International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I5.76 ISSN: 1308-5581 Vol 14, Issue 05 2022

ACCIDENT DETECTION SYSTEM: A CNN APPROACH

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***Abstract*—In present situation, deaths due to accidents are increasing very fast. The full picture for the happened accidents are drunken driving, rash driving, carelessness, drowsiness, etc. Most of the accident demises occur due to not proving instant medicinal care in time to the accident site and carelessness. Anyone is not taking any action when they saw an accident. The main intent this work is developing a system that will detect the accident using CCTV footage. From the stream of video images are extracted. To classify images Convolutional Neural Networks (CNN) incorporated. This system detects the accident if occur. Since CNN proven to be a fast and precise method to classify images, it detects the accident with more accuracy. For smaller datasets it gives more than 95%. It also requires less processing time when compared to other image classifying algorithms.**

Keywords—Deep Learning, Convolutional neural networks, Accident detection, CCTV footage.

I. INTRODUCTION

In India, it is observed that road accident are four to five times more than the every twelve months death clang from terrorism. More than 450,000 accidents occur every year, of which 150,000 people die. Every day, 377 people die in India as a result of traffic accidents, which is four times the yearly death toll from terrorism. India has only 1% of total world's vehicles but has 11% of global deaths due to accident. The majority of deaths occur as a result of the victim's lack of urgent medical attention following an accident. There may be many reasons which cause the accidents. Some of them are drunk and driving, road infrastructure, overspeed, not following the traffic rules etc. Our government has been implementing lots of new precautions to minimize in an effort to limit the accident rate that are on the rise. Even though the count of road accidents increasing constantly. Deaths due to road accidents also increasing.

Among all, deaths due to accidents is more. There are many reasons for this, one among them not giving medical care in time. When an accident occurs, the victim does not have immediate medical assistance. Immediate medical care also reduces deaths due to road accidents to some extent. So, this system is incorporated. Whenever an accident occurs this system will report immediately to the control room and medical care centres, so that quick medical care can be offered to the patient.

Root causes of road accidents were analysed and list as follows: Leaping Red Light, Speeding, Drunken drive, over taking drivers without judgements/careless manner and distracted driver.

Elements affecting accidents while driving are: Avenue situations, Climate conditions, Drivers, Over-speed of car, liquors, rapid driving, not aware of road signs, bypassing the road lane policies, Pedestrian, Jaywalkers, Carelessness in driving, not aware of road rules and so forth. Passengers, projecting their frame out of doors automobile, urgent walks to catch bus, by using gadgets, Automobiles, Wreck failure, un-serviced engine of car, malfunctioned parts, loading an automobile with more than its capacities.

Comparisons of the accidents yearly shows from the graph that they are increasing continuously. Trend of Road Accident Cases, Persons Injured and Persons Died during 2015–2019 [22].

This uses camera as input and produces the results. Camera monitors the traffic continuously. When an accident occur, this system will send alerts to the control rooms and nearby hospitals so that the patient can be provided with medical care.

This system uses deep learning techniques like Convolutional Neural Networks (CNN) to tackle complex problem of classifying video footage. The video classification with CNN contains four layers Single Frame, Late Fusion, Early Fusion, and Slow Fusion are some of the options. CNN provided efficient system that automatically finds the predominant features by not considering human

The main goal was to put together a system capable of detecting accidents from video sequences fed by the camera. The system provides such a design, as a tool to help accident victims when needed by detecting accidents in time and now notifying authorities via text messages and so on. The main goal is to detect a crash in seconds. It uses advanced deep learning algorithms on unsaturated precipitation resulting in storms, snow, etc [23].

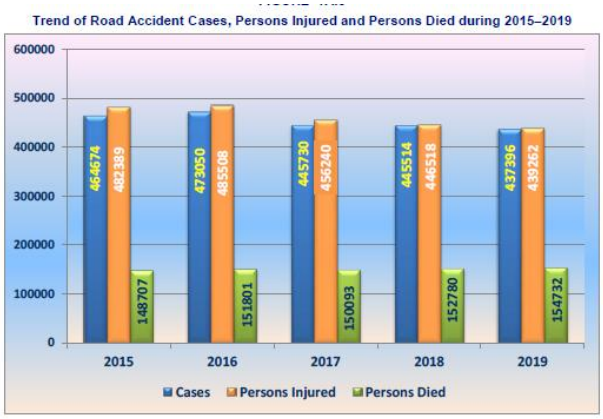

Fig. 1. Comparison number of road accidents yearly

II. Leterature Survey

In the existing accident detection system, the main objective is to detect accident.

