarm, which is used to prevent fires in substations. The study begins in a substation because there is a desire to reduce fire-related accidents. Due to the high cost of property insurance and the various damages to buildings, property, businesses, houses, and substations in relation to fire safety that have negative social, environmental, and economic effects, a fire risk principle that can cause irreparable and valuable damage and loss of life is necessary. The purpose of this document is to provide a detailed explanation of fire alarm and detection systems, including information on each device's infrastructure, operational procedures, and intended usage.

Keyword: Security, Alarm, Fire, Sensors, Intelligent, and Building.

1. INTRODUCTION

A fire prevention system must be successful in order to be able to prevent, detect, and put out the fire in its early stages. Fire protection is essential to prevent both material damage and, more importantly, potential human losses. A fire system must take into account a number of design factors, including hydraulic, electrical, mechanical, etc., to do this. The minimum requirements that must be incorporated into the design are governed by each nation's fire brigade, taking into account the unique characteristics of each region, but based on specific rules recognized globally, such as those of the NFPA (National Association for the Protection against Fire), whose codes and standards are widely adopted because they are developed through an inclusive and consensus-based process. More than 5000 volunteers who have years of professional expertise serve on committees that draft and review all Codes and NFPA standards on a regular basis [1].

There are currently a variety of manufacturers' and quite full systems' worth of fire detection and alarm systems available. Prices can vary widely, ranging from a few hundred dollars to several thousands of dollars, depending on the sort of system that must be installed. Additionally, manufacturers can be discovered that specialize in particular gadgets like gas sensors, gas sensors that smoke, speakers, sirens, etc. That is connectable to a broad system. Everyone agrees that there must be sensors that can identify the beginning of a fire or other dangerous anomalies, as well as devices that can inform people when this occurs.

When approaching the theme, "Alarm and Fire Detection System," it is important to remember that it also refers to fire prevention, suppression, and safety systems because fires can occur anywhere, regardless of the political, geographic, or economic situation, and they can grow to devastating proportions that result in irreparable loss and damage. In the prehistoric era, getting access to fire or man dependent on chance; to use it, one would have to wait, "for example," for lightning to hit a tree or a volcano to erupt. These occurrences were linked to the wrath of the gods, actual heavenly punishment. The ancient people respected the fire itself. The discovery of fire led to significant advancements in both understanding and application. Civilization began when man began to improve his food and artifacts and use them to frighten off animals and the dark. With global development, nations are undergoing a process of industrial and urban growth, resulting in a larger concentration of people in the most varied spheres of human activity. One illustration of this is the verticalization of urban structures. As a result, technological risks develop, leading to an increase in the demand for energy, a high concentration of loads, materials, fuels, chemicals, machinery, and equipment, as well as a marked increase in the vulnerability of buildings to fires that endanger the safety of those structures and their occupants. As a result, people seek out safe and secure locations more frequently. Buildings, condominiums, businesses, hospitals, offices, shopping malls, and other structures are currently becoming more automated and intelligent as a result of technological advancement, with a consensus being able to learn skillfully and accurately control conditions environmental requirements for human activities, enhancing people's comfort and quality of life The expense of developing a cutting-edge, intelligent structure is undoubtedly considerable. Additionally, the costs of running and maintaining it last for the duration of its useful life, necessitating the assistance of an insurance provider to somehow ensure the security of the assets while ignoring personal safety. Due to the high cost of a smart building, you should be concerned about issues involving the security of people and property in relation to a fire principle. To address these issues, it is necessary to implement safety measures, which will lower the cost of an insurance company and the risk of a fire.

Exercises in fire safety are more complicated than they need to be. seem. Procedures are established in the prevention, protection, and combat phases in relation to, among other things, studies on fire and fires, the creation of building codes and legislation, inspections of fire protection systems, techniques, and firefighting tactics. This case study sought to present a fire detection and alarm system for an intelligent building in the northwest Minas Gerais region that focuses on producing cardiac products. Using Brazilian and international standards, we aimed to illustrate each piece of equipment's function in this study, making it feasible to put out a fire before it spreads and enhancing both human and property safety.

2. TYPES OF SYSTEMS

Conventional

They are those that are made up of initiating and announcing devices that satisfy the requirements without necessarily including a control panel that indicates the location or region where the alarm or the type of alert will sound [2]. They might be firefighting systems modified to function as burglar alarm systems.

