



# Linkpulse Analytics: LinkedIn Engagement and Sentiment Dashboard

Mrs.P Niharika<sup>1</sup>, Yerrogolla Swathivika<sup>2</sup>, Nellutla Anjali<sup>3</sup>, Seemran Kumari<sup>4</sup>, Mohammed Anwar<sup>5</sup>

<sup>1</sup>Assistant Professor, Department of CSE(Data Science), ACE Engineering College, Hyderabad, Telangana India

<sup>2,3,4,5,6</sup> Students, Department of CSE(Data Science), ACE Engineering College, Hyderabad, Telangana, India

Corresponding Author Email: swathivika1505@gmail.com

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## Abstract—

LinkPulse Analytics is a data-driven dashboard which will help you analyze post performance on LinkedIn and Audience Engagement using analytical techniques and natural language processing. LinkPulse uses Key Engagement Metrics (like Likes, Comments, Impressions, Shares) to measure how effective your Content is at engaging with its Audience. The dashboard provides an interactive interface built using Streamlit, and allows you to visualize how your Engagement metrics over time (which is a good way to identify Engagement trends and Performance patterns). Furthermore, in addition to using a quantitative approach, LinkPulse uses Sentiment Analysis to classify User comments into Positive, Negative, or Neutral Categories. Keywords extracted from User comments will be used to identify Frequently Discussed Themes and Audience Feedback. In addition, the dashboard can also be used to provide Competitive Benchmarking data across multiple LinkedIn Profiles, so you can compare your Engagement metrics against your Competitor's LinkedIn profiles. Overall, LinkPulse Analytics turns raw social Media data into actionable insights, which will help you optimise your Content Strategy and Improve Audience Engagement through Data Driven Decision Making.



## I. INTRODUCTION

Social media platforms (such as Twitter, Facebook and Instagram) have become critical tools for businesses to communicate with their employees, potential customers, partners and clients. Of these, LinkedIn has established itself as the dominant platform for professionals to network with each other while providing content to an audience of millions worldwide. As the number of posts created on LinkedIn continues to increase, understanding how well posts perform and how people engage with them are becoming essential factors in developing a data-driven content creation strategy. The majority of current analytics tools measure engagement using quantitative metrics like likes, comments and impressions. Although these metrics give an indication of the number of people who saw a post (the reach) and how many people accomplished the desired objective of seeing or reading a post (the visibility); they do not reveal anything about whether those individuals feel positively or negatively toward a post, nor do they provide qualitative information about what the user thinks of the post. User comments to posts contain qualitative information on user sentiment toward a post, but very little of that information is being used because there are no integrated analytical systems that can process text and provide the analyst with insight into how users perceive a post.

To overcome the limitations mentioned above, the proposal for a new functionality called LinkPulse Analytics will be put forward as a way to give you access to a full-featured dashboard that allows you to analyze engagement on LinkedIn and have an understanding of your audience's sentiment through data analytics and Natural Language Processing methods. LinkPulse Analytics will give you engagement metrics, sentiment analysis, keyword extraction, and interactive visualisations from one dashboard. It allows you to take social media data and translate it into useful information for evaluating how effective your content has been, comparing your performance against your competition, and optimising your content strategy for maximum audience engagement.

- LinkedIn serves as an effective means of connecting with other pros in your field and sharing helpful info with them throughout the year.
- Engaging with people via post engagement is the first step toward improving your content strategy.

- Engagement metrics are not a true reflection of your audience's feelings about your posts or their interest in continuing to follow you through the course of the year.

- Analyzing comments will provide insight into how your audiences feel about your posts; therefore, analyzing comment trends will help you know what content is resonating well or poorly with your audience.

- Using LinkPulse Analytics will allow you to view both comment and engagement data in one application, enabling you to analyze your posts for engagement and sentiment simultaneously.

