

In [1]:

```
import os
import numpy as np
import matplotlib.pyplot as plt
from datetime import datetime
```

In [2]:

```
import tensorflow as tf
from tensorflow.contrib.layers import fully_connected,dropout,l2_regularizer
```

In [3]:

```
x = tf.placeholder('float', [None, 4096])
y = tf.placeholder('float')
hl = tf.placeholder('float') #hinge_loss
```

In [4]:

```
def get_video_list(path):
    videos=[]
    with open(path, 'r') as f:
        for line in f:
            videos.append(line.strip())
    return videos
```

In [5]:

```
def get_training_set(path):  
    abnormal_path =path  
    normal_path = path  
    batchsize=60  
    batch_Ab_size = 30  
    num_abnormal = 170  
    num_normal =160  
    abnorm_list = np.random.permutation(num_abnormal)  
    abnorm_list=abnorm_list[:batch_Ab_size]  
    norm_list = np.random.permutation(num_normal)  
    norm_list = norm_list[:batch_Ab_size]  
  
    #print("Loading abnornmal Features...")  
    videos = get_video_list(abnormal_path+"/anomaly.txt")  
  
    abNormal_features ={}  
  
    for i in abnorm_list:  
        vid_path=os.path.join(abnormal_path,videos[i] )  
        with open(vid_path,'r') as f:  
            lines = f.read().splitlines()  
            key=os.path.basename(videos[i])  
            key=os.path.splitext(key)[0]  
            #print(key)  
            abNormal_features[key]=[]  
            for line in lines:  
                abNormal_features[key].append(np.float32(line.split()))  
    abNormal_features[key]=np.array(abNormal_features[key])  
  
    #abNormal_features=np.array(abNormal_features)  
  
    #print("Abnoraml features videos loded suceesfully.")  
  
    #print("Loading normal Features...")  
  
    videos = get_video_list(normal_path+"/normal.txt")  
    normal_features={}  
  
    for i in norm_list:  
        vid_path=os.path.join(normal_path,videos[i] )  
        if (os.path.isfile(vid_path) ):  
            with open(vid_path,'r') as f:  
                lines = f.read().splitlines()  
                key=os.path.basename(videos[i])  
                key=os.path.splitext(key)[0]  
                normal_features[key]=[]  
                for line in lines:  
                    normal_features[key].append(np.float32(line.split()))  
    normal_features[key]=np.array(normal_features[key])  
  
    #normal_features=np.array(normal_features)
```

```
#print("Normal Features Loaded successfully")
return abNormal_features, normal_features
```

In [6]:

```
def get_features_specific_video(key,path,is_abnormal=True):

    if is_abnormal:
        videos = get_video_list(path+"/anomaly.txt")
    else:
        videos = get_video_list(path+"/normal.txt")

    for video in videos:

        if key in video:
            vid_path=os.path.join(path,videos[i] )
            with open(vid_path,'r') as f:
                lines = f.read().splitlines()
            features=[]
            for line in lines:
                features.append(np.float32(line.split()))
    return np.array(features)
```

In [7]:

```
Anomaly,Normal=get_training_set("./out")#RoadAccidents028_x264
```

In [8]:

```
n_hidden1 = 512
n_hidden2 = 32
n_output = 1
batch_size = 32
```

In [9]:

```
def dnn_network(X):
    tf_h1 = {'weights':tf.Variable(tf.random_normal([4096, n_hidden1])), #4096 feature vector
              'biases':tf.Variable(tf.random_normal([n_hidden1]))}

    tf_h2 = {'weights':tf.Variable(tf.random_normal([n_hidden1, n_hidden2])), 
              'biases':tf.Variable(tf.random_normal([n_hidden2]))}

    tf_op = {'weights':tf.Variable(tf.random_normal([n_hidden2, n_output])),
              'biases':tf.Variable(tf.random_normal([n_output])),}

    l1 = tf.add(tf.matmul(X,tf_h1['weights']), tf_h1['biases'])
    l1 = tf.nn.relu(l1)
    l1 = tf.layers.dropout(l1, 0.6)

    l2 = tf.add(tf.matmul(l1,tf_h2['weights']), tf_h2['biases'])
    l2 = tf.layers.dropout(l2, 0.6)

    output = tf.matmul(l2,tf_op['weights']) + tf_op['biases']
    output = tf.nn.sigmoid(output)

    return output , tf_h1['weights'] , tf_h2['weights'] , tf_op['weights']
```

In [10]:

```
output , weights_1 , weights_2, weights_3 = dnn_network(x)
cost = 0.001 * (tf.nn.l2_loss(weights_1) + tf.nn.l2_loss(weights_2) + tf.nn.l2_loss(weights_3)) + h1
optimizer = tf.train.AdagradOptimizer(0.001).minimize(cost)
```

In [11]:

```
# Initialize and run
init = tf.global_variables_initializer()
sess = tf.Session()
sess.run(init)
```

In [12]:

```
saver = tf.train.Saver() # to save model
```

In [13]:

```
saver.restore(sess, './model_logs/501/501/model-501')
```

```
INFO:tensorflow:Restoring parameters from ./model_logs/501/501/model-501
```

In [14]:

```
def check_video_contains_anomaly(video):
    prediction_a=sess.run(output,feed_dict={x: video})
    prediction_a=prediction_a.flatten()
    # if anomaly score is greater than 0.4 then consider as anomaly
    index = np.where(prediction_a>0.4)[0]
    pred=0
    if prediction_a.max() > 0.4:
        pred=1
    return pred,index
```

this section generates data for further classification of video in to (fighting/accident)

In [15]:

```
abnormal_path="./out"
a_t_vid = get_video_list("./out"+"/anomaly.txt")
```

In [16]:

```
# for fighting video class will be 1
# for roadaccidents vlass will be 0

class_vid=[]
prediction =[] # prediction only for anomaly detection
anomaly_frames=[]

#video_class
for i in range(len(a_t_vid)):

    vid_path=os.path.join(abnormal_path,a_t_vid[i] )

    with open(vid_path, 'r') as f:
        lines = f.read().splitlines()
        key=os.path.basename(a_t_vid[i])
        key=os.path.splitext(key)[0]

        if "Fighting" in key: # this is for further classification using DNN
            class_vid.append(1)
        elif "Road" in key:
            class_vid.append(0)

    #abNormal_features[key]=[]
    features=[]

    for line in lines:
        features.append(np.float32(line.split()))


    is_anomaly,a_loc=check_video_contains_anomaly(features)

    prediction.append(is_anomaly)
    anomaly_frames.append(a_loc)
    #abNormal_features[key]=
    #if is_anomaly>0:
    #    is_anomaly)

    #abNormal_features[key]=np.array(abNormal_features[key])
```

In [17]:

```
import pickle

dup_set=open("Data_set.pkl","wb")
pickle.dump({"File_location":a_t_vid,
            "Anomaly_type":class_vid,
            "anomaly_frames":anomaly_frames},dup_set)
```

Anomaly type menas (1:Fighting / 0: Accident) AnomalyFrame contains frame no where anomaly occured.

