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Marathi Text Summarization using Extractive Technique

Kirti Pankaj Kakde, H. M. Padalikar

Abstract*: Multilingualism has played a key role in India, where people speak and understand more than one language. Marathi, one of the official languages of the state of Maharashtra, is frequently used in various sources, including newspapers and blogs. However, manually summarizing bulky Marathi paragraphs or texts for easy comprehension can be challenging. To address this, text summarisation becomes essential for making large documents easily readable and understandable. This research article focuses on single-document text summarisation using the Natural Language Processing (NLP) approach, a subfield of Artificial Intelligence. Automatic text summarization is employed to extract relevant information concisely. Information Extraction is beneficial when summarising documents consisting of multiple sentences into a concise three or four sentences. While extensive research has been conducted on English Text Summarization, the field of Marathi document summarization remains largely unexplored. This research paper explores extractive text summarization techniques specifically for Marathi documents, utilizing the LexRank algorithm along with Genism, a graph-based technique, to generate informative summaries within word limit constraints. The experiment was conducted on the IndicNLP Marathi news article dataset, yielding 78% precision, 72% recall, and 75% F-measure using the frequency-based method, and 78% precision, 78% recall, and 78% F-measure using the LexRank algorithm.

***Keywords*: Artificial Intelligence, Automatic text summarization, Extractive text summarization, Natural Language Processing, Indic NLP.**

I. INTRODUCTION

Text summarization is necessary when a large amount of text data or a paragraph needs to be condensed into a shorter form. Natural Language Processing (NLP) is a subfield of artificial intelligence that deals with this task. It involves extracting valuable information and summarising a significant volume of unstructured data into concise, readable sentences. The purpose of automatic text summarisation is to manage extensive amounts of information efficiently. It is crucial to preserve the original meaning of the text during the text summarization process. The reader can save time by reading a concise summary instead of the entire paragraph.

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This research article focuses on the exploration of extractive text summarization, which is a technique within Natural Language Processing (NLP) [10]. Extractive text summarization is accomplished using the Genism Python package. In this technique, the model extracts key sentences from the original text. Contrarily, abstractive text summarization models may introduce new words or rephrase sentences. It's important to note that the words appearing in the summary may not necessarily be present in the original text. [1]

II. PREVIOUS WORK

Researchers have explored several text summarisation techniques. Most text summarisation methods are effective for English language datasets. In this section, the work of researchers specifically focusing on the Marathi language has been explored.

Jagadish S Kalimani et al. [1] suggest text summarization by extractive method. The method involves extracting data from the source document, which is then further processed to extract key concepts from the original text. The author presents techniques such as pre-processing, summarizing, and post-processing.

Yogeshwari V. Rathod et al. [2] presented a technique for the summarization of Marathi news articles using extractive text summarization. The method involves selecting meaningful sentences and concatenating them into a shorter form. The authors implemented a PageRank algorithm specifically for Marathi text summarization.

Desai Nikita et al. [3] presented an approach to designing an automatic text summarizer for Hindi news articles. A supervised machine learning tool, SVM rank, is used to extract essential sentences, and sentence ranking is assigned accordingly. In the sentence ranking process, sentences are assigned ranks ranging from 1 to 4, with 1 indicating the most important sentence and 4 indicating a less critical sentence. Pre-processing, processing, and extraction steps are conducted on the text. During the pre-processing phase, the features of each sentence are calculated.

Nikhil S. Shirwandkar et al. [4] extractive text summarization approach is designed and implemented for single document summarization. Implements the logic of Boltzmann machine and fuzzy logic to select essential sentences.

R. C. Balabantaray et al. [5] calculated score for individual words and assigned sentences score by adding phrase score. The summarizer extracts the top-ranked sentences and includes them in the summary.

