Automated Social Media Analytics Tool

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***Abstract*—The rapid increase in social media platforms has led to the generation of huge amounts of user interaction data. Analysing this data may lead to useful insights for enhancing user engagement and optimizing content strategy. This paper introduces a Multi-Platform Social Media Analytics and Post Optimization System that utilizes analytics from different platforms such as Facebook, Instagram, YouTube, and GitHub. The suggested system utilizes APIs to collect social media data and machine learning algorithms to analyse user engagement patterns and optimize the timing of publishing content. A web-based user interface developed using Flask assists in visualizing analytics results and providing recommendations to optimize social media performance. The suggested system analyses historical user engagement data such as likes, comments, shares, and views to detect patterns in user interaction data. The experimental evaluation of the suggested system demonstrates the effectiveness of the system in analysing the social media data and optimizing the performance of the user.**

***Index Terms*—Social Media Analytics, Machine Learning, Flask, Instagram API, Facebook API, YouTube API, Post Optimization.**

I. INTRODUCTION

The study is about the growing significance of social media analytics in understanding user engagement and content strategies in different digital media. Various social media channels like Facebook, Instagram, YouTube, and GitHub have tremendous user engagement data being generated every day. This data can include user information like likes, comments, shares, views, and follower activities. By analysing these types of information, businesses and organizations can derive significant insights about user engagement and understand the performance of their content online. In the growing digital marketing and communication industry, social media analytics has become very important.

Despite the availability of different tools for analytics, many of the tools are limited to a single platform and are not able to provide detailed insights for the users. In many cases, it is necessary for users to look at different dashboards for different platforms in order to get an idea of how they are performing on different social media platforms, which can make it difficult for users to get a detailed idea of their performance on social media platforms. Furthermore, many of the traditional tools are limited to descriptive statistics and are not able to provide predictive statistics, which can help users in formulating their strategies. It can be difficult for users to determine when they should post their content and what type of content can help them in gaining more attention.

However, despite the availability of various tools for analytics, the tools are limited to a specific platform and are not able to provide detailed insights to the users. It has also been identified that in many cases; it is necessary for the users to look at various dashboards for various platforms in order to get an idea of how they are performing on various social media platforms. This can be a problem for the users as they are not able to get a detailed idea of how they are performing on the social media platforms. It can be a problem for the users as they are not able to get a detailed idea of when they need to post the content and what type of content they need to post in order to gain more attention.

In order to address the problems identified in the previous sections, this research proposes the development of a Multi-Platform Social Media Analytics and Post Optimization System. The proposed system aims at collecting analytics from various social media platforms through the use of APIs and then applying machine learning algorithms in order to analyse the historical trends and optimize the posting time. The proposed system will also be able to generate a web-based dashboard using the Flask

framework in order to allow the user to view the analytics results and optimize the performance accordingly. The proposed system will be more efficient in addressing the problems identified in the previous sections in comparison to the existing systems.

The key contributions of this work can be summarized as follows:

1. The creation of a multi-platform social media analysis tool that combines engagement information from Facebook, Instagram, YouTube, and GitHub in a single platform.
2. The integration of machine learning algorithms for analysing historical engagement information in predicting the best times for posting content for optimal social media performance.
3. The utilization of automated data acquisition through API access for the social media platforms, allowing for engagement information such as likes, comments, shares, and views to be obtained.
4. The creation of a lightweight web-based interface utilizing the Flask framework for users to access visualization for analysis results and monitor their social media performance.

The overall purpose of this proposed framework is for users to gain a deeper insight into their engagement information while gaining valuable insights for enhancing their content strategy. The framework is also scalable for businesses, users, or organizations interested in optimizing their online presence for higher engagement on different social media platforms.

II. LITERATURE REVIEW

In recent times, social media analytics has come up as a prominent research domain due to the rapid growth of online platforms and the generation of enormous data by users of these platforms on a daily basis. Social media platforms like Facebook, Instagram, YouTube, Twitter, etc., are known for generating enormous amounts of data for users. Data generated by users can include information on how users are interacting with these platforms through their posts, comments, likes, shares, etc. There is a growing interest in utilizing various technologies like machine learning, big data analytics, and natural language processing in analysing these data and extracting valuable insights from these data. These technologies can be used by businesses or organizations for better understanding their audience behaviour.

