CRIME VISION:ADVANCED CRIME CLASSIFICATION

Submitted by :

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1.INTRODUCTION

1.1 PROJECT OVERVIEW

"CRIME VISION:ADVANCED CRIME CLASSCIFICATION"

Predictive policing is the use of analytical techniques to identify likely places of future crime scenes or past crime perpetrators, by applying statistical predictions [1]. As a crime typically involves a perpetrator and a target and occurs at a certain place and time, techniques of predictive policing need to answer: (a) who will commit a crime, (b) who will be offended, (c) what type of crime, (d) in which location and (e) at what time a new crime will take place. This work does not focus on the victim and the offender, but on the prediction of when and where a certain crime type will occur, using past data.The ultimate goal, in a policing context, is the selection of the top areas in the city for the prioritisation of law enforcement resources per department. One of the most challenging issues of police departments is to have accurate crime forecasts to dynamically deploy patrols and other resources to improve deterring of crime occurrence and police response times. Routine activity theory [2] suggests that most crimes take place when three conditions are met: a motivated offender, a suitable victim and lack of victim protection. The rational choice theory [3], suggests that prospective criminal weights the gain of successfully committing the crime against the probability of being caught and makes a rational choice whether to actually commit the crime or not. Both theories agree that a crime takes place when a person willing to commit it has an opportunity to do so. As empirical studies in near repeat victimisation [4,5,6,7] have shown, these opportunities are not randomly distributed but follow patterns in both space and time. Traditionally, police officers use maps of an area and place a pin on the map for every reported incident. Studying these maps, they can detect these patterns and, thus, efficiently predict hotspots; the areas with the higher possibility for a crime to occur, compared to the neighbouring areas.

1.2 PURPOSE

Criminology literature investigates the relationship between crime and various features, developing approaches for crime forecasting.

The majority of the works focus on the prediction of hotspots, which are areas of varying geographical size with high crime probability. The methods include Spatial and Temporal Analysis of Crime (STAC)[22], Thematic Mapping [42] and Kernel Density Estimation (KDE) [33]. In STAC, the densest concentrations of points on the map are detected and then fit to a standard deviational ellipse for each one. Through the study of the size and the alignment of the ellipses, the analyst can draw conclusions about the nature of the underlying crime clusters [6].

2. LITERATUTE SURVEY

Songnian Li et.al.in their paper "Geospatial big data handling theory and methods: A review and research challenges", mentioned the proposed system, they made review on various geospatial theory and methods used to handle geospatial big data. Given some special attributes. Authors considered that customary data taking controlling methodologies and techniques are lacking and the following domains were recognized as in requirement for further advancement and examination in the control. This incorporates the advancements in calculations to manage real-time analytics and to support ongoing flooding data, as well as improving new spatial indexing techniques. The improvement of theoretical and methodological ways to deal with transfer of big data from illustrative and parallel research and applications to ones that investigates easygoing and illustrative connections.

2.1 EXISTING PROBLEM

The primary research aims to find various efficient algorithms for predicting neighborhood crimes. In our previous work [6], we used statistical analysis to predict the crimes in Newyork city. Our paper got good attention from the researchers, so we wanted to look for the efficient machine learning and deep learning approaches used in

this area. We have followed a systematic approach to select the papers for this review. As part of this research, we have considered the papers from multiple databases related to predicting crime.

2.2 REFERENCES

Nowadays automatic visual surveillance is the main need for security and this paper presents the first step in the direction of automatic visual weapon detection. The objective of our paper is to develop a framework for visual weapon detection for surveillance. By using the K-mean clustering algorithm the proposed framework exploits the color-based segmentation to eliminate unrelated objects from an image. Speeded up robust features (SURF) interest point detector is used to locate the weapon. Our framework is robust enough in terms of scale, rotation, and occlusion. We have implemented and tested the system over sample images of weapons. Our system performs under different appearances of images.