Smart

These systems enable users to locate the location where a fire alarm is set off on a central panel, send the appropriate alarm to the associated annunciators on the equipment, and use programmable devices to turn on pumps or fans [2].

3. ELEMENTS OF AN INTELLIGENT SYSTEM

Devices that can initiate addresses

They are the ones who identify the initial alarm signal and, as a result of technology and scientific improvement, are highly skilled at identifying fire outbreaks. You can also find a wide range of brands of these devices on the market [3]. These components' two main operating states are normal and alarm. These devices come in a variety of types, some of which are depicted in Figure 1.1.

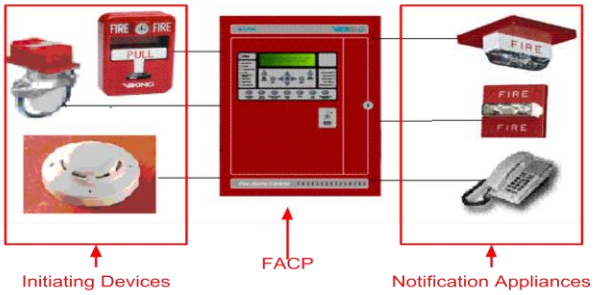


Figure 1.1 Initiating Devices, Taken From [2], [3]

In addition to serving as signs or directions for evacuation routes, they act as the alert signal in the event of a fire. Signaling, sirens, and strobes, among other things, are employed to make this sign visible and heard [3].

Control board

where you can quickly determine the location and the cause of the alarm, as well as turn on the associated programmable annunciator and relay devices. You can also examine each device's status with this, [4].

Figure 1.3 Control Panel, Taken From [4].

Scriptable Relays

They are devices that take some action in response to the activation of another specific device or collection of devices, such as automating an alarm response process, or they can aid in the suppression of fire in certain regions by turning on sprinklers or ventilation systems.

Modules for monitoring
Panels must utilize a few additional components and devices that enable them to communicate with initiating devices because there are numerous manufacturers of initiating devices with varying kinds of communication. The central panel receives information from the monitoring modules about the initiating element's state together with an indication of a specific direction, allowing the panel to recognize each connected initiator device separately [3].

Control elements
They receive the signal from the control panel and activate the annunciator or relay device so that the control panel may correctly address each annunciator device when an alarm arises. [3].

4. HOW AN INTELLIGENT SYSTEM WORKS
Programming and mode of operation are the two fundamental modes of operation for smart systems.

Scripting mode
It makes it easier for the user to identify the communication loop's initiators and broadcasters, and it also enables you to save the required details about the devices' locations and relationships, such as if they are part of the same monitoring or alarm zone.

working style
There are three ways that an intelligent system can function: operation good, problematic, or alarming:
Normal Operation: The control panel conducts the following tasks on a regular basis while the system is in normal operation and does not display any issues or alerts. This indicator is often visual and is provided by a screen or keyboard:
- Inspects all devices in the control loop (Power Line Circuit Signalling) and verify that the answer is valid, alarms, problems, etc.
- Monitors AC output voltage and battery capacity.
- Refresh the normal status indicator.
- Scans him or system keyboards.
- Test the detectors.
- Test your memory.
- Update / Read the EIA-485 communication bus.

Troubleshooting: When a problem is found in the system but no fire alarms are sounding, the system will activate a specific alarm signal to let users know that a disturbance condition is present. Problem with the system other than a fire alarm. Sensor malfunction, damage to the control loop, power failure, power supply failure, communication failure, lack of maintenance, etc. are only a few of the potential causes of system problems. While a system's efficiency increases with how well it can identify and pinpoint the faults that are there. As a result, any abnormality can be easily found and fixed by the user or the programmer.
Alarm operation: During the alarm's operation, it is determined where the signal originated and which zone or zones it impacts; the appropriate alarm signals are then created; a monitor or an indicator panel then displays the event that has occurred.

5. CONNECTIONS OF AN INTELLIGENT FIRE SYSTEM
Features of a control loop
Through a Signalling Line, the control panel, monitoring modules, and control devices communicate with one another (SLC). This circuit may be wired in accordance with NFPA Style 4, Style 6, or Style 7 wiring requirements.
NFPA Style 4 SLC, [5]: The diagram depicted in Figure 1 satisfies NFPA Style 4 specifications.
5. The T-branch of the SLC wiring for the Style 4 arrangement.