Manjula Subramaniam et al. [6] have implemented an abstractive method using a rich semantic graph technique to summarize Hindi text. A set of features is extracted from each sentence, which helps identify its importance within the document. The authors have used the Hindi WordNet for checking SOV(Subject-object-verb). Similarity among the sentences has been calculated, and sentences are merged. Arti Jain et al. [7] proposed Hindi text summarization by using a real-coded genetic algorithm. The highest-scoring sentence is extracted and included in the corpus summary. Sentences are selected based on the text's statistical parameters and linguistic features. Extractive summarisation is achieved through a pre-processing, feature extraction, and post-processing phase. Feature extraction is accomplished with sentence paragraph position, numerical data, sentence length, keywords within a sentence, sentence similarity, Named Entities, English-Hindi words within a sentence, and Term Frequency (TF)- Inverse Sentence Frequency. Vaishali V. Sarwadnya et al. [8] implemented extractive text summarization on a multi-document dataset in the Marathi language. The text summary generated by their approach was evaluated using the ROGUE metric, a commonly used evaluation metric for summarization tasks. Their work employed the TextRank algorithm, which utilizes the weighted positional distribution of sentence scores to determine the importance of sentences in the summary generation process. Virender Dehru et al. [9] explores different techniques of text summarization and evaluated them on various parameters. The author concludes that statistically based algorithms generate fast and decent summaries. In the extractive method, word frequency is calculated, and then the greedy approach is used to determine the top k sentences. Other techniques, such as word probability and the TextRank algorithm, are implemented in the research.

III. METHODOLOGY

Text summarization means the large text is broken into a limited number of sentences by extracting vital information and preserving the actual meaning of the original text using AI and NLP to a large extent [12]. In Text summarization, the shorter text is created without changing the semantic structure of the text [13]. In the text summarization of Marathi news articles, an extractive technique is implemented using the IndicNLP Marathi news article dataset. The dataset comprises 4779 records and is divided into predefined sets of training, testing, and validation datasets.

A. Extractive text summarization

In the extractive text summarisation process, both the frequency method and the LexRank algorithm are employed. In the frequency method, the first step involves the pre-processing stage (removal of stop words and special characters), followed by the calculation of word frequencies. These frequencies are then stored in a dictionary format where the data is tokenised [15]. Tokenisation involves dividing a complete sentence into individual words. During the summarization process, sentences containing high-frequency words are selected and retained in the final summary. The evaluation of the final summary of each document is performed using ROUGE metrics (Recall-Oriented Understudy for Gisting Evaluation). The complete explanation is summarized to Figure 1.

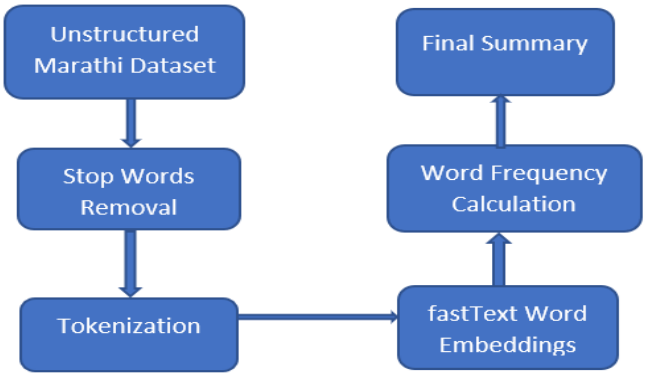

Fig. 1. Text Summarization using Frequency-Based Method

B. Lex Rank Algorithm

In the implementation of the LexRank algorithm for automated text summarisation, cosine similarity and vector-based algorithms are utilised. A Bag-of-Words model is created to determine the minimum cosine distance. The cosine similarity is computed between two non-zero vectors, which helps identify similar words that are then stored [11]. The LexRank algorithm leverages the similarity between words and phrases to determine the centrality of sentences. This approach helps identify the most important sentences for inclusion in the summary based on their centrality within the text, as shown in Figure 2.