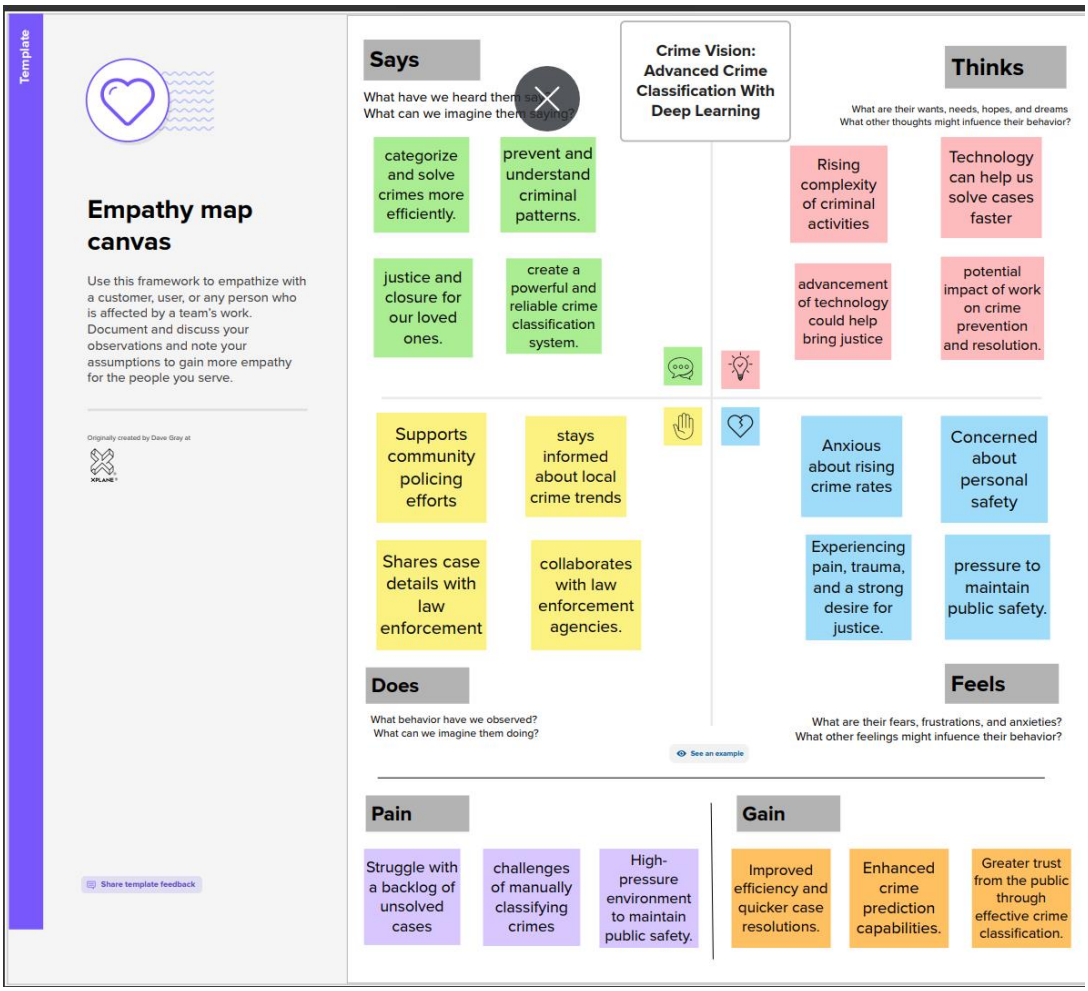
2.3 PROBLEM STATEMENT DEFINITION

Crimes now a days are increasing day by day and with different level ofintensity and versatility. The result is a great loss to society in terms of monitory loss,social loss and further it enhances the level of threat against the smooth livelihood inthe society. To overcome this problem, the computing era can help to reduce the crimeor even may be helpful in predicting the crime so that sufficient measures can betaken to minimize the loss to property and life. The crime rate prediction strategiescan be applied on historical data available in the police records by examining the dataat various angles like reason of crime, frequency of similar kind of crimes at specificlocation with other parameters to prepare the model crime prediction.