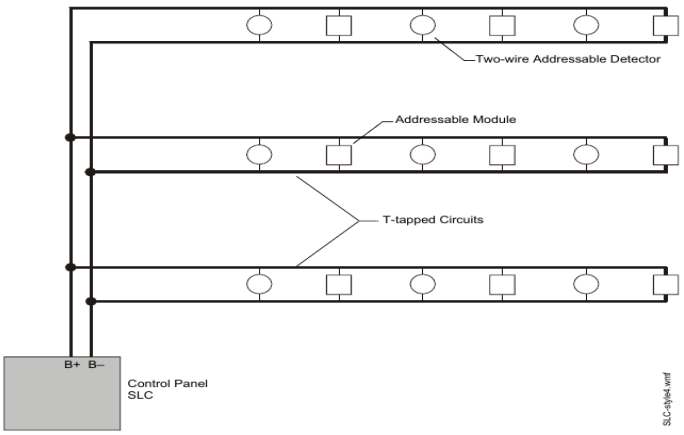
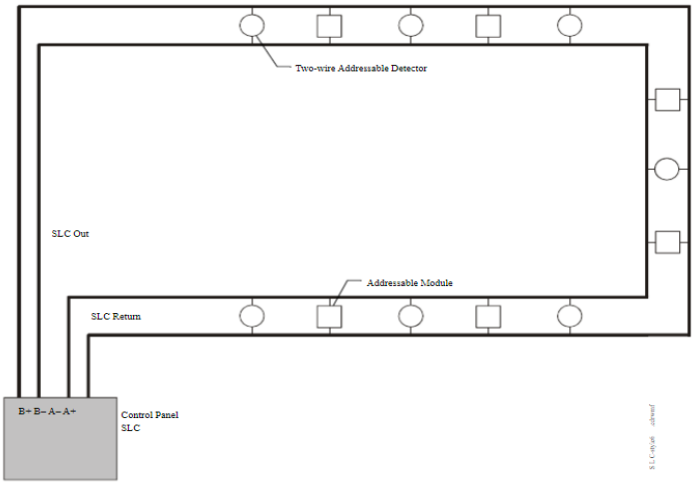


Figure 1.5 NFPA Style 4 SLC, taken from [4].

NFPA Style 6 SLC, [5]: The schematic in Figure 1.6 complies with NFPA Style 6 standards. For SLC wiring in the Style 6 arrangement, T-branching is not permitted.



Style 7 operation necessitates the use of isolator modules before and after each device, according to the NFPA Style 7 SLC, [5]. All other circuit devices are protected from failure by isolator flagging around each device. also has the following qualities:

• T-branches are not allowed.
• When using a detector base or manual station, the 1300 modules they should be installed on both sides of the device.
• The connections between the isolator modules and the device they isolate must be in conduit with “straight thread nipple”, a maximum distance of 3 feet (91.44 cm).

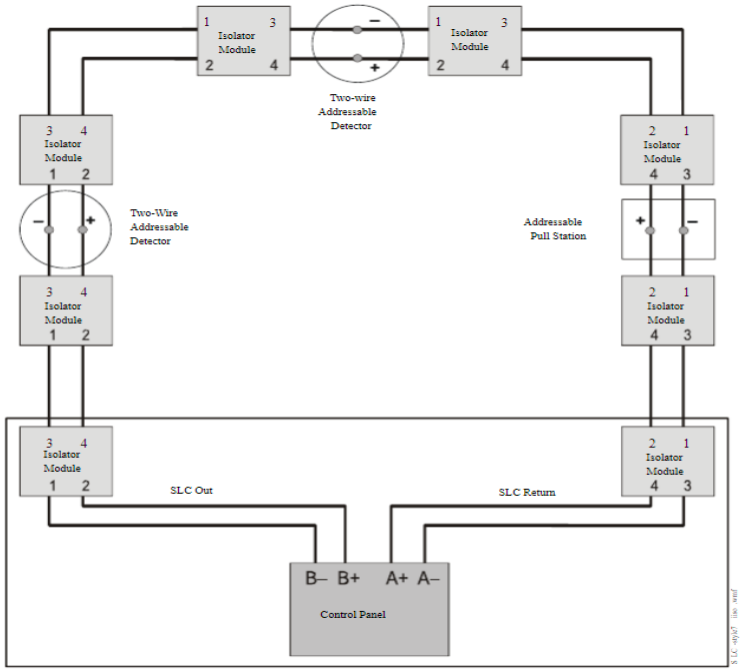


Figure 1.7 NFPA Style 7, Taken From [4].

