An Intelligent System for Automated translation of Videos from English to Native Language applying Artificial Intelligence Techniques for Adaptive eLearning

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Abstract. Generally providing the content in one's own language is helpful for students to learn better in their mother tongue. Using the mother tongue for learning in Adaptive eLearning has been particularly effective in terms of understanding and engagement level. So, translation to one's mother tongue becomes one of the most important phases in the Adaptive eLearning development process. But translation of eLearning videos has been one of the toughest jobs to do due to the involvement of various stake holders and manual coordination work involved. The entire translation process of the videos had been tried earlier by involving mostly manual work and found to be tiresome. After the recent evolution of Machine learning and Natural language processing techniques, it is feasible now to do the translation by inculcating intelligent techniques in the process. We have implemented machine learning techniques while translating the videos. The results show that this intelligent automation drastically reduces the time to translate the videos by involving less manpower. The methodology help us to achieve optimised utilization of resources and production time.

Keywords: Machine translation, Adaptive eLearning, Machine learning, Animated videos translation.

1. Introduction

The importance of the language option in Adaptive learning is already emphasized by us in the paper [1]. This option of learning using the native language is being requested by several colleges, universities, and international clients as they see the benefits of usage of native language. But some universities may prefer teaching using an international standard language like English. So, while providing eLearning solutions for these universities, having materials in both English and Native languages will be beneficial. But translating the eLearning materials especially eLearning videos from English to their native language is a challenging task. Automating Translation is one of the hardest problems as many contextual and expressive nativity of different languages [2].

Earlier it involved the skills, time and exhaustive teamwork of human translators, voice artists, and subject matter experts to convert a video from English to Native languages. This traditional process is expensive and time consuming. The effort needed is going to be intensified if we need translation in multiple languages. Recently, Machine learning based translation is a feasible solution that is being explored as the accuracy has improved [2].

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In this research, the Animated videos in English are translated by machine into different languages used across the world by understanding the story board and applying machine learning cloud services. This research project was proposed by us based on the need and demand to convert and use the existing English videos.

Section 2 discusses the literature review about related research. Section 3 describes the detailed methodology while section 4 presents the expected results and discussion. The final session concludes the paper summarizing the intelligent automation and reduced production time.

2. Literature Review

Researchers have been exploring Machine Translation for many years and have found that Machine Translation has been more accurate after the recent evolution of the deep learning. Here, we are listing related works which were the base for our proposed methodology and inspiration for taking this research work.

Christian Katzenstein, a Danish scientist was the pioneer to start research on translation systems in the year 1799. Thereafter based on research inputs from many researchers, improvements slowly began to appear. Inspired by IBM founder Thomas Watson Sr, IBM came up with a translation system in the year 1927 itself for which the groundwork started from 1920s [3]. In 1949, during the Second World War researcher Warren Weaver at Rockefeller Foundation proposed for machine-based translations. Then many universities in US started

research on Machine Translation [4]. In 1954, Georgetown-IBM experiment translated sixty Russian sentences to English and gained much media and public interest. Sadly, the ALPAC report suggested to stop funding for Machine Translation research stating that machines cannot compete with the human translation quality. But several researchers continued their study on automatic machine translations and kept the ball rolling. Most of these researchers used rule-based machine translation and had limitation on the language pairs and inputs. During the 1980s, most of machine translation engines were based on Main Frame technologies.

The initial effort in India regarding machine translation was tried by IIT Kanpur researcher RMK Sinha [5]. This

effort involved human involvement as a post-production work. This was reduced to some extend by developing an another application called "Anusaaraka"[6]. Only Indian languages were considered in these applications.

The Evolution of Translation using machines can be classified as shown in figure 1 in to following types based on technique used as

1. Rule Based – 1950 to 1980

2. Example Based – 1980 to 1990

3. Statistical based – 1990 to 2015

4. Neural Network Based – From 2015 onwards

Fig 1: Evolution – Translation Techniques using Machines
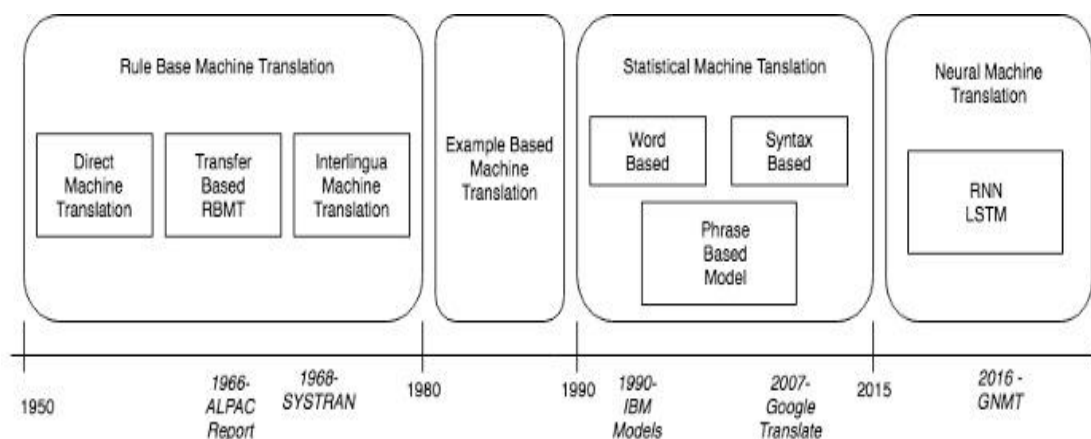
Rule based Machine Translation and Example based Machine Translation are the old techniques [8-13] and Statistical Machine Translation and Neural Machine Translation are the recent ones [14-19]. The latest technology used is based on Neural Networks.

In the paper [20] Bibekananda Kundu and Sanjay Kumar Choudhury proved that a machine learning based approach will help in machine translation systems while using for English to Bangla conversion. Mary Priya et al. [21] Remya Rajan et al [22] and Rinju O.R et al [23] came up with methods to translate English documents to Malayalam. Apart from the machine translation efforts done for English to Malayalam there are systems for each language like the one proposed by Keerthi Lingam et al. [24] for English to Telugu. Srikar Kashya Pulipaka etal [25] used an open-source applications to convert English language video to some of Indian language audio for visually impaired people and reading handicapped people. Their output is only audio and here we propose to a matching video in multiple languages. Moreover, video with multiple voices is not considered in their work. The case of conversational videos is also not considered in their work.

Most of the related work has been focused and done for text or speech-based input and output. Not much research

work has been done for the video-based translation work for multiple languages across the world. So, we proposed to work on this area as we had a requirement internally to convert the English videos to multiple languages with less human involvement.

