A Project/Dissertation Review Report

on

Vehicle Crash Detection System for Emergency Assistance

Submitted in partial fulfillment of the
requirement for the award of the degree of

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GALGOTIAS UNIVERSITY
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Under The
Supervision of

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SCHOOL OF COMPUTING SCIENCE AND ENGINEERING
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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the thesis/project/dissertation, entitled **"VEHICLE CRASH DETECTION SYSTEM FOR EMERGENCY ASSISTANCE"** is in partial fulfillment of the requirements for the award of the B.Tech. Computer Science and Engineering submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of September 2021 to December 2021, under the supervision of Mrs Heena Khera (Assistant Professor), Department of Computer Science and Engineering/Computer Application and Information and Science, of School of Computing Science and Engineering, Galgotias University, Greater Noida

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

Priyavrat Sharma (19SCSE1010699)

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Mrs. Heena Khera
Assistant Professor

CERTIFICATE

The Final Thesis/Project/ Dissertation Viva-Voce examination of Priyavrat Sharma (19SCSE1010699) and Ayush Tripathi (19SCSE1010271) has been held on _____ and his/her work is recommended for the award of B.Tech. Computer Science and Engineering

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date: December 2021
Place: Greater Noida

Abstract

Road accidents are a major cause of deaths not only in India but in many other parts of the world as well. Road accidents cause more harm to human lives in densely populated countries like India, China. Sometimes people die because of the severe nature of the accident but most of the time people involved in a road accident lose their lives due to lack of medical treatment. Our aim through research paper is to research a particular accident detection system that will alert us about the possibility of an accident and if an accident does occur it will alert the nearest police station and hospital so that the people can be saved during these tragic situations. The system will have high-resolution camera sensors that can record video and produce a large number of high-quality frames. A dataset will be chosen from Kaggle which will be used for training purposes. It will contain a number of videos in which accidents are occurring then these cameras will be trained using machine learning algorithms so that they can identify a similar situation in which there is a slight probability of an accident occurring and alert the nearest police station and hospitals. The algorithm which we will be using is a part of Artificial Neural Network (ANN), which is used to create models that generate output on various input parameters. The algorithm is known as Convolutional Neural Network (CNN), this algorithm is specifically used for object detection, this is a highly efficient algorithm that has become significantly popular in past years this algorithm identifies input features and gives output accordingly.

We will test this system for different types of real-time situations and try to find if the system is accurately predicting the possibility of an accident and its ability to alert the nearest community services in case an accident does occur. After carefully studying the results, we will write the conclusion if the particular system is giving accurate results.

Chapter-1

1.1 Introduction

India is a densely populated country so it has a greater number of vehicles and the higher the number ofvehicles higher will be the traffic. According to the data provided by the Indian Government, the number of road accidents that occur in India during a year is more than four lakhs fifty thousand and each year the percentage of death caused by road accidents is increasing. National and state highways of India are just five percent of the total road network of India but most of the accidents occur on these highways (fifty-two percent of the road accidents). So, the accident detection system that we will be studying will help reduce the number of road accidents and deaths caused by road accidents. Two main technologies that will be used by this accident detection system are Image processing and Object Detection. Image processing is a technique that is used to predict or decide if the object in the image belongs to a particular class or not. It takes an image with objects as input and produces a class label which can be mapped to several other class labels as output. Object detection on the other hand is a different technique that is used for finding if there is a particular type of objectpresent in the given data or not. It also takes images with objects as input but it produces output thatis defined by some properties such as object width, object height, or object position. The above two mentioned techniques are related to each other which will help get accurate results.

Convolutional Neural Network (CNN) is a very good object detection algorithm that we will be used to detect objects which will be vehicles in this case. By using this algorithm camera sensors will be trained with the help of a training dataset to identify vehicle position in order to decide if a particular vehicle is too close to another vehicle and there is a possibility of an accident.

1.2 Formulation of Problem

Crash of vehicles had become a major reason for the death of individuals nowadays. If proper help can be provided on time, we can save the lives of many. So, we have come up with research of crash detection system which detects the crash of vehicle through high-resolution camera's installed on the highways, express-way, and peripherals. We can make machine learning through supervised learning through machine learning algorithms. We can make a machine learn through various video and images of vehicle crash so that it can differ between accidental vehicles and non accidental vehicles.

