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Multimodal prediction of profanity based on speech analysis

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Introduction

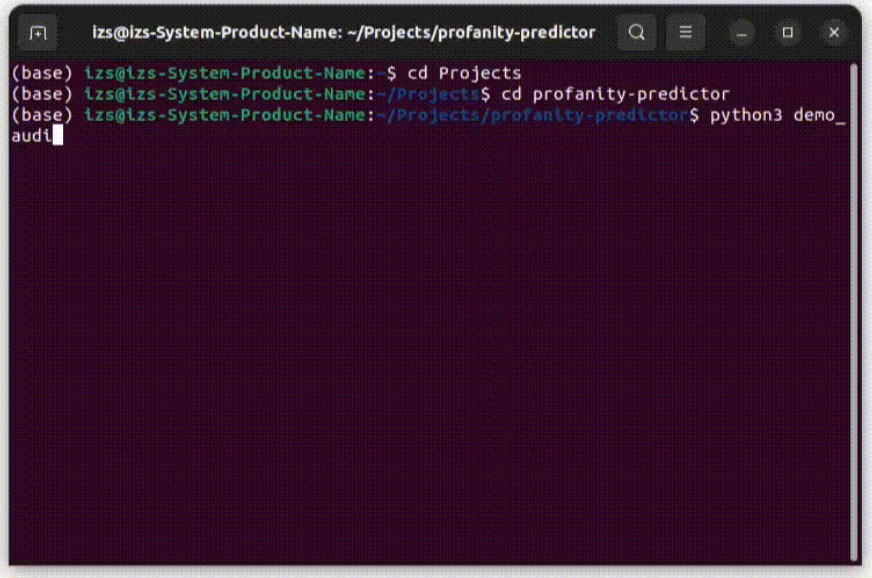
Many profane words have strong connotations and can be offensive; they may be used to provoke confrontations and even violence.

- Profanity affect mental health
- The information space is becoming insecure
- The content of speech broadcasts may be unexpected

The ability to predict profanity allows us to prevent it.

Relevance

Speech prediction task

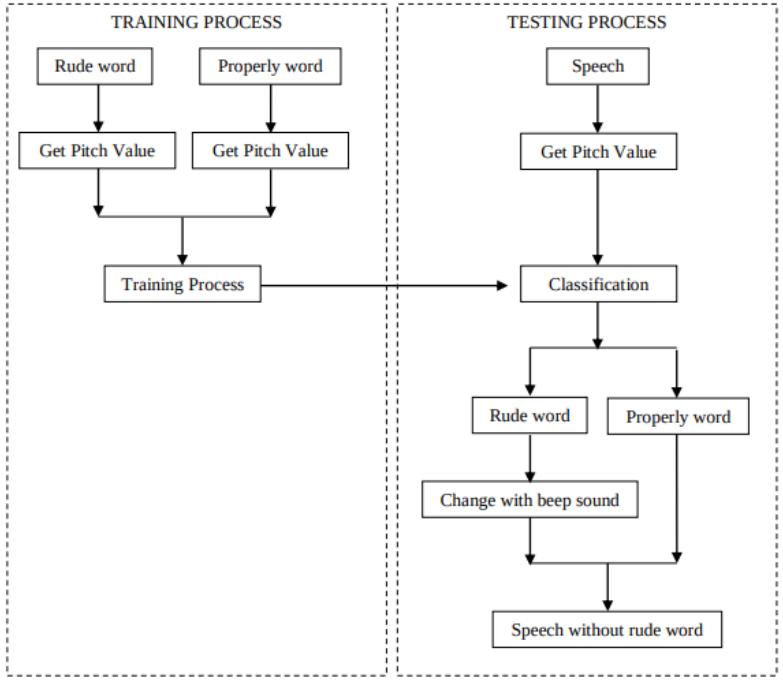


Realms of application

- Automatic censoring during broadcasts
- Moderation of audio messages
- Call center moderation

