A SMART MULTIPURPOSE MONITORING AND CONTROLLING IOT SOLUTION TO ENHANCE SAFETY IN RAILWAYS

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Keywords:

8051 Microcontroller, IR Sensors, smoke sensor, cloud, eye blink sensor, GSM, LCD, Keil microvision.

Introduction:

Nowadays, more and more people are targeting their journey using railways as it is more comfortable, cheap and conventional. In India and many other countries, safety measures for any emergencies in railways are not much prioritized. The driving factors of the smart railways are expected to enforce the growth of the industry. These factors include the increasing importance of sustainability, government regulations, demographics (i.e., growing traffic of passengers and freight, aging population, and rapid urbanization), macroeconomics (i.e., limited public funding and government deficit, government initiatives and partnership models), microeconomics (i.e., price sensitivity, demands for an improved passenger experience, stakeholders interests), the growing importance of smart cities, the incredible pace of telecommunications and technological change, and the need for mobility. There is a very high possibility of an elevated number of deaths during any emergency due to more time required for the rescue management. It takes more time to reach in place of the incident. This situation happens because of delay to alert the rescue team about accident and many times victims could not notify the rescue team about the exact location due to lack of vision during the night or they may be travelling to a completely new place. There is a very high need to upgrade the railways using advanced technology for the safety measures of the travelling passengers.

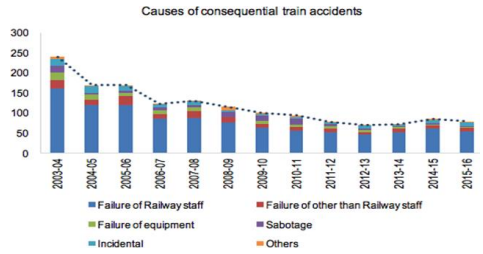

Figure 1.1: Statistical Analysis of consequential railway accidents over the years

The statistical analysis from the Figure 1.1 represents the causes of consequential railway accidents (till the year 2014) because of the failure of Railway staff, failure of equipment, incidental, failure due to other than railway staff , sabotage and others which includes fire crisis, derailment, delinking of coaches.

Therefore, there is an immediate need to upgrade railways with automated emergency detection for crash and fire emergencies. Also, an automated quick response system with minimum latency for the safety of on-boarding passengers is required. In case a railway accident occurs, passengers and the driver may not be in a condition to call for help and rescue the victims immediately. They may not know the exact location of the incident which can make the conditions worse if help does not reach the place of incident immediately.

To overcome this problem and improvise the safety of railways, the idea of implementing automated emergency detection and a quick response system to resolve the issue is proposed. In this system, sensors like IR sensors, smoke sensors, fire sensors, gsm- these are used to detect the corresponding emergency automatically. In case of emergency detected, an alert is broadcasted using cloud based real time database and an alert is sent to the operator and control section with the type of emergency occurred and the exact GPS location of the incident is tracked.

Objectives:

Considering the existing railway emergency management system, the following objectives are defined.

1. To develop a railway emergency system using IoT to detect any delinking of coaches and fire accident of the train.
2. To develop an automatic response system which will send an alert as well as cloud-hosted database alert to the respected emergency control module.
3. To develop a passenger-side emergency alert system to give alert to the specific rescue team members such as doctors, firemen and police.
4. To develop driver's health/negligence monitoring system.
5. Reduce risk of accidents-developing track-side and delinking of compartments and track crack detection emergency alert system.

Methodology:

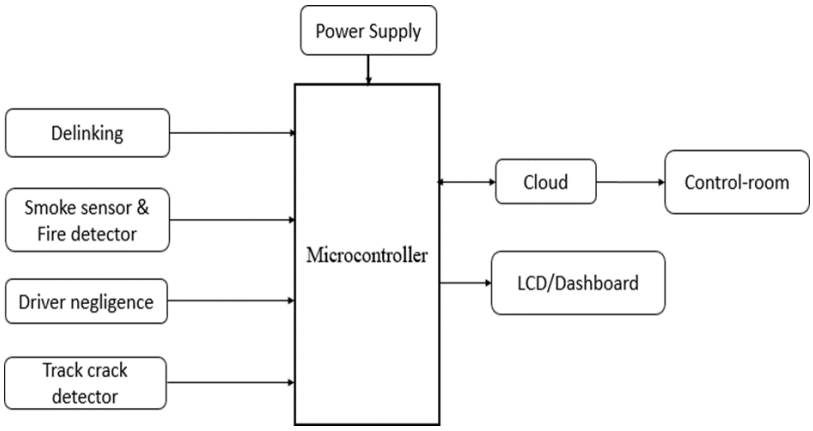

Figure 3.1: Block diagram of the proposed system

The block diagram illustrates how a mini computer that is the microcontroller connects with several peripheral devices (sensors) to enhance the security and control the Railway accidents.

In case a railway accident occurs, passengers and the driver may not be in a condition to call for help and rescue the victims immediately. However it can be avoided or the effect can be reduced by implementing IoT technology.

In the proposed system, Microcontroller (8051-SST P89V51RD2 family) performs the main role by taking data from the sensors and passing over to the control room via cloud. The Infrared sensor (IR) detects the infrared emitted from an object. If the bogies get disconnected, the IR sensor connected at the end of compartments does not receive any signal and there won't be any continuity in the signal. Hence this IR sensor as it does not receive any signal sends an alert message to the control room via the cloud and also displays alert message on the LCD dashboard and stops the train.