3. Methodology

There are several applications developed for translating various languages, but they are either developed for individual languages or individual multimedia elements or purposes alone. This proposed system is an end-to-end tool that allows users to choose the target language and the intelligent cloud services based on neural translation to convert the English videos to the target language videos. The following steps are followed to translate the videos

1. Getting the voice over from the source video

2. Translating the voice over of the source video into the target language

3. Creating sub-title files based on the voice overs and translation

4. Combine all those pieces to get the target video

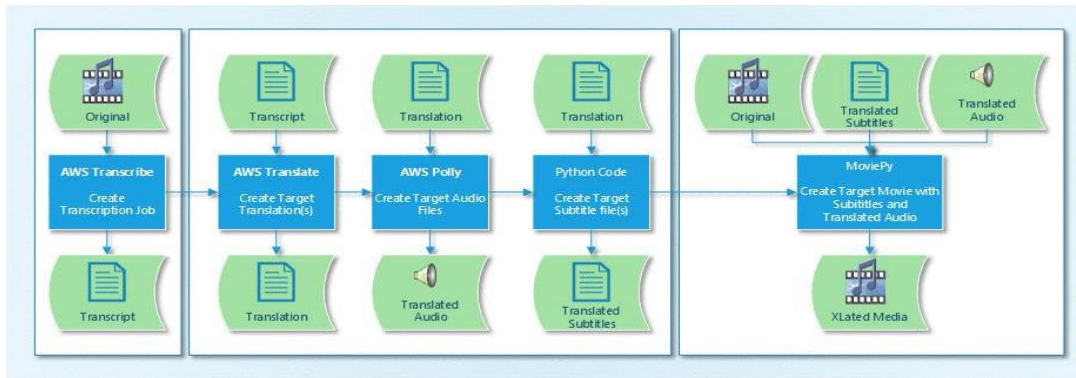The following diagram illustrates the process in detail:

**Fig 2:** Suggested Automatic Translation Process

Our proposed process begins by creating a transcription from the original video by using any of the intelligent cloud services and transcript is translated to get the translation. For better translation and syncing later, we need to do an intelligent splitting based on the context of the contents in the story board used to create the animated videos. Then the translated script is used by the appropriate intelligent cloud service to generate the translated audio. As the over dubbed videos in which the lips of the characters don't line up with the audio, we treated subtitles and their audio for translations differently compared to the original transcript. We used MoviePy which leverages ImageMagick and FFmpeg to build key functionalities like text titles, animation, audio, and videos. Then, we will replace the audio from the video clip. Next, we will create the subtitles. After the subtitles are created, we will create an array of subtitled clips. Next, we will concatenate all the clips in to one final clip. Finally. We will write the subtitled video and audio to a new video file.

The steps of the Implementation based on the above methodology for different modules is given below
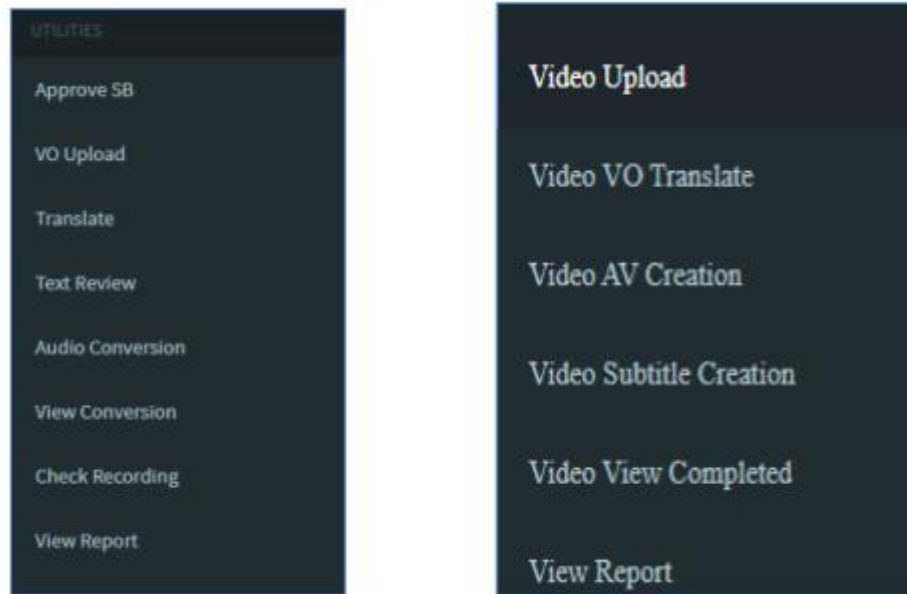
Login Module

1. Once you click the URL to access the tool, the following window will appear
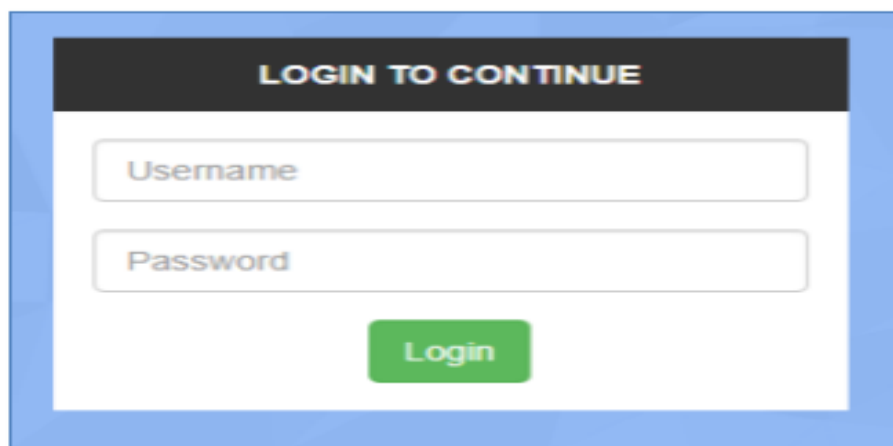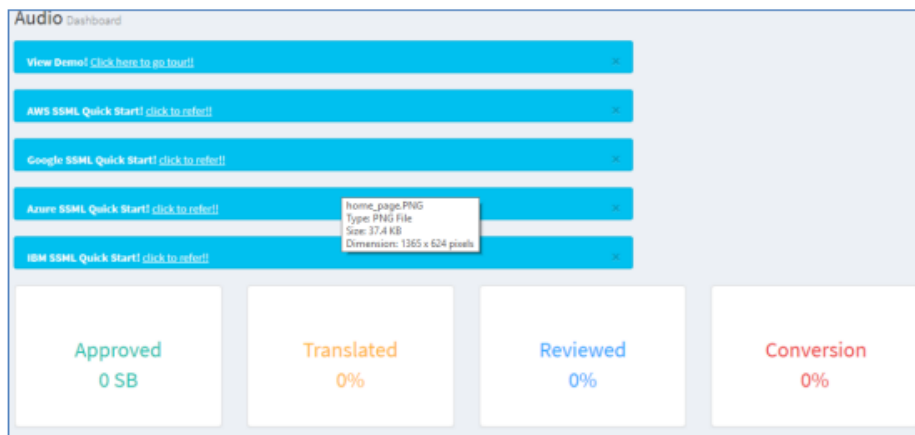

2. Enter your credentials to login to the tool.

Home Page

3. The homepage has the following options for Video upload

The homepage also shows the dashboard for managing audio and video files.