Object detection on the other hand is a different technique that is used for finding if there is a particular type of object presents in the given data or not. It also takes images with objects as input but it produces output that is defined by some properties such as object width, object height, or object position. The above two mentioned techniques are related to each other which will help get correct results. Convolutional Neural Network (CNN) is a very good object detection algorithm that we will be used to detect objects which will be vehicles in this case. Taking a database from Kaggle we can have such a system of crash detection that can help us out in saving one's life by informing the local emergency services. We have learned about the pre availablesystem in our research and will work on loopholes of them to make it a better one.

1.2.1 Tools and Technologies Used

Two main technologies that will be used by this accident detection system are Image processing and Object Detection. Image processing is a technique that is used to predict or decide ifthe object in the image belongs to a particular class or not. It takes an image with objects as input and produces a class label which can be mapped to several other class labels as output. Object detection on the other hand is a different technique that is used for finding if there is a particular type of object present in the given data or not. It also takes images with objects as input but it produces output thatis defined by some properties such as object width, object height, or object position.

The above two mentioned techniques are related to each other which will help get accurate results. Convolutional Neural Network (CNN) is a very good object detection algorithm that we will be used to detect objects which will be vehicles in this case. By using this algorithm camera sensors will be trained with the help of a training dataset to identify vehicle position in order to decide if a particular vehicle is too close to another vehicle and there is a possibility of an accident. Through this research paper, we will find out if this system is capable of preventing an accident and if can alert the nearest community services in need.

Chapter-2

Literature Survey

This is a standalone section of the literature survey for Our Project, the focus of which is on the study of previous researches based on the working idea of Accident Detection System which used image processing and object detection.

Following are the researches that happened based on the Accident Detection System or functioning ofAccident Detection System.

- IoT based Vehicle accident detection and rescue information system: In [1] accident detection system was developed using the Internet of things. This system discovered the vehicle accident and send the message to nearby hospitals and police stations using a network. The place was traced with the help of GPS. A vehicle tracking algorithm was used to detect abnormal vehicles and by use of a server's notifications were sent to all users in that particular network.
- Traffic Accident Detection using Machine learning Techniques: In [2] proposed system was designed to take data from normal roads and identify the situation in which an accident might occur, then an algorithm was used to identify behaviors of vehicles. By using clustering algorithms those behaviors were classified so if a vehicle was showing accidental behavior then it was marked.
- IoT based Accident identification and Alerting System: In [3] proposed system if avehicle collided the accelerometer and an ultrasonic sensor sends a signal to Arduino. The accelerometer sends the signal about increasing speed to Arduino. Then it will send an alert to the number that is predefined and the alert will pop on to the LCD screen of the user. This system was made for car users. it was made user-friendly it was good for the automobile industry.

- Real-time autonomous highway accident detection model based on Big Data Processing a Computational Intelligence: In [4] proposed system was a real-time accident detection system that was based on computational brainpower techniques. The extracted data was fed to themodel which contained a feed-forward neural set of connection prototypes to decide the possible occurrence of an accident and send the alert.
- Paper [5] proposed a mobile application for automatic accident detection and alert system which uses an accident detection algorithm. Use of the e-Call system for automatically detectingvehicle accidents.
- In [6] an algorithm was proposed which detected a traffic accident from the crash of anairbag of a vehicle. GPS was used to locate the place of the accident and Vehicle Ad-hoc networks were used to send messages. This system informed the nearest medical services in case of emergency and also discovered a re-route path for avoiding congestion to reach the destination on time.
- Paper [7] proposed an application for accident detection through On-Board Diagnostics (OBD-II) devices and android smartphones. The application makes use of Bluetooth to findan ODB-II device. Then it decides which device is suitable for this particular vehicle, when the connection is established, it starts the monitoring of the system. If the airbag is opened orthe speed is increased beyond a certain mark, using GPS it makes the critical call in emergency situations.
- Paper [8] discusses the various techniques used in Automatic Road Accident Detection which includes the use of smartphones, GPS and GSM, Vehicular Ad-hoc networks (VANET), and the mobile application.

