JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

Deep Learning CNN for Accident Detection System from CCTV Videos

Dr. K. Smitha[1], G. Akshitha[1], B. Akhila[1], E. Jagruthi[1]

[1]Professor, [2]UG Student, [1,2]Department of Information Technology

[1,2]Malla Reddy Engineering College for Women (UGC-Autonomous), Maisammaguda, Secunderabad, Telangana, India

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 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 preprocessing as compared to other image classifying algorithms.

Keywords: Video surveillance, accident detection, CNN model, deep learning.

1. 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 because of road accidents. In a survey conducted by the World Health Organization (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 roads 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 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. The main objective is to incorporate a system which can detect an accident form video footage provided to it using a camera. The system is designed as a tool to help 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

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

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 cameras 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 proposed accident detection model 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 Pi then 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 roads accident related deaths that occur in our country.

2. LITERATURE SURVEY

2.1 An enhanced accident detection and victim status indicating system: Prototype.

Authors: Prabakar, S., et al.

Abstract: In the speedy moving world, nobody is ready to look what's happening around them. Even when there occurs an accident nobody cares about it. This is an intention to implement an innovative solution for this problem by developing an Enhanced Accident detection System for Indicating Victim Status from the accident zone. This system has been developed and implemented using the biomedical smart sensors and microcontroller based mobile technology integrated with the evolving LabVIEW platform. The system will automatically identify the accident, then immediately transmit the location of the accident and the status of the physiological parameters of the victims to the emergency care center phone number through Short Message Service (SMS). The victim's physiological parameters such as body temperature, Heartbeat, Coma stage recovery status have been transmitted in the SMS. So the proposed system ensures that to reduce the human death ratio by accidents. When the accident occurs and realizes that there is no severe collision, then the person involved in accident has to press the switch provision which has been made to indicate that the accident is diminutive, and no communication will be established i.e. no further alarming SMS has been transmitted.

2.2 Car Accident Detection and Notification System Using Smartphone

Authors: Hamid M. Ali,Zainab S. Alwan

Abstract: Every day around the world, a large percentage of people die from traffic accident injuries. An effective approach for reducing traffic fatalities is: first building automatic traffic accident

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

detection system, second, reducing the time between when an accident occurs and when first emergency responders are dispatched to the scene of the accident. Recent approaches are using built-in vehicle automatic accident detection and notification system. While these approaches work fine, they are expensive, maintenance complex task, and are not available in all cars. On the other hand, the ability to detect traffic accidents using smartphones has only recently become possible because of the advances in the processing power and sensors deployed on smartphones. Most of the smartphone-based accident detection systems rely on the high speed of the vehicle (extracted from the smartphone GPS receiver) and the G-Force value (extracted from smartphone accelerometer sensor) to detect an accident. As many references assure that 90% of road-traffic accidents occur at low speed of the vehicle. Hence, in addition to the high-speed accident detection, this paper concentrated on low speed car accident detection. The main obstacle that encounters the low-speed accident is how to differentiate whether the user is inside the vehicle or outside the vehicle, walking or slowly running. The effect of this obstacle is minimized, in this work, by a proposed mechanism that distinguishes between the speed variation of low-speed vehicle and walking or slowly running person. The proposed system consists of two phases; the detection phase which is used to detect car accident in low and high speeds. The notification phase, and immediately after an accident is indicated, is used to send detailed information such as images, video, accident location, etc. to the emergency responder for fast recovery. The system was practically tested in real simulated environment and achieved quite very good performance results.

2.3 Smart Car: An IoT Based Accident Detection System

Authors: Arif Shaik,Natalie Bowen,Jennifer Bole,Gary Kunzi

Abstract: The Internet of Things (IoT) offers limitless possibilities to both the public and private sectors. Automobile manufacturers are interested in IoT applications to increase the safety of their vehicles, to meet customers' demands and ultimately to offer cutting-edge products which maximize profit. The healthcare industry is concerned with how the IoT can improve the speed and accuracy of communication. This paper describes the feasibility of equipping a vehicle with technology that can detect accident and immediately alert emergency personnel. When there is a car accident someone has to actively seek help such as calling 911 for emergency services. There is no automatic notification to the police, ambulance, friends, or family. The Internet of Things (IoT) can be used to produce an automatic notification and response to the scene. A signal from an accelerometer and a GPS sensor are automatically sent to the cloud and from there, an alert message will be received by whoever is subscribed to that car. The signal will indicate the severity of the accident and the GPS location. The ambulance will use the GPS coordinates to get to the scene quickly.

