Road Accident Detection Model Using Deep Learning

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Abstract - In this fast-paced world, the number of deaths due to accident is growing at an expeditious rate. Major reasons for these accidents are rash driving, drowsiness, drunken driving, carelessness, etc. An indicator of survival rates after detecting accidents is the time between the occurrence of accidents and the advent of medical care to the victim. The rapid growth of technology has made everything more facile and this advancement in technology additionally increased accidents. Due to this delayed medical attention, the accident victims might die as well. As a solution to these problems, we introduce a system that detects road accidents and will provide an alert message to the most proximate control room immediately. The camera module of the system is deployed in accident-prone areas. Whenever an accident occurs, it will detect the accident and immediately report about it to the nearby control room. The working of the system is based on deep learning techniques that use convolutional neural networks. By utilizing this system, many people can be saved from death.

Index Terms—Deep learning, image processing, neural networks.

1. INTRODUCTION

In India, more than 150,000 people die due to traffic accidents that means, about 400 fatalities a day! Surveys have been conducted and found that the source of majority deaths across the world is due to road accidents. Approximately 50 – 60 percent of the delays on urban freeways are associated with incidents, and on urban surface streets, a large percentage of traffic accidents and most delays occur at or near intersections [1]. In India 377 people die every day due to road accident which is four times more than the annual death toll from terrorism [2]. World Health Organization conducted a survey on different causes of death due to injury [3]. 93 percent of the world's fatalities on the roads occur in low- and middle-income countries, even though these countries have approximately 60 percent of the world's vehicles [4]. Most of the deaths arise due to the lack of immediate medical care provided to the victim at the time of an accident. Traffic hazard is one of the major issues to be dealt with, when it comes to transportation. Studies have shown that approximately four deaths are happening in every minute due to road accidents. Deaths occur mostly during the first hour of impact. Delay in reporting the accidents immediately to the control room is a serious issue. A lot of delay arises in each and every stage due to the human element involved [5]. Our government had implemented many strict rules to reduce the accidents that are increasing day by day. But unfortunately, they are not proven to be sufficient to reduce the number of accidents. Thus, only possible solution is to reduce the number of deaths caused due to these accidents. Existing systems for accident detection include components like IR sensors, IMU sensors, ARDUINO UNO etc.

2. LITERATURE SURVEY

Various literature papers were studied and analysed to understand their work and techniques. Thus, we studied the demerits and merits of various ideas related to accident detection. In one paper [6], two phases are used, an accident detection phase and an accident prevention phase. The authors have mentioned that they used IR sensors and Arduino Uno technology. But in [6], they do not provide an accurate result and also the sensors are costly.

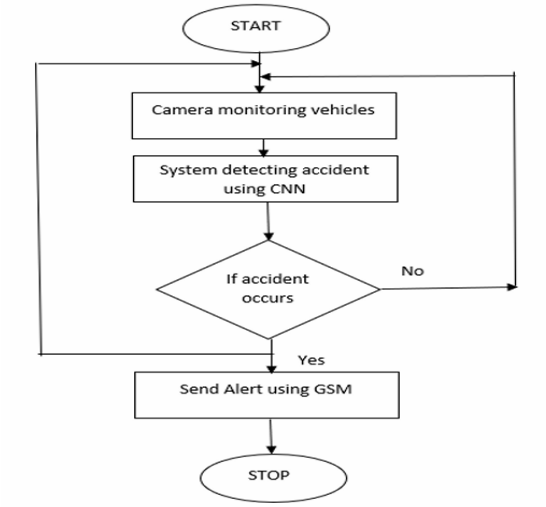

Fig. 1. Working of the System

In another paper [7], an accident detection system using Inertial Measurement Unit (IMU) and 3G cellular module using an accident detection method, but the IMU suffer accumulated error and it is complex. Another technology discussed in the paper [8] was a vision-based accident detection system for detecting, recording, and reporting accidents at intersections. They extract features of moving vehicles using cameras in order to detect accidents. In [8], the results may be wrong when vehicles move fast. There is a method in which accidents are detected using a set of speed sensors spatially located in a street that can communicate using a particular network [9].