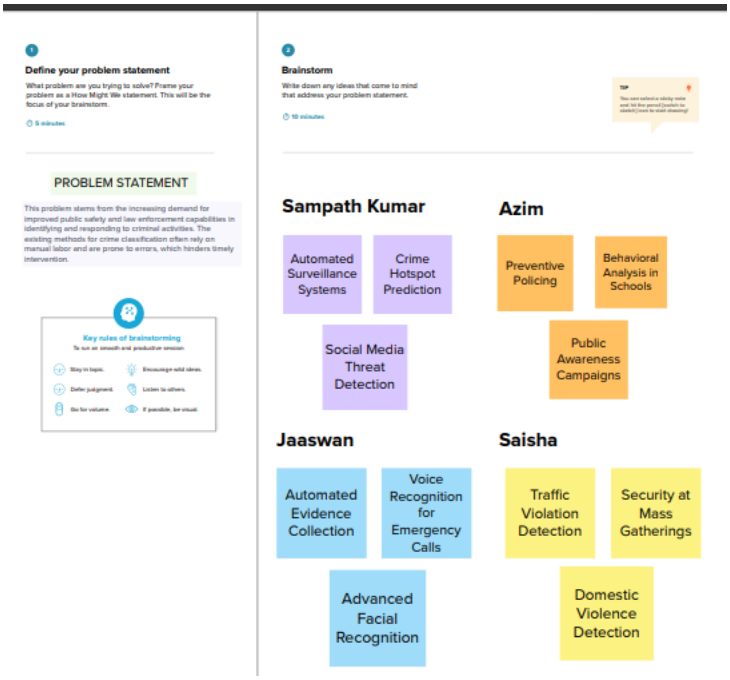
3. IDEATION AND PROPOSED SOLUTION

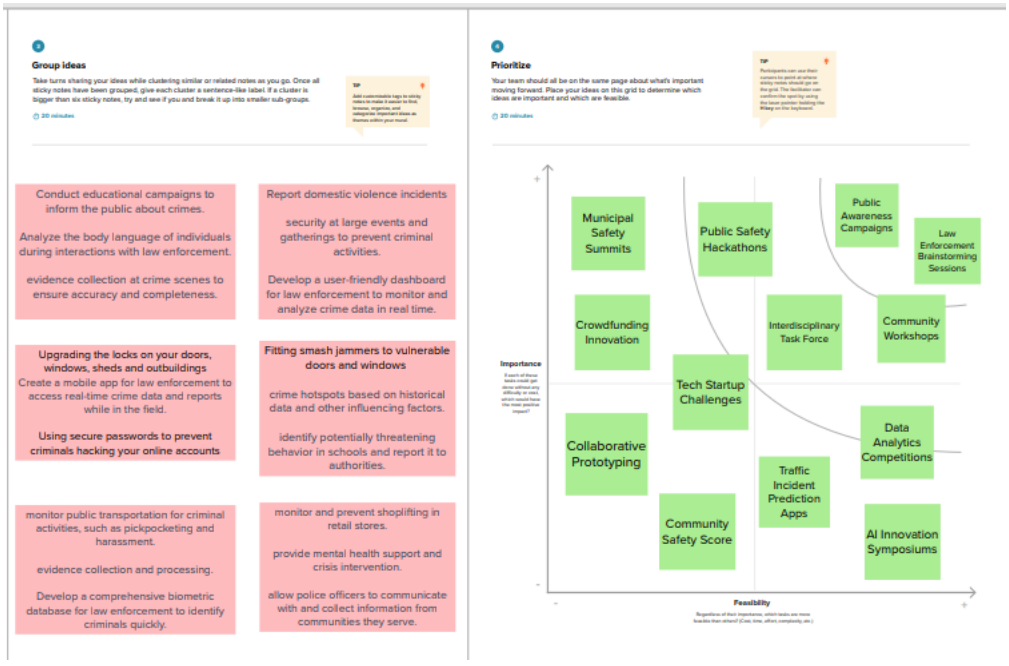
The proposed system is made on the basis of the research work that is done bygoing through various such documentations. Nearly all of the crimes are predictingbased on the location and the types of crimes that are occurring in those areas. Onsurveying previous works, Linear Regression, Decision Tree and Random Forest tendto give good accuracy so these models are used in this paper to predict crimes. Thedataset used in this paper is fromdata.world.com. The data set contains different typesof crimes that being committed in India according to the state and year respectively.

