A Project Report on

Speech Analysis for Teaching a Vernacular Language
(Case study with the Urdu language for kids)

Submitted in partial fulfilment for the award of the degree of

MBA

In **Business Analytics**

Submitted by

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R19DM006

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Candidate's Declaration

I, Taiba Naz hereby declare that I have completed the project work towards MBA in Business Analytics at, REVA University on the topic entitled Speech Analysis model for Teaching a vernacular language (Case study with the Urdu language for kids) under the supervision of Dr. J.B. Simha Chief Mentor, RACE, CTO, ABIBA Systems. This report embodies the original work done by me in partial fulfilment of the requirements for the award of the degree for the academic year 2020.

Place: Bengaluru

Date:15-10-2020

Taiba Naz

Certificate

This is to Certify that the PROJECT work entitled Speech Analysis model for Teaching a language (Case study for the Urdu language) carried out by Taiba Naz with R19DM006, is a bonafide student of REVA University, is submitting the project report in fulfilment for the award of PGDM in Business Analytics during the academic year 2020. The Project report has been tested for plagiarism and has passed the plagiarism test with a similarity score of less than 15%. The project report has been approved as it satisfies the academic requirements in respect of PROJECT work prescribed for the said Degree.

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Guide: Dr. J.B. Simha   Name: Dr. Shinu Abhi

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Names of the Examiners

1. <Name> <Designation> <Signature>
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Place: Bengaluru

Date:

Acknowledgments

Place: Bengaluru

Date: 15 October 2020

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This is to certify that this project report titled **Speech Analysis for teaching a vernacular language** was scanned for similarity detection. Process and outcome is given below.

Software Used: Turnitin

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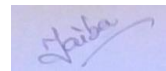
Total word count: 4555

Name of the Guide: Dr. J. B Simha

Place: Bengaluru

Taiba Naz:

Date:15 October 2020

Verified by:

Signature

Dr. Shinu Abhi,

Director, Corporate Training

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Abstract

Language learning applications have the potential to transform the way languages are learned so far(Heil et al., 2016). These applications being used to learn a foreign language or to learn a second language has attracted many users(Jason et al., n.d.). The growth of the global market for the educational app has increased from $3.4 billion in 2011 to $37.8 billion in 2020(*Statista.Com*, n.d.). English language learning apps like Duo Lingo have expanded with over 90 million downloads(*Duolingo Statistics.Pdf*, n.d.). These data show the demands of these apps are increasing day by day. But unfortunately, not much attention has been given to develop such applications for local languages of India like Hindi, Urdu, Kannada, Malayalam, Tamil, etc.

This project is a Web Application to teach a 5yr old kid the correct pronunciation of a language. This suggested application is an Urdu learning app that evaluates the kid's performance and capable of giving immediate feedback to users. This application focuses on the main aspects of language learning skills i.e. Listening, Speaking, and Reading. Building this type of application requires some statistical processing, Data Mining, and Natural Language Processing (NLP) techniques that have been implemented in this project. The accuracy of the model is 94.3% with 160 words samples taken from the NCERT Urdu textbook for grade1.

Keywords: Web Application, Urdu, Statistical Processing, Natural Language Processing

Contents

Chapter 1: Introduction

We are in the era of computers in which the local languages have necessarily to be used to keep them from the onslaught of English and, in consequence, from their extinction(Jason et al., n.d.). The present education system and the indifferent attitude of the users towards their language and lack of interest in them is mainly because of the poor learning environment of these local languages and the resources. To avoid this and to help using the local languages, it is the need of the time that we should have an interactive learning medium that is required to identify and correct the mistakes committed by users. But, so far, Urdu Language has not got a fairly accurate medium.

Urdu is being taught in only some Urdu medium government schools, where the teacher to student's ratio is very poor, no proper infrastructure for pre-primary classes. Teachers' stress level and fatigue causing improper learning of these kids.

To assist these teachers to reduce their stress and students in getting quality education we intend to develop a web application backend with ML to teach kids Urdu languages interactively. This web app will evaluate the kid's pronunciation for all the words given in the grade 1 Urdu NCERT textbook and give immediate feedback.

In our schools, the teacher read, and write words from the book, and students are asked to repeat and write the same in their notebook. In teaching grade 1 textbook words they spend 3years (LKG, UKG, and grade1). But still, some kids are not able to read and write those words, because they need individual attention, which might not be possible for teachers of government schools.

A case study by K. Vaijayanti presents "the important findings of the survey conducted in Bengaluru on government Urdu schools regarding the problems of access and quality in education. They have done a survey with all 171 Urdu-medium schools in the Bengaluru Urban district of Karnataka and interviews with 25 Headmasters and 35 teachers from these schools. They have collected data from household survey conducted by Akshara Foundation and information (K.Vaijayanti, n.d.).