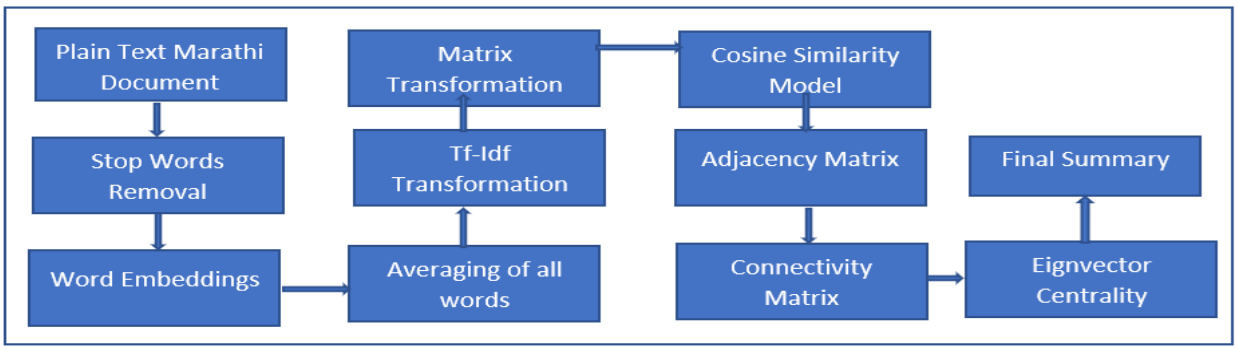

Fig. 2. Text Summarization using Lex Rank Algorithm

All the above phases of Text Summarization using the LexRank algorithm, as shown in Figure 2, are explained below:

- **Plain text Marathi document**

  In phase one, as shown in Figure 2, Plain Text is given as input to the algorithm. The plain text contains unstructured data, consisting of multiple sentences. The final output is extracted into a concise summary of a few sentences from the original text.

- **Stop word removal.**

  In phase Two, as shown in Figure 2, in Marathi documents, stop words such as अधिक, अनेक, अशी, असा, असून, असे, which occur frequently in the document, are removed [2]. By removing these stop words, the sentence score can be increased. To enhance the sentence scores, essential and relevant words from the actual summary are used. This approach ensures that the summary includes key information by giving higher weightage to significant words.

- **Word Embeddings**

In phase Three, as shown in Figure 2, Word embeddings are used to represent every single word in vector form during the process of sentiment analysis[15]. For English, word embedding models such as Word2Vec, FastText, and GloVe are readily available. In this research, the Natural Language Toolkit for Indic Languages (iNLTK) word embeddings are utilized, which have been trained on Marathi Wikipedia text.

Word embeddings for Marathi text=" अंधेरी पूर्व आणि पश्चिमेला जोडणारा गोखले उड्डाणपूल खुला करण्याची अंतिम मुदत पुन्हा हुकणार आहे. यापूर्वी मे महिन्यापर्यंत गोखले पूल खुला केला जाणार होता. मात्र मुंबई महापालिकेकडून नोव्हेंबरच्या मध्यापर्यंत उड्डाणपूल खुला केला जाणार आहे."