The animated videos are made based on the story Board (SB) creation, so the story board must be approved and uploaded to compare and convert the animated videos. The following are the steps to approve Story board.

Approve Story Board

1. Select Approve Story Board from the menu bar.

2. The following form will appear.

3. Select from and to dates from the drop-down calendars.

4. Select the following from the respective drop-down menus.

 a. University

 b. Subject

c. Semester

d. Unit

e. Project Manager

5. Enter Topic in the field provided.

6. Click Submit button to submit data.

7. The result will appear in the following table.

SB(Topic) Name	PM	University	Subject	Semester	Unit	Approve
Memory Management - Execution and Loading of User Programs	null	Rathinam Group of Institution	Operating Systems	4	5	Approve
Introduction to Predictive Aesthetics	null	IDSC-POC	Densitry Study	1	1	Approve
Introduction to Organisational Behaviour	null	West Bengal University of Technology-As per AICTE	Management - I (Organizational Behaviour)	4	1	Approve

8. To approve a topic, click Approve under Approve column for conversion.

9. The following confirmation message will appear.

Success!

Approved for Conversion!

OK
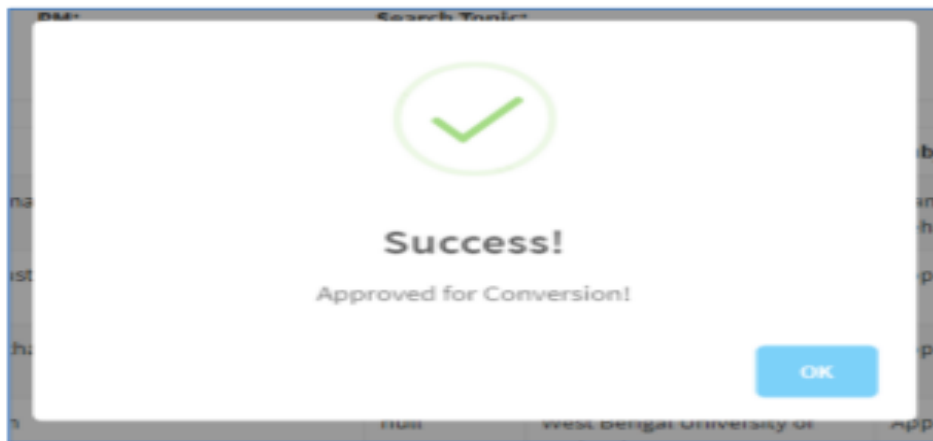
As the story board has the voice overs in it already, we utilize that to reduce the errors while transcribing the animated videos. The voice overs (VO) are uploaded using the following steps

VO Upload

1. Select VO Upload from the menu bar.

2. The following form will appear

6

4. Select From and to dates from the drop-down calendars.
5. Select the following from the respective drop-down menus.
a. University
 b. Subject
 c. Semester
d. Unit

e. PM
6. Click Fetch SB button to fetch storyboard.
7. Select the following from the respective drop-down menus.
a. SB Name
b. Source Language
c. Target Language
8. Click Choose File to upload a CSV file.

9. Click Upload VO to upload VO file.

10. You can also add VO Text and Names instead of uploading a single file.

10. Click Add More to add more VO data.

11. Click Save to save and submit all VO data.

Text Review

The translated text is reviewed by following steps

1. Select Text Review from the menu bar.
2. The following form will appear

3. Select from and to dates from the drop-down calendars.

4. Select the following from the respective drop-down menus.

   a. University

   b. Subject

   c. Semester

   d. Unit

   e. PM

5. Click Get SB button to fetch storyboard.

6. Select Storyboard from the drop-down menu.

7. Click Fetch button to fetch data.

Audio Conversion

Next the audio must be converted in the target language based on the translated content from the voice overs. The audio conversion is done by following the steps given below

1. Select Audio Conversion from the menu bar.

2. The following form will appear

3. Select from and to dates from the drop-down calendars.

4. Select the following from the respective drop-down menus.

a. University

b. Subject

c. Semester

d. Unit

e. PM

5. Click Get SB button to fetch storyboard.

6. Select Storyboard from the drop-down menu.

7. Also select Format and voice from the drop-down menus.

View Conversion

The conversion can be viewed and tuned to perfection by following the steps given below

1. Select View Conversion from the menu bar.

2. The following form will appear.

3. Select from and to dates from the drop-down calendars.

4. Select the following from the respective drop-down menus.

a. University

b. Subject

c. Semester

d. Unit

e. PM

5. Enter Search topic in the field provided.

6. Click Submit button to submit data.

7. The result will appear in the following table.

8. To view any storyboard, click here under Preview column.

9. The following form will appear.

10. Enter VO Name in the search box to search by VO Name. Click Search button.

11. Click any of the following button to download the file:

a. Export as CSV file

b. Export as Audio Zip file

c. Export as Merged Mp3 file

12. All fields in the table are editable.

13. Click Add More button to add more rows.

14. Click Edit and save to edit and save modified rows.
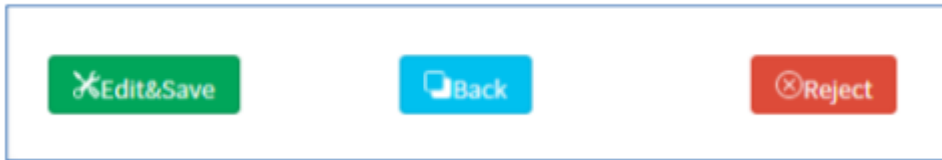
15. Click Back button to go back to previous page.

