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Enhancing User Interface and Experience of the Bukalapak Application: A Sentiment Analysis Approach for Improved Usability and User Satisfaction in Indonesia's E-Commerce Sector

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Abstract

In this research, we utilize sentiment analysis to refine the User Interface (UI) and User Experience (UX) of the Bukalapak application, a leading online trading platform in Indonesia. We focus our scrutiny on 4,462 reviews related to the UI within a larger dataset of 246,947. Nearly a third of these critiques express dissatisfaction, predominantly pointing out issues related to the UI design and its functionality. The critiques underscore the potency of sentiment analysis as a tool to uncover areas in user-centric design that need improvement. To address these issues, it is necessary to incorporate user feedback and sentiment analysis into the design workflow, thus enabling a more in-depth comprehension of user needs and facilitating more effective service enhancements. Embracing a user-centered methodology allows UI fine-tuning, leading to better functionality and increased user contentment. Our investigation reveals a positive link between design refinements and usability ratings, indicating improved user experience satisfaction. To summarize, this research highlights the essential contribution of user feedback and sentiment analysis in spotting and correcting UI shortfalls, thereby augmenting UX and contributing to the triumph of platforms like Bukalapak within Indonesia's dynamically changing e-commerce environment.

Keywords: sentiment analysis; user interface; user experience; user-centric design; online marketplace

1. Introduction

Technology maintains a pivotal role in the dynamic landscape of the Fourth Industrial Revolution, shaping critical aspects of life. The rapid progression in information technology heightens the significance of the internet and computers, expanding their reach into vital sectors like remote work and instant knowledge accessibility. This trend is distinctly visible in Indonesia, marked by a consistent rise in internet utilization, enabled by digital platforms encompassing e-commerce and social networking sites.

As digital transformation accelerates, traditional commerce paradigms are experiencing a substantial shift toward online marketplaces. This transition highlights the need for enhanced user experiences and polished User Interfaces (UI) within e-commerce platforms. A prime example is Bukalapak, a significant entity in Indonesia's online commerce. Despite its prominent status, Bukalapak has seen a decline in visitor volume relative to its rivals as shown in Figure 1. This study explores and counteracts potential reasons for this decline, focusing primarily on the user interface and experience.

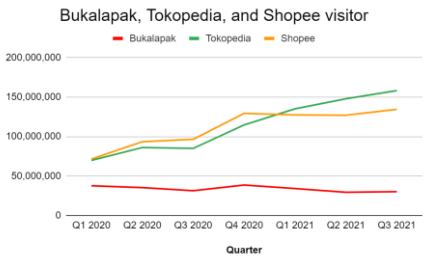

Figure 1. Comparison of E-commerce Visitors[1]

Various methods exist for evaluating e-commerce platforms' performance, including analyzing user feedback and sentiments. This tactic provides insights into user experiences and satisfaction rates, offering a transparent view of the platform's efficacy. This research adopts this strategy for Bukalapak, harnessing user reviews from the Google Play Store to better understand the app's functionality [2].

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Our methodology incorporates sentiment analysis on an extensive collection of 246,947 reviews, focusing specifically on 4,462 reviews pertinent to the UI aspect. Originating from Neuro-linguistic Programming (NLP), sentiment analysis — also known as emotional analysis — is designed to identify, extract, and categorize emotions and opinions hidden within textual data [3]. This method reveals the emotions, attitudes, assessments, and sentiments concealed within the data and illuminates users' opinions about the quality of services, individuals, organizations, or subjects. By undertaking this, our study endeavors to deepen our understanding of user experiences on Bukalapak's platform, thereby identifying potential areas for enhancement and improvement.

The examination of user perspectives and responses on platforms such as Google Play and social media through sentiment analysis has emerged as a powerful tool. It aids in understanding people's positive or negative emotions concerning a wide array of entities, including products, issues, individuals, services, events, subjects, and other facets [4].

The rapid spread and impact of sentiment analysis have catalyzed a swift expansion in associated research endeavors. Approximately 30 companies have embraced sentiment analysis in the United States to gauge public sentiment regarding their offerings and services [5].

By employing sentiment analysis, we can unearth critical insights about the strengths and weaknesses of UI design, consequently identifying areas ripe for potential improvement [6]. This evaluation not only illuminates user sentiments but also uncovers specific elements of the UI that elicit either positive or negative commentary. Such insights are crucial in enhancing the overall user experience and fine-tuning the UI design to meet user requirements

Numerous prior studies have investigated the impact of user interface, usability, and sentiment analysis on user experience in different contexts. Previous research on the Shopee application underscored the significant influence of usability on user experience and proposed recommendations for user interface redesign [7]. Additional research focused on sentiment analysis of reviews for Formaggio Coffee and Resto, underscoring positive and negative sentiments regarding food and general elements [8]. Another study focused on the sentiment surrounding the Female Daily application, revealing both positive and negative ratings on the Google Play site. However, it stopped short of proposing specific UI enhancements [9]. The Kudo mobile application's user experience (UX) was analyzed, emphasizing the need for UI enhancements based on established UI design principles [10]. Additional research concentrated on aligning the E-auction application process with UI design, emphasizing the significance of interface design for optimal user-system interaction [11]. Another study determined customer sentiment across leading e-commerce platforms, unearthing high levels of negative sentiment for Bukalapak, Tokopedia, and Elevenia on social media. Despite these findings, this study did not extend to prototype development based on the sentiment analysis results [12]. While past research has underscored the role of UI and usability in augmenting user experience, many studies have centered on analysis without advancing to the improvement phase. This study seeks to bridge this gap by employing sentiment analysis to suggest UI improvements rooted in user feedback [13]. The research will utilize the User-Centered Design (UCD) method to develop design prototypes and assess their efficacy.

This study leans on User-Centered Design (UCD) principles to refine the design. In contrast, Activity-Centered Design (ACD) favors task analysis, potentially overlooking the broader context of user goals. On the other hand, goal-directed Design (GDD) emphasizes understanding users' overarching objectives. Given the research objective and the need to comprehensively address users' needs, UCD is deemed the most suitable approach. UCD assures that the design meets user demands by prioritizing user objectives and preferences. The research employs user feedback and sentiment analysis techniques to gather insights and corroborates these findings using the System Usability Scale (SUS). The study aims to reconcile sentiment analysis predictions with questionnaire data to enhance the user interface and create a user-friendly experience.