3.1 EMTATHY MAP CANVAS

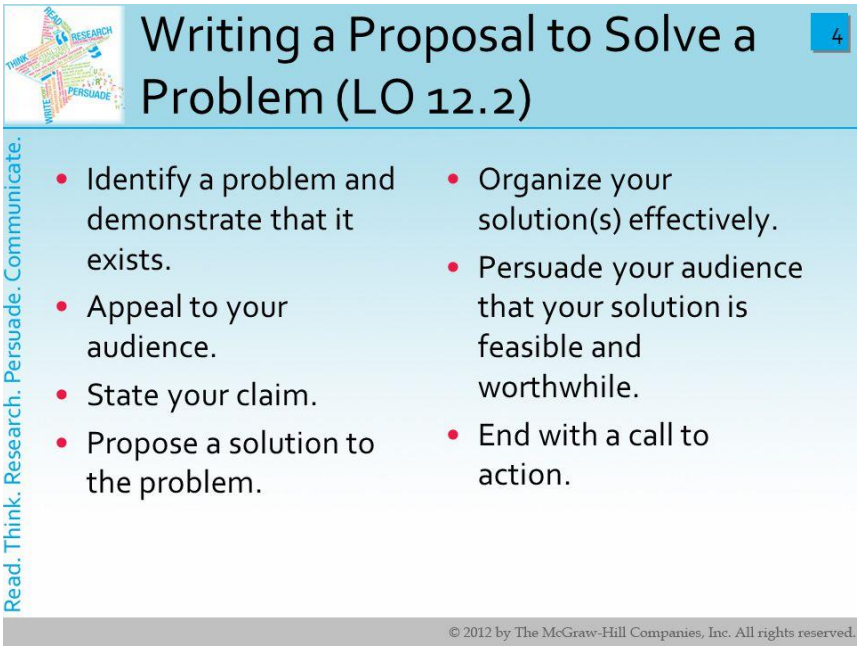


3.2 IDEATION &BRAIN STORMING

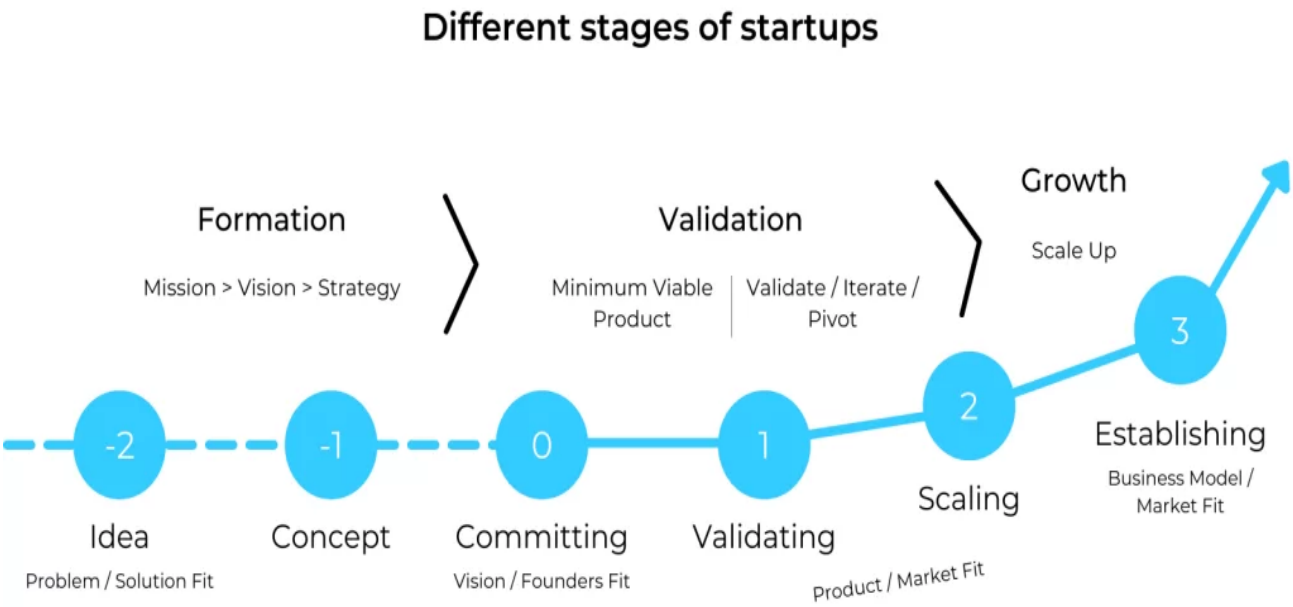




3.3 PROPOSED SOLUTION



3.4 PROMBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

1.Data Collection

2.Data Pre processing

3.Training and Testing

4.Modiling

5.Predicting

4.1 FUNCTIONAL REQUIREMENT

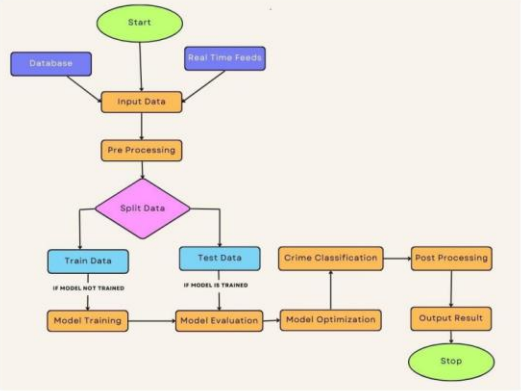
A functional requirement is a statement of how a system must behave. It defines what the system should do in order to meet the user's needs or expectations. Functional requirements can be thought of as features that the user detects.

4.2 NON-FUNCTIONAL REQUIREMENT

Packing slips shall be printed on both sides of 4”x 6” white paper, the standard size for packing slips used by local printers.

