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Accident Prevention Technique Based on Vital Parameters A Survey

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Abstract - In the recent years, number of accidents due to trains is more and losses are also heavy. Accidents are not only caused by poor technical conditions of vehicles, but also by tired, indisposed, or bad state-of-minded drivers. The human factors can be managed by controlling, recording and monitoring of the most important vital parameters of the driver. The paper proposed a real-time Improved Driver Monitoring System which is developed to ensure safe operations of trains, by monitoring eye-blink rate and recording loco-pilot's vital parameter. Intelligent train tracking and management system is used to improve the existing railway transportation service. The system helps in avoiding the head-on collision in an efficient way by notifying the status of the two trains on the same track when they are separated by few kilometers away to reduce the human death ratio by accidents.

Keywords - *Real-time, Improved Driver Monitoring, Eye-blink, Vital parameters, Head-on collision, Intelligent train tracking.*

1. Introduction

Railway industry has a valuable role in economic development of each country. India's massive railway network is hit by an average of 300 accidents a year. With the development of technologies in high-speed railway, speed and capability of the trains improved constantly, and the density of traffic gets more and more serious.

In comparison to the other modes of transportation, Railways provide a better alternative since it can carry a large number of people and goods at the same time. So, requirements to the safety and reliability of the high-speed train enhances increasingly. The maximum number of accidents are reported from the transport sector i.e. road as well as railways.

Railway accidents can be classified in terms of cause and effect.

1.1 Classification of rail accident by Effects

1.1.1 Collisions

1) Head-on collision
2) Rear collision
3) Collisions with buffer stops
4) Obstructions on the line (e.g. Landslides, road vehicles)

1.1.2 Derailments

1) Plain track
2) Curves
3) Junctions

1.1.3 Others

1) Fires and explosions (sabotage, terrorism)
2) Collisions with people on tracks, Falls from trains.

1.2 Classification of Rail Accidents by Causes –

1.2.1 Drivers' Errors

1) Passing signals at danger
2) Excessive speed
3) Mishandling engine (e.g. boiler explosions)

1.2.2 Signalmen's Errors

1) Allowing two trains into same block section
2) Incorrect operation of signals

1.2.3 Mechanical Failure of Rolling Stock

1) Poor design
2) Poor maintenance

1.2.4 Civil engineering failure

1) Track (permanent way) faults
2) Bridge and tunnel collapses
3) Poor track or junction layout

A huge number of accidents are due to errors by human. Therefore, an organized way for Railway operation management and reduction of human intervention could play a significant role in reducing the number and impact of accidents. So, collection, transfer and prediction of infrastructure and environment information are the key points to ensure the safety of the high-speed railway.

Intelligent Transportation System (ITS) is the advanced technologies which aim to provide innovative services relating to different modes of transport and traffic management. It enables various users to be better informed and make safer, more coordinated and 'smarter' use of transport network [1]. ITS is the combination of artificial intelligence and transportation system. It encompasses a broad range of wireless and wire line communication and information processing. These technologies help in relieving congestion and increase the productivity.

1.3 Various applications of ITS are as follows

1) Traffic surveillance and management
2) Autonomous driving
3) Driver assistance
4) Traveler information
5) Collision notification and avoidance

In recent years, train accidents occur frequently in our country, which are simply due to natural disasters, technical faults etc around railway. But, accidents are not only caused by poor technical conditions of the vehicles. It can also be caused by tired, indisposed, or bad state-of-minded drivers and the time for correcting and avoiding accident are extremely short, and alternative ways also are very limited. Intelligent train tracking and management system is used to improve the existing railway transportation service. The solution is based on combination of mobile computing, and wireless technologies (WI-FI, GSM, and GPS). By using wireless technologies e.g. GPS and GPRS, the location and position of the train can be located.

The paper proposes a system which constantly monitors the health status of a person and if any abnormalities were found then the information will be immediately transferred to the Authentication Server (AS). Various sensors are used in order to timely collect, transfer, analyze and process the information. An embedded controller scans the data from all the sensors and transfers it to the AS. The proposed system will establish a management structure based on performance evaluation and monitoring process.

2. Literature Review

Xinhong Heir, Lining Chang, Weigang Ma [2] proposed a safety framework and alarming model for train operation environment based on CPS (Cyber Physical System). It is a system of collaborating computational elements controlling physical entities. The safety of high-speed railway extremely relies on its surrounding environment (earthquakes, landslides, debris flow and rail bed deformation, etc.) which cause great threat to high speed train operation. For this, it uses the thought of Wireless Sensor Network (WSN) in order to collect, transfer, analyze and process the surrounding environment information. The processed data will be the data sources for the alarming models. When the MC (Monitor Computer) receives the monitoring data and analyses the data safety it will transmit the data to the train control centre, which can be much efficient to keep train safe.

Nisha S.Punekar, Archana Raut [3] proposed a system which monitors the track in front of a train for Obstacle detection using multi sensor setup. In this paper the authors proposed a Wireless Network access framework according to monitoring network surrounding environment and the deployment of transition network to avoid collision of trains and obstacle detection. If an obstacle is detected, the in-built GPS module identifies the train location with a highest accuracy and transfers the information to the central system via GSM.

C.Chellaswamy, S.Arul, L.Balaji [4] proposed a new method called Intelligent Collision avoidance System (ICAS) for avoiding frontal collisions. The main reason for these accidents is irresponsibility of driver and signaling problems which results severe damage to life and property. This system avoids the collision in an efficient way by notifying the status of two trains in the same track when they are separated three kilometers. This is done by warning the driver both visually and by giving

a sound alert. The system will manage situations in an efficient way and notify the opposite train which is on the same track.