16. Click Reject button to reject changes made.

Check Recording

3. Select the following from the respective drop-down menus.

a. Source Language

b. Voice ID

c. Input Format

4. Enter Text in the fields provided.

5. Click Translate button to translate text to audio.

1. Select Check Recording from the menu bar.

2. The following form will appear.

6. Play the translated audios for review.

7. Click Reset button to reset player.

8. Click Download button to translated audio.

View Report

1. Select View Report from the menu bar.

2. The following form will appear.

3. Select from and to dates from the drop down calendars.

4. Click Submit button to submit data.

5. Click Export Data/ SB data button to download storyboard data.

6. The result will appear in the following table.

SBName	Approved	Reviewed	Converted	Format	VoiceCount	StartedOn	ReviewedOn	CompletedOn
Examples and Case Studies	admin mtutor	admin mtutor	admin mtutor	text,	1	2020-11-06 12:32:20	2020-11-06 12:32:20	2020-11-06 12:35:56

Video upload

1. Select Video Upload from the menu bar.

3. Select the following from the respective drop-down menus.

> a. University
>
> b. Subject
>
> c. Semester
>
> d. Unit
>
> e. PM

4. Enter Storyboard name in the field provided.

5. Select the Video language and Target language

6. Upload the Video and its respective Video file

7. Click Upload button to submit data.

2. The following form will appear.

Video Cutter

The Full Video must be spitted based on scenarios in the story board for better synchronisation of Audio and Video in the output. Below is the format to split the Clips

Clip1:00:00>02:39, Clip2:02:39>05:28,Clip3:05:28>05:58,Clip4:05:58>06:20

After automatic splitting video will be displayed as per the Clips spitted, for that we need to update the Voice over relevant to that clip

Video VO Translate

1. Select Video VO Translate from the menu bar.

2. The following form will appear.

3 Select from and to dates from the drop-down calendars.

4 Select the following from the respective drop-down menus.

a. University
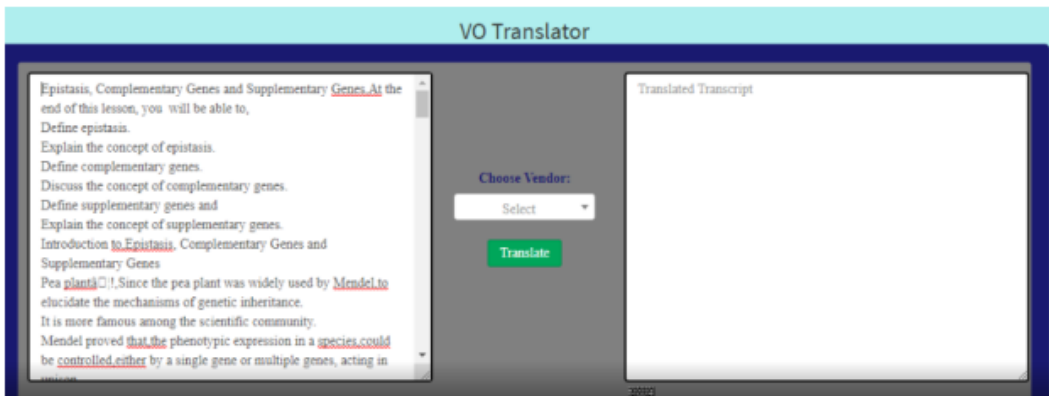
b. Subject

c. Semester

d. Unit

e. PM

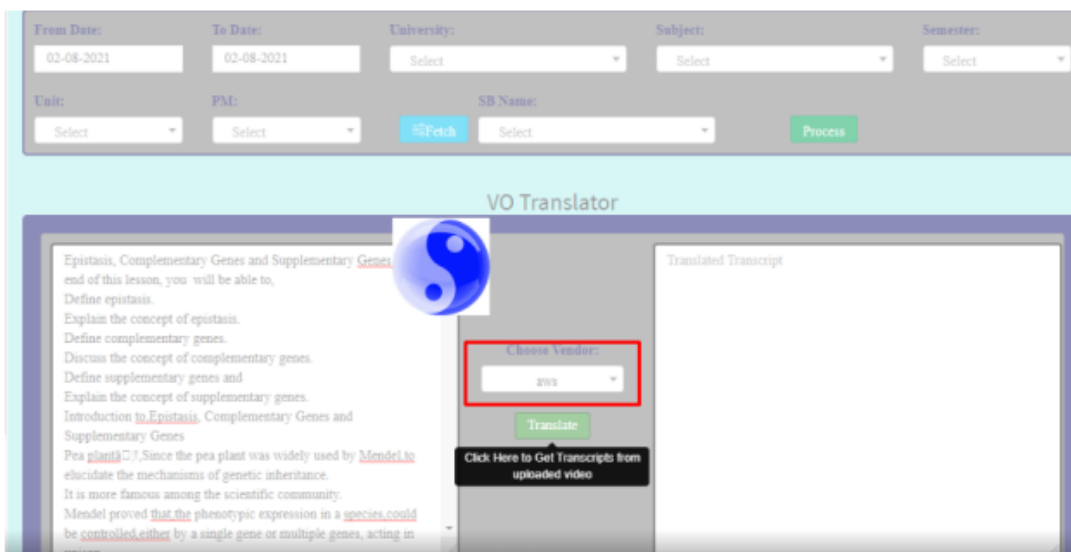5 Click on the fetch button to get the data