Also, there is a smart phone-based accident detection system, in which data is continuously collected from smartphone's accelerometer and analysed using Dynamic Time Warping (DTW) [10]. In another paper [11], Accident Detection and Reporting System (ADRS) is placed inside the vehicle that uses a sensor to detect accidents. The sensor output is monitored using a microcontroller. In a paper [5], two methods for detecting and reducing accidents were discussed, one was to use a Smart Helmet in which the mechanism automatically checks whether the rider is wearing a helmet, and another system is used to detect accidents and report it using GSM module. But this system mainly focuses on two-wheeler accidents.

3.PROPOSED METHODOLOGY

Since there was no dataset available, a dataset was created that includes accident and non-accident images. If an accident occurs, an alert message will be sent to the nearby control unit. We trained the system with the created dataset. The trained system is then incorporated with the cameras so as to capture the video of the vehicles on the road. By calculating the probability, the system predicts whether an accident happened or not. In case of an accident, an alert is sent to the control rooms using the GSM module. Fig. 1 is the flowchart depicting working of the system. The camera module records the video of vehicles in the road. The camera is placed at fixed locations, mostly in accident-prone areas. Whenever an accident occurs, it is predicted using our deep learning model and followed by sending alert message to the nearby control rooms.

A. Dataset Creation

Our main focus is on accidents occurring in India. But the dataset was not available, so the dataset was created initially. It consists of five thousand images which includes 2500 accident images and 2500 non-accident images. The dataset consists of Fig. 1. Working of the System the images of accident that happen at different parts of India. The images are downloaded from google images. All images are then converted into the same format and same size.

Training and Validation

4000 images belonging to 2 classes were used for training purpose. These images are passed through the different layers of convolutional neural network. It consists of convolutional and max pooling layers. The images are resized before passing through the convolutional layers. Dropout is used to prevent overfitting. This is set down by setting the outgoing edges to 0 during each update of the training phase. Overfitting is a noticeable issue that occurs when the system learns too much. This happens when the model which we use fits so well to the training set. The dataset consists of accident and non-accident images. For validation, we use 1000 images belonging to two classes which are accident and non-accident. The trained model has to be evaluated with some other images. This is important since it helps to evaluate the accuracy of our system. Dataset was trained for 30 epochs to get more accuracy. We got both training and validation accuracy and loss to understand how well the images have been learned by the model. Fig. 2 shows the accuracy gained for training and validation of images, the training and validation curve indicates that the system is trained well. Fig. 3 shows the loss

occurred during training and validation. The curve here also indicates the loss incurred is also less as the number of epochs increased. The model is created using sequential API. This sequential model is actually a linear stack of layers. After the creation of this sequential model, image is passed through different convolutional, max pooling and dense layers.

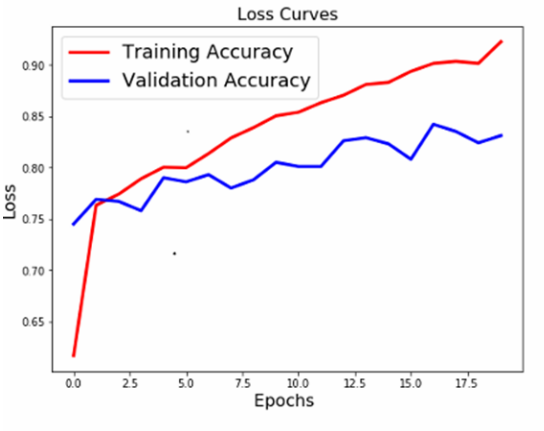

Fig. 2. Training and Validation accuracy.

