

MedicBot: A New Virtual Assistance for the Children with Auditory Processing Disorder

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Overview

1 Introduction

2 Methodology

3 Techniques

- Auditory processing is defined as what we do with what we hear ¹
- Auditory Processing Disorder (APD) is a condition where someone has normal hearing, but the auditory system does not faithfully bring information to the brain ²
- **Approximate 2-4% of school age children have APD** ³

¹Katz & Tillery, 2004

²<https://www.sac-oac.ca>

³<http://www.ementalhealth.ca/>

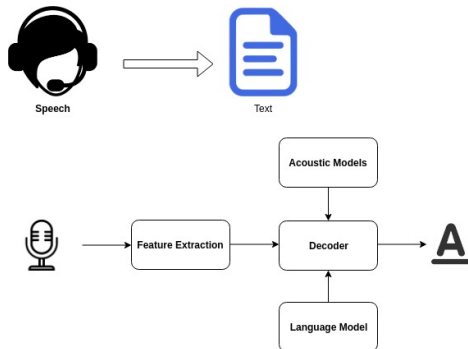
Propose an AI model (virtual assistance) to assist in diagnosing, monitoring, and training of the children with APD problem

- Diagnose APD symptoms based on conversation with the considered children
- Create a Training Therapy Model Assistance (adaptable)
- Build the Reinforcement Learning (RL) Model to monitor the progress of APD treatment

- Analysis the given APD symptoms by speech recognition based on Deep learning
- Analysis the given APD therapy and recommend the treatment to the APD children. Apply a natural language processing (NLP) to generate sentences and exploit Deep learning to understand the context of the speech
- Monitoring the process of APD treatment by using speech analysis based on Deep learning

Convert speech to text

- **Acoustic modeling** represents the relationship between linguistic units of speech and audio signals.
- **Language modeling** matches sounds with word sequences to help distinguish between words that sound similar.

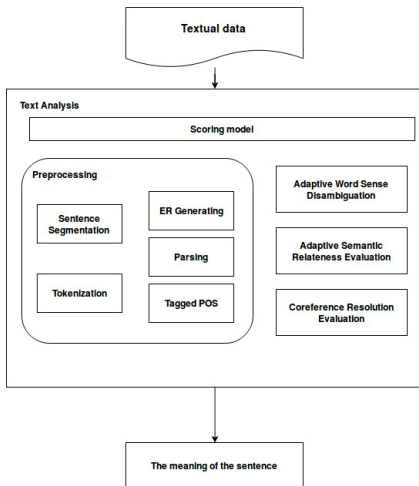


We evaluated the quality of output by using two factors:⁴

Accuracy and **Speed**

⁴<https://pypi.org/project/SpeechRecognition/>

Proposal for the objective 1 solution

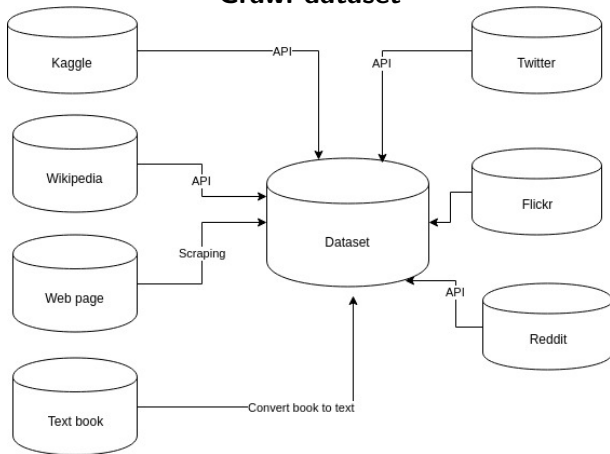


- Step 1: Get the raw text data from the user conversation
- Step 2: Process text go extract and compute the score of features based
- Step 3: Adapt word sense disambiguation
- Step 4: Evaluate the semantic relatedness and coreference resolution
- Step 5: Get the meaning of the sentence