Vaishnavi Ravindran [2] With the help of CCTV cameras in different points, this system will detect damaged vehicles. This system uses the object detection of machine leaning for developing this model and for detecting the images. From the input, the damaged vehicles detection can be done by a framework that includes three crucial stages. These three different Support Vector Machines with Histogram of gradients (HOD) and Gray level co-occurrence matrix (GLCM) features are used in the stages. The accuracy of this system of this system is 81.83%.

Jae Gyeong Choi [3] The proposed model provides car crash detection which relies on collective deep learning. It uses video and audio data from cameras. A GRU and CNN based classifier id developed for dataset that contains of both audio and video dataset.

Maha Vishnu [6] The proposed system is based on has a traffic control and monitoring system as well as a dynamic traffic light control and crash detection mechanism. Associative support vector machines, flux gradient histograms, and polynomial logistic regressions used in real-time live videos. Deeksha Gour [5] In this project they used YOLO algorithm which results by applying convolutional neural networks on the images. This is based on deep learning and neural networks on object detection, computer vision technology. This approach works on pictures, deferred and live accident videos and detects an accident.

III. Algorithm Implementation

Steps involved in implementation of accident detection system are:

- Data gathering
- Date preprocessing and feature extraction
- Image classification

1) Data Gathering

For collecting dataset we searched in several resources. Some resources are Kaggle, github etc. After searching in several resources, we collected some datasets. Among the collected datasets the dataset that is appropriate for this model has been selected.

2) Data Preprocessing and feature Extraction

The collected data is raw data. This dataset is collection of images. This dataset has lot of images which are useful and some are not useful. Data preprocessing includes cleaning of raw data. During this process the dataset is structured in a way that is suitable for the model in designing.

After Data preprocessing, feature extraction is done. This is the important step in implementation of the model. For better model best feature should be extracted.

3) Image Classification

After data preprocessing and feature extraction using deep learning technique CNN image classification is done. Since CNN is more accurate in image classification

B. Architecture of CNN

Three types of layers are existing on CNN architecture. They are convolutional, pooling, and fully connected layers. Once all these layers are piled, architecture is formed. Fig.2 gives us the overview of this architecture.

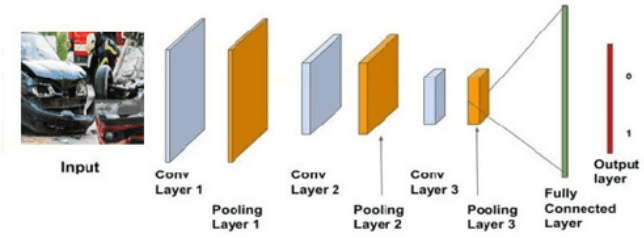

Fig. 2. Architecture of CNN

1) Convolutional layer

Convolutional layer is the first and core layers in CNN architecture. There are many learnable filters in this layer.

The network learns new filters and uses them while detecting the images.

2) Pooling layer

There are functions to implement pooling. Mainly there two types of pooling, they are max pooling and average pooling. These techniques are used to reduce the size of the weights matrix which is received from previous layers.

3) Fully Connected layer

Arter convolutional layers and pooling layers final classification is done in full connected layer.

C. Design

Design shows how the system functionality is designed for detecting the accident. The design of the system can be shown using UML diagrams. Dataflow diagram will depict the flow of processes in this system. This will show which process occur first, then second and so on.

D. CNN Algorithm

Algorithm used in this system for training and testing is CNN Algorithm. *CNN with LSTM* able to detect accidents in the videos.

CNN algorithm is given below:

1) Splitting of dataset to train, test and validation set

The dataset is divided into three parts for training, testing and validation respectively.

```
train_data = datasets.ImageFolder(data_dir, transform=train_transforms)

print(len(train_data))
train_data, test_data, valid_data = torch.utils.data.random_split(train_data, [
                                                                  27298, 5850, 5850])
trainloader = torch.utils.data.DataLoader(
    train_data, batch_size=8, num_workers=1, pin_memory=True)
testloader = torch.utils.data.DataLoader(
    test_data, batch_size=8, num_workers=1, pin_memory=True)
validloader = torch.utils.data.DataLoader(
    valid_data, batch_size=8, num_workers=1, pin_memory=True)
```