## II. LITERATURE REVIEW

Engagement analysis, along with sentiment analysis of LinkedIn, represents a critical area within both social media analytics and data science. Through measurement of engagement metrics and word clouds created from user feedback, researchers can better understand how people are interacting with the platform and how their perception of an organization has changed as result of interaction on this platform. Ultimately, research in this segment of LinkedIn analysis aims to enable organizations and content creators to assess how well a piece was received by users and make informed, data-driven decisions regarding future content creation.

Historically, many different forms of methodologies have been proposed to study social media engagement. Prior to more advanced forms being explored, early approaches typically were predominately based on summarizing and analysing various types of metrics. For instance, (Smith et al., 2019), used only like, comment, view and share metrics; thus, they provided a quantitative way to measure how far a post had been shared and/or seen; however they did not provide qualitative analysis of user feedback (for example, using keyword) or accurately measure user sentiment.

In their research, Kumar and Sharma (2020) used NLP techniques for sentiment analysis of comments made on social media. The method created classifications for positive, negative, and neutral comments enabling a better understanding of the audience's opinion. However, the model struggled to interpret sarcasm, context-based, and informal



language, which is commonly found in social media communications.

Lee et al. (2021) analyzed the performance of LinkedIn content through analyzing engagement rates and determining what types of content had the highest level of engagement; however, the study failed to include any sentiment or keyword analysis, thereby providing less insight into how the audience perceives the content.

Brown et al. (2021) used TF-IDF and other methods to identify recurring themes in user feedback by using keywords. Their analysis identified common discussion points, but did not connect these insights with any engagement metrics, leading to a fragmented analysis of the user feedback.

Using Streamlit and Python, Patel & Mehta created a dashboard-based social media analytics platform in 2022, which provided both improved data visualization and user interaction via improved user interface. There were also no features for competitor benchmarking or sentiment analysis.

Shing & Rao developed a product in 2023 that enhanced the analytical insight of combining engagement metrics with sentiment analysis. However, their product experience problems such as scalability, adaptability across profiles, and real-time data processing.

While continuous improvements have been made within this space, limitations persist around the unified analysis, scalability, and ability to create actionable insights through existing solutions. To help address this challenge, a solution such as LinkPulse Analytics that provides a comprehensive platform for providing sentiment analysis, keyword extraction, engagement metrics and interactive visualizations via a single data source within a scalable environment will be valuable.

### III. METHODOLOGY

The LinkPulse Analytics system is an analytical tool built using data analytics and natural language processing technologies to evaluate engagements on LinkedIn and gauge the overall sentiment of the target audience. LinkPulse Analytics applies LinkedIn's post metrics and the sum of comments written by people on those posts to assess the performance of the content, how well the audience engages with the

content, and what sentiment is trending over time on those posts. The process used to create the LinkPulse Analytics dashboard follows several steps:

#### 1. Collecting Data

LinkedIn post-related data is obtained from publicly available data sources or through exported data analysis files. Collected LinkedIn post-related data includes the key performance indicators on the post level that measure engagement (Likes, Comments, Impressions, Shares, Engagement Rate, Created Date of the Post, and Content of the Comment) to establish a baseline on how to gauge the performance of a post and the behavior of the audience in relation to a post.

#### 2. Preprocessing Data

The data derived from the LinkedIn database may have incomplete or null field values, could have random values that affect data quality (noise), duplicate entries, or inconsistent formats. Therefore, data preprocessing is done prior to analysis so that the data can be cleaned and prepared for subsequent phases of analysis: Deletion of all duplicate or irrelevant records The treatment of null or incomplete data The cleaning and tokenization of comment text Normalization of Numerical Engagement Metrics Formatting of the data for Analytical and Visualization Processing These steps in data preprocessing help improve the data quality and ensure reliable analytical results.

#### 3. Feature Construction

In order to provide accurate results and improve the effectiveness of the analyses conducted on data and to provide meaningful benefit in the analysis, features will be created from the processed data which will be created from a variety of different processes. The specific features that will be extracted will include:

- a) Engagement Metrics - Likes, Comments, Shares, and Engagement Rate
- b) Time-based Features - Posting date and Frequency of Posting
- c) Text features derived from Comments will include Keywords and Sentiment Scores



#### d) Aggregated Metrics for Performance Comparison

Through Feature Construction users will have the ability to evaluate Engagement Patterns and Audience Reaction in a statistically relevant way.

