3. Proposed Model

A. System Architectures

The proposed method is used for automating the indexing for video lectures with the information attached to it, created from content. The major sources of information about the video lecture are the lecturers' talk and slides used for explaining the topic.

The objective of the system is to provide the efficient search for the video lectures through the browser which can be done by adding more relevant metadata with the lecture video files. The metadata can be added by capturing the information from audio and video frames. For audio extraction we have used the ASR technique and for content retrieval from the frames we used the OCR technique. Also in this paper we have used clusters for returning the result with linked video files. For this purpose, we have implemented a model which separates frames from a video for keyframe identification. All the captured frames are then classified according to the duplication property. The keyframes are identified and will be used for the information extraction. We fetch all the text from these frames by using OCR strategy. Also we extract audio information by using ASR technique. The collected information (Text and Voice from Video) is used for creating metadata and clustering of terms according to their text and voice parameters.

The architecture of the proposed system can be shown in figure 3

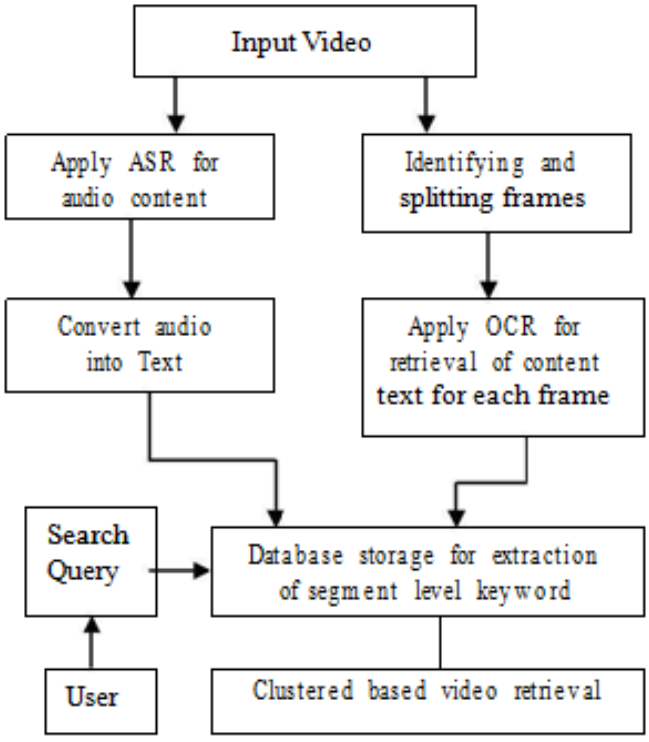

Figure 3: Proposed System Architecture

As shown in the architectural diagram, the metadata extraction is done from visual as well as audio resources of the video lectures by using OCR and ASR technique. The dictionary software is used for identifying valid words collected from both techniques. For the evaluation purpose of the system the existing systems has used the different automatic indexing techniques which are assigning the collected text to that particular file only. In the proposed system, we have used the clustering technique, which automatically forms the clusters depending on the frequency of the extracted words by ignoring stopwords. Based on that, the result will be returned to the user's query which is more appropriate and more related to the user's requirement.

B. Implementation Modules

The modules involved in the proposed system are as described below:

a). Slide Segmentation

When the frames are separated from the lecture video files, many of the frames we get which are similar in its content due to monotonous scene view. This property of the video files is different than other multimedia video files in which the frames are classified based on difference in the scene structure. The segmentation has to be done which will be for the same title or subtitle on the slide. The segmentation method is used for the video lecture files which identifies the difference among frames by connected component analysis. The connected component analysis, similarity is identified based on the group of pixels. The segmentation method consists of following steps:

- The time interval from three seconds to five seconds is provided for analysis of frames. The frames coming after the given time period are considered for further processing and others are discarded, assuming that the frames coming within interval are monotonous. Sometimes, same frame is displayed for a longer period of time then to reduce duplication we will have to increase the time interval of video segmentation.
- Canny edge maps are created, which builds the pixel differential images from edge maps.
- Then, for the similarity detection between the content of the frames is done by connected component analysis. The number of CC will act as a threshold value for segmentation. The further segmentation is done only when the number of CC exceeds this threshold value.
- In the next step of segmentation, the title and content region are first defined. Any small change in the title region may cause slide transition.
- Again the threshold value is calculated and slide transition occurs when the difference among object regions exceeds this threshold value.

b) OCR Technique

Optical character recognition retrieves the text information from images and converts it into editable text. In this paper, we have used the Tesseract OCR which is the open source, freely available and platform independent tool for extracting the data from video slides. For Tesseract the image needs to be converted into binary format. [5] For effective result to be gain by OCR tool, we need to do some pre-processing task to the keyframes. The pre-processing task is done which identifies the keyframes from the video

files.

The steps to be followed by the OCR tool are:

- The first step is Adaptive Thresholding, which converts input image into binary format.
- Next step is connected component analysis, which can be used to detect character outlines.
- Lines and words are analyzed within fixed area or equivalent text size.
- Character outlines are organized into words by two passes. In the first pass, the word is recognized by text and is passed to an adaptive classifier. In the second pass, the adaptive classifier will have training dataset provided which can be used to resolve various issues for text extraction from images.

b) ASR Technique

The automatic speech recognition (ASR) technique extracts speech or voice from multimedia files and converts it into meaningful textual information. Speech is one of the most important carriers of information in video lectures. Therefore, it is of distinct advantage that this information can be applied for automatic lecture video indexing. Unfortunately, the ASR technique is still under development and is not providing the efficient results expected. The Word Error Rates returned by the existing systems are not as expected. ASR is aimed to enable computers to recognize speaking voice characters without human intervention.

