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Multi-Sensors in Locomotives for Explosion Detection and Avoider through De-Clamping and WPAN

Ellipilli Appala Raju
M.Tech (Embedded System)
Department of E.C.E
Miracle Educational Society Group of Institutions, Vizianagaram, AP, India.

Mr.Budireddi Siva Prasad, M.Tech., (Ph.D)
Associate Professor & HoD
Department of E.C.E
Miracle Educational Society Group of Institutions, Vizianagaram, AP, India.

Abstract

Fire accidents are very dangerous and cause harm to human life and property. If these types of accidents occur in some public transport, then it's a matter of concern. In the recent times we have seen a lot of accidents occurring in trains, and a major part of it is due to fire accidents in the compartments. This fire is not confined to just one compartment. In case the train is moving then there are chances of the fire spreading to other compartments too. To avoid such incidents, there are different methods that are in use. Most of the present day systems use detectors in the compartments to detect any fire accidents. In case of any such occurrences, the information is passed on to the driver, so that he can take necessary decision. Hence we propose a system wherein we incorporate wireless sensors and WPAN to carry out similar operations. We have also designed some extra features which cater to the safety of the passengers. At the end we are sure to get a more reliable system which also has advanced safety features incorporated in it.

Keywords: ***Fire accidents, microcontroller, proximity sensor, de-clamping, WPAN.***

I. INTRODUCTION

Day by day, new technologies are being developed to improve the railways and other systems related to it. Generally the department sees to increase the speed of the trains for better connectivity. As per recent records, the Indian railways are planning to increase the speed of trains to about 140 km/h. Apart from increasing the speed; we also have to consider the safety of passengers. Accidents which include fire are one of the most dangerous incidents possible in trains. Generally when a compartment catches fire, it is hard to detect the fire and take initiatives to douse it. Hence we need an automated system to reduce the casualties.

Here we propose an automated system which not only detects any fire or explosion, but also carries out necessary operations for the safety of the passengers. In this system we use a flame sensor to detect any fire accidents and a proximity sensor is used to detect any explosions. In the compartment section, we have made use of water sprinkler to bring the fire under control. A zigbee module is used to transfer the alert message to the driver compartment. Simultaneously we use a motor to slide open the doors.

II. LITRATURE SURVEY

Most of the fire accidents happen due to the lack of passenger knowledge. Fire accidents can be stopped by educating the passengers about the safety measures, but in case a fire accident occurs, then we have to take measures to control and douse the fire. In the event of a fire accident, the first step is to detect it. Parameters such as temperature, humidity can be collected in real time to detect fire. This collected data can be use for fire fighting and alarming purpose. In the previous attempts, it has been proposed that these parameters can be used to send a signal to the driver through ZigBee transmission, so that he can take

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necessary steps. In the compartment, we can deploy various steps like water sprinkler, sliding doors and an alert system to save the lives of passengers. Wireless sensors are finding use in many applications, hence it can be used in any situations. Monitoring the parameters in real time help us to obtain precise results due to the high precision sensors used [1]. We can also use rescue systems in case of a fire. By detecting fire using temperature sensors, we can use zigbee to send a signal to the nearest detection centre. Once signal is received then it sends a message to the rescue centre and help will be sent immediately [2]. Another way of saving live during a fire is by designing a braking system which is initiated by fire accidents. Normally the brake control will be with the driver, but during fire accidents he may not know about the accident.

Hence we make use of a fire sensor to detect the fire and once fire is detected then we use automatic braking system. Once the train stoops, the passengers can get themselves out of the train and hence they are safe from the fire. This reduces the loss of lives [3].

III. PROBLEM DEFINITION

As we all know that fire accidents are very dangerous and fire in moving trains may have a catastrophic effect. It may lead to a lot of deaths and injuries. In the previous systems we have seen that after detecting fire, the train can be stopped immediately. This is not an appropriate method. In case the train is travelling over a bridge then there is no use in stopping the train automatically. The passengers can't get out of the train. This system is useful only when the passengers can go out in a safe way. But any system should be useful in all the conditions. Hence we propose a system which works in all conditions. Moreover there are a few advancements to it compared to the old system which makes it more useful in helping out passengers when there is a fire accident. Comparing with the previous systems, we make use of sliding doors to make sure the passengers can go out without hindrance.

IV. EXISTING SYSTEM

Since fire accidents are very dangerous, the railway department has taken measures to stop it the maximum possible level. The interiors of the train are mostly made of materials, which are less prone to catching fire. Few of the materials are fire resistant. Even after all these, a fire can arise due to a short circuit or if any passenger is carrying any flammable material.

Keeping all these factors in mind, the railway department has installed fire extinguishers in all the compartments. But this doesn't seem to be a good idea. In case of a fire accident, the passengers will be panicked and they do not know what to do. Hence, the use of it doesn't flash to them immediately. Moreover, if the fire extinguisher doesn't work properly on time or if the person using it is not well educated on how to use it, then it is a waste of keeping the extinguishers in the compartments.