This study further aims to fortify the quality of the UI and elevate the overall user experience of the Bukalapak application by integrating enhancement factors and a UI design prototype derived from sentiment analysis. The research will address two primary questions: first, how can user sentiment be harnessed to identify improvement factors for enhancing the UI quality of the Bukalapak application, and second, what is the outcome of usability testing for assessing the effectiveness of the updated UI design?

The scope of this study is limited to user feedback on the Bukalapak app collected from the Google Play Store between January 2021 and November 2022. The analysis focuses on the UI element, omitting the technical aspects beyond the author's expertise. The information extracted from reviews provides insight into public sentiment regarding the Bukalapak UI

From the background and previous research, it is clear that the user experience influenced by the User Interface is the primary area for further investigation. Earlier research was limited to the analysis stage without progressing to the improvement phase. In this specific

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study, the researchers have focused on the user interface.

2. Research Methods

The methodology of this research paper commences with a preliminary investigation to amass data and insights related to sentiment analysis and user interface and their impact on customer satisfaction and user experience. User reviews of the Bukalapak app on the Google Play Store are collected and scrutinized to interpret user sentiments.

The research step starts with analyzing 4,463 data out of 246,947 user reviews, focusing on UI-related aspects to identify potential improvement areas. The study employs sentiment analysis to unearth negative sentiments and UI flaws, enhancing the analysis with User-Centered Design (UCD) principles such as user feedback integration to design the improved design. A system Usability Scale (SUS) measures usability improvements, and validity and reliability evaluations are performed to analyze the data.

In the data collection phase, primary data from survey responses is collected through a Google form. The questionnaire's content is designed to determine the System Usability Scale (SUS) used to measure public assessment of the Bukalapak application. This information will subsequently be compared to predictions based on sentiment analysis.

Selecting a sampling technique is crucial in any research to ensure that the results accurately represent the population under study. This investigation uses simple random sampling to select a subset of the population. Simple random sampling guarantees that each member of the population has an equal chance of being chosen for the sample [14]. The sample size calculation uses the Slovin formula, with a margin of error set at 10% [14].

$$n = \frac{N_o}{1 + Ne^2} \quad (1)$$

n is the number of samples, N is the total population and, e is the error tolerance (level).

Based on Formula 1, the calculation for determining the amount of sample is:

$$n = \frac{No}{1 + Ne^2}$$

$$n = \frac{4462}{1 + 4462*(0,1)^2}$$

$$n = \frac{4462}{45,62}$$

$$n = 97,8 \approx 100$$

The calculation resulted in a sample size of 97.8 samples and rounded up to 100 samples from a total of 4462 population size. This sample size is deemed appropriate and representative of the population under study. The study is anticipated to be adequate for drawing valid conclusions. Secondary data was gathered from user reviews of the Bukalapak application on the Google Play Store using "Web Scraping."

Web scraping is a data-gathering method used to extract details from web pages. Typically built with text-based languages such as HTML and XHTML, these pages frequently hold valuable text data. However, web pages are mainly intended for human use rather than automated data extraction. Tools and software are developed to expedite web scraping procedures[15].

Web scraping typically aims to pinpoint specific websites or web pages to collect certain information. Scrapers are tailored to reach predefined pages and may require alterations if the target site changes or the information sought-after is updated. Conversely, web crawling is more extensive, aiming at the entire website. Crawlers can be programmed to gather more detailed information as shown in Algorithm 1.

Algorithm 1. Data Scraping

Algorithm 1: Data Scraping

```
from google_play_scraper import app
import pandas as pd
import numpy as np
from google_play_scraper import Sort, reviews_all
result = reviews_all(
    'com.bukalapak.android',
    sleep_milliseconds=0,
    lang='id',
    country='id',
    sort=Sort.NEWEST,
from google_play_scraper import Sort, reviews
result, continuation_token = reviews(
    'com.bukalapak.android',
    lang='id',
    country='id',
    sort=Sort.MOST_NEWEST
    count=200000,
    filter_score_with=None
df_busu =
pd.DataFrame(np.array(result),columns=['review'])
df_busu =
df_busu.join(pd.DataFrame(df_busu.pop('review').tolist()))
df_busu.head()
my_df.to_csv("scrapped_data.csv", index = False)
```

The data processing phase of this research plays a vital role in evaluating user sentiment and generating improvement suggestions for the User Interface (UI) of the Bukalapak application. Following the data collection phase, the gathered data undergoes text preprocessing to ensure accurate and reliable results during sentiment analysis. This preprocessing step involves cleaning, tokenizing, and removing stop words.

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Upon completing text preprocessing, sentiment analysis determines the overall sentiment in the user reviews. This evaluation aids in distinguishing between positive, negative, or neutral sentiments, which assists in driving UI enhancements.

The research employs the User-Centered Design (UCD) method to formulate improvement recommendations, focusing on understanding users' needs and preferences to design a more user-friendly and effective UI[16]. The suggestions derived from the UCD method aim to address issues and enhance user experience.

The evaluation procedure includes using the System Usability Scale (SUS), providing a standardized measure to assess the usability of the redesigned UI [17]. The effectiveness of the proposed enhancements was measured by comparing the expected improvements with the feedback collected through the SUS questionnaire. This evaluation helps to confirm the impact of the suggested improvements and informs further iterations of the UI design process.

Text preprocessing is a pivotal stage in natural language processing, designed to enhance the precision and quality of the analysis. Data processing using text preprocessing techniques follows the data collection from web scraping. Text preprocessing comprises several stages: cleaning, case folding, tokenizing, and removing stopwords. This text preprocessing process employs Python, which provides an array of libraries to streamline the procedure. By discarding redundant and irrelevant data, the analysis results will deliver more accurate insights and valuable information as shown in Algorithm 2.