- Paper [9] makes use of 5G and IoT for Reporting and Accident Detection. It also includes delivery of first aid boxes through an aerial carrier which is automatic. It uses different methods such as Edge computing, Intelligent transportation, IoT and 5G.
- This paper [10] discusses the Automatic Detection of traffic accidents through videos using Deep learning techniques. It uses Temporal Segmentation to divide a video into frames based on various features such as time and space.
- Paper [11] implemented an Accident alert system with vehicle tracking by making use of the GPS and the GSM. The system also used different types of sensors Impact sensor, Piezoelectric sensor Transducer and Arduino.
- Paper [12] focuses at the location of the accident. This paper used a computer system within a vehicle to send a message to accurately locate the vehicle involved in the accident.

Chapter-3

Working/Functionality of the Project

The objective behind this paper is to prevent a road accident and provide emergency assistance as quickly as possible. The main technique that we will be using for the research of this system is:

Convolutional Neural Network: It is different from other neural networks because of its higher performance with images, audio signals, and speech, etc. It has three layers:

1. Convolutional layer
2. Pooling layer
3. Fully connected (FC) layer

With each layer, its complexity increases to identify more features of the image. The earlier level concentrates on the normal features of the image such as its color and edges. As the data processes through the layers of the Convolutional Neural Network it starts to identify large aspects of the image such as the shape of the object until it finally recognizes the intended object.

Convolutional layer

It is the main layer and building block of the Convolutional Neural Network. In this layer most of the computation process takes place. It needs some components which are input data, a feature map, and a filter. For example, if we consider a colored image that is made up of matrix pixels in 3D. This indicates that input will have three dimensions depth, width, and height which concurs to RGB in an image. It also contains a feature detector which is also known as kernel it moves to different areas of the image to check if the feature is there or not. This process is known as convolution. A feature detector is a 2D array with weights that represent areas of the image. The filter can vary in size but typically it is a 3x3 matrix this also calculates the size of the receptive field. Then the filter is applied to different parts of the

image to calculate the dot product between the filter and the input pixels, then it is fed to the output array. This process is repeated until the whole image is covered, the final output from the strings of dot products is known as an activation map, feature map, or a convolved feature. There are some parameters that affect the size of output that is set before the training of the neural network. These parameters are

Number of filters: - More filters mean more depth of the output.

Stride: - Number of pixels kernel moves on the input matrix. Higher stride means small output.

Zero-padding: - It is used when filters do not fit the input image. It is of three types

1. Valid padding: In this recent convolution is dropped if dimensions do not fit.
2. Same padding: Ensures that the output layer has a similar size as the input layer.
3. Full padding: It grows the size of output through the addition of zeroes to the end of the input.

After every convolution process Convolution Neural Network implements Rectified Linear Unit (ReLU) transformation to feature map to make the model non-linear.

Pooling Layer

It is also known as down sampling because it conducts reduction of dimension to reduce the number of input parameters. It is similar to convolutional layer pooling filter moves over entire input but the difference is pooling layer does not contain any weights instead it applies an aggregation function to the values. It is of two types:

1. Max Pooling: In this filter select the maximum value from the input and send it to the output array.
2. Average Pooling: In this filter calculates the average value from the input and sends it to the output array.

Fully-Connected Layer:

As we discussed earlier pixel values of the images are not connected to the output array directly in the above layers but as you can guess from the name in this layer every node in the output layer is connected to the node in the recent layer. This layer performs classification based on the features collected by earlier layers and filters. Both the Convolutional layer and the Pooling layer uses Rectified Linear Unit (ReLU) function while the Fully connected layer uses a Softmax activation function to classify the input into appropriate categories and produce a probability between 0 and 1.