2.4 Vehicle to Vehicle communication

Authors: Shagufta Ali

Abstract: Vehicle to Vehicle communication A robust wireless network of connected vehicles is needed to enable future telematics and infotainment applications in the vehicular domain. We need to focus on terms reliable and continuous system performances as vehicle to vehicle (V2V) faces a highly dynamic time-varying channel conditions and varying vehicle network topology. This paper mainly focuses on Wireless communication technologies used in v2v communication. Keeping in mind the term’s reliability, scalability, latency and throughput of the system, the technologies we have focused on are Cellular vehicle to everything communication (C-V2X), 4rth Generation Long term evaluation (4G-LTE) and dedicated short range communication (DSRC). Also, we have discussed the

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

technical challenges v2v is facing. Further, we propose three methods related to high-speed vehicles mobility and complex channel environment along with vehicle network topological variations Loss differentiation Rate Adaption (LORA) is a scheme proposed to approximate the average packet loss rate (PLR) for every sender and select a data rate based on PLR. Exponential Effective SNR Mapping (EESM) and Mutual Information Effective SNR Mapping (MIESM) are two Adaptive modulation and coding mechanisms used for data rate selection according to current channel conditions. In order to adjusts and modify the data rate between vehicles according to the number of connectable vehicles nearby, a physical topology-triggered adaptive transmission scheme is proposed. Reliability and more continuous data transmission for V2V communications can be ensured by these methods and it can be proved by Extensive evaluation results. As a result, the effective improvement in performance on network throughput can be observed.

3. Proposed System

3.1 DL-CNN

According to the facts, training and testing of any deep neural network or transfer learning involves in allowing every source image via a succession of convolution layers by a kernel or filter, rectified linear unit (ReLU), max pooling, fully connected layer and utilize SoftMax layer with classification layer to categorize the objects with probabilistic values ranging from [0,1].

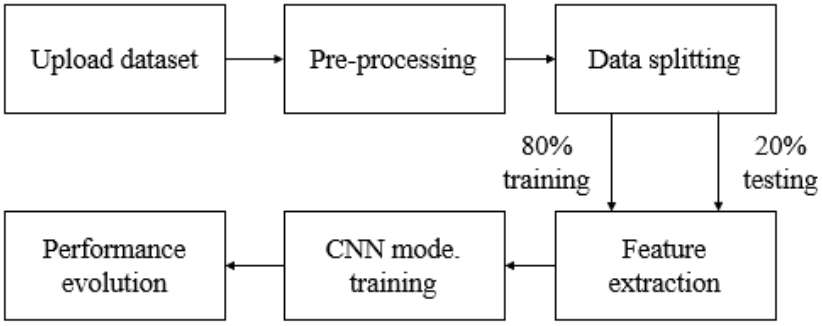


Fig. 1: Proposed system for DL-CNN model training.

Convolution layer as is the primary layer to extract the features from a source image and maintains the relationship between pixels by learning the features of image by employing tiny blocks of source data. It's a mathematical function which considers two inputs like source image $I(x, y, d)$ where x and y denotes the spatial coordinates i.e., number of rows and columns. d is denoted as dimension of an image (here $d = 3$, since the source image is RGB) and a filter or kernel with similar size of input image and can be denoted as $F(k_x, k_y, d)$.

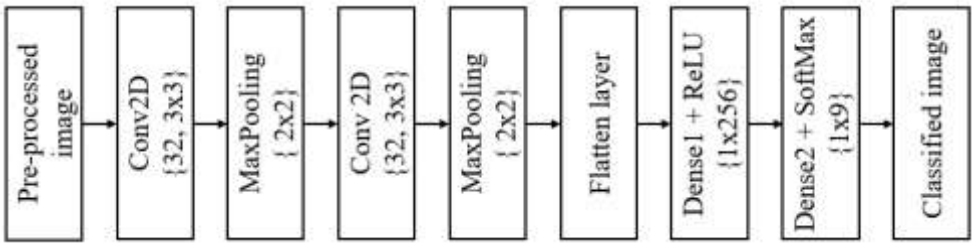


Fig. 2: CNN architecture.