6 Select the Storyboard name in the drop-down menu
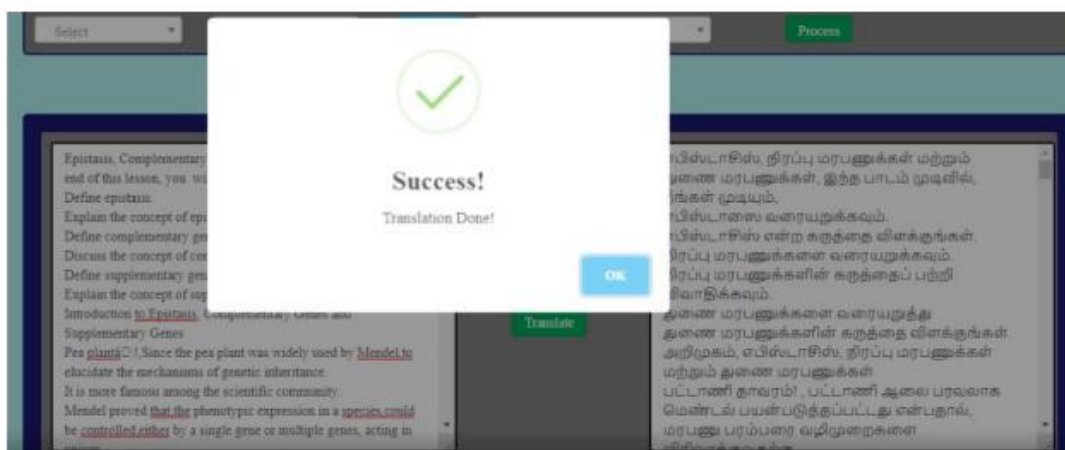
7 Click on process button

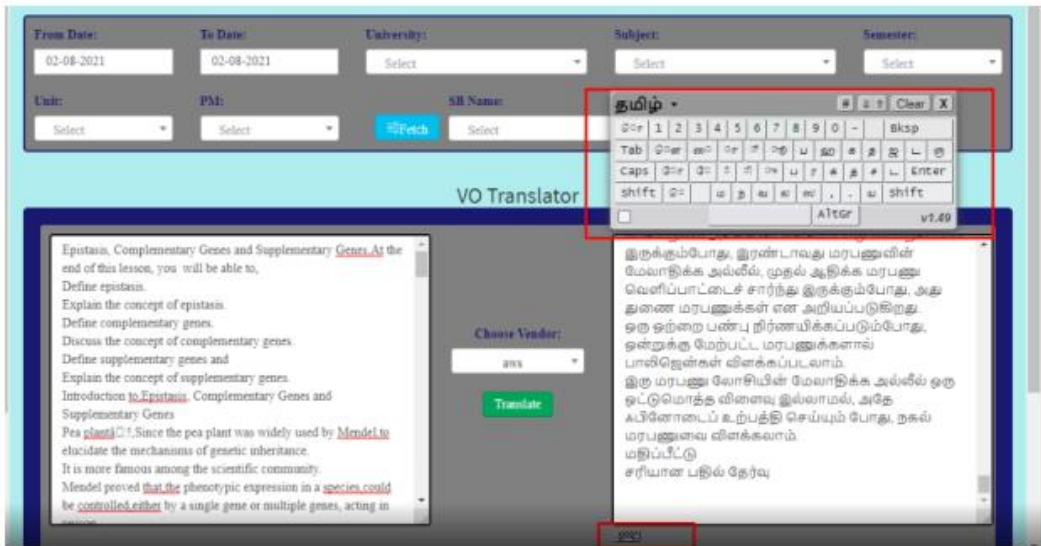8 The below VO translator gets loaded with the file to be translated

9 Chose the algorithm and select the Translate button, the tool starts translating
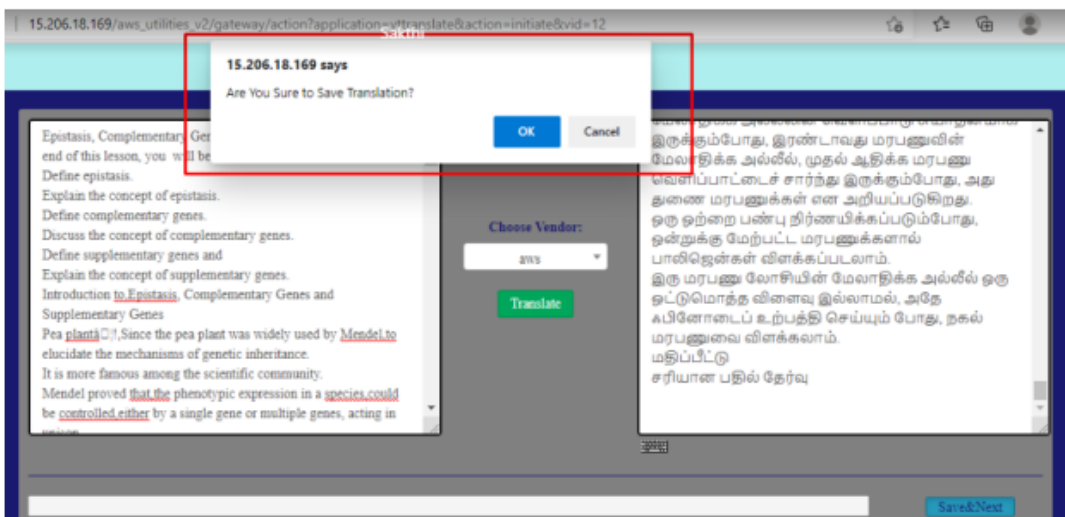

10. Once Translation is completed, we get to see the below screen

11 To verify the translation and to make correction a keyboard on the selected language is provided as shown below
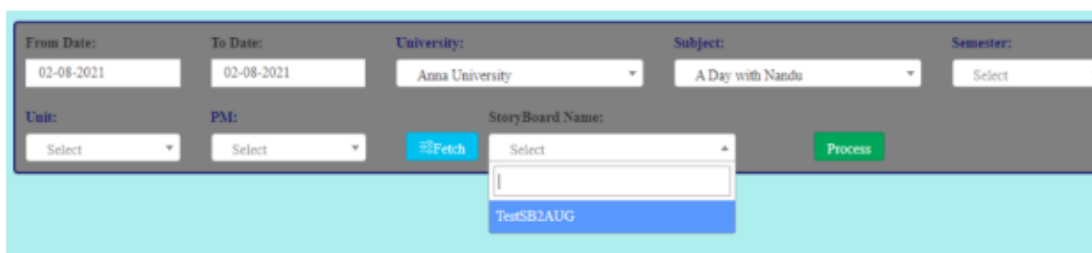
12 On confirming the translation Save by selecting the save and proceed an alert is thrown to save the translation

Video AV Creation

2 The following form will appear.

1 Select Video AV Creation from the menu bar.

3. Select from and to dates from the drop down calendars.

4. Select the following from the respective drop-down menus.

a. University

b. Subject

c. Semester

d. Unit

e. PM

5. Click on the fetch button to get the data

6. Select the Storyboard name in the drop-down menu

7. Click on process button

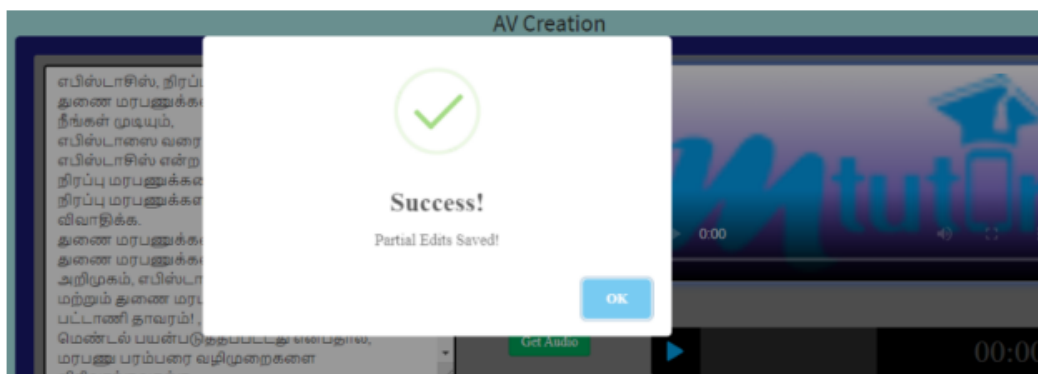8. AV Creation is loaded with the translated file and the video file