The high-resolution CCTV camera receives images at a certain frame rate for processing. In the early stages, images are uploaded manually. The system is integrated with Convolution Neural Network and an alert system. Images are received and classification is performed only the images showing any kind of accident are categorized and an alert is sent to the nearby hospitals and police stations for providing emergency and medical assistance. As mentioned earlier CNN has multiple layers that work on the activation layer (ReLU) and a loss function that removes noise from the images. The ideal activation function is identified by experimenting with the system. The accuracy of the system directly depends upon the quantity of data. The model also categories the images based on the nature of the accident. It is trained through large data to identify if that particular accident is severe or minor. Once the image is processed and is categorized into a severe or minor category then an alert is sent to the nearby hospitals and police stations. The alert sent to the hospitals also contains the coordinates of the accident area in order to save time in that critical moment. In this way, the model identifies the images and recognizes an accident to provide emergency assistance. Feedback is taken after every iteration to constantly improve the model.

Project Design

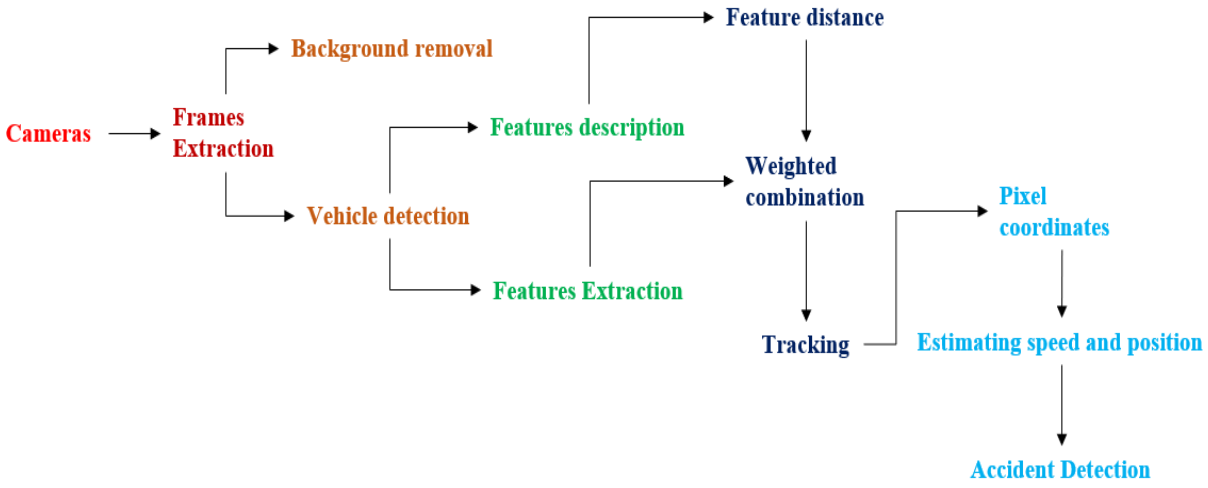


Figure 1. Layout Accident Detection System

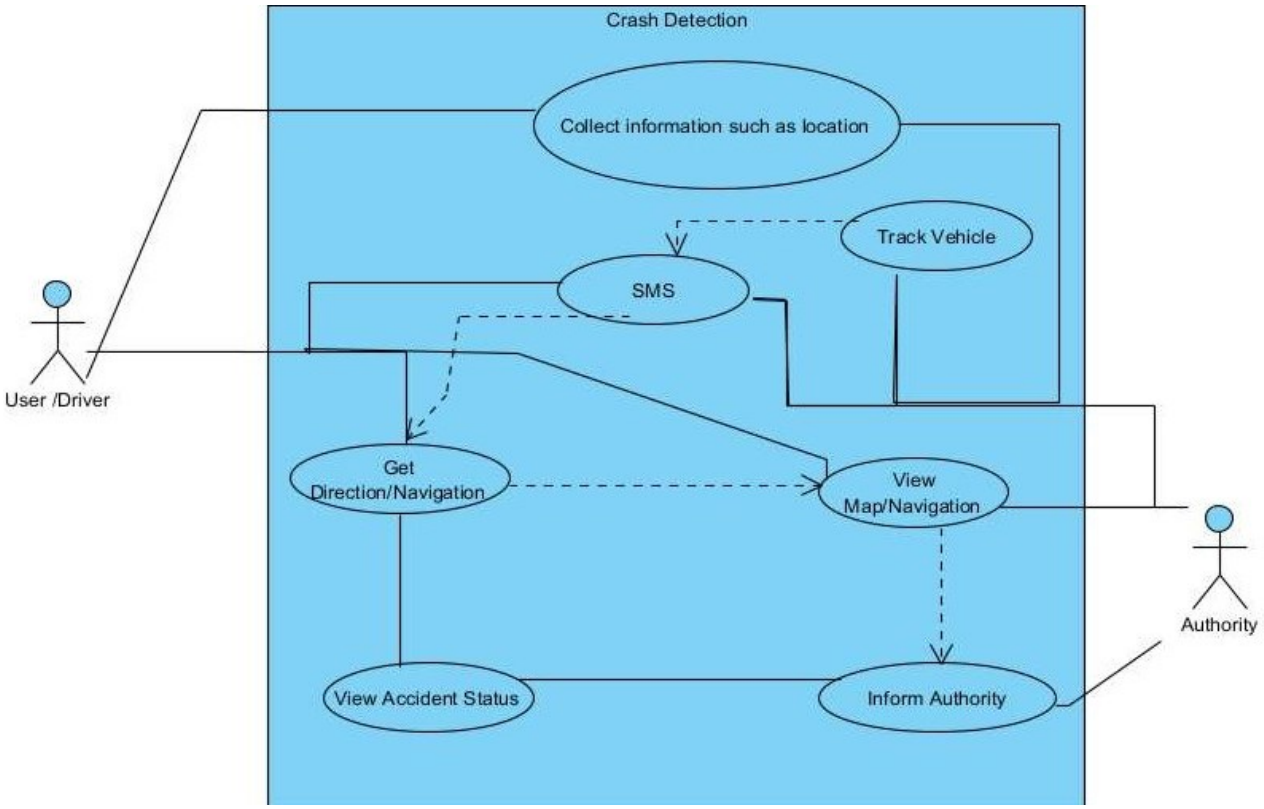


Figure 2. Use Case diagram for Accident Detection System

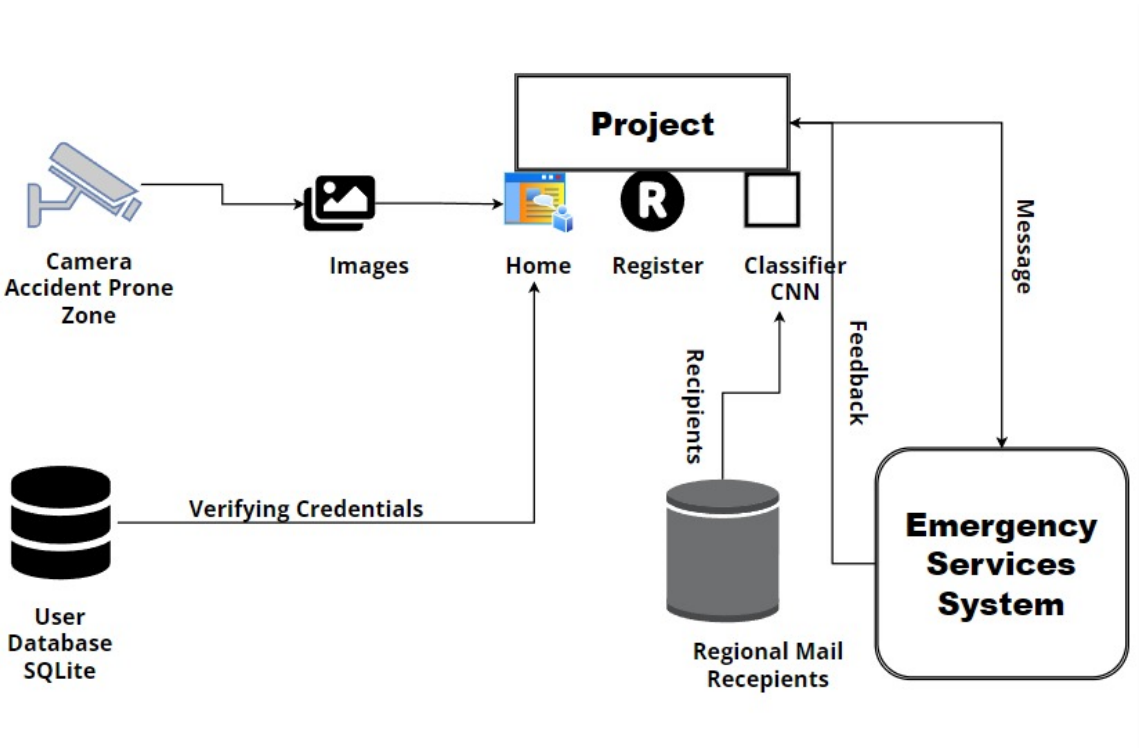


Figure 3. Working of the System

Implementation

Reading the dataset

