Application of Deep learning for vehicleaccident detection using CCTV videos

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Abstract: Accidents have been a majorcause of deaths in India. More than 80% of accident-related deaths occur not due to the accident itself but the lackof timely help reaching the accident victims. In highways where the traffic isreally light and fast-paced an accident victim could be left unattended for along 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 videoand run it through a deep learning convolution neural network model which has been trained to classifyframes 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 preprocessing as compared to other image classifying algorithms.

1. INTRODUCTION

Over 1.3 million deaths happen each year from road accidents, with a furtherof about 25 to 65 million people suffering from mild injuries as a result of road accidents. In a survey conductedby 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% ofroad 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 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 13deaths 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 inthis 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 avoidedby timely help reaching the victims. The objective is to help accident 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 toolto 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. Wehave 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 isan accident frame or not. If the prediction exceeds a threshold of 60% or 0.6 the Raspberry Pi then initiates the GSM module setup with it to send a message to the nearest hospital and police station, informing them about theaccident 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 anaccuracy of about 95.0%. It can be doneon 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.

II. BACKGROUND WORK

we have tried to compare our work with other accident detection techniques. Most of the studies in this field revolve around the enhancement of tangible infrastructure rather than on Intelligent Transportation Systems (ITS) which include traffic congestion detection, accident detection, detecting the occurrence of an event etc. Even the few existing studies in the domain lack implementation details and are terrain specific i.e. there are constraints both in the geographical as well as demographic aspects

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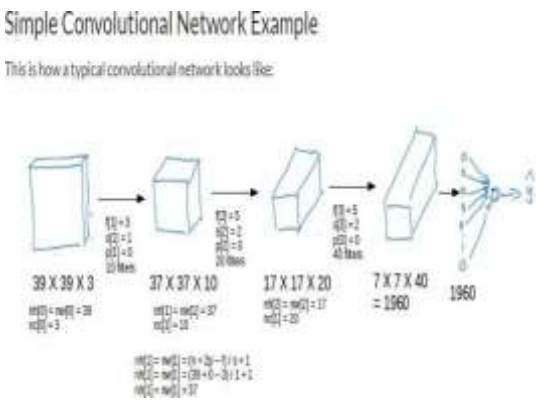
.The idea of model is a fusion of CNN and LSTM layers for continuous video classification taken from a camera. The CNN part of the proposed model was mainly inspired by the Inception v3, but with certain tweaks it has fitted well to our training images. The LSTM layers were added to the existing Convolution 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.

ADVANTAGES OF PROPOSED SYSTEM:

1. Initially, the model had difficulties in predicting the right class since the only difference between cars and broken cars were dents, broken headlights etc.
2. Thus, random noise was being accounted during the prediction since not all the accident images were of high clarity.

RELATED WORK



. Accident Detection using Convolutional Neural Networks. Sreyan Ghosh, Sherwin Joseph Sunny and Rohan Roney[1], "Accident Detection using Convolutional Neural Networks". CNN's are used in the modeling of spatial data such as photographs. CNN had been successful in tasks such as photo classification, item detection, and so on. LSTMs are algorithms that are used to model sequential data and make predictions based on it. LSTMs are widely used in the textual content category for creating language models, series generation, and so on. Standard LSTMs can be applied to sequential data with a spatial center right away. As a result, a CNN-LSTM structure is desired to carry out tasks involving photo or video sequences. For non-stop video taken from a camera, the proposed version is a fusion of CNN and LSTM layers. The CNN portion of the proposed version was particularly stimulated by Inception v3, but with a few tweaks, it has fitted well to our education photographs. The LSTM layers have been added to the existing Convolution Network to recall temporal as well as spatial capabilities. This is further divided into the version's convolution and recurrent elements. The CNN is frequently used in a CNN-