This Data Set is used for further anomaly type classification

In [18]:

```
import pandas as pd
pd.DataFrame(zip(a_t_vid,class_vid,anomaly_frames),columns=['File_location', 'Anomaly_type', 'Anomaly_frame'])
```

Out [18] :

	File_location	Anomaly_type	Anomaly_frame
0	Anomaly-Videos-Part-2/Fighting/Fighting002_x26...	1	[]
1	Anomaly-Videos-Part-2/Fighting/Fighting003_x26...	1	[]
2	Anomaly-Videos-Part-2/Fighting/Fighting004_x26...	1	[]
3	Anomaly-Videos-Part-2/Fighting/Fighting005_x26...	1	[]
4	Anomaly-Videos-Part-2/Fighting/Fighting006_x26...	1	[]
5	Anomaly-Videos-Part-2/Fighting/Fighting007_x26...	1	[]
6	Anomaly-Videos-Part-2/Fighting/Fighting008_x26...	1	[28, 29, 30, 31]
7	Anomaly-Videos-Part-2/Fighting/Fighting009_x26...	1	[]
8	Anomaly-Videos-Part-2/Fighting/Fighting010_x26...	1	[22]
9	Anomaly-Videos-Part-2/Fighting/Fighting011_x26...	1	[]
10	Anomaly-Videos-Part-2/Fighting/Fighting012_x26...	1	[0, 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 15, 30]
11	Anomaly-Videos-Part-2/Fighting/Fighting013_x26...	1	[]
12	Anomaly-Videos-Part-2/Fighting/Fighting014_x26...	1	[]
13	Anomaly-Videos-Part-2/Fighting/Fighting015_x26...	1	[]
14	Anomaly-Videos-Part-2/Fighting/Fighting016_x26...	1	[31]
15	Anomaly-Videos-Part-2/Fighting/Fighting017_x26...	1	[21, 22, 27, 28, 29, 30]
16	Anomaly-Videos-Part-2/Fighting/Fighting018_x26...	1	[26, 28]
17	Anomaly-Videos-Part-2/Fighting/Fighting019_x26...	1	[0, 1, 2, 3, 12, 17, 18, 20, 23, 24, 25, 27, 2...]
18	Anomaly-Videos-Part-2/Fighting/Fighting020_x26...	1	[4, 5, 30, 31]
19	Anomaly-Videos-Part-2/Fighting/Fighting021_x26...	1	[]
20	Anomaly-Videos-Part-2/Fighting/Fighting022_x26...	1	[]
21	Anomaly-Videos-Part-2/Fighting/Fighting023_x26...	1	[0, 1, 2, 22, 29, 30, 31]
22	Anomaly-Videos-Part-2/Fighting/Fighting024_x26...	1	[19, 24]
23	Anomaly-Videos-Part-2/Fighting/Fighting025_x26...	1	[]

	File_location	Anomaly_type	Anomaly_frame
24	Anomaly-Videos-Part-2/Fighting/Fighting026_x26...	1	[0, 31]
25	Anomaly-Videos-Part-2/Fighting/Fighting027_x26...	1	[]
26	Anomaly-Videos-Part-2/Fighting/Fighting028_x26...	1	[23]
27	Anomaly-Videos-Part-2/Fighting/Fighting029_x26...	1	[]
28	Anomaly-Videos-Part-2/Fighting/Fighting030_x26...	1	[27, 28, 29]
29	Anomaly-Videos-Part-2/Fighting/Fighting031_x26...	1	[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,...]
...
146	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[24, 28]
147	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[1, 5, 6, 7, 9, 11, 12, 22, 31]
148	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
149	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[0, 13, 28]
150	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
151	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[3, 4, 6, 7, 9, 27]
152	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
153	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[27]
154	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
155	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
156	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[7]
157	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14...]
158	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[7, 9, 13, 14, 16]
159	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[1, 2, 3, 4, 9, 10, 11, 12, 13]
160	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[17]
161	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
162	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
163	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[1, 14, 15, 16, 17, 18, 19, 20, 21, 22, 28, 29...]

	File_location	Anomaly_type	Anomaly_frame
164	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[0, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14...]
165	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[31]
166	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[0, 2, 3, 4, 6, 7, 18, 20, 21, 22, 23, 24, 25,...]
167	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[11]
168	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[0, 9, 10, 11, 12, 21, 22, 23, 24]
169	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
170	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]
171	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[0, 1, 2, 3, 4]
172	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[1, 2, 3, 6, 7, 8, 10]
173	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[4, 5, 6]
174	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14]
175	Anomaly-Videos-Part-3/RoadAccidents/RoadAccide...	0	[]

176 rows × 3 columns

In [19]:

```
normal_path=".out"
n_t_vid = get_video_list("./out"+"/anomaly.txt")
```

In [29]:

```
pred_n=[]
for i in range(len(n_t_vid)):
    vid_path=os.path.join(abnormal_path,n_t_vid[i] )

    with open(vid_path, 'r') as f:
        lines = f.read().splitlines()
    features=[]

    for line in lines:
        features.append(np.float32(line.split()))

    pred,_=check_video_contains_anomaly(features)

    pred_n.append(pred)
```

In [30]:

```
tp=np.array([1]*176)
tn=np.array([0]*176)
```

In [31]:

```
actual=np.hstack((tp,tn))
```

In [38]:

```
final_pred=np.hstack((np.array(prediction),np.array(pred_n)))
```

In [39]:

```
import sklearn.metrics as metrics
fpr, tpr, threshold = metrics.roc_curve(actual, final_pred)
roc_auc = metrics.auc(fpr, tpr)
```

In [41]:

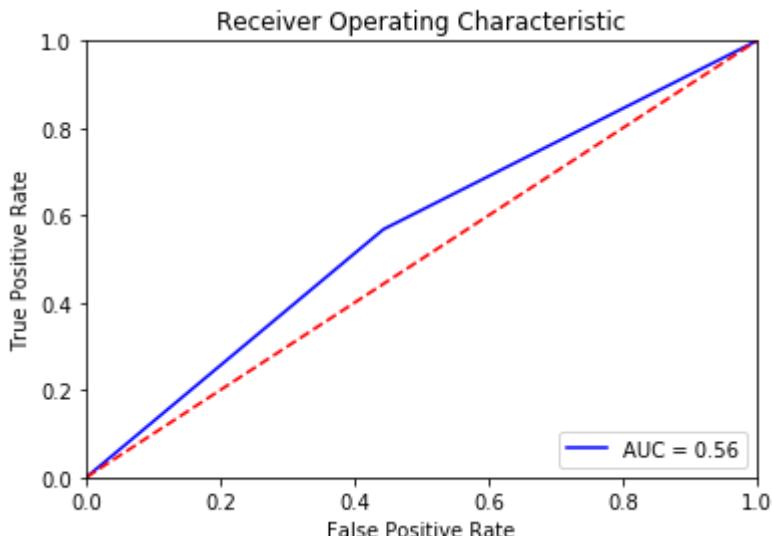
```
metrics.confusion_matrix(actual,final_pred)
```

Out[41]:

```
array([[ 98,  78],
       [ 76, 100]])
```

In [40]:

```
plt.title('Receiver Operating Characteristic')
plt.plot(fpr, tpr, 'b', label = 'AUC = %0.2f' % roc_auc)
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1], 'r--')
plt.xlim([0, 1])
plt.ylim([0, 1])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



Video Visualization

In [171]:

```
from video_utils import *
import matplotlib.image as mpimg
```

In [133]:

```
import glob
def create_video(Image_source,output_video):
    img_array = []
    for filename in glob.glob(Image_source+'*.jpg'):
        img = cv2.imread(filename)
        height, width, layers = img.shape
        size = (width,height)
        img_array.append(img)

    out = cv2.VideoWriter(output_video,cv2.VideoWriter_fourcc(*'DIVX'), 10, size
    )

    for i in range(len(img_array)):
        out.write(img_array[i])

    out.release()
```

In [164]:

```

def capture_anomalous_video_segment(video_path,video_key):
    max_processing_sec = 599
    sample_every_N_sec = 1
    frame_inc=16
    num_frames_per_clip = 16
    start_frame = 1

    # print(video_key)
    fc,fr=get_frame_count(video_path)

    end_frame = min(fc, int(max_processing_sec * fr)) -num_frames_per_clip

    #video_feature =get_features_specific_video(video_key,"./out",)
    pred_a=sess.run(output,feed_dict={x: Anomaly[video_key]})

    #print(pred_a)

    start_frames=list(range(start_frame, end_frame, frame_inc))

    frame_bin=np.round(np.linspace(1, len(start_frames), num=33))

    pred_a=pred_a.flatten()
    fb_pre=np.where(pred_a>0.4)[0]

    video_segments=[]
    i=0
    #for i in range(len(fb_pre)-1):
    #loop to capture anomalous start and end segment
    while(i<len(fb_pre)-1):
        s_seg=frame_bin[fb_pre[i]]*16
        if (fb_pre[i+1] -fb_pre[i] ==1): #diffreication
            while(i<len(fb_pre)-1 and fb_pre[i+1]-fb_pre[i]==1):
                i +=1
            #i+=1
            e_seg=frame_bin[fb_pre[i]]*16+16
        else:
            i += 1
            e_seg=s_seg+16
        video_segments.append([s_seg,e_seg])

