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System for Identifying Problems and Obstacles on Railway Tracks

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ABSTRACT

Equipment issues must be identified and resolved quickly to ensure the smooth and safe running of trains. This presentation discusses state-of-the-art technologies designed to facilitate issue identification and resolution on railroads. Modern technologies like sensors, machine learning, and data analytics are being used to help develop a thorough and proactive strategy for issue detection. These systems are not limited to monitoring track conditions; they may also monitor tool health and external variables.

Issues such as worn-out wheel bearings or damaged rails may be promptly located with the use of sound and pressure monitors. This reduces the possibility of derailments by enabling repairs to be made before they occur. By using historical data patterns, machine learning systems might forecast future issues and increase the rail system's dependability. Additionally, these devices transmit information quickly thanks to communication networks. This enables support personnel to swiftly resolve any issues that arise.

KEYWORDS: CNN, 2D SSA, RAILWAY TRACK, ELEPHANTS, CAPTURING, CAMERA, AUTOMATIC DETECTION, REAL-TIME DATA,

1. INTRODUCTION

The Indian Railway system, which provides passenger train service, has become an essential part of the country's transportation network. Because trains are cheaper than other forms of public transportation like buses and airplanes in India, they are used for the vast majority of the country's commercial transit. There has been a tremendous increase in the amount of traffic on the Indian Railway network as a direct consequence of the country's rapidly growing economy in recent years. Transportation is a fundamental need for specialization since it enables dispersed production and consumption. Increasing the efficiency and capacity of transportation has always been essential to economic growth. However, transportation infrastructure and operations have a significant influence on the landscape and use the most energy of any sector, making sustainable transport an urgent concern. As transportation has improved, so has commerce. Increasing transportation's capacity and quality is crucial to the economy's growth. A more trustworthy approach to identify defect and save time, lives, and money is required in light of recent incidents. We can utilize sensors like infrared, ultrasonic, and lidar to find the split in the rails. When a fracture is discovered, the coordinates of its location (latitude and longitude) are texted to a nearby mobile device. We also employ camera for identifying any item which may be present on the track and the 2-D Singular Spectrum Analysis (SSA) is used as decomposition technique that decomposes the picture in usable components. Then, the deep learning classifier network uses that feature. The integration of 2D-SSA with deep network improves the efficiency with which obstacles are recognized. Integrating both camera and sensor to a single unit will offer an efficient and more dependable system. All rail engines are suitable candidates for mounting this safety mechanism. For this system's object recognition, we use machine learning so that it can function independently and without human intervention. We believe this is the first attempt to combine 2D-SSA with a deep network classifier to improve the system's object identification ability, which should lead to more confidence in the accuracy of the final product.

2. TECHNIQUES USED FOR IDENTIFICATION OF DAMGES AND CONDITION MONITORING OF RAILWAY TRACKS

In the realm of excitingly identifying damage and monitoring the status of railway rails, two basic sorts of approaches exist. Sensory Method is one example. Different types of dye penetrating Fiber optic sensors, eddy existing techniques, thermal field methods, magnetic field methods, radio graphics, and acoustic emissions/ultrasonic technologies. Visual examinations Track defects are often identified by the use of graphical inspection, which is most useful in niche fields. This approach may be time-consuming and expensive.

3. EXISTING SYSTEM

Currently, surveys of the rail network are performed manually. On the concrete of the trackbed, LED LDR (Light Dependent Resistor) sensors will not function. photos processing input photos are noisy system, high cost, and it's not generating correct output. Because video colour analysis is employed to locate the break in rail track under the poor weather situation, the Automated Visual Inspection technique is a sophisticated system. Information is delayed under the current system.

4. PROBLEM STATEMENT

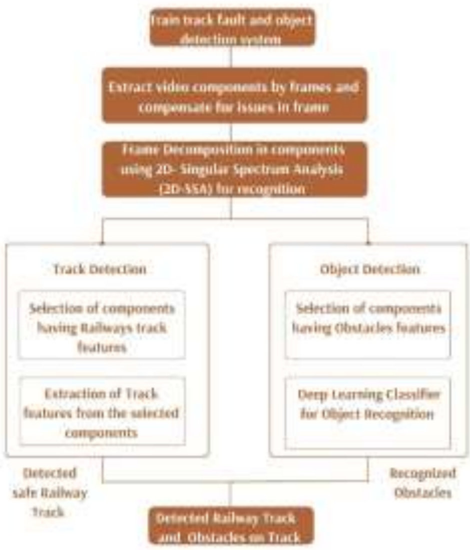
Recent instances, including trains colliding and intentional derailment of high-speed passenger trains, have shown the inadequacy of the current system, and a broken rail is one of the major causes of the most costly and catastrophic rail derailments that occur across the globe.