Algorithm 2. Algorithm of Text Preprocessing

Algorithm 2: Text Preprocessing

```
def remove_punct(content):
    content = re.sub(r"\$\w*", '', content)
    content = re.sub(r'^rt[\s]+', '', content)
    content = re.sub('((www\.[^\s]+)|(https?://[^\s]+))', ' ', content)
    content = re.sub('&quot;'," ", content)
    content = re.sub(r"\d+", " ", str(content))
    content = re.sub(r"\b[a-zA-Z]\b", "", str(content))
    content = re.sub(r"[^\w\s]", " ", str(content))
    content = re.sub(r'(.)\1+', r'\1\1', content)
    content = re.sub(r"\s+", " ", str(content))
    content = re.sub(r'#', '', content)
    content = re.sub(r'[^a-zA-z0-9]', ' ', str(content))
    content = re.sub(r'\b\w{1,2}\b', '', content)
    content = re.sub(r'\s\s+', ' ', content)
    content = re.sub(r'^link[\s]+', '', content)
    return content
df['content'] = df['content'].str.lower()
df
import nltk
def tokenization(content):
    content = re.split('\W+', content)
    return content
df['tokenisasi'] = df['cleaning'].apply(lambda x:
tokenization(x.lower()))
df
stopword = nltk.corpus.stopwords.words('Indonesian')
def remove_stopwords(content):
    content = [word for word in content if word not in stopword]
    return content
df['stopword_removal'] = df['tokenisasi'].apply(lambda x:
remove_stopwords(x))
df
stop_removal = df[['stopword_removal']]
def fit_stopwords(content):
    content = np.array(content)
    content = ' '.join(content)
    return content
df['stopword_removal'] = df['stopword_removal'].apply(lambda x:
fit_stopwords(x))
df
df.to_csv('databersih_content.csv',encoding='utf8', index=False)

```

User sentiment collection uses data from the sentiment analysis on the dataset containing relevant words. By examining the sentiment conveyed in user feedback, this research aims to interpret users' overall perspectives and satisfaction concerning the UI design. The outcomes of the sentiment analysis provide insightful revelations about the strengths and weaknesses of the UI, highlighting areas requiring improvement and facets that users view positively. These findings lay the foundation for further investigation and refinement of the UI design, aiming to enhance user experience and satisfaction. Sentiment analysis is done on data containing words indicating sentiment toward the User Interface.

User-centered design (UCD) is a design ethos that positions the user or users at the heart of the target. As per ISO 13407, the UCD methodology centers development around the user, making them the reference point for the application's design. The closer the application aligns with user desires, the higher its acceptance in the market [18].

User-Centered Design (UCD) incorporates a methodical approach composed of four phases. The initial phase involves identifying potential users and comprehending the context in which they will utilize the product. The subsequent phase establishes user and organizational needs by dissecting the recognized issues. The third phase generates a design solution predicated on the accumulated information. The concluding phase involves assessing the design against user requirements via testing and validation. UCD underscores user participation and aspires to develop user-friendly and efficacious products [8]. The entire process can be seen in Figure 2.

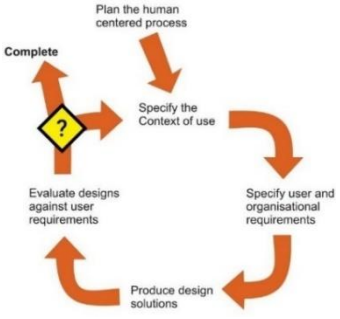

Figure 2. Stages of UCD based on ISO 13407

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User-Centered Design (UCD) is a philosophy that prioritizes the user's needs and preferences throughout the design procedure. The guiding principles of UCD comprise five primary tenets: emphasizing the user, integrating design, conducting user testing, and implementing an interactive design approach.

The System Usability Scale (SUS) is a methodology developed by Brooke for assessing the usability quotient of a system. The SUS uses a Likert scale of 1 to 5, indicating respondents' agreement or disagreement level based on ten declarative statements. The scale is in Figure 3. Various usability elements are incorporated into the system usability scales statement, such as system complexity, the need for assistance from others, the rate of adaptation, and other aspects. The SUS questionnaire was initially introduced by Brooke in 1986 and later translated into Indonesian by Sharfina and Santoso in 2016 [19], [20]. This survey has been modified based on cross-cultural and actual validity to ensure that the translated SUS results are valid, significantly when the population and culture differ.

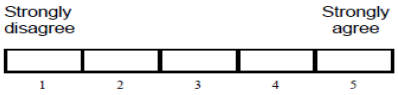

Figure 3. Likert Scale [21]

The validity test is a measure that determines whether a data collection instrument used in the study is appropriate or not. The criteria for assessing the test's validity state that the questionnaire is valid if the calculated r-value exceeds the table r-value.

Table 3. List of SUS Statements in Bahasa Indonesia [20]

No	Question
1	*Saya berpikir akan menggunakan sistem lagi*
2	*Saya merasa sistem ini rumit untuk digunakan*
3	*Saya merasa sistem ini mudah untuk digunakan*
4	*Saya membutuhkan bantuan dari orang lain atau teknisi dalam menggunakan sistem ini*
5	*Saya merasa fitur-fiture sistem ini berjalan dengan semestinya*
6	*Saya merasa ada banyak hal yang tidak konsisten (tidak serasi) pada sistem*
7	*Saya merasa orang lain akan memahami cara menggunakan sistem ini dengan cepat*
8	*Saya merasa sistem ini membingungkan*
9	*Saya merasa tidak ada hambatan dalam menggunakan sistem ini*
10	*Saya perlu membiasakan diri terlebih dahulu sebelum menggunakan sistem ini*

Conversely, the questionnaire is deemed invalid if the calculated r-value is less than the table r-value. For achieving a trustworthy level of validity, this instrument testing mandates using 100 samples.

The reliability test evaluates whether the measurement tool crafted in a survey is dependable. A measurement tool is considered reliable if it consistently delivers similar results when used repeatedly. The assessment of the tool's reliability is determined statistically through the reliability coefficient. If the reliability coefficient exceeds 0.60, the overall statement is reliable.