Pictures are categorized according to the nature of the accident such as images containing mild accidents and images containing severe accidents. Using the labels and features from our dataset the provided images will be detected through a statistical relation between the features of the dataset.

Sample images:

Mild Accidents

Severe Accidents

+ Code + Text

Connect | Editing

```
import numpy as np
import pandas as pd
import os
import cv2
import matplotlib.pyplot as plt
```

```
[ ] pip install patool
```

```
Collecting patool
  Downloading patool-1.12-py2.py3-none-any.whl (77 kB)
     |████████████████████████████████| 77 kB 3.5 MB/s
Installing collected packages: patool
Successfully installed patool-1.12
```

```
[ ] import patoolib
    patoolib.extract_archive("Accident Images Analysis Dataset.rar")
```

```
patool: Extracting Accident Images Analysis Dataset.rar ...
patool: running /usr/bin/unrar x -- "/content/Accident Images Analysis Dataset.rar"
patool:     with cwd='./Unpack_rtr1tt4o'
patool: ... Accident Images Analysis Dataset.rar extracted to `Accident Images Analysis Dataset'.
'Accident Images Analysis Dataset'
```

```
[ ] DATADIR="accidents"
    Categories=["Mild", "Severe"]
    for cat in Categories:
      path=os.path.join(DATADIR,cat)
      for img in os.listdir(path):
        img_array=cv2.imread(os.path.join(path,img),cv2.IMREAD_GRAYSCALE)
        plt.imshow(img_array,cmap="gray")
        plt.show()
        break
      break
```

Training our dataset

```
training_data = []

def create_training_data():
    for category in CATEGORIES:

        path = os.path.join(DATADIR,category)
        class_num = CATEGORIES.index(category)

