Automated Literature Review with Transformers

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***Abstract*— Business research is producing new knowledge at an astounding rate, yet it is still fragmented and heterogeneous. This makes it challenging to stay up to date, be at the forefront of research, and interpret the data in context in a particular area of business research. Because of this, it is more crucial than ever as a research strategy. Traditional literature reviews usually lack thoroughness and rigour and are conducted haphazardly rather than in accordance with a predetermined methodology. As a result, questions about the validity and reliability of these kinds of evaluations may be brought up. Despite the value of conducting Systematic Literature Reviews (SLR) of the literature to pinpoint research needs across various disciplines of study, manually doing SLR is a challenging, multi-stage, and time-consuming process.**

The primary goal of this research topic is to extract the reference paper and summarize it based on existing research papers in the same area and generate a Summary of the text which prevents duplication.

The text has been taken from different papers and after that with the help of different regular expressions collected data was cleaned from unnecessary words or punctuation marks. On the cleaned text different NLP techniques (Text Rank, Lex Rank, LSA, Luhn, KL Sum, BERT, GPT-2) have been utilized for summarization of the text. Out of all NLP techniques it has been observed that GPT and BERT were giving the best result.

On a selected topic, different research papers have been explored. Literature reviews of different research papers have been taken and summarized for reference to new researchers in that field. In this way, this model reduces the research time of different researchers and gives them an idea of previous research which has taken place on this topic in recent years.

Keywords: Text Summarization, Transformer, Research Paper, Extractive Summarization, Transformer, NLP

I. INTRODUCTION

A literature review looks at information that has been published on a particular subject and, on occasion, information from a certain time period in a particular field. A mature subject addresses the need for critique of the topic's expanding and more varied body of knowledge as well as prospective reconceptualization. The second kind of it is centred on cutting-edge or unique topics that could profit from a thorough conceptualization and synthesis of the literature. Because of the novelty of these topics and the lack of a comprehensive literature review, A new model or framework, as well as a first or preliminary conception of the subject, are more likely to emerge from the review.

There are several potential justifications for doing this, including gathering data for the creation of evidence-based care, both as a step in the research process and as a component of an academic assessment. Conducting it seems to be a challenging task to too many capable students. The most often queries range from what a literature review comprises to how to choose a subject, how many articles to include, and where to start [1].

1.1 Literature Review Understanding:

In this sense, it is a scientific publication that presents up-to-date information, including significant findings as well as theoretical and methodological advancements in a certain field. Secondary sources, do not report on new or unusual experimental work, as in literature reviews. These reviews which are most frequently associated with academic literature, are published in scholarly publications and should not be confused with book reviews, it might be published in the same journal. Evaluations of the literature form the basis for study in almost every academic field.

It is crucial to think of knowledge as having **three layers** while discussing a particular subject.

1. The researchers' initial studies, known as primary studies, are carried out and published.
2. Second, assessments of those results often go beyond the original investigations while summarising and proposing new interpretations based on them.
3. Third, there are unofficial judgments, opinions, and interpretations that get incorporated into the legend around the subject.

It is important to note that this third layer of knowledge is commonly referred to as "true" while writing this, despite just having a tenuous connection to the primary studies and secondary literature evaluations.

The three categories are **evaluative**, **exploratory**, and **instrumental**. The systematic review, a fourth form that is sometimes categorised independently, is simply a literature review that is concentrated on a particular research issue and makes an effort to find, evaluate, select, and synthesise all high-quality research data and arguments pertinent to that topic.
A meta-analysis is a systematic review that makes good use of statistical tools to combine data from all chosen studies in order to get a more accurate conclusion. An interactives' objective is to create new knowledge about a subject by analysing, evaluating, and synthesising the literature in question [2].

Types of Literature Review: The numerous types of literature reviews are listed below:

Argumentative Review
This approach examines the literature only when it is necessary to support or refute an established thesis, a long-held belief, or a philosophical issue. The main objective is to produce a corpus of writing that could serve as a counterargument. Considering how some social science studies are value-laden. For example, immigration regulation and educational reform. Argumentative methods of literary analysis may be appropriate and worthwhile. However, they can cause bias issues when used to generate summary claims like those seen in systematic reviews [2].

Integrative Review
Known as a study style that incorporates, analyses, evaluates, and synthesises representative literature on a subject to create fresh frameworks and viewpoints on the subject. Within the body of literature are all the research that specifically address related or parallel hypotheses. A well-done integrative review satisfies the same standards as primary research in terms of clarity, rigour, and replication [2].

Historical Review
Few things stand apart from historical precedent. Examining studies through time, historical reviews frequently start with the first time an issue, concept, theory, or phenomenon appears in the literature and trace its development within a discipline's scholarship. The objective is to contextualise research within a historical framework to demonstrate knowledge through cutting-edge discoveries and to identify potential future research fields [2].

