Speech Emotion Recognition System

We intend to build a speech emotion recognition project using machine learning techniques. It discusses the difference between text and audio data and how they are used in natural language processing and speech emotion recognition projects. We use a dataset consisting of audio recordings of actors expressing different emotions and various machine learning algorithms to build and compare different models for emotion recognition. We conclude by discussing the limitations of the project and potential areas for improvement. Overall, it provides a useful introduction to the topic of speech emotion recognition and demonstrates how machine learning can be applied to this problem.

We describe the difference between text and audio data and how they are used in natural language processing (NLP) and speech emotion recognition projects. Text data can be processed using NLP techniques, such as tokenization, stemming, and part-of-speech tagging, to extract useful information. On the other hand, audio data requires a different set of techniques, such as feature extraction and signal processing, to extract meaningful features for emotion recognition.

We here discuss the dataset used in the project, which consists of audio recordings of actors expressing different emotions and so we use various machine learning algorithms, such as Support Vector Machines (SVMs), Random Forests, and K-Nearest Neighbors (KNN), to build and compare different models for emotion recognition.

```
print((model.predict(X_testcnn)[0]).argmax(axis=0))
print(y_test[0])

39/39 [==============================] - 0s 2ms/step
5
[0. 0. 0. 0. 0. 1. 0. 0.]
```
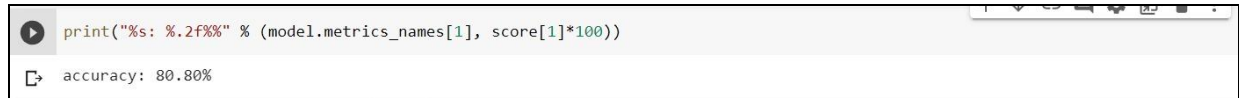
With this we conclude by discussing the limitations of the project and potential areas for improvement, such as using deep learning techniques or a larger dataset. Overall, it provides a useful introduction to the topic of speech emotion recognition and demonstrates how machine learning can be applied to this problem.
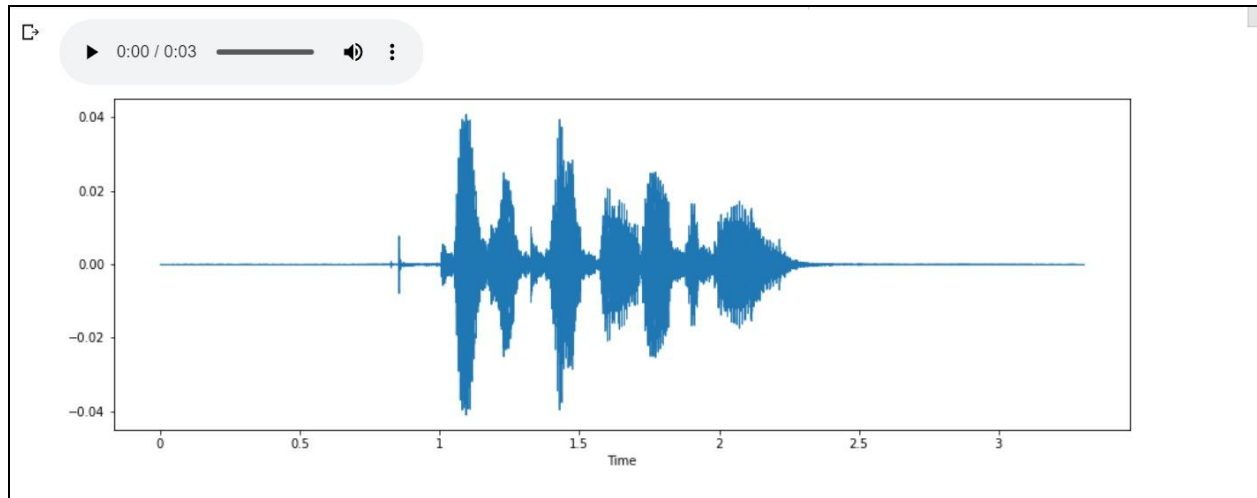
Here is a summary of the steps and workflow for the speech emotion recognition project that we have planned:

- Import the necessary libraries, such as pandas, numpy, librosa, and sklearn.

- Load the dataset of audio recordings and their corresponding emotion labels. We use the Ryerson Audio-Visual Database of Emotional Speech and Song (RAVDESS).

- Extract features from the audio recordings using the librosa library. We extract features such as MFCCs (Mel Frequency Cepstral Coefficients), spectral centroid, and zero-crossing rate.

- Preprocess the feature data by scaling it to have zero mean and unit variance.