The output obtained from convolution process of input image and filter has a size of $C\left((x - k_x + 1), (y - k_y + 1), 1\right)$, which is referred as feature map. Let us assume an input image with a size of

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

5×5 and the filter having the size of 3×3. The feature map of input image is obtained by multiplying the input image values with the filter values.

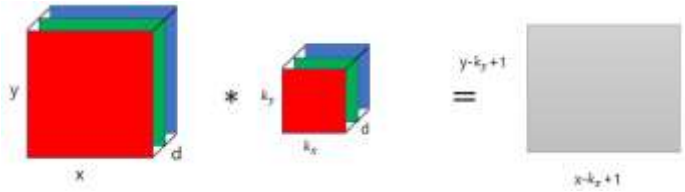
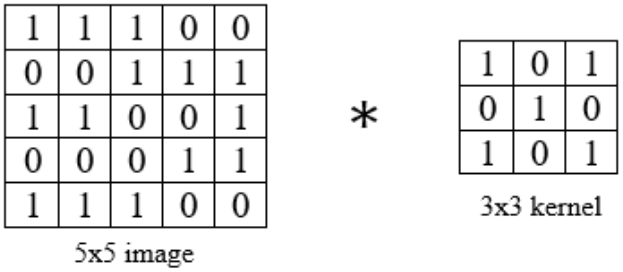
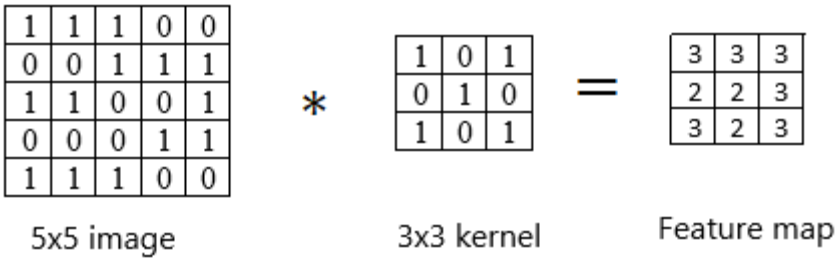


Fig. 3: Representation of convolution layer process.



(a)



(b)

Fig. 4: Example of convolution layer process (a) an image with size $\mathbf{5 \times 5}$ is convolving with $\mathbf{3 \times 3}$ kernel (b) Convolved feature map.

3.1.1 ReLU layer

Networks that utilize the rectifier operation for the hidden layers are cited as rectified linear unit (ReLU). This ReLU function $\mathcal{G}(\cdot)$ is a simple computation that returns the value given as input directly if the value of input is greater than zero else returns zero. This can be represented as mathematically using the function $max(\cdot)$ over the set of 0 and the input x as follows:

$$\mathcal{G}(x) = \max\{0, x\} \quad (1)$$

3.1.2 Max pooing layer

This layer mitigates the number of parameters when there are larger size images. This can be called as subsampling or down sampling that mitigates the dimensionality of every feature map by preserving the important information. Max pooling considers the maximum element form the rectified feature map.