#### 4. Model Selection and Analysis

User Comments and Engagement Data will be analyzed using Natural Language Processing Machine Learning methods. The following models and methods will be used for this analysis:

- a) Text will be preprocessed and Tokenized
- b) Sentiment Classification will be completed using Machine Learning methods
- c) Keyword extraction will be completed using Statistical Text Analysis Methods

Additionally, to ensure Sentiment Classification results are valid, the Data Set will be broken down into appropriate subsets.

#### 5. Model Evaluation:

Standard metrics are used to evaluate the accuracy and effectiveness of the sentiment analysis classification and the overall analytical output; classification metrics include:

Accuracy, Precision, Recall, F1-Score

Use of these metrics provides a way to test that the sentiment analysis process is providing reliable results

#### 6. Development of the Dashboard:

An interactive dashboard was created to display the analytical results; the dashboard includes:

- Display of performance metrics and engagement trend \* Visualization of the distribution of sentiment and frequency of keywords
- Competitor benchmarking ability across profiles
- Ability for users to interact with the dashboard via filters and charts that are dynamic The use of an interactive dashboard provides a means for users to easily interpret the insight and make data driven decisions.

#### 7. System Implementation:

This system has been developed in Python with the use of several libraries, including NumPy, Pandas, Scikit-learn, NLTK, and Streamlit. These libraries assist in performing several actions; thus, data preprocessing, the classification of sentiment, the extraction of features, and the visualization of LinkedIn engagement statistics.

The system has been designed to be simple to use through a web interface, which has been created using Streamlit, allowing users to upload their LinkedIn post data and view engagement trend information, the distribution of sentiment and keyword insights in an interactive manner.

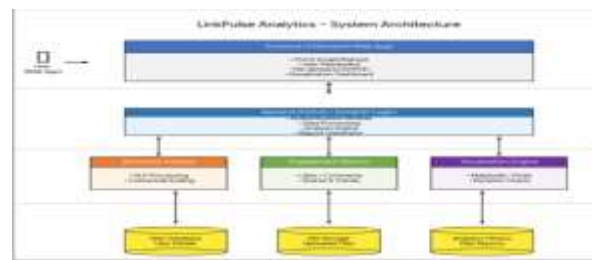


Figure 1: System Architecture

**Performance Evaluation:** The results outlined in Table 1 show the evaluation of multiple machine learning techniques focused on Classifying the Sentiment of User Comments on LinkedIn in the LinkPulse Analytics System (e.g., Naive Bayes, Decision Trees, Logistic Regression, and Random Forests). For each of these algorithms, a standard set of classification measures was used to gauge performance, including accuracy, precision, recall, and F1-score. Upon evaluation, the Random Forest algorithm demonstrated superior accuracy and precision compared to the other algorithms. Its performance advantage is largely the result of Random Forests ensemble method for combining multiple tree models which reduces overfitting while improving generalization. Thus, Random Forests are able to identify much more complex relationships within textual data than others thereby providing a much higher degree of accuracy for Sentiment Classifications than other algorithms.



Based on the Evaluation results, the Random Forest model will be used for the final implementation of the Sentiment Analysis Module to generate reliable and consistent analysis of the Sentiment of users commenting on LinkedIn as they will have access to all content (e.g. Pages) of links posted.