Actual methods

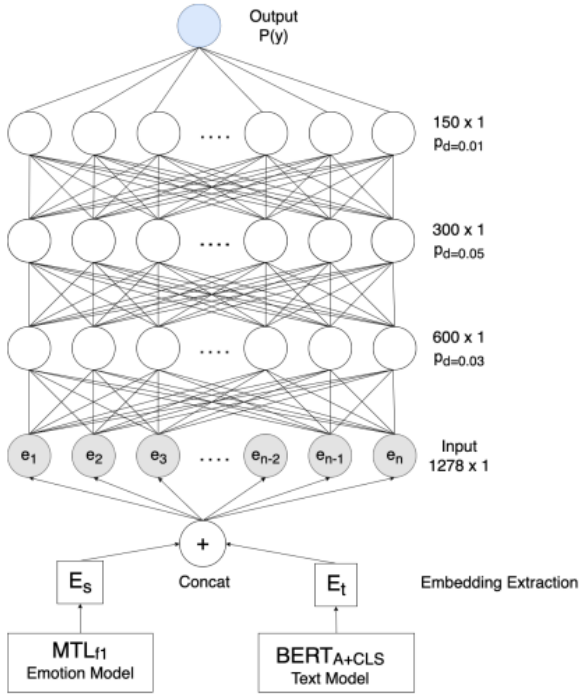
Word frequency matching and classification with Support Vector Machine



Disadvantages:

- Method does not consider sequences in dynamic
- Classification use only one feature statistic information for it

Combining of the text model and the audio emotion classifier

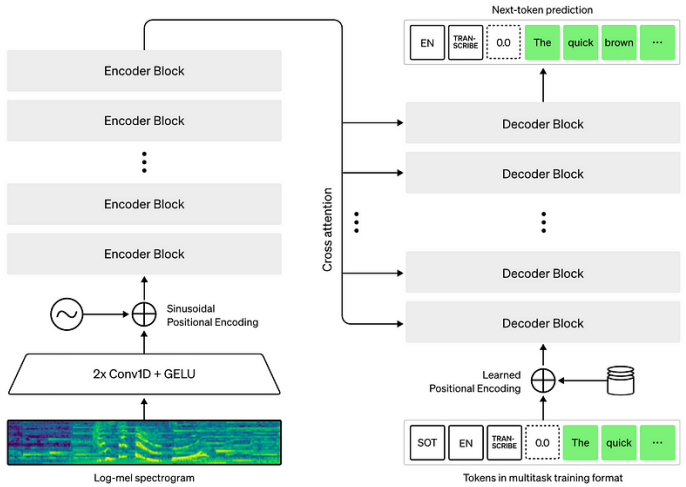


Disadvantages:

- The quality of recognition will vary depending on the quality of the recording
- The proposed models are resource-intensive

Problems

We wanted people to know that ~~how~~ to me where i know and essentially this product is uh what we call scripted changes the way that people are rapid technology.



01 **Speech can be transcribed incorrectly**

02 **ASR models are computationally complex**

Limitations for data

It is necessary to follow the next criteria:

1. **Authenticity:** The audio and video recordings should be authentic and not scripted.
2. **Diversity**: The recordings should come from a diverse set of speakers and contexts
3. **Quality**: The audio and video recordings should be of suitable quality

Dataset

The main problems:

- Unbalanced classes
- Not every “toxic” includes profanity
- The lack of timestamps

Statistics of annotated English datasets after balancing

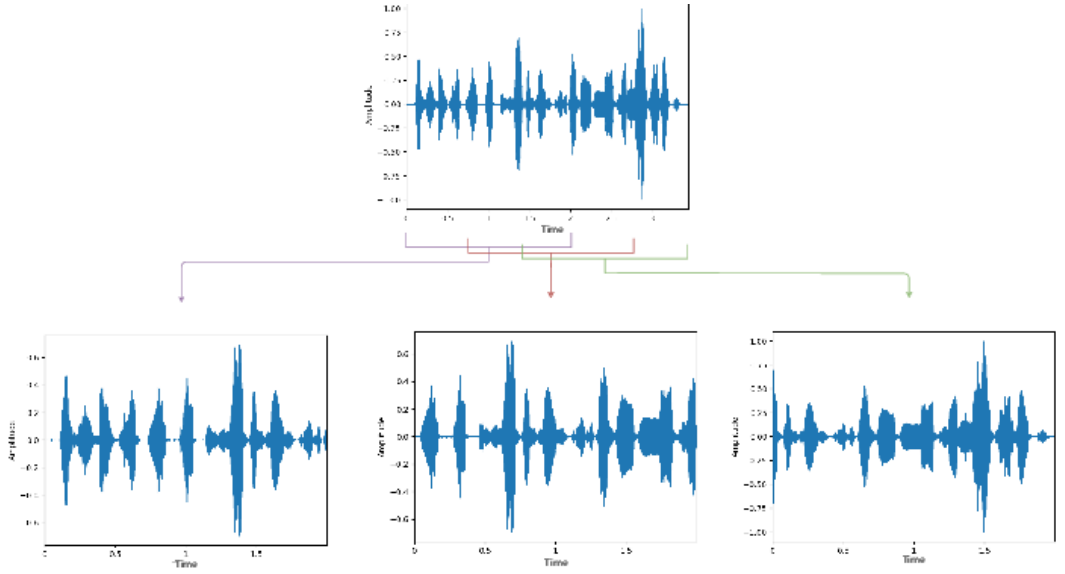
Dataset	Utterances (num)	Toxic (num)	Non-Toxic (num)	Total Duration (hh:mm:ss)
CMU-MOSEI	860	217	643	1:44:25
CMU-MOSI	260	67	193	0:18:03
Common Voice	11,551	2,888	8,663	12:38:17
IEMOCAP	1,090	274	816	1:19:26
LJ Speech	148	40	108	0:14:57
MELD	565	142	423	0:31:05
MSP-Improv	523	129	394	0:36:32
MSP-Podcast	2,772	692	2,080	4:01:57
Social-IQ	479	122	357	0:36:40
Switchboard	1,824	456	1,368	2:28:57
VCTK	199	50	149	0:08:51
Total	**20,271**	**5,077**	**15,194**	**24:39:10**