Automatic Speech Recognition model mostly uses the probabilistic approach for identifying original word. When the word or word sequence is pronounced its score is calculated by using acoustic properties of phonemes for matching the word with the speech signal. [13] The ASR model has the following steps:

- Pre-processing
- Feature Extraction
- Decoding
- Post-processing

The preprocessing is done for removing the unnecessary sound in speech like background noise, door closing voice etc. The high pass filtering method can be used for reducing this noise and for identifying the speech and non-speech segmentation. Signal energy based algorithms can be used for identifying the start of the speech segments By this algorithm the speech segment can easily be detected when it crosses the given signal threshold value. As there may be some small energy signals with pauses between the words, the algorithm must be enhanced by time windowing.

For extracting the features, the acoustics observations have to be extracted from a time frame of uniform length 25ms. From this time frame a multidimensional acoustic vector is calculated. Human ear can respond to the non-uniform frequency bands. The band-pass filtering can be used for non-uniform frequency bands by defining the frequencies in Mel scale. By discrete cosine transformations, the spectrums created are correlated. As the first coefficients carry the most significance, they are selected to form feature vector. Resulting features are called as Mel cepstra, for which the further processing is done by cepstral mean subtraction. The vector created will be of high dimensionality. To project it into lower dimension, the algorithms like principle component analysis is used.

Decoding is the process of matching the sequence of words with the acoustic that is represented by feature vector. The prerequisite for the decoding is availability of the dictionary which has words to be spoken with its phoneme sequence. Three information sources must be available for decoding

- An acoustic model with an HMM for each unit
- A dictionary with list of words and phoneme
- A language model with word or word sequences.

For improving the recognition accuracy, rescoring is done by higher order language model. The triagram model based rescoring is done in this system.

d) Database Creation

The databases are created which are collected from OCR, ASR and also from the metadata which is manually created for the video files. This database information will act as a metadata for that video files. The important aspect of our system is we are storing this metadata in memory rather than storing in somewhere else. Due to this, the time for the search gets reduced. When the user will fire the query for accessing the videos, due to in memory storage the search time reduces significantly. The redundancies are checked between the words collected for avoiding the wastage of storage space.

e) Clustering for efficient Search:

The databases collected from the above sources are large in size, in which all characters and words are present including insignificant words like stopwords. The stopword removal technique is used which gathers only the important characters. The search is related to all the video files for the same query for which the dataset collection has to be arranged efficiently. For efficient finding of video files the clustering methodology is used. The clustering is done based on the frequency of the terms. The TF-IDF score is calculated, which gives the value of the word by its term frequency and inverse document frequency. By these calculations we can exactly identify the important words. These important words are again clustered for different video files for returning the result with all its related videos. Here, we are using k-means clustering algorithm which forms the clusters will be formed based on term frequency.

4. Result Analysis

The comparison between the results of existing system and proposed system is as shown in the figure 4 and figure 5 by considering two parameters, accuracy and time for search. The graphic representation in the figure 4 shows the efficiency of the proposed system with the existing system. For the small search query length the accuracy provided by the existing system is nearly 60%. But the proposed system is giving nearly 80%, which is far more efficient than the

existing system. Also as the length of the search query increases, the accuracy results are also get improved proportionally for the proposed system. If time required for search is considered, then too our system providing more efficient result rather than existing systems. This shows the existing system is much efficient for all kind of query length and providing more accurate result than the existing system.

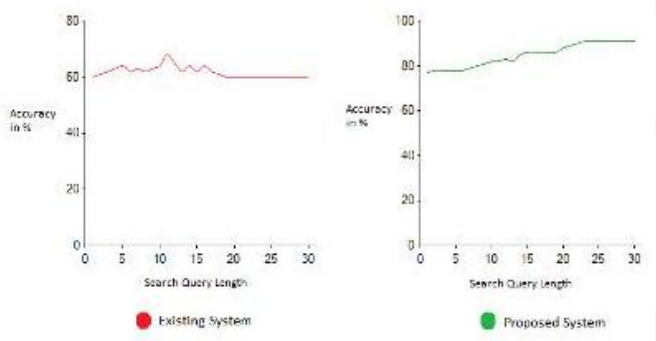

Figure 3: Result comparison between existing and proposed system by considering Accuracy parameter

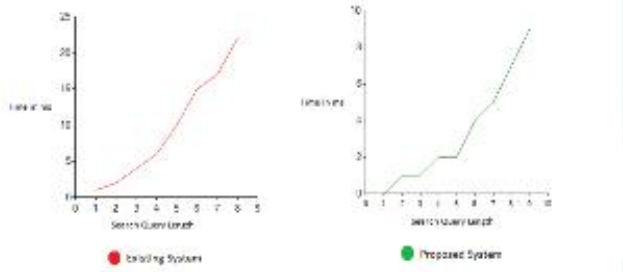

Figure 4: Result comparison between existing and proposed system by considering time for search as a parameter

5. Conclusion

In this paper, we have developed an efficient information retrieval method from video lecture files. The existing systems are doing extraction based on various methods which provides the WER nearly 71%. But as here we have used Tesseract OCR with ASR technique with preprocessing methods, which reduces word error rate much and also the clustering method used after data extraction, which is based on ontology of the terms, provides much related and desired metadata for the file and linked information for the videos. So the video lecture browsing becomes efficient. This metadata created can be treated as indexing to that video file which is automatically created. As the results shows, the proposed method also provides more accuracy with least search time. The future scope of this system will be to retrieve the information for the handwritten text which can be combined with the audio text.

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