



Aspect Based Sentiment Analysis

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Abstract: Abstract- Aspect-based sentiment analysis (ABSA) is the subfield of natural language processing that follows the norms for the sole purpose of identifying and extracting the aspects of the given texts. This allows for a more fine-grained sentiment analysis than the other forms of generic sentiment analysis systems, which only provides an overall sentiment viewpoint for an entire document. For example, consider the following hotel review: "The hotel staff members were very friendly and helpful for different tasks. The rooms during that time were clean and comfortable, but the location could have been better because it was a bit away from the airport. In conclusion, I had a great experience." In simple and most widely used sentiment analysis systems, this review would be classified only with the tag of positive. On the other hand, in aspect-based sentiment analysis, we can identify specific aspects (e.g., "staff", "room", "location") and determine the sentiment expressed towards each of them. In this case, the view towards the "staff" and "room" aspects are positive, while the sentiment towards the "location" aspect is negative. ABSA has a wide range of applications, including product reviews, customer feedback analysis, and social media monitoring. It can be used to understand customers' opinions and preferences, identify areas for improvement, and track the sentiment toward a brand or product over time. Index Terms—component, formatting, style, styling, insert

INTRODUCTION

Aspect-based sentiment analysis is a machine learning methodology that is used to identify the particular aspect the mentioned paragraph or a particular statement is conveying information about. It is widely being used to determine a more detailed and in-depth look at a body of a given data with giving emphasis also on the polarity or sentiment of a particular aspect of an object. This methodology is widely used to automate human efforts by simply mentioning the aspects and their respective polarities such as positive, negative, or neutral. This methodology is widely being implemented by industry-leading firms to gain a deeper understanding and a holistic view of not Identify applicable funding agency here. If none, delete this. only the entire product but also the feedback of a particular aspect of the product to gain the viewpoints or critical points on which the company an determines its shortfalls and work on improving it. For example, in the sentence "The drinks were flat, but the ambiance was good", the following sentence will be processed by ABSA to give output for aspects 'Drinks' and 'Ambience' with their respective polarities being 'negative' and 'positive'.

II. LITERATURE SURVEY.

2.1 Aspect-based sentiment analysis using SVM and Stanford NLP [1]

The hair care industry is a big established industry and this paper researched the ABSA system on a hair care product by gathering data from various platforms with a main emphasis on eBay in form of a CSV file for pre-processing capitalized letters was converted to simpler words and main emphasis was given in removing the undesired special characters with the help of EmojiPraser library, the opinion extraction is done using the MonkeyLearn API which accepts text files and returns a JSON file as output and then the aspect extraction is done using the Support Vector Machine (SVM) model therefore, is trained on a pre-processed data of 200 entries. Finally, the system uses the Stanford CoreNLP functionalities to predict the respective polarities. This system reached considerable accuracy due to Stanford CoreNLP. The accuracy can further be improved as mentioned by adding and training on more Aspects.

2.2 Feature Extraction using hierarchical attention network [2]

The RNN used in the feature/aspect extraction operation provides considerable results but they are fairly limited to the sequential processing. The time taken and the same time taken for the performing any types of operations using it is very time-consuming. This aim of this research was to combine the multi-head attention mechanism which comes under the wing of Transformer, fusion model of CNN and hierarchical attention network.

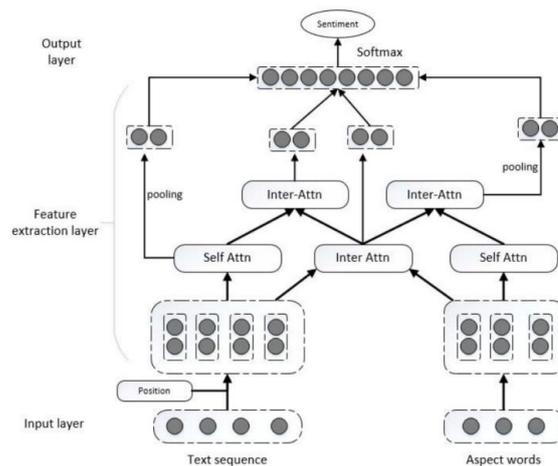


Fig. 1. Fusion Architecture of RNN and hierarchical attention network

The model is divided into the preliminary input layer, the aspect layer and at the end the output layer. The first layer's job is to read the text in the form of input and then produce its vector form which corresponds to the succession. The aspect extraction unit or layer contains a convolutional layer for encoding purpose, and then layers for attention and fusion in order. The convolutional encoding unit works to reduce the training hyper-parameter which works in the parallelizability of the network. On top of this, the model uses two-layer multiple headed attention mechanism where context features are interdependent and then finally the sentiment view of the aspects in attention is given by the final part of the architecture as output.