3.2 Advantages of proposed system

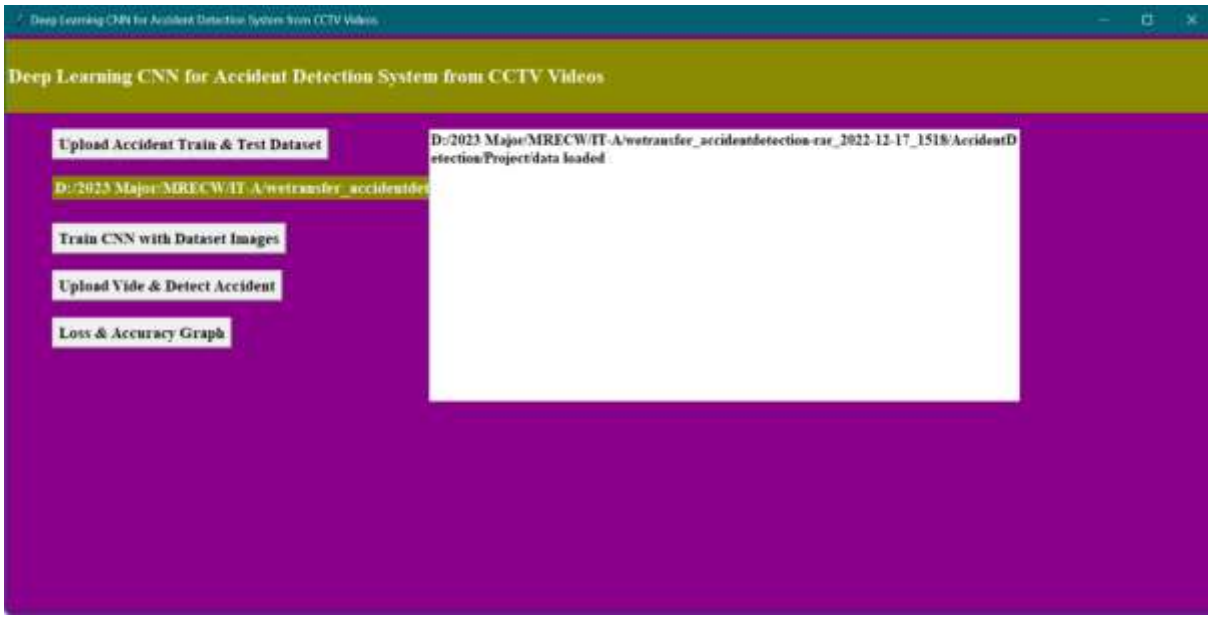
- CNNs do not require human supervision for the task of identifying important features.
- They are very accurate at image recognition and classification.

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

- Weight sharing is another major advantage of CNNs.
- Convolutional neural networks also minimize computation in comparison with a regular neural network.
- CNNs make use of the same knowledge across all image locations.

