Railway track tracer system for creature detection

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Abstract. Railway Track Tracer System for creature detection is a system for detecting creatures on the railway tracks. This system will help to avoid many accidents that occur on rails. This system mainly focuses on some areas where creatures are always seen on the railway tracks. In some areas, elephants are crossing the railway tracks frequently. This system frequently monitors the railway tracks using a camera, so that the presence of creatures can be easily identified and then necessary actions can be taken to prevent accidents. The system includes a camera, train status system and an application for alert. The camera captures the images on the track at each interval of time and then through image processing the captured image will be recognized. If an object is identified on the track, then immediately an alert message will be sent to the nearby control room and loco-pilot. This system will be helpful for the society to prevent accidents due to creatures on the railway tracks.

Keywords: Railway track, tracer, alert system, creature detection, control.

1. Introduction

We know that the railways are the most convenient and cheapest mode of transportation because of its capability, speed and safety. Indian Railways are the largest railway in Asia and the second largest network in the world. The small improvement in this sector will lead to a great development in the country. Due to its huge size, there is a system to monitor and maintain the rails properly and the poor maintenance will create accidents in the rails. Many lives are affected due to the lack of carelessness. To avoid this, we were introduced a system that can avoid many of the accidents occur on rails. This system mainly focuses on some areas where creatures are always seen on the railway tracks. Using the cameras, the presence of creatures can be easily identified and thus the accidents can be prevented. The system contains details of train, loco-pilot, alert system and camera. In the proposed system, the images were captured using the camera and recognized using the process of image processing. If it detects an object in the image, then another image will also be captured within fractions of seconds and again the processing takes place. Both the images will be then compared and if it detects the image in both images, then the alert message will be immediately created by the application and send to loco-pilot and also to nearby control room.

In 2007, Oh et al. proposed an ultrasonic crack detection method and used in the complete station for the railway track surveying system [1]. This system identified any living being was crossing the railway track [1]. By using the system, the flaws in the railway tracks could be detected and whenever
the flaws were detected, the information were send to the nearest station. By using ultrasonic technique, it detected even the minor cracks on the track. [1]. In 2017, Parvathy et al. introduced a real time monitoring fault observation system which was based on microcontroller [2]. The authors described about a methodology where issues identified automatically. It detected the rail stress, evaluated the stream and provided the rail break alerts, so that the concerned authorities were notified easily [2]. In 2016, Lad et al. introduced a vision based platform monitoring system for railway station safety [3]. The system monitored the complete length of the track in the platform. There were many video cameras which conducted surveillance [3]. When the objects were identified to be fallen, immediately the notification was sent to the control room [3]. Closed circuit television cameras that were located at busy areas for monitoring and controlling passengers from the Central Control Room (CCR). But it was too difficult to manage this system when an urgent situation arrives [3]. In 2017, Manikandan et al. proposed a method enhances the track image using adaptive histogram equalization technique and further feature are extracted from the enhanced rail track image [4]. These extracted features are trained and classified using neural network classifier which classifies the rail track image into either cracked or non-cracked image [4]. In 2017, Naresh Kumar et al. proposed a system in which the IR sensors are used for detect the cracks in the rail track, ultrasound sensors measure the distance between the two track and PIR sensors are used to detect the presence of humans in the track [5]. If any cracks or obstacles are detected on the railway tracks or if any change in the distance between two tracks, the longitude and latitude of the track location is messaged to the nearest railway station using GPS and GSM modems [5].

The main objective of the proposed system is to avoid the accidents occurring frequently on the train. In this system cameras will be placed at specific areas nearby the track. The camera captures the images of the railway track continuously, until the train is in a critical distance away from the object. The image will be captured several times. And if the final image captured still contains the object on the train then the alert message will be created immediately and send to the nearby control room. The officials in the control room immediately check the situation through the camera vision, while the notification arrived at them. Then if necessary the officials in the control room report the situation to the loco-pilot and command to stop the train. Thus many of the accidents could be prevented.

2. Materials and Methods

Railway Track Tracer System (RTTS) for creature detection was introduced for monitoring railway tracks. In the proposed system, the accidents could be avoided if any living creatures that are on rails. We were contributed this system to places where accidents occur frequently. Accidents may be caused due to crossing of animals like elephants that may tumble down the train which may affect lot of life including those animals.

Camera

The Capturing process is done through camera which was in railway tracks [6]. The railway images were added into the database file with creature in the track and without creature in the track. Both the images were compared and detection of object took place [7]. The images stored in the database file in Train application includes Clear railway track image, and obstacle detected image. The elephant and car images were used as input images. Two images of elephant were present for recapturing process also which is shown in figure 1.
Capturing Process

The proposed system contained two capturing processes, capturing process 1 and capturing process 2. When only one image was captured and any obstacle was identified in the image, a sudden stopping decision would not be a best one. If the object was still in the track then red alert was produced. There are three processes in each capturing. The feature detection, the feature abstraction and the feature recognition [8]. The feature detection method was used for abstracting the image information and making decisions at every image point to detect whether, there was an image feature for particular type at the point or not. Feature abstraction was a hypothetical process by which people learn examples of different categories to determine the features that might be used to define membership in these categories. Feature recognition systematically classified objects based on their manufacturing method [9]. The object features and overall object recognition was done through feature recognition. It was an advanced feature of feature abstraction.

