

A Low cost Automated Fire Rescue System for Locomotives

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Abstract- The main aim of this paper is to decrease the mortality rate caused due to fire accidents that occur in locomotives. This is the impetus behind the design of our proposal. The main objective of this proposal is to rescue lives from such fire accidents at the earliest as possible, especially designed for moving locomotives. The over all proposed system has been segmented into four main parts: i) Fire Suppressing (Extinguishing) System ii) Actuating Mechanism iii) Alarming System iv) Telemetry System. The compartments are fitted with temperature sensor-LM35, smoke detector-21007581, microprocessor-MSP430FR5729 (Launch Pad), circuit breaker- TPS2311, solenoid valve, GSM module-SIM900, and a buzzer. The temperature sensor fitted in every compartment detects a temperature (>70°C), and these signals are sent to the microprocessor. Once the signals are received, the developed rescue system starts its action .. The first action plan of the developed system is to pull the chain and stop the moving locomotive. Further the compartment is isolated from electrical supply by activating the circuit breaker. A moving train can be the main cause for the advancement of fire to the next compartments, and thereby increasing the death toll. Thus, a need arises to bring the fire under control. This is taken care by the above discussed developed chain actuating mechanism and the circuit breaker in this paper. Fire extinguishing system consists of a solenoid valve. Water from the cubicle tank is directed into the compartment via the solenoid valve to suppress the fire. GSM module is used for transmission of data to the official at a near by station house. The buzzer (alarm) performs the task of alerting the people.

Keywords- Fire Suppressing system ,MSP430 , SIM900, Rescue System

1. Introduction

In the recent past and present times, news papers and news channels are flooded with headlines and reports about fire accidents that occur frequently in locomotives which causes a huge loss to the most priceless human lives and the government property [1]. Some of the main source for occurrence of fire accidents in train: 1. Carrying stoves, gas cylinders, kerosene oil, petrol, fireworks etc. in passenger compartments. 2. Making fire/using fire near paper, wood, petrol or such other inflammable articles. 3. Lighted match sticks, cigarette ends carelessly thrown. 4. Short circuit in electrical wiring. [2] The damage caused is catastrophic as the rescue service could not reach the destination at right time due to improper communication. So, effective and immediate information to the respective authorities should be provided

so as to reduce the severity of loss of lives and property. Such an initiative was proposed which senses the abnormalities in temperature and the signals thus received, enable the alarm and LED simultaneously at the same time to show which compartment is having the fire. [1] Further large number of nodes was deployed in the environment and depending on the outputs from these sensors a control action is expected to be taken. It requires an effective real-time communication and coordination [3]. This effectiveness could be achieved by using automatic water sprinkling system, alarming buzzer and a GSM module [4]. Previously at around 2003, in countries such as Switzerland and Germany, a Fire Fighting and rescue compartment was attached along with the train which basically consists of one Equipment Car, one Fire Extinction Car, and one or two Rescue Cars[5] But a question arises will this system prove efficient enough to take an immediate and instantaneous action. Such questions are answered by the present proposed system, which was remodeled resulting in the solution for the drawbacks of the past ideas with present technology that uses xbee wireless communication [6]. Next technology updation in the field of rescue system is Voice recognition with the use of RF technology using Microcontroller[7].

So this paper projects the use of temperature sensor, smoke detector, actuating circuit (chain pulling mechanism), circuit breaker, water sprinkler, the GSM module and alarming circuit whole integrated to perform their respective operations. In this paper, a GSM Module is used because the practical network implementation of an xbee module is very difficult and it is referred to as a two point communication. It gives a maximum range of just 10km. Since the alerting and rescue system discussed here is for a moving locomotive, GSM module is more preferred since it is active in far distances and follows a one to many communications.

