

LMSDS: Learning Management System for Deaf Students in Collaborative Learning Environment

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Abstract

Objectives: To develop the system that maps the natural speech to the lip shape animation. **Methods/Analysis:** Now a day's speech technology plays a vital role in e-learning especially to design in respond to human voice. This technology mainly used for voice disabled, hearing-disabled and blind and so on. **Findings:** The sign Language being in use among Deaf and Dumb People. This study proposed the new approach called (LMSDS) Learning Management System for Deaf Students. This system used in speech processing and real-time implementation of chat application. Visual animated face will helpful for deaf students to learn the lip movement language more effectively. **Applications:** This is used in education for disability, deaf students to learn Lip movement language.

Keywords: Collaborative Learning, LMSDS, Lip Movement Language, Sign Language, Speech Processing

1. Introduction

IR proximity sensors and Braille keyboards are available for the blind to lead their life successfully. But then and there, the technological sophistication should reach the hearing impaired so that they can also enjoy the fruit of modern life. The speech signal is sampled into frequency phonemes and classified into viseme classes using neural networks, which eliminates the need for human effort¹. The study presented an implementation of real time, language independent lip synchronization based on the classification of the speech signal into visemes using Neural Networks (NNs)¹. This system helps effectively in personal situations such as press conferences, business meetings, lectures or event parties.

Another study discussed the speech signals using three different evaluation methods. The results indicated that very good lip synchronization quality in real time conditions and for different languages, making the method suitable for a wide range of applications². The Interactive problem-based learning environment project

is COS, which incorporated in the marine science book for deaf high school students. Classroom of the sea is a mixes online and offline environment for the student and the teacher aboard a research container as they gather marine science data to concentrate on a problem³. The previous study described the multimodal information, which is used to improve the native English language with first language⁴.

The method proposed by⁵, a set of 32 signs, each representing the binary 'UP' and 'DOWN' positions of the five fingers. The method has been developed with respect to a single user both in training and testing phase. The static images have been pre-processed using feature point extraction method and are trained with 10 numbers of images for each sign. The images are converted into text by identifying the fingertip position of static images using image processing techniques. The proposed method is able to identify the images of the signer which are captured dynamically during the testing phase.

A method called effective group formation of students⁶ in an online collaborative learning environment,

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where K-NN algorithm is used for improve the group performance, and balancing the normal students' knowledge level⁷. According to⁸ integrates speech cues from many sources and this improves fluency, especially when the acoustic signal is degraded.

Another method had been developed to automatically localize lip feature points in the speaker's face and to carry out a spatial-temporal tracking of these points⁹. A life prototype is evaluated with multiple speakers under natural conditions. In order to approve our lip feature extraction approach, specific audio-visual corpus was created. The results showed different configuration of the mouth through visemes. Finally, the visemes classes are relatively with some physical measures. The realism of synthesized speech animation was also proposed¹⁰.

After considering all drawbacks of previous study, this study has come up with a new idea that involves the implementation of speech to video/graphics as its base. The implementation of the idea basically involves conversion of human speech in English into the video/graphic of the lip movement, a hearing impaired person can find use. The problems with the sign language are: firstly, not everyone can understand it, and secondly, the signs vary from place to place. These two problems, if solved, the hearing impaired can benefit a lot. Thus, the main idea of this paper is to develop a system that maps a natural speech to the lip shape animation in the real time. Initially it is to design a system based on the trial and error method that can considerably improve the Phoneme classification results. This method may find suitable for online and offline applications.

2. Method

This study proposes the system called Learning Management System, which is used for Deaf-Dumb Students (LMSDS) to learn the lip movement language effectively without the need of human effects. The system maps the natural speech to the lip shape animation. Figure 1 represents the overall architecture of lip movement language processing.