Usability testing is an essential step following the system evaluation using the System Usability Scale (SUS). This subsequent step involves calculating the responses provided by the participants. The calculation is executed by determining the contribution value of each answer, which can range from 0 to 4. Below are the guidelines used for computing the SUS value:

In statements 1, 3, 5, 7, and 9 (odd numbers), the contribution value is from the respondent's answer minus the number 1 as shown in Formula 2.

$$Odd\ SUS\ Score = P_x - 1 \quad (2)$$

In statements number 2, 4, 6, 8, and 10 (even numbers), the contribution value is obtained from the number 5 minus the respondent's answer as shown in Formula 3.

$$Even\ SUS\ Score = 5 - P_x \quad (3)$$

The total contribution value is added up and then multiplied by 2.5 to change the score to a range from 0 to 100 as shown in Formula 4.

$$(\Sigma \text{Odd Score} + \Sigma \text{Even Score}) \times 2{,}5 \quad (4)$$

The average SUS score is calculated by dividing the total by the number of respondents. The formula of the average SUS score can be seen in Formula 5.

$$\bar{X} = \frac{\Sigma x}{n} \quad (5)$$

The way to understand the results of the SUS questionnaire used a scale, which is divided into three parameters: the level of acceptability, grade scale, and adjective ratings [22]. A system can be accepted if the SUS value ranges from 60 to 100. The SUS value parameter can be seen in Figure 4.

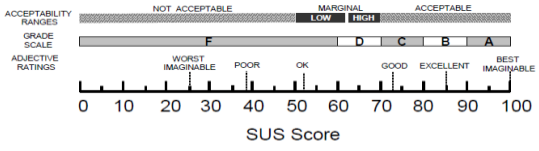

Figure 4. Parameter Value of SUS

3. Results and Discussions

In the data collection phase, data was acquired through web scraping techniques deployed on the Google Play Store website. The time frame of data collection spanned ten months, specifically from January 1, 2021, to November 1, 2022, resulting in an extensive dataset of 246,947 user reviews. The user reviews about the Bukalapak application included references to WEBQUAL 4.0 parameters such as usability, quality of

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information, interaction/service quality, and user satisfaction. This study concentrates on the usability facet (primarily user interface design) and user satisfaction. Following categorizing data into these selected aspects, 4462 reviews expressed sentiments towards the User Interface. The said data is organized and displayed in Table 4.

Table 4. Examples of Bukalapak Application's User Reviews on Google Play Store

User	Rating	Date	Review
User 2	1	09/10/2021 11:56	*Baru buka aplikasinya sudah jenuh...bingung terlalu banyak menu tapi gak membantu. Baru pertama kali transaksi ehhh mau kena tipu. Masak suruh konfirmasi barang diterima tapi barang belum diterima. Sudah ngajukan komplain dan minta dana dikembalikan tapi respon sangat lama.*
User 3	1	13/02/2021 13:54	*Sangat kcewa. Buat apa banyak menu kalau sulit digunakan. Bisa buka tapi gk da apa apa. d refressh juga sma gtu ajhKlo bikin apk tu yg berkualitas dong.*
User 4	1	19/04/2021 13:40	*Menurut saya aplikasi ini makin membingungkan. Menunya pindah-pindah. Coba membuka beberapa menu, kaya lomba marathon, bikin lelah. Klik menu, yang keluar malah popup apa tahu Terus begitu. Saya compares dengan marketplace lain, mereka lebih konsisten.*

Table 5. Example of text Preprocessing

Cleansing	
Before	After
Menu dalam apps lebih sedikit, contohnya tidak ada menu history pengiriman, dan nomor resi tidak ada dalam daftar transakski, yang ada cuman status pembelian sementara history pengiriman atau status pengiriman hanya bisa di akses di website. Tolong segera lengkapi, hampir saja saya menyalahkan penjual karena tidak di prosesÂ²	*Menu dalam apps lebih sedikit contohnya tidak ada menu history pengiriman dan nomor resi tidak ada dalam daftar transakski yang ada cuman status pembelian diproses dikirim sampai selesai sementara history pengiriman atau status pengiriman hanya bisa akses website. Tolong segera lengkapi hampir saja saya menyalahkan penjual*
Folding	
Before	After
Chat Online Dengan Admin Susah X, Menu Utk Chatnya dimana	*chat online dengan admin susah menu utk chatnya dimana*
Tokenization	
Before	After
menu buka bantuan mohon perbaiki menu live chat nya	*['menu', 'buka', 'bantuan', 'mohon', 'perbaiki', 'menu', 'live', 'chat', 'nya']*
Filtering/Stopwords Removal	
Before	After
Tolong di halaman akun di beri menu Keranjang. Saya kesulitan mencari keranjang belanja.	*tolong halaman akun menu keranjang kesulitan mencari keranjang belanja*

The text preprocessing phase of this study is comprised of several steps, including the removal of punctuation, conversion of text to lowercase, and elimination of stop words. These steps are vital for cleansing the text and removing extraneous information that might hinder the precise sentiment analysis. This preprocessing stage utilizes Python and the Natural Language Toolkit (NLTK) library. Python offers a robust and flexible environment for undertaking various text-processing tasks, and NLTK provides numerous tools and functions tailored explicitly for natural language processing as shown in Table 5.

Sentiment analysis is executed on user reviews to understand sentiments directed toward the User Interface (UI) of the Bukalapak application. This analysis aims to decipher the positive or negative sentiments expressed in user comments, thereby gaining insights into user perceptions and experiences. The outcome of sentiment analysis furnishes valuable data for the development team, empowering them to identify and address user issues, improve UI design, and ultimately deliver an improved, user-centered experience for Bukalapak application users. The results of the sentiment analysis of Bukalapak user reviews are presented in Table 6.

Table 6. Sentiment Analysis for Words Indicating Sentiment toward UI

Sentiment Analysis	Frequency	Percentage
Neutral	2142	48%
Negative	1380	31%
Positive	490	11%
Mixed	450	10%

The User-Centered Design (UCD) methodology is employed during the prototype development stage. UCD is a design philosophy that prioritizes user needs and preferences throughout the design process. Applying the UCD process ensures that the UI redesign of the Bukalapak application is user-friendly and addresses users' needs effectively as shown in Figure 5. The UCD method's process employed in the prototype development stage is depicted in Figure 6.