Operation of the Signalling Line Circuit (SLC)

Whether it is a Style 4, Style 6, or Style 7 circuit determines how the SLC functions. Codes at the national and local levels set the style standards for each wiring. The authority with jurisdiction to wire the SLC must be consulted. The Firefighters Regulations in our nation don't specify the kind of wiring that should be used, yet a revision to that regulation is now being made and needs to be approved now.

6. MONITORING MODULE

Operation

The Monitoring Module assesses the connected device's status on its terminals and transmits it to the fire panel. A typically open contact must be used by devices that attach to a monitoring module. This contact is parallelly linked to the module with a resistance of 5.6K. This is how the commercial fire apparatus that was examined functions, including manual

stations, fires, and smoke detectors. This form of connection allows for the detection of the states of normal, alarm, and difficulty.

Standard state
The typically open contact and an end resistance line are connected in parallel with the normally open contact on the detecting device's connection to the monitoring module.

Alarm Status
The detection device is linked to the monitoring module with a resistance of an end-of-line in parallel with the contact closed and the normally open contact in its abnormal position.

Issue Status
The typically open contact is parallel to the open contact without an end-of-end resistor when the detecting device is connected to the monitoring module.

7. CONTROL MODULE
Operation
The Control Module sets the appropriate annunciator device in the state in which it gets the status of the zone to which it belongs (ALARM or NORMAL).
Commercial annunciator devices have a typically open contact and run on 12 or 24 Vdc. The module is linked to the device in parallel with a 5.6K resistance. (to be aware that it is linked to the network). Commercial fire alarm systems, like strobes and sirens, function in this fashion. This kind of connection allows for the detection of the statuses of normal, alarm, issue, and short circuit.

Standard state
An end resistance line is connected in parallel with the normally open contact on the annunciator device's connection to the control module so that the annunciator device does not feed and does not emit an alarm.

Warning Status
The typically open contact and an end resistance line are connected in parallel with the normally open contact on the detecting device's connection to the monitoring module. The source of the alarm signal powers the device.

Issue Status
The typically open contact is parallel to the open contact without an end-of-end resistor when the detecting device is connected to the monitoring module. The announcing apparatus is not fed.

state of a short circuit
The typically open contact on the detecting device is linked to the monitoring module in an unnatural position, with an end resistor wire running parallel to it. Announcer for equipment without power.

8. INITIATING DEVICES AND ANNOUNCERS
To create a detection and fire alarm, initiating and annunciating devices are connected to the monitoring and control devices, respectively. Each of these devices comes in a variety of varieties with unique features, so it is necessary to choose one in accordance with the app. The latter are the ones that can be used in applications like the one in the project at hand and are described below. Some of these devices are specialized to operate only with a specific brand of control panels, but there are also those that are general for use with various types of panels and even with other security systems:

Automatic Station
A manual station is a tool that enables the manual operation of its mechanism to generate an alarm signal; it essentially functions as a switch with a normally open contact. Generally speaking, a manual station has the following traits:
- It is made of a resistant material and in an identifiable colour, generally Red.
- It is clearly indicated how it works and its status. Many include graphic callsigns for any language and even in Braille language.
- Mechanical memory, that is, once it is activated it maintains its state until it is manually restarted. A wrench is usually required to open it and restart it from inside.

Electronic Photosensor
A photoelectronic sensor that detects smoke uses an optical sensing chamber to find smoke particles created by combustion from different sources, along with an electronic circuit that lessens false alarms. The sensor chamber is sealed against airflows, dust, and insects for increased efficiency.
There are numerous types of photoelectronic sensors, some of which include contacts auxiliary that may be utilized with other security measures or even stand-alone systems.

Sensor for Thermo-Velocimetry

When smoke detectors cannot be utilized and there is no increased risk to human lives, the thermo-velocimetric sensor can be employed to detect fire. They can detect a source of temperature rise that can be in the range of 57 to 90 °C or a quick increase in temperature of about 8 °C per minute, among other choices for operation. They are wired into a straightforward typically open circuit.

