

SENTIMENT ANALYSIS OF PRODUCT REVIEWS FOR SMALL-SCALE BUSINESSES

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"Success in business requires understanding your customers' needs, and sentiment analysis offers a powerful tool to decipher their unspoken desires."

Abstract

The modern world has opened many opportunities for start-up companies to start their business and take it to a higher level. The rapid digitalisation has brought the world closer. However, small-scale businesses often face challenges in competing with larger enterprises due to limited resources and market reach. They need efficient tools to gauge customer satisfaction and improve their products. This report outlines a business model for implementing sentiment analysis on product reviews using machine learning (ML) to assist small-scale businesses in enhancing their products and services. By analysing customer reviews, small businesses can gain valuable insights into customer sentiment, identify areas for improvement, and make data-driven decisions to boost customer satisfaction and competitiveness.

Table of Contents

1.0	Introduction	3
1.1	Problem Statement	3
2.0	Market-Customer-Business Need Assessment	3
3.0	Target Specifications and Characterization	4
4.0	Applicable Patents.....	5
5.0	Applicable Constraints	5
6.0	Prototype Selection.....	6
7.0	Product Development	6
8.0	Business Modelling	6
9.0	Concept Generation	7
10.0	Concept Development	8
11.0	Final Product Prototype	8
11.1	Prototype Abstract:	9
11.2	Schematic Diagram:	9
11.3	Prototype Development:.....	10
12.0	Product details	10
12.1	How Does It Work?	10
12.2	Data Sources:	10
12.3	Algorithms, Frameworks, Software:.....	10
12.4	Team Required:	10
13.0	Financial Equation	11
14.0	Conclusion.....	11
14.1	Future Implications and Opportunities	11

1.0 Introduction

In today's highly competitive market, the digital landscape offers numerous opportunities for start-up companies to establish and grow their businesses. Rapid digitalization has significantly reduced barriers, bringing the world closer and enabling businesses to reach a wider audience with relative ease. However, small-scale businesses often find themselves at a disadvantage when competing with larger enterprises due to limited resources and market reach. To thrive, these businesses must efficiently gauge customer satisfaction and continuously improve their products and services.

One of the critical tools for understanding customer needs and improving product offerings is sentiment analysis. By leveraging machine learning (ML) to analyse customer reviews, small-scale businesses can gain valuable insights into customer sentiments, identify areas for improvement, and make data-driven decisions. Using AI/ML for analysing the reviews not only saves time and reduces labour costs but also enhances the ability to address customer feedback promptly, thereby boosting customer satisfaction and maintaining competitiveness.

1.1 Problem Statement

Small-scale businesses often lack the resources to manually analyse vast amounts of customer reviews for their products. This limits their ability to understand customer sentiments, address negative feedback, and utilize positive reviews, leading to missed opportunities for improvement and growth. Sentiment analysis using ML can provide insights into customer opinions, helping businesses address issues promptly and enhance product features/varieties.

2.0 Market-Customer-Business Need Assessment

The need for sentiment analysis in small-scale businesses arises from:

1. **Valuable Customer Insights:** ML-driven sentiment analysis enables businesses to decipher customer emotions and opinions from reviews, providing deep insights into customer satisfaction levels and preferences. These insights help businesses understand what customers appreciate and what needs improvement.
2. **Improved Product and Service Quality:** With detailed feedback at their fingertips, businesses can make informed decisions to enhance their products and services. Identifying common complaints and praises allows for targeted improvements, which can lead to higher customer satisfaction and loyalty.

3. **Cost and Time Efficiency:** Manual review analysis is time-consuming and resource-intensive. Automating this process with ML not only reduces labour costs but also accelerates the feedback loop, enabling quicker responses to customer concerns. This efficiency is crucial for small businesses operating with limited resources.
4. **Competitive Edge:** By leveraging sentiment analysis, small-scale businesses can stay ahead of the competition. Understanding customer sentiments better than competitors allows for proactive measures to enhance customer experience, leading to increased market share and customer retention.
5. **Enhanced Customer Satisfaction:** Promptly addressing the reason for negative feedback and building on positive reviews helps create a positive customer experience. Happy customers are more likely to return and recommend the business to others, fostering a loyal customer base.