        for img in tqdm(os.listdir(path)):
            try:
                img_array = cv2.imread(os.path.join(path,img) ,cv2.IMREAD_GRAYSCALE)
                new_array = cv2.resize(img_array, (IMG_SIZE, IMG_SIZE))
                training_data.append([new_array, class_num])
            except Exception as e:
                pass

create_training_data()

print(len(training_data))
```

```
100%|██████████| 2500/2500 [00:00<00:00, 14247.46it/s]
100%|██████████| 2398/2398 [00:00<00:00, 14782.33it/s]4898
```

```
[ ]  import random

     random.shuffle(training_data)
     for sample in training_data[:10]:
         print(sample[1])
```

```
1
1
0
0
0
0
1
0
0
1
```

```
[ ]  X = []
     y = []

     for features,label in training_data:
         X.append(features)
         y.append(label)

     print(X[0].reshape(-1, IMG_SIZE, IMG_SIZE, 1))

     X = np.array(X).reshape(-1, IMG_SIZE, IMG_SIZE, 1)
```

```
[[[[224]
   [228]
   [235]
   ...
   [226]
   [224]
   [223]]

  [[223]
   [227]
   [232]
   ...
   [223]
   [221]
   [219]]

  [[222]
   [224]
   [228]
   ...
   [218]
   [214]
   [212]]

  ...

  [[ 66]
   [ 67]
   [ 68]
   ...
   [150]
   [150]
   [150]]

  [[ 60]
   [ 61]
   [ 62]
   ...
   [154]
   [154]
   [154]]

  [[ 57]
   [ 57]
   [ 59]
   ...
   [157]
   [157]
   [157]]]]
```

Testing and Validation of dataset

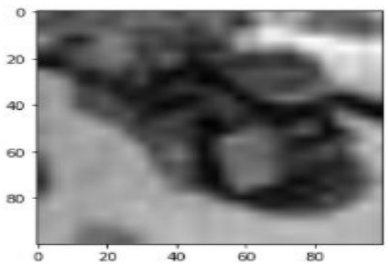
In this part we will divide the dataset according to the categories and test it then we will resize the images and predict from the data, this process will be repeated for every iteration.

```
[57] from sklearn.model_selection import train_test_split
     X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 4)
```