5. MAIN IDEA FOR PROBLEM SOLVING

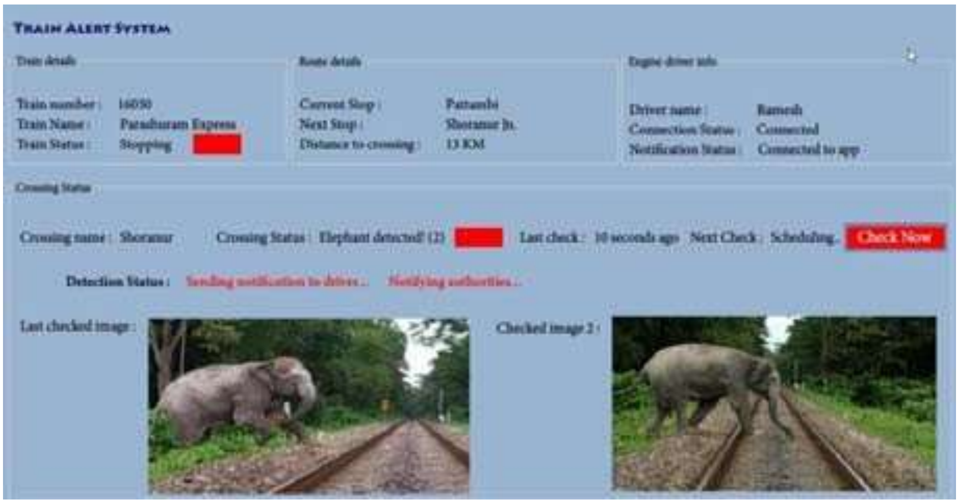
This study addresses the issue of railway track defect and object detection as a potential low-cost solution to the problem of train accidents. An automated system that does not depend on the physical labour is fetched into bright, and this method is employed for usage outside of the base station to keep the already dire state of the Indian railway networks from causing more shutdowns. Microcontroller, ultrasonic sensor, thermal camera, buzzer, GPS, and Bluetooth assembly are used to present a low-cost solution to the issue with high reliability, repeatability, and ease of implementation. A break or other obstruction on the track may be detected using an ultrasonic sensor. Any potential obstructions on the rails may be located with the help of a thermal imaging camera. The alarm will sound and the location where the issue was discovered will be reported to the proper authorities if either is found. The addition of a speed reducer also makes for a more sophisticated system.

6. PROPOSED METHOD

In thermal video of train tracks, this technique is used to distinguish the track from any impediments (https://www.youtube.com/watch?v=xzGc71JFiBI). Fig. 1 depicts the fundamental block layout of the recommended procedure. Motion defects may be extracted from the thermal video stream and corrected individually for each frame. Next, the frames are dissected using 2D-singular spectrum analysis (2D-SSA). Every component of the deconstruction stands for a distinct, significant piece of scene-related information. Subsequently, the train is located by using the "ith" portion to look at the track. The deeper network (Faster R-CNN, SSD, Yolov2/Yolov5) is additionally trained to detect obstacles using the 'kth' component. Finally, a single image of the anticipated outcomes (railroad track and barrier) is created.



A camera was installed inside the train's rails as part of the recording procedure. Pictures of trains on the tracks, both with and without cryptids, are now included. By placing the two shots adjacent to each other, the item was located. The database file for the Train app contains images of both deserted train lines and ones with obvious dangers. Images of a vehicle and an animal were sent. Two images of elephants that could have been utilized in the recapturing procedure are shown in Figure 2.