The government's focus on access seems to have not sufficient with quality in terms of infrastructure and learning outcomes. The urban planning seems to lack a holistic approach towards the maintenance and functioning of these schools. Many schools are in a bad state and do not offer even basic facilities(K.Vaijayanti, n.d.).

This study aims to design and develop a web application for self-directed learning named Urdu_Zabaan, for 1st grade Urdu Language. This application is designed in such a way that makes the learning process interesting while reducing the time of learning. In the first stage, the application is being tested internally and in the final stages of research, the application made will be tested to determine the level of ease of use (usability) to be applied in schools.

This application focuses on the main aspects of language learning skills i.e. Listening, Speaking, and Reading. Two models have been created separately and then combined to get the desired output. Implementation of Data Mining and Natural Language Processing (NLP) techniques like the text to speech conversion, Automatic Speech Recognition (ASR), Sequence matcher, and spaced repetition has been used in designing this app.

Speech recognition systems depends on three main components. First one is an acoustic model, second is a pronunciation lexicon, and the third one is a language model. To build these components, one must have linguistic as well as technical expertise, which is a barrier in low resource domains like Urdu. Although there are millions of Urdu speakers all over the world, It is still a low-resource language in terms of standard publically available linguistic resources(Zia et al., 2019).

Self-directed learning requires students' willingness to undergo the process until it is complete. Students' enthusiasm depends on the degree of motivation. Thus motivation is the key to successful learning. The easiest method to increase student motivation is to apply game elements in the learning context (Wihidayat et al., 2018).

The first requirement of learning any language is to remember the spoken pronunciation of the words. The first task of remembering words is to remember the spoken pronunciation of words. It can be seen that accurately remembering oral pronunciation is the fundamental way to remember the words. Correct oral pronunciation habits can also greatly improve listening(Xin, 2020).

Some puzzles comprising the same words have been introduced after the completion of each lesson to engage kids. Some points are also associated with all the lessons to encourage kids to learn more to accumulate those points and unlock the puzzles.

Chapter 2: Literature Review

Catherina and Jason had published a paper in 2016 for mobile language learning applications: trends, challenges, and opportunities. They reviewed the fifty most popular commercially available language learning mobile applications and evaluated them according to a wide range of criteria. They found three major trends: first, all apps teach vocabulary in isolated units instead of relevant contexts, second, apps rarely suit the skill sets of individual learners, and third apps don't offer explanatory corrective feedback to learners" (Heil et al., 2016).

In 2016 Asadullah and his team had developed an approach for automatic speech recognition of Urdu isolated words. In their study, they found that Urdu phonetics and phonology differ widely from the English language. They performed some experiments based upon different arrangements of datasets using 10 fold cross-validation approach. For feature extraction, they used MFCC (Mel Frequency Cepstral Coefficients) and for speech recognition, they used Hidden Markov Model (HMM). They got an overall recognition accuracy of 78.2% for 100 words with the use of deep learning models for automatic speech recognition of Urdu. (Asadullah et al., 2016)

Computer-based solutions for pronunciation training are becoming popular for foreign language learning purposes. Nevertheless, currently available solutions offer considerable room for improvement, especially concerning the feedback generated by the system. (Menzel et al., 2000)

For Bengali Language "A Speech Recognition System using Recurrent Neural Network has been designed in 2019 by Jahirul Islam and his team. In their study, they used convolution neural network technique and recurrent neural network for creating a speech recognition system and to find the Bengali character probabilities respectively which they again improved further by using the CTC loss function and language model. This paper mentioned that unlike English language Bengali language consisting of diacritic characters(special symbols) and such languages are very much difficult to train any model"(Islam et al., 2019).

According to Behzad Tabibian, "Spaced repetition is a technique for efficient memorization which uses a repeated review of content following a schedule calculated by a spaced repetition algorithm to improve long-term retention. He mentioned that the ability to remember a piece of information depends on the repetition of that information,i.e. number of times we have seen it and the time gap since the last review"(Tabibian et al., 2019).

The popular language-learning app Duolingo which offers 95 different language courses in 38 languages is not teaching the Urdu language. Google Bolo Application does support the Urdu language but it is only focused on a child's reading skills. Learn Urdu Quickly, Learn Urdu Free, and Learn Urdu kids are some of the apps which help kids to learn Urdu but none of them is evaluating the user performance(*Duolingo Statistics.Pdf*, n.d.).

Demand for language learning apps will further increase exponentially as the accessibility of mobile computing devices increases(Heil et al., 2016).