Implementation

In the proposed system, a camera was placed on the accident prone areas. The captured image was then converted from analog to digital and then capturing process 1 took place. Capturing process was divided into three phases such as feature detection, feature abstraction and feature recognition. We used OpenCV library for computer vision. We used python for coding. After the capturing process 1, the images were stored in the database. Within fraction of seconds, another image of the same rail was captured again and capturing process 2 is done. The image was there after stored in the database and now both the images were being compared using image comparing algorithms [10]. The alert will be shown to the loco-pilots through their mobile phone. A message was also sent to the control room. These are the three situations where the proposed system was applied, the normal mode, detection 1 and detection 2. In the application side, it gave the details about the train as well as the current situation of the rail. The system gave the details about the train that included the train number, destination, driver details and the train status. Thus, the system gave information to the driver that how and when to stop the train and also whether the object was detected or not is given in figure 2.

Figure 1. Object detection in the track.

Figure 2. Implementation of the proposed system.
Mode 1 is the normal mode. The application gave the real time information about the track in normal mode. In this mode, the track was clear in normal mode, so that the loco-pilot could analyze there was no any accident causing object on the track. In Mode 2, it analyzed the creature was crossing the track. But as per the proposed system, the image should be captured twice to confirm that the creature was on the track. So in mode 2, the crossing status will turn from green to orange alert. And then the rechecking process took place. In Mode 3, the recapturing process took place. If still the object was identified on the track as in the mode 1, then immediately the alert message was sent to the loco-pilot and to the nearby control room. In this Mode 3, the alert message was turned into red when the object is detected.

Detection Process
For detection purpose, we used convolutional neural network (CNN) which is given in figure 3. The set of classes were learned using CNN [10]. The input image which we capture through camera is passed to convolution layer in the convolutional neural network model [11]. The images were pooled in the pooling layer. The pooling layer combines the images in the convolution layer by reducing the dimensions and pass in to the fully connected layer. The neurons in the fully connected layer are connected with each and every neuron in the output layer [11]. The files were stored using dark net tool. The images were learned using CNN and then compared those with the stored animals in the set [12]. The classification process is similar to the process which we perform with Multilayer perceptron [11]. The layer trains the neurons with training rate of 0.3 [11]. The output of the neuron is calculated by using the weights attached to the neuron and passed to the output layer. The errors in the layers can be increased with the increase in applying the hidden layers [11, 13]. While doing the training, a momentum of 0.2 was applied to perform the modifications in training [11, 13]. With the help of convolutional neural network model, we can perform both feature detection and classification.

Figure 3. Architecture of Convolutional Neural network.

3. Results
We know that, railways are the convenient and easiest mode of transportation. But due to carelessness, a lot of accidents are occurring. So to avoid such accidents we introduced the proposed system which uses the image processing technique. Here, the images stored in the database after the capturing process were compared together and then detected the image. The application extracted and opened in visual studio. The images with empty railway track and railway track with an object were uploaded into the system [14].

When a creature was detected then there will be a recapturing process which was second detection to make sure the object was still in the track [15]. Based on that only the notifications were sent to the loco pilots and control room. They received an alert message through phone so they can stop train. For detection purpose, we used CNN [13]. When there were no any obstacles in the track, the green light was shown at the train status and crossing status. If any obstacles were identified, then the green alert turned to orange and after then recapturing and comparing takes place. And if the same object was
identified, then orange light was turned to red that indicated the stopping of train. Alert message was sent to the mobile phone which was connected with the application and also to the control room.

Notification

When alert button on train system was pressed as soon as an object was detected. When we press the allow button, the alert system was turned on. The figure 4. shows the permission message for sending the alert notification. Figure 5. shows the notification ON message.

![Figure 4. Notification Permission.](image1.png)

![Figure 5. Notification ON.](image2.png)

When the object was detected, then the system will turn on alert reminder about animal detected on track and train name and details also. Then the train started to stop as shown in figure 6. that the train status has been stopped before that an alert message also sent to the phone where the application was installed. In the proposed system, three phases of railway track were uploaded in a class or file that was uploaded to the system. These images were compared for object detection process.

![Figure 6. Showing Alert.](image3.png)

Our System cannot implement on a complete track. This system is mainly focussed on some particular areas alone. The implementation cost of our system is very high. Stopping of the train depends upon several factors like speed of train, load etc.

4. Conclusion

The proposed system for creature detection was used for the creature detection on the rails. The proposed system was placed in the accident prone areas where the accidents occur due to the wild animals crossing the rail, vehicle accidents, falling down of trees etc. will be monitored. This system provided the real time image using the image processing technology. According to the system, we were verified the system performance in real condition. The present state of the train and the objects were identified using the proposed image processing algorithms. Here a new recognition method was pursued using image processing technique which calculated the real image of the creature or objects in the track. This information will be helpful for the loco-pilot to stop the train and avoid accidents that harm the creature in the track. The system has an application side where we had the current status of
the train and it also produced a notification or an alert message when the creature was detected. This system is a contribution to the Indian Railways that help them to deal with the accidents immediately. We expect this system will play a key role for establishing high intelligent monitoring system in railways.

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