2. Overall Process Flow

The overall system process is explained from the above figure 1. In the above block diagram LM35 and smoke sensor are the two main inputs to the MSP430 launch pad. LM35 is taken as a float value to have higher precision. Smoke sensor is taken as an integer value. In this system both analog and digital outputs are taken into account. Buzzer, solenoid valve and, relay all fall under analog outputs and GSM is a digital output. For convenience and effective calibration, all the outputs are taken as digital while making the algorithm and designing the circuit. Since the solenoid valve input is 12 VDC, an intermediate circuit –breaker circuit using relay is developed. While programming with MSP430, a special focus is required on the development of library for each and

every component since no predefined library exists for MSP430F229. Once the signals are received, its action starts. It first pulls the chain and stops the moving locomotive. Further the compartment is isolated from electrical supply by activating the circuit breaker. the spreading of fire from one compartment to other compartment is mainly caused due to the motion of train . So to restrict the motion of train we have chain pulling mechanism , which actually pulls the safety chain in train which is used to stop train. Fire extinguishing system consists of a solenoid valve. Water from the cubicle tank is directed into the compartment via the solenoid valve to suppress the fire. GSM module is used for transmission of data to the official at a near by station house. The buzzer (alarm) performs the task of alerting the people. This system is very effective in rescuing i.e.; the way of solving the problem is comparatively easier because of the analog design.

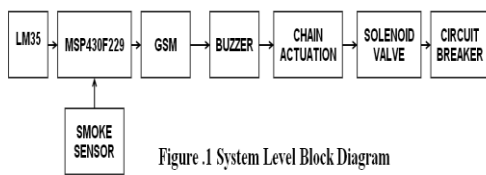


Figure .1 System Level Block Diagram

3. Methodology Followed

A. Proposed Solution

A Solution arises from the proposed fire rescue system which is acceptable for all locomotive shown in the Figure 2 It can be interpreted that the microcontroller MSP430F229 is considered to be the brain of the whole system. It gets data from the temperature sensor LM35 and smoke sensor .Then the MSP430F229 compares the data obtained from the sensor with the data given in the algorithm which is already programmed. If the condition is satisfied, other components interfaced with the microcontroller gets actuated which includes the solenoid valve, relay, GSM and the buzzer. When the system is actuated, the GSM sends information in the form of a message to the concerned authority. Immediately, the solenoid valve opens and the water in the tank flows down to the compartment which extinguishes fire. Further, the buzzer alerts the people inside the compartment that an emergency has popped up and the relay that acts as a circuit breaker that is with the trigger pulse isolates the compartment supply from the main supply that reduces the risk to an extent.

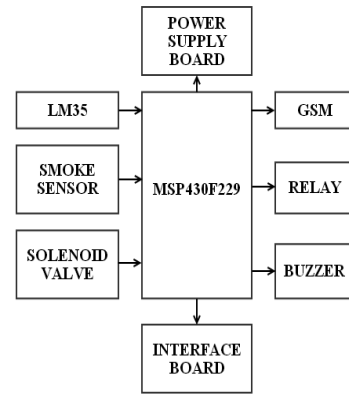


Figure .2 Top Level Block Diagram

B. Alert Signal flow

The alert signal generated by the microcontroller depending on the sensor data. The sensor data are accessed continually by the micro controller , the microcontroller check the predefined conditions in the program . If the condition becomes true the microcontroller gives alert signal to the GSM modem. The GSM modem transmits data , the transmitted data is received by the phone which is provided to Ranger or near by fire station . The authorities take appropriate action according to the situation . If the condition fails the microcontroller keeps on checking the sensor data.

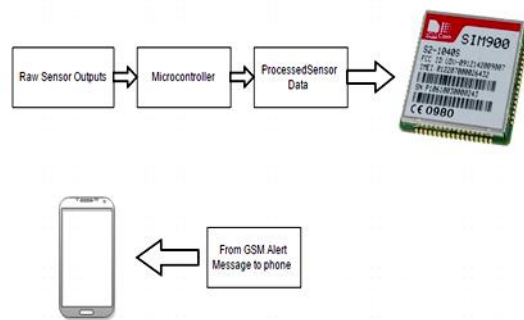


Figure 3 Possible Solution

4. Implementation

A. Hardware Implementation

This is the basic power distribution board, which helps to power all the peripheral components like GSM, buzzer, smoke sensor, and the microcontroller Refer [Figure 3].This board consists of fuse (to protect the components from over current and to create a FAIL PROOF system) , voltage regulator ICs like 7805, 7809, and 7812. These ICs 78XX gives regulated output XX v which are used to power various sensor subsystems used in this project .