Chapter 3: Problem Statement

Times of India surveyed with class 4 students of an NCR government school, where they found now more kids are going to school but most of them can't read their mother tongue(*Newspaper_Article.Pdf*, n.d.).
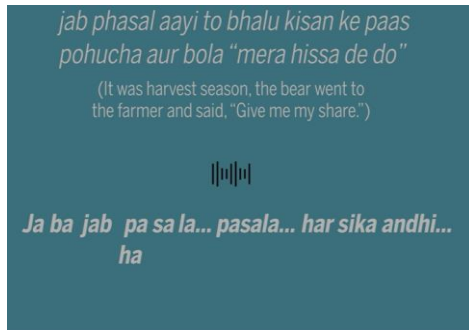
jab phasal aayi to bhalu kisan ke paas pohucha aur bola "mera hissa de do" (It was harvest season, the bear went to the farmer and said, "Give me my share.") ‖ılı‖ıl *Ja ba jab pa sa la... pasala... har sika andhi... ha* **This is how a Class 4 student reads a Class 2 text in his mother tongue**		

Percentage of students who failed to read even one word correctly

STATE	LANGUAGE	(IN %)
Uttar Pradesh	Hindi	75.9
Rajasthan	Hindi	62.5
Karnataka	Kannada	53.2
Odisha	Oriya	38.8
Uttarakhand	Hindi	30.1
Chhattisgarh	Hindi	23.2
Maharashtra	Marathi	3.8

Source: 2018 USAID study conducted in seven states

3_1: Problem with Current learning system

It probably took 3-4 seconds to read this sentence, if someone knows Hindi, but for Abhishek who is a class 4 student and his mother tongue is Hindi took 30 seconds to get the last letter though he speaks the language at home and with his friends(*Newspaper_Article.Pdf*, n.d.).

It's the same for all for other languages like Urdu, Tamil, Malayalam, etc. According to data from 2018 released recently by the United States Agency for International Development oral reading fluency in the mother tongue in Class 2 is zero for 76% of the students in Uttar Pradesh, 62% in Rajasthan, and 53% in Karnataka (*Newspaper_Article.Pdf*, n.d.).

It's the same with not just mother tongue but with the overall quality of education, So can AI tools help in this?

Chapter 4: Objectives of the Study

This case study is to develop an application to help a 5-year-old to learn Urdu pronunciation by focusing on the important characteristics of the language, providing equal focus to all parts of learning: Listening, speaking & reading.

The application will be able to evaluate kids' pronunciation for the textbook, while the other apps available in the market are not giving feedback and interactively correct them.

Chapter 5: Project Methodology

CRISP-DM (Cross Industry Standard Process for Data Mining) approach has been followed in this project from Business understanding till deployment.

CRISP-DM (Cross-Industry Standard Process for Data Mining)
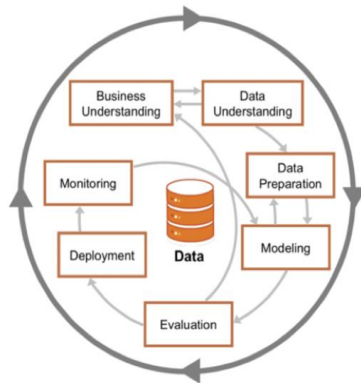
Business Understanding: App requirement.
Data Understanding: Urdu words from NCERT text grade1 book.
Data Preparation: Normalization of the data.
Modeling: Speech Recognition model, Sequence matcher.
Evaluation: Evaluated it with grade 1 kids
Deployment: Deploying model in Django framework**.**

5_1: CRISP-DM approach

Chapter 6: Business Understanding

As it is shown below, there is a shortage of teachers in a government school. In most of these schools' teacher to students' ratio is 1:40, there is no proper infrastructure for kids which is causing poor learning. Individual attention will be not possible but as we know all kids are not the same, they can't learn easily which might affect their learning of that language.

Teacher Fatigue is another issue that creates biasness and stress as we can see them below. On the contrast of that in another picture, it can be seen how happy teacher and kids are, with the use of technology in their class, which create a happy learning environment.

One-to-one interactions will be a costly affair. As Private tutor fees are expensive, these unprivileged kid's parents cannot afford it. But with a one-time investment in these apps and technology by our government can prepare a quality learning environment for them.

With all the literature survey, it is found that there is not a single app available in the market which evaluates kids'/users pronunciation for Urdu for grade1 kids, so there is a need to develop an application (A virtual teacher) to assist these government school teachers and improve quality of education.