Model	Restaurant		Laptop	
	Precision	F1-Measure	Precision	F1-Measure
SVM	0.6500	0.4333	0.7040	0.6333
TD-LSTM	0.7568	0.6451	0.6825	0.6561
ATAE-LSTM	0.7794	0.6702	0.6883	0.6596
MemNet	0.7867	0.6685	0.7094	0.6642
AOA-LSTM	0.8039	0.6898	0.7247	0.6734
RAM	0.8043	0.7088	0.7439	0.7135
MGAN	0.8135	0.7129	0.7451	0.7204
AEN	0.8058	0.7052	0.7351	0.7167
MCLA	0.8124	0.7114	0.7459	0.7218

Fig. 2. Precision Table of the proposed model [2]

2.3 ABSA For Student Accommodation [3]

- Demand for the student accommodation has seen a drastic spike in recent, this field can also be considered as a perfect example for ABSA implementation and how it can play a vital role in such businesses. The following methodology was implemented by first pre-processing the text and proposed two models, one for extraction of the particular aspects and then for the sentimental polarity (customer's view) with extensive evaluation. Each review was converted to word to vector of size (1,834). Using word2vec semantics and for labels encoding i.e., for converting aspects labels to numeric representation scikit-learn was utilized using noun-chunks.

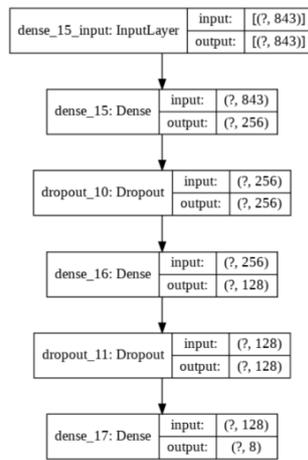


Fig. 3. Architecture

The project used two neural networks which consisted of 4 dense and fully connected layers. The valuable size of words is 843 for the first input layer. The same manner was used to create to classify the sentimental polarities of the reviews and argmax function was used along with reverse labelling encoding unit to get sentimental views of the feedback.

2.4 Aspect Based Sentiment Analysis of Movie Reviews [4]

This paper [4] focuses on the ABSA technique to be implemented for the movie review. The proposed model works in the flow as denoted in the diagram for the dataset the reviews for various movies were collected from different sources and platforms. The pre-processing step involves formatting different views so they can convert to the format suitable for the input. For this HTML tags and other miscellaneous tags was removed. For this model tagging of sentences was done using Stanford part-of-speech tagger then the words (lexicon) were matched for the sentence structures having the same elements of speech. Concerning the polarity of the reviews concerning the aspects a Naïve Bayes classifier was used which calculated the probability between the positive or negative categorization of the reviews and the output is denoted in to form of 1 or -1. As for accuracy the model was able to achieve more than 0.75.

Aspect	Aspect Words
Screenplay	scene, scenery, animation, violence, screenplay, action etc
Music	music, score, lyric, sound, audio, musical, title track, etc
Acting	acting, role playing, act, actress, actor, role, portray, character, villain, performance etc
Plot	plot, story, storyline, tale, romance, dialog, script, storyteller, ending, storytelling, revenge, betrayal, writing etc
Movie	movie, film, picture, moving picture, motion picture, show, picture show, pic, flick, romantic comedy etc
Direction	directing, direct, direction, director, filmed, filming, film making, filmmaker, cinematic, edition, cinematography etc

Fig. 4. Aspect focused for movies

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2.5 Aspect Based Feature Extraction and Sentiment Classification of Review Data sets using Incremental Machine learning Algorithm [5]

The method for the ABSA methodology utilized in this paper is none other than the Incremental Machine Learning Algorithm with main emphasis on sentiments for the users. Data pre-processing is performed by removing repetition and information which is not relevant and extracting aspects from the word vector. Finally, for the sentiment or polarity extraction and summarization Incremental Decision Tree algorithm is utilized which follows iterative methodology for classification. The results were done in comparison with the Naïve Bays algorithm along with the proposed methodology

2.6 BERT-IAN Model for Aspect-based Sentiment Analysis [6]

For Aspect-Based Sentiment Analysis this model essentially works by improving the accuracy of confidence score. The first step is to select the aspect and context. Transformers are then used to extract the features in parallel to produce the final representation. Input it into the classification layer to classify the polarity of the sentence. An accuracy metric was used to check the prediction accuracy of the laptop and restaurant datasets. Results of this experiment show that this model help us to improve the accuracy of model prediction.