This system architecture shown in Figure 1 is working on two sides' viz., client and server. In LMSDS, server side is used by the tutor, where the tutor can act as the administrator, teacher and manage the students group. Then tutor able to speak the content through the microphone and convert into the text, and then the text

will be sent to the client (students), where the converted texts will be synchronized with the animated lip.

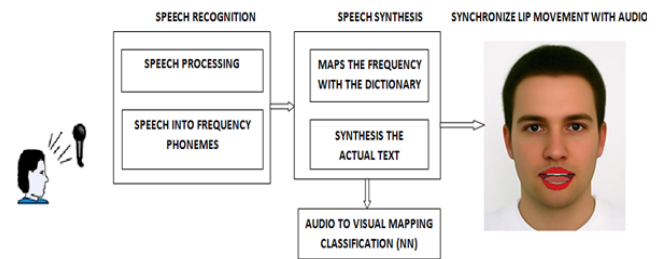


Figure 1. System architecture.

This system consists of three parts that are speech recognizer, speech synthesizer, synchronize lip movement with audio. The tutor spoke the content via mice (headphone), initially speech recognizer module recognize the speech and converts into the frequency phonemes. The SAPI Framework which is developed by Microsoft. SAPI (Speech Application Programming Interface) checks the grammar, libraries and resource files. SAPI is the middleware between speech recognizer and speech synthesizer. The speech synthesizer module maps speech frequency phonemes with the dictionary, and then it synthesize the actual text. The neural network classifier which is used in the system for phonemes classification needs to be trained. The NN classifier is used for audio to visual mapping is done at the client side.

In LMSDS consists of the three main modules. They are

2.1 Speech Recognition

- Input the speech through the input device (mice).
- Recognize speech signals by a recognizer.
- Samples the speech into frequency phonemes.

2.2 Speech Synthesis

- Input the sampled frequency phonemes.
- Maps the frequency with the dictionary.
- Synthesis the actual text.

2.3 Synchronize Lip Movement with Audio

- Input the synthesized text.
- Text is sampled as frequency phonemes.
- Viseme classification is done and mapped to an animated lip control.
- Based on frequency phonemes, audio is produced.

In English language, two type of phonemes are there one is vowel phonemes and another one is consonant phonemes, that is categorized as 44 phonemes. The list of phoneme is listed in Table 1.

Table 1. List of phonemes

a	ae	oo	er
e	ec	ar	ow
i	ie	ur	oi
o	oe	or	air
u	ue	au	ear
b	d	f	G
h	j	k	L
m	n	p	r
r	s	t	V
w	wh	y	z
th	ch	sh	zh
ng			

Figure 2 consists of pictorial representation of speech to text classification using neural network. Example Ring speech word is classified into frequency phonemes in the hidden layer than the frequency phonemes are organized to form the text. These processes are done using the neural network configuration.

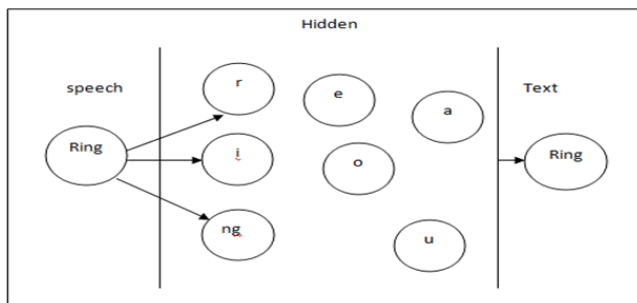


Figure 2. Speech to text classification using neural network.

3. Results and Discussion

In order to do performance analysis, arranged the classroom for deaf students to learn lip movement language, where tutor and students are participated. In this system, 25 deaf students have participated effectively for lip movement language learning practice.