- Data is divided into training and testing sets using the train_test_split functiosn from the sklearn library.

- Train various machine learning models on the training data, such as Support Vector Machines (SVMs), Random Forests, and K-Nearest Neighbors (KNN).

- Evaluate the performance of the models on the testing data using metrics such as accuracy, precision, recall, and F1 score.

- Tune the hyperparameters of the best-performing model to optimize its performance.

- Use the tuned model to predict the emotions of new, unseen audio recordings.

- Discuss the limitations of the project and potential areas for improvement, such as using deep learning techniques or a larger dataset.

```
print("%s: %.2f%%" % (model.metrics_names[1], score[1]*100))
```
```
accuracy: 80.80%
```

Overall, the workflow involves loading the dataset, extracting and preprocessing features from the audio recordings, training and evaluating machine learning models, tuning the hyperparameters of the best-performing model,
and using the model to predict emotions in new recordings.

After the speech recognition emotion part we will be proceeding towards the information extraction where we will be using the concepts of Natural Language Processing.

Information Extraction using NLP in python

We use a dataset of news articles and apply various NLP techniques such as named entity recognition, part-of-speech tagging, and dependency parsing to extract information such as organization names, person names, locations, and events. We describe the workflow for building an information extraction project, which includes tasks such as data cleaning, text preprocessing, and feature extraction.We use the spaCy library for text processing and feature extraction, and train and evaluate a model for information extraction using different machine learning algorithms such as Conditional Random Fields (CRF) and Support Vector Machines (SVM).

We define information extraction and its applications in various industries. It then explains the different components of information extraction, such as named entity recognition (NER), part-of-speech tagging, and dependency parsing.

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Here is a summary of the steps and workflow for the information extraction project
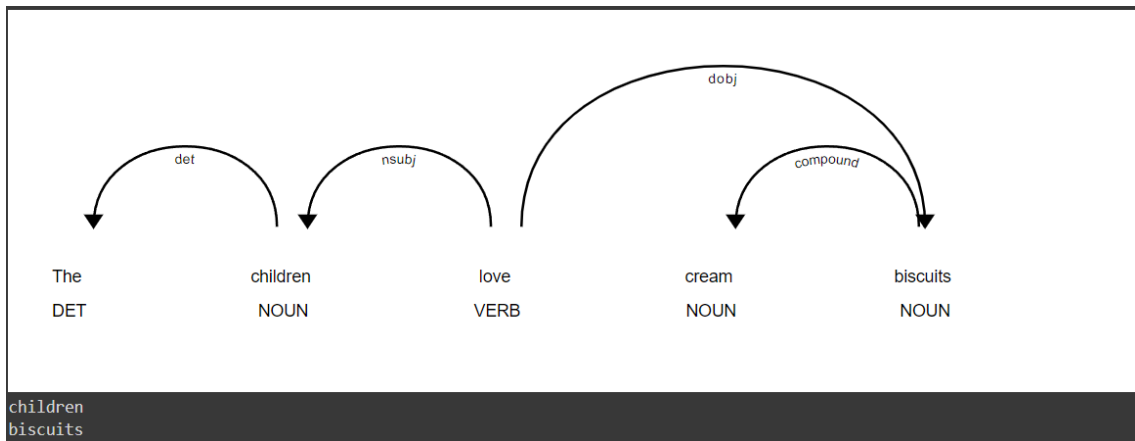
- Import the necessary libraries, such as pandas and spaCy
- Using these, we extract the subject and the object from a sentence

```
This -> PRON
is -> AUX
a -> DET
sample -> NOUN
sentence -> NOUN
. -> PUNCT
```

- Now, using SpaCy's display visualizer, we generate a dependency graph as follows:


```
children
biscuits
```

- Load the dataset of news articles and their corresponding labels. We use the [United Nations General Debate Corpus](#)

  We use a subset of this dataset we will take a subset of this dataset and work with speeches made by India at these debates.

	Country	Speech	Session	Year
0	IND	40.\t Mr. President, I offer you our congratul...	25	1970
1	IND	38.\tMr. President, on behalf of the people of...	26	1971
2	IND	Mr. President, I offer you on behalf of India ...	27	1972
3	IND	122.\tMr. President, I bring to you and to al...	28	1973
4	IND	Mr. President, I have already had occasion to ...	29	1974

