ENSURING PASSENGER TRAIN SAFETY BY USING SMART COLLISION AVOIDANCE SYSTEM

Mr.B.Naidu, [1]V.Esther Rani, [2]S.Jahnavi, [3]P.Bhagya sri, [4]Y.Uma Maheswari, [5]S.Ashritha sai lakshmi

Assistant Professor, Department of Electrical and Electronics Engineering,
Vignan's Institute Of Engineering For Women,Visakhapatnam,Andhra Pradesh, India
from [1,2,3,4,5] Department of Electrical and Electronics Engineering,
[1,2,3,4,5] Vignan's Institute Of Engineering ForWomen, Visakhapatnam, Andhra Pradesh, India

ABSTRACT

This initiative smart collision avoidance systems contributes to a considerable advancement in rail safety. Train explodes on the track are the root cause at great deal of railway accidents. The system's objective is to make use of infrared (IR) sensors to recognize the presence of an approaching train from either the opposite or the same direction, and then trigger the halt mechanism to minimize the probability of a collision. Each train incorporates IR sensors that are strategically designed so that they are able to identify the presence of approaching trains while blotting out external barriers. Using this technique, one may determine if trains are expected to clash head-on or rear-end. When a train notices the presence of an oncoming train, its speed is progressively slowed down and avoids collision within the distance.The proposed system incorporates an Inter-platform Bridge for railway stations with the aim of enhancingpassenger convenience and safety. This system provides a direct, seamless and efficient route for passengers to transfer between platforms without the need to navigate through crowded concourses or cross active railway tracks. By introducing this system, the potential of train accidents will be tremendously dropped, resulting in a network of railway transit that is more reliable and safe.

INTRODUCTION

Train disasters have the potential to result in catastrophic loss of life or injury, loss of railroad property, or disturbances in rail traffic which go beyond predetermined limits. Increased demand for trains and the frequency of already-existing trains related to the extending population leads an excessive increase in rail traffic over a number of years, putting strain on rail tracks and pushing above the "safe" limit[1].They inflict catastrophic loss of life or injury, destruction of railroad property, or train traffic disruptions that go beyond established limits[2]. Increases in population lead to more demand for trains and an increase in the frequency of already-existing trains, which results in an irregular increase in rail traffic over an arrayof years[3]. Collisions within trains may result in substantial harm, serious injuries, and even fatalities. Numerous factors, like as human mistake, technical faults, signal problems, unfavorable weather, or even deliberate actions like sabotage, could lead to these collisions[4].The combined forceof the collision causes severe damage and often results in casualties in head-on crashes. The combined force of the hit causes considerable damage and often results in casualties. Trains collidingwith one another from behind result in rear-end collisions. Even though they are usually not as serious as head-on collisions, they can nevertheless result in damage and injuries.

LITERATURE SURVEY

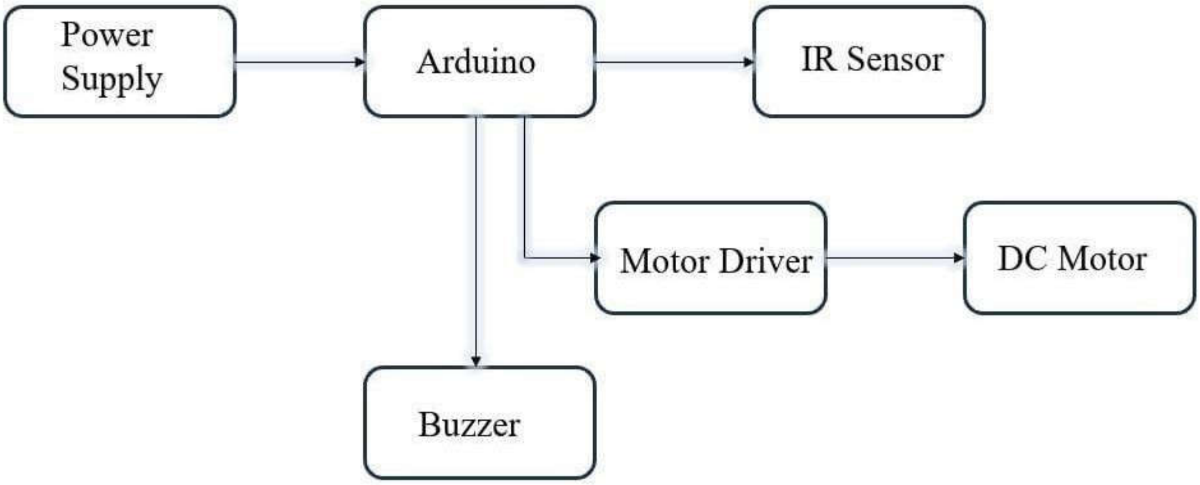
One essential component of contemporary transportation networks involves ensuring rail safety. There is an enormous danger of train collisions for people, property, and other people. The creation and application of Train Collision Avoidance Systems (TCAS) have shown promise in recent years as a way to reduce these dangers. The aim of this literature review is to examine the state of TCAS research, techniques, and technology in relation to improving train safety[5].At least 238 people have died and almost 900 more have been injured in a crash involving three trains in Balasore, Odisha. The Coromandel Shalimar Express derailed and collided with a goods train at approximately 7:00 p.m. on Friday. The derailed coaches were then collided with by the Yesvantpur-Howrah Superfast, another train. The Indian Railways implemented the KAVACH system, an in-house designed Automatic Train Protection (ATP) system, to stop these kinds of train crashes. The goal ofdeveloping the technology was to increase train operation efficiency and safety.At least 238 people have died and almost 900 more have been injured in a crash involving three trains in Balasore, Odisha. The Coromandel Shalimar Express derailed and collided with a goods train at approximately7:00 p.m. on Friday. One more train, the derailed coaches were struck by the Yesvantpur-Howrah Superfast.

