



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Rail Raksha – IoT Based Accident Prevention

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Abstract: Derailments are the major reason obtained for railway accidents as many factors are responsible for the cause of accidents. Factors such as signal malfunctioning, over speeding of the railways lead to the derailment of the railway and result in the loss of mass destruction of railway property and lives.

To avoid this issue our project has been brought up with a solution of railway over speed control IoT device and signal automation that gives loco pilot real-time signal from the base station so that they don't have to rely on the poles for running the vehicle. This may also help in decreasing accidents caused by climate reasons, machine failure, and human error.

I. INTRODUCTION

The safe transportation of passengers is a result of the public's trust and confidence in the railways. These situations damage our image and raise questions about safety and efficiency. Accidents can occur due to negligence or actions, violations of rules, bad practices, short-term use, etc. Peace of mind. A combination of factors causes most cases. Experience shows that railway accidents can be divided into the following two categories: i) Equipment failure ii) Human failure

The main purpose of our work is to prevent serious incidents such as train derailments. Derailments usually occur due to signal loss or vehicle speed. To prevent this, measures were taken to improve the operation of the railway and reduce accidents. The main causes are signal failure, weather changes, and speed. To focus on these important areas a) IoT sensors are being developed that will be placed on the railway line, these sensors will identify the vehicle speed starting from a certain distance and will now initiate a cabin warning when the cabin speed is evaluated. This way a lot of speed can be controlled. B). You don't have to rely on signs or be affected by weather changes.

Keywords: Derailment, Speed sensors, transmitter, receiver, signaling, loco-pilot.

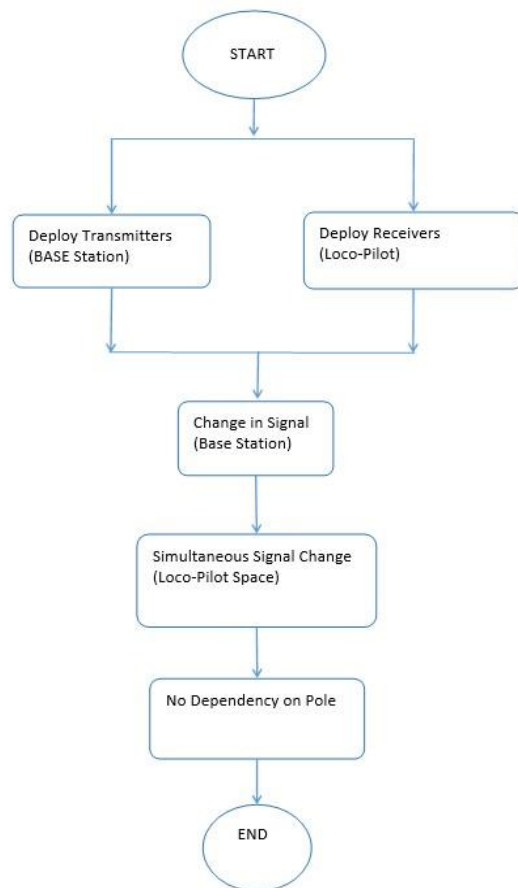


Fig 1: Process of Signaling

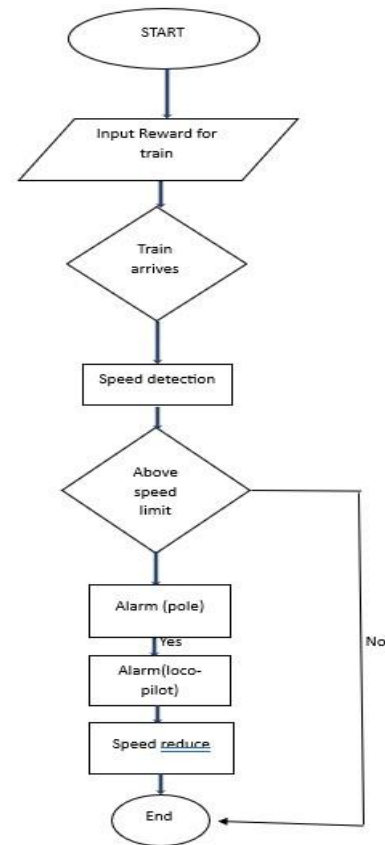


Fig 2: Process of speed monitoring

II. ISSUES AND PROBLEMS IN DERAILMENT

A. Derailment

This is a common issue in railways worldwide, and India is no exception. Derailments can occur due to various factors, including track defects, signal failures, human error, and equipment malfunctions. They can lead to significant property damage, injuries, and loss of life.

B. Human Error

Human error is a significant contributor to railway accidents. This can include mistakes by train drivers, signal operators, track maintenance personnel, and other railway staff. Factors such as fatigue, stress, and inadequate training can increase the likelihood of human error.

C. Signal Failure

Signal failures can disrupt train operations and lead to accidents. Equipment malfunctions, power outages, or human error can cause these failures. In India, the railways have been investing in modern signaling systems to improve safety and efficiency.

D. Fire accidents in coaches

While not as common as derailments or signal failures, fire accidents can occur in railway coaches. These can be caused by various factors, such as electrical faults, cooking accidents, or deliberate acts of sabotage. Fire safety measures are crucial to prevent and mitigate such accidents.