Data augmentation

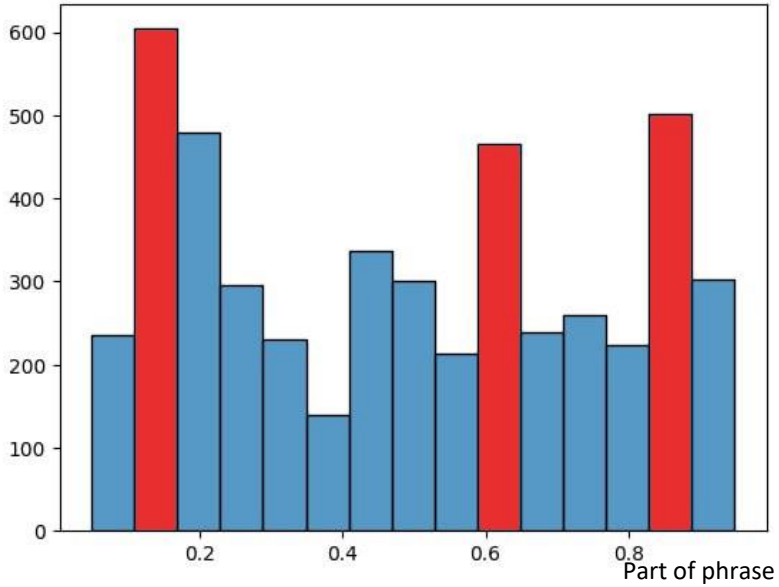
To increase the number of records, the next audio distributions were used with some probabilities:

- Gaussian noise
- Pitch shift
- Time stretch
- High pass filter

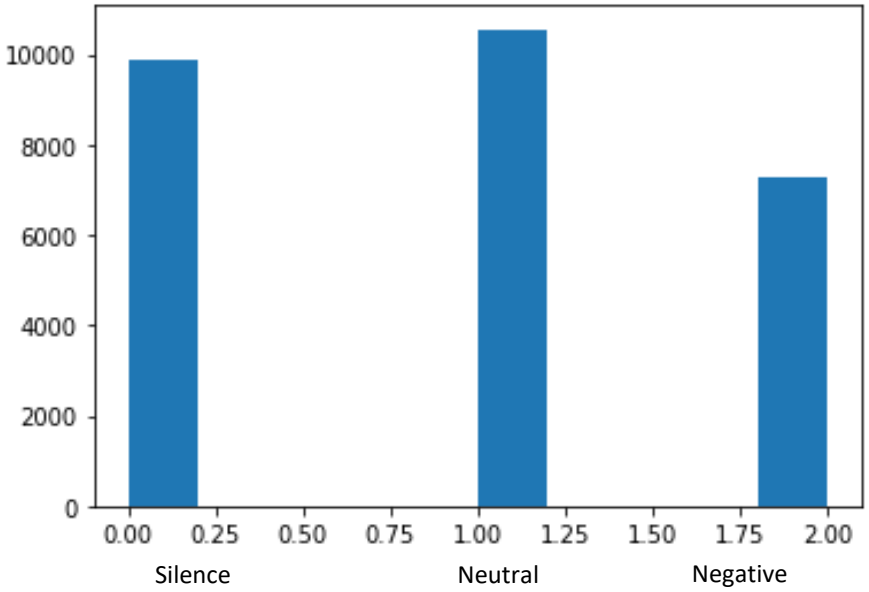
Also, sampling with a sliding window was used.