3.0 Target Specifications and Characterization

Our target customers are small-scale businesses operating across diverse sectors, including e-commerce, retail, hotels, and more.

Here's a characterization of these businesses:

- **Limited Resources:** Small-scale businesses often face constraints in terms of manpower and financial resources. They lack the capacity to manually analyse large volumes of customer reviews efficiently.
- **Data-Driven Decision-Making:** Despite their resource limitations, these businesses recognize the value of leveraging data to make informed decisions. They seek solutions that provide actionable insights from customer feedback.

- **Focus on Customer Satisfaction:** Customer satisfaction is paramount for small-scale businesses as they strive to build a loyal customer base. They are eager to address customer concerns promptly and enhance positive experiences to drive retention and growth.

By understanding these characteristics, our sentiment analysis platform aims to provide sentiment report for the product reviews for their products, enabling them to thrive in competitive markets.

4.0 Applicable Patents

Some of the relevant patents for sentiment analysis of product reviews:

- US Patent ID 20160267377: REVIEW SENTIMENT ANALYSIS
- US Patent ID 20080249764: SMART SENTIMENT CLASSIFIER FOR PRODUCT REVIEWS
- US Patent ID 11645682: REVIEW RESPONSE GENERATION AND REVIEW SENTIMENT ANALYSIS

5.0 Applicable Constraints

When implementing the sentiment analysis platform, several constraints must be considered to ensure its successful deployment and operation:

- **Budget:** As a new start-up, the budget constraint must be kept in mind.
- **Expertise:** Skilled technical employees proficient in machine learning (ML) and natural language processing (NLP) are essential for the platform's development and maintenance.
- **Space:** The project requires minimal physical space as it primarily relies on digital infrastructure for operation.
- **Time:** Timely implementation is essential to provide actionable insights promptly, facilitating efficient project execution to meet deadlines effectively.

6.0 Prototype Selection

1. Feasibility

This project can be developed and deployed within a year as SaaS (Software as a Service) to use.

2. Viability

The evolution of start-ups both in growth and number is increasing at an exponential rate. The businesses need a proper review analysis system to clearly know the customer requirements. So, this business will survive in the future.

3. Monetization

This can be monetised by taking it on a contract basis for the startups.

7.0 Product Development

1. Input Dataset

The first step of the project is to collect and organize the company product review data.

2. Analyse Data

In this Phase, we analyse the given data from the company and try to identify the sentiment of the review along with important repetitive keywords.

3. Visualize the Analysis and Create a Report

From the above phase, we get a clear understanding of customer sentiments for each product along with some common keywords pointed out in the reviews. The analysis can be tabulated or visualised using bar graphs, pie charts, etc. These can be compiled into a report for the company to view and access.

8.0 Business Modelling

A contract-based business model can be implemented to ensure the sustainability and scalability of the sentiment analysis platform for small-scale businesses.

This model offers a cost-effective and accessible way for businesses to leverage sentiment analysis tools without the need for significant upfront investment. The contract model should include various tiers and features designed to cater to small enterprises' diverse needs and budgets.

The prominent features in the Business Model include:

1. Contract Agreement:

A contract must be drawn between the company and the customer's company. The contract should highlight privacy protection and secure data transfer between the company and the customer. The period of the contract and the number of times the analysing is needed must be specified among other details.