5.PROJECT DESGIN

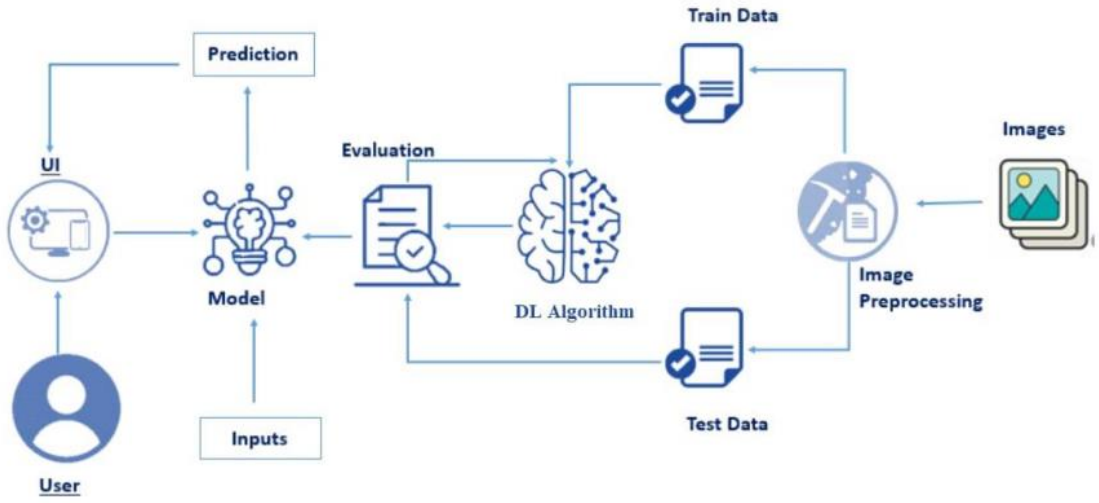
5.1 Data Flow Diagrams & User Stories



A process of outlining all of a project's stages and creating a project plan . It includes strategizing, developing ideas, gathering resources and creating processes to achieve goals and keep within a budget and deadline.

5.2 Solution Architecture

The proposed solution architecture for an AI crime classification system using deep learning follows a supervised learning approach, where a deep neural network is trained to predict the type of crime based on diverse features such as location, time, and crime characteristics. This architecture comprises several key stages. It initiates with the collection and preprocessing of crime data from various sources, followed by the crucial step of data labeling, associating each entry with its respective crime type. Feature extraction is then employed to derive relevant input attributes for the neural network, allowing it to discern patterns and relationships in the data. The heart of the system lies in the deep learning model, which is trained on the labeled dataset. Subsequently, rigorous evaluation ensures the model's accuracy and effectiveness, leading to its deployment within law enforcement agencies for real-time or batch crime classification tasks. Importantly, a feedback loop is integrated to continually improve the model's performance, adapt to evolving crime patterns, and accommodate new data sources or features. This scalable and modular architecture empowers law enforcement to enhance the precision and efficiency of crime classification, ultimately contributing to more effective crime resolution and safer communities



6. PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture

S.No	Component	Description	Technology
1.	UI (User Interface)	The system incorporates visual and interactive components that enable users to engage with and manipulate its features.	HTML, CSS, JavaScript, UI frameworks (e.g., React, Angular)
2.	Model	The computational framework or model that acquires knowledge from data and generates forecasts.	Deep learning frameworks (e.g., TensorFlow, PyTorch), programming languages (e.g., Python), neural network architectures (e.g., CNN, RNN)
3.	Deep Learning Algorithm	The particular algorithm or method employed in the deep learning model to discern patterns and make forecasts.	Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), YOLO (You Only Look Once), etc.
4.	Evaluation	Evaluating the model's performance and its effectiveness in action.	Metrics (e.g., accuracy, precision, recall, F1score), programming languages (e.g., Python), data analysis libraries (e.g., NumPy, pandas)
5.	Image Pre-processing	The input images undergo various operations to improve their quality and make them more suitable for analysis..	Image processing libraries (e.g., OpenCV), programming languages (e.g., Python), image manipulation techniques (e.g., resizing, normalization)
6.	Train Data	The data with assigned labels utilized for training the deep learning model.	Labelled image datasets, data collection and labelling tools
7.	Test Data	The labeled dataset employed to assess the effectiveness of the trained model..	Labelled image datasets, data collection and labelling tools

6.2 Sprint Planning & Estimation

6.3 Sprint Delivery Schedule

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Team Member
Police officer	Crime Classification using Deep Learning	USN-1	I want to upload crime-related images to the system for classification.	-The system should provide an option to upload an image file. -The system should accept common image formats such as JPEG or PNG. - Upon uploading, the system should process the image for crime classification.	High	Saisha
		USN-2	I want the system to accurately classify the type of crime based on the uploaded image.	-The system should analyze the image using deep learning techniques to identify the type of crime present. - The classification should be based on predefined crime categories such as assault, burglary, robbery, etc. -The system should provide a confidence score or probability for the classification result.	High	Sampath

		USN-3	I want to view the classification result along with additional information about the crime.	-The system should display the classified crime category prominently. -The system should provide relevant details or metadata about the crime, such as location, date, and time. -The system should present any additional insights or recommendations based on the classification result.	Medium	Azim
		USN-4	I want to track and analyze crime classification results over time.	-The system should maintain a log or history of classified crimes. -The system should allow filtering and searching of classified crimes based on various criteria such as date, location, or crime type. -The system should provide statistical or graphical representations of crime trends and patterns.	Medium	Jaaswand
User Type	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Acceptance criteria**	**Priority**	**Team Member**
Prosecutors	Crime Classification using Deep Learning	USN-5	As a Prosecutor, I want it for assisting in research case law and legal precedents to build stronger legal arguments.	-The system must achieve a minimum level of accuracy and precision in crime classification, evidence analysis, and suspect identification. -The system should perform well on a diverse range of criminal cases, considering different types of crimes, locations, and evidence types. -The system must demonstrate effective measures to mitigate biases related to race, gender, age, or other factors. It should undergo bias testing, and bias levels should be within acceptable limits.	Low	Sampath

