



**Sentiment analysis of reviews written in the Saudi
dialect to classify customer satisfaction levels in
e-commerce.**

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Introduction

Problem Definition

E-commerce has witnessed rapid growth in recent years, and dependence on digital platforms has become an essential component of customers' decision-making processes. Customer reviews and textual evaluations now represent a significant source for understanding user experiences with products and services. With the increasing amount of content generated by customers on e-commerce platforms, companies are facing a major challenge in analyzing these data effectively, especially since relying on traditional methods or manual analysis has become impractical given the massive and continuously growing volume of data.

Accordingly, there has emerged a growing need to develop more advanced approaches based on artificial intelligence techniques to understand customers' opinions and accurately analyze their sentiments, enabling companies to improve their products, enhance the quality of services provided, and support future decision-making. Although several Arabic studies have addressed the field of sentiment analysis, there remains a need for further development in terms of the models used, the accuracy achieved, and the diversity of data sources. Moreover, there is still a clear need to integrate more advanced natural language processing techniques capable of handling dialectal language and analyzing textual content more precisely and effectively.

Thesis Objectives

The objectives of this thesis are as follows:

1. To collect and prepare a dataset of customer reviews written in the Saudi dialect from e-commerce platforms.
2. To apply Natural Language Processing techniques to preprocess, clean, and analyze informal text written in Saudi dialect.
3. To develop a sentiment analysis model, including Aspect-Based Sentiment Analysis (ABSA), capable of classifying customer satisfaction levels (positive, negative, and neutral).

4. To evaluate and compare the performance of various machine learning and deep learning algorithms in sentiment classification.
5. To identify the most influential linguistic features that contribute to determining sentiment in Saudi dialect customer reviews.

Thesis Contribution

This thesis provides several scientific contributions, the most prominent of which are:

1. Developing a sentiment analysis model specifically designed for customer reviews written in the Saudi dialect, within a research area that remains relatively limited.
2. Establishing a clear methodology for processing informal Arabic text in the context of e-commerce, including preprocessing, analysis, and feature extraction stages.
3. Providing an annotated dataset that can be utilized in future research related to sentiment analysis in the Arabic language.
4. Enhancing the understanding of customer satisfaction patterns in the Saudi market and supporting data-driven decision-making for e-commerce platforms.

Background

In the last few years, e-commerce has seen unprecedented growth, and it has become an inseparable part of consumers' buying behavior. Along with this growth, organizations have become increasingly aware of the need to understand customers in a digital environment through opinion analysis and reviews coming from every online platform and social networking site. The modern markets cannot solely depend on conventional feedback mechanisms but need intelligent tools that can interpret customer digital impressions for service quality improvements, data-driven decision-making, and increasing customer satisfaction.

Therefore, it is important to have digital tools that help companies understand their customers' opinions about products, especially given the vast number of reviews that cannot be analyzed manually. Sentiment analysis provides insights into customer opinions by examining their reviews and determining whether they are positive, negative, or neutral through the processing of textual content.

Sentiment analysis in the Arabic language has become a crucial area of research, especially for understanding customer opinions on social media and online reviews. Researchers face significant challenges, including dialectal variation, morphological complexity, and ambiguity in informal or abbreviated texts. To address these issues, previous studies have emphasized the importance of building corpora and lexicons specific to different dialects, such as Jordanian, Egyptian, and Saudi Arabic, to develop more accurate and effective models for sentiment analysis in Arabic.

In the field of text analysis and sentiment classification, a set of traditional and modern algorithms are used, each with its own characteristics and way of functioning. Among the most widely used algorithms in previous studies are the following:

Support Vector Machine (SVM) Algorithm

SVM is considered one of the most effective methods for text classification, as it relies on separating data in a high-dimensional space, allowing for maximum distinction between different classes. This method is notable for its ability to handle nonlinear data through the use of kernel functions that help improve classification accuracy, which is why it is widely used in sentiment analysis applications.

Naïve Bayes (NB) Algorithm

The Naïve Bayes algorithm is based on probability principles and assumes that features within the text are independent of each other. Although this assumption is not always

accurate in natural language, the algorithm has proven to be highly efficient and fast in training, making it a popular choice for classifying opinions and reviews, especially when dealing with large datasets.

K-Nearest Neighbors (KNN) Algorithm

This algorithm relies on measuring similarity between texts by comparing a new sample with its closest examples in the training set. The class is determined based on the majority of the most similar neighbors. Despite its simplicity, it can be slow with large datasets because it requires calculating distances for each sample during classification.

Decision Tree Algorithm

Decision trees build a model based on a series of sequential rules used to make decisions step by step. This method is easy to interpret; however, it may suffer from overfitting if not properly tuned. It is used in several studies to classify texts and sentiments in a simple and clear manner.