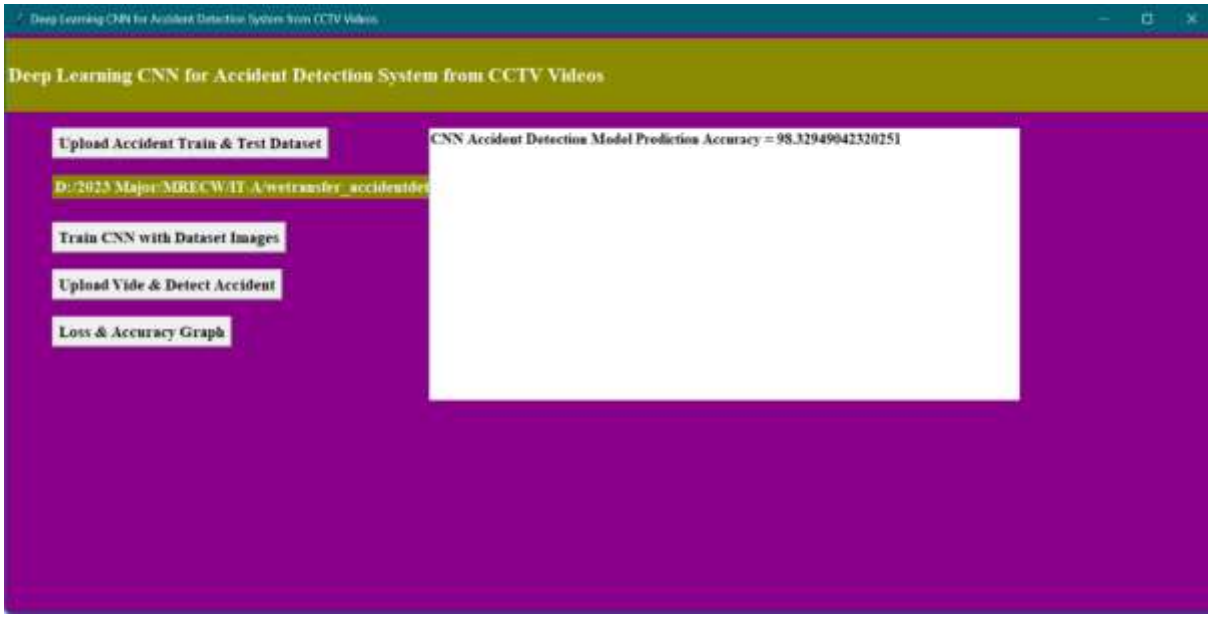
4. Results and Discussion

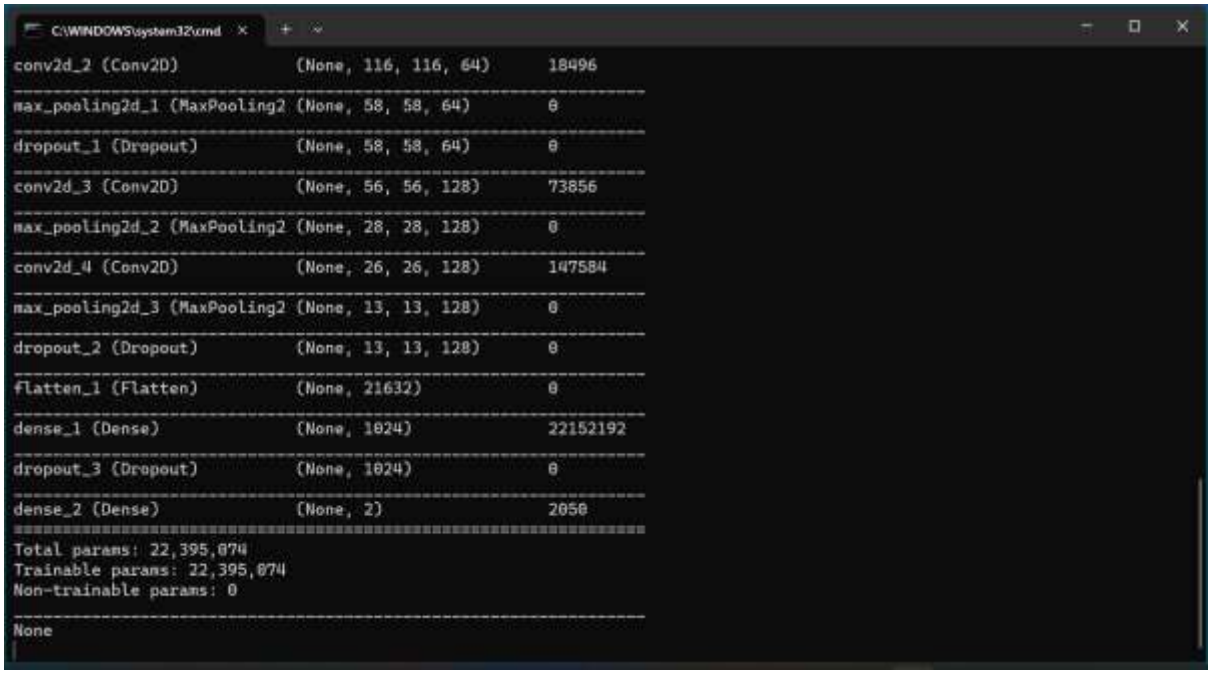
In above screen click on 'Upload Accident Train & Test Dataset' button to load dataset. By selecting and uploading 'data' folder and then click on 'Select Folder' button to load dataset and to get below screen



In above screen dataset loaded and now click on 'Train CNN with Dataset Image' button to train dataset with CNN and to get below screen