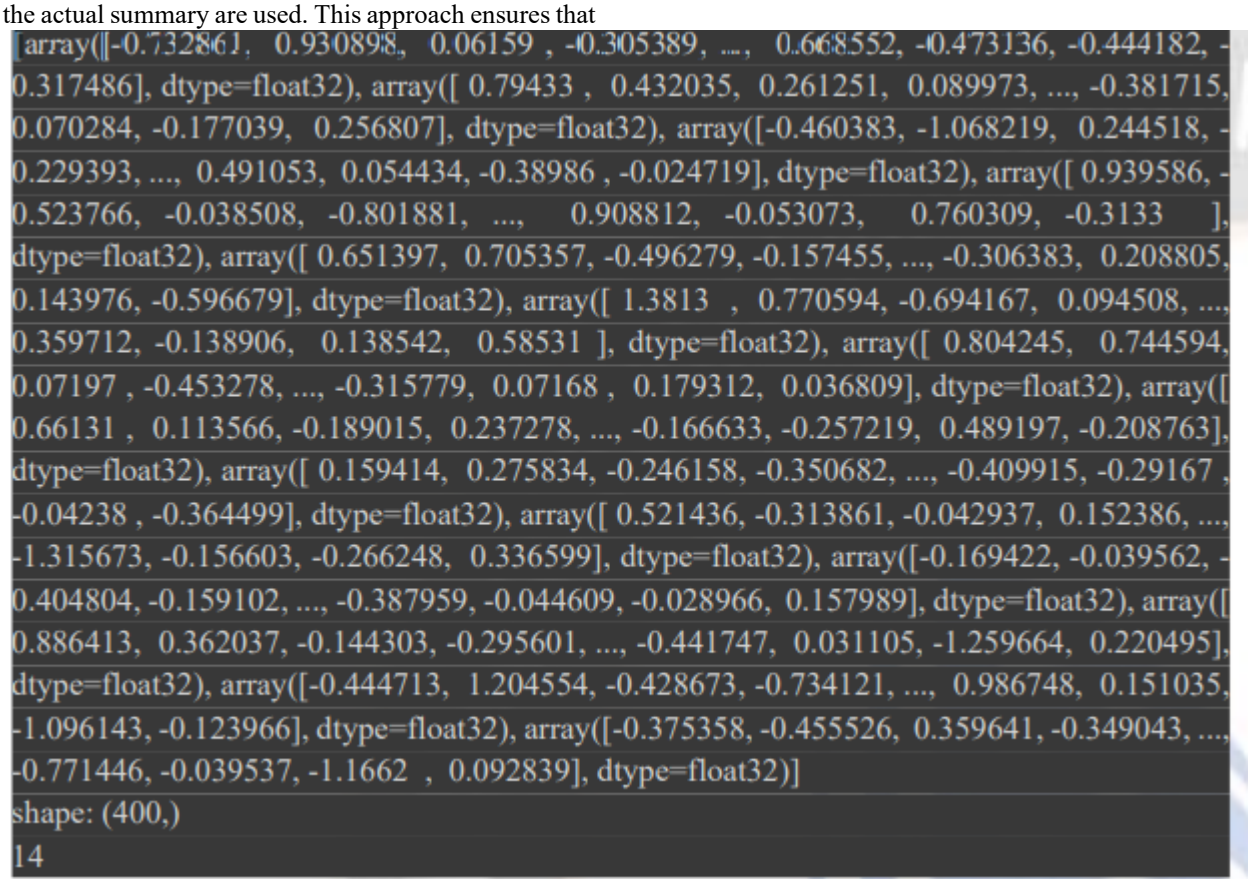

Fig. 3. Word Embeddings for Marathi Text

- **Aaveraging of all words:**

In Phase Four, averaging all word embeddings from a sentence is used to compare it with another sentence. Intra-sentence averaging is implemented.

- **TF-IDF transformation:**

In phase Five, Term Frequency — Inverse Document Frequency [4] is used for information retrieval or feature extraction. This process shows the importance of the word in a sentence.

- **Matrix transformation**

In phase Six, essential words are fetched in the TF-IDF process and are transformed into numeric data in terms of the matrix for further processing [14].

- **Cosine similarity**

This is Phase 7, as shown in Figure 2. Text vectors are generated using the Bag-of-Words model for the representation of N-dimensional vectors. For every single word in a document that is present in a sentence, the value of the respective dimension from the vector representation of the sentence is the number of occurrences of the word in the sentence times the IDF of the word. The formula formulates the cosine score:

IDF modified cosine (a.b) =

$$\frac{\Sigma_{w\epsilon a,b} tf_{w,a} tf_{w,b} (idf_w)^2}{\sqrt{\Sigma_{a_i \epsilon a} \left(tf_{a_i,a} idf_{a_i}\right)^2} \sqrt{\Sigma_{b_i \epsilon b} \left(tf_{b_i,b} idf_{b_i}\right)^2}} \quad (1)$$

- **Adjacency matrix**

In step number 8 of Figure 2, the adjacency matrix is utilised to determine similarities between all sentences. The primary reason for implementing the LexRank algorithm is that it considers both the weightage of the sentences and their importance.

- **Connectivity matrix**

In phase 9 of Figure 2, the connectivity matrix is used to keep track of the links from other sentences, mitigating the issue of local traps where some sentences in a document may be more relevant while others are less relevant [10]. To address this, a threshold is applied in the LexRank algorithm to count the number of connections based on the cosine similarity value.

- **Eigenvector centrality**

In phase 10 of Figure 2, using Eigenvector centrality, introductory sentences are determined. Here is the step-by-step process:

Step 1: Initially, every element in the matrix is set to 1.

Step 2: In the second step, the rows of the matrix are squared, and the square root of the sum of the squares is calculated. This step is repeated iteratively until the normalized values no longer change significantly.

Step 3: The formulation of the sentence importance is expressed using a specific formula.

$$P(u) = \sum \frac{p(v)}{deg(v)} \quad (2)$$

P(u) is the centrality of the node u, and deg(v) is the degree of the node v.

