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Accident Detection using Convolutional Neural Networks

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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 preprocessing as compared to other image classifying algorithms.***

Keywords—Convolutional Neural Network; Accident Detection; Deep Learning; Video Classification; Recurrent Neural Network

I. 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.

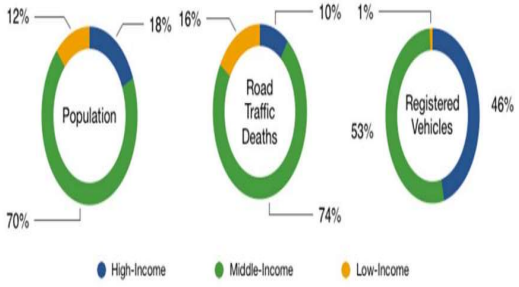

Fig. 1. Comparative analysis of population, income and road accidents

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 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.

II. LITEARTURE SURVEY

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

The *Global status report on road safety 2015*, reflecting information from 180 countries, indicates that worldwide the total number of road traffic deaths has plateaued at 1.25 million per year, with the highest road traffic fatality rates in low-income countries. In the last three years, 17 countries have aligned at least one of their laws with best practice on seat-belts, drink–driving, speed, motorcycle helmets or child restraints. While there has been progress towards improving road safety legislation and in making vehicles safer, the report shows that the pace of change is too slow.

Urgent action is needed to achieve the ambitious target for road safety reflected in the newly adopted 2030 Agenda for Sustainable Development: halving the global number of deaths and injuries from road traffic crashes by 2020. Made possible through funding from Bloomberg Philanthropies, this report is the third in the series, and provides a snapshot of the road safety situation globally, highlighting the gaps and the measures needed to best drive progress.

[2] Prabakar, S., et al. "An enhanced accident detection and victim status indicating system: Prototype." India Conference (INDICON), 2012 Annual IEEE. IEEE, 2012.

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.

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

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[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].

SOSmart detects car accidents using the internal sensors(Accelerometer and GPS) of your smartphone, and sends an emergency notification with you location to your pre selected emergency contacts. This allowing your contacts to send help as soon as possible. SOSmart car accident service can be configured in manual mode or automatic mode. Automatic mode: Whenever SOSmart detects you are in a moving vehicle, it will automatically turn on the crash detection monitoring, allowing you to absolutelly forget about the app. Recommended for people that frequently travels in a vehicle. Manual mode: User must manually turn the monitoring system in the app. Recommended for people who rarely travels in a moving vehicle.

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

Vehicle-to-vehicle (V2V) communication's ability to wirelessly exchange information about the speed and position of surrounding vehicles shows great promise in helping to avoid crashes, ease traffic congestion, and improve the environment. But the greatest benefits can only be achieved when all vehicles can communicate with each other. That's why NHTSA has been working with the automotive industry and academic institutions for more than a decade to advance V2V communication's lifesaving potential into reality. Vehicle-to-vehicle (V2V) communication enables vehicles to wirelessly exchange information about their speed, location, and heading.

The technology behind V2V communication allows vehicles to broadcast and receive omni-directional messages (up to 10 times per second), creating a 360-degree "awareness" of other vehicles in proximity. Vehicles equipped with appropriate software (or safety applications) can use the messages from surrounding vehicles to determine potential crash threats as they develop. The technology can then employ visual, tactile, and audible alerts—or, a combination of these alerts—to warn drivers. These alerts allow drivers the ability to take action to avoid crashes. These V2V communication messages have a range of more than 300 meters and can detect dangers obscured by traffic, terrain, or weather. V2V communication extends and enhances currently available crash avoidance systems that use radars and cameras to detect collision threats. This new technology doesn't just help drivers survive a crash—it helps them avoid the crash altogether.

III. PROPOSED SYSTEM

A. Raspberry Pi 3 Model B+

Raspberry Pi 3 Model B+ is a very small-sized portable computer created by the Raspberry Pi foundation in the United Kingdom to provide a low-cost experience for programming enthusiasts and helping them to understand the basics of computer science. The Raspberry Pi comprises of a 1.4 GHz 64-bit quad-core processor, a dual-band wireless LAN, 4 USB ports along with other

features like Bluetooth 4.2, faster Ethernet and is originally shipped with 1GB of RAM. It consists of 40 GPIO (General Purpose Input Output) pins which helps us to easily interface the required hardware with the pi.

