

INLAND TRANSPORTATION SYSTEMS: LOCOMOTIVE-WILD ELEPHANT ACCIDENT PREVENTION METHOD

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Introduction

Wild elephant's deaths due to human intervention have increased considerably recent past. Deaths due to accidents of trains and wild elephants are only second to killing of wild elephants when it invades cultivated lands and this accounts to 10-15 per year. These collisions only occur on limited stretches of northern and eastern railway lines which are plying through wildlife sanctuaries.

Many of these accidents could have been prevented if locomotive engineers were able to notice them at a safely distance or even they were cautioned of elephants availability in advance so that they could have stopped or slow the trains. Though this is a serious issue in Sri Lanka still it's harder to find any research work conducted on this. However, there are number of literature which studied this problem (A.K. Singh and A. Kumar 2001). According to Singh A.P. and Sharma R.C, (2001) many accidents occurred in India when they were in herds. Sometime mother caught up with the accident while she was trying to safeguard its babies or calves.

Two studies previously stated proposed to improve the mitigation by providing over passing for elephants in these stretches and to improve the topology and to introduce speed limits to trains during the accident prone time slots. However, none of the

previous works considered to use technological advances towards preventing this problem. Therefore this research investigates to adapted GIS information towards predicting probable collisions (Tracking system) and to avoid such accidents to create an early warning system. There are number of researches which had used GIS for animal tracking. DigitalGlobe QuickBird Satellite imagery was used to locate elephants (African Conservation Foundation, 2002) in Kenya's Amboseli National Park and surrounding ecosystem. Using Quickbird satellite imagery, it was revealed that high resolution photographs were used to determine the wildlife composition within that area (Figure 1 shows a giraffe in its exhibit).

Methodology

The primary task before developing a tracking system based on GIS, it is necessary to investigate required resolution and capturing frequency of satellite images. Once that is finalized, a quick response image processing approach has to decide since decision has to be taken quickly. It is obligatory to detect the elephants in the time duration a train passes the endangered area. Next, it is necessary to develop a methodology to predict the most consistent movement pattern of the elephants thereby identify whether they are in the face of an accident.

Finally, with the information attained by the tracking system a warning system is activated to inform the train drivers the possibility of an accident ahead and to manage the speed of the train accordingly.



Figure 1: Spotting a giraffe by satellite

In the proposed method the position details of the elephants at a particular instant are acquired using satellite images. The position and speed data of the train are acquired using a GPS transmitter mounted on the train. This information is fed to a CPU mounted on the train and analyzed to find any possibility of an accident and it is indicated to the user through the user interface. The transmission of information/signals is shown in Figure 2.

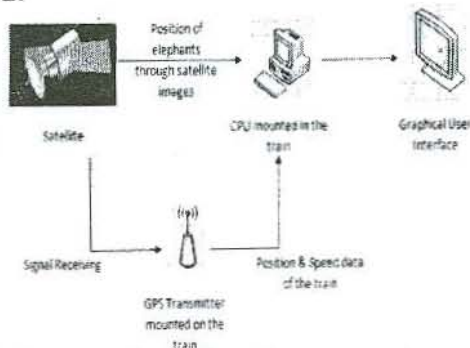


Figure 2: Signal transmission through the system

Modeling the collision situation

Since a train travels in a pre-determined path with a small curvature, for the selected region we can assume it to be linear and thus can develop an equation for the path easily. Alternatively the position, speed of the train can easily be measured with a GPS module mounted on the train. It is difficult to predict behavior of elephants to the accuracy of trains. However, by considering its maximum possible speed we can define a region represented by a circle in which their next position would be located. From satellite images analyzed using GIS software the coordinates of the current position of elephants can be found. With these coordinates range of motion can be defined for the next time interval.

Simulation studies

Number of simulations was carried out to test the proposed model in Matlab environment. The model illustrates the motion of the train and the elephants using the images assuming that they are acquired from the satellites in the order they have been taken. By giving coordinates and the velocity as input data for the motion of the elephants and the train respectively, a virtual situation can be modeled and the operation of the warning system can be simulated. Figure 3 shows one simulation. Here train was plying from Gal-Oya to Kantale direction and two herds of elephants were detected at two locations and its probable paths were modeled. The herd in (150,300) was on the track when train was nearing that location hence danger warning was given to driver. In the other instance since herd and trans current locations were far apart danger

warning would not given yet cautious signal was activated since herd anyway on the tack at that time.

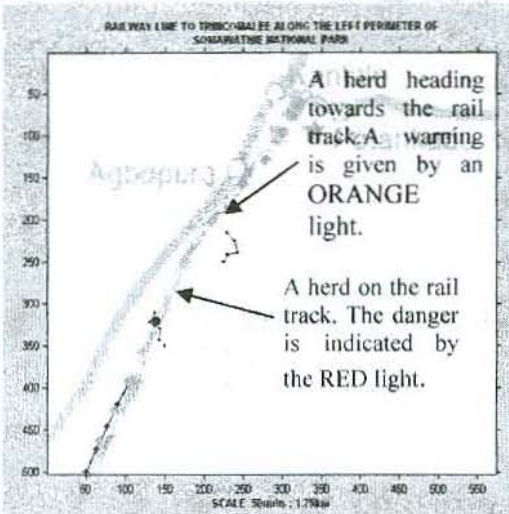


Figure 3: Screen shot of a simulation model

Conclusion

Trains and elephants movements tracked simultaneously using satellite images and predicted possible accidents thereby creates warning signal. This method is advantageous since it tracks the presence of an elephant herd even at night. But there are some limitations when investigating this due to the cost incurred to get satellite images at

regular time intervals hence simulations only done. As further improvements a technique for acquisition and processing of satellite images and a method for implementing the warning system accordingly has to be developed.

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