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An application of a deep learning algorithm for automatic detection of unexpected accidents under bad CCTV monitoring conditions in tunnels

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ABSTRACT:
Accidents have been a major cause of deaths in India. More than 80% of accident-related deaths occur not due to the accident itself but the lack of timely help reaching the accident victims. In highways where the traffic is really light and fast-paced an accident victim could be left unattended for a long time. The intent is to create a system which would detect an accident based on the live feed of video from a CCTV camera installed on a highway. The idea is to take each frame of a video and run it through a deep learning convolution neural network model which has been trained to classify frames of a video into accident or non-accident. Convolutional Neural Networks has proven to be a fast and accurate approach to classify images. CNN based image classifiers have given accuracy's of more than 95% for comparatively smaller datasets and require less pre-processing as compared to other image classifying algorithms.

INTRODUCTION

Over 1.3 million deaths happen each year from road accidents, with a further of about 25 to 65 million people suffering from mild injuries as a result of road accidents. In a survey conducted by the World Health Organisation (WHO) on road accidents based on the income status of the country, it is seen that low and middle-income or developing countries have the highest number of road accident related deaths. Developing countries have road accident death rate of about 23.5 per 100,000 population, which is much higher when compared to the 11.3 per 100,000 population for high-income or developed countries [1]. Over 90% of road traffic related deaths happen in developing countries, even though these countries have only half of the world's vehicles. In India, a reported 13 people are killed every hour as victims to road accidents across the country. However, the real case scenario could be much worse as many accident cases are left unreported. With the present data, India is on the way to the number one country in deaths from road accidents due to the poor average record of 13 deaths every hour, which is about 140,000 per year [2]. An accident usually has three phases in which a victim can be found. First phase of an accident is when the death of the accident victim occurs within a few minutes or seconds of the accident, about 10% of accident deaths happen in this phase. Second phase of an accident is the time after an hour of the accident which has the highest mortality rate (75% of all deaths). This can be avoided by timely help reaching the victims. The objective is to help accident

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victims in this critical hour of need. Third phase of an accident occurs days or weeks after the accident, this phase has a death rate of about 15% and takes medical care and resources to avoid. Fig. 1. Comparative analysis of population, income and road accidents The main objective is to incorporate a system which is able to detect an accident form video footage provided to it using a camera. The system is designed as a tool to help out accident victims in need by timely detecting an accident and henceforth informing the authorities of the same. The focus is to detect an accident within seconds of it happening using advanced Deep Learning Algorithms which use Convolutional Neural Networks (CNN's or ConvNet) to analyze frames taken form the video generated by the camera.

We have focused on setting up this system on highways where the traffic is less dense and timely help reaching the accident victims is rare. On highways we can setup CCTV camera's placed at distance of about 500 meters which act as a medium for surveillance, on this camera we can set up the proposed system which takes the footage from the CCTV camera's and runs it on the propsed accident detection model in order to detect accidents. In this system, we have a Raspberry Pi 3 B+ Model which acts as a portable and remote computer to be set up on a CCTV camera. For demonstration purposes, we will be using a Pi Camera which can be directly set up on a Raspberry Pi. We have pre-trained an Inception v3 model to be able to detect accidents by training it on two different sets of images and sequence of video frames. The images and video frames are 10,000 severe accident frames and 10,000 non-accident frames. The Inception v3 algorithm can now detect an image or frames of a video to be an accident frame by up to 98.5% accuracy. This model was then implemented on a Raspberry Pi using TensorFlow, OpenCV and Keras. When a video is shown to the Raspberry Pi through the Pi camera, it runs each frame of the video through the model created and then predicts whether the given frame is an accident frame or not. If the prediction exceeds a threshold of 60% or 0.6 the Raspberry Pithen initiates the GSM module setup with it to send a message to the nearest hospital and police station, informing them about the accident which has been detected with the timestamp of when it occurred, the location of where it occurred, and the frame at which the accident was detected for further analyses. Also, an emergency light lights up. The system we have made can detect accidents to an accuracy of about 95.0%. It can be done on a Raspberry Pi which is a card-sized computer, which makes it easily portable and remote. The system developed can act as a reliable source of information in detecting accidents which can be done automatically. This project would help us in reducing the ginormous number of road accident related deaths that occur in our country.

This project is trained with images where vehicles collided and accident occurred and in test video if anything such collision happens between vehicles then application detect as accident. Training is done with tensorflow and CNN Algorithm.