2. Periodic Data Transfer

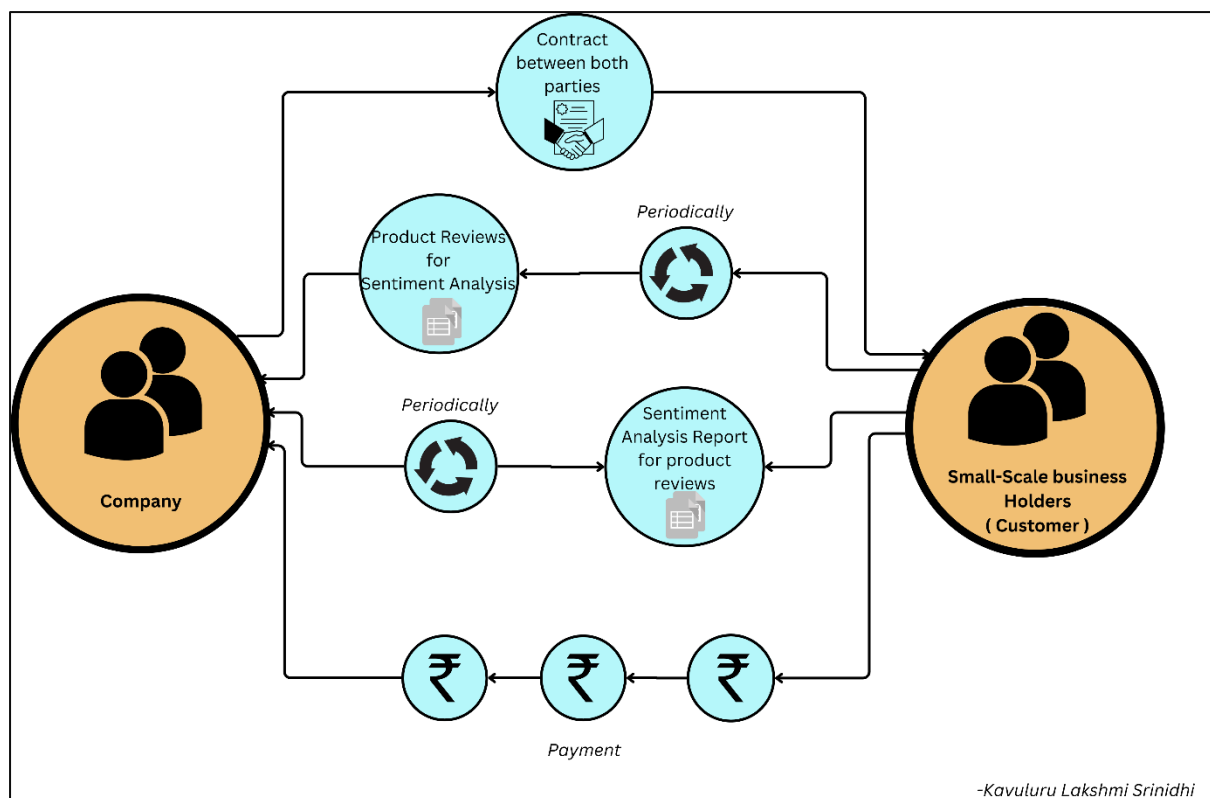
The customer company needs to give the product reviews for various products periodically as per the decided contract agreement.

3. Periodic Analysis Report

The Company must do proper Sentiment Analysis and give the report securely back to the customer company.

4. Monetary Agreement Fulfilment by the Customer

The customer must pay the money agreed by both the parties on time to the company.



9.0 Concept Generation

The concept revolves around crafting an efficient sentiment analysis company designed to meet the unique needs of small-scale businesses. This platform will analyse customer reviews for various products in a business with the help of Machine Learning (ML), thereby providing useful insights to improve customer satisfaction and the overall income.

Key features of this concept include:

- **ML-based Analysis:** Leveraging sophisticated machine learning algorithms to efficiently process and interpret customer feedback, enabling businesses to extract valuable insights from reviews.
- **Affordability:** Offering cost-effective solutions that align with the budgetary constraints of small businesses, enabling them to leverage advanced technology without incurring prohibitive expenses.
- **Efficiency:** Streamlining the review analysis process to save time and resources, allowing businesses to focus on core operations while still gaining valuable insights from customer feedback.

10.0 Concept Development

Building upon the initial concept, the development phase will involve the implementation of an efficient sentiment analysis for small-scale businesses.