It does not consist of massive storage like the built-in hard drive, but it does consist of microSD card used for light storage and booting applications. The operating system that the Pi works on is known as Raspbian installed NOOBS. The various programming languages supported in Pi are Python, Wolfram etc. The two key application areas are: • Interfacing of various hardware components • Understanding of basic programming concepts

B. GSM Module SIM800L

Global System for Mobile Communication is one of the most widely used mobile telephony systems. SIM800L helps to connect onto any global GSM network using a 2G SIM. GSM uses the concept of Time Division Multiple Access. Data is digitized and compressed which is later sent down a communicating channel along with two streams of the user's data each of which has its own unique time frame. SIM800L is quad-band i.e., operation lies in the 850/900/1800/1900 MHz frequency band. The SIM800L module is capable of supporting a quadband GSM network, which can be utilized for GPRS as well as remote SMS transmission.

Thus, we can send and receive messages using cellular network along with an arbitrary location based on the tower location to which the SIM is synched at that particular moment in time. The board features compact size and low current consumption. Communication is achieved using the UART port using the various AT commands. Additional features include scanning and reception of FM radio broadcasts.

C. Pi Camera

The main task of a Pi camera is to take still photographs and high-definition videos. The module consists of a fivemegapixel camera capable of capturing stills as well as support for the 1080p30, 720p60, and VGA90 video modes. It is attached to the CSI port of Pi using the 15cm ribbon cable. The images obtained are generally in JPEG or JPG format. The camera module can be altered to implement various additional effects like time-lapse or slow-motion. Additional libraries can be used to create effects as well. It can be accessed using the Pi camera Python library. The camera module is used for a wide range of home-security applications as well as in wildlife camera traps.

INCEPTION V3 ANALYSIS

For several years now, Inception v3 has served as a benchmark for image classification. A brief comparison as shown in table 1 shows several benchmark CNN models for image classification shows that Inception v3 gets lowest error rate among all others [8][9]. The inception v3, unlike normal neural networks, works on a heterogeneous set of convolutions. This allows the model to dive deeper into the image and extract more features. The advent of Inception models came from the very question "Why not do it all?" One is generally confused as to which layers to out in a convolutional neural network.

Sometimes different filter sizes also seem to work considerably well. Thus, through the Inception architecture, we aim at putting several convolutional filters of different dimensions and also pooling layers, all into the same layer of the network and allow the model to choose the best. This makes the model far more complicated than a primitive CNN but also improves classification margin considerably. The Fig. 4. architecture does two functions. First, it uses the smaller convolutions for the successful recovery of the basic local features. Secondly, it utilises the larger convolutions in order to recover the more complicated abstracted features.

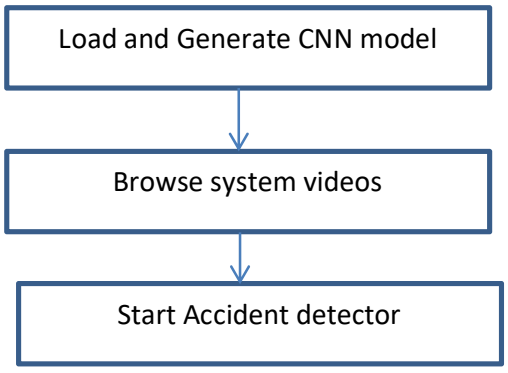


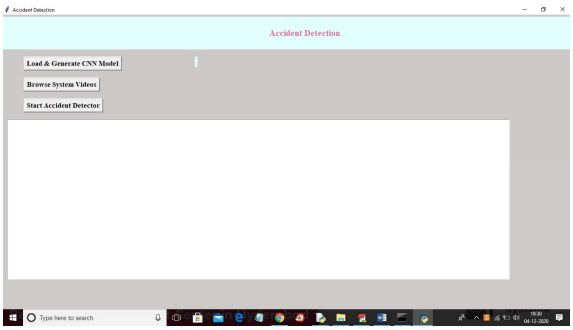
Fig. Flowchart

- Data Collection: Collect sufficient data samples and legitimate software samples.
- Feature Extraction: For each video's extract the features using image processing.
- Train and Test Modelling: Split the data into train and test data Train will be used for training the model and Test data to check the performance.
- Modelling: CNN. Combine the training deep learning algorithms and establish a classification model.
- Detection: in this module we will detect accident by uploading video

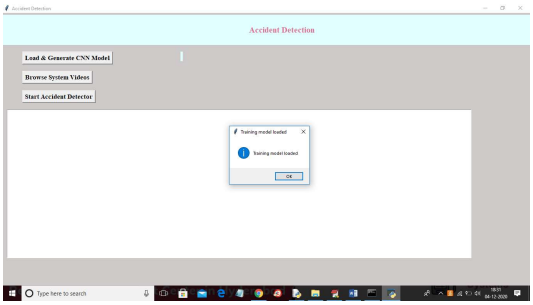
IV. RESULT

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.