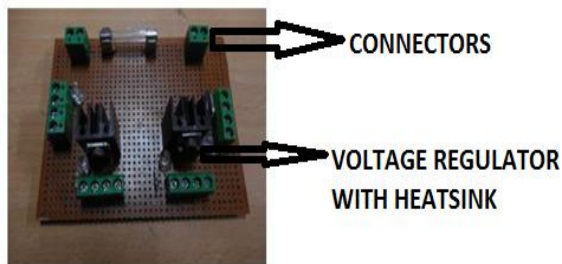


Figure . 4 Power Supply Board

C. Circuit Breaker Design :

The circuit breaker is designed to break the 230v supply by using relay and power transistor . For prototyping the figure 5 represents the circuit breaker with 15VDC control using NPN transistor. When the tripper pulse is obtained from microcontroller the relay witches from NC to NO there by breaking the circuit .

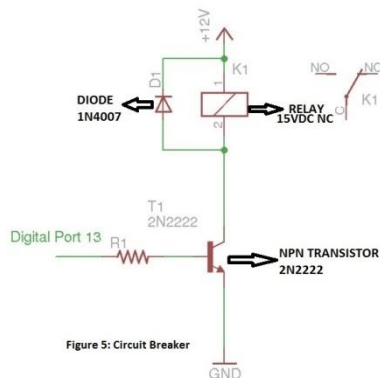


Figure 5: Circuit Breaker

D. Interface board design:

An Interfacing board for circuit breaker consists of relay which is connected to the diode in order to protect reverse current. [Figure 4]. Similarly, we made interfacing boards for each and every component which includes GSM, solenoid valve, buzzer, and LM35 .These is some of examples of hardware implementation.



Figure . 6 Interfacing Circuit Board

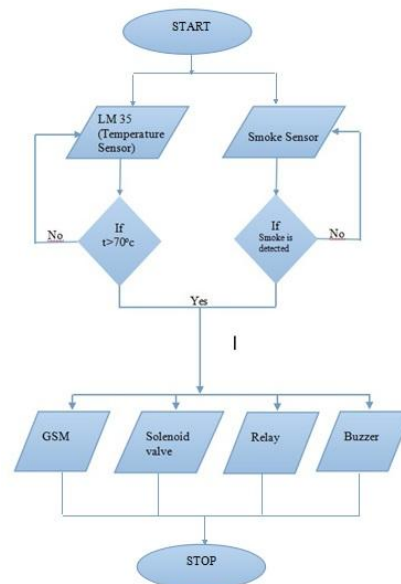
E. Software Implementation

The Implementation of software is mainly done using Energia. Firstly, the temperature values are continuously monitored by LM 35 and smoke sensor. These values are read and given to the microcontroller. The microcontroller MSP430F229 gives a triggering signal to switch ON all the peripherals like GSM, buzzer, actuator, Solenoid valve, and circuit breaker. These

components are actuated once the temperature value crosses room temperature (by assumption as 27degree Celsius).For the safer side, the system is calibrated to start its process if the temperature goes above 45-60 degree Celsius. Once it crosses the given temperature limits the peripherals connected to it start its process and an alert message is sent to the concerned authority.



Figure . 7 Our Rescue System



Results

The major two results are that of LM35 and GSM. LM35 is calibrated to a certain temperature. Once it senses the increase in temperature above the calibrated limit, it takes further action to turn on the solenoid valve thus sprinkling water and extinguishing fire. Further the GSM is responsible for contacting an authority of the nearby station house and informing them that the help is needed in so and so location.

Conclusions

This our overall proposed system helps to rescue people from fire accidents in moving locomotives at the earliest as possible. This reduces the risk of loss caused due to fire accidents.

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