Fig. 3. Splitting of data

2) Training the data

The dataset is then trained with CNN algorithm. Then it is tested an validated.

```
model.classifier = nn.Sequential(nn.Linear(2208, 1000),
                                 nn.ReLU(),
                                 nn.Dropout(0.2),
                                 nn.Linear(1000, 2),
                                 nn.LogSoftmax(dim=1))

criterion = nn.NLLLoss()
# Only train the classifier parameters, feature parameters are frozen
optimizer = optim.Adam(model.parameters(), lr=0.001)
scheduler = lr_scheduler.StepLR(optimizer, step_size=7, gamma=0.1)

model = model.cuda()


total_params = sum(p.numel() for p in model.parameters())
print(f'{total_params:,} total parameters.')
total_trainable_params = sum(
    p.numel() for p in model.parameters() if p.requires_grad)
print(f'{total_trainable_params:,} training parameters.')
```

Fig. 4. Training of data

```
for epoch in range(1, epoches+1):
    torch.cuda.empty_cache()
    # keep track of training and validation loss
    train_loss = 0.0
    valid_loss = 0.0
    ###################
    # train the model #
    ###################
    model.train()
    for data, target in trainloader:
        # move tensors to GPU if CUDA is available
        if train_on_gpu:
            data, target = data.cuda(), target.cuda()
        # clear the gradients of all optimized variables
        optimizer.zero_grad()
        # forward pass: compute predicted outputs by passin
        output = model(data)
        # calculate the batch loss
        loss = criterion(output, target)
        # backward pass: compute gradient of the loss with
        loss.backward()
        # perform a single optimization step (parameter upd
        optimizer.step()
        # update training loss
        train_loss += loss.item()*data.size(0)
        scheduler.step()
        # torch.cuda.empty_cache()
        total_correct += get_num_correct(output, target)
```

Fig. 5. Training of data

Fig.3 to 5 has given the overview of the system implementation. This will keep track of training and validation loss of the traing model and in testing and validation model.

IV. Results

When system starts, the camera monitors the traffic and captures the stream of videos. From the captured video the system extracts the images. After extracting the images using CNN it detects whether accident occurred or not. If accident occur it will send alerts to the control room and nearby hospitals. It will send alerts with the image of accident for confirmation. The fig.6 given below shows the image with no accident occurred.

Fig. 6. Non Accident Detection on a Real Time Video

The fig.7 given below shows the image with accident occurred in it.

Fig. 7. Accident Detection on a Real Time Video

This model was trained and tested with the image dataset. The total numbers of images in the dataset are 39001. Among them 13338 are images in which accident occurred, remaining 25663 are images with no accident. The accuracy of the developed model is 93%. Accuracy is calculated as

Accuracy= No. of Predictions that are Correct / Total No. of Predictions.

The frequency of the accident is compared with the time. From the observations it is find that more accidents occurred during morning and evening. The below fig.8 shows the frequency of accidents

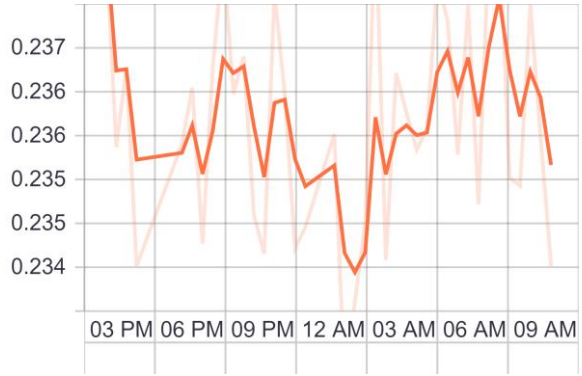

Fig. 8. Frequency of accidents vs Time

From the figure we can see that graph is developed with time on X-axis and frequency of accidents on Y-axis.

V. Conclusion And Future Work

This system uses CNN for image classification and identification, which is expertise in this area. There are many hidden layers present in CNN which will distinctly identify the image. CNN can accomplish the multiple processes simultaneously. But this will work correctly as long as your equipment has Graphical Processing Unit (GPU). With GPU it will run faster otherwise it will take more time to run. Since it takes more time, our primary goal is to optimize the time taken will become impossible.

In anyway it can't replace human with few lines of code, neural networks are designed after human cognitive functions. So, it can still learn to for improving its accuracy in detecting the images. Some changes still needed to be made to make the model more appropriate.

This model detects the accidents from the existing CCTV footage with high performance. Since the dataset used for training this model may not show all the situation of accidents which may not be detected by the if it happens in real time situation. For example, the dataset may have only some type of vehicle accidents like car, bus etc. So, if an accident occurs for bike, it can't detect. This is also can be improved in future work. The dataset size can be increased to improve its working model.

Since, the accuracy of this system is 93%. In future the accuracy of the system can also be increased. It can also be implement with other deep learning methods. Finally, a model with more accuracy can be designed in future.

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