Urdu schools in a pathetic state
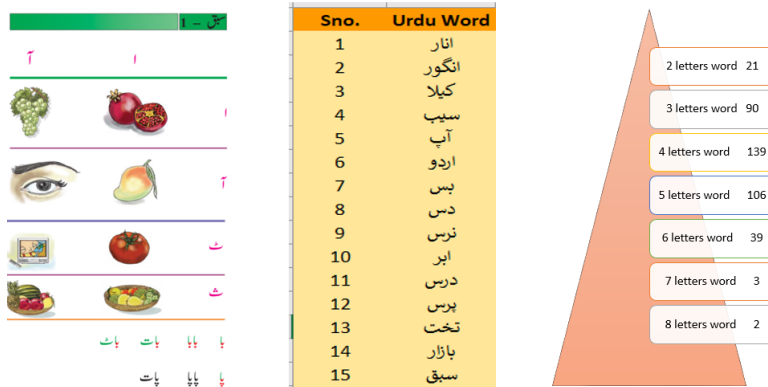bangaloremirror.indiatimes.com

Government Urdu School, Yeshwant…

*6_1: Comparison of two different learning environment*

Chapter 7: Data Understanding

The initial requirement of this project is a text dataset, which has created using the Urdu NCERT textbook for grade 1 and arranged the words based on the complexity level.

7_1: Data collection

The dataset contains 400 words from the book, the number of letters in these words are varying from 2 to 6. Most of the words used in this dataset contain 3to 5 characters i.e. 85%.
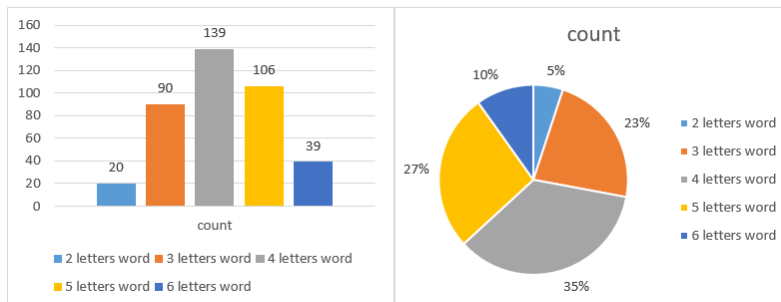
7_2: Data Exploration

It has been observed that 6 letters words are in actual 4 or 5 letter words only with aerab (a sign, when written above or below a letter give a difference in pronunciation from the same letter when unmarked or differently marked). Hence these words are removed from the dataset.

All the remaining word is exposed to the child to listen, speak, and read. For that audio files have been created for all those words (using GTTS python package) to make users listen and pronounce accordingly. Most of the words can be pronounced in 2 seconds on average.

7_3: Sound wave data

Chapter 8: Data Preparation

Dataset has been created using the pdf of the NCERT Urdu textbook for grade1 taken from the internet. Text data has been checked manually for any spelling mistakes. words ranging from 6 to 8 letters are due to aerab (a special character in Urdu) as mentioned above, so for simplicity, those words have been removed from the dataset. It has been also observed that some words were repeated, spelled wrong, hence these words have also been removed. All 400 words have been divided into 10 chapters, each chapter contains 10 lessons and in all lessons, only four words have been kept to help kids learn easily complete one lesson in one day by just learning these four words.

To remember a words, it is important to know/remember its spoken pronunciation. With the help of the python gtts package, all text has been converted into mp3 audio files and included in the database. These audio files have also been checked manually. It is found that out of 400 audio files, only 6 words are not pronounced correctly with gtts package, so these file has been created manually and replaces previous files.

Further to make learning fun and interactive, images from the textbook and the internet have been collected for all those words and included in the model building. After all the data preparation work the dataset looks like the below figure.

| Id	Urdu Word	Chap_lesson	Audio_files	Image_files
1	انار	1_1	audio/1_1.mp3	image/1_1.jpg
2	انگور	1_1	audio/1_2.mp3	image/1_2.jpg
3	کیلا	1_1	audio/1_3.mp3	image/1_3.jpg
4	سیب	1_1	audio/1_4.mp3	image/1_4.jpg
5	آپ	1_5	audio/1_5.mp3	image/1_5.jpg
6	اردو	1_6	audio/1_6.mp3	image/1_6.jpg
7	بس	1_7	audio/1_7.mp3	image/1_7.jpg
8	دس	1_8	audio/1_8.mp3	image/1_8.jpg
9	نرس	1_9	audio/1_9.mp3	image/1_9.jpg
10	ابر	1_10	audio/1_10.mp3	image/1_10.jpg

8_1: Pre-processed data

Chapter 9: Data Modeling

All the texts, audio files, and images collected for these words have been stored in the PostgreSQL database. Primarily two tables have been created in this database, one containing words, audio files, and images, and the other one with user details.

