Uluslararası Avrasya Sosyal Bilimler Dergisi / *The International Journal of Eurasia Social Sciences*
Cilt/Volume: 16, Sayı/No: 59, Yıl/Year: 2025, ss. / pp.: 115-152
E-ISSN: 2146-1961
URL: https://rrpubs.com/index.php/ijoess

User perception and emotions towards navigation in nature: A text mining study on Reddit comments

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Araştırma Makalesi/*Research Article*		**DOI:** 10.70736/ijoess.557
Gönderi Tarihi/ *Received:*	Kabul Tarih/ *Accepted:*	Online Yayın Tarihi/ *Published*:
05.10.2024	10.02.2025	15.03.2025

Abstract

The aim of this study is to examine user perceptions of nature navigation applications on the Reddit platform. To achieve this, data collected from Reddit was analyzed using both qualitative and quantitative methods. The qualitative analysis was conducted to support the quantitative findings and identify main themes, employing a phenomenological research design to explore the phenomenon of "Reddit users' perceptions of navigation applications for finding directions in nature." In the quantitative analysis, NRC and VADER sentiment analyses were performed, followed by correlation analysis to identify relationships between emotions and sentiment classification was carried out using various machine learning models. The research reveals that users highlight security risks arising from map errors and navigation inaccuracies. Inconsistencies in difficulty level assessments suggest that some trails may be dangerous for inexperienced users and the importance of traditional map and compass usage is emphasized. While applications provide practical access for short hikes, topographic maps are preferred for longer hikes and offline usage is observed to offer a significant safety advantage. Additionally, the destruction caused by unauthorized routes in nature is noted and it is suggested that this issue needs to be controlled. Users find subscription systems expensive and complex, opting to search for free alternatives rather than paying for premium features. In challenging trails, due to map accuracy issues and slow GPS responses, users prefer additional navigation tools. Finally, it is noted that map updates are insufficient.

Keywords: Navigation in nature applications, phenomenological research, Reddit comment analysis, sentiment analysis, text mining

Doğada navigasyona yönelik kullanıcı algısı ve duyguları: Reddit yorumları üzerine bir metin madenciliği çalışması

Öz

Bu çalışmanın amacı, Reddit platformunda doğada navigasyon uygulamalarına yönelik kullanıcı algılarını incelemektir. Bu doğrultuda, Reddit'ten toplanan veriler hem nitel hem de nicel yöntemler kullanılarak analiz edilmiştir. Nitel analiz, nicel bulguları desteklemek ve ana temaları belirlemek amacıyla gerçekleştirilmiş olup, "Reddit kullanıcılarının doğada yön bulma için navigasyon uygulamalarına ilişkin algıları" olgusunu keşfetmek için fenomenolojik bir araştırma deseni benimsenmiştir. Nicel analiz kapsamında, NRC ve VADER duygu analizleri uygulanmış, ardından duygular arasındaki ilişkileri belirlemek için korelasyon analizi yapılmış ve çeşitli makine öğrenimi modelleri kullanılarak duygu sınıflandırması gerçekleştirilmiştir. Araştırmanın bulguları, kullanıcıların harita hataları ve navigasyon doğruluğundaki eksikliklerden kaynaklanan güvenlik risklerini sıklıkla vurguladığını göstermektedir. Zorluk seviyesi değerlendirmelerindeki tutarsızlıklar, bazı parkurların deneyimsiz kullanıcılar için risk taşıyabileceğini ortaya koymakta ve geleneksel harita ile pusula kullanımının önemini vurgulamaktadır. Kısa yürüyüşlerde uygulamaların pratik bir çözüm sunduğu, ancak uzun yürüyüşlerde topografik haritaların tercih edildiği ve çevrimdışı kullanımın önemli bir güvenlik avantajı sağladığı belirlenmiştir. Ayrıca, doğada izinsiz oluşturulan rotaların çevresel tahribata yol açtığı ve bu sorunun kontrol edilmesi gerektiği öne sürülmüştür. Kullanıcılar, abonelik sistemlerini pahalı ve karmaşık bulmakta, premium özellikler için ödeme yapmak yerine ücretsiz alternatifleri tercih etmektedir. Harita doğruluğu sorunları ve GPS'in yavaş tepki vermesi nedeniyle zorlu parkurlarda ek navigasyon araçları kullanılmaktadır. Son olarak, harita güncellemelerinin yetersiz olduğu ifade edilmiştir.