Open Dataset

- (NLVR) A Corpus of Natural Language for Visual Reasoning, 2017
- (MS MARCO) MS MARCO: A Human Generated MACHine Reading COMprehension Dataset, 2016
- (NewsQA) NewsQA: A Machine Comprehension Dataset, 2016
- (SQuAD) SQuAD: 100,000+ Questions for Machine Comprehension of Text, 2016
- (GraphQuestions) On Generating Characteristic-rich Question Sets for QA Evaluation, 2016
- (Story Cloze) A Corpus and Cloze Evaluation for Deeper Understanding of Commonsense Stories, 2016
- (Children's Book Test) The Goldilocks Principle: Reading Children's Books with Explicit Memory Representations, 2015
- (SimpleQuestions) Large-scale Simple Question Answering with Memory Networks, 2015
- (WikiQA) WikiQA: A Challenge Dataset for Open-Domain Question Answering, 2015
- (CNN-DailyMail) Teaching Machines to Read and Comprehend, 2015
- (QuizBowl) A Neural Network for Factoid Question Answering over Paragraphs, 2014
- (MCTest) MCTest: A Challenge Dataset for the
- Open-Domain Machine Comprehension of Text, 2013
- (QASent) What is the Jeopardy model? A quasisynchronous grammar for QA, 2007

Crawl dataset



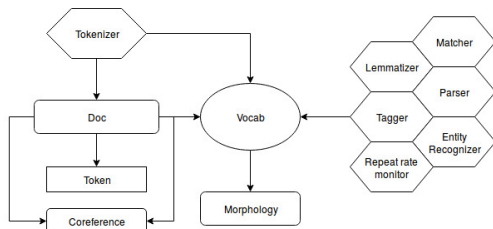
Listening
Has difficulty locating a sound source.
Has difficulty hearing in noisy background.
Often asks for repetition or clarification
Speaking
Has difficulty answering open-ended questions
May speak in oversimplified short sentences with difficulties in syntax
Mispronounced words, especially long words.
Phonological Awareness
Has difficulty focusing during conversations
Forgets information that is easily heard

Table: A part of checklist for assessing whether the child with APD⁵

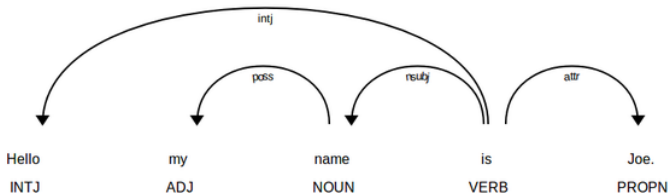
⁵<https://kidshear.com.au>

Preprocessing

- Recognize the subject, verb, object in a given sentence
- Recognize noun, adj, adv, preposition of a sentence
- Recognize the entities in a sentence
- Recognize the coreference of a sentence



Unit tests of the system

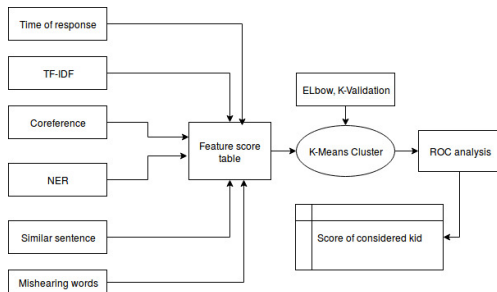


But **Google** **ORG** is starting from behind. The company made a late push **GPE** into hardware, and **Apple** **ORG** 's Siri, available on **iPhones** **PRODUCT**, and **Amazon** **ORG** 's **Alexa** **ORG** software, which runs on its **Echo** **GPE** and **Dot** **ORG** devices, have clear leads in **GPE** consumer adoption.

```
text 1: My sister has a dog.
text 2: She loves him
0.016491954893255212 a dog loves him
0.9719385606143631 my sister loves him
0.011569484492381571 she loves him
```

