Firearm Classification

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Glock 19
Sig Sauer P320

Goal:
Use audio to identify specific gun models.

The Glock 19 and Sig Sauer P320 are two of the most common handguns in the United States.

They pose a difficult classification problem given the strong similarities between the two.

The project can act as a proof of concept to expand upon with more data to classify a larger set of firearms.

Datasets

01 **Youtube**
300 audio clips of gunshots and label with roughly even split. Augmented data is created by adding gaussian noise and segmented clipping. 1-2 seconds

02 **Free Sound Audio Tagging Dataset**
600 assorted samples of sound to train on non-gunshots. 1-4 seconds

Audio Clip

Cut
SIlence is removed from clip.

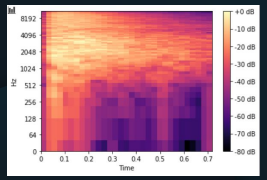
Augmentation
Noise is added to each individual clip and saved as a new observation to improve generalization.

All clips are then cut into seperate .5 second bits as new observations as well.

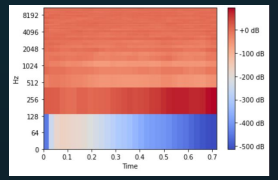
Preprocessing

7,770 clips after augmentation

Log Mel Spectrogram



Mel-Frequency Cepstral Coefficients



Final Input Layer

64 X 1 features per clip

Convolutional Neural Network

	Glock 19	P320	Neither
Glock 19	881	0	0
P320	0	160	0
Neither	1	0	588

Training Accuracy: 99.7%

Custom CNN Model

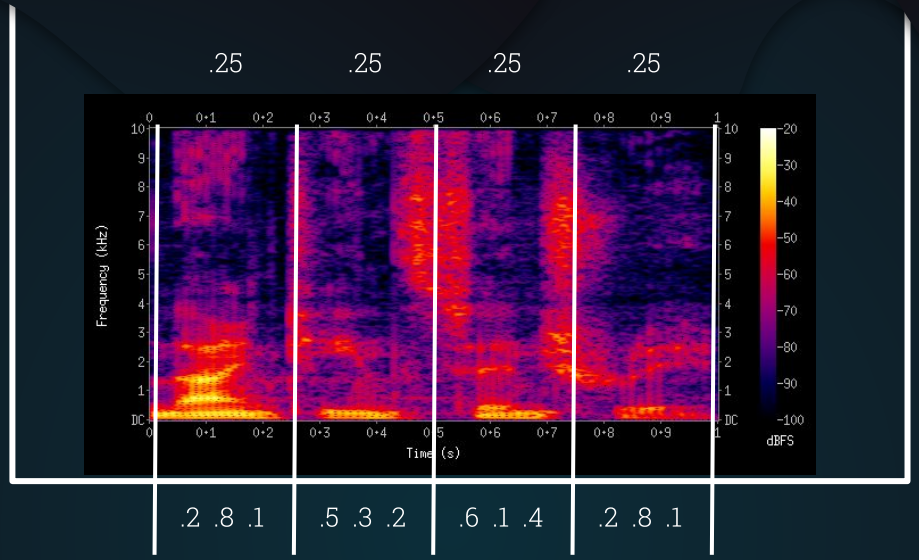
	Glock 19	P320	Neither
Glock 19	392	2	7
P320	1	220	2
Neither	0	0	1707

Test Accuracy: 99.1%

	Glock 19	P320	Neither
Glock 19	16	6	1
P320	7	13	3
Neither	0	0	8

Out of Sample Accuracy: 68.5%

Custom CNN Model



1 Second Classification (Average)

.375	.5	.2
Glock 19	Neither	P320

Streaming Audio Detection

Caution

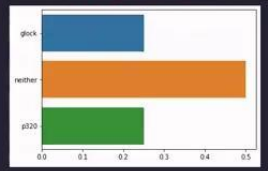
I would like to flag the following slide does contain video of gunfire with the audio removed.

```
fs = 44100  # Sample rate

while True:
    myrecording = sd.rec(int(seconds * fs), samplerate=fs,
channels=2, dtype='int16')
    sd.wait()  # Wait until recording is finished
    write('output.wav', fs, myrecording)  # Save as WAV file
    y, sr = librosa.load('output.wav',sr=16000)
    #fig, ax = plt.subplots(nrows=3, sharex=True, sharey=True)
    #librosa.display.waveplot(y, sr=sr, ax=ax[0])
    data = extract_features('output.wav')
    data = data.reshape(1, 40)

    running_pred.appendleft(tree_m.predict(model.predict(data))
[0][:])
    running_pred.pop()

    sns.barplot(np.mean(running_pred,axis=0),['glock',
'neither','p320'])
    plt.show()
    display.clear_output(wait=True)
```



p320 shooting

Sig Sauer P320 / M17: Perfection Improved (US Army MHS Modular Handgun System)

143,695 views • Jan 10, 2017

TFB TV

950K subscribers

SUBSCRIBE

This episode of TFBTV Patrick takes the Sig Sauer P320 out to the range. Previous to the P320, if you wanted a striker fired Sig, you were out of luck. Since it's introduction the P320 has become a serious contender in the striker fired handgun market and has taken a large bite out of sales

SHOW MORE

Up next

AUTOPLAY

Additional Work

Data

Add additional data to improve NN accuracy.

Streaming

Work on live streaming classification to find optimal windows.

Preprocessing

Investigate additional audio preprocessing techniques to extract relevant features.

Classes

Expand the models ability to detect firearms of new classes.

Thank You

I would be happy to take any questions at this time.