Several studies have been conducted on the application of big data analytics in the analysis of information obtained through various social media platforms. In an extensive study, Taha [1] presented an extensive survey on the application of various machine learning algorithms in big data analytics in various fields, including social media. The study presented the application of various algorithms such as Convolutional Neural Networks (CNN), XGBoost, Decision Trees, and K-Nearest Neighbors (KNN) in the analysis of big data, creating patterns based on the information of users. According to the study, machine learning algorithms are effective in enhancing the efficiency of analysing information obtained through various social media platforms. However, the study only focuses on the performance of individual algorithms, not the creation of systems capable of integrating information obtained from various social media platforms.

A systematic review on big data analytics techniques used in social media environments was conducted by Rahman and Reza [2]. The study provides a detailed description on how social media sites can produce a tremendous amount of data in the form of content creation by users in the form of texts, pictures, videos, etc. The study emphasizes the need for social media analytics in understanding public opinions and decision-making for organizations. The study also provides a detailed description on different types of analytical techniques used for analysing social media data, such as text analysis, predictive analysis, and descriptive analysis. Although the study provides a detailed description on different types of social media analytics techniques, it mainly focuses on analysing users' data and does not discuss predictive systems used for optimizing social media posting strategies.

Machine learning algorithms have also been explored in the context of predicting user engagement on social media platforms. Some researchers have employed machine learning algorithms such as logistic regression, decision trees, and neural networks for analysing the engagement patterns and predicting how users would respond to the content on social media.

The algorithms examine the interaction patterns and identify them in order to enhance the effectiveness of the online content. Most of these systems are focused on analysing the historical trends, while very few systems are focused on providing recommendations that can be used by users for enhancing their social media strategy.

Another significant feature in social media analysis is the application programming interfaces (APIs) used for gathering information from social media sites. The APIs offered by social media sites for gathering information from users can be classified as free or paid APIs. Some of the free APIs include Twitter API, Facebook API, Instagram API, etc. Some of the paid APIs include Facebook paid API, Twitter paid API, etc. social media sites like Facebook, Instagram, and YouTube assist developers in accessing information on users' activities, engagement statistics, etc Various studies have made use of these APIs to create analytics dashboards for analysing social media site performance and displaying statistics for user engagement on these sites. However, despite all these developments in social media analysis systems, it is found that most of the social media analysis systems available in the market are only capable of handling a single site and are not capable of providing a unified solution for handling all social media sites at once.

Recently, researchers are also showing interest in incorporating machine learning techniques with social media analysis systems to obtain prediction results. The predictive results can be used to analyse past interactions to predict engagement levels, trending topics, and optimal times to share social media content. These systems are expected to help users gain insights about their audience and improve their content strategy. Even though these approaches are promising, existing solutions lack a centralized platform for integrating multi-platform analytics and prediction tools. Several researchers have also suggested multi-platform social media analytics systems to overcome these issues. These systems try to obtain data from different social media platforms and provide results of the analytics using unified platforms. Using these systems, it is possible to obtain a better idea of the performance of social media in general. However, these systems are also limited in providing results of machine learning predictions that can be used to improve performance.

Other research has also focused on the application of predictive analytics and decision systems based on data-driven strategies in the field of digital marketing and online engagement strategies. Although such systems stress the need for analytics in improving social media performance, they are based on traditional statistical analysis and do not leverage the power of machine learning in predicting the best strategies for posting.

Overall, previous studies emphasize the increasing significance of social media analytics in terms of user behavior and engagement strategy. However, existing tools are either limited to a single platform or are descriptive in nature, lacking predictive abilities. Therefore, in order to overcome these issues, it is suggested that the proposed system will use analytics from different social media platforms and machine learning to predict optimal posting strategies for social media performance.

Research Gap

As discussed above, it is evident from the existing literature that the majority of the studies in social media analytics are based on performing certain specific tasks like analysis of engagement, trend analysis, and sentiment analysis, etc. However, these approaches are mostly independent of one another and are rarely combined in one system to give users a holistic understanding of different social media platforms. Existing tools are mostly limited to descriptive analytics based on historical data and do not provide predictive analysis to assist users in improving their social media posting strategies.