Some of the important components of the concept development include:

- **Data Collection:** We need to collect the data (product reviews for various products).
- **Data Preprocessing:** Implementing preprocessing techniques to clean and standardize the collected data, to ensure consistency and reliability in sentiment analysis outcomes.
- **ML Models:** Using machine learning models for sentiment analysis to accurately classify the sentiment of customer reviews.
- **Report:** Develop an intuitive Report that presents important insights derived from sentiment analysis in a user-friendly format, facilitating easy interpretation and decision-making. A Sentiment Analysis Classifier can be provided to the customer company for usage, with maintenance support.

By adhering to these components of concept development, the sentiment analysis platform will emerge as a great tool for small-scale businesses to understand customers feedback quickly and have continuous improvement and sustainable growth.

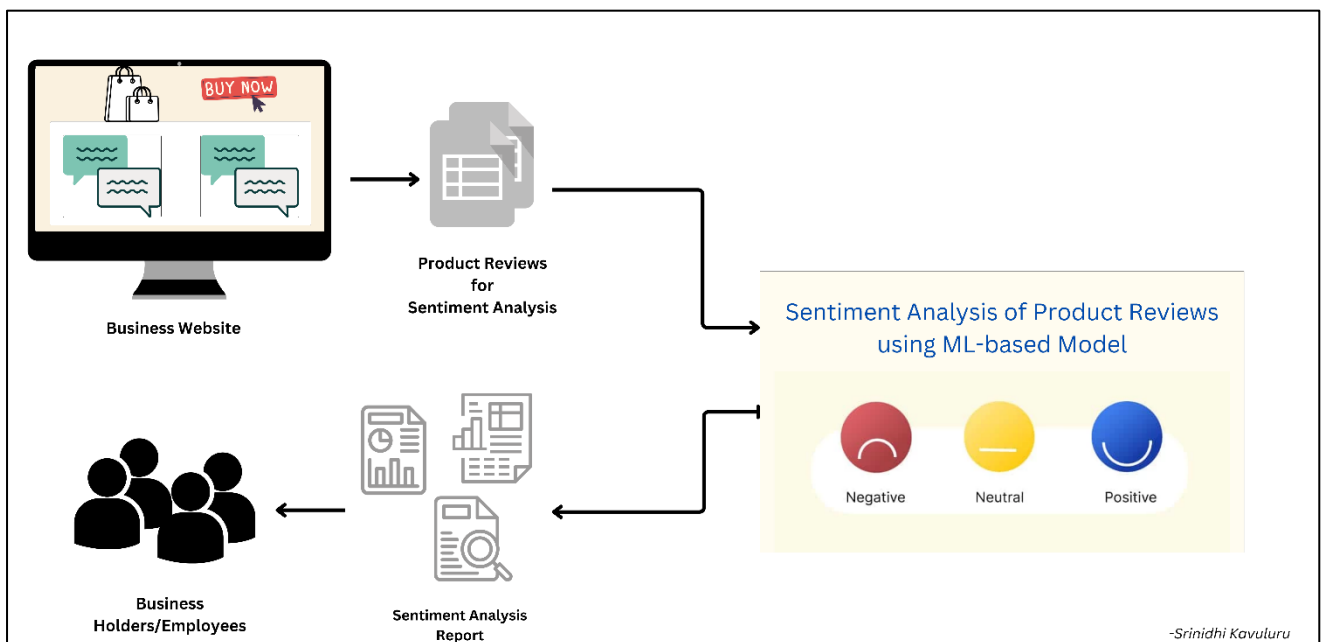
11.0 Final Product Prototype

11.1 Prototype Abstract:

The prototype will be developed ML team:

- **Data Ingestion:** A gateway to collect reviews consolidating data.
- **Preprocessing:** The preprocessing cleanses and standardizes text data. Employing techniques such as tokenization, stemming, and stop-word removal, the engine ensures data uniformity and enhances the accuracy of sentiment analysis results.
- **Sentiment Analysis Models:** Empowered by sophisticated machine learning algorithms, the sentiment analysis models dissect text data to classify sentiment with precision. Leveraging methodologies like natural language processing (NLP), sentiment lexicons, and deep learning, these models decipher the emotional nuances of customer reviews, enabling businesses to discern emerging trends and patterns. Models like Naive Bayes Classifier, Logistic Regression, BERT, can be used for the task.
- **Report:** Data Report is given to the customer company for enhancement, take advantage of positive feedback, and proactively address customer concerns. A Classifier can be build for the company to utilize further.