Methodological Review
The focus of a review is often on the method of analysis rather than the content of what was said. This method offers a framework of comprehension at different levels (theory, substantive fields, research approaches, and data collection and analysis techniques), allowing researchers to draw on a variety of knowledge ranging from the conceptual level to practical documents for use in the fieldwork in many fields of ontological and epistemological consideration as well as for quantitative and qualitative analysis [2].

Systematic Review
In order to find and critically evaluate relevant research, as well as to gather, present, and analyse data from the studies included in the review, this form includes an overview of the currently available evidence pertinent to a clearly defined research question. The main focus is typically on a relatively specific empirical topic, which is frequently presented in a cause-and-effect structure, such as "How much does A contribute to B?" [2].

Theoretical Review
This form's objective is to investigate the body of theory that has been accumulated in regard to a certain subject, idea, theory, or phenomenon in a concrete way. Theoretical analysis aids in identifying current theories, their connections, the depth to which concepts have been researched, and the creation of new hypotheses to be tested. This method is widely used to show that there are no valid theories or that existing theories are insufficient to explain novel or emerging research problems. A single theoretical idea, a whole theory [2].

As there are total of six types of literature reviews i.e., Argumentative, Integrative, Historical, Methodological, systematic, and theoretical. Different research falls into a different category by summarizing it researcher can come to know in which category a particular paper belongs to.

II. Literate Review

The writing of a thesis, dissertation, or journal article, among other graduate and post-graduate student assignments, typically calls for it. A study proposal or prospectus frequently includes a review of the literature (the agreement signed before a researcher officially starts writing a dissertation or thesis). It may simply be a summary of relevant sources. The key points of the source are summarised in a summary, whereas the information is reorganised or rearranged in a synthesis to help with how to analyse a research paper.

This project creates a list of previously published articles on a particular subject. A full academic work or a portion of one. In any case, the goal of this is to provide the researcher/author and the audience with a broad overview of the material that is currently accessible on the topic at hand. A thorough review of the literature helps ensure that an appropriate theoretical framework and/or research methods were used, as well as that a valid study issue was addressed. In other words, this gives the reader a perspective by setting the current work within the context of the pertinent literature. In these circumstances, the review typically comes before the sections discussing the work's procedures and results.

A review article can be included as a literature review. It is a scientific journal that delivers up-to-date information, together with significant findings and theoretical and methodological contributions to a particular field. Literature reviews are an example of a secondary source that does not present new or original experimental work. Academic publications sometimes contain such reviews, which are frequently associated with academic literature. Practically every academic discipline's research starts with a literature review.

Although some of the earliest reports mentioned in the literature were vocal, written reports make up the vast majority of reports. scholarly work that may be methodological, theoretical, empirical, or critical in nature. Second, it makes an effort to summarise, analyse, evaluate, make clear, and/or include the content of original reports [3]. A complete summary and critical analysis of the existing research and non-research literature on the subject at hand constitutes a literature review [4] [1]. This serves as a foundation for another goal, such providing evidence for further research into the field, while also keeping the reader informed about recent publications on the subject. A good literature review gathers data from several sources on a

particular subject. It should have a distinct search and selection process [5].

It differs from a report on scholarly research. Establishing a novel argument is one of the main objectives of an academic research paper, and it might be one of its components. In a research paper, the researcher used the literature to provide the groundwork and provide evidence for a novel insight. Contrarily, this aims to summarise and synthesise the thoughts and arguments of others without adding anything new.

There are several uses for this, and the vast majority of them are found in a primary research article that provides the theoretical framework for the article's main investigation. It provides the framework for the remaining parts of an academic piece. It clearly communicates to the reader the importance of earlier work while explaining the nature and content of the current body of knowledge [6].The review must synthesise the available information and provide a scientific critique of the theory in order to contribute to the work as an academic paper. It cannot simply restate the subject matter [6].

III. Research Methodology

In this section, we will explore the different techniques, methods, and features used in this experiment. We will divide the section into two sections: data exploration and pre-processing and model building.

Text/Data Extraction: Retrieved the relevant 15 papers from the same business area/research topic from different journals and online portals along with their abstracts and the title has been collected. The data is from an online Journal i.e., Arxiv, Pergamon, ASP. Sample papers have been selected from the area of Customer segmentation.

Text Pre-processing: It is the most vital part of any analysis. Considering a few important pre-processing steps, the below-mentioned techniques have been used.

1. **Stopwords Removal** - Stopwords are meaningless and repeated words that do not contribute to the semantics of the statement. It should be removed.