Pre-trained Language Models

They are artificial intelligence models initially trained on large volumes of texts to learn about linguistic structures, context, and relationships of words. Later, they can be fine-tuned for specific tasks such as text classification, sentiment analysis, question answering, or information extraction, with no need to train them from scratch, which saves time and resources and increases accuracy.

There are clear gaps in previous studies, as the datasets used to train the models were small and were often collected manually from multiple platforms. This lack of sufficient data has directly affected the models' performance, and the limited dataset may have contributed to the inaccuracy of the models' evaluation results.

Key Word

Nlp, Sentiment analysis Arabic, Customer reviews, Saudi dialect, e-commerce.

Related work

Paper 1: Enhancing Customer Experience Through Arabic Aspect-Based Sentiment Analysis of Saudi Reviews

Summary

This study addressed Aspect-Based Sentiment Analysis (ABSA) of product reviews written in the Saudi dialect, with the aim of enhancing customer experience using Natural Language Processing (NLP) techniques and machine learning. The researchers manually collected and constructed two datasets containing a total of 4000 reviews (2000 for electronics and 2000 for clothing) sourced from prominent Arabic platforms such as Amazon, Jarir, Shein, Noon, and Twitter, The data was annotated by labeling aspects such as quality, battery, and price for electronics, as well as size, color, and fabric for clothing, and assigning sentiment scores of ‘1’ (positive), ‘-1’ (negative), or ‘0’ (neutral).

Methodology

1. Conducted aspect-based sentiment analysis on Saudi dialect product reviews using machine learning and NLP techniques.
2. Machine learning algorithms: SVM, RF, NB, KNN.
3. Manual annotation of two datasets of 2000 reviews each .
- 4 . Feature extraction techniques: POS tagging, TF-IDF, n-grams.
5. Data preprocessing: Tokenization , stemming , normalization.
6. Feature extraction: converting text into numerical vectors using POS tagging, TF-IDF, n-grams.
7. Performed 10-fold cross-validation for reliability.

Evaluation Metrics and Results

Dataset	Combination	Algorithm	Accuracy	F1-score	Recall
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Electronics	TF-IDF + POS + Tri-grams	RF	86.25%	84.47%	86.25
Clothes	TF-IDF + POS + Bi-grams	SVM	86.50%	85.82%	86.50%

Paper 2: Arabic Tweets Sentimental Analysis Using Machine Learning

Summary

In this study the researchers built an Arabic tweets corpus, specifically in the Jordanian dialect, suitable for sentiment analysis. They also explored several preprocessing strategies and machine learning algorithms to evaluate performance in order to find the best ML approach . They found that SVM outperforms Naïve Bayes, achieving higher accuracy and F-score.

Methodology

1. Data Collection: Tweets were retrieved using multiple keywords related to general Jordanian topics through the Twitter API.
2. Data Filtering using RapidMiner: RapidMiner was used to retrieve and initially filter the tweets before manual processing.
3. Manual Selection for Dialect Verification: Tweets were manually selected to ensure they were written in the Jordanian dialect or Modern Standard Arabic (MSA), based on content and expression of sentiment.
4. Data Cleaning using ASAP Utilities: The cleaning process included removing links, duplicate tweets, hashtags (#), foreign characters, and correcting repeated characters within the text.
5. Manual Annotation: Tweets were annotated as positive or negative by two human experts, with a third expert consulted when necessary to ensure annotation accuracy.

Evaluation Metrics and Results

Combination	Algorithm	Accuracy	F1-score	Recall
TF-IDF – Stemmer-Bigrams	SVM	88.72%	88.27%	84.89%
TF- light stemmer-Trigrams	NB	83.61%	84.73%	90.89%

Paper 3: Social media Sentiment Monitoring in Smart Cities An application to Moroccan dialects

Summary

This study examines citizens' sentiments extracted from social media posts written in the Moroccan dialect to assess their satisfaction with traffic conditions. The study applied machine learning algorithms to extract and analyze textual data and accurately classify sentiments. It focused on three Moroccan cities, and the results revealed a predominance of negative sentiments, particularly in the city of Rabat.

Methodology

1. Automatically extracted and processed social media data to generate reports on city concerns.
2. Used a Python script to collect a training dataset of 4,000 lines and a test dataset of 2,750 rows related to three Moroccan cities.
3. Employed machine learning techniques: Naive Bayes, SVM, KNN, and Decision Tree for classification.
4. Preprocessing steps included binary weighting, transformation of acronyms and emoticons, translation to MSA Arabic, and stemming using ISRI Arabic Stemmer.