11.2 Schematic Diagram:



11.3 Prototype Development:

The prototype implementation will require a dedicated team working with dataset from a small-medium scale company. The team should develop a clear report along with a classifier for sentiment classification.

A simple and basic implementation is provided in below GitHub Link:
[https://github.com/SrinidhiKavuluru/FeynnLabs_Projects/blob/main/Sentiment_Analysis_Classifier\(Project3\)/Project_3_Feynn_Labs.ipynb](https://github.com/SrinidhiKavuluru/FeynnLabs_Projects/blob/main/Sentiment_Analysis_Classifier(Project3)/Project_3_Feynn_Labs.ipynb)

12.0 Product details

12.1 How Does It Work?

The platform functions by first collecting. Next, it employs a cleaning and preprocessing step to refine the text data. Subsequently, machine learning (ML) models are applied to classify the sentiment of the reviews. Finally, the insights derived from sentiment analysis are displayed on a dashboard for easy visualization and interpretation.

12.2 Data Sources:

The reviews of various products must be given by the customer company.

12.3 Algorithms, Frameworks, Software:

- The platform might utilize a range of tools and technologies including natural language processing (NLP), machine learning frameworks like Scikit-learn and TensorFlow, and sentiment analysis models such as Logistic Regression, BERT to facilitate accurate sentiment classification.

12.4 Team Required:

The development and maintenance of the platform needs a team of technical people having good knowledge of Machine Learning and Natural Language Processing and basic knowledge of web development for the development and maintenance of ML Models.

It is also required to have some who have good soft skills for customer interaction to ensure the successful execution of the project and its alignment with business objectives.

13.0 Financial Equation

Let us consider the price of the contract to be Rs. 10,000 per month. The cost of the product will include, money for the ML Team, a one-time investment for computers, and general maintenance.

Let us assume, the team is of 5 members with Rs. 70,000 salary each. Then,

$$\begin{aligned}\text{The cost per month for employees wage} &= 5 * \text{Rs. } 70,000 \\ &= \text{Rs. } 3,50,000\end{aligned}$$

Let the one-time investment and maintenance charges distributed per month per contract be equal to Rs. 10,000.

Then the total production cost = Rs. 3,60,000.

The Financial Equation is given by,

$$y = x(t) * m - c$$

where,

y = Total Profit,

$x(t)$ = Total sale as a function of time,

m = Price of the product,

c = production cost.

Substituting the values we get the financial equation as,

$$y = x(t) * 10,000 - 3,60,000$$

14.0 Conclusion

Implementing sentiment analysis using Machine Learning for small-scale businesses offers a transformative approach to managing and interpreting customer feedback. This technology provides a comprehensive solution to one of the most pressing challenges faced by small enterprises: understanding customer sentiment and responding to it effectively.

14.1 Future Implications and Opportunities

The integration of sentiment analysis in small businesses not only meets current needs but also opens doors to future opportunities. As ML and natural language processing (NLP) technologies advance, the accuracy and depth of sentiment analysis will improve, providing even more nuanced insights. Small

businesses can leverage these advancements to fine-tune their strategies further and stay relevant in a rapidly evolving market.

Moreover, the data generated from sentiment analysis can be used for predictive analytics, helping businesses anticipate trends and customer needs. This foresight can be instrumental in strategic planning and innovation.

In conclusion, the adoption of ML-powered sentiment analysis is a game-changer for small-scale businesses. It empowers them to transform customer feedback into actionable insights, leading to enhanced products, services, and overall customer satisfaction. The proposed business model, with its emphasis on accessibility, affordability, and efficiency, provides a robust framework for small enterprises to take advantage of the sentiment analysis. By doing so, they can make data-driven decisions that drive growth, competitiveness, and long-term success in their respective markets. This will thus serve as a catalyst for these small-scale businesses to grow and firmly mark their place in the market.