When the user pronounces a word, the model will take the audio signal and convert it into text using ASR then this text will be compared with the text stored in the database using sequence matcher.

Text to Speech Conversion

To convert Text to Speech in Python, gTTs (Google Text-to-Speech) package is used. It's a Python library and command-line tool to interface with Google text-to-speech API. It creates an audio file from text data.
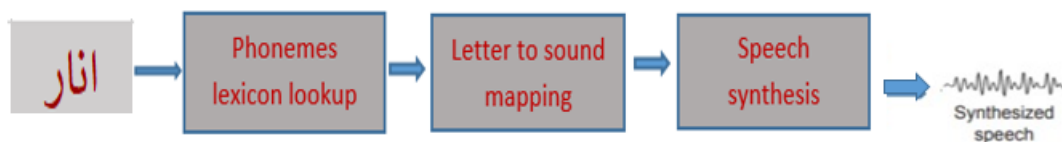
9_1: Text to speech conversion

"Text-to-speech synthesis converts raw text into a phonetic string which generates the appropriate digital signal using a particular synthesis technique"(Hussain, 2004).
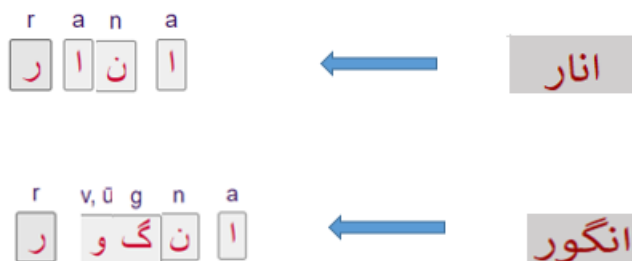
9_2: words to phonemes

There are phonemes for all the different letter sounds.

|								
alif	ا	–	–					
be	ب	b	[b]	shin	ش	sh	[ʃ]
pe	پ	p	[p]	swad	ص	ş	[s]
te	ت	t	[t]	zwad	ض	z̧	[z]
ṭe	ٹ	ṭ	[t]	to, toe	ط	t	[t]
se	ث	s	[s]	zo, zoe	ظ	z̧	[z]
jīm	ج	j	[dʒ]	ayn	ع	'	–
che	چ	ch	[tʃ]	ghayn	غ	gh	[ɣ]
he	ح	h	[h]	fe	ف	f	[f]
khe	خ	kh	[x]	qaf	ق	q	[q]
dal	د	d	[d]	kaf	ک	k	[k]
ḍal	ڈ	ḍ	[d]	gaf	گ	g	[g]
zal	ذ	dh	[z]	lam	ل	l	[l]
re	ر	r	[r]	mim	م	m	[m]
ṛe	ڑ	ṛ	[r]	nun	ن	n	[n]
ze	ز	z	[z]	vao	و	v	[ʊ/u, o, ɔ]
zhe	ژ	zh	[ʒ]	he	ه	h	[h]
sin	س	s	[s]	ye	ی	y	[j/i]

*9_3: phoneme corresponding to Urdu characters.*

Speech to Text conversion

"The Speech Recognition library acts as a wrapper for several popular speech APIs and it is extremely flexible. One of these—the Google Web Speech API—supports a default API key that is hard-coded into the Speech Recognition library" (Jason et al., n.d.). The library also has support for different languages including Urdu. It can recognize audio from the user and convert it into Urdu text. "Conventional speech recognition systems utilize the Gaussian mixture model (GMM) based on hidden Markov models (HMMs) to represent the sequential structure of speech signals"(Shirodkar, 2016).
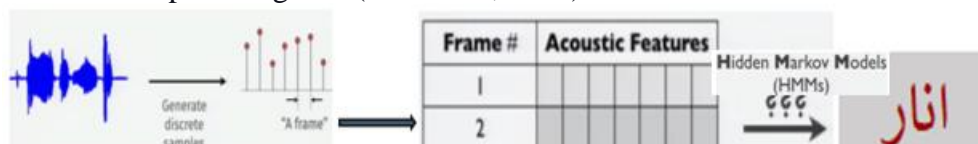
9_4: Speech to Text conversion

Sequence Matcher

"Sequence Matcher is a flexible class for comparing pairs of sequences of any type. The motive is to find the continuous matching subsequence that contains no junk elements. The same idea is then applied recursively to the pieces of the sequences to the left and the right of the matching subsequence. This does not yield minimal edit sequences but does tend to yield matches that look right"(Jason et al., n.d.).