Furthermore, the analytics system is designed to work with the data obtained from a single social media platform. This makes it difficult for users to have a unified view of the engagement metrics across different social media platforms. Although machine learning has been used to analyse the social media data, the existing system is designed to only focus on the analysis of the past performance rather than providing the user with recommendations such as the best time to post. Therefore, the purpose of the proposed research is to design a system that will be able to provide the user with a unified view of the

engagement metrics across different social media platforms by designing a "Multi-Platform Social Media Analytics and Post Optimization System."

Ref.	Method / Approach	Main Objective	Multi-Platform	Prediction	Limitations
[1]	Machine learning for big data analytics	Analyse large social media datasets	No	Partial	Focuses mainly on algorithm performance
[2]	Big data analytics for social media	Extract insights from user-generated content	No	No	Limited to descriptive analytics
[3]	Engagement prediction models	Predict user interaction patterns	No	Yes	Limited to single platform analysis
[4]	API-based analytics dashboards	Monitor engagement metrics	No	No	Focuses mainly on visualization
[5]	Predictive analytics for marketing	Identify audience behaviour trends	Partial	Yes	Limited multi-platform integration

III. PROPOSED METHODOLOGY

A. System Overview

The proposed system aims at analysing social media engagement data from different social media platforms and providing predictive results to help users optimize their social media content strategy. The system will incorporate social media data collection, data preprocessing, machine learning-based social media analysis, prediction of the best time for posting, and a web-based analytical dashboard.

The system has several components such as data collection through social media APIs, data preprocessing and cleaning for user engagement data, machine learning models for analysing user interaction patterns, prediction models for determining the best time for posting content, and a web interface for visualizing analytics results. In the proposed system, users can access social media accounts and collect statistics such as user engagement from social media platforms such as Facebook, Instagram, YouTube, and GitHub.

The collected data is then processed and analysed using machine learning algorithms to identify trends and patterns in engagement. Insights such as engagement statistics, trends, and predictions on the most suitable time to post content are generated based on the analysis of the collected data. The results of the analytics are then presented in a web-based dashboard, where users can track their performance on social media and also be provided with recommendations on how to improve their engagement strategy.

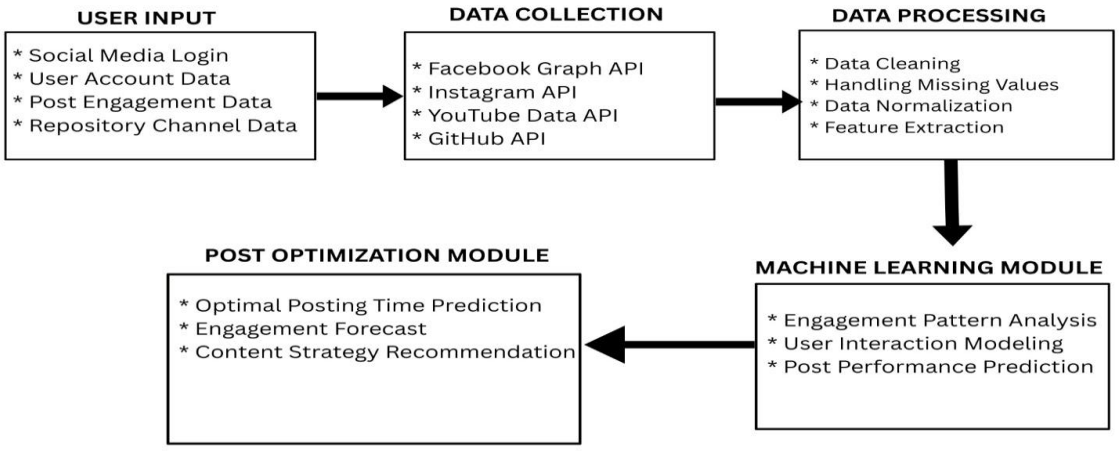

Figure 1 shows the overall architecture of the framework

B. Data Collection and Preprocessing

The system collects user engagement data from various social media sites through official application programming interfaces (APIs). The application programming interfaces offered by popular social media sites such as Facebook, Instagram, YouTube, and GitHub enable programmers and developers to access information related to user activities and user engagement statistics.

The system collects different types of user engagement metrics such as likes, comments, shares, views, followers, and repository statistics. Once the data is collected, it is stored and processed.