The final summary after applying the Eigen Vector is:

Sentence 1: अंधेरी पूर्व आणि पश्चिमेला जोडणारा गोखले उड्डाणपूल खुला करण्याची अंतिम मुदत पुन्हा हुकणार आहे. यापूर्वी मे महिन्यापर्यंत गोखले पूल खुला केला जाणार होता.

Sentence 2: मात्र मुंबई महापालिकेकडून नोव्हेंबरच्या मध्यापर्यंत उड्डाणपूल खुला केला जाणार आहे.

Sentence 3: मुंबई महापालिका अतिरिक्त आयुक्त (पूल विभाग) वेलरासू आणि अन्य पालिका अधिकाऱ्यांनी पुलाची पाहणी केली.

Sentence 4: गोखले उड्डाणपुलाचे पाडकाम पश्चिम रेल्वे, तर पुलाची पुनर्बांधणी मुंबई महापालिका करत आहे.

Sentence 5: पूल पुनर्बांधणीचे काम मे २०२३पर्यंत पूर्ण करून किमान एक मार्गिका सुरू करण्याचा प्रयत्न होता. या पुलाच्या आरेखनाला पश्चिम रेल्वेने २ फेब्रुवारीला मंजुरी दिली.

Sentence 6: १५ जुलैनंतर रेल्वे हद्दीतील भाग पूर्ण करणे आणि अन्य कामांसाठी तीन महिन्यांची आवश्यकता आहे.

Sentence 7: त्यामुळे हा पूल दिवाळीच्या मध्यापर्यंत पालिकेकडून खुला करण्याचा प्रयत्न असल्याची माहिती पालिकेतील सूत्रांनी दिली.

Sentence 8: मे महिन्यात सुरू होणाऱ्या पुलाला पाच महिने विलंब होणार असल्याचे स्पष्ट झाले आहे. गोखले उड्डाणपूल बंद असल्याने अन्य पर्यायी मार्गांचा वापर करताना वाहतूककोंडीचा सामना करावा लागतो. सन १९७५मध्ये बांधण्यात आलेला गोखले पुलाचा भाग ३ जुलै २०१८ रोजी कोसळून दोन जणांचा मृत्यू झाला होता. रेल्वे हद्दीतील भाग धोकादायक असल्याच्या तक्रारीमुळे त्याचे काम हाती घेण्यात आले आणि ७ नोव्हेंबर २०२२ पासून पूल वाहतुकीसाठी बंद करण्यात आला होता.

Table I: Lex Rank Eigenvector Centrality Performance Evaluation

1st Iteration	Sentence 1	Sentence 2	Sentence 3	Sentence 4	Sentence 5	Sentence 6	Sentence 7	Sentence 8	Standardized
Sentence1	0	1	0	0	1	0	1	1	0.532
Sentence 2	1	1	0	0	0	1	0	1	0.511
Sentence 3	0	1	0	1	0	1	1	1	0.224
Sentence 4	0	0	0	1	1	0	0	0	0.698
Sentence 5	1	0	0	0	0	0	1	0	0.524
Sentence 6	0	1	0	0	0	1	0	1	0.697
Sentence 7	1	0	0	1	0	1	1	1	0.698
Sentence 8	0	0	0	0	0	0	1	1	0.345

Based on the information provided in Table I, Sentences 4, 6, and 7 have the highest scores and will be included in the final summary.

IV. EXECUTION OF LexRank ALGORITHM ON MARATHI LANGUAGE DOCUMENT:

```
In [1]: original_text = 'अंधेरी पूर्व आणि पश्चिमेला जोडणारा गोखले उड्डाणपूल खुला करण्याची अंतिम मुदत पुन्हा हुकणार आहे. यापूर्वी मे महिन्यापर्यंत गोखले पूल खुला केला
        print(original_text)
```