LSTM network for function extraction from photographs, which is then passed directly to the LSTM for series prediction. They are widely used in tasks such as activity recognition, image description, and video description, among others. B. Accident Detection, Severity Prediction, Identification of Accident Prone Areas in India and Feasibility Study using Improved Image Segmentation, Machine Learning and Sensors. "Accident Detection, Severity Prediction, Identification of Accident Prone Areas in India and Feasibility Study using Improved Image Segmentation, Machine Learning and Sensors"[2], In this paper, The system provides a three-stage solution that uses machine learning and computer vision to analyze traffic accidents in India. The solution is through the classification of car accidents. This step can be accomplished by using any object detection and image segmentation algorithm. We experimented with the You Look Only Once (YOLO) algorithm. However, the probability of accident misclassification is as high as, which becomes a major problem when using real-time data. Image segmentation is an alternative method of classifying car accidents. We experimented with the watershed algorithm, the cunning edge detection, and the cunning automatic algorithm for separating cars from accidental cars. The YOLO algorithm found that the limitation is that the region of interest is satisfactory, but it was misclassified and lost some of the cars indicated in the input video image. Cunning edge detection performs best in car accident classification and has a very interesting area, making it suitable for good preprocessing technology for image enhancement of car accident images. C. Ubiquitous GPS Vehicle Tracking and Management System. Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad and Rania M. Jodeh[3], "Ubiquitous GPS Vehicle Tracking and Management System", This document proposes a system to make vehicle tracking more accessible to individual users and fleet companies. The proposed system provides not only traditional web-based tracking software but also mobile software for tracking anytime, anywhere. Services for a variety of users. This system allows people to track the position, speed, stop, and movement of their vehicles. The monitoring process includes real-time tracking of location or collection of historical reports on vehicle movement, setting speed, and geographic limits. Services (GPRS) Global System for Mobile Communications (GSM) Internet or World Wide Web and Global Positioning System (GPS) D. Improving Estimation Of Vehicle's Trajectory Using the Latest Global Positioning System With Kalman Filtering "Improving Estimation Of Vehicle's Trajectory Using the Latest Global Positioning System With Kalman Filtering"[4] Predicting a vehicle's future location with accuracy is a critical but difficult problem in intelligent transportation systems.It can be advantageously employed in car or robot obstacle avoidance systems.Many of the currently being researched obstacle-avoidance systems are limited to line-of-sight sensors. Much research looks into the possibility of using GPS data received from various vehicles to forecast where each car will be in the future. The methods used to construct these predictions are rather simple, and they do not produce particularly accurate results in cases where the predicted future position of the vehicles is not a straight route, such as curves. The current research shows that we need a better technique to anticipate the trajectory of vehicles in a variety of conditions. The Kalman filter (KF) is used in this situation. The KF has a long history of reliably predicting future states of moving objects, and it has been used in a variety of applications.

METHODOLOGY

We collected datasets from an online data store called traffic-net, which categorizes datasets as accidents, crowded traffic, fires, and sparse traffic.This is part of DeepQuest AI that trains you to recognize, understand, and fix problems accordingly in all environments where machine learning systems are deployed. Contains 4400 images containing 4 classes. There are 1,100 images in each of the categories, and 900 educational images, and 200 test images. An Android application was used to alert real-time. The coordinates of the incident are sent to the Android client user and compared with the user's location. this helps users make appropriate decisions. A. Architecture The video stream from CCTV is directly sent to a preprocessing part. This preprocessing is carried out by openCV library, which converts the video into frames of images. These images will be sized and formatted in order to be compatible with the ResNet-CNN model. The CNN model used here is a ResNet50[5]. which is implemented on a highly functional computer system with a high clock rate. These CNN models are system independent hence migration and implementation to any other machine including cloud computing systems are hassle free. An android application will be used for the user interface. The alert system uses REST API for communicating with users and appropriate authorities over HTTP protocol. A relational database stores user's data.

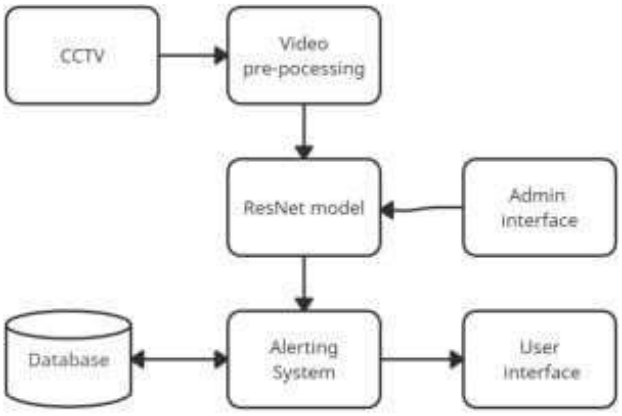


Fig 1. Architecture

B. pre-processing The collected data set is pre-processed before feeding it into the CNN model. This preprocessing makes the data compatible for the model and also keep it homogeneous. The pre-processing is carried out using the openCV library. This library is available in python. C. Building And Training The ResNet-50 Model For the main implementation of the ResNet-50 model architecture, an open source library called imageai is used. ResNet-
50 is a 50-layer deep convolutionalneural network. A pre-trained version of the network trained on over a million images from the ImageNet database can be loaded. The pretrained network can categorise images into 1000 different object categories.As a result, the network has learned detailed feature representations for a diverse set of images. The network accepts images with a resolution of 224 by 224. The below image show a conceptual architecture of ResNet.