While learning initial stage students understand the lip movement accuracy is very low. After one month of

the learning process, the understanding of lip movement language is better than the initial stage. Because of the continuous learning process the deaf students can able read the human lip movement and understand normal human being English Language.

$$\text{Accuracy of LR} = \frac{\text{Number of Correct Words}}{\text{Total Number of Words}} \times 100$$

Figure 3 and 4 show the percentage of accuracy taken before and after the lip reading practice, respectively. Before entering into the LMSDS, the student can't able to understand the lip movement language accurately so that accuracy of lip reading percentage will be low. After a month of lip reading practice, the deaf student can able to communicate with the normal person without knowing the sign language, at that time accuracy of lip reading will be high.

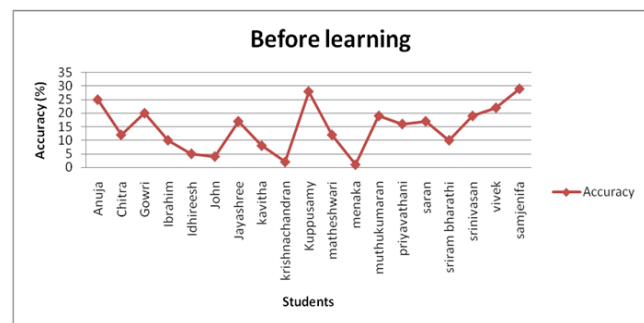


Figure 3. Accuracy of lip reading before practice.

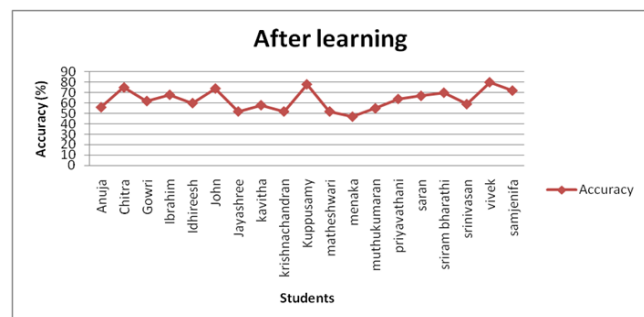


Figure 4. Accuracy of lip reading after practice.

Test case specification was developed in the development phase. A test case specification of the LMSDS system is presented in Table 2. A test case specification describes the purpose of a specific test, identifies the required inputs and expected results, provides step-by-step procedures for executing the test, and outlines the

Table 2. Test case specification table

TC#	Test Case	ER#	Expected Results
TC-01	To Validate the user name and Password	ER-01	Display the corresponding user Environment
TC-02	To obtain the speech input through microphone	ER-02	Input is recognized and displayed as text
TC-03	To obtain the speech input through microphone	ER-03	Speech is converted to text and displayed
TC-04	To process the input instruction(text)	ER-04	Corresponding Lip Animation is displayed
TC-05	To process the input instruction(text)	ER-05	Corresponding audio is played

Table 3. Test report table

Test Case	Expected Results	Actual Results	Pass/Fail Criteria
TC-01	ER-01	ER-01	PASS
TC-02	ER-02	ER-02	FAIL
TC-03	ER-03	ER-03	PASS
TC-04	ER-04	ER-04	PASS
TC-05	ER-05	ER-05	PASS

pass/fail criteria for determining acceptance is presented in Table 3.

It has been estimated that the staff and deaf students ratio in India about 400:1. The total numbers of deaf children are about 5 millions. The problems with the sign language are not everyone can understand and the signs vary from place to place in India. These two problems are rectified in this proposed study.

4. Conclusion

Speech technology plays a vital role in e-learning especially to design in respond to human voice. This technology mainly used for voice disabled and hearing-disabled people. This study proposed the new approach called (LMSDS) Learning Management System For Deaf Students. The LMSDS helps for disability, deaf students to learn Lip movement language and helps hearing impaired ones to communicate properly and also provide more generalized and unchanging signs which will help in nationalizing the language uniformly. The usage of specialized voice training kit with advanced features can be effectively used in the fields of distance-learning, mobile communication for deaf/dumb, war zones and healthcare centers.

5. References

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