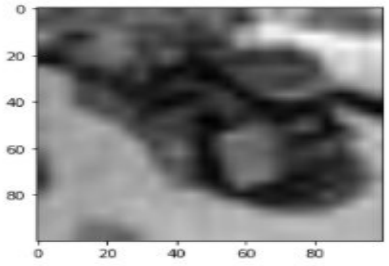
```
[63] batch_size = 32
     nb_classes =4
     nb_epochs = 3
     img_rows, img_columns = 100, 100
     img_channel = 3
     nb_filters = 32
     nb_pool = 2
     nb_conv = 3
```

```
[66] import tensorflow as tf

     import tensorflow_datasets as tfds
     model = tf.keras.Sequential([
         tf.keras.layers.Conv2D(32, (3,3), padding='same', activation=tf.nn.relu,
                                input_shape=(100, 100, 1)),
         tf.keras.layers.MaxPooling2D((2, 2), strides=2),
         tf.keras.layers.Conv2D(32, (3,3), padding='same', activation=tf.nn.relu),
         tf.keras.layers.MaxPooling2D((2, 2), strides=2),
         tf.keras.layers.Dropout(0.5),
         tf.keras.layers.Flatten(),
         tf.keras.layers.Dense(128, activation=tf.nn.relu),
         tf.keras.layers.Dense(4,  activation=tf.nn.softmax)
     ])
```

```
[46] IMG_SIZE = 100

     new_array = cv2.resize(img_array, (IMG_SIZE, IMG_SIZE))
     plt.imshow(new_array, cmap='gray')
     plt.show()
```




```
[47] new_array = cv2.resize(img_array, (IMG_SIZE, IMG_SIZE))
     plt.imshow(new_array, cmap='gray')
     plt.show()
```

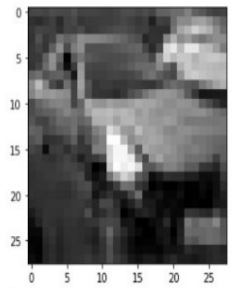


Chapter-4

Results

The sample input for the system is shown below with the code and the diagram

```
[ ] DATADIR="accidents"
    Categories=["Mild", "Severe"]
    for cat in Categories:
      path=os.path.join(DATADIR,cat)
      for img in os.listdir(path):
        img_array=cv2.imread(os.path.join(path,img),cv2.IMREAD_GRAYSCALE)
        plt.imshow(img_array,cmap="gray")
        plt.show()
        break
      break
    print(img_array.shape)
```



(28, 28)

The accuracy that was received after the data was processed through our system is shown below with the code

```
model.compile(optimizer='adam',loss='sparse_categorical_crossentropy',metrics=['accuracy'])

model.fit(X_train, y_train, batch_size = batch_size, epochs = nb_epochs, verbose = 1, validation_data = (X_test, y_test))
```

```
34/34 [==============================] - ETA: 0s - loss: 0.3249 - accuracy: 0.9106
```

After sending the alert to nearby hospitals and community services it is shown below

Chapter-5

Conclusion

The discussed system worked efficiently for detecting the accidents and sending alert to the nearby hospitals and police stations which provided emergency assistance to the people involved in the accidents. Technology is evolving at a rapid pace and new technologies are discovered every day with the help of new technologies we will work towards improving the efficiency of the system to increase its accuracy so more lives can be saved. The proposed model was helpful in identifying the data related to the road accidents and also it was ideal for detecting the data based on the categories or nature of the accident. Overall the output of this proposed system will help people to get timely medical and other emergency services so more harm can be avoided.

Future Scope

This proposed model deals with the detection and sending the alerts to the nearby hospitals and other community services for emergency assistance. In the future it can be integrated into the highway authorities. The authorities can prepare in advance if there is a accident and provide help more quickly. Also, through the increasing technology this can somehow be applied to the vehicle so the vehicle involved in the collision can send the alert it will save the time required for processing the images.

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