2.7 Transfer learning method for Aspect-based Sentiment Analysis [7]

Here [7] we have found out that this paper focuses on the above method approach by making a pre-trained advanced deep learning model. The reason for using transfer learning method is that training a deep learning model from start requires very big and well-generated data. His transfer learning algorithm used in this work is Bert. Transformer encoder typically use a six-layer neural network. Each layer has a multi-layer attention layer and his two sub-layers of a single layer feed forward network. Here is an example of ratings and labels.

TABLE II: Examples of reviews and labels

Reviews	Labels
The food was delicious service always came quickly with a joke or a smile and the portions are unbelievably HUGE	10000000100000000000
The food selection was fantastic but waiting over hour to be seated	10000000001000000000
Everything that I have eaten here has put me in a coma of ecstasy so please bring a designated driver to take you home	10000000000000000000

TABLE III: An example of a label

Aspects																			
Food				Price				Service				Ambient				Misc.			
pos	neu	neg	con	pos	neu	neg	con	pos	neu	neg	con	pos	neu	neg	con	pos	neu	neg	con
1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

Fig. 5. Examples of reviews and labels

2.8 Survey of Deep Learning Models for ABSA [8]

Here [8] we have investigated three main directions, including dictionary method, traditional based methods, and deep learning methods. The lexical based method first resonates aspects contained in a sentence with a word or phrase, then analyses the aspects to infer the mood polarity of the aspects. Other methods treat ABSA as a multi-level classification problem. In this question, the emotional polarity of each aspect is categorized as the polarities and the other being the neutral. Deep learning methods can directly identify the emotional polarity of the sides end-to-end. For deep learning methods, he classifies into categories like: Classification neural network and Recurrent neural network. RNN includes basic RNN and GRU. Improving the performance of ABSA in various applications, such as social media analysis and government policy related to COVID-19, is a guideline that researchers need to focus on.

2.9 CNN and Bidirectional LSTM for ABSA [9]

This paper mainly focuses on the best F1 at SemEval 2016. The authors developed a one versus all strategy for aspect category classification (Slot1), a constraint based random field for opinion target expression removal (Slot2) and a method used for sentiment polarity classification (Slot3). The model is trained on his 992 sentences and evaluated on his 382 sentences. Design of CNN was used to solve slot 1 to slot 3. The list of names has not been used as a function of his ABSA in Indonesian as the Indo double transmission rule was not discussed. We solved Slot1 using CNN stochastic outputs as features producing F1 scores above 0.870 using a feed forward neural network with a one-versus-all strategy.

Label	Total Sentences
Food	505
Service	97
Price	125
Place	440
Total	1165

Fig. 6. Slot1 Training Data Distribution

TABLE 4. SLOT 1 CNN TOP EXPERIMENT RESULTS

Hyperparameter		Score			
Name	Value	Precision	Recall	F1	
Filters	128	0.9534	0.9220	0.9356	
Convolution activation	Tanh				
Dropout rate	0.5				
Dense Activation	Tanh				
Dense units	64	0.9461	0.9272	0.9346	
Dense layers	1				
Filters	256				
Convolution activation	Tanh				
Dropout rate	0.5	0.9502	0.9218	0.9344	
Dense Activation	Tanh				
Dense units	128				
Dense layers	2				

Fig. 7. Slot1 CNN Top Experiments Results

2.10 ABSA with Deep Self Attention Network [10]

In this paper [10], the authors proposed a new approach to perform a deep self-awareness extraction-attendance prediction process for side-based sentiment analysis to address the hurdle of coding sides and sentences separately. Aspects have no context information - neither adjacent aspect were considered. The overall framework of the model is divided into four parts: Sentiment Prediction Layer First, a fine companion layer is taken in account for the task to find one of the most similar sentence contents which is based on the taken aspect representations. Secondly, we use a fine adjunct layer to compute the similarity of each aspect-clause pair and find what the sentence has related to each aspect. Finally, a classification was made based on the aspect representation and the two visited representations. Results on the two public data says how good the approach is.