9. Select the desired language for audio

10. For saving the files partially Click on the Save partial button

11. On getting partially saved the below alert is thrown

12. To get transcripts from the uploaded video click on the Get Audio

1. Once the Audio track is created the below alert is thrown
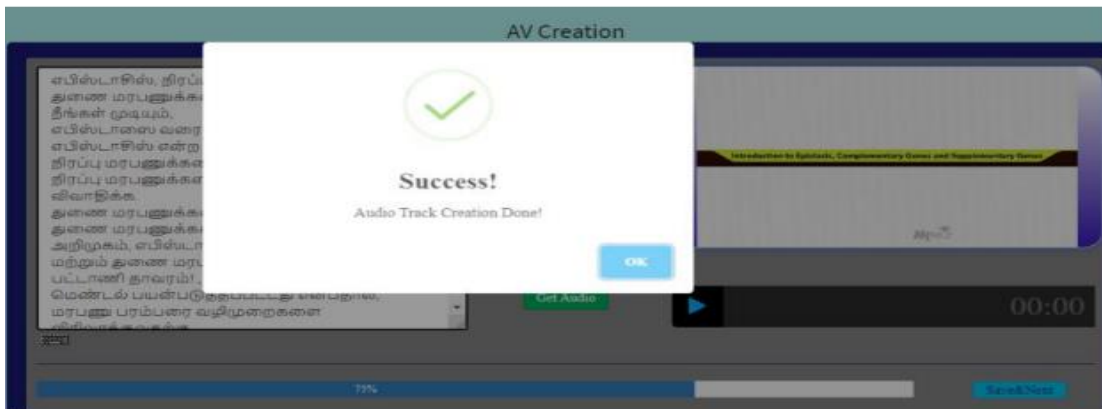
14. To Save the AV translation created click on the Save & Next button

Choose Language:

Here the language will the default language select it.

Choose Type:

In type selection there will be two options.

1. Text

If we are not using any tags, then we can go for TEXT option.

2. SSML

When we are using the Tags then we must select SSML type, this type is used to Sync the audio to video appropriately.

Tag we have use is

<break time="1s"/> - this tag is used to give break between the words in this we can increase/decrease the time from millisecond to

Minutes

<prosody rate="0.7"> Test Text </prosody>

rate -->   1 = normal , less than 1 slow down, greater than 1 fast up the speed of the voice,

Choose Voice

For Tamil we have 4 voice is available

AZ Pallavi (In)(N)

AZ Valluvar (In)(N)

GC Iniya (In)(N)

GC Tamil (In)(N)

Here AZ & GC denotes to which Cloud services this voice is from. AZ – Azur e& GC – Google Cloud

When we are using Azure, we can use the tag given above directly,

Eg,.

To keep it beneath the surface of the water, we must apply a downward force. <break time="0.85ms"/>What does this indicate?

but when we are using Google cloud, we have to mention the command in the script as given below

Eg,.

<speak>To keep it beneath the surface of the water, we must apply a downward force. <break time="0.85ms"/>What does this indicate? </speak>

Then click Get audio to start the sync, is there is any gap in syncing, then we need to check & correct the tags by increasing the timing, if pronunciation issue then the spelling must be corrected to get the correct pronunciation.

Once the syncing is perfect as per the SB flow then click save&Next. To move it to Video Subtitle Creation Tab

Video Subtitle Creation

1. Select Video Subtitle Creation from the menu bar.

2. The following form will appear.

3. Select from and to dates from the drop-down calendars.

4. Select the following from the respective drop-down menus.

     a. University

     b. Subject

     c. Semester

     d. Unit

     e. PM

5. Click on the fetch button to get the data

6. Select the Storyboard name in the drop-down menu

7. Click on process button

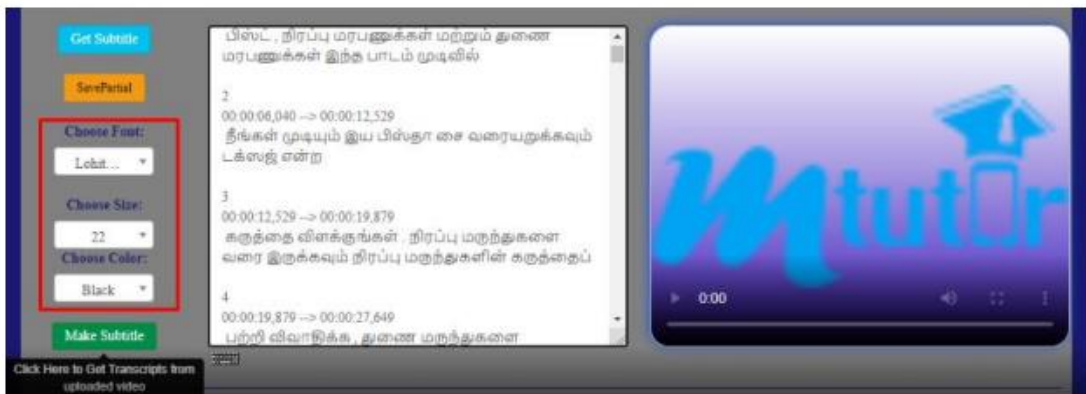8. Subtitle maker screen opens, Click on Get Subtitle
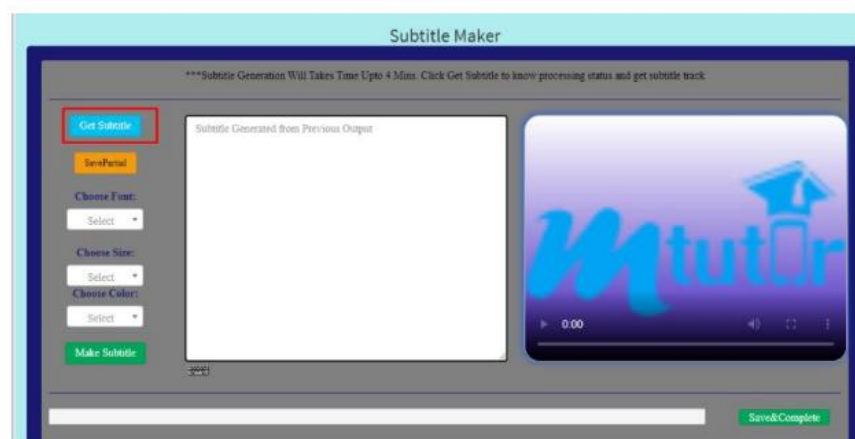
9.   Once the Track is received, an alert is also received
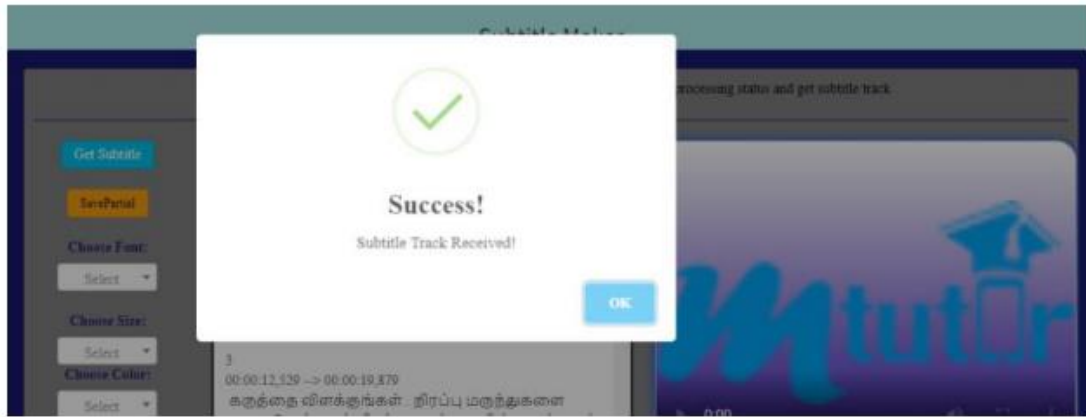
10. To save the partial changes use the Save Partial option