Natural gas and carbon monoxide sensors

This sensor guards against explosions brought on by natural gas buildup and carbon monoxide poisoning in humans and animals. These sensors come in several varieties, and for them to function completely, extra attention must be given during installation and maintenance. They can be connected to a monitoring module to use it in a monitoring system because they also have additional outputs to run other devices. protection from fire.

Sensor for Liquefied Petroleum Gas

Like the ones mentioned above, there are other independent liquefied petroleum gas sensors that can be integrated into separate systems by connecting to monitoring modules.

Siren

Due to its extremely loud sound, which can be heard from a distance and allows proper action to be taken, it is an aural method of fire alarm warning. allows for several volume levels and includes a contact to check the connection's accuracy.

Flashing Light

Due to the intensity of the light utilized, it is a visual method of signaling a fire alarm and is especially helpful in circumstances of smoke (programmable between 15 and 115 candles). Combinations of the device's annunciators, strobe sirens, or LED speaker are also available.

Bypass Solenoid Valve for Gas

The solenoid valve typically operates with cold coils to prevent overheating and premature coil aging. It also has a manual reset so that once the alarm has started, it remains its state. The solenoid valve acts ordinarily open to allow the passage of gas and is closed when the sensor commands it.

9. CONCLUSIONS

Utilizing the technologies offered for each component of the design, the fire detection and alarm system complies with the project's scope. The RS232 - 485 interface, which is intended for communication between the user interface and the modules, satisfies the design specifications in terms of both the required distance and the number of devices it can support as a component of the control loop. Similar to this, the 5-byte protocol employed, combined with appropriate programming, sends all the information required for the current application and ensures proper system connection.
Utilizing a 4-wire communication system improved control performance and allowed it to scan all installed devices and wait for a unique response for each repetition. The modules were generalized for monitoring and control in order to operate with various common firefighting equipment due to the characteristics found in commercial detection and fire alarm systems.

This generalization of the modules was justified by:
- The behaviour of the monitoring devices is similar between the different manufacturers: feeding with a voltage of 12 VDC, using a normally open contact and accepting a resistance to its terminals as end of line; so a module could be generalized as interpreter of the device before the control loop.
- The behaviour of the control devices is also similar between the different brands, adopting a voltage range from 8 to 24 Vdc approximately, and also allowing an end-of-end resistor to be used. line.

The user interface created in Labview adheres to the project's requirements and functions similarly to a commercial fire station, but with certain limitations. This interface keeps track of the control loop by promptly checking the connected devices' state and responding appropriately. successfully before to an alarm.

The complete system was tested using a small number of devices to avoid incurring excessive costs and to ensure that all system characteristics operated quickly and effectively. Regarding the power supply of this detecting system, a design in particular is necessary since each case must take into account the load to be installed and size its necessary power supply, but only if The load of a case was examined, and the required source was sized.

The developed system performed similarly to commercial fire suppression systems, but at a lower cost and with a wider range of operational configurations. The technology used for this project was used for a detection and fire alarm system, but it could also be used for other systems, such as centralized home automation with a communications bus that incorporates security, fire, light control, etc. This project can act as the foundation for a more intricate network of control systems for many purposes, such as Lonworks, EIB, etc.

Fire safety should never be underestimated in situations where there is a possibility of accidents since compliance with international standards and consideration of facility laws might mean the difference between a catastrophic consequence and a prompt response.

10. RECOMMENDATIONS

To find out if other very specialized devices can interact with the modules created for this project, it is vital to analyze their technical and functioning features in the event that they are used. By This project, for instance, does not take into account this type of device from their interface but can utilize them with a manual power reset because there are some devices that need a power supply resettable to return to a normal state.

Within the parameters, this system behaves very similarly to the behavior of a central commercial firefighting system and may be used in situations where numerous devices are not necessary or when a particular design that has not been regularized or certified by international standards is preferred.

The power supply recommended in this system is 12 Vdc, therefore carrying it in the same ductwork as the control loop is not a problem for installation. However, if an ac power signal is to be carried, the pipes must be isolated.

Changing the type of control system in this project from centralized to distributed, i.e., using the same installation and user interface, but taking into account that the system must continue to operate even when the control panel is disconnected, necessitates that the programming be stored in each module and directly communicate with one another.

The option to load a previous device programming using as a reference a text file indicating the connected devices, zone to which they belong, location, type, etc. is one feature that was not considered in the scope of this project and that could be expanded. In the same way, the user interface can continue to be debugged and expanding its applications.

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