2.11 Issues and Challenges of Aspect-based Sentiment Analysis [11]

The field of AbSA has gone through many various modifications and touched many new eras over long period of time. The researchers are trying hard to resolve the challenges with multi-faceted issues. To cope up with these peculiar challenges they are trying to come up with different solutions using ML, involving methods such as deep learning that show their important plan. They presented numerical modelling and various graphical representation to support complex eventualities through methods that involves neural memory methods and attention mechanisms. For elaborated data on deep-learning techniques, attention mechanisms and memory networks. Some of the surveys provides a structured, organized and in-depth look at present difficulties of Aspect analysis, sentiment analysis and collected the answers over a period of time. The survey also gives new hints that influence maximal thoughts and challenges to enhance existing answers, which might be beneficial for future studies directions; alongside thinking about how sentiment analysis is necessary and thrilling study the difficulty in plenty of implementations.

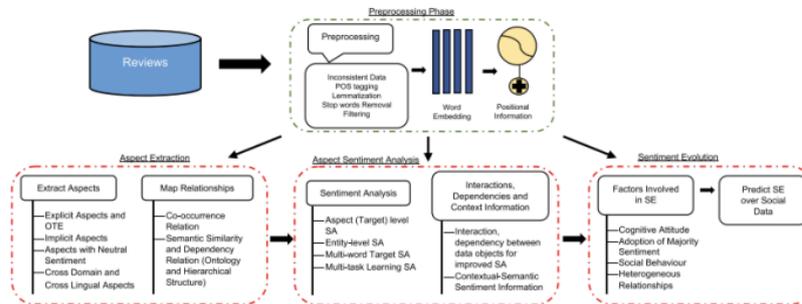


Fig. 8. A framework regarding the main phases of aspect-based sentiment analysis

2.12 ISAR: Implicit Sentiment Analysis of User Reviews [12]

Numerous users utilize the internet daily to buy goods, reserve bus tickets, and order services. On the internet, users also express their opinions about goods, eateries, news stories, etc. through comments, reviews, blogs, etc. Many people examine online reviews before making judgments on things like buying items, viewing movies, dining out, etc. Reviews include customer opinions on various product kinds. Users on the web find it challenging to read and understand the contents of numerous reviews. For reviews and social media for a variety of purposes SA is used, from advertising to product retention. The technique of extracting user opinions about a movie, hotel, or product from reviews is known as opinion mining. They may comprehensively examine views with the help of an aspect-based opinion mining approach, which also offers a more practical means of making decisions. Review data from restaurants is the focus of this study. Through the use of an implicit methodology and in this examination[12] researchers were able to create a system that would take aspect level reviews into account

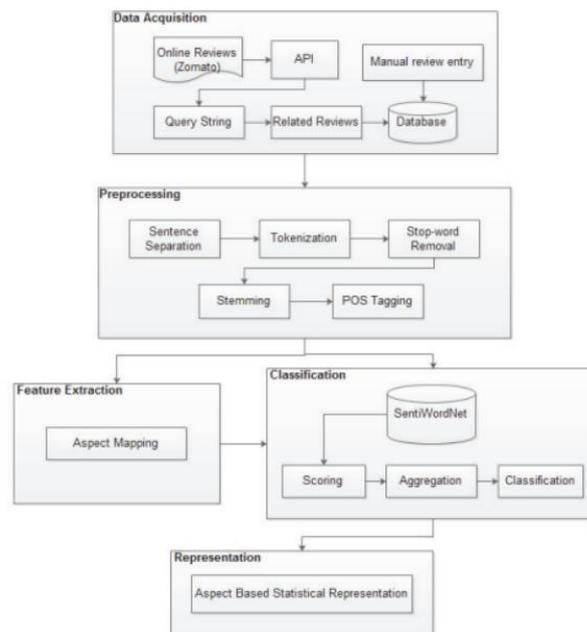


Fig. 9. Proposed System Architecture

2.13. Supervised Learning Based Approach (using SVM) [13]

In this research paper [13], the authors went more in particular to the development of a product recommendation system based mainly on check the research. In principle, the suggested system can be further developed by revision Compare different classification algorithms to determine the optimal application. This analysis [13] was mainly carried out using common tools and languages that mainly included Python and Natural Language Coaching Kit which used Linux as platform. For supervised learning mechanism authors used support vector machine. The given methodology can be implemented in models with associated learning

Algorithms such as supervised learning, which analyses knowledge and determine Classification and regression analysis models. Search field used basic phenomenon of SVM, to specify line separators that can separate better Categories changed it attempts to build a file which is the best hyper fit line to deal with infrocentric analysis, accuracy, neutrality and the size of the data set on which the research is based by separating 2 classes with larger potential vulnerability. Two sets of data were used, namely: Restaurant Data Summary: The data set contains 1315 training sets and 663 test sets. The data was collected from e-commerce website which was related to the laptop and contained 450 English reviews for the aspect category extraction task, 75.78 was the accuracy score for the data set compared to the state of art accuracy of 83.98 which were for restaurant and laptop data sets respectively.