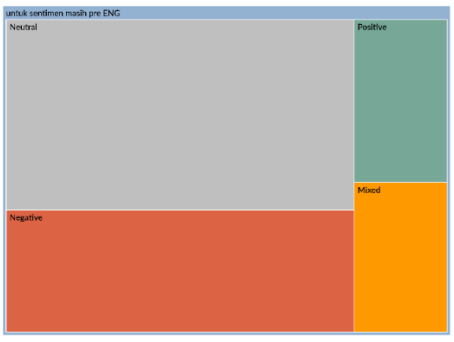

Figure 5. Comparison of Sentiment Analysis from reviews that Indicate sentiment toward User Interface

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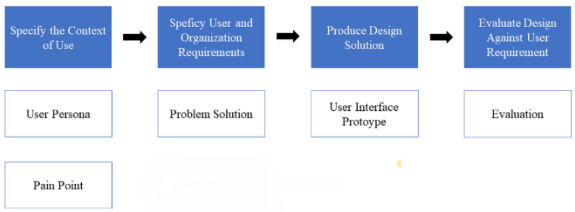

Figure 6. Prototype Development Stage

Identifying the context of Bukalapak application usage is crucial as it provides insights into its real-world use and users' specific needs while interacting with it. This leads to the creation of user Personas, which assist in understanding the needs and objectives of the target users.

Figure 7. User Persona Buyer & Seller

A user Persona includes vital information like the user's name, identity, motivation, frustrations, etc. These personas comprehensively view user behavior, pain points, and expectations. The user persona is bifurcated into buyer and seller personas. The buyer persona concentrates on users who employ the Bukalapak application for purchasing. In contrast, the seller persona is focused on users who use the application to sell products on the marketplace as shown in Figure 7.

A 'pain point' signifies any obstacle users face with a product or application that can guide system development and improvement. Recognizing these pain points is essential for boosting user experience. Developers can customize the product or application to address these concerns. Pain points can be discovered through user research methodologies such as surveys and user feedback analysis.

The pain points of potential users are presented here, derived from the analysis of user reviews: Hard to find and access the Live Chat menu; Bad visibility and confusing navigation; There is no notification for sold-out products in the cart; There is no detailed information in the Transaction History; The store Page does not highlight feedback and ratings; Vouchers and promotions are disturbing product views; There is too little information in the profile menu; Users need to click many times to access a special menu.

Defining user requirements aims to discern users' challenges while utilizing the Bukalapak application. Evaluating the collected data assists in determining particular features and enhancements needed in the application to enhance user satisfaction and experience. These improvements will coincide with the users' stated needs and preferences gleaned from their reviews. By incorporating user feedback and implementing the necessary adjustments, the ultimate objective is to create an application that fulfills user requirements, thereby augmenting the overall user experience. The insights obtained from this analysis will guide future updates and modifications to the Bukalapak application.

Existing issues with the application are addressed based on the earlier identified pain points. Once the problems are pinpointed, appropriate solutions will be proposed. These solutions might encompass user interface enhancements, the addition of new features, enhancements to the user experience, and other measures to tackle user pain points. Specific problems and corresponding solutions are detailed in Table 7.

Creating a prototype is a pivotal step in the overall design process as it offers a tangible representation of potential solutions. The prototype development is divided into two stages: the formation of a wireframe and a design mockup. The wireframe, a low-fidelity prototype, presents a basic concept of the application's design, while the design mockup, a high-fidelity prototype, provides a detailed and comprehensive sketch. Both wireframes and design mockups represent methods utilized to resolve identified issues.

Table 7. Problem and solution

Problems	Solutions
Hard to find and access the Live Chat menu.	Provide a floating Live Chat menu to ease users' access.
Difficult to fill product categories due to bad visibility and confusing navigation.	Provide filtering based on categories, increasing visibilities and easy-to-understand menu navigation.
There is no notification for should out product in the cart.	Provide a notification for the sold-out products in the cart.
Transaction History is confusing as there is no detailed information on the history of payments.	Provide detailed transaction history (progress bar and transaction progress bar).
Store information does not highlight feedback history and rating.	Highlight store information, such as feedback and ratings.
Vouchers and promotions are disturbing the product view.	Decrease vouchers and promotions on the product view page.
The profile menu has too little information, and users must click many times to access specific menus.	Provide detailed information on the profile menu and give information for every access menu.

A wireframe serves as a simplified visual guide to the application interface, aiding developers in visualizing the application structure. This elementary design layout provides a clear understanding of the application's features, functions, structure, and layout. In this

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context, the wireframe creation is predicated on solutions identified through an analysis of user reviews. The wireframe acts as a roadmap for developing an application interface that specifically targets and aims to alleviate users' identified pain points as shown in Figure 8.

A high-fidelity design mockup will be meticulously developed, leveraging the foundational elements of the preliminary wireframe. This mockup is an intricate and sophisticated upgrade of the wireframe, rendering a precise visualization of the ultimate product. High-fidelity prototypes are indispensable when assessing a product's usability and functionality, as they provide a near-replica of the final product. The design tool Figma, renowned in UI/UX design circles, will be harnessed to shape this mockup, further enhancing its precision and aesthetic finesse.

The workflow illustrates a user's sequential journey while navigating the application. It provides a detailed account of the user's interactions with various interfaces, mapping out their traversal through the application's features and functions. A visual representation of the user journey, the workflow diagram illuminates the different routes and decision-making points a user may encounter. An illustrative depiction of the application's workflow is provided to foster a comprehensive understanding of the Bukalapak application's operational flow and organizational structure as shown in Figure 9.