Data looks like this

```
'40.\t Mr. President, I offer you our congratulations on your election as the President of th
e current session of the General Assembly. You represent Norway, a country which can take pri
de in its reputation as peaceful, just and progressive. Your personal qualifications and your
family\'s dedication to international effort are well known. I should also like to express ou
r appreciation of the services of your distinguished predecessor, Mrs. Angie Brooks Randolph.
I would also repeat our admiration for U Thant, whose skill and dedication have won him our r
espect.\n41.\tToday is Mahatma Gandhi\'s one-hundred-first birthday, and we in India will tak
e a fresh pledge to dedicate ourselves once again to the ideals for which the Mahatma lived a
nd died, peace and nonviolence being the foremost among them. We may not fully succeed in liv
ing up to his ideals but we must continue to try.\n42.\tThere are many developments in India
which give us satisfaction. Our people are expecting a better life through our development pl
ans. We have had a sizable increase in agricultural and industrial production. Our trade is a
lso showing signs of improvement. India has once again demonstrated its faith in full-fledged
democracy. Alongside this there is a growing desire of the common man to share more equitably
in the distribution of national wealth.\n43.\ttwenty-two days ago a great conference ended at
Lusaka, and in 22 days from now we shall be celebrating the signing of the Charter of the Uni
ted Nations. The Conference of Lusaka owes much of its success to the efforts and organizatio
n undertaken by the Government and people of Zambia, and once again we should like to thank t
hem. The final declarations and resolution s of that Conference are being circulated as Unite
d Nations documents. They represent the consensus of 53 Members of the United Nations, repres
enting about half the human race. I would urge that everyone read them.\n44.\tThe Conference
at Lusaka highlighted several key points. These are: international peace and security, peacef
ul coexistence and friendly relations, solution of international problems by negotiations, th
e value of the United Nations as a universal forum, decolonization, development, disarmament
and the pursuit of the principles of nonalignment. In order to fulfill the objectives we subs
```

- Using SpaCy, Information can be extracted – Clean and preprocess the text data by removing stopwords, punctuation, and numbers. We use the spaCy library for this task.

- Finding Mentions of Prime Minister in the Speech – Extract features from the text data using NLP techniques such as named entity recognition (NER), part-of-speech (POS) tagging, and dependency parsing. We use the spaCy library for these tasks.

```
-> After the communal violence of 1983, the Prime Minister of India offered her good offices
to help find a political solution to the problem

-> The Prime Minister of India has categorically stated that India does not intervene in the
internal affairs of Sri Lanka or, indeed, of any other country

-> As the Prime Minister of India, Mrs Indira Gandhi, stated in a recent message: cannot be
reformed; it must be ended

-> Recently, a group of five eminent experts appointed by the Chairman of the Movement of No
n Aligned Countries, the Prime Minister of India, Mrs Indira Gandhi, completed a detailed stu
dy of the substantive and procedural issues that would arise in the context of convening such
a conference

-> As the Prime Minister of India said at the thirty eighth session of the General Assembly
on behalf of the non aligned countries: Firm faith in the United Nations is central to the no
n aligned
```

- Extracting Initiatives -we use simple regex to select only those sentences that contains keyword 'initiative', 'scheme' or 'agreement',

```
->  The Jan Dhan plan must surely count as the world's largest financial inclusion scheme
->  India has already said that it is deeply committed to the Paris Climate Change Agreement
->  Our Prime Minister has, on his personal initiative, launched the International Solar Alliance as witness to our a
biding commitment to this cause
```

- Finding Patterns :
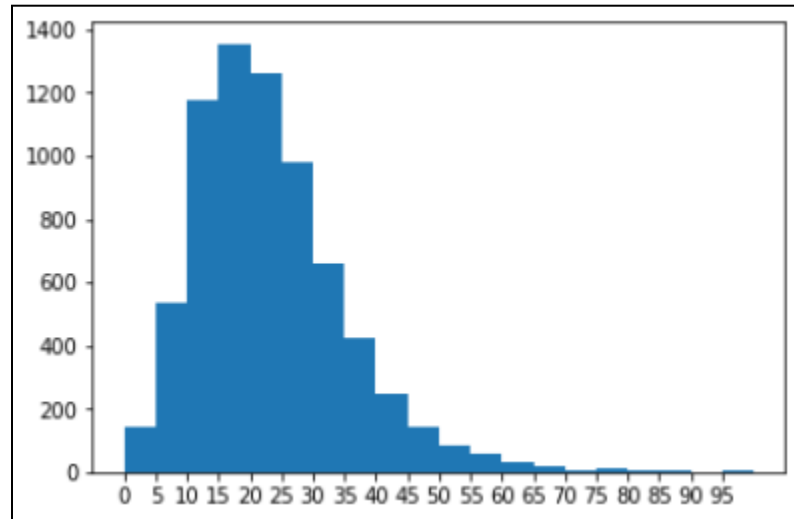
Histogram :majorly sentences range from 15-20 words. We remove the sentences that contain less than 15 words