7.CODING & SOLUTIONING

```
train_set=image_dataset_from_directory(
    train_dir,
    label_mode="categorical",
    batch_size=BATCH_SIZE,
    image_size=IMG_SHAPE,
    shuffle=True,
    seed=seed,
    validation_split=0.2,
    subset="training",
)

val_set=image_dataset_from_directory(
    train_dir,
    label_mode="categorical",
    batch_size=BATCH_SIZE,
    image_size=IMG_SHAPE,
    shuffle=True,
    seed=seed,
    validation_split=0.2,
    subset="validation",
)

test_set=image_dataset_from_directory(
    test_dir,
    label_mode="categorical",
    class_names=None,
    batch_size=BATCH_SIZE,
    image_size=IMG_SHAPE,
    shuffle=False,
    seed=seed,
)
```

```
Found 1266345 files belonging to 14 classes.
Using 1013076 files for training.
Found 1266345 files belonging to 14 classes.
Using 253269 files for validation.
Found 111308 files belonging to 14 classes.
```

\

```python
def transfer_learning():
    base_model=DenseNet121(include_top=False,input_shape=INPUT_SHAPE,weights="imagenet")

    thr=149
    for layers in base_model.layers[:thr]:
        layers.trainable=False

    for layers in base_model.layers[thr:]:
        layers.trainable=True

    return base_model
```

8. Performance Testing

8.1 Performance Metrics

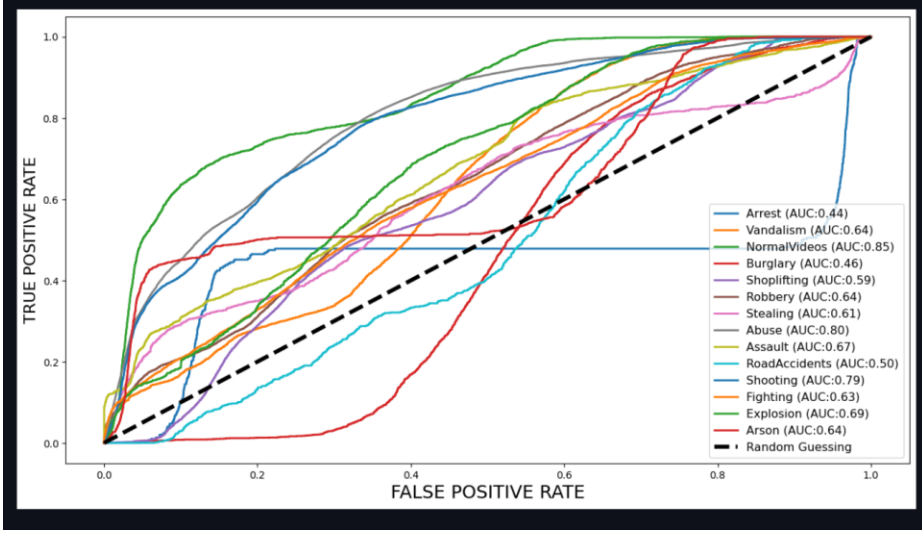
```python
def multiclass_roc_auc_score(y_test, y_pred, average="macro"):
    lb = LabelBinarizer()
    lb.fit(y_test)
    y_test = lb.transform(y_test)
    for (idx, c_label) in enumerate(crime_types):
        fpr, tpr, thresholds = roc_curve(y_test[:,idx].astype(int), y_pred[:,idx])
        c_ax.plot(fpr, tpr,lw=2, label = '%s (AUC:%0.2f)'  % (c_label, auc(fpr, tpr)))
    c_ax.plot(fpr, fpr, 'black',linestyle='dashed', lw=4, label = 'Random Guessing')
    return roc_auc_score(y_test, y_pred, average=average)



fig, c_ax = plt.subplots(1,1, figsize = (15,8))


print('ROC AUC score:', multiclass_roc_auc_score(y_true , y_pred  , average = "micro"))
plt.xlabel('FALSE POSITIVE RATE', fontsize=18)
plt.ylabel('TRUE POSITIVE RATE', fontsize=16)
plt.legend(fontsize = 11.5)
plt.show()
```

```
ROC AUC score: 0.8255602143613621
```