अंधेरी पूर्व आणि पश्चिमेला जोडणारा गोखले उड्डाणपूल खुला करण्याची अंतिम मुदत पुन्हा हुकणार आहे. यापूर्वी मे महिन्यापर्यंत गोखले पूल खुला केला जाणार होता. मात्र मुंबई महापालिकेकडून नोव्हेंबरच्या मध्यापर्यंत उड्डाणपूल खुला केला जाणार आहे. मुंबई महापालिका अतिरिक्त आयुक्त (पूल विभाग) वेलरासू आणि अन्य पालिका अधिकाऱ्यांनी पुलाची पाहणी केली. गोखले उड्डाणपुलाचे पाडकाम पश्चिम रेल्वे, तर पुलाची पुनर्बांधणी मुंबई महापालिका करत आहे. पूल पुनर्बांधणीचे काम मे २०२३पर्यंत पूर्ण करून किमान एक मार्गिका सुरू करण्याचा प्रयत्न होता. या पुलाच्या आरेखनाला पश्चिम रेल्वेने २ फेब्रुवारीला मंजुरी दिली. या स्टील उपकरणांसाठी दोन उत्पादक आहेत. यातील एका उत्पादकाच्या प्लाण्टमध्ये अचानक अनिश्चित काळासाठी संप झाल्याने पुलासाठी लागणारे गर्डर आणि अन्य साहित्य पुरवठ्यावर परिणाम झाला. त्यामुळे एप्रिल अखेरीस पुरवठ्याला सुरुवात होणार आहे. याचा परिणाम पुलाच्या पुनर्बांधणीवर झाला आहे. १५ जुलैनंतर रेल्वे हद्दीतील भाग पूर्ण करणे आणि अन्य कामांसाठी तीन महिन्यांची आवश्यकता आहे. त्यामुळे हा पूल दिवाळीच्या मध्यापर्यंत पालिकेकडून खुला करण्याचा प्रयत्न असल्याची माहिती पालिकेतील सूत्रांनी दिली. मे महिन्यात सुरू होणाऱ्या पुलाला पाच महिने विलंब होणार असल्याचे स्पष्ट झाले आहे. गोखले उड्डाणपूल बंद असल्याने अन्य पर्यायी मार्गांचा वापर करताना वाहतूककोंडीचा सामना करावा लागतो. सन १९७५ मध्ये बांधण्यात आलेला गोखले पुलाचा भाग ३ जुलै २०१८ रोजी कोसळून दोन जणांचा मृत्यू झाला होता. रेल्वे हद्दीतील भाग धोकादायक असल्याच्या तक्रारीमुळे त्याचे काम हाती घेण्यात आले आणि ७ नोव्हेंबर २०२२ पासून पूल वाहतुकीसाठी बंद करण्यात आला होता.

```
In [25]: # Creating a summary of 3 sentences.
lex_rank_summarizer = LexRankSummarizer()
lexrank_summary = lex_rank_summarizer(my_parser.document,sentences_count=3)

# Printing the summary
for sentence in lexrank_summary:
  print(sentence)
```

The output after executing the LexRank algorithm on the Marathi Text is

गोखले उड्डाणपुलाचे पाडकाम पश्चिम रेल्वे, तर पुलाची पुनर्बांधणी मुंबई महापालिका करत आहे.१५ जुलैनंतर रेल्वे हद्दीतील भाग पूर्ण करणे आणि अन्य कामांसाठी तीन महिन्यांची आवश्यकता आहे. त्यामुळे हा पूल दिवाळीच्या मध्यापर्यंत पालिकेकडून खुला करण्याचा प्रयत्न असल्याची माहिती पालिकेतील सूत्रांनी दिली.

The plaintext document contains 20 sentences, and after performing the LexRank Algorithm, the output contains only three sentences, as shown in the above output.