    # p=np.zeros(end_frame)
    # for i,time in enumerate(video_segments):
    #     p[int(time[0]):int(time[1])]=pred_a[fb_pre[i]]
    v_map=frame_bin[fb_pre]*16
    return video_segments,v_map,pred_a #,p

```

In [165]:

```
def clip_anoloums_video_from_segment(video_to_extract,video_key,output_vid_dir):
    vf,gf,pred_a=capture_anomoulus_video_segment(video_to_extract,video_key)

    #path to store Video segment
    path = os.path.join(output_vid_dir,video_key)
    os.makedirs(path, exist_ok=True)

    for start, end in vf:
        n_frames = int(end-start)
        extract_frames(video_to_extract,start,path,n_frames)

    output_video=os.path.join(path,video_key)
    #print(output_video)
    create_video(path,output_video+".avi")

    return gf,pred_a
```

generating video for RoadAccident

This solution also includes video and images where exact anomaly happened

In [218]:

```
video_to_extract=("../Anomaly-Videos-Part-1/Anomaly-Videos-Part-3/RoadAccidents/RoadAccidents095_x264.mp4"
frame_nos,pred_a=clip_anoloums_video_from_segment(video_to_extract,"RoadAccidents095_x264","./test5"))

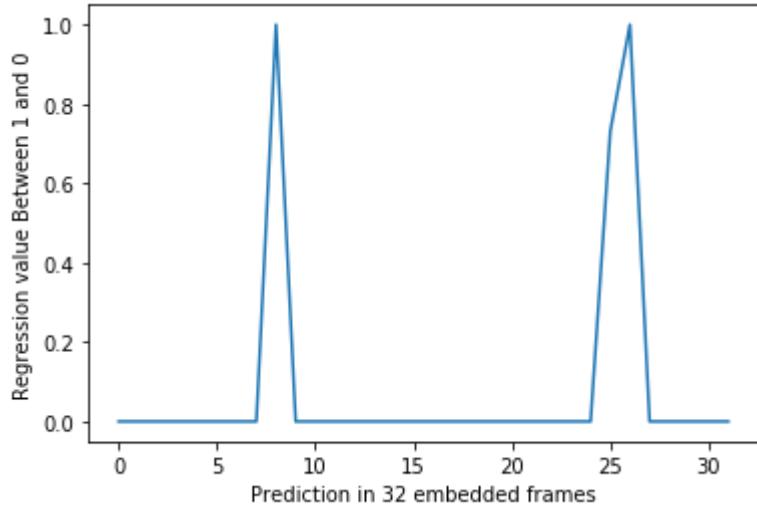
width = 320.0
height = 240.0
```

In [219]:

```
plt.plot(pred_a)
plt.ylabel('Regression value Between 1 and 0')
plt.xlabel('Prediction in 32 embedded frames')
```

Out[219]:

```
Text(0.5, 0, 'Prediction in 32 embedded frames')
```



The plot above shows anomaly in video so what are the frames where anomaly occurred

In [220]:

```
frame_nos
```

Out[220]:

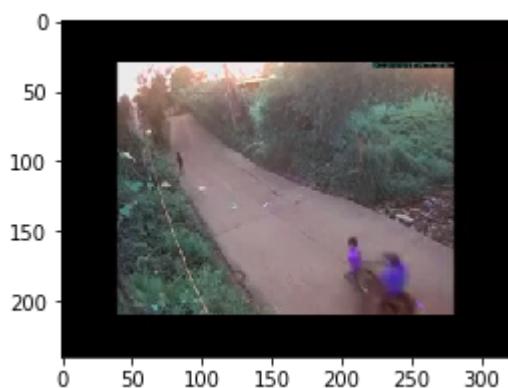
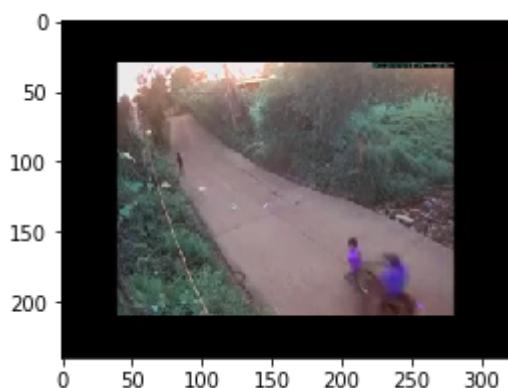
```
array([288., 896., 928.])
```

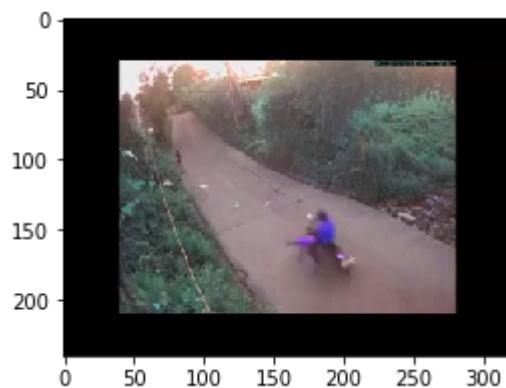
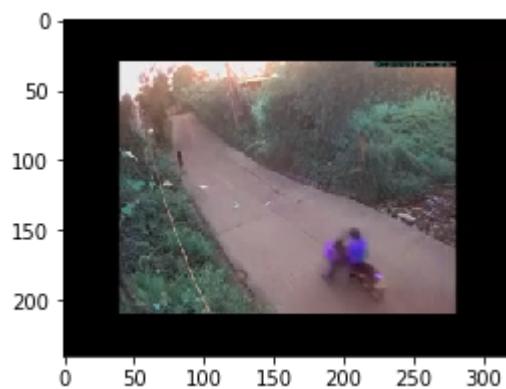
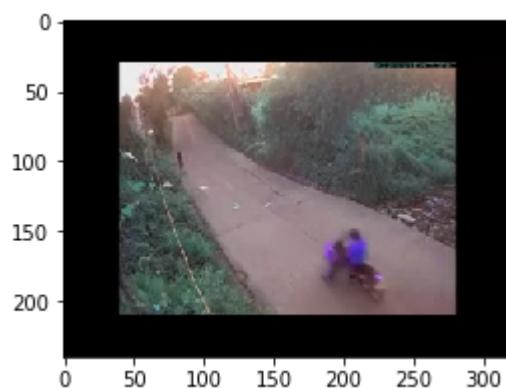
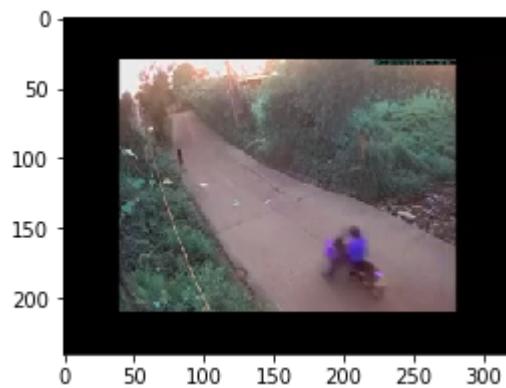
The plot below shows exact frames where anomaly occurred

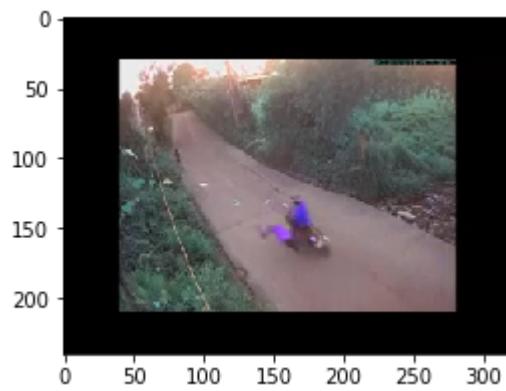
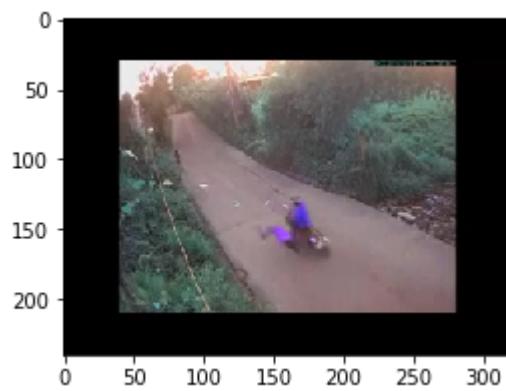
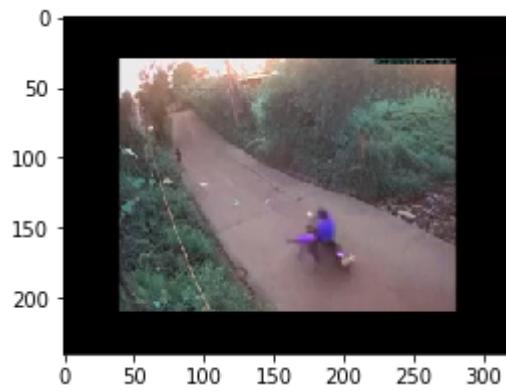
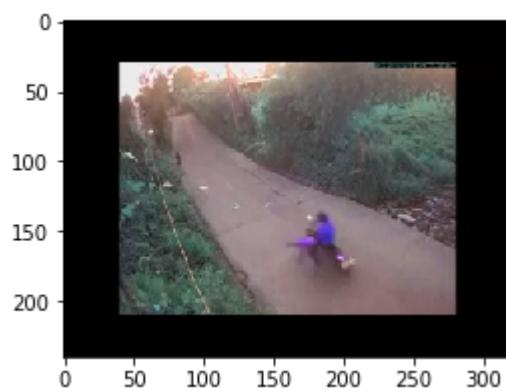
In [184]:

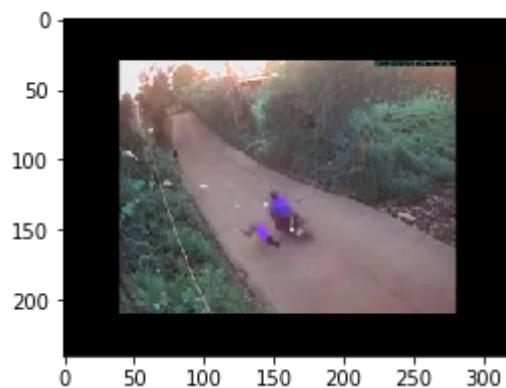
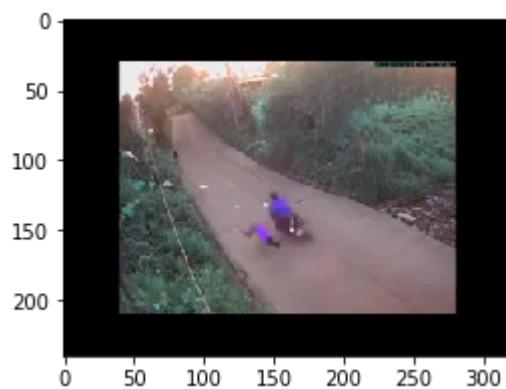
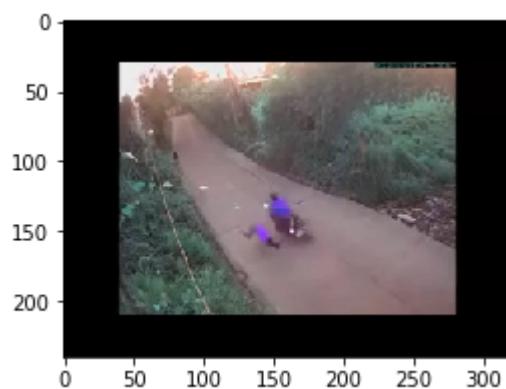
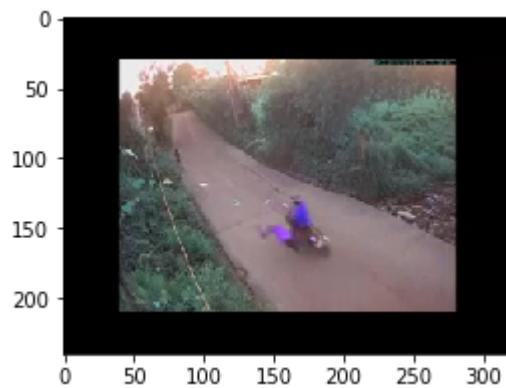
```
imgs=glob.glob("./test5/RoadAccidents095_x264/*/*.jpg")
#mpimg.imread('MyImage.png')
imgs.sort()
# from IPython.display import Image
# Image(filename=imgs[0])
# Image(filename=imgs[1])
for img in imgs:
    plt.figure(figsize=(4,4))
    plt.imshow(cv2.imread(img))
```

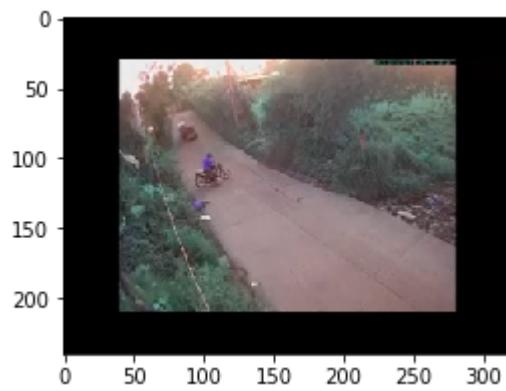
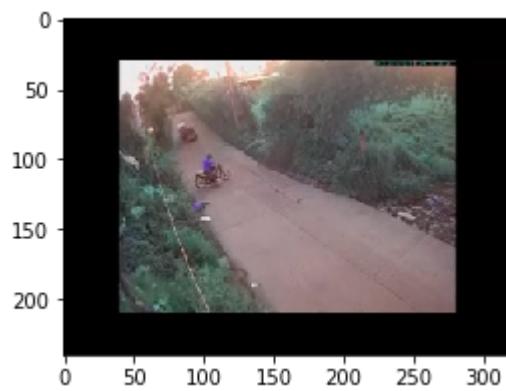
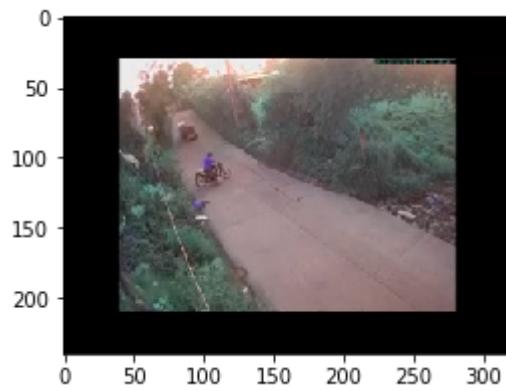