9. Results

9.1 Output Screenshots

```
img= image.load_img("/content/Test/Abuse/Abuse028_x264_1190.png",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=['Fighting','Burglary','Vandalism','Assault','Stealing','RoadAccidents','NormalVideos',
    'Explosion','Abuse','Robbery','Arrest','Shooting','Shoplifting','Arson']
print(pred)
op[pred]
```

```
1/1 [==============================] - 0s 311ms/step
8
```

```
'Abuse'
```

```
img= image.load_img("/content/Test/Arson/Arson007_x264_1140.png",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=['Fighting','Burglary','Vandalism','Assault','Stealing','RoadAccidents','NormalVideos'
    ,'Explosion','Abuse','Robbery','Arrest','Shooting','Shoplifting','Arson']
print(pred)
op[pred]
```

```
1/1 [==============================] - 0s 149ms/step
13
```

10.ADVANTAGES & DIS-ADVANTAGES

Advantages

As such crime has no advantages in perspective of society but for the in perspective of criminal the advantages are

- Criminal may get recognition in the society, though it will be bad recognition.
- Criminal may possess physical goods through burglary

Disadvantages

- The criminal has to face various punishments set by the law department.
- The person will get hatred from the society.
- He may feel remorseful after doing that and may get trouble sleeping.

11.CONCLUSION :

It is clear that basic details of criminal activities in a neighborhoodcontain indicators that will be employed by machine learning agents to classify acriminal activity given a location and date. The training agent suffers fromimbalanced categories of the dataset, it had been ready to overcome the problemby oversampling and under-sampling the dataset. This paper presents a crimedata prediction by taking the types of crimes as input and giving are in whichthese crimes are committed as output using Jupyter notebook having python as acore language and python provide inbuilt libraries such as Pandas and Numpythrough which the work will be completed faster and Scikit provides all theprocesses of how to use different libraries providing by the python.

12.FUTURE SCOPE

From the encouraging results, we believe that crime data mining has a promising future for increasing the effectiveness and efficiency of criminal and intelligence analysis. Visual and intuitive criminal and intelligence investigation techniques can be developed for crime pattern. As we have applied clustering technique of data mining for crime analysis we can also perform other techniques of data mining such as classification.

S13. APPENDIX

Source Code

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import os

import tensorflow as tf
from tensorflow.keras.preprocessing import image_dataset_from_directory

from tensorflow.keras.applications import DenseNet121
from sklearn.preprocessing import LabelBinarizer
from tensorflow.keras.layers import Dense, GlobalAveragePooling2D, Dropout,MaxPooling2D ,
Conv2D,Flatten
from tensorflow.keras.models import Sequential

from sklearn.metrics import roc_curve, auc, roc_auc_score
from sklearn.metrics import classification_report


from IPython.display import clear_output
import warnings
warnings.filterwarnings('ignore')

!mkdir ~/.kaggle
!cp kaggle.json ~/.kaggle
!kaggle datasets download -d odins0n/ucf-crime-dataset

!unzip /content/ucf-crime-dataset.zip



train_dir="/content/Train"
test_dir="/content/Test"

SEED = 12
IMG_HEIGHT = 64
IMG_WIDTH = 64
BATCH_SIZE = 128
EPOCHS = 1
```

```
LR =  0.00003

crime_types=os.listdir(train_dir)
n=len(crime_types)
print("Number of crime categories : ",n)

crimes={}
train=test=0
for clss in crime_types:
    num=len(os.listdir(os.path.join(train_dir,clss)))
    train+=num
    test+=len(os.listdir(os.path.join(test_dir,clss)))

    crimes[clss]=num

plt.figure(figsize=(15, 10))
plt.pie(x=np.array([train,test]), autopct="%.1f%%", explode=[0.1, 0.1], labels=["Training Data", "Test
Data"], pctdistance=0.5)
plt.title("Share of train and test images ", fontsize=14);

plt.figure(figsize=(10, 7))
plt.barh(list(crimes.keys()), list(crimes.values()), height=0.6, align="center")
plt.yticks(rotation=0)

plt.xlabel("Frame count", fontsize=14)
plt.ylabel("Classification", fontsize=14)
plt.tight_layout()
plt.show()

plt.figure(figsize=(15,10))
plt.pie(x=np.array(list(crimes.values())), autopct="%.1f%%", explode=[0.1]*n,labels=list(crimes.keys()),
pctdistance=0.5)
plt.title("Share of train and test images ", fontsize=14);

IMG_WIDTH=64
IMG_HEIGHT=64

IMG_SHAPE=(IMG_HEIGHT,IMG_WIDTH)
seed=69

INPUT_SHAPE=(IMG_HEIGHT,IMG_WIDTH,3)

train_set=image_dataset_from_directory(
    train_dir,
    label_mode="categorical",
```