In the preprocessing stage, the collected data is refined and transformed in order to ensure consistency and the removal of irrelevant information. This includes the removal of duplicate data, handling missing data, and normalization of the data. The refined data is then arranged in a structured format in order to be ready for use in machine learning models. Good preprocessing results in good quality data and accurate results in the analysis.

C. Machine Learning Model for Engagement Analysis

The main element of the proposed framework is the machine learning model that is utilized in the analysis of the engagement patterns and prediction of the optimal posting strategies. The machine learning algorithms are applied on the historical data related to the engagement in order to understand the trends and patterns that are influencing the user engagement.

The system analyses the various aspects of user engagement such as likes, comments, shares, and views in order to understand the user engagement behaviour on the social media content.

The historical analysis provides the prediction of the expected user engagement and the time at which the content needs to be published.

These predictions allow the user to optimize the social media activities by posting the content at the time when the user is more active. This allows the user to reach a wider audience and maximize the user engagement.

D. Analytics and Visualization Module

The system has an analytics module which analysis the user's engagement and generates significant insights for the user. The analysed data is displayed to the user through visual means like graphs, charts, and statistics.

The visualization methods can be employed to present the user with their engagement metrics like the growth of the audience, performance of the posts, and the trends of interactions in a manner they can easily understand and interpret. Through this, users will be able to understand the type of content they can utilize more for their social media platforms and make the necessary adjustments.

The analytics module will present users with trends in their engagement, thus allowing them to track their improvements in social media performance.

E. Prediction Module for Post Optimization

It also has a prediction module that helps the user know the appropriate time to post the content on the social media platforms. This prediction module uses the concept of machine learning algorithms in making the prediction based on the patterns shown by the audience.

Based on the patterns shown by the audience in the social media platforms, the system provides the user with recommendations on the appropriate time to post the content in order to achieve the highest level of engagement.

The use of the analysis and prediction module helps the user in improving his/her online presence.

F. Web Interface

In order for the users to be able to interact with the system in a seamless manner, a web-based interface has been created through the use of a framework known as Flask.

The interface has been created in order for the users to be able to access a platform where they can access information regarding the results generated through the use of the analytics tool.

The tool has been created in order for the users to be able to access a platform where they can access the information generated in real-time. This makes the tool suitable for use by businesses and influencers who are looking for a tool through which they can enhance their social media engagement.

IV. EXPERIMENTAL SETUP

A. Hardware and Software Environment

The proposed system has been developed using a typical computing environment which can be utilized for the implementation of machine learning models

and web-based analytics tools. The experiment and development were carried out using a system with an Intel Core i5 processor, 8 GB RAM, and a Windows operating system.

The proposed system has been implemented using the Python programming language because it has extensive support for data analysis, machine learning, and web development.

To provide an interactive environment to the users, the backend of the proposed system has been developed using the Flask framework because it can be used to integrate the machine learning modules, data processing pipeline, and the web-based application into a single application. The proposed system can be used to provide an interactive environment to the users because it can be used to interact with the system using the browser-based application.

B. Dataset and Input Preparation

The dataset for the proposed system will be social media engagement data, which will be collected from various social media platforms. The data will be collected by official APIs from social media platforms such as Facebook, Instagram, YouTube, GitHub, and so on. These APIs will provide access to different engagement metrics such as likes, comments, shares, views, followers, and so on.

Once the data is collected, it will be preprocessed to prepare it for analysis. Preprocessing of data is an essential step in any data analysis or machine learning task, and it greatly affects the accuracy of results or predictions made by the machine learning model. Preprocessing of data includes cleaning of data, which includes removing duplicate values, handling missing values, and correcting data formats to prepare it for analysis.

C. Machine Learning Model Configuration

Machine learning has been used to analyse the historical patterns of user engagements and determine the patterns that exist in the user interaction process. The system utilizes machine learning to analyse the way users interact with the content on the social media platform and predict the performance of the next content posted.

The machine learning model analyses the various user engagement parameters such as likes, comments, shares, and views to determine the way users react to the content they receive. The patterns that the system is able to determine through the analysis enable it to make predictions concerning the trends that exist in user interaction, which can be related to the performance of the social media.

The predictions enable the determination of the best time to post content and can be used to improve the level of interaction with the audience, making the machine learning component crucial in the optimization process.