GTTS: Google Text to Speech converter
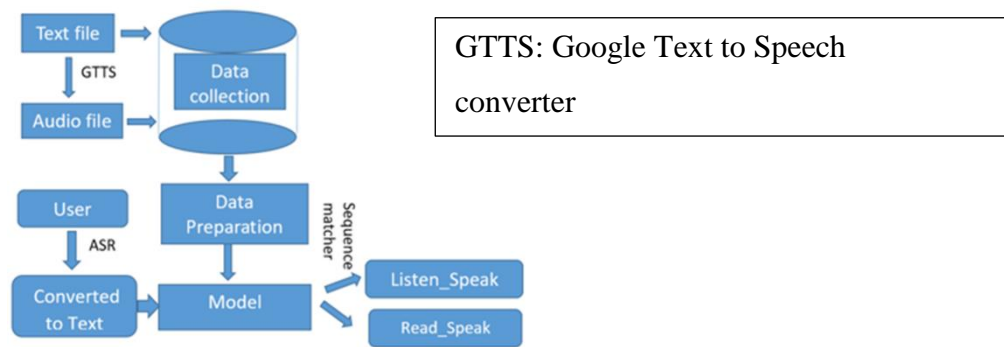
9_5: Final Model

Python speech recognition package is used to recognize the word and then use a sequence matcher to find the similarity quotient and check if it satisfies a high threshold of 0.85 to accept the response. Accurately classifying the correct answer is an important part of maintaining user interaction. Many python algorithms are utilized for comparison and understanding of user input (Jason et al., n.d.).

Spaced repetition

"For efficient memorization it is required to repeat the content following a schedule calculated by a spaced repetition algorithm for long-term retention". (Tabibian et al., 2019).

Some words are more difficult than others so the number of attempts taken by a user to achieve the required output has been stored in the database. By repeating these words frequently help kids to learn these words easily. We have implemented the spaced repetition in our app. For the first 5 days, 4 new words will be given to kids to listen and speak, and the same words will be shown to read and speak. On the 6th and 7th day these 20 words will be repeated to retain in the kid's memory. So in one week kids will be able to learn the right pronunciation of 20 words. In this way, kids will be able to learn 400 words in 20 weeks.
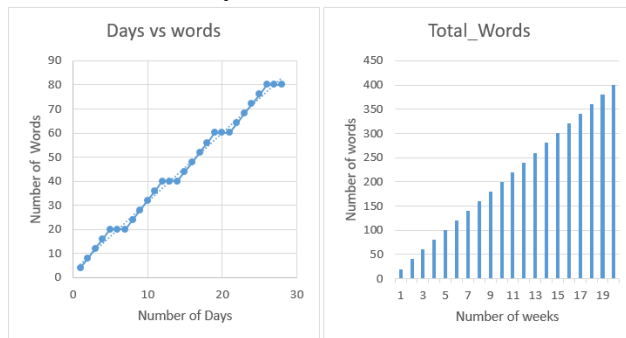
9_6: spaced repetition

Chapter 10: Data Evaluation

All 400 words audio file (converted by ML model) tested & evaluated with the teacher. Some words are difficult to pronounce, so kept in the last. To make the model more interactive some puzzles and surprises are included at the end of every lesson (comprising only 4 words). The target is to teach 400 words in 20 weeks with a gap and revision frequently (spaced repetition technique). Reducing the period of 52 weeks to 20 weeks only.

The Error rate of the Listen_Speak model is 8.13% and the Read_Speak model is 8.75%(calculated with a sample of 160 words).

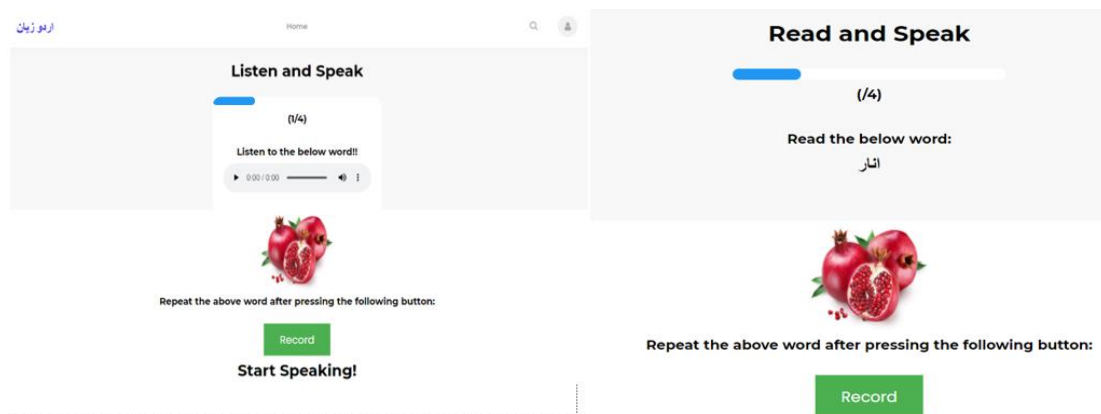| Model Type	Error Rate
Listen and Speak	8.13%
Read and Speak	8.75%