EXISTING SYSTEM

The Indian Railways implemented the KAVACH system, an in-house designed Automatic Train Protection (ATP) system, to stop these kinds of train crashes. The goal of developing the technology was to increase train operation efficiency and safety. The Research Design and Standards Organisation (RDSO) developed the armour-like Kavach anti-collision technology withthe intention of achieving "zero accidents". It is the least expensive automatic train collision prevention technology, according to the railways. The technology possesses the highest certification level, Safety Integrity Level 4 (SIL-4) certification. It indicates that there is a 10,000-year chance of only one Kavach mistake.Compared to similar technology utilised in other countries, the anti-collision system's running cost of ₹50 lakh per km is substantially lower. In order to avoid collisions, Kavach uses high frequency radio communication and works on the continuous update of movement principle. The train's brakes are automatically engaged by the system if the driver fails to keep it under control. In order to prevent a collisionbetween two locomotives that are fitted with the system, Kavach also applies the brakes. It complies with Safety Integrity Level-4 (SIL-4) requirements and monitors the current signalling system, warning the loco pilot when a "red signal" is approaching and braking automatically to avoid overshooting the signal. An indigenously created Automatic Train Protection (ATP) system is called Kavach. Because of how technologically advanced the system is, it needs the greatest level of safety certification. In addition to helpingthe train run safely in bad weather, Kavach automatically applies the brakes when the loco pilot forgets to doso, assisting in keeping trains operating within designated speed restriction. In 2022–2023, the government intended to bring 2,000 kilometres of the train network under Kavach. The system is intended to span around34,000 kilometres of rail network. Union Railways Minister Ashwini Vaishnaw oversaw a Kavach test in March of last year. During the test, two trains approached each other at full speed—one carrying the chairmanof the Railway Board and the other the railway minister. Mr. Vaishnaw claims that Kavach stopped the trainbefore another locomotive in front by 380 metres.

PROPOSED SYSTEM

By installing an advanced rail Collision Avoidance System, the proposed system seeks to greatly improve rail safety. Assuring the safety of travellers, staff, and infrastructure in train networks, this technology will reduce the chance of collisions and boost productivity and the block diagram of system is shown in the Fig[1]. By using preventive collision avoidance techniques, it maximises train movements, lowers delays, and increases network capacity. This technology promises to revolutionise railway safety procedures and guarantee the dependability and effectiveness of train transportation by utilising proactive tactics. The proposed TCAS has the potential to define new benchmarks for train safety and dependability in the transportation sector with careful planning, strong implementation, and continuous support



Fig[1]:Block Diagram of proposed TCAS

The suggested system is made to be able to identify trains coming from both directions and detect their existence before activating the halt mechanism. A buzzer and LED are also included in the system, which increases its viability overall. An Inter-platform Bridge for railway stations is part of the proposed system, which intends to improve passenger convenience and safety. In addition to guaranteeing accessibility for everyone, including those with mobility issues, this bridge will create a smooth connection between platforms, allowing passengers to travel between trains with ease. Instead of having to go through congested concourses or across moving train lines, this technology offers passengers a quick and easy option to switch between platforms. An effective technique to improve passenger movement, accessibility, and safety in train stations is the Inter-platform Bridge system that has been proposed. This technology enhances the entire traveller experience while fostering efficiency and safety in station operations by offering a clear and accessible route between platforms.