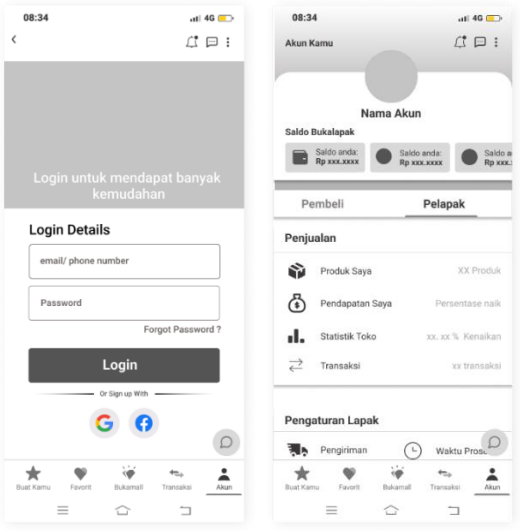

Figure 8. Example of Low-Fidelity of the Improved Design

The summary encapsulates the orderly procession of users' actions while engaging with the Bukalapak application. It outlines the application's navigational trajectory, commencing at the home page that serves as the user's launchpad. The search menu directs them to the Search Page, facilitating their quest for specific products. Subsequently, they can delve into exhaustive product details on the Product Detail Page. The Sellers Profile Page allows users to examine seller profiles for credibility assessment and item perusal. Before they add items to the cart or proceed to purchase, the Login Page enables the necessary user authentication. The Cart Page equips users to scrutinize and manage their selected items. At the same time, the Product Review Page guides them through the checkout process by displaying relevant product information and gathering requisite details. Finally, the Payment Page finalizes the transaction, after which users receive updates on the processing and shipping of their purchased items.

The evaluation phase of this research venture will employ a System Usability Scale (SUS) questionnaire to compare the developed prototype with the original design. This phase is vital in determining whether the prototype has effectively mitigated primary user concerns identified during the study. The SUS questionnaire will address various aspects, including ease of navigation, clarity of presented information, and overall user experience. This questionnaire aims to gather precious insights from the target audience, ultimately enhancing the prototype's usability. The results from this evaluation will be examined and contrasted with the initial design to identify potential enhancements for the prototype. This process ensures that the prototype design meets the needs and preferences of the target users, thereby forging a path toward a more effective and user-focused product.

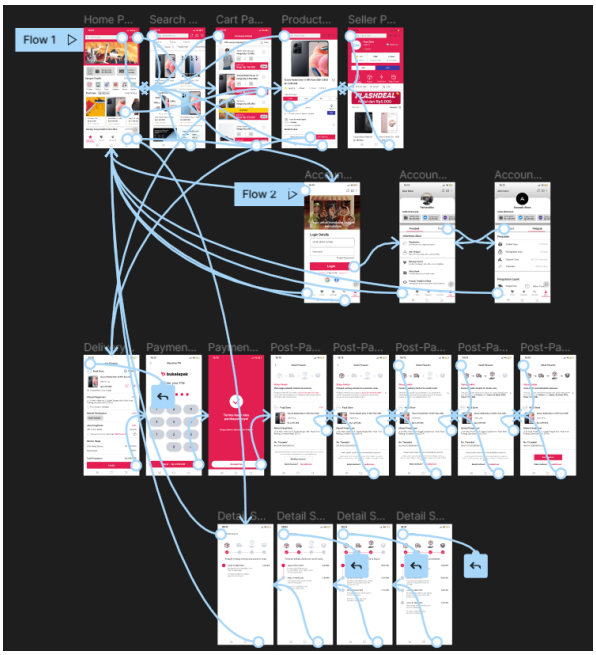

Figure 9. Workflow of Bukalapak application

The questionnaire participants were users with prior experience with the Bukalapak Application. From the pool of 126 respondents, 108 were found eligible to complete the questionnaire. The survey results revealed

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a gender distribution of 60 (55.6%) female and 48 (44.4%) male participants. A graphical representation of the gender distribution among respondents was created to provide a visual summary of the data as shown in Figure 10.

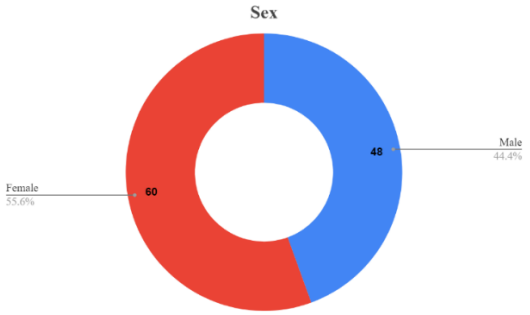

Figure 10. Gender of Respondents

The survey participants in Figure 11 represented a wide geographical range within Indonesia. The largest cluster of respondents, comprising 64 individuals (59.26%), originated from Padang. The rest of the participants were dispersed across various regions in Indonesia, including 16 individuals (12.04%) from Jakarta, 5 (4.63%) from Medan, and 3 (2.78%) apiece from Tangerang, Pekanbaru, and Bandung. Additionally, 2 (1.85%) of the respondents were from Yogyakarta. Taking into account the geographical distribution of respondents is essential, as it provides insights into the penetration and usage of the Bukalapak Application in diverse areas of Indonesia.

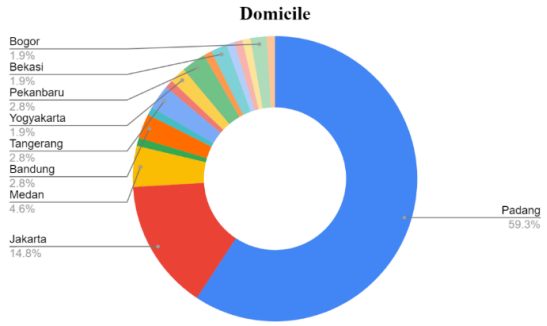

Figure 11. Location of Respondents

The participants encompassed a broad spectrum of age groups. In Table 8 among the 108 eligible respondents, the age bracket of 21-23 years was the most heavily represented, with 79 individuals (73.15%). The 18-20 years age group was the second largest, encompassing 16 respondents (14.81%), followed by the 24-26 years age group with 12 respondents (11.11%). Notably, a solitary participant fell within the 30-32 years age range, constituting a slender 0.93% of the total respondents.

Table 8. The age group of respondents

Grouped Age Distribution	Count of Respondent
18-20 years age group	16
21-23 years age group	79
24-26 years age group	12
30-32 years age group	1
Total	108

Survey participants shared their insights based on their engagement with the newly improved version of the Bukalapak application. Utilizing a Likert scale ranging from 1 to 5, where 1 indicated 'strongly disagree' and 5 signified 'strongly agree', participants rated their level of concurrence or dissent with a series of statements. All the compiled responses were organized in a tabular format, and the analysis of these responses is elaborated upon in the ensuing section as shown in Table 9 and 10.