At present, the railway department is using aspiration based smoke and fire detectors. In this system, there is a chamber where the air present in the compartment is pulled into a chamber. In this chamber the light is subjected to a test where any suspended particles in it will scatter the light rays, which is being emitted by the laser. Once the scattering is above the threshold level, the alarm goes on and alerts the passengers. During a fire accident, the suspended particles will be more in the air compared to normal time. Hence we use an aspiration based smoke detector. These mechanisms are one of the fastest to detect any change in the scattering pattern of the air.

V. PROPOSED SYSTEM

As we all know that fire accidents are dangerous and catastrophic, we have to take certain steps to control and douse the fire. In case a fire is detected, we first have to alert the passengers about it. Even the driver needs to be alerted. The transmission of signal should be done using a wireless system so that any wires used does not burn out rendering the system useless.

In our proposed system, we make use of a PIC microcontroller for the basic computation process. At the compartment section, we make use of an IR sensor for flame detection, a buzzer for alerting the passengers, a DC motor to slide open the door. A water sprinkler is used to sprinkle water all over the compartment and reduce the fire and the temperature. To transfer the signal to the drivers end, we make use of a zigbee module. This wireless module eliminates the use of any wires.

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At the drivers end we again make use of a PIC microcontroller to control various components. Here a zigbee transceiver is again used to receive the signal and passes it on to the PIC. An LCD display is used to display the alert message and the compartment number at which the accident has occurred. We also make use of an automatic de- clamping mechanism to separate the compartment, which is under fire. This can be done to avoid the spreading the fire to other compartments.

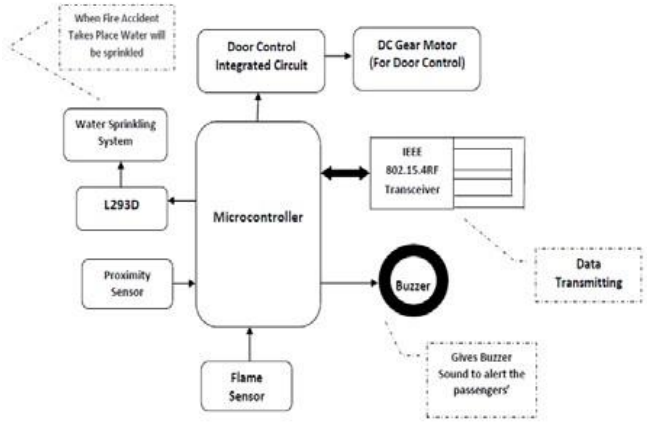

Fig 1: Block diagram of the module at the compartment

The above block diagram shows the module at the compartment end. In case of a fire accident, the flame sensor (IR sensor) detects the fire and if there is any change in its threshold value, and then it sends a signal to the driver section through the zigbee module. At the compartment, firstly the buzzer goes on alerting the passengers. Next the water sprinkler will turn on sprinkling the water so that the fire is extinguished and the temperature comes down. Simultaneously the door of the train will slide open, making it convenient for the passengers to go out. This can be done only when the train slows down or stops completely.

The block diagram in the next section shows the module at the driver's section. Once the compartment sends the signal, the transceiver takes the signal and sends it to the PIC microcontroller. This controller then sends the message through the I2C line to the digital display. Here IO expander is used to convert the digital message into readable alphabets. Later the buzzer at the drivers end also goes on alerting the driver too. The LCD then displays the compartment number at which the accident has occurred. The moving train is stopped now and the de-clamping mechanism is put into effect detaching the affected compartment.

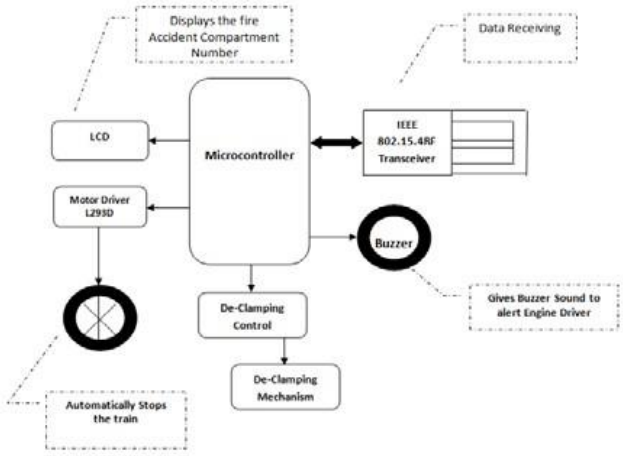

Fig 2: Block diagram of the module at the drivers end

In the above sections, we have explained the working of the system. Now we shall see the inner working of the system through the flowchart.