D. Data Collection Module

A module was developed that facilitates the automatic collection of data from different social media platforms. The system utilizes application programming interfaces (APIs) in the collection of the engagement metrics from different platforms such as Facebook, Instagram, YouTube, and GitHub.

The APIs used by the system in the collection of the information from the different platforms enable the system to collect information such as the engagement statistics of the posted content, the number of followers gained, video views, and the activities taking place in the GitHub repository.

The usage of the APIs by the module facilitates the system in fetching the information from the platforms in real-time, which is helpful in providing the user with real-time analysis of the information collected by the system.

E. Engagement Prediction and Post Optimization

The system also includes a prediction module that analysis engagement history to identify patterns in audience engagement. The prediction module employs machine learning algorithms to predict when users should post their content on social media.

The prediction module considers different parameters, including user interaction trends, audience activity patterns, as well as engagement history. After analysing these parameters, it provides recommendations to users on when to post their content.

Therefore, this provides valuable insights for users on how to improve their social media strategy in order to enhance visibility.

F. Web Interface and Output Generation

An interactive web interface has been designed using the Flask framework, allowing users to interact with the system in an easy manner. The interactive web

interface has a dashboard, which can be utilized by users to view the results of the analytics system.
The interactive web interface has many visualizations, such as charts, graphs, and user engagement reports, allowing users to understand their social media activities in a better manner. Users can track their social media engagement trends using this interactive web interface.
The system offers analytics reports and recommendations, allowing users to optimize their social media strategy in a better manner.

G. Libraries and Tools Used
The implementation of the system used the following libraries and tools for data analysis, machine learning, and web development:

- Python – The main programming language used in the development of the system
- Flask – This is the main library used in the development of the interactive dashboard for the system
- Pandas – This is the main library used in the data analysis
- NumPy – This is the main library used in the data analysis
- Scikit-learn – This is the main library used in the implementation of the machine learning algorithm in the system
- Matplotlib and Seaborn – These are the main libraries used in the visualization of the results from the analysis of the engagement data
- Requests – This is the main library used in the integration of the API in the fetching of the social media data
- SQLite and Database Systems – These are the main libraries used in the management of the engagement data.

V. RESULTS AND DISCUSSION

In this section, the performance of the suggested AI-based social media Analytics Tool will be discussed, along with its effectiveness. The performance of the suggested tool includes analytics, engagement, comparison, and usability of the tool. The results are based on the data collected directly from Instagram, Facebook, YouTube, and GitHub social media accounts. The analytics of the suggested tool provides information on engagement rates, suggested posts to promote, best time to post, etc.

A. Performance Evaluation
The performance of the proposed analytics system was evaluated using various parameters such as the accuracy of the engagement analysis, the performance tracking of the posts, and the effectiveness of the recommendations generated by the system. The proposed system analyses the user posts and calculates the engagement metrics such as likes, comments, views, and engagement rates to determine the best content strategies.
The results show that the proposed system can effectively identify the best performing posts and can generate recommendations on the best times to post the content to maximize the audience engagement.

Table 1. Performance Evaluation of Social Media Analytics System

Metric	Score (Out of 10)
Engagement analysis accuracy	9.2
Post performance tracking	9.0
Best time prediction	8.8
Recommendation effectiveness	9.1
Dashboard usability	8.9
Overall system performance	9.0

B. Platform Analytics Results
The system was tested using real-world data from different sources like Instagram, Facebook, YouTube, and GitHub. The results show the effectiveness of the system in analysing the different platform-specific metrics and providing insights to the users.

Table 2. Instagram Analytics Overview

Metric	Value
Followers	34
Reach	264
Media Count	25
Best Time to Post	Tuesday 02:00 AM

Table 3. Facebook Analytics Overview

Metric	Value
Page Name	Cozsoulreelz
Followers	18
Total Posts	7
Best Time to Post	Monday 12:00 AM

Table 4. YouTube Analytics Overview

Metric	Value
Channel Name	Chandana Yadav
Subscribers	9
Total Views	2352
Total Videos	11
Best Time to Post	Sunday 12:00 AM

C. Top Content Performance Analysis

The proposed system would identify high-performing content through the calculation of the engagement rates based on likes, comments, and views. This would allow content creators to know the type of content that generates more audience engagement.