Table 9. Number of Respondent's Recapitulation Before Redesign

Question	Scale 1	2	3	4	5
Q1	*5*	*22*	*28*	*41*	*12*
Q2	*16*	*29*	*21*	*28*	*4*
Q3	*19*	*22*	*22*	*18*	*27*
Q4	*14*	*44*	*28*	*16*	*6*
Q5	*3*	*17*	*23*	*52*	*13*
Q6	*22*	*20*	*18*	*20*	*28*
Q7	*8*	*18*	*19*	*46*	*17*
Q8	*8*	*18*	*32*	*36*	*14*
Q9	*4*	*21*	*21*	*51*	*11*
Q10	*4*	*20*	*20*	*51*	*13*

In addition to offering their ratings on the Likert scale, participants were also encouraged to put forward suggestions for further enhancements to the recently revamped design. Out of the 108 respondents, 33 proffered suggestions concerning the latest iteration of the Bukalapak Application, whereas the others conveyed contentment with the current design. These suggestions were classified into various categories to facilitate easier interpretation as shown in Figure 12.

To ascertain the reliability and accuracy of the feedback obtained through the questionnaire, a validity test was conducted. This involved utilizing the Statistical Package for Social Sciences (SPSS) software, version 26.0, to carry out an analysis of the data amassed. The results of this validity test are consolidated into a table, furnishing a clear depiction of the data evaluation and the extent of validity of the questionnaire. In this particular validity test, a critical value of 0.1874 is employed as shown in Table 11.

Table 10. Number of Respondent's Recapitulation After Redesign

Question	Scale 1	2	3	4	5
Q1	*3*	*8*	*18*	*53*	*26*
Q2	*32*	*55*	*11*	*6*	*4*
Q3	*1*	*3*	*29*	*67*	*8*
Q4	*35*	*49*	*13*	*6*	*5*
Q5	*2*	*7*	*8*	*57*	*34*
Q6	*27*	*57*	*7*	*12*	*5*

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Question	Scale				
	1	2	3	4	5
Q7	*0*	*6*	*13*	*58*	*31*
Q8	*37*	*53*	*4*	*10*	*4*
Q9	*1*	*11*	*18*	*52*	*26*
Q10	*16*	*29*	*21*	*38*	*4*

Table 11. Comparison of Number of Respondents Before and After Redesign

Question	Scale									
	Before					After				
	1	2	3	4	5	1	2	3	4	5
Q1	5	2	2	4	1	3	8	1	5	2
		2	8	1	2			8	3	6
Q2	1	2	2	2	4	3	5	1	6	4
	6	9	1	8		2	5	1		
Q3	1	2	2	1	2	1	3	2	6	8
	9	2	2	8	7			9	7	
Q4	1	4	2	1	6	3	4	1	6	5
	4	4	8	6		5	9	3		
Q5	3	1	2	5	1	2	7	8	5	3
		7	3	2	3				7	4
Q6	2	2	1	2	2	2	5	7	1	5
	2	0	8	0	8	7	7		2	
Q7	8	1	1	4	1	0	6	1	5	3
		8	9	6	7			3	8	1
Q8	8	1	3	3	1	3	5	4	1	4
		8	2	6	4	7	3		0	
Q9	4	2	2	5	1	1	1	1	5	2
		1	1	1	1		1	8	2	6
Q10	4	2	2	5	1	1	2	2	3	4
		0	0	1	3	6	9	1	8	

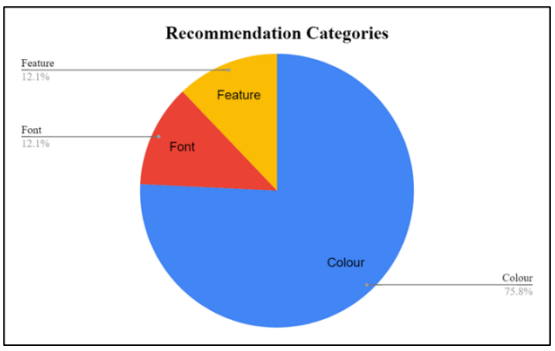

Figure 12. Recommendation categories

Table 12. Validity Test for Usability Questionnaire Before Redesign

No Statement	r Count	Result
1	0.575	*Valid*
2	0.237	*Valid*
3	0.540	*Valid*
4	0.200	*Valid*
5	0.621	*Valid*
6	0.343	*Valid*
7	0.424	*Valid*
8	0.606	*Valid*
9	0.449	*Valid*
10	0.207	*Valid*

Table 13. Validity Test for Usability Questionnaire After Redesign

No Statement	r Count	Result
1	0.383	*Valid*
2	0.705	*Valid*
3	0.208	*Valid*
4	0.742	*Valid*
5	0.285	*Valid*
6	0.750	*Valid*
7	0.240	*Valid*
8	0.687	*Valid*
9	0.339	*Valid*
10	0.642	*Valid*

Reading Tables 12 and 13, it can be inferred that an item is deemed valid when the rCount value surpasses the rTable value. This implies that every item within the questionnaire has been classified as valid, as their respective rCount values exceeded the corresponding rTable values. Such a conclusion suggests that the responses gathered from the participants hold substantial statistical significance and reliability.

The reliability of the survey instrument was scrutinized through a reliability test, a critical procedure to verify the accuracy and authenticity of the data accrued from the survey. The test was implemented via the 'Analyze Scale' function within IBM SPSS Statistics, with Cronbach's Alpha serving as the metric to assess the survey's reliability. A Cronbach Alpha score in the vicinity of 0.6 indicates a commendable level of reliability in the data procured from the survey. The higher the Cronbach Alpha score, the more reliable the survey is considered. The findings of the reliability test, showcasing the obtained Cronbach Alpha score for the survey, are elaborated upon in the subsequent section.

Table 14. Reliability Test for Usability Questionnaire Before Redesign

Cronbach's Alpha	N of Items	Result
0.610	10	*Reliable*

Table 15. Reliability Test for Usability Questionnaire After Redesign

Cronbach's Alpha	N of Items	Result
0.702	10	*Reliable*

Tables 14 and 15 reveal a Cronbach's alpha score surpassing the 0.60 threshold, underscoring the reliability of both the respondents and the survey itself. This elevated score suggests that the survey's individual components consistently measured the intended construct, thereby bolstering the overall credibility of the research findings. The substantial Cronbach's alpha score further underscores the survey's proficient design and its effective capacity to measure the target construct.