RESULTS

Train safety has improved significantly since sophisticated collision avoidance systems were installed, lowering the likelihood of collisions. These systems are effective in preventing accidents because they make use of cutting-edge technology, well-thought-out implementation tactics, and strict adherence to safety laws. Continual monitoring and extensive testing further guarantee the system's dependable performance in actual operating circumstances, enhancing passenger and railway employee safety. Train safety may be improved by installing smart collision avoidance systems since they lower the chance of collisions. A project like this might have varying degrees of success depending on implementation tactics, safety laws, and technology employed. By identifying oncoming trains and initiating halt procedures to avoid crashes, the Smart Collision Avoidance system, that makes use of infrared sensors, seeks to boost railway safety. It attempts to improve passenger safety by preventing head-on and rear-end crashes by cautiously placing sensors on trains. as shown in fig[2]. Furthermore, by offering a direct path between platforms, the Inter-platform Bridge concept for trainstations aims to improve passenger convenience and further lower accident risks as shown in fig[3] All things considered, the network of railway transport might become more reliable and secure by the use of this type of systems.

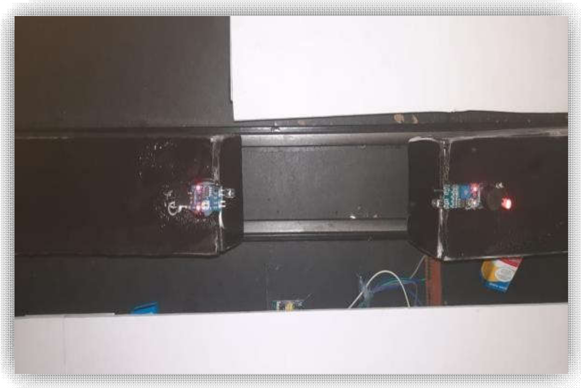


Fig:[2]
collision avoided by signal passing
to oncoming trains

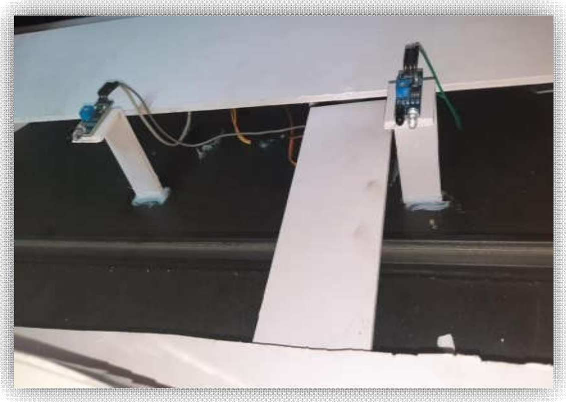


Fig:[3]
IR sensors in inter-platform bridge

Fig:[4]
connection of Arduino for an inter-platform bridge

Fig:[5]
Train approaching near to platform bridge

Fig:[6]
Passing of train through the
Opening of an inter platform bridge

Passengers can transition between platforms directly, smoothly and efficiently with the help of this system, eliminating the need to squeeze through congested concourses or cross moving railway lines.By implementing this system, the likelihood of train accidents will be greatly decreased, resulting ina network of railway transit that is more dependable and safe as shown in fig[4]. By employing state-of-the-art technology, the collision avoidance system anticipates possible dangers and reduces the likelihood of collisions by implementing prompt actions such as autonomous braking. Concurrently, the installation of an inter-platform bridge expedites passenger movement, which is especially advantageous for individuals with accessibility requirements and during peak hours as shown in fig[5] However, for the implementation to be successful, a number of considerations must be given careful thought, including budgetary allocation, compliance with regulations, technological compatibility, user education, and privacy protection.

CONCLUSION

The installation of intelligent Train Collision Avoidance Systems (TCAS) in trains has great potentialto improve safety and reduce collision-related risks. Through the use of cutting-edge sensor technology, TCAS possesses the capacity to foresee possible collision situations and take the necessary action to stop accidents. This may involve notifying the train operator to take evasive action, automatically applying the brakes, or changing the course. TCAS also has the ability to lessenhuman error, which is a major contributor to railway mishaps. TCAS can enhance train operators' abilities and add another level of safety assurance by automating collision detection and reaction systems. Deploying TCAS, however, is not without its difficulties and considerations. It is crucial toensure the system's robustness and dependability because any failure or false alarm could have majoroutcomes. Therefore, before introducing anything widely, it is imperative to conduct thorough testingand validation procedure

FUTURE SCOPE

Future studies should concentrate on training methods, user experience design, and human aspects to guarantee smooth communication between train operators and TCAS. Investigating TCASintegration with more comprehensive traffic management systems can optimise train operations, boost productivity, and raise the standard for overall rail safety. This involves synchronicity with algorithms for scheduling, signalling systems, and infrastructure maintenance procedures. Furthermore, investigating the addition of cutting-edge technologies like computer vision and machine learning may improve the TCAS's capacity to identify and categorise such threats. Train

colliding were warned and this collision was computed. In addition to the collision avoidance system, physically impaired persons will also benefit significantly from the implementation of an inter-platform bridge between two platforms, which offers a smooth way for crossing. Numerous lives and numerous properties

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