The proposed model is a fusion of CNN and LSTM layers for continuous video classification taken from a camera. The

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CNN part of the proposed model was mainly inspired by the Inception v3, but with certain tweaks it has fitted well to our training images. The LSTM layers were added to the existing Convolution Network to take into account temporal features along with spatial features. This is further divided into the convolution and recurrent parts of the model. In a CNN-LSTM network, the CNN is primarily used for feature extraction from the images, which is passed on to the LSTM for sequence prediction. They are widely used in tasks similar to Activity Recognition, Image Description, Video Description etc.

System Architecture

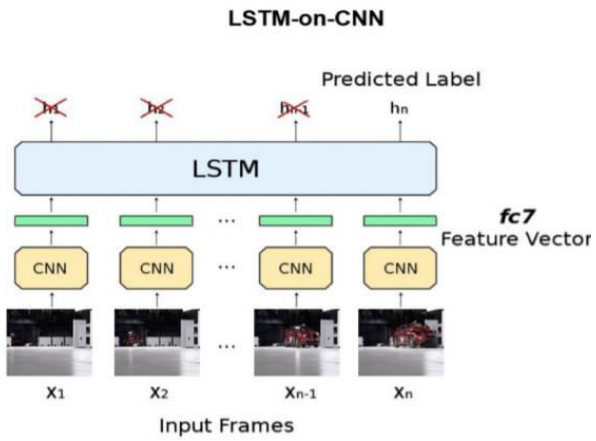
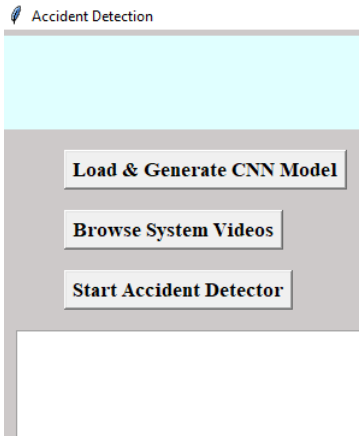
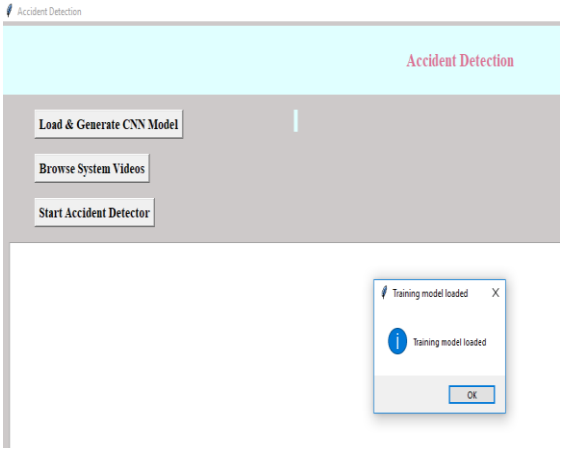


Fig. 5. Feeding Sequences of Frames to the LSTM Layer

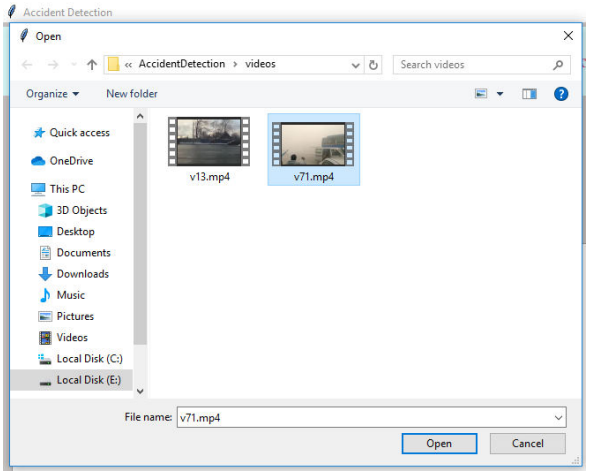
To run project double click on run.bat file to get below screen



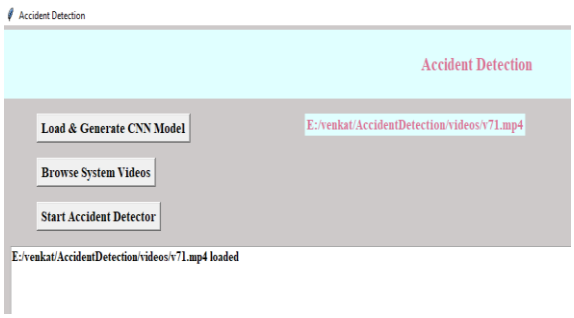
In above screen click on 'Load & Generate CNN Model' button to trained CNN with dataset and to load CNN model using tensorflow