Usability evaluation was carried out to compare and contrast the usability metrics of the user interface before and after its revamp. The assessment employed the System Usability Scale (SUS), framed as a ten-question questionnaire.

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The SUS encompasses ten questions, each evaluated on a scale from one (strongly disagree) to five (strongly agree). These responses are subsequently scored and translated into a SUS score, which falls between 0 and 100. In this research, the SUS score was derived by subtracting one from the odd-numbered questions' scores and five from the even-numbered questions' scores. The resulting SUS scores for both the original and redesigned interfaces are delineated in the tables.

Table 16. Usability Test for the Interface Before Redesign

Respondent	Contribution	Contribution x 2.5
1	16	40
2	30	75
3	19	47.5
4	19	47.5
5	26	65
6	20	50
7	27	67.5
.	.	.
.	.	.
108	34	85
Total Contribution		6225
SUS Score (TC/total respondent)		57.64

Table 17. Usability Test for the Interface Before Redesign

Respondent	Contribution	Contribution x 2.5
1	33	82.5
2	27	67.5
3	26	65
4	32	80
5	22	55
6	22	55
7	32	80
.	.	.
.	.	.
108	39	97.5
Total Contribution		7672.5
SUS Score (TC/total respondent)		71.04

Table 16 and Table 17 demonstrate that the usability evaluation indicated that the revamped interface received higher usability scores compared to its original counterpart. The initial design received a SUS score of 57.64, while a consistent upsurge in scores was observed across all respondents for the redesigned interface, emphasizing the effective enhancement of user experience via the redesign process. The average SUS score for the redesigned interface was 71.04, which is above average, signifying a reasonable degree of usability. These results imply that the redesign initiatives effectively tackled the usability issues previously identified, leading to a notable boost in the user experience.

The concluding stage in the user-centric approach is the design iteration, a process aimed at ensuring the final product is aligned with user needs and preferences. Even though the redesign showcased successful improvements in the usability tests, respondents to the questionnaire still provided valuable suggestions for further enhancement. The iteration process, therefore, should primarily focus on these user-highlighted facets. By doing so, the final design will more faithfully mirror user needs and preferences, leading to an optimized user experience. By taking into account and incorporating user feedback, designers can make the necessary refinements and upgrades to generate a more streamlined and user-focused design.

As depicted in Table 18, which encapsulates user recommendations, the majority of users suggested enhancing the interface's color diversity and incorporating a night mode. While a user-centric design approach underscores the importance of catering to user preferences, it's paramount that developers also maintain the integrity of the brand's identity, bearing in mind color regulations, principles of color theory, and branding guidelines.

Table 18. Summary of User Recommendations

Respondent	Recommendation
1	Add more color to the design, not only red
2	Add Night mode
3	Need more color in the design

Maintaining the Bukalapak application's brand image necessitates adherence to its specific color guidelines throughout the design refinement process. The dominant brand color of Bukalapak is red, a color that traditionally symbolizes passion. The inclusion of additional colors, without considering these guidelines, may undermine the application's unique brand identity. Furthermore, the introduction of a night mode could potentially conflict with the brand's aesthetic values, as it might not align with the brand's core image and ethos. Hence, it is essential to find a harmonious balance between user preferences and brand guidelines, ensuring that the suggested enhancements do not compromise the distinctiveness of the application's branding. The color guidelines that pertain to the Bukalapak brand are detailed in Figure 13.

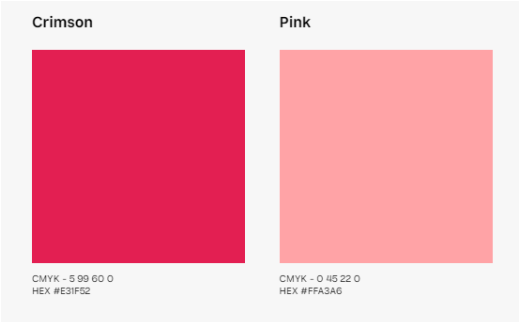

Figure 13. Bukalapak Brand Colour Guideline

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4. Conclusions

This study accentuates the vital role of user reviews and sentiment analysis as key catalysts for the refinement of user interfaces. By methodically dissecting user feedback sourced from the Google Play Store and harnessing the principles of User-Centered Design (UCD), developers can glean deep insights into user demands and preferences. This enables them to identify and address specific challenges, as well as capitalize on opportunities for improvement. The substantial usability score improvement by 23.25% (from an initial score of 57.64 to 71.04) post-implementation of design alterations based on user feedback, is a testament to the efficacy of this approach. This impressive surge in score denotes that the reimagined interface enhances user experience and satisfaction.

The study emphasizes that user feedback ought to be consistently captured and leveraged throughout the design and developmental processes. By actively acknowledging and integrating user feedback into the developmental trajectory, developers can ensure that the resulting product or application meets user expectations, leading to heightened user satisfaction. Moreover, this research illuminates the powerful role of sentiment analysis in extracting invaluable insights from user reviews, thereby fostering a more data-driven approach to interface enhancement. This research enriches the growing body of knowledge on user-centered design and underscores the paramount importance of embedding user sentiment and feedback within the user interface development process. By adopting a user-focused approach, developers can design applications and products that more adeptly address user requirements, resulting in augmented usability, enhanced user satisfaction, and consequently, greater market success.

Conflict of Interest Statement

One of the authors of this article, Ikhwan Arief, is a member of the editorial team of this journal, Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi). This relationship could potentially create a conflict of interest. However, several steps have been taken to ensure the review and publication process's integrity, transparency, and fairness.

1. The author was not involved in any stage of the article's editorial decision-making process.
2. The article was subjected to the same rigorous peer-review process as any other submissions, handled independently by another editorial board member.
3. Ikhwan Arief had no access to the review reports or any other privileged information regarding his manuscript's submission.

We believe these eliminate any undue influence and uphold the ethical standards of scholarly publishing. We are committed to maintaining the highest level of integrity in all aspects of our publication process.

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