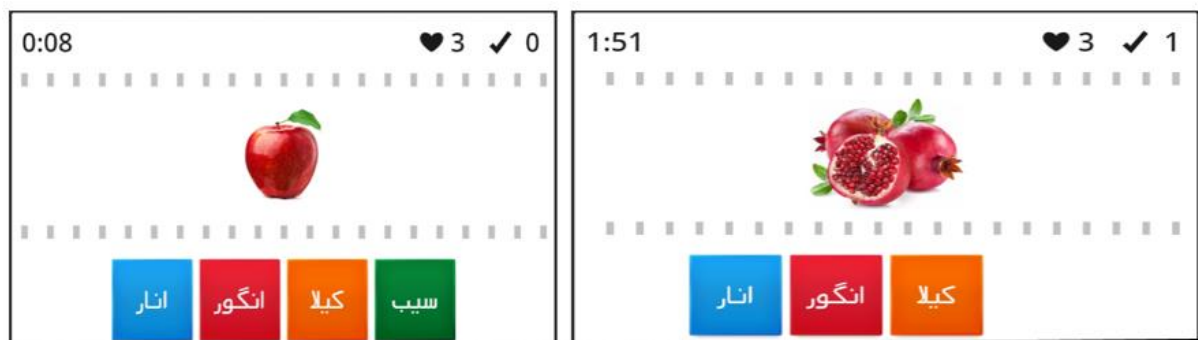*10_1: Error rate*

Chapter 11: Deployment

Listen Speak and Read_speak model has been deployed using the Django framework and evaluated with a kid. The app accuracy was quite satisfactory, presented below in the confusion matrix.
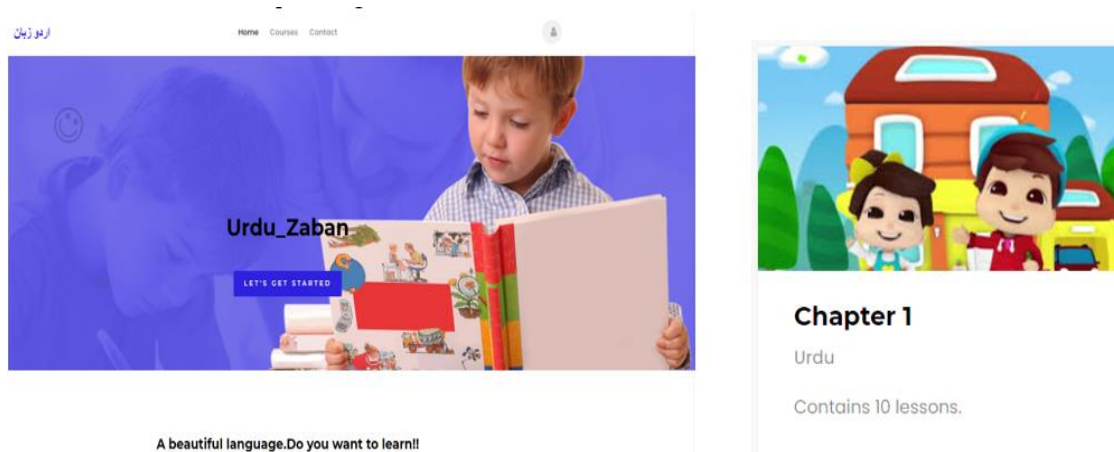
11_1: Django app

11_2: App performance

11_3: interactive puzzles

App Evaluation:

The suggested application has been evaluated with a 5-year-old kid internally. The confusion matrix for the same has been created and the accuracy of the model has been calculated with 160 words.

True positive(TP): Model has predicted successful when kid has pronounced right.

True negative(TN) Model has predicted not successful when kid has pronounced wrong.

False Positive(FP): Model has predicted successful even kid has pronounced wrong.

False Negative(FN): Model has predicted not successful although kid has pronounced right.