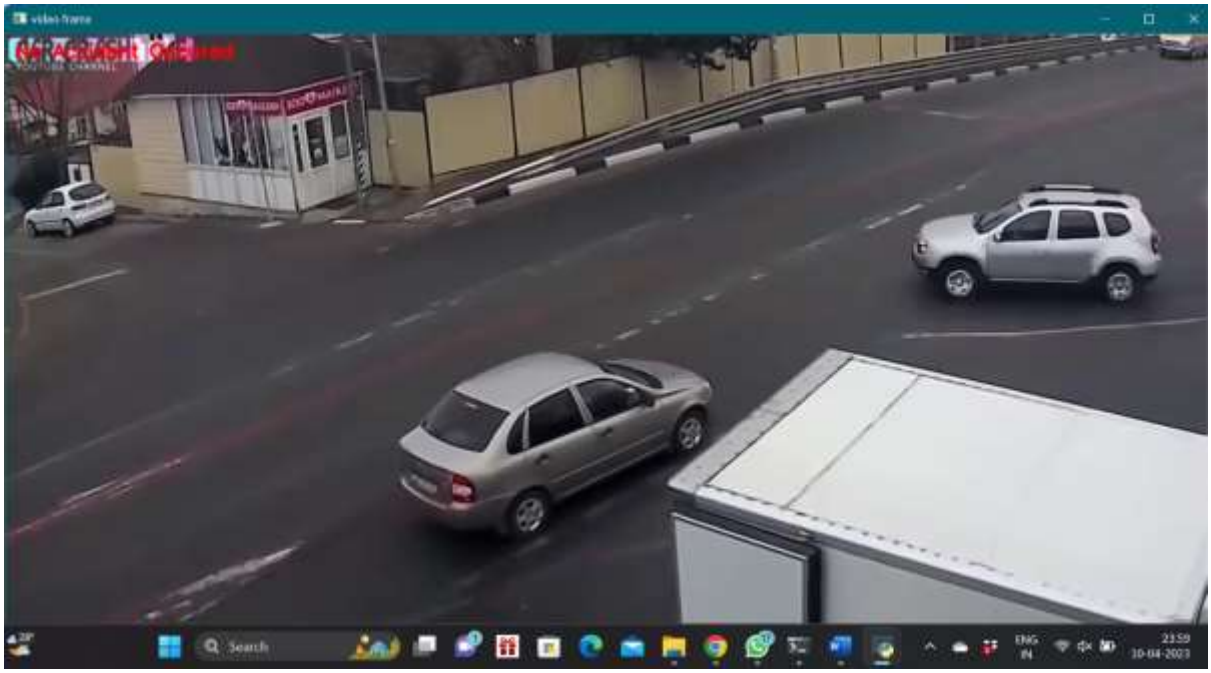
ISSN- 2394-5125 VOL 10, ISSUE 01, 2022



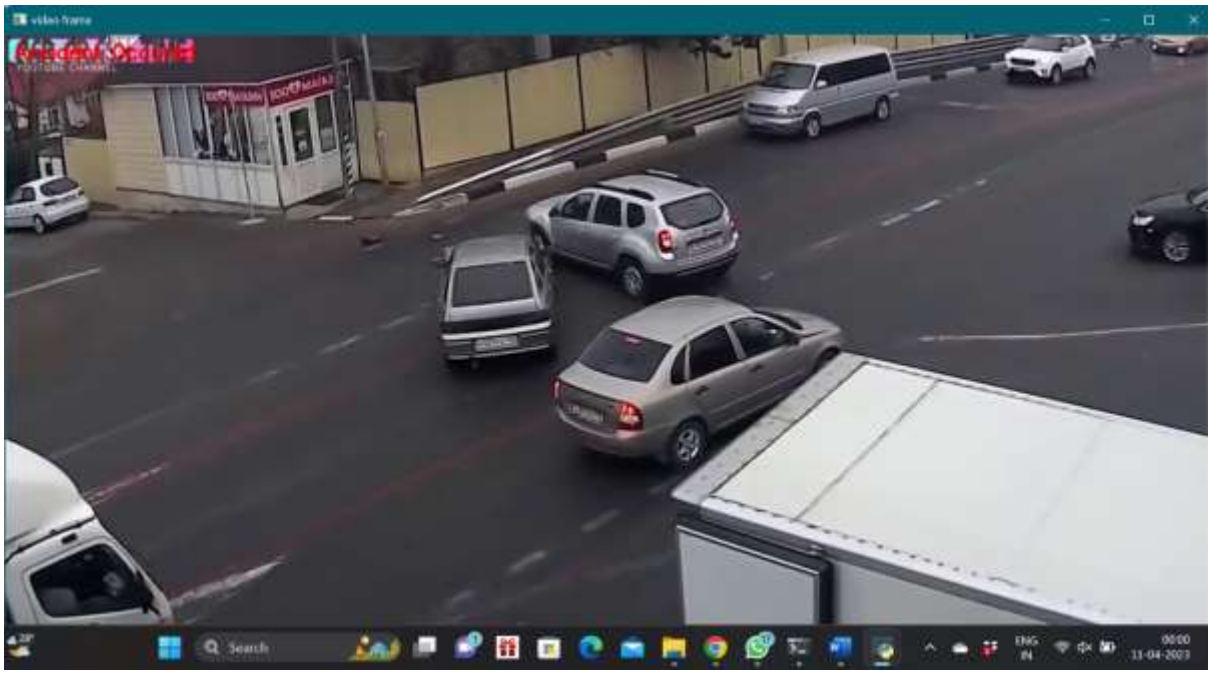


In above screen CNN model generated with prediction accuracy as 98.32% and now model generated and now click on 'Upload Video & Detect Accident' button to upload video and to get below screen