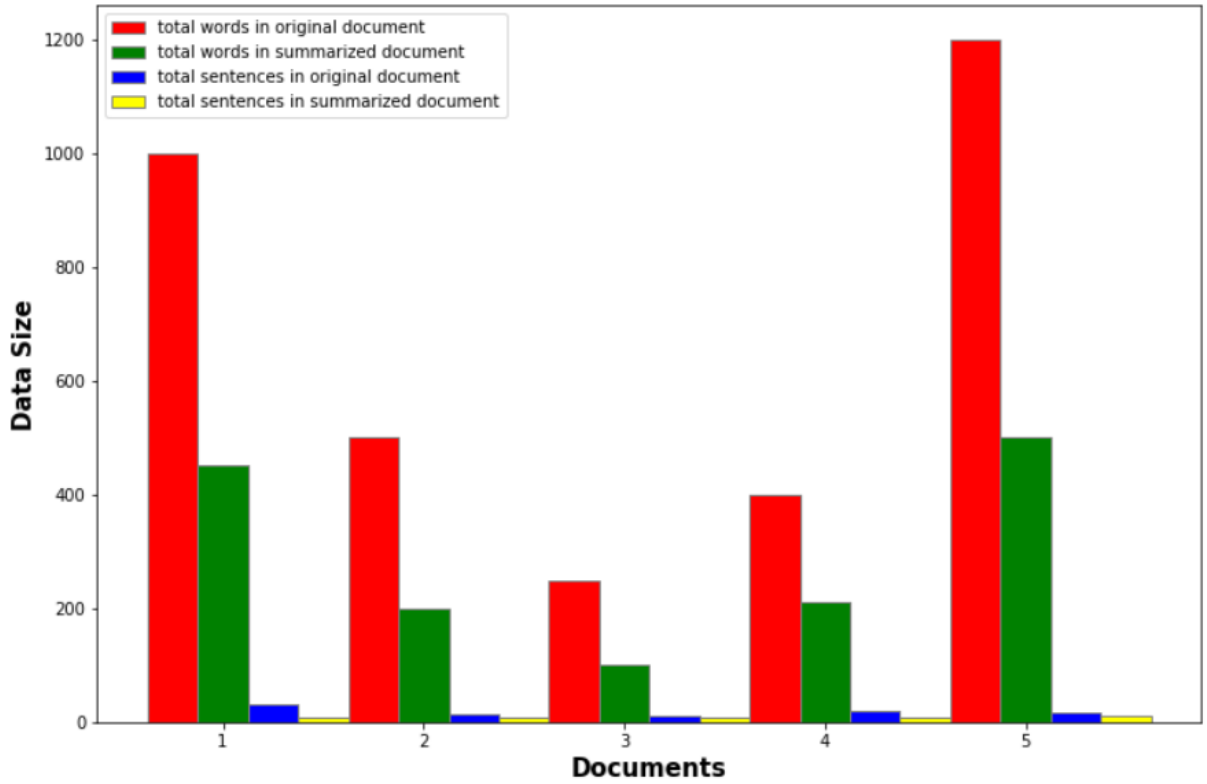

Fig. 4. LexRank Result

In the provided graph as shown in Figure 4, four parameters are taken into consideration for text summarization namely the total number of words in the original document, the total number of words in the summarized document, the total number of sentences in the original document, and the total number of sentences in the summarized document. According to the analysis of Figure 4, for Document 1:

- Out of 1000 words in the original document, 450 words are included in the summarised document.
- Out of 30 sentences in the original document, only 6 sentences are extracted in the final summary.

V. EXPERIMENTAL RESULTS

In evaluating the text summarisation as presented in Table II, the ROUGE metrics (Recall-Oriented Understudy for Gisting Evaluation) are employed. Specifically, the ROUGE-N measure is implemented, which counts all shared words between the two texts. The ROUGE-N measure is utilized because it assesses the adequacy of the summary. It is preferred for evaluation as it aims to minimize the need for further post-processing by humans. In this research, the F-score achieved by the LexRank algorithm is superior to that of the Frequency-based method.

Table II: ROUGE N=2 evaluation measure

Techniques	ROUGE 1	ROUGE 2
Frequency Based	0.804	0.794
Lex Rank	0.865	0.856

Table III: Comparison of Evaluation Measures of Extractive Text Summarization Methods

Document number	Frequency Based			LexRank Algorithm		
	Precision	*Recall*	*F-Measure*	*Precision*	*Recall*	*F-Measure*
1	0.63	0.67	0.65	0.64	0.66	0.64
2	0.64	0.65	0.64	0.63	0.65	0.64
3	0.66	0.64	0.65	0.68	0.64	0.66
4	0.67	0.65	0.66	0.69	0.66	0.67
5	0.68	0.62	0.65	0.66	0.65	0.65
6	0.70	0.58	0.64	0.77	0.69	0.73
7	0.72	0.61	0.66	0.72	0.70	0.71
8	0.75	0.56	0.65	0.75	0.76	0.75
9	0.78	0.67	0.72	0.78	0.77	0.77
10	0.78	0.72	0.75	0.78	0.78	0.78

From the observation of the table as given in Table III, it is noted that the maximum features are incorporated in Document 10. Comparing the results obtained from the frequency-based method and LexRank algorithm, it is observed that the LexRank algorithm produces superior results for many of the documents when compared to the frequency-based method. These values are obtained from the Marathi News article dataset.