- An inference : sentence structure - subject (noun), action (verb), and an object (noun). we can use this structure to extract the main parts of information from the sentence. We similarly work for adjectives and prepositions.
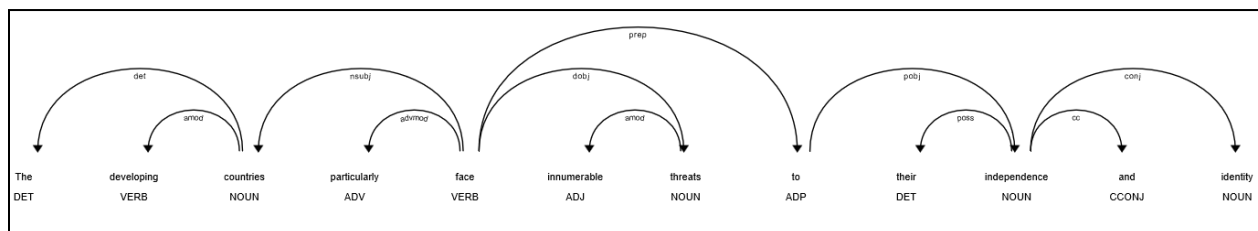
	Sent	Year	Noun1	Verb	Noun2
0	Mr President, I offer you our congratulations...	1970	[I]	offer	[congratulations]
1	You represent Norway, a country which can tak...	1970	[You]	represent	[Norway]
2	I would also repeat our admiration for U Than...	1970	[I]	repeat	[admiration]
3	I would also repeat our admiration for U Than...	1970	[skill]	win	[respect]
4	Today is Mahatma Gandhi one hundred first bir...	1970	[we]	take	[pledge]

|	Sent	Year	Noun1	Verb	Noun2
16	The developing countries particularly face in...	1970	[countries]	face	[threats]
17	They also face impediments in their economic ...	1970	[They]	face	[impediments]
81	We are facing grave social, economic and poli...	1971	[We]	face	[consequences]
130	The world today is facing a major economic cr...	1971	[world]	face	[crisis]
309	We are now in the middle of the Second United...	1975	[majority]	face	[patterns]
346	Developing countries now face the dilemma of ...	1976	[countries]	face	[dilemma]
391	The authority, credibility and prestige of th...	1977	[authority]	face	[challenge]
396	While in southern Africa we face colonialism ...	1977	[we]	face	[colonialism]
630	Like most other nations, we too faced the con...	1980	[we]	face	[conflict]
651	All countries in our region face similar econ...	1981	[countries]	face	[problems]
654	IWenty years since its inception, the nonalig...	1981	[movement]	face	[situation]
674	Their terms of trade have further declined, a...	1981	[exports]	face	[walls]
680	We would like to reiterate, therefore, that t...	1981	[community]	face	[reality]
779	Industrialized countries with planned economi...	1983	[countries]	face	[problems]
818	We are facing not only an acute and troubled ...	1984	[We]	face	[situation]
819	We are facing the danger of a retreat from mu...	1984	[We]	face	[danger]

- Adjectives

	Year	Sent	Output
0	1970	Mr President, I offer you our congratulations...	[current session]
2	1970	Your personal qualifications and your family ...	[personal qualifications, international effort]
3	1970	I should also like to express our appreciatio...	[distinguished predecessor]
5	1970	Today is Mahatma Gandhi one hundred first bir...	[fresh pledge]
8	1970	Our people are expecting a better life throug...	[better life, development plans]
9	1970	We have had a sizable increase in agricultura...	[sizable increase, agricultural production]
11	1970	India has once again demonstrated its faith i...	[full democracy]
12	1970	Alongside this there is a growing desire of t...	[common man, national wealth]
13	1970	twenty two days ago a great conference ended ...	[great conference]
15	1970	The final declarations and resolution s of th...	[final declarations, Nations documents]

- Prepositions
  The rule on prepositions helps identify relationships between various components of a sentence. Let's take an example, '*The people of India believe in the principles of the United Nations.*'