11. Choose the Font, size, colour click on Make subtitle option

12. Once Video translation is completed, alert is seen
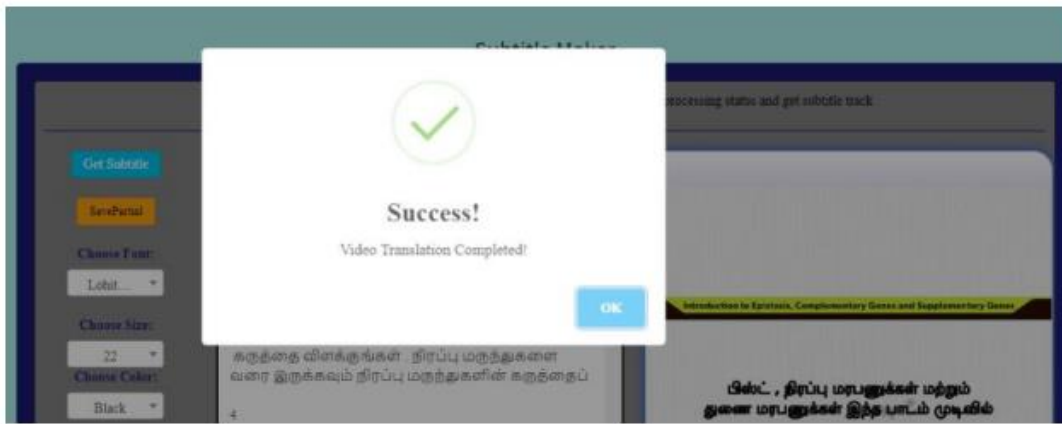
13. Video subtitle creation is completed. click on Save and Complete
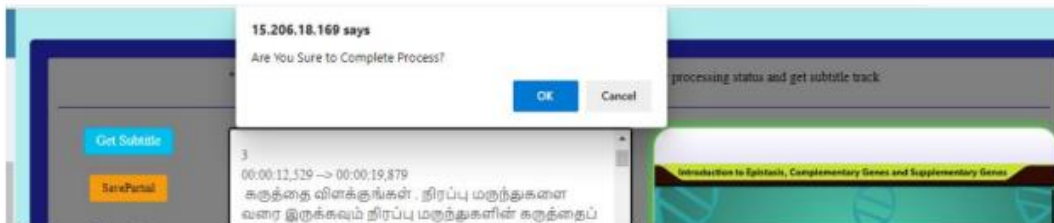
Video Merge

In the Video Merge Tab select the date of video uploaded & then click Fetch button. Completed SB name will be displayed select the SB & click Process Button spitted video will be displayed, check all the clips before merging, if you find any clip has a translation/sync/subtitle issue same can be moved to video translation/AV creation/Subtitle tab

If there is not an issue in the clip same can be merged & move to next stage

Video View

1. Select Video Subtitle Creation from the menu bar.
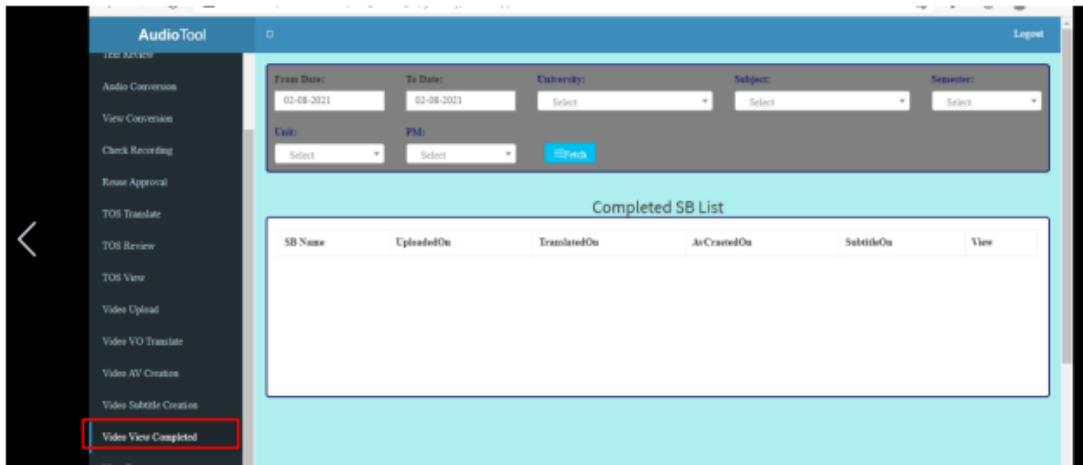
2. The following form will appear

3. Select from and to dates from the drop-down calendars.

4. Select the following from the respective drop-down menus.

     a. University

     b. Subject

     c. Semester

     d. Unit

     e. PM

5. On fetching, the list of completed converted video appears

6. The converted video can be downloaded

4. Results and Discussions

Final Output AV

Download

Video Conversion Process Timing

Tool Actual Process Timing

Upload Process Timing – 2 to 4 minutes,

Translation Process Timing - 4 to 6 minutes,

Audio Track Creation + Audio & Video Merging Process – 5 to 7 minutes,

Subtitle Generation – 9 to 15 minutes.