V. CONCLUSION

In this research work, Extractive Text Summarization is performed on the Marathi News Article dataset, resulting in state-of-the-art results for generating concise text summaries. The final summary is extracted, containing a few sentences from the original text. Two extractive text summarization techniques, namely the frequency-based method and the LexRank algorithm, are evaluated and compared in this research. The results indicate that the LexRank algorithm outperforms the frequency-based method, as assessed using the ROUGE metric and F-score. Further research can be conducted to explore the potential of deep learning techniques in text summarization.

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REFERENCES

1. Kallimani, J. S., & Srinivasa, K. G. (2010, August). Information retrieval by text summarization for an Indian regional language. In Proceedings of the 6th International Conference on Natural Language Processing and Knowledge Engineering (NLPKE-2010) (pp. 1-4). IEEE. [CrossRef]
2. Rathod, Y. V. (2018). Extractive text summarization of Marathi news articles. Int. Res. J. Eng. Technol, 5, 1204-1210.
3. Desai, N., & Shah, P. (2016). Automatic text summarisation using a supervised machine learning technique for the Hindi language. Int. J. Res. Eng. Technol, 5(06), 361-367. [CrossRef]
4. Shirwandkar, N. S., & Kulkarni, S. (2018, August). Extractive text summarization using deep learning. In 2018, the fourth international conference on computing, communication, control, and automation (ICCUBEA) (pp. 1-5). IEEE. [CrossRef]
5. Balabantaray, R. C., Mohammad, M., & Sharma, N. (2012). Multi-class Twitter emotion classification: A new approach. International Journal of Applied Information Systems, 4(1), 48-53. [CrossRef]
6. Subramaniam, M., & Dalal, V. (2015). Test model for rich semantic graph representation for Hindi text using an abstractive method. International Research Journal of Engineering and Technology (IRJET), 2(2), 113-116.
7. Jain, A., Arora, A., Morato, J., Yadav, D., & Kumar, K. V. (2022). Automatic text summarisation for Hindi using real-coded genetic algorithm. Applied Sciences, 12(13), 6584. [CrossRef]
8. Sarwadnya, V. V., & Sonawane, S. S. (2018, August). Marathi extractive text summarizer using a graph-based model. In 2018, the fourth international conference on computing, communication, control, and automation (ICCUBEA) (pp. 1-6). IEEE. [CrossRef]
9. Dehru, V., Tiwari, P. K., Aggarwal, G., Joshi, B., & Kartik, P. (2021, March). Text summarization techniques and applications. In IOP Conference Series: Materials Science and Engineering (Vol. 1099, No. 1, p. 012042). IOP Publishing. [CrossRef]
10. Kakde, K.., & Padalikar, H. M. (2022). Context-based Sentiment analysis of Indian Marathi Text using Deep Learning. International Journal on Recent and Innovation Trends in Computing and Communication, 10(11), 71–76. https://doi.org/10.17762/ijritcc.v10i11.5782 [CrossRef]
11. Mamidala, K. K., & Sanampudi, S. K. (2021). Text summarization for Indian languages: a survey. Int J Adv Res Eng Technol (IJARET), 12(1), 530-538.
12. Sunitha, C., Jaya, A., & Ganesh, A. (2016). A study on abstractive summarization techniques in Indian languages. Procedia Computer Science, 87, 25-31. [CrossRef]
13. Sri, S. H. B., & Dutta, S. R. (2021, October). A survey on automatic text summarization techniques. In Journal of Physics: Conference Series (Vol. 2040, No. 1, p. 012044). IOP Publishing. [CrossRef]
14. D'Silva, J., & Sharma, U. (2019). Automatic Text Summarisation of Indian Languages: A Multilingual Challenge. J. Theor. Appl. Inf. Technol., 97(1).
15. Baruah, N., Sarma, S. K., & Borkotokey, S. (2019, February). Text summarization in Indian languages: a critical review. In 2019 Second International Conference on Advanced Computational and Communication Paradigms (ICACCP) (pp. 1-6). IEEE. [CrossRef]

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