  We scan through each token to identify any prepositions. In the given sentence, we examine whether a preposition is followed by a noun, such as the word "faith". Next, we investigate the tokens located to the right of the preposition to identify any related child tokens, like the word "democracy".
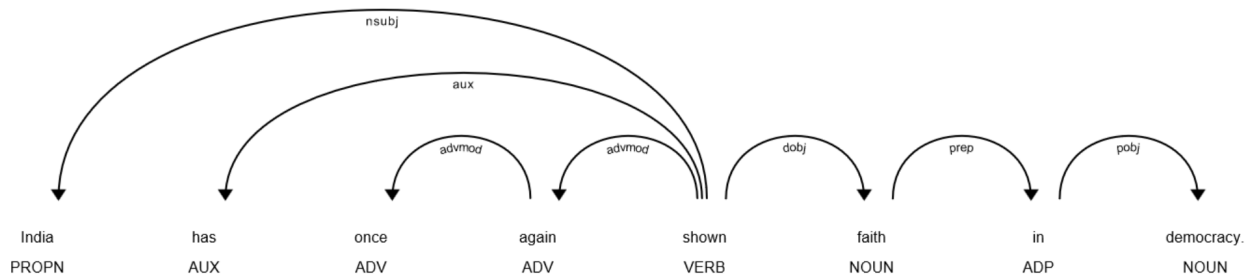
Applying the rule on short sentences we get the following results:

	Year	Sent	Output
0	1970	Your personal qualifications and your family ...	[dedication to effort]
1	1970	There are many developments in India which gi...	[developments in India]
2	1970	Our people are expecting a better life throug...	[]
3	1970	We have had a sizable increase in agricultura...	[increase in production]
4	1970	Our trade is also showing signs of improvement	[signs of improvement]
5	1970	India has once again demonstrated its faith i...	[faith in democracy]
6	1970	I would urge that everyone read them	[]
7	1970	The Conference at Lusaka highlighted several ...	[]
8	1970	This situation requires attention from the wo...	[attention from community]
9	1970	The developing countries particularly face in...	[]

	Sent	Year	Noun1	Preposition	Noun2
0	Mr President, I offer you our congratulations...	1970	congratulations	on	[election]
1	Mr President, I offer you our congratulations...	1970	session	of	[Assembly]
2	Your personal qualifications and your family ...	1970	dedication	to	[effort]
3	I should also like to express our appreciatio...	1970	appreciation	of	[services]
4	I should also like to express our appreciatio...	1970	services	of	[predecessor]
5	I would also repeat our admiration for U Than...	1970	admiration	for	[Thant]
6	There are many developments in India which gi...	1970	developments	in	[India]
7	We have had a sizable increase in agricultura...	1970	increase	in	[production]
8	Our trade is also showing signs of improvement	1970	signs	of	[improvement]
9	India has once again demonstrated its faith i...	1970	faith	in	[democracy]

- Train various machine learning models on the training data, such as Conditional Random Fields (CRF) and Support Vector Machines (SVM).

- Evaluate the performance of the models on the testing data using metrics such as accuracy, precision, recall, and F1 score.

- Use the trained model to extract information from new, unseen text data.

- Discuss the limitations of the project and potential areas for improvement, such as using deep learning techniques or a larger dataset.

	Sent	Year	Noun1	Preposition	Noun2
0	Mr President, I offer you our congratulations...	1970	congratulations	on	[election]
1	Mr President, I offer you our congratulations...	1970	session	of	[General Assembly]
2	Your personal qualifications and your family ...	1970	dedication	to	[effort]
3	I should also like to express our appreciatio...	1970	appreciation	of	[services]
4	I should also like to express our appreciatio...	1970	services	of	[predecessor]
5	I would also repeat our admiration for U Than...	1970	admiration	for	[U Thant]
6	There are many developments in India which gi...	1970	developments	in	[India]
7	We have had a sizable increase in agricultura...	1970	increase	in	[production]
8	Our trade is also showing signs of improvement	1970	signs	of	[improvement]
9	India has once again demonstrated its faith i...	1970	faith	in	[democracy]
10	Alongside this there is a growing desire of t...	1970	desire	of	[man]
11	Alongside this there is a growing desire of t...	1970	distribution	of	[wealth]
12	twenty two days ago a great conference ended ...	1970	signing	of	[Charter]
13	The Conference of Lusaka owes much of its suc...	1970	people	of	[Zambia]
14	The final declarations and resolution s of th...	1970	declarations	of	[Conference]
15	They represent the consensus of 53 Members of...	1970	consensus	of	[Members]
16	They represent the consensus of 53 Members of...	1970	Members	of	[United Nations]
17	These are: international peace and security, ...	1970	solution	of	[problems]

- There is undoubtedly more information here than previously. For instance, "impediments in economic growth" instead of "impediments in development" and "greater transgressor of human rights" instead of "transgressor of rights".
  Once more, combining rules has given us greater control and freedom to only thoroughly examine the phrases that contain a meaningful extracted term.

The procedure, in general, entails loading the dataset, cleaning and preparing the text data, extracting features using NLP methods, training and assessing machine learning models, and then utilising the model to extract information from fresh text data.

References:

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