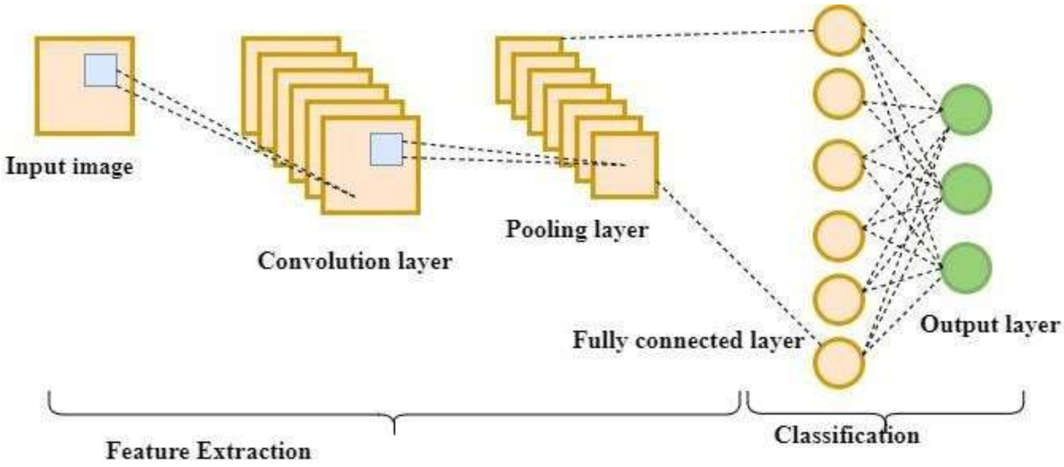
First, the Grasping Method

Capturing Process 1 and Capturing Process 2 were two of the many components of the proposed system. When there is just one picture available and an impediment is seen in it, the wisest course of action is not to stop abruptly. A warning signal was sent if the item was still following the path. Each capture involves three distinct phases. The process of spotting, abstracting, and recognizing features. The picture data was abstracted using the feature detection approach, and choices were made at each pixel to determine whether a feature of a certain kind existed at that location. The phrase "feature abstraction" was coined to describe a made-up method by which individuals supposedly learn about various categories in order to identify the qualities that may be used to characterize their membership in those groups. Through the use of pattern recognition, items were methodically sorted according to their fabrication technique. Feature recognition was used to identify the objects' attributes and identify the objects themselves. That level of feature abstraction sophistication was unprecedented.

A camera was trained on likely accident sites as part of the intended system. Acquiring the analog photograph was the first step in procedure 1. Features were first captured, then captured again, and then validated in a third step of the capturing process. finding, isolating, and identifying key features. As a computer vision library, we relied on OpenCV. We coded in Python. Following step 1 of the capture procedure, the photos were saved to a database. A second picture of the identical rail was taken in a matter of seconds, completing step 2 of the imaging process. After that, the picture was saved to a database, and now image comparison algorithms were being used to examine the similarities and differences between the two photographs. The loco-pilots will get the warning on their smartphones. The command center received a similar message. Normal operation, detection scenario 1, and detection scenario 2 are examples of when the suggested system was put to use. On the app side, it displayed information about the train and its current status. The condition of the train, as well as its location, destination, and driver information, were all shown by the system. Figure 3 shows how the system alerted the driver to the presence of the item and whether or not the train should be stopped.

The easy setup is really effective. When the app was first set up, it provided real-time journey information. Because the track was visible while the train was operating correctly, the loco-pilot could inspect it for potential hazards and steer clear of them if necessary. In Mode 2, we examined the vehicle's motion during motion. Nonetheless, the design requires two images to demonstrate that everything happened according to schedule. This indicates that the crossing light will become orange when in mode 2. We then double-checked to be sure nothing had slipped through the cracks. The precise moment of recapturing took place in Mode 3. In Mode 1, the loco-pilot and the nearby control room were notified as soon as the item was located on the track. When anything is discovered in Mode 3, the warning light becomes red.

Various techniques for detecting 1) Figure 4 displays the results of our convolutional neural network (CNN) search. CNN was used to examine the outcomes. A convolutional neural network model receives an image from a camera and processes it in its convolution layer. The photographs needed to be assembled next. The pooling layer combines and slows down the convolution layer's images so that the fully connected layer may utilize them. Every neuron in the output layer is coupled to every other neuron in the fully connected layer. They were concealed using a dark web program. After learning from the images using convolutional neural networks, we cross-referenced the results with our collection of animals. Multilayer Perceptrons are used in a similar manner in our classification process. A cell's output is transferred to the output layer once its weights have been determined. As additional levels are added, mistakes in hidden layers become more common. Convolutional neural network models are useful for both feature extraction and feature classification.



7. RESULTS

After the first detection of an item, a second detection, or recapturing, will be performed to verify that the object is still following the trail. Only after that were the loco pilots and control room informed. They were instructed to halt the train after receiving a phone notice. We used CNN for this detecting function. The train status and crossing status indicators both turned green when there were no obstructions in the way. If any problems were found, the green warning would become orange, and the process of recapturing and comparing would begin again. If the same thing was found again, the orange light would change to red, meaning the train would come to a halt. The app's associated mobile device and the command center both received an alert.

Upon detection, the system will sound an alarm and display information about the item, the location where it was found, and any relevant train information. Then the train began to halt as depicted in figure 5. that the train status has been halted before that an alarm message was issued to the phone.

8. CONCLUSIONS

We now have a useful method to distinguish between the train and any potential obstructions thanks to this work. The proposed technique initially extracts significant characteristics from the normal and thermal pictures using 2D SSA. This aids in identifying the obstruction's source using a deep learning network. The fact that rail lines may be located using SSA is another important finding of this study. An early warning system that is more accurate is produced when 2D support vector machines and deep neural networks are combined. Because collisions will be detected early on, trains will become safer as a result. The system's application end kept us informed about the train's situation and notified us when the beast was located. The Indian Railways received this technology as a gift, enabling them to respond to accidents more quickly. This technology will enable the development of a more sophisticated train monitoring system.

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