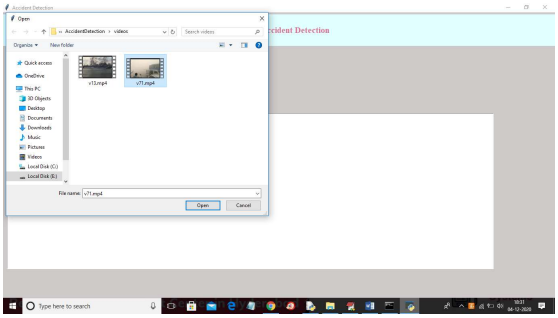
To run project double click on run.bat file to get below screen



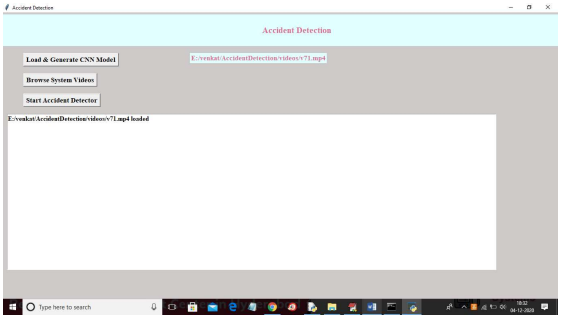
In above screen click on 'Load & Generate CNN Model' button to trained CNN with dataset and to load CNN model using tensorflow



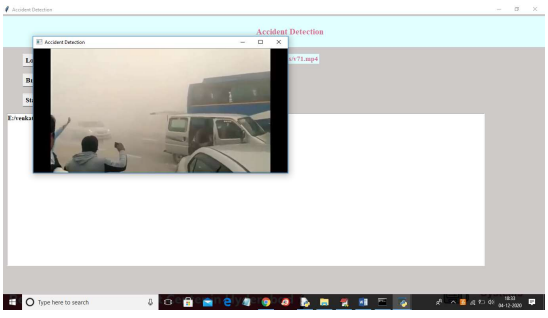
In above screen tensorflow model is loaded and now click on 'Browse System Video' button to upload video



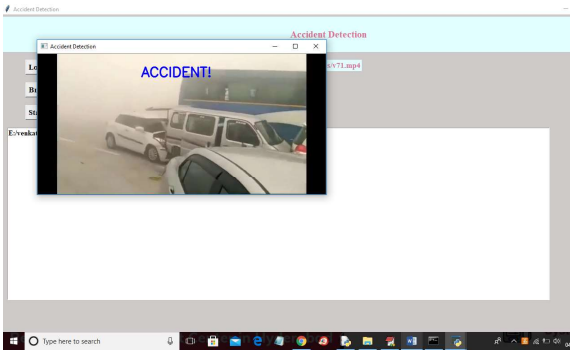
In above screen selecting and uploading video and then click on 'Open' button to load video



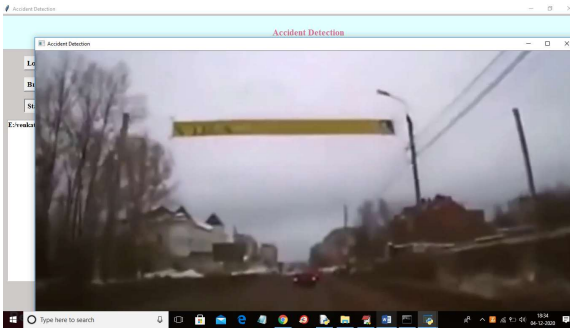
In above screen video is loaded and now click on 'Start Accident Detector' button to play video and detect accident

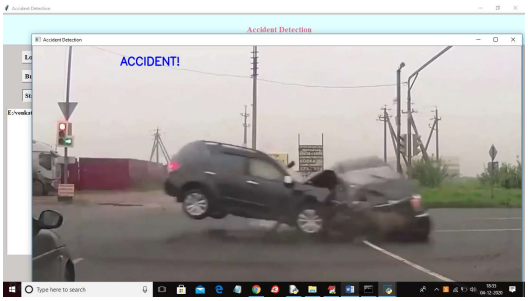


In above screen video start playing and upon accident detection will get below screen with beep sound



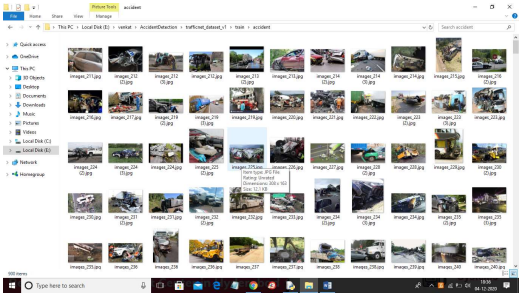
In below screen playing another video without message if normal driving appear





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

In below screen application is trained with below images



V. 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 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. Thus, the project works 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.

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[4] “Prabakar, S, et al.” An enhanced accident detection and victim status indicating system: Prototype

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