Scoring model

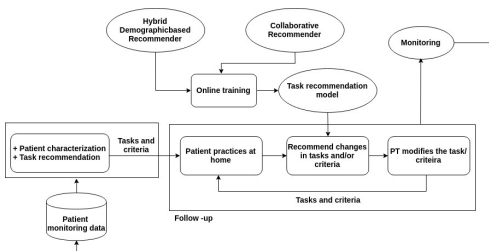
- Create the features for the scoring model
- Compute the score for these ones
- Using the K-Mean Clustering algorithm to cluster the kid
- Apply the Elbow and K-validation algorithm to optimize the K-value of K-Mean Clustering algorithm
- Make the score table of considered kids



time of response	$\sum_{t=0}^T(t_i)$, t_i the duration of one sentence
tf-idf(k,d,D)	$tf(k, d) \times idf(k, D)$, k : term k d : document d ; and $d \in D$
coreference	coreference resolution evaluation
ner	name entity recognition
similar sentence	similarity evaluation
mishearing word	spelling and grammar checking evaluation
elbow algorithm	choose a small value of k that still has a low SSE
ROC analysis	Receiver Operating Characteristic analysis

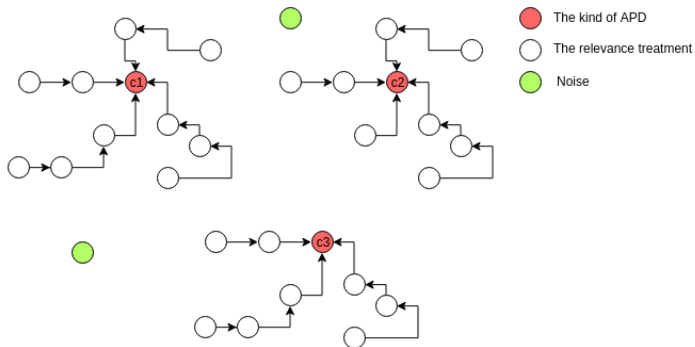
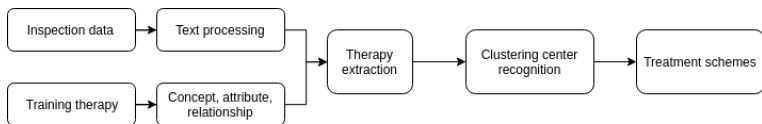
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- Monitoring the process of APD treatment by using speech analysis based on Deep learning

Proposal for the objective 2 solution



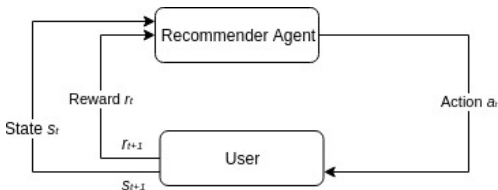
- Propose a training therapy to the APD kid based on the diagnosing report and Task recommendation model
- Monitor the progress of therapy
- Update the monitoring data
- Suggest the fit training therapy by using reinforcement learning based on recommendation system

Task recommendation model⁶



⁶<https://www.thebsa.org.uk>

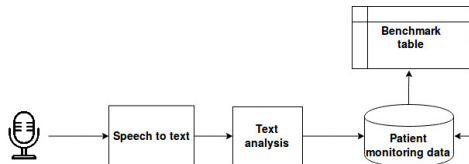
Tasks and criteria



- State space \mathcal{S} : A state $s_t = \{s_t^i\}, i = (1, N)$
- Action space \mathcal{A} : An action $a_t = \{a_t^j\}, j = (1, K)$
- Reward \mathcal{R} : $r(s_t, a_t)$ according to the user's feedback
- Transition probability \mathcal{P} : $p(s_{t+1}|s_t, a_t)$ defines the probability of state transition from s_t to s_{t+1} when Recommender Agent takes action a_t

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Proposal for the objective 3 solution



- Convert the APD speech to text
- Analysis the meaning of the text
- Make the score of the benchmark table

Describe the score of the training for the respective user at home

	Observation	Assessment	Therapy lesson	Other
Listening				
Speaking				
Phonological Awareness				

Table: Benchmark table

Thank You