Peter Istvan Sas, Laszlo Lukacs, Adalbert Kovacs, Endre Borbely, Levente Kovacs [5] proposed a real-time system, which uses ECG signal for observing the driver and transmits the measured values through the CAN (Controller Area Network) ,which is widely used in cars. The device is capable to send the measured signal via Bluetooth to the Computer software allowing storing the measured value.

Hairong Dong, Bin Ning, Baigen Cai, and Zhosheng Hou [6] proposed the automatic train control system. It requires two sets of data to execute accurate train operation. One set is static data, such as rail parameters, locomotive traction force and braking capabilities, etc., which is closely related to the train model. Another is dynamic, such as train position, speed, and motion states. It is a key mission to obtain and provide the train control system with these two sets of data in real time.

3. Proposed Work

The main objectives of this proposed work are to reduce the ratio of Human Death due to accident. The train safety has been an issue with increasing number of incidents being reported that has caused death and injuries. An average train accident would cost millions of Indian rupees and it can be avoided if there is a mechanism to track the train location and speed and warn the locomotive drivers about possible safety issues. It is necessary to have an intelligent system which identifies the accident before it happens and informs or signals a driver to be alert.

A system that has pre-analysis about the driver can prevent the accidents. Fig (1) represents the communication between the devices. As issues related to security are considered, there is a possibility of accident, due to indisposed, tired and bad state-of-minded driver.
The work is extended by managing human factor which needs controlling, recording and monitoring the vital parameters. The solution is based on constantly monitoring the vital parameters (Heart rate variation, ECG) and eye blink rate of locomotive driver, in noisy environment to avoid accidents. If any abnormalities were found, then the auto-pilot mode will get activated to control the train.

In order to collect and send the information, the locomotive drivers should wear jacket with sensors attached in it. The sensors are used for sensing the vital parameters such as heart beat rate, pulse of the driver. If there is any fault detected then the information is send to the Authentication Server.

The fundamental process in the system is to obtain the train location using GPS technology and transmitting the data via GSM network to the Authorized server (AS) for data processing and information analysis and to take the appropriate decision. The position data is periodically sent to the server through the GSM transmitter of the module. Server automatically updates the database with current position, speed and direction information of each train. The GPS receiver is used for identifying the latitudinal and longitudinal position and ground speed of the specific train.

An Eye-blink sensor is fixed to the Driver's head to monitor the eye-blink rate of the driver. For detecting the face area and further regionalizing it, Haar-Classifer algorithm is used. Additionally, for accurate localization of eye and blink detection, Hough transformation is used.

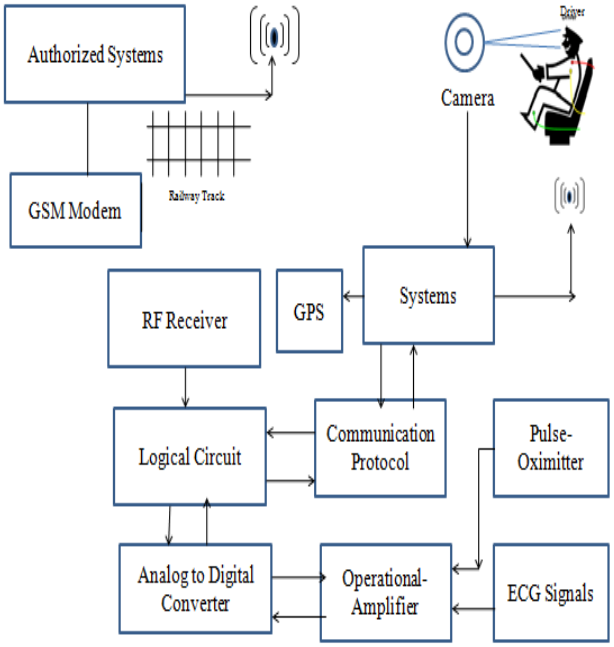

Fig.1 Proposed Work for Device Communication

When the eye blink rate falls below a certain level, the driver gets alerted. The device responds to the commands and data calls from the central remote server as per administrative requirements of the train controllers. The Authorized system or Central Control System includes a remote server for handling and processing all the position information received from train locators via the GSM

network. If two trains are on the same track and any abnormalities were found in any one of them regarding collision point then the alert message is sent using Wi-Fi technology. Also, the vital and biomedical parameter (ECG, Pulse Reading) are monitored and transmitted via wireless network to the Authorized system for classifying the driving condition (tiredness).

3.1 Advantages of the system are:

1) It will establish a management structure based on performance evaluation and monitoring process.
2) To improve the percentage of efficiency.
3) It provides facility to send alerts/warnings to particular train drivers on possible collisions, derailment through the system.
4) Time-Distance graph can be generated for trains which can be used to control and plan the train movements.

4. Conclusion

In order to ensure safe operation of trains, we put forward a wireless network access framework for safety train operation based on the driver's vital parameters in noisy environment. The scope of the proposed work is to develop a system which constantly monitors the health status of a person and if any abnormalities are found, it is immediately transferred to the authentication server. The system will be able to generate alert message if any abnormality is detected to avoid head-on collision. The system will establish a management structure based on performance evaluation and monitoring process. The work can be extended to control the traffic congestion while transmission of the signals and also security measures can be added for better and secured transmission. The goal of the work is to design a system that helps in reducing accidents to achieve good level of security.

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