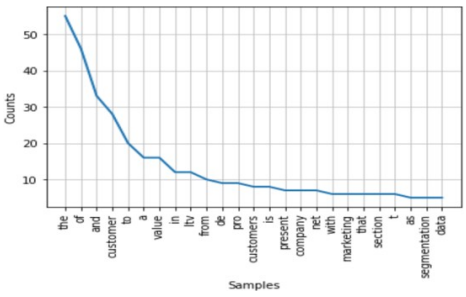

Figure No. 3.1: Word Frequency

2. **Symbol Removal** – Reviews generally contain symbols like @,#,$ with no contribution towards analyzing the sentiments. So, it should be removed.
3. **Contractions and Annotation Removal** – Contractions and annotations like ‘shouldn’t’ should be removed with ‘should not.
4. **Exploration** – It is to check the word frequency of the corpus. It gives an idea of what the document is about.

Figure No. 3.2: Word Cloud

Text Summarizing: NLP technique to get the Title feature, Sentence Length, Sentence position, and Sentence Frequency.

Summarized Text: In summarized text researcher could get the Summary of the text based on some predefined criteria.

Seven algorithms have been identified as having the potential to Generate it. **These are as follows:**

Text Rank: It is a graph-based text processing ranking model that demonstrates how this model may be used effectively in natural language applications. When utilising an unsupervised method to extract phrases and keywords, it is really helpful. An extractive summarization method is TextRank. It is predicated on the idea that words with higher frequency have greater significance [7] [8] .

1. An extractive summarization method is TextRank.
2. It is predicated on the idea that words with higher frequency have greater significance.
3. Therefore, it is crucial to pay attention to sentences with many common words.
4. The system awards grades to each sentence in the text based on this.

Lex Rank: It is a different PageRank method offspring with the text summarising tool TextRank as a sibling. A sentence is likely to be considered important if it can be related to several other sentences in the text. Finding a sentence that is supported by other, comparable sentences and is scored higher is how LexRank works. The higher the rank of the sentence is, the higher the priority of being included within the summarized text [9] [10].

An unsupervised learning approach called latent semantic analysis can be applied to extractive text summarization.

1. By applying Singular Value Decomposition (SVD) to the matrix of term-document frequency, it extracts phrases that are semantically significant.

Latent Semantic Analysis (LSA): it is a technique for examining the connections between a collection of documents and the terms they include by creating a collection of concepts pertaining to both the documents and the terms. By using SVD on the grid of term-document frequency, it extracts phrases that are semantically significant. Latent

Semantic Analysis is a generally applicable unsupervised learning approach for extractive text summarization [11] [10].

1. A sentence has a high likelihood of being significant if it is comparable to numerous other sentences in the text.
2. According to LexRank's methodology, a sentence is ranked higher if other sentences that are similar to it recommend it.
3. The priority of being included in the summary text increases with rank.

Luhn: Based on **Term Frequency-Inverse Document Frequency (TF-IDF)** method for summarising Luhn When both very low-frequency words and highly common words (stopwords), approach is quite helpful. It is used to separate sentence ranks, and the top-ranking sentences are featured in the summary [10].

1. The technique of the Luhn Summarization algorithm is based on TF-IDF (Term Frequency-Inverse Document Frequency). When both highly frequent words (stopwords) and very low frequency words (VLF) are insignificant, it is helpful.
2. Accordingly, sentence scoring is done, and the best-scoring sentences are included in the summary.

KL Sum: It is an extractive strategy that chooses phrases based on how frequently words appear in the original text. It seeks to reduce the KL-divergence threshold (learn more). To reduce the KL-divergence, it employs a greedy optimization strategy and keeps adding sentences [10].

1. The KL-Sum algorithm is another extraction technique.
2. Based on how closely the word distribution resembles the original text, it chooses which sentences to use.
3. It seeks to reduce the KL-divergence threshold (learn more).
4. It employs a greedy optimization strategy and continues to add phrases as long as the KL-divergence remains low.

Bidirectional Encoder Representations from Transformers (BERT): BERT is a transformer that is used to get around the long-term dependencies that Recurrent Neural Networks (RNN) and other neural networks have. It is a pre-trained naturally bidirectional model. This pre-trained model can easily complete the given NLP tasks because it is highly adaptable, which is in our case summarization [12] [6] [13].

BERT is a transformer that is used to get around the long-term dependencies that RNN and other neural networks have. It is a pre-trained model that is naturally bidirectional. This pre-trained model can be adjusted to easily carry out the specified NLP tasks, Summarization in our case.

Generative Pretrained Transformer 2 (GPT-2): GPT-2 is a seq2seq model that can be altered to carry out the task of text summarization. Here the format of data is very similar to the translation task- "*text = summary"* [13] [14] .