In above screen tensorflow model is loaded and now click on 'Browse System Video' button to upload video



In above screen selecting and uploading video and then click on 'Open' button to load video



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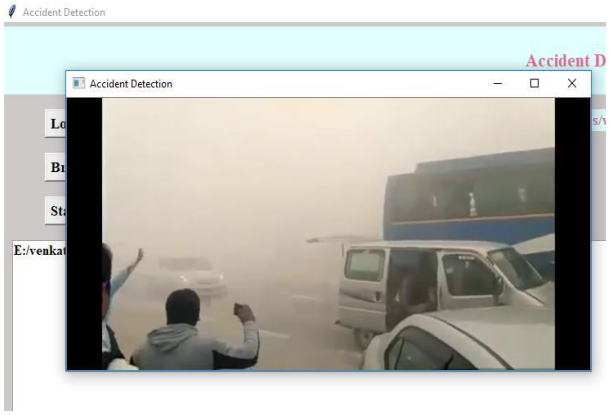
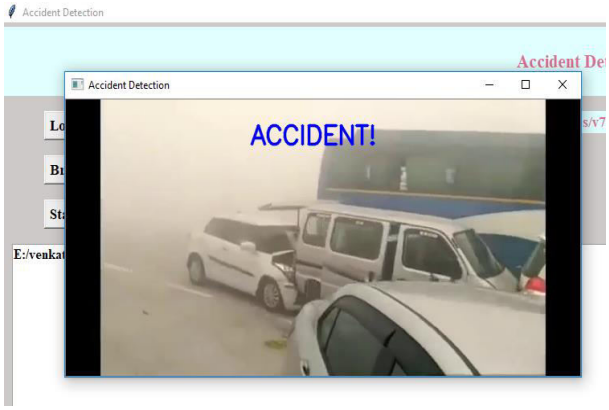
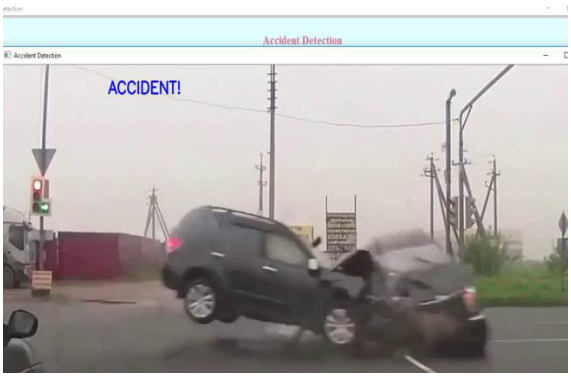
In above screen video is loaded and now click on 'Start Accident Detector' button to play video and detect accident



In above screen video start playing and upon accident detection will get below screen with beep sound

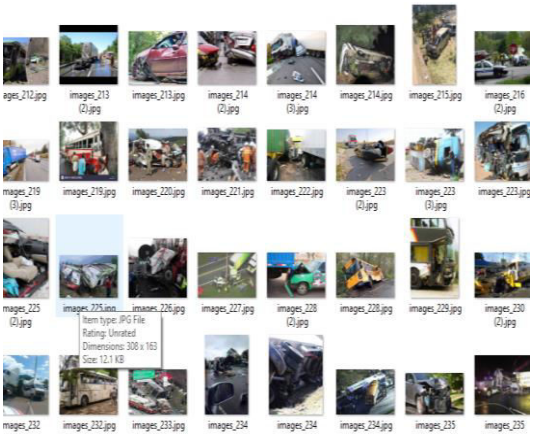


In below screen playing another video without message if normal driving appear



In above screen upon collision then accident display message will appear with beep sound

In below screen application is trained with below images



CONCLUSION

Accidents are one of the most common problems that humanity faces on a daily basis, leading to loss of both life as well as property. The proposed system provides a very viable and effective solution to this problem. The proposed vehicle accident detection system can track an accident at its moment of occurrence and sends an instantaneous alert SMS regarding the accident to the nearby hospitals and police stations which includes details like timestamp and the geographical location. Unlike other systems in use, which consists of expensive sensors and

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unwanted hardware, the proposed system is much more cost effective and foolproof with a much-improved accuracy rate than its counterparts mainly due to a model-based approach. The experimentation, testing and validation has been carried out using images and the results show that higher sensitivity and accuracy is indeed achieved using this method, henceforth, making it a viable option for implementing this system in most of the state and national highways of the country.

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