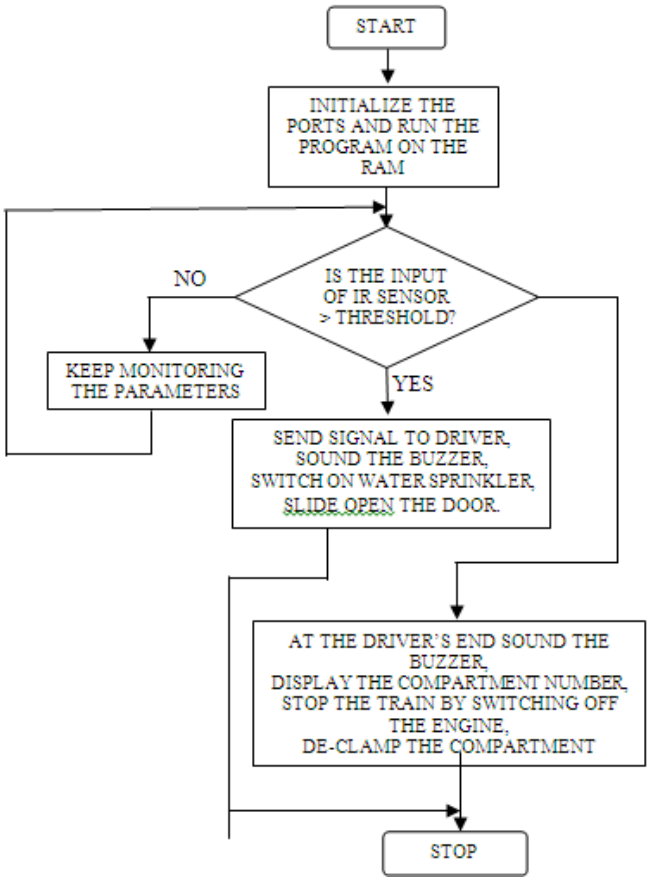

Fig 3: Flowchart of the system operation

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In fig 3, we can see the flowchart of the system. The microcontroller takes the program from the flash memory to the RAM as soon as it is switched on. It then initializes all its ports and gets all the components ready for operation. The IR sensor then keeps sensing the light intensity. Once it crosses the threshold, it sends a signal to the microcontroller. Once the program is initiated, the operations mentioned in the flowchart are carried out.

VI. EXPERIMENTAL RESULTS

In the above sections, we have spoken about the various aspects of designing of the safety system for trains. After research, we have come up with the prototype of the system.

Fig 4: Hardware of the compartment module

In fig 4 we can see the hardware of the module at the compartment end. We have an IR sensor to detect any fire in the coach. The main PCB consists of the PIC microcontroller to which the zigbee module is connected at the SPI port. The DC motor and the water sprinkler are connected to the motor driver IC. This is done to amplify the current so that the motor can rotate as desired. The proximity sensor is connected to another port to detect any metallic objects.

Fig 5: Hardware at the driver's end

In fig 5, we see the hardware at the driver's end. The zigbee is connected to the SPI port and the LCD display is given connection to the I2C port. One of the motors shows the train in running state and another motor is used to demonstrate the de- clamping. In case of any fire accidents, the buzzer switches on alerting the passengers. The train turns off and the de-clamping is activated.

Fig 6: LCD display in case of any fire accident

Fig 6 shows the message displayed at the drivers end when there is any fire accident. The system not only alerts the driver, but also displays the compartment number where the fire has taken place. In our prototype, we have made use of only one compartment module, hence the LCD always displays as compartment 1.

Fig 7. Motor performing the de-clamping operation

Another added feature in our system is the de-clamping mechanism. The de-clamping mechanism is used to separate the compartment under fire from the rest of the train. This mechanism can be deployed manually or automatically. Manual operation is recommended for safety purpose.

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Fig.7 shows the DC motor that has been used in the prototype to illustrate the de-clamping mechanism. Since it is a prototype, we have done this mechanism to work automatically. In real time applications, it can be done manually. The wooden piece connected to the shaft is used to show the mechanism. The shaft moves around 180 degrees to show its operation. At the end we are sure to get a reliable system. Since we are using wireless technology, we can count on it. It helps in faster data transfer and also it is not affected by the fire accidents. All the components used are readily available and the whole system is cost effective. The system has few added features than the previous systems, which makes it more preferred.

VII. CONCLUSION

Railways are one of the best modes of transport in the world as they are much feasible and more comfortable to the passengers. Around 20 million people in India travel by train per year. The development of railways in our country took place rapidly, but still there are number of unsolved problems in the path of steady growth like train fire accidents, train collisions etc. The human death rate is increased due to these problems. The planning of accident prevention and emergency measures, are still an important issue of the rail rapid transit operations.

The model presented in this study analyses the process of hazard identification in two stages, which clearly indicate the factors of the inherent and direct hazard and the weaknesses in the response system. Hence we have proposed a system which makes use of microcontrollers. This is designed to provide maximum safety towards fire accidents. We make use of sensors which act swiftly and detect the fire at the earliest. The module is designed in such a way that it provides complete details of the accident which has taken place. The use of wireless system for transmission of signals has made it more reliable than wired systems and also most of the preset day systems. It would be a good step if this system is applied in reality.

In the future development of this system, we can integrate a GSM module to the system. In case of a fire accident, a message is sent to the nearest rescue station and other stations that the train has passed. By this method we are sure that the help will arrive on time to the spot of the accident. We can also integrate a GPS module to find out the location if the train is travelling in any remote area.

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