When the researcher searches the literature review in different research papers it's not an easy task to understand the context of it. Usually, it takes a considerable time to read and understand it fully. It is quite difficult to summarize the whole literature review in a few words manually by a research scholar. When they need to refer to a greater number of papers on any topic it becomes a very time-consuming and tough task. So, there was a need for a method or model which can resolve this issue and provide some relief to the research scholars.

The text summarization model takes a lot of text for processing that's why it needs a high-end configurations system with high computation intensive CPU\GPU otherwise for the normal system it's a time-consuming task.

Evolution: Matrices to evaluate the score of summarized text i.e., Rough, Bert score.

Recall-Oriented Understudy for Gisting Evaluation-N (Rough-N): Between the model-generated text and references RAUGE-N measures the number of matching n-grams. ROUGE score can be used for scoring [15] [16].

Bert Score: it is an automatic evaluation metric for text generation from existing text. The main advantage of using this metric is to calculate a score of comparable ness between each token in the candidate sentence and each token in the reference sentence [17]

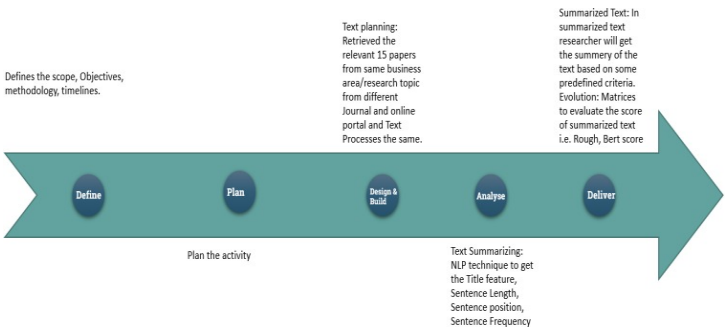

Figure No. 3.4: Research Methodology

IV. Results and Discussion

This part of the research enumerates the result and its analysis: of the repercussions of the achieved result. This is inclusive of the outcome of the proposed methodology and covers descriptive work.

The outcome was best when the GPT-2/ GPT-3 was adopted as the procedure as it showed a better performance in the field of text generation in the field of **Automated Literature Review with Transformers.**

Validation: Two different research papers on the topic of Customer segmentation have been taken for the text summarization:

1. Customer Segmentation using clustering algorithms.
2. Customer Segmentation Technique on Ecommerce

'Literature Review Customer Segmentation Over the years as there is very strong competition in the business world the organizations have to enhance their profits and business by satisfying the demands of their customers and attract new customers according to their needs. The identification of customers and satisfying the demands of each customer is a very complex task. According to customer segmentation is a strategy of dividing the market into homogenous groups.': ['data/**Customer segmentation using clustering algorithms**.pdf]'

'Review on Customer Segmentation Technique on Ecommerce Ecommerce transactions are no longer a new thing. In marketing personalization technique can be used to get potential customers in a case to boost sales. Duration when seeing the product can be used as customer interest in the product so that it can be used as a variable in customer segmentation. Keywords Ecommerce Customer Segmentation Personalization. It will generate more profits for the company. Several researchers discuss the customer segmentation method on their papers such as Magento who used several variables to perform customer segmentation namely transaction variable product variable geographic variable hobbies variable and page viewed variable Baer and Colica discuss customer segmentation methods of Business Rule Quantile membership Supervised Clustering Unsupervised Clustering Customer Profiling RFM Cell Classification Grouping Customer Likeness Clustering and Purchase Affinity Clustering.': ['data/**Review on Customer Segmentation Technique on Ecommerce.pdf**']

Figure No. 4.1: Summary using Bert against each paper

Score:

	Score									
	Rouge									BERT
	Recall			Presission			F-Score			F-Score
	ROUGE-1	ROUGE-2	ROUGE-L	ROUGE-1	ROUGE-2	ROUGE-L	ROUGE-1	ROUGE-2	ROUGE-L	
Model Name										
TextRank	0.27	0.2	0.27	1	0.97	1	0.42	0.33	0.42	0.22
LexRank	0.48	0.42	0.47	1	0.97	1	0.64	0.59	0.65	0.24
LSA	0.33	0.22	0.33	1	0.96	1	0.49	0.36	0.49	0.23
Luhan	0.54	0.5	0.54	1	0.98	1	0.7	0.66	0.7	0.24
KL-sum	0.34	0.3	0.34	1	0.99	1	0.42	0.33	0.42	-0.03
Bert	0.22	0.14	0.22	1	0.96	1	0.36	0.25	0.36	0.42
Gpt-2	0.27	0.17	0.27	1	0.98	1	0.42	0.29	0.42	0.28

After the text summarization researcher could get the context of it in a small summary para with the citation of each included in it, so he can refer to the same in their research.

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