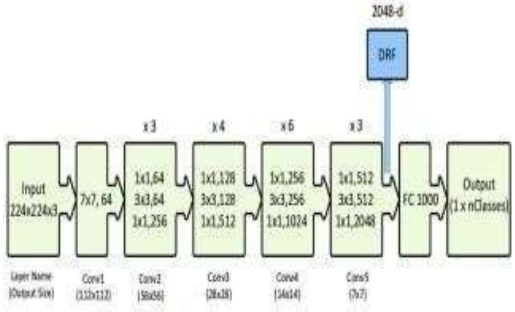


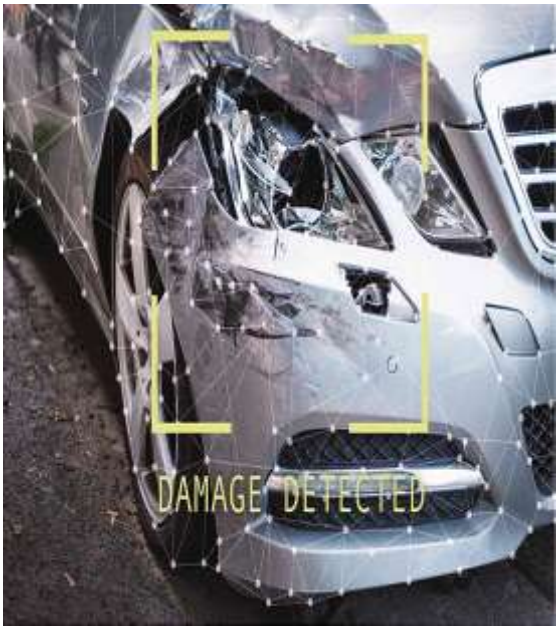
Fig 2. ResNet-50

This model is trained using the collected datasets. The training is conducted in a supervised learning fashion where the example data sets along with its class value is fed into the model for its learning. for training the model image frames of collected data sets are used, which are preprocessed to fit the modelsdimensions and pixel resolution.
Alerting system
The alerting module checks the ResNet model's output in realtime, if the probability of an accident is high it sends alerts towards the user. We use an android application for client side. The coordinate of accident location is forwarded to the android application, along with it alert messages are passed to emergency response teams like ambulance and fire engine. To communicate with the android application the alerting system which is written in python uses REST API. When the location of an accident is passed, the user can then choose to take a different route if he wishes to

RESULT

The following are the results we got during the testing of model on unseen data. Fig 3. image

frame with Dense traffic Fig 4. image frame with accident



VI. CONCLUSION

Accident detection operation is not an easy task to handle; it can be an extremely complicated process when it comes to real time applications, which is the main reason why it is not implemented yet on a large scale. The proposed system will help to improve the present scenarios. Although an in- vehicle accident detection system provides emergency responders withessential information as fast as possible but unavailability of this system are restricted by their nonportability andcosts.The proposed vehicle accident detection system can track an accident at its moment of occurrence. Compared with other deployment systems composed of expensive sensors and unnecessary hardware, the proposed system is more economical, more reliable, and more accurate than similar systems, mainly due to the model-based approach.

VII. FUTUREWORK

In the future , we can combine both supervised and unsupervised methods together to improve the system . We can use supervised learning models to identify the accidents from the frames which are flagged anomalously by unsupervised models. Moresophisticated methods for trackingaccident happened area. Algorithms likekelman can be used to predict the potential of a vehicle passing through the accident happened place. this willhelp the driver to avoid incident happenarea and evade a potential traffic jam.

VIII REFERENCES

[1]. Sreyan Ghosh, Sherwin JosephSunny and Rohan Roney, “Accident Detection using Convolutional Neural Networks” ,2019 InternationalConference on Data Science andCommunication (IconDSC), Bangalore,India,DOI: 10.1109/IconDSC.2019.8816881 [2].
Vipul Gaurav, Sanyam Kumar Singh and Avikant Srivastava, “Accident Detection, Severity Prediction, Identification of Accident Prone Areas in India and Feasibility Study using Improved Image Segmentation, Machine Learning and Sensors ”, 22-10- 2019 ,IJERT [3]. Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad and Rania M. Jodeh, “Ubiquitous GPS Vehicle Tracking and Management System”, 2011 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), DOI: 10.1109/AEECT.2011.6132526 [4].
Cesar Barrios and Yuichi Motai, “Improving Estimation Of Vehicle’s Trajectory Using the Latest Global Positioning System With Kalman Filtering”, IEEE Transactions on Instrumentation and Measurement , 19 May 2011, DOI: 10.1109/TIM.2011.2147670 [5].
ResNet50:https://in.mathworks.com/hel p/deeplearning /ref/resnet50.html;jsessionid=8ba3118b0 f95ca5feb6af 9abc53