2.14 Aspect-based Sentiment Analysis using Multi-task BERT [14]

In this [14], the authors covered the Self-Awareness Network (SAN). BERT and designed a totally distinct multitasking BERT framework called BERT-SAN for aspect-based sentiment analysis. They tended to handle several observations to get the optimal results for the given one Methodology and compared to other traditional methods. They first worked on some similar aspect-based sentiment analysis work then followed by the architecture and introduced the proposed BERTSAN framework treated sensation by aspects Analysis in two related subtasks. Now, to determine when aspect a is mentioned in sentence s was the purpose of this first sub task.

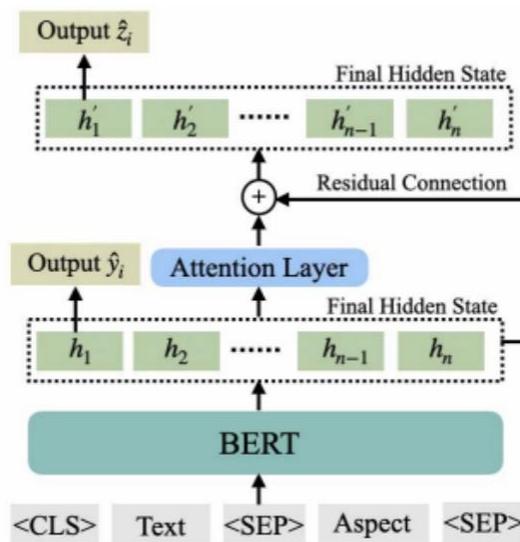


Fig. 10. Proposed BERT-SAN framework[14]

For the second sub task they expected a sentiment label with positive, neutral, negative, conflict on various aspects A. Note that the second sub task is only valid if the aspect is mentioned in the sentence. Harvest 2 Data set of restaurant ratings from 2014 to 2016 REST-14 the data set contains five facets and four classes of moods during The REST Large dataset contains eight facets and three sentiment classes

2.15 Combination of Recursive and Recurrent Neural Networks [15]

In this article [15], the authors introduced a framework to address the issues of aspect-based SA. To capture the mood bass was used which is a built-in recursive and recurrent neural network model. For the recursive model, they used closed recursive units (GRU). As for the recursive form, have developed new ways to extract satisfactory partial tests Groups of appearance conditions, from ratings. These minor changes are obtained in such manner so that each one is changed by exactly one emotion. A separate exam is developed and trained with recursive neural networks for every secondary exam. The combinations of the major moods of each sub-test are remotely captured and observed, which correlates to the embedding of the similar aspect. The recursive input model then takes these embeddings as input. Then we team the model combined recursive and recursive models hierarchically, for example input of the recursive network was given as output of the recursive network. The repeating pattern was the same as the core model. The recursive model was mainly based on a technique using sub examine and apply each voter and dependency analyzer. Within this technique, the recursive model takes the time records through disclosure interaction of the poles. The recursive model takes into account what is being called grammatical, semantic and syntactic form of the text content Purpose. Each of these models makes up for what the other lacks. More information about the content of the text and his feelings about it wait can be received by combining of these neural models. The suggested assembly model is displayed. After that there are sub-revisions extracted and trained from recursive patterns, foundation embedding (status hidden in the root node) preserved for each sub-revision (facet). To the recursive model. At the entrance to the recursive network for every one of the sentences, the integration of the sentence and its corresponding aspect, and the integration of the root they are combined. GloVe vectors were used for the phrases and looks Conditions. If an aspect consists of additional sentences, we remember it Average Vector.

III. Conclusion

We explored various different methods for the task of ABSA with main focus on attention-based models and need of open portals for the general population to be made aware of the technology. With the above observations at the end, we can conclude that even being time consuming and initially requiring large capital the state-of-the-art model comes on top in terms of being accurate and reliable. The field of ABSA is relatively new and there still needs attention with implementation being from different

backgrounds with main focus being on the medium to small size business as they benefit the most because they can understand their clients more and save time as compared to large e-commerce firms.

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