Similarly for crack detection the IR sensors if it does not receive any signal that means there is no crack. If it receives any signal then there is a crack and it sends an alert message to the control room and as well as to the driver displaying it on the LCD dashboard.

The fire detector sensors, as the name suggests detects the fire using infrared rays from the flame, which will open the water valve of the water sprinkler which will be installed in each coaches and simultaneously sends an alert message to the operator as well as to the control room so that an immediate action can be taken. Also the smoke sensor when it detects the smoke, like if any person smoking or gas leakage it alerts people by sending the buzzer sound and also on the LCD display that the smoke is detected.

There are many accident happens because of the operator's negligence or may be his/her health issues. To avoid crisis happening due to such things we can keep an eye on operator throughout the journey using eye blink sensor which will collect the data such as facial

expression and eye movement which will be analyzed and if there is any fault from the operator end it will send an alert message to the operator as well as to the control room.

In the microcontroller what we are using the port 3 is the communication port and the GSM will be attached in this port. This GSM will take the phone number of the control room and sends an alert SMS via the application (cloud) wherein even though the phone is kept in silent we will get a special alert for alert. The GSM also detects the latitude and longitude of the specific place where crisis has occurred and also sends the location while sending an alert SMS. These specifications will be coded using Keil microvision software.

Flowchart:

The complete flowchart of the proposed system is shown as in the Figure3.2. It gives a brief overview on the working of the system. It explains that, once the train starts moving, all the sensors get activated and check for any fault. There won't be any action taken if everything is normal. However, when an accident gets detected by any sensors. The control room and the train operator get an alert message along with the exact location. And the train will be stopped gradually. Once the situation is under control the system comes to its initial stage.

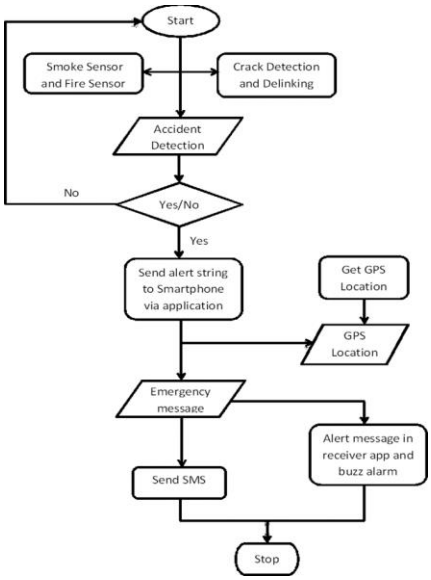

Figure 3.2: Flowchart of the proposed system

Results and Conclusion:

This proposed system examines the role of enabling technologies to revolutionize the railway industry. Broadband technologies like IoT, provide the capacity needed to create novel services. The adoption of the paradigm opens a wide area of short and medium-term potential applications. Examples like predictive maintenance, smart infrastructure, advanced monitoring of assets, video surveillance systems, railway operations, Passenger and Freight Information Systems (PIS/FIS), train control systems, safety assurance, signaling system, were detailed in order to expose the IoT capabilities to reinforce competitive advantages, to create new business

models, and to change Sensors of railways. For each of the services, the latest technologies and the main academic and commercial developments were thoroughly examined.

After all the analyses performed, it can be stated that the Internet of Things provides following outcomes/solutions for the problems

1. To send an alert notification to the operator during crisis to reduce the amount of accidents
2. The technology will be able to handle the emergency (such as fire emergency/smoke, delinking of compartments, track crack detection)
3. By applying this proposal the Railways will be safer and more efficient
4. Improves passenger experience due to enhanced operation and more reliable transport services

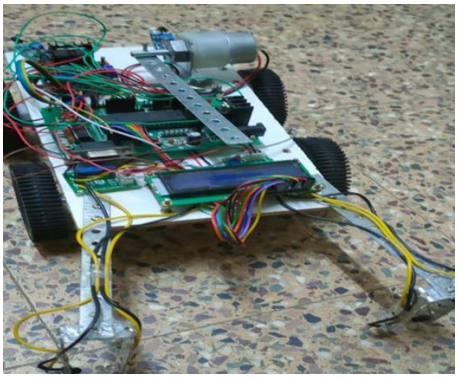

Figure 4.1: Prototype of the system developed

Scope For Future Work:

The Railways is called the Lifeline of the nation in transportation and even then the safety of passengers needs more upgradation. There is a requirement in updating the emergency response systems of railways using trending technologies which can control as well as send an alert message to the operators. The Internet of things (IoT) provides abundant opportunities to mitigate the problems in day to day life. An automatic emergency detection system consists of various sensors which trigger the microcontroller on detection of an accident

The proposed system focuses mainly on enhancing the existing safety system to some more extent. Railway accidents prove to be fatal and are increasing eventually. The railway passenger's safety is considered an utmost priority. At the same time it also alerts driver in case of any emergencies. The Indian railways can adopt these strategies to provide better safety for its passengers. This system can also be used to detect the animals which comes in between the track side using LIDAR or ultrasonic sensors which is a futuristic approach. The same system in future can also be used for metro train, buses, cars and also in huge parking areas which are likely to be affected with fire hazards.