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
Naïve Bayes	82.6	81.4	80.9	81.1
Decision Tree	84.8	83.5	82.7	83.1
Logistic Regression	88.2	87.0	86.6	86.8
Random Forest	91.0	89.9	89.2	89.5

**Table 1:** Performance Evaluation

	Predicted Positive	Negative	Neutral
Positive	140 (TP)	6	4
Negative	7	132 (TP)	5
Neutral	8	6	125 (TP)

**Table 2:** Confusion Matrix

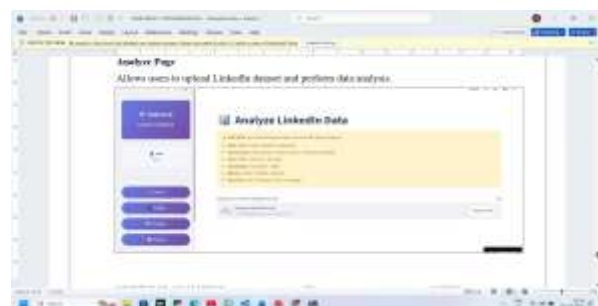
A confusion matrix can be used to verify the effectiveness of a sentiment classification system by checking how well the predicted and actual classifications matched up with each other. True positives are found on the positive diagonal and represent the sentiment was classified correctly by the sentiment classification system. The true number of LinkedIn comments that are classified correctly represents the overall quality of the sentiment analysis component.

#### IV. RESULTS AND DISCUSSION

LinkedIn Engagement Analytics (Link Pulse) is an advanced capability using data analytics and natural language processing technology for evaluating how well content is being performed on LinkedIn, as well as how audiences are engaging with it. Link Pulse analyzes the data from a LinkedIn post, as well as all of the user comments associated with the post, to as



positive, negative and neutral classifications for each user comment associated with the LinkedIn post. These results indicate that Link Pulse successfully identifies trends in engagement and produces accurate analyses of audience sentiment, thereby providing insights that can help improve LinkedIn content strategy.



The first page that a user sees when they use the LinkPulse Analytics system is called the Analyze Page, where they can upload engagement datasets from LinkedIn and starts the process of analysing it. The analyse page includes clear guidance to tell users how to set up their datasets so that they have the correct format and column structure needed for LinkPulse to process their data correctly. Users can upload their files to the Analyze Page either by dragging and dropping or by browsing their computer. After the user has uploaded their dataset to the LinkPulse system, LinkPulse will validate the dataset's information before performing more in-depth analysis, such as analysing engagement metrics and sentiment on that dataset. The first page users see when they come into this system is the Analyze Page, and that page is what starts the conversion of raw data from LinkedIn into structured, actionable information/insight.



The second output screen is the Visualization Dashboard, which presents processed data through pictorial display (charts) and graphical information (e.g., engagement metrics distribution, correlation matrix) showing how likes, comments, and shares relate to each other. The dashboard provides visual representations of top-performing posts and overall engagement distribution. This permits users to rapidly identify patterns within engagement data and conduct analyses of that data easily with the aid of visual representation.



The Third screen of the output shows important information of the main page of insight. The output contains information about the best posts based on likes, along with an overview of engagement across posts in the form of likes, comments, and shares. Lastly, it has quick information providing users with the overall performance and user engagement of posts through total likes, comments, and shares.

The entire system developed is an analytics-based application which can take unstructured raw data and turn it into meaningful insights via visualizing the data. It consists of multiple modules including those used for data collection, cleaning, analysing, and presenting on dashboards. Interactive charts offered within the system include engagement distribution; correlation analysis; and highest performing pieces of content as well as summary statistics are also offered within the system. The platform is intended to allow users to understand patterns simply, monitor their performance, and make decisions about their business based upon the information provided by the analytics platform.

## V. CONCLUSION

Through the analysis of LinkedIn engagement and audience sentiment, LinkPulse Analytics serves as an effective example of how businesses can apply Data Analytics and Machine Learning to gain valuable insights about their target audience and improve their marketing strategies by optimizing their content resources based on analytics derived from currently available engagement metrics (Likes, Comments, Shares) and Engagement Rate; while simultaneously utilizing Sentiment Analysis to categorize user comments as Positive, Negative, or Neutral. This analysis provides users with the ability to visually display trends within their posts via an Interactive Dashboard that allows users to compare and contrast the performance of multiple posts simultaneously. Coupling Engagement Analysis with Sentiment Classification and Visualizations on a single, unified platform enables LinkPulse Analytics to turn raw LinkedIn data into actionable insights that can assist businesses in developing improved, data-driven personalized strategies for honing in on their target audiences.

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