Accuracy=(TP+TN)/Total

Accuray =	96.25%

Total=160	Predicted: Right	Predicted: wrong	
Actual: Right	TP=146	FN=6	152
Actual: wrong	FP=0	TN=8	8
	146	14	

Listen_Speak Model

Accuray =	95.63%

Total=160	Predicted: Right	Predicted: wrong	
Actual: Right	TP=143	FN=7	150
Actual: wrong	FP=0	TN=10	10
	143	17	

Read_Speak Model

11_4: Confusion matrix

Chapter 12: Analysis and Results

All 400 words audio file (converted by ML model) tested & evaluated with the teacher. Some words are difficult to pronounce, so kept in the last.

Some text to speech converted audio file using the gtts package was not proper, so these files have been created manually and replace the previous one.

To make the model more interactive some puzzles and surprises are included at the end of every lesson (comprising only 4 words). The target is to teach 400 words in 20 weeks with a gap and revision frequently (spaced repetition technique). Reducing the period of 52 weeks to 20 weeks only.

Chapter 13: Conclusions and Recommendations for future work

The Listen_speak model and Read_speak model built using Speech Recognition algorithms are working well with good accuracy. In the future, it is planned to implement Writing evaluation as well with Read_ write and Listen_ write models. Right now the evaluation work has been restricted to word-level only. In the future, it can be extended for sentence and paragraph level also.

The same framework can be used for different regional languages as well as foreign languages as well. Furthermore, a similar framework from a textbook to an app can be designed for other subjects like maths, science, etc.

Bibliography

Asadullah, Shaukat, A., Ali, H., & Akram, U. (2016). Automatic Urdu Speech Recognition using Hidden Markov Model. *2016 International Conference on Image, Vision and Computing, ICIVC 2016*, 135–139. https://doi.org/10.1109/ICIVC.2016.7571287

Duolingo statistics.pdf. (n.d.).

Heil, C. R., Wu, J. S., Lee, J. J., & Schmidt, T. (2016). A Review of Mobile Language Learning Applications: Trends, Challenges, and Opportunities. *The EuroCALL Review*, *24*(2), 32. https://doi.org/10.4995/eurocall.2016.6402

Hussain, S. (2004). *Letter-to-sound conversion for Urdu text-to-speech system.* 74. https://doi.org/10.3115/1621804.1621823

Islam, J., Mubassira, M., Islam, M. R., & Das, A. K. (2019). A speech recognition system for Bengali language using recurrent Neural network. *2019 IEEE 4th International Conference on Computer and Communication Systems, ICCCS 2019*, 73–76. https://doi.org/10.1109/CCOMS.2019.8821629

Jason, G., Jones, K., Thomas, K. G., Jason, G., & Jones, K. (n.d.). *Title Page Category : Research Paper / Review Article / Survey Report Kannada Kali Kannada Kali*.

K.Vaijayanti. (n.d.). *A case study of Government Urdu Schools in Bengaluru; Silicon city K.Vaijayanti 1*. 1–17.

Menzel, W., Menzel, W., Herron, D., Herron, D., Bonaventura, P., Bonaventura, P., Morton, R., & Morton, R. (2000). Automatic detection and correction of non-native English pronunciation. *Proceedings of InStil2000*, *October*, 49–56.

Newspaper_Article.Pdf. (n.d.).

Shirodkar, N. S. (2016). *KONKANI SPEECH TO TEXT RECOGNITION USING HIDDEN MARKOV MODEL TOOLKIT Submitted by in partial fulfillment for the award of the degree Department of Computer Science and Technology*. *December*. https://doi.org/10.13140/RG.2.2.12807.80802

Statista.com. (n.d.). https://www.statista.com/statistics/273960/global-mobile-education-market-volume/

Tabibian, B., Upadhyay, U., De, A., Zarezade, A., Schölkopf, B., & Gomez-Rodriguez, M. (2019). Enhancing human learning via spaced repetition optimization. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(10), 3988–3993. https://doi.org/10.1073/pnas.1815156116

Wihidayat, E. S., Utami, Y. D., & Budianto, A. (2018). Learn Arabic Language App, Mobile Based Application for Self-Directed Learning. *2018 4th International Conference on Education and Technology, ICET 2018*, 13–17. https://doi.org/10.1109/ICEAT.2018.8693934

Xin, Y. (2020). The Design of Automatic Correction System for Spoken English Pronunciation Errors Based on Phonemes. *Proceedings - 2019 6th International Conference on Dependable Systems and Their Applications, DSA 2019*, 247–254. https://doi.org/10.1109/DSA.2019.00038

Zia, H. Bin, Raza, A. A., & Athar, A. (2019). Pronouncur: An Urdu pronunciation lexicon generator. *LREC 2018 - 11th International Conference on Language Resources and Evaluation*, 2393–2397.

Appendix

Plagiarism Report

Speech Analysis for Teaching a Vernacular Language

by Taiba Naz

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