E. Human Resources

The Indian Railways is a vast organization with a large workforce. Effective human resources management ensures efficient operations, safety, and employee satisfaction. Issues such as recruitment, training, and compensation can impact the performance of the railways.

III. CLASSIFICATION METHODS FOR DERAILMENT

There are many ways to prevent rail accidents:

Further learning: using historical accident data to predict future accidents and take preventive measures

Machine learning: using sensor data from trains and other sources to predict future accidents. Object Tracking

Fire Detection: using fire sensors to detect fire on the tracks

Automatic Gates: using sensors to open and close gates at crossings

Research on railway safety can be divided into various categories depending on the purpose of the analysis. For example, railway safety can be viewed as a risk issue and can be addressed from the perspective of resources, capabilities, and outcomes (Liang et al., 2020; Parkinson et al., 2016; Yang and Li, 2020). On the other hand, classical utility models believe that introducing issues into actual safety management can prevent the influence of the power of bad plans (Brutas et al., 2014; Syeda et al., 2019; Zhou and Ding, 2017). Regardless of the purpose of this study, identifying hazards that may cause adverse effects is one of the most important tasks before other risk-related identifications (Rausand, 2013).

Railway accidents can be classified according to the application of interest. For example, classification based on main entities such as hazards and natural disasters is widely used in the literature (Ouyang et al., 2010; Rydstedt Nyman and Johansson, 2015; Whittingham, 2012). Some studies also define hazards as intrinsic hazards and exclude other hazards that are the subject of research (Hulin et al., 2016; Li et al., 2021; Li et al., 2021). Data-driven methods that aim to eliminate hazards in the accident or manually identify them use a hazard plan such as Preliminary Hazard Analysis (PHA) (Guenab et al., 2008; Yan and Xu, 2019) and Failure of Action, Effects, and Critical Assessment (FMECA) (Catelani et al., 2021; Ciani et al., 2019). Conceptual design, on the other hand, takes into account the depth of research data (Bang et al., 2020; Li et al., 2021, Li et al., 2021) or feedback (Berrado et al., 2021). For example, the hazards and operations study (HAZOP) is used to identify differences and adverse events in train operations. Finally, the analysis of the railway industry is difficult, and the construction problems that need to be solved by the hierarchical management need to be corrected (Ouyang et al., 2010; Zhang et al., 2021). Train accidents are caused by the incompetence of the person, organization or management (Rausand, 2013). System analysis therefore focuses on the problems caused by improper controls. Some methods such as the collision theory model (STPA) (Gong and Li, 2018; Ouyang et al., 2010; Song et al., 2012) and the social process (Accou et al. Carpinelli, 2022; Akel et al., 2012, 2022) et al., 2021) have been widely used in the railway problem. Data are recorded on paper and manual review of data is time-consuming (Rosadini et al., 2017).

Previous studies aimed to develop a hazard assessment model based on highspeed railway data (Kim and Yoon, 2013; Zhou and Lei, 2018); however, the inability to modify the model after the new train and the hard work.

These limitations may weaken the dissemination of information on railway safety and increase the risk of recurring train accidents with similar characteristics. For example, before 2010, pedestrians wearing headphones were commonly at risk of being hit by trains at level crossings in Dhaka, Bangladesh, and its surrounding areas; more than 535 people lost their lives (NDTV, 2019). However, RAIB only became aware of this risk after the fatal level 1 accident at Kings Mill and asked the Health and Safety Executive and the Central Department of Justice to look into solutions (RAIB, 2014).

Effective monitoring of train accident reports across the region will enable RAIB to be aware of such risks and take early action. NLP is a technique that uses computers to process large amounts of text to extract information of interest from unstructured text (Ly et al., 2020; Marquez et al., 2000). The use of NLP in railway hazard assessment is limited. Most of the studies focus on hazard classification (Dong et al., 2022; Hughes et al., 2018; Liu et al., 2022) and hazard extraction from data (An et al., 2013; HadjMabrouk, 2019; Huang et al., 2019) to support policy development by classifying risk levels (Reniers and Dullaert, 2013) and estimating the impact on performance (Li and Rong, 2021). However, some limitations on NLP hinder its further application in railway disaster planning and decision-making.

For example, NLP models are often designed for specific purposes and can only be used on certain data types, making future studies difficult (Alawad et al., 2020; Dong et al., 2022; Lee et al., 2021). Additionally, an overreliance on academic supervision has been observed in the context of railway monitoring, which may limit understanding of dimensions and ignore other available capabilities (Yang et al., 2022). This may lead to policy oversight by predicting disagreements in maintenance work (Evans, 1996). Although the experimental use of training was not controlled, previous studies fail to explain the consequences of development policy that hinders the use of professionals in treatment (Bougacha et al., 2019; Lasisi and Attokine, 2020). This represents a gap in the literature that this study aims to address.

IV. CONCLUSION AND FUTURE DIRECTION

This paper reviews the signaling system and the possibility of derailment. There will be a decrease in rail accidents caused by derailment. Enhancement in the signaling system will help the loco pilots to get the signals more effectively. The accidents caused by overspeeding will decrease as we install the sensors that help observe the limited speed required and alert the loco pilot accordingly. If any signal is not visible or not known by the weather change, the loco pilot has a clear view of the signal by having the rear signal from the signaling department direct the loco pilot's system.

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