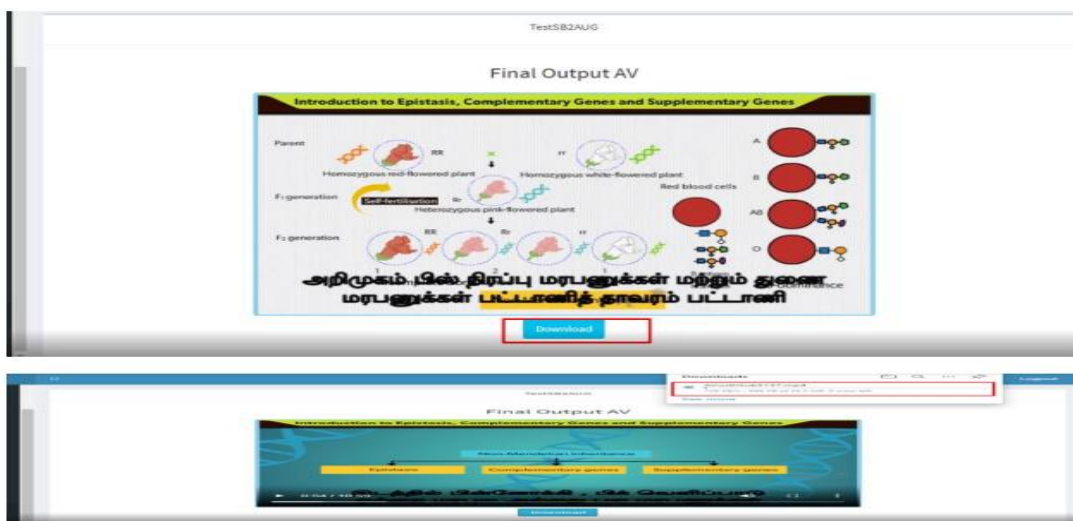Whole Process will take 15-20 minutes.

Manual Process Timing

After doing tool translation, Language translate experts will correct the language, flow of the content & sync the voice over a per Story Board of the video by using SSML tag. To correct the language, flow of the content will take one and half hours on average.

Translation Process	Detailing
Session Title: **Learning Outcomes:** **Assessment Criteria:**	Learning Theories and ID Models To provide guiding framework for creating a Story board Quiz at the end of the class and to help in self-regulated creation of story board at the end of the training
Time (mins): 60 minutes	Define main points, methods used and learning aids proposed for the session
	Introduction
10 minutes	G: Give overview of how models enable the ID to give structure and meaning to an ID problem L: Prior knowledge in the form of divergent approaches that help problem solving, O: Inform how models help to visualise the problem and break down into discrete manageable units

	S: ARCS Model, GAGNE's nine steps, S: Common examples that link the model	
	Body	
	Presentation	**Activity**
20 minutes	Explain the four steps in the ARCS Model	Present a problem or situation and ask the learner to link to ARCS model
	Presentation	**Activity**
20 minutes	Explain the nine steps in the GAGNE's Model	Name all nine steps with linking examples
10 minutes	**Conclusion**	
	O: Summarise and Answers to activities are discussed F: Learners can clear any doubt and Feedback is given F: IF learner interested, reference to other models like Dayles cone, ADDIE, etc are mentioned	
Comments:	Excellent	

Animated Videos translation system from English to various languages was implemented using intelligent machine learning techniques and cloud services. For testing the system, 50 videos from various languages were selected. Each of these videos was translated using a smaller number of Human Resources and generated using the proposed methodology and the tool developed. The effectiveness of the automatic intelligent translation of animated videos is given in the Table I

TABLE I. Performance of Machine Translation System

Videos	50
Accuracy	85%
Experts	Human Translation Experts

The key adaptive feature based on language is shown in the following screen shot
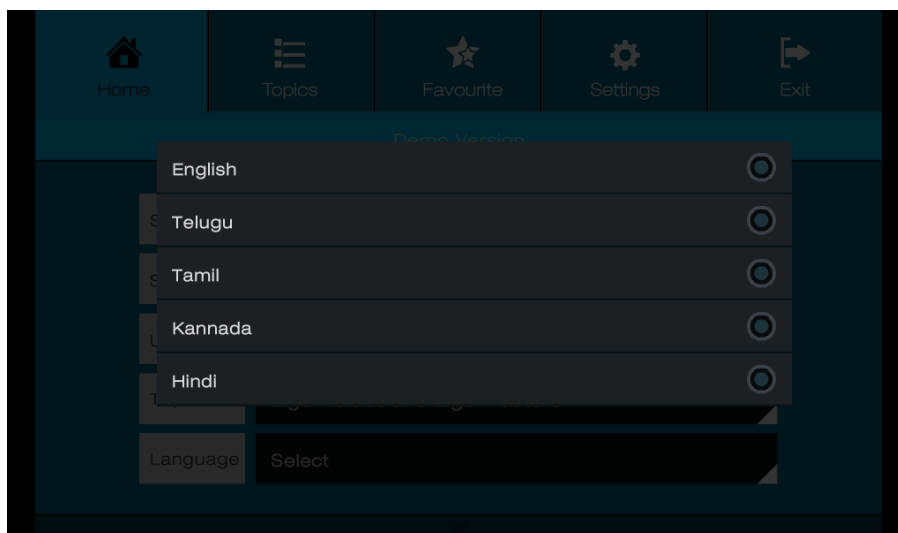
Fig 7: Preferred language learning

We were able to enhance the understanding and improve completion rate of the videos by 30% in most of the places.

5. Conclusions

We conclude by saying that machine translation using machine learning is expected to drastically reduce the manual work and increase the productivity of the translation work. Based on this implementation, we decide that Neural based translation techniques will result in accuracy closer to human expert-based translation. The overlapping issue can be addressed by providing the subtitles in a separate space. The new model proposed using the Machine learning techniques and intelligent automation will help to fasten the process of translation of videos. The model can be further improved by doing an intelligent splitting and post editing so that the manual work and production time can be reduced.

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