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

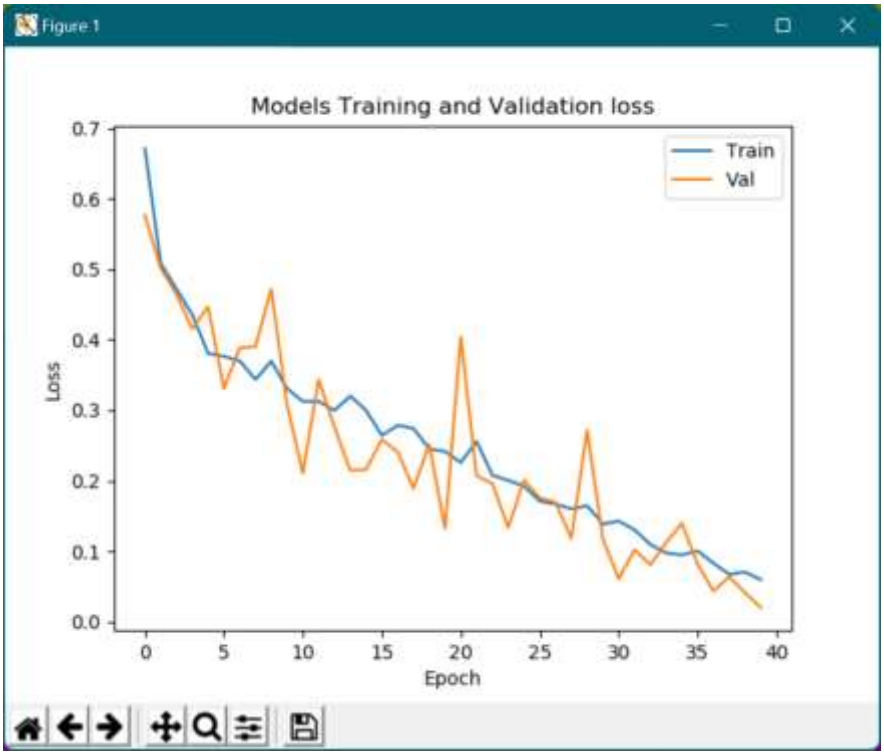


In above screen in yellow colour text application display predicted result as ‘No Accident Occurred’ and now when video play further then will get below screen



In above screen when accident occurred then beep sound generated and display prediction result as ‘Accident Occurred’.

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022



5. CONCLUSION AND FUTURE ENHANCEMENT

Accidents are one of the most common problems that humanity faces daily, 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 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.

Future enhancement

Future Enhancement is being planned to further analyze and enhance the protocol towards a social cause and helps create a system which guarantees that no individual is left unattended or helpless in an unforeseen event of an accident, in turn, securing and maintaining the quality of life to the highest standards.

REFERENCES

[1] "Global status report on road safety 2015", World Health Organization, 2019. [Online]. Available: http://www.who.int/violence_injury_prevention/road_safety_status/20 15/en/. [Accessed: 07- Mar- 2019].

[2] Prabakar, S., et al. "An enhanced accident detection and victim status indicating system:

ISSN- 2394-5125 VOL 10, ISSUE 01, 2022

Prototype." India Conference (INDICON), 2012 Annual IEEE. IEEE, 2012.

[3] "Lexus Enform", Lexus, 2019. [Online]. Available: https://www.lexus.com/enform. [Accessed: 07- Mar- 2019].

[4] "OnStar Safety and Security Services", Onstar.com, 2019. [Online]. Available: https://www.onstar.com/us/en/services/safety-security/. [Accessed: 07- Mar- 2019].

[5] "SOSmart automatic car crash detection and notification app", SOSmart automatic car crash detection app, 2019. [Online]. Available: http://www.sosmartapp.com. [Accessed: 07- Mar- 2019].

[6] C. Kockan, "Communication between vehicles" PhD thesis, Istanbul Technical University, 2008

[7] Zeng, Yuanyuan, Deshi Li, and Athanasios V. Vasilakos. "Opportunistic fleets for road event detection in vehicular sensor networks." Wireless Networks 22.2 (2016): 503-521.

[8] Szegedy, Christian, et al. "Rethinking the inception architecture for computer vision." Proceedings of the IEEE conference on computer vision and pattern recognition. 2016.

[9] Szegedy, Christian, et al. "Going deeper with convolutions." Proceedings of the IEEE conference on computer vision and pattern recognition. 2015.