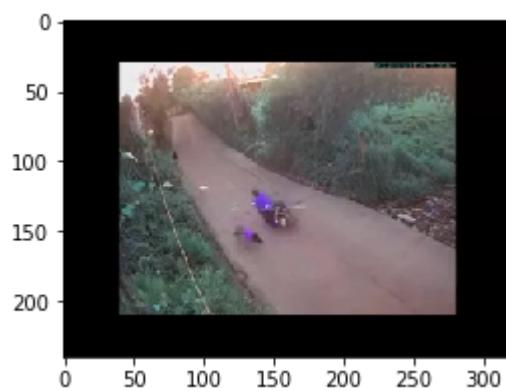
```
/home/ganesh/anaconda3/envs/env_3_6/lib/python3.6/site-packages/ipykernel_launcher.py:8: RuntimeWarning: More than 20 figures have been opened. Figures created through the pyplot interface (`matplotlib.pyplot.figure`) are retained until explicitly closed and may consume too much memory. (To control this warning, see the rcParam `figure.max_open_warning` ).
```

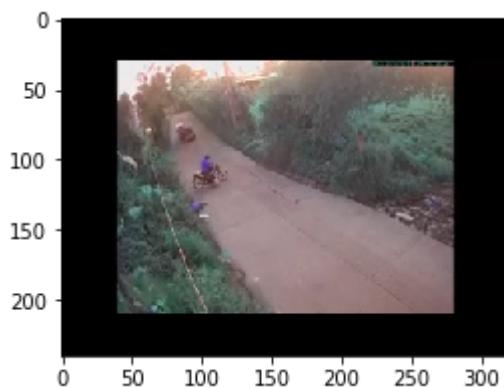
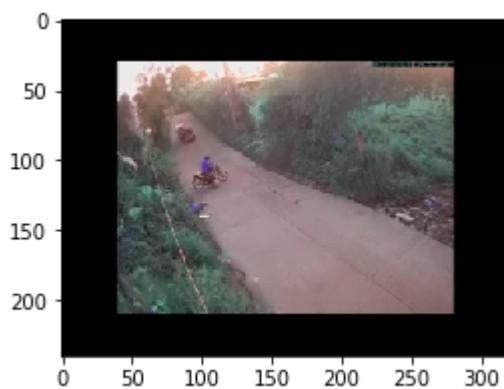
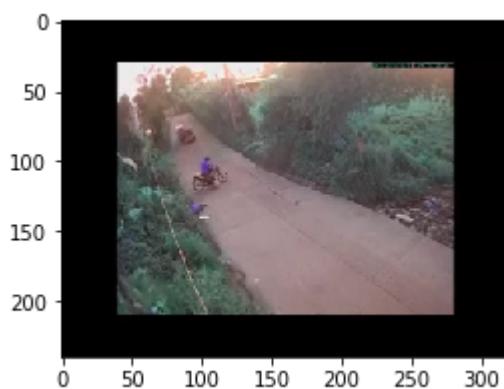
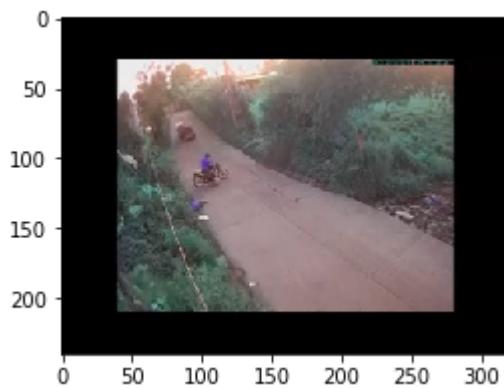


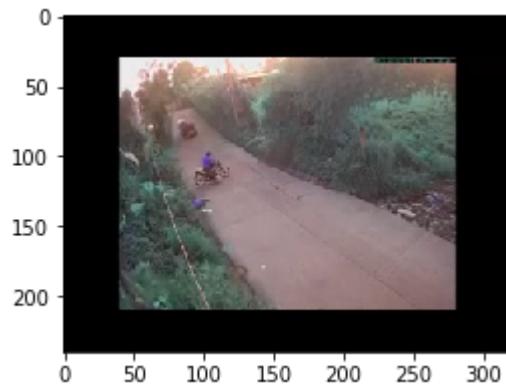
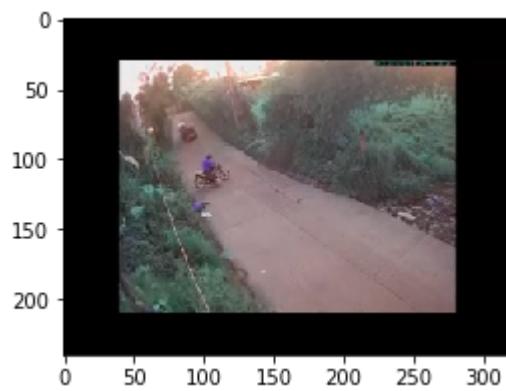
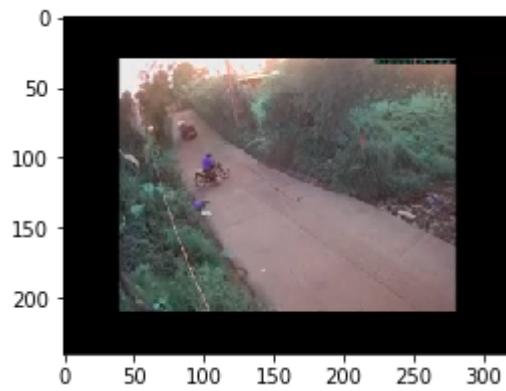
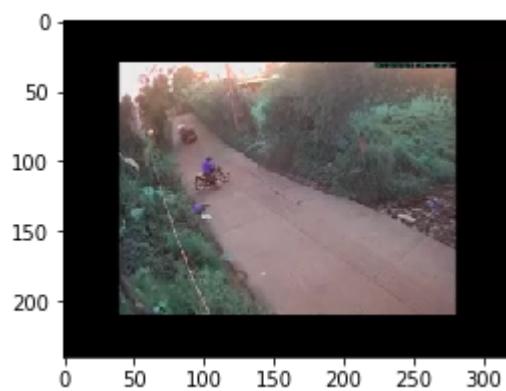


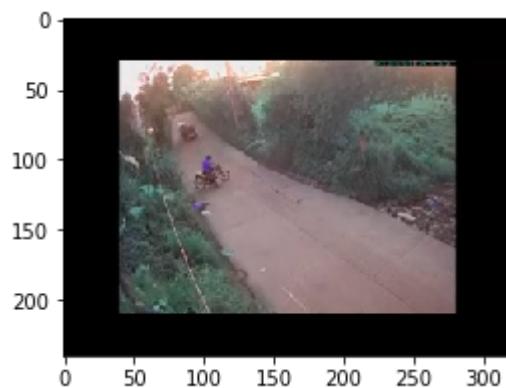
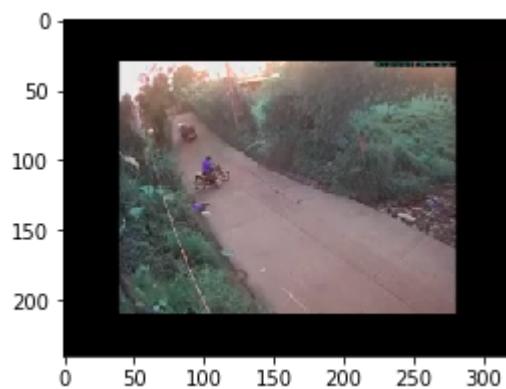
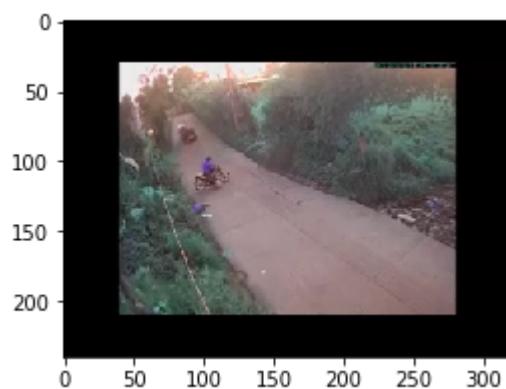
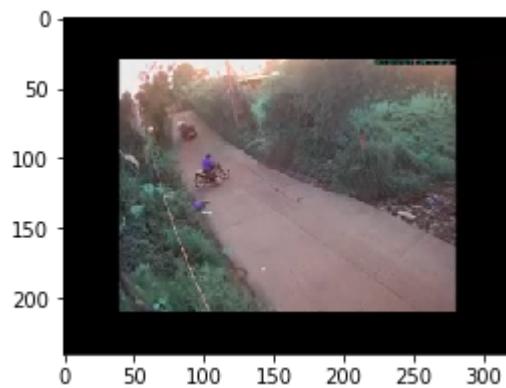


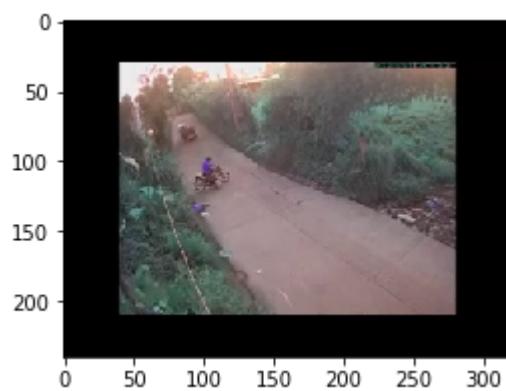
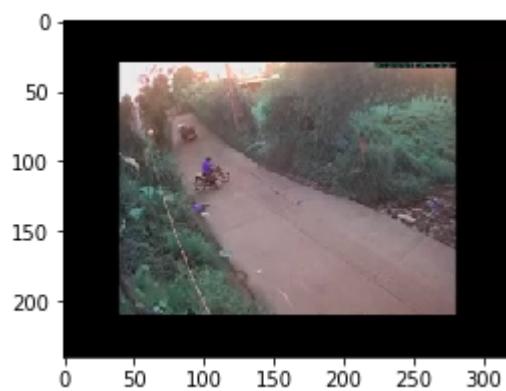
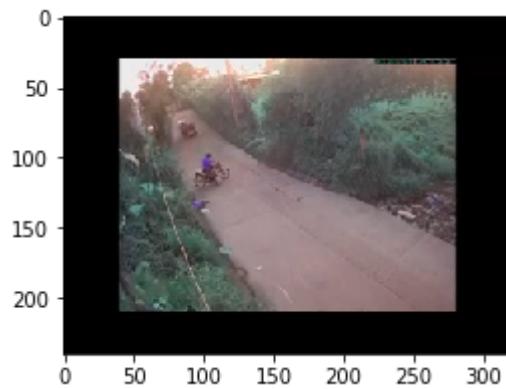
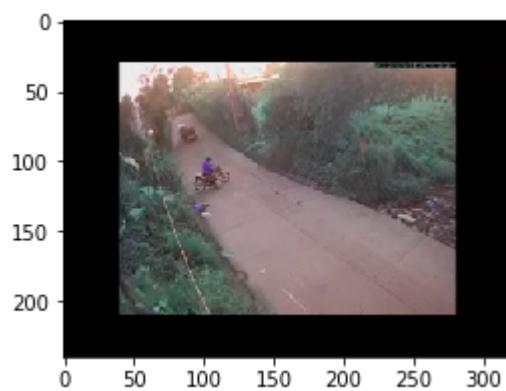


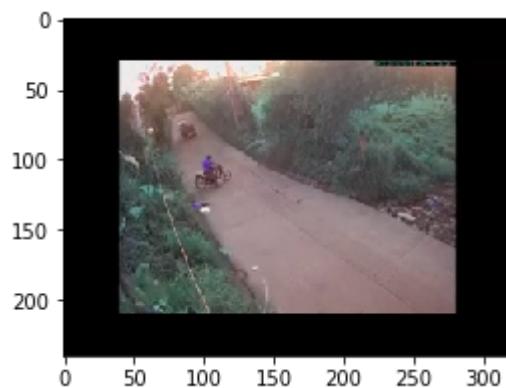