Paper4: Sentiment Analysis of Arabic Course Reviews of a Saudi University Using Support Vector Machine

Summary

This study aims to develop a sentiment analysis system for opinions written in Arabic by higher education students, with the goal of enhancing and improving the educational process. The study proposes the SVM-SAA-SCR algorithm, which relies on preprocessing the text and then classifying it into positive, negative, or neutral sentiments using the Support Vector Machine (SVM) algorithm. The researchers used a real dataset from Prince Sattam bin Abdulaziz University (PSAU), which includes students' opinions regarding various educational aspects. To evaluate the system's performance, it was compared with the advanced CAMELBERT model. The results showed very small differences between the two models, confirming the strength and effectiveness of the SVM-SAA-SCR.

Methodology

1. Collected student course review data from Prince Sattam University, consisting of 1,870 reviews., totaling 384 records, which include 30 features comprising both numerical and textual attributes.
2. Performed text preprocessing by removing diacritics, URLs, names, and irrelevant content.
3. Converted the text into numerical representations using the TF-IDF technique.
4. Split the dataset into training and testing sets.
5. Trained the SVM-SAA model on the training set.
6. Tuned model parameters (kernel type, regularization) using cross-validation to optimize performance.
7. Evaluated the model using accuracy, recall, and precision metrics, achieving a strong performance of 84.7% accuracy in sentiment classification.

Literature Review Matrix

This table provides a summary of the most relevant previous studies related to sentiment analysis in the context of e-commerce, highlighting the methodologies used and the key findings of each study.

Paper	Author /year	Algorithm	Dataset	Key Findings
Enhancing Customer Experience Through Arabic Aspect-Based Sentiment Analysis of Saudi Reviews	Razan Alrefae, Revan Alqahmi, Munirah Alduraibi, Shatha Almatrafi, Asmaa Alayed/2024	SVM, Random Forest (RF), Naive Bayes (NB), KNN	Amazon, Jarir, Shein, Noon, and Twitter	-For electronics dataset, the RF algorithm combined with TF-IDF, POS tagging, and trigrams achieved the highest effectiveness, with an average accuracy of 86.26% per aspect. -For clothing dataset , the algorithm combined with TF-IDF, POS tagging, and bigrams achieved an average accuracy of 86.51% per aspect.
Sentiment lexicon for sentiment analysis of Saudi dialect tweets	Abdulmohsen Al-Thubaity, Qubayl Alqahtani, Abdulaziz Aljandal/2018	Lexicon-based approach	Collect data in twitter	SauDiSenti performed better for neutral tweets and showed promising results despite being smaller than AraSenTi.
Arabic Tweets Sentimental Analysis Using Machine Learning	Khaled Alomari, Khaled Shaalan, Hatem M. Elsherif/2017	SVM +Naïve Bayes	collected from the X platform(Twitter).	A corpus of 1,800 Arabic tweets was built in the Jordanian dialect and Modern Standard Arabic (MSA) (900 positive, 900 negative). The results showed that SVM outperformed

				Naïve Bayes in terms of accuracy and F-score.
Social media Sentiment Monitoring in Smart Cities An application to Moroccan dialects	Monir Dahbi, Saadane Rachid, Samir Mbarki, Rachid Saadane/2019	Naive Bayes, SVM,KNN, Decision Tree	using a Python script from Twitter and Facebook	-Particularly in the city of Rabat, the results showed a predominance of citizens' sentiments. -Converting the text to Modern Standard Arabic (MSA) led to better results in machine learning algorithms compared to using the Moroccan dialect. -SVM and Naïve Bayes achieved the highest performance after converting the text to MSA.
Sentiment Analysis of Arabic Course Reviews of a Saudi University Using Support Vector Machine	Ali Louati, Hassen Louati, Elham Kariri, Fahd Alaskar, Abdulaziz Alotaibi/2023	SVM	real student opinions from the Department of Computer Science and Information Systems at Prince Sattam University.	-The results showed that the majority of student reviews were positive, with more than 69% classified as positive. - The SVM-SAA-SCR model achieved strong performance with an accuracy of 84.7%. -The performance of the SVM model was very close to that of the advanced CAMELBERT model, indicating high efficiency. - The close results between both models confirm the effectiveness of the SVM-SAA-SCR model in accurately classifying student sentiments.

Research Gaps:

Previous studies on Arabic sentiment analysis face a significant lack of resources and datasets, as most research relied on limited-sized datasets that do not cover all dialects and domains. In addition, there is a lack of adequate utilization of linguistic lexicons and dictionaries, and they have not been integrated with modern techniques such as Transfer Learning, which limits the models' ability to understand nuanced and figurative expressions and accurately analyze sentiments, delaying the development of reliable and effective tools for Arabic text analysis.

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