```
    batch_size=BATCH_SIZE,
    image_size=IMG_SHAPE,
    shuffle=True,
    seed=seed,
    validation_split=0.2,
    subset="training",
)

val_set=image_dataset_from_directory(
    train_dir,
    label_mode="categorical",
    batch_size=BATCH_SIZE,
    image_size=IMG_SHAPE,
    shuffle=True,
    seed=seed,
    validation_split=0.2,
    subset="validation",
)

test_set=image_dataset_from_directory(
    test_dir,
    label_mode="categorical",
    class_names=None,
    batch_size=BATCH_SIZE,
    image_size=IMG_SHAPE,
    shuffle=False,
    seed=seed,
)

def transfer_learning():
    base_model=DenseNet121(include_top=False,input_shape=INPUT_SHAPE,weights="imagenet")

    thr=149
    for layers in base_model.layers[:thr]:
        layers.trainable=False

    for layers in base_model.layers[thr:]:
        layers.trainable=True

    return base_model

def transfer_learning():
    base_model=DenseNet121(include_top=False,input_shape=INPUT_SHAPE,weights="imagenet")

    thr=149
```

```
    for layers in base_model.layers[:thr]:
        layers.trainable=False

    for layers in base_model.layers[thr:]:
        layers.trainable=True

    return base_model

def create_model():
    model=Sequential()

    base_model=transfer_learning()
    model.add(base_model)

    model.add(GlobalAveragePooling2D())

    model.add(Dense(128, activation="relu"))
    model.add(Dropout(0.2))

    model.add(Dense(n,activation="softmax",name="classification"))

    model.summary()

    return model

model=create_model()

model.compile(optimizer="adam",
              loss='categorical_crossentropy',
              metrics = [tf.keras.metrics.AUC()])

history = model.fit(x = train_set,validation_data=val_set,epochs = 5)

y_true =  np.array([])

for x, y in test_set:
  y_true = np.concatenate([y_true, np.argmax(y.numpy(), axis=-1)])

y_pred=model.predict(test_set)

y_pred

y_true

def multiclass_roc_auc_score(y_test, y_pred, average="macro"):
```

```
    lb = LabelBinarizer()
    lb.fit(y_test)
    y_test = lb.transform(y_test)
    for (idx, c_label) in enumerate(crime_types):
        fpr, tpr, thresholds = roc_curve(y_test[:,idx].astype(int), y_pred[:,idx])
        c_ax.plot(fpr, tpr,lw=2, label = '%s (AUC:%0.2f)'  % (c_label, auc(fpr, tpr)))
    c_ax.plot(fpr, fpr, 'black',linestyle='dashed', lw=4, label = 'Random Guessing')
    return roc_auc_score(y_test, y_pred, average=average)

fig, c_ax = plt.subplots(1,1, figsize = (15,8))


print('ROC AUC score:', multiclass_roc_auc_score(y_true , y_pred  , average = "micro"))
plt.xlabel('FALSE POSITIVE RATE', fontsize=18)
plt.ylabel('TRUE POSITIVE RATE', fontsize=16)
plt.legend(fontsize = 11.5)
plt.show()

model.save("crime1.h5")

model.save("/content/drive/MyDrive/crime1.h5")

from tensorflow.keras.models import load_model
model.load_weights('/content/crime1.h5')

y_true= np.array([])
for x,y in test_set:
  y_true=np.concatenate([y_true,np.argmax(y.numpy(),axis=-1)])

y_true

import keras.utils as image
from tensorflow.keras.preprocessing.image import load_img

from tensorflow.keras.models import load_model
model=load_model('/content/crimee2.h5')

from tensorflow.keras.preprocessing import image
img= image.load_img("/content/Test/Abuse/Abuse028_x264_1070.png",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=['Fighting','Burglary','Vandalism','Assault','Stealing','RoadAccidents','NormalVideos','Explosion','Abu
se','Robbery','Arrest','Shooting','Shoplifting','Arson']
print(pred)
```

```
op[pred]

from tensorflow.keras.preprocessing import image
img= image.load_img("/content/Test/Arson/Arson007_x264_1110.png",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=['Fighting','Burglary','Vandalism','Assault','Stealing','RoadAccidents','NormalVideos','Explosion','Abu
se','Robbery','Arrest','Shooting','Shoplifting','Arson']
print(pred)
op[pred]

img= image.load_img("/content/Test/Abuse/Abuse028_x264_1190.png",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=['Fighting','Burglary','Vandalism','Assault','Stealing','RoadAccidents','NormalVideos','Explosion','Abu
se','Robbery','Arrest','Shooting','Shoplifting','Arson']
print(pred)
op[pred]

img= image.load_img("/content/Test/Arson/Arson007_x264_1140.png",target_size=(64,64))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=['Fighting','Burglary','Vandalism','Assault','Stealing','RoadAccidents','NormalVideos','Explosion','Abu
se','Robbery','Arrest','Shooting','Shoplifting','Arson']
print(pred)
op[pred]
```

Demo Link and Github link :

https://github.com/smartinternz02/SI-GuidedProject-601034-1697638314

THANK YOU

SUMMITED BY : TEAM WORK .