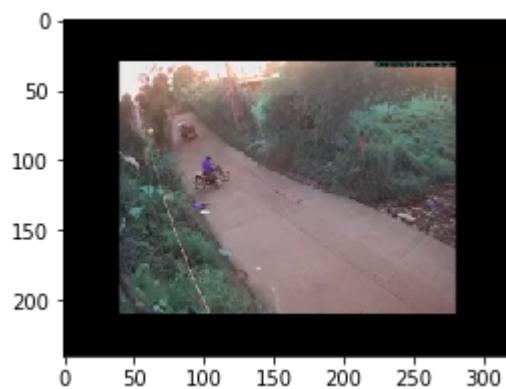
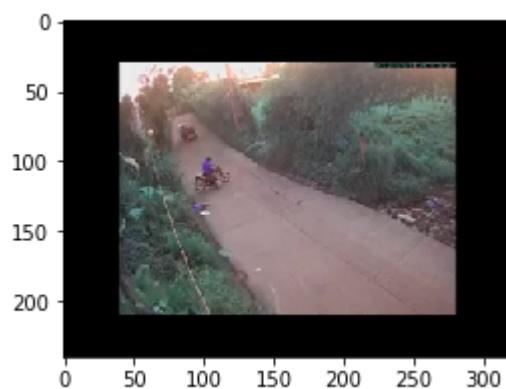
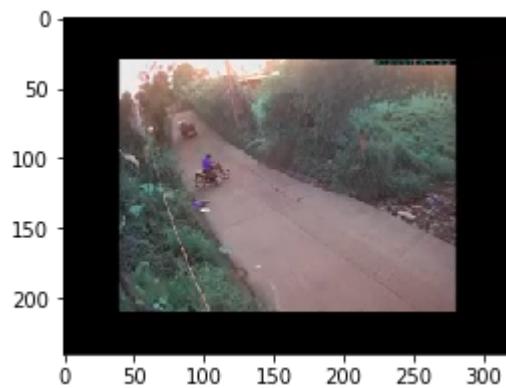


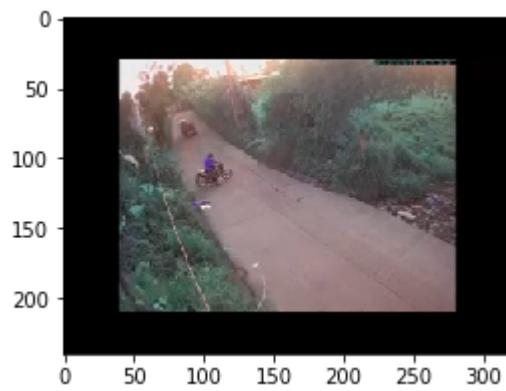
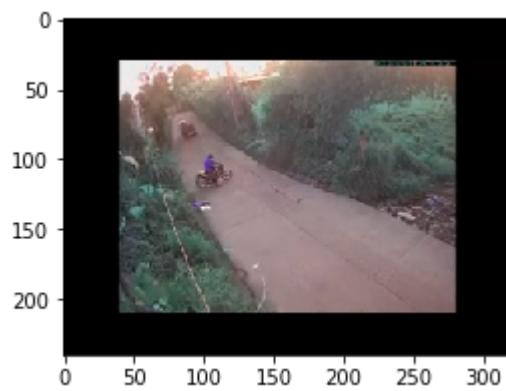
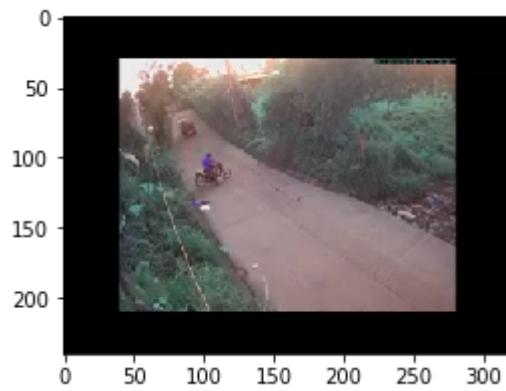
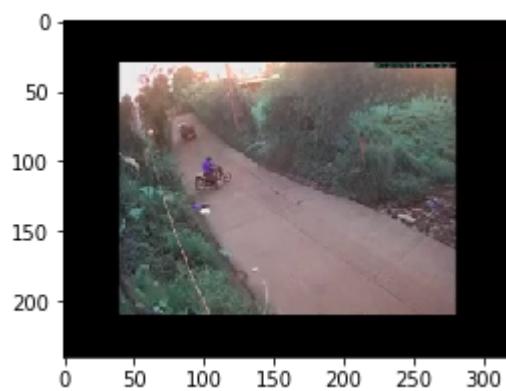


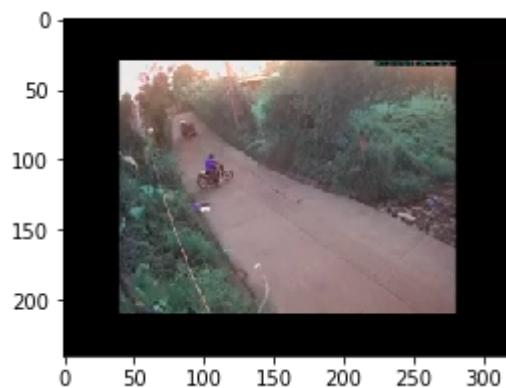
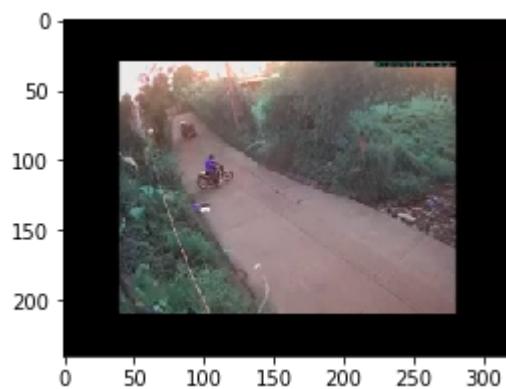
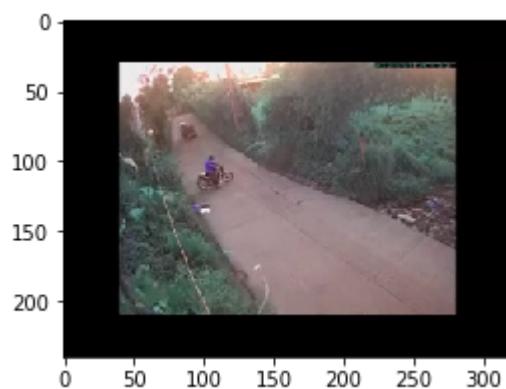
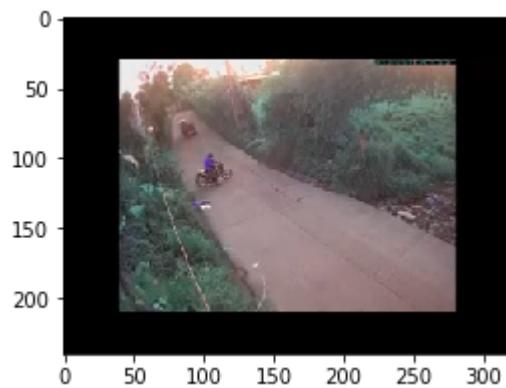


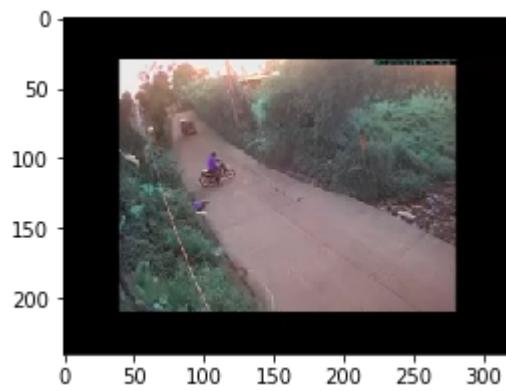
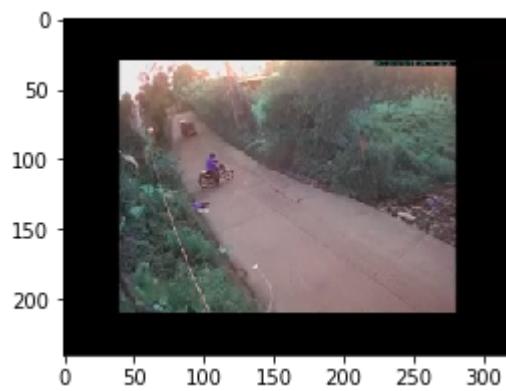
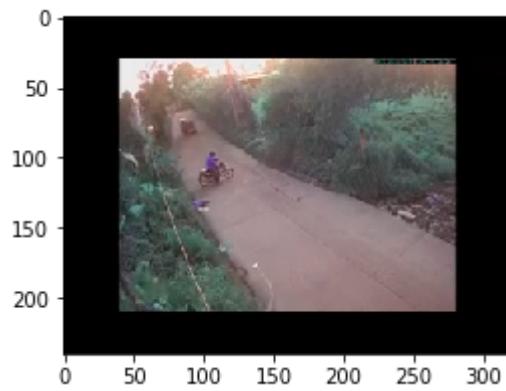
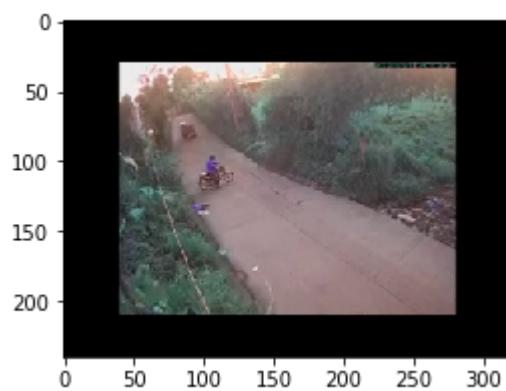


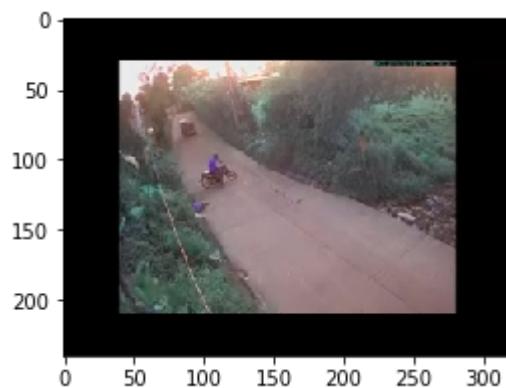
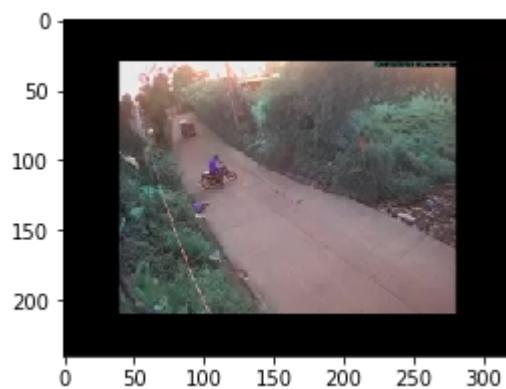
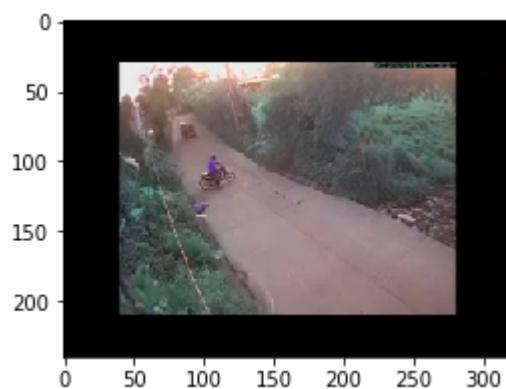
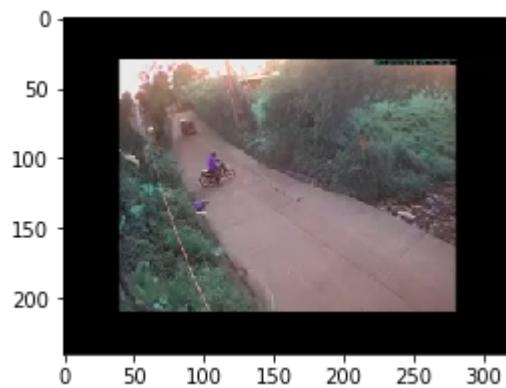


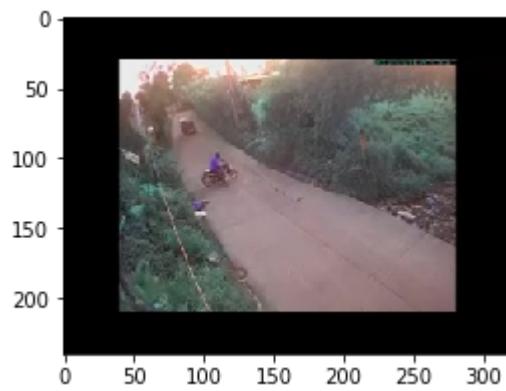
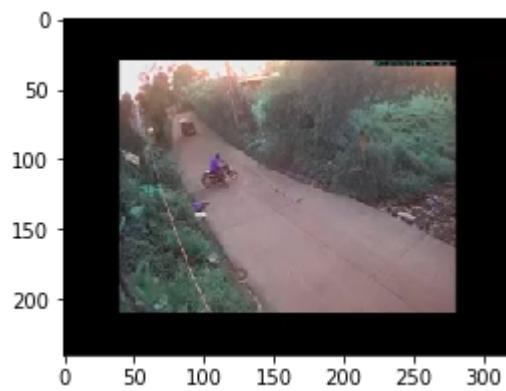
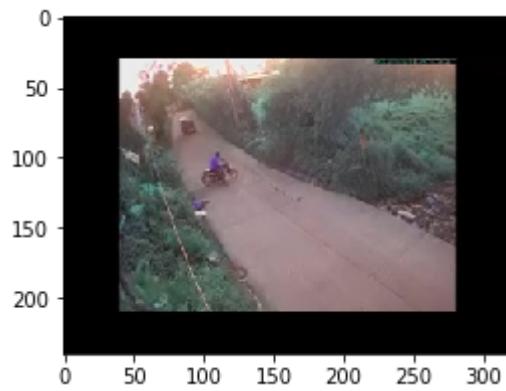
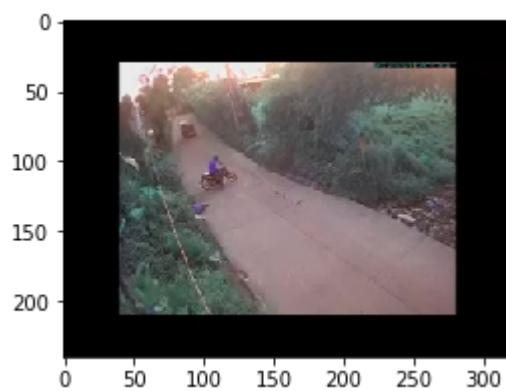


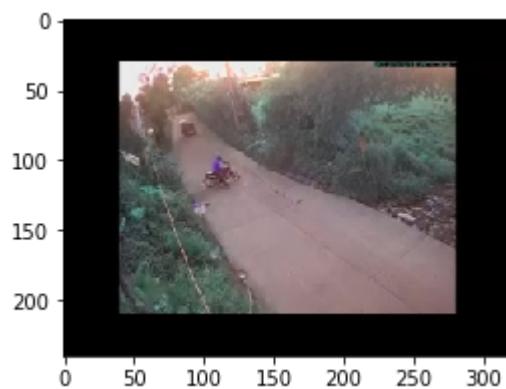
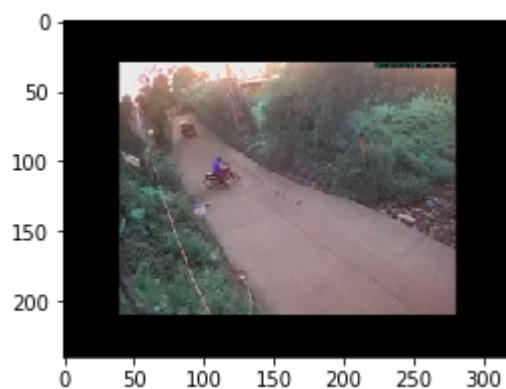
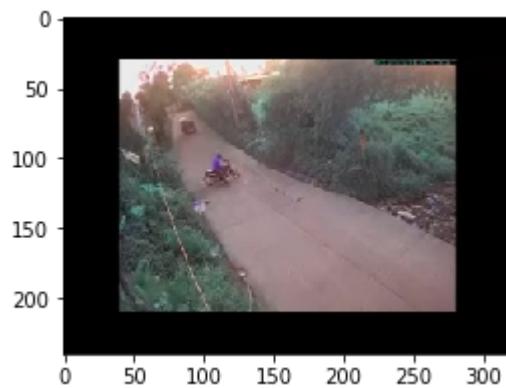














generating video for fight

In [221]:

```
video_to_extract="..../Anomaly-Videos-Part-1/Anomaly-Videos-Part-2/Fighting/Fighting032_x264.mp4"
frame_nos,pred_a=clip_anoloums_video_from_segment(video_to_extract,"Fighting032_x264","./test5")

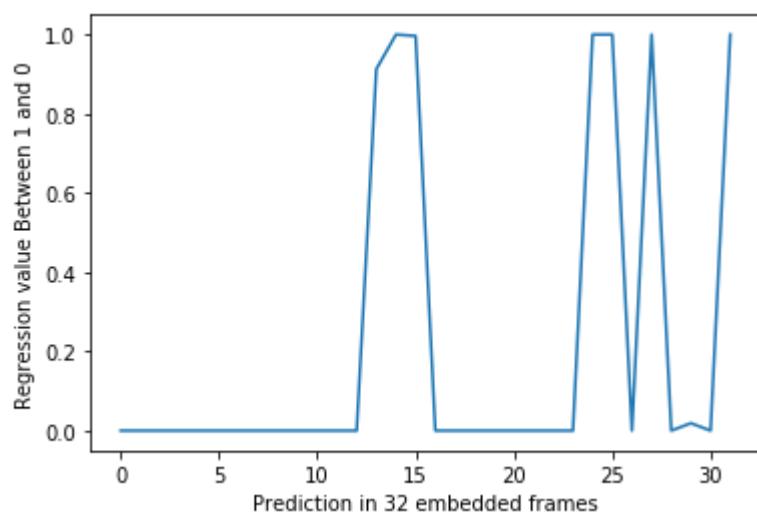
width = 320.0
height = 240.0
```

In [222]:

```
plt.plot(pred_a)
plt.ylabel('Regression value Between 1 and 0')
plt.xlabel('Prediction in 32 embedded frames')
```

Out[222]:

Text(0.5, 0, 'Prediction in 32 embedded frames')



This video has anomaly at multiple places like initially fighting starts then after some garbage discussion and again fight so model predicts this temporal anomalies

In [188]:

```
imgs=glob.glob("./test5/Fighting032_x264/*/*.jpg")
#mpimg.imread('MyImage.png')
imgs.sort()
# from IPython.display import Image
# Image(filename=imgs[0])
# Image(filename=imgs[1])
for img in imgs:
    plt.figure(figsize=(4,4))
    plt.imshow(cv2.imread(img))
```

```
/home/ganesh/anaconda3/envs/env_3_6/lib/python3.6/site-packages/ipykernel_launcher.py:8: RuntimeWarning: More than 20 figures have been opened. Figures created through the pyplot interface (`matplotlib.pyplot.figure`) are retained until explicitly closed and may consume too much memory. (To control this warning, see the rcParam `figure.max_open_warning` ).
```



























































































Normal Videos are predicted as 0

In [215]:

```
pred_a=sess.run(output,feed_dict={x: Normal['Normal_Videos135_x264']})
```

In [217]:

```
plt.plot(pred_a)
plt.ylabel('Regression value Between 1 and 0')
plt.xlabel('Prediction in 32 embedded frames')
```

Out[217]:

```
Text(0.5, 0, 'Prediction in 32 embedded frames')
```