Data analysis

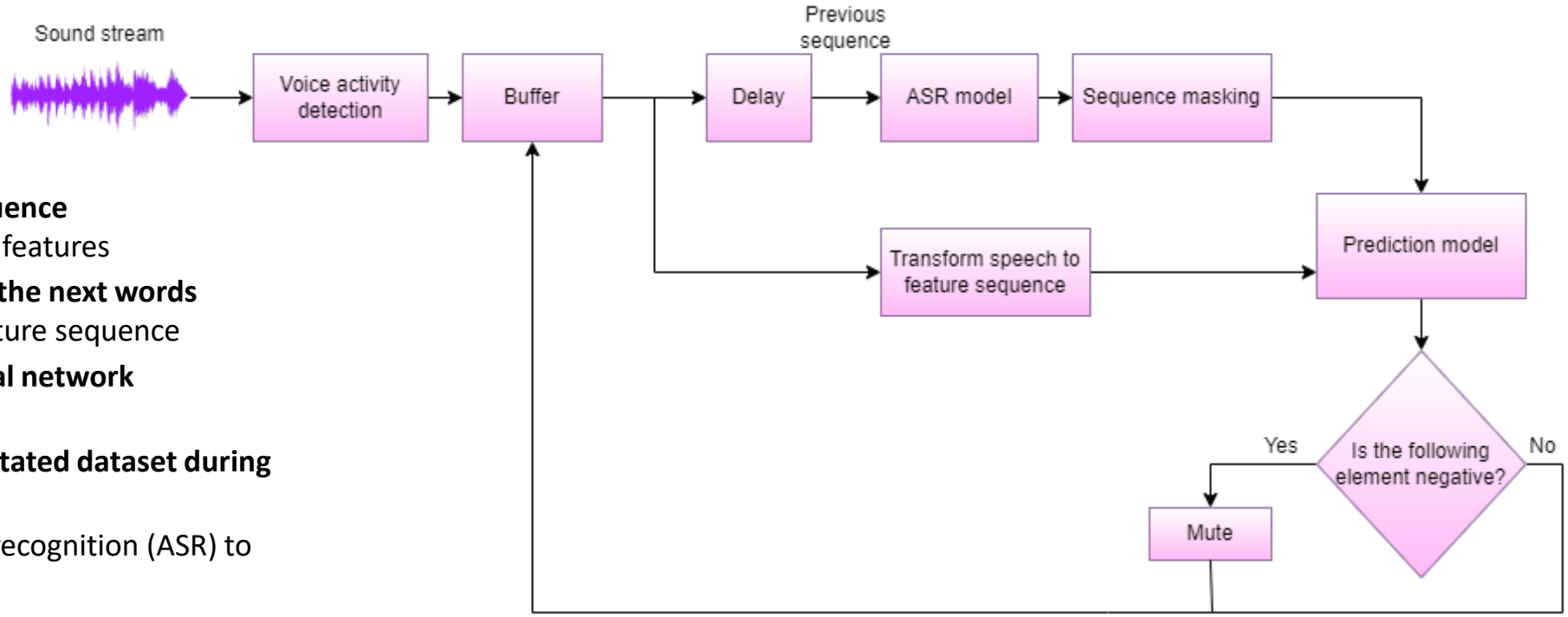


Distribution of the profanity speech in parts of Common Voice dataset phrases



Number of samples for each class after augmentation

Pipeline



- **Describing a word sequence** by a sequence of audio features
- **Predicting the color of the next words** sequence based on feature sequence
- Using a **recurrent neural network for prediction**
- Use **text** from the **annotated dataset during model training**.
- Use automatic speech recognition (ASR) to **correct the prediction of the model**.

Model comparison

Approach	F1 score (The main dataset)	F1 score (MELD dataset)	F1 score (Picked records)	Latency (sec)	Weights (mb)
LSTM (MFCC)	86.6	65.2	73.7	0.347*	51.53
LSTM (MFCC) + Attention	87.1	65.9	76.7	0.348	231.16
LSTM Wav2Vec + Attention	92.0	71.4	86.6	1.171	432.25**
LSTM (MFCC) + ASR + Attention	90.3	67.6	74.6	2.148	231.19

* - the average duration of the element is 0.34 sec
** - it is also necessary to use Wav2Vec feature extractor

Conclusion

1. We propose the method for word's label prediction in real-time fashion.
2. With the proposed approach, it is possible to deal with the latency of speech recognition while using information from it.
3. A trained multimodal prediction model with an F1 score of 74.6%
4. The expansion of textual information can increase performance.

https://github.com/expertspec/profanity-predictor

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Thanks for your attention