The sequential model mainly consists of the convolution, Batch Norm and the ReLu activation function. Each frame of the video is passed through the convolutional layer. The activation function used is ReLu or rectified linear unit. It is defined as

Y=max(0,x)

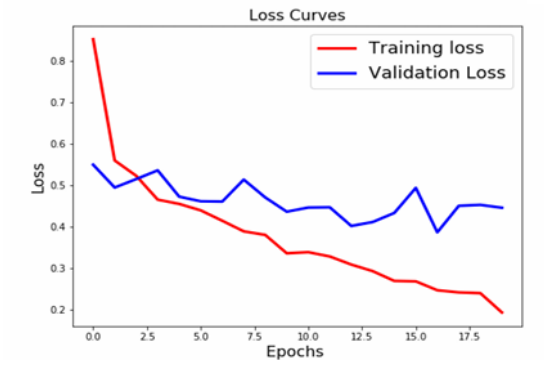

Fig. 3. Training and Validation loss

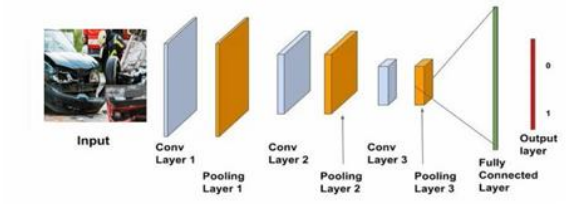

Fig. 4. Layers in the neural network

After that, it passes through the max pooling layer. It reduces the spatial dimensions of the output and followed by convolutional layer of 64 filters. The first dropout makes 25 percent of dropout to reduce the overfitting. Flatten operation is added after this layer to reshape the tensor. It is reshaped such that it is equal to the number of elements contained in tensor. Then it is passed through the dense layers. Finally, a soft-max classifier is added. Output will be the prediction values. Image data-generator is used for data augmentation and batch size is usually fixed during training and inference. The train batch size is fixed to 100 and validation batch size to 10. Fig. 4 represents the convolution layers and the output predictions.

B. Video Classification

After training, model predicts accidents with an accuracy of 85 percent. For video classification, deque was used for performing the rolling prediction averaging. The deque is initialized to the default value 128. Then it starts to loop over frames of the video which is given as the input. If there are no frames to grab it means that it has reached the end of the video. The frame dimension was set to 64. This is done because the dataset with which we trained are images with 64*64 dimensions. The next step is the mean subtraction. After that, the results of predictions of each frame were obtained. These results are then stored into a deque. Using the probability of frames, it was able to predict whether it is an accident or not. The model will detect when an accident occurs and message will be sent to officials.

C. Alert System

For informing officials about the accident, an alert message is sent to them using GSM module which is incorporated along with the camera. When an accident occurs, immediately an alert message is sent to the control room. Thus, immediate medical support can be provided to the victim of the accident. GSM module is used for the communication purpose. Certain numbers are stored in the memory of the GSM module. So, whenever an accident occurs, alert will be sent to those numbers along with the location of the cameras stored in the database.

5. RESULTS AND DISCUSSIONS

After the training, the system was able to detect accident images and non-accident images. We tested

the system for 2000 images and out of that 1702 images were correctly predicted. So, almost eighty five percent of image prediction was successful.

As of now, we tested our system using videos of accidents that are available. Fig. 5 and Fig. 6 are the two different frames of our test video. The video contains an accident that has been occurred between a bike and a scooter. Since we trained the system using the created dataset, the accuracy of predicting the accident is eighty-five percent.

Fig. 5. Prediction of accident

We have tested the system with 20 videos. The system predicted an accident successfully for those videos. Whenever an accident occurs, an alert message is sent to predefined numbers along with the location camera.

Fig. 6. Prediction of Non- accident

The cameras used are night-vision cameras, so that accidents occurring at night can be predicted. The camera has a vision of about 10 to 150m. The camera module is deployed in accident-prone areas like large curves, slippery roads, etc.

6. CONCLUSION

The proposed system is used to detect road accidents. When an accident is detected, an alert message is sent to nearby control rooms using the GSM module. This system is more reliable and economical when compared to existing systems. It can detect accidents with high level of accuracy as the model architecture is trained using the created dataset. Our preliminary evaluation shows that the system works in a perfect manner and can be deployed over a large area. With the help of this system, immediate action can be taken by sending alert to the officials and will help the medical teams to reach the accident spot in time and save the valuable human lives. Thus, the proposed system will play an important role in the society where road accidents have nowadays become a major threat.

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