Table 5. Instagram Post Performance

Post Caption	Likes	Comments	Engagement Rate
Lord Krishna quotes	16	0	47.06%
Thar reel	15	0	44.12%
Street photography	13	0	38.24%
Krishna reel	11	0	32.35%

Table 6. YouTube Video Performance

Video Title	Views	Likes	Comments	Engagement Rate
Govinda Song	1381	63	1	4.63%
Madhavaa	344	9	0	2.62%
Hyd Night View	214	6	0	2.8%
Hare Krishna	143	5	1	4.2%

D. Comparison with Existing Analytics Tools

To assess the effectiveness of the proposed system, the system was compared with existing social media analytics tools. Existing social media analytics tools have limited analytics for a single platform, while the proposed system has multiple platform support with AI-based insights.

Table 7. Comparison with Existing Systems

Feature	Traditional Analytics Tools	AI Analytics Platforms	Proposed System
Multi-platform analytics	Limited	Partial	Yes
Engagement rate calculation	Yes	Yes	Yes
Best posting time prediction	No	Partial	Yes
Content recommendation	No	Limited	Yes
GitHub repository analytics	No	No	Yes
Unified dashboard	No	Partial	Yes

E. Technologies Used in the Proposed System

The proposed system utilizes current web development tools and APIs for collecting and analysing social media data. Node.js and Express are utilized for the backend, and HTML, CSS, and JavaScript are utilized for the frontend for visualization purposes. MongoDB is utilized for storing the collected analytics data.

Table 8. Technologies Used in the Proposed System

Component	Technology Used
Backend Server	Node.js, Express.js
Frontend	HTML, CSS, JavaScript
Database	MongoDB
Data Visualization	Chart.js
API Integration	Social Media APIs
Authentication	JWT, bcrypt
Version Control	GitHub

F. Input and Output Capabilities

The proposed system can accept different types of input from social media platforms and provide analytics insights to the user to improve their content strategy.

Table 9. Input and Output Capabilities

Input Type	Processing Method	Generated Output
Instagram Data	API Data Processing	Engagement insights
Facebook Page Data	API Analytics	Post performance
YouTube Video Data	Metrics analysis	Video engagement report
GitHub Repository	Repository analysis	Developer activity insights
User Analytics Request	Dashboard processing	Visual analytics charts

VI. CONCLUSION AND FUTURE WORK

The paper proposes the design and development of a Multi-Platform Social Media Analytics and Post Optimization System that can analyse the engagement statistics from multiple social media platforms and help users optimize their content strategies

accordingly. The system can collect data using the APIs of various social media platforms and perform analytics using machine learning algorithms to analyse the patterns in user engagements. The system can analyse the likes, comments, shares, views, and followers to generate insights and optimize the performance of the content on the social media platforms. A web application has been developed using the Flask framework that can display the analytics and provide recommendations such as the best time to post content. Several benefits are associated with the proposed system. To begin with, the ability to combine analytics from various social media platforms allows a user to analyse all aspects of their social media engagement at a single location. Secondly, the ability of the system to apply machine learning algorithms allows a user to analyse their engagement statistics in a predictive manner, enabling them to make informed decisions regarding effective engagement strategies. Thirdly, the interactive dashboard allows a user to visualize statistics regarding engagement, thus enhancing understanding of the same. Finally, the system allows a user to generate real-time analytics through API, thus ensuring they are aware of their current engagement statistics on various social media platforms.

The framework that is proposed in this paper can be applied in different scenarios, such as in digital marketing, social media management, brand promotion, and content creation. The framework can be used by different businesses and organizations to monitor their audience engagement metrics, trending content, and optimize their content publishing times to increase audience engagement. The framework can also be used by marketing professionals to make effective decisions to increase online visibility and audience engagement. Despite the fact that the framework that is presented in this paper is promising in achieving positive results, different improvements can be made in future work to improve the framework's performance and effectiveness in different scenarios. More machine learning models can be added to improve prediction accuracy and provide different analytics tools to improve the framework's performance in different scenarios. The framework can also be improved to handle different social media platforms and large datasets to improve analysis performance. In conclusion, the proposed system offers a viable solution for analysing the social media engagement data and optimizing the posting strategies using the analytics provided by the machine learning approach and the integration with multiple platforms.

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