Anahtar Kelimeler: *Doğada navigasyon uygulamaları, fenomenolojik araştırma, duygu analizi, metin madenciliği, Reddit yorum analizi*

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INTRODUCTION

The integration of technology into outdoor sports and activities has enriched user experiences, increasing interest in these areas. In particular, mobile applications used in outdoor activities provide a safe and enjoyable experience with features such as route planning, GPS tracking and offline map access. GPS plays a critical role in outdoor activities by providing location data as the cornerstone of navigation in nature (Nilwong et al., 2019), while supporting these applications with advanced technologies like deep learning and sensor fusion enables more precise navigation and obstacle detection in complex outdoor environments (Geng et al., 2019; Giusti et al., 2016).

In addition to the advantages provided by machine learning and sensor fusion, recent research has shown that deep neural networks effectively support navigation in mobile robots by providing efficient classification and identification of trails and pathways, significantly enhancing the user experience (Giusti et al., 2016). Furthermore, the application of sensor fusion techniques in autonomous systems enables multiple robot systems to efficiently follow trails, a feature that is particularly beneficial in search-and-rescue missions and environmental monitoring tasks (Geng et al., 2019). Alongside these developments, designing navigation applications with user safety in mind is crucial, especially in outdoor learning environments where users may be unfamiliar with their surroundings, making safety precautions a priority (Wulandari, 2023). The integration of social navigation principles enriches user experiences by allowing information sharing about trails and obstacles encountered, while also contributing to the formation of a community among nature enthusiasts who share information (Farzan and Brusilovsky, 2018). Additionally, cognitive flexibility has been identified as playing a critical role in navigation and decision-making processes in unfamiliar environments, highlighting the importance of developing applications that support navigation and problem-solving skills (Song, 2024; Capdevila, 2024).

Although navigation applications used in outdoor activities are becoming increasingly common, users face several issues that limit the effectiveness of these applications. These issues primarily involve technological limitations and challenges related to user experience. Dependency on GNSS for outdoor navigation presents a significant technological challenge. While GNSS provides strong positioning in open areas, signal loss occurs due to signal reflection caused by certain environments and line-of-sight (NLOS) situations, negatively impacting location accuracy and limiting users' ability to navigate (Wen et al., 2021). Due to GNSS's lack of functionality in indoor environments, alternative technologies such as Inertial

Navigation Systems (INS) or Ultra-Wideband (UWB) are required (Yao, 2023; Gan et al., 2019). The inability to ensure seamless transition between indoor and outdoor areas creates a significant barrier for users and causes confusion (Claridades and Lee, 2021; Vanclooster et al., 2016). On the other hand, user experience is a critical factor in the success of navigation applications, as users struggle to understand navigation instructions when the applications do not provide contextual information or guiding cues (Fellner et al., 2017). The complexity of navigation interfaces can be challenging for users unfamiliar with technology, negatively impacting the overall usability of the applications (Basiri et al., 2017).

However, research on the user experience and perceptions of these applications is limited. To address this gap, valuable feedback is being gathered through social media platforms where users share their experiences, especially through channels like Reddit. In this context, the study will analyze user comments on the most preferred navigation application for nature on the Reddit platform, exploring users' perceptions and emotions regarding the applications. To contribute to the literature, users' positive and negative reactions, shortcomings of the applications and user expectations will be identified, providing guiding information for application developers. These analyses will serve as a guide for developers to make updates aimed at improving user experiences.

The research will seek answers to questions such as "What emotional tendencies do users have towards navigation applications in nature?" and "Which emotions are associated with users' perceptions of the applications?" The study is limited to comments on the Reddit platform and does not cover other social media channels. Additionally, to comply with ethical principles, the name of the application has not been specified. In this context, since the findings reflect the experiences of Reddit users, it should be considered that other user groups may exhibit different tendencies.

METHOD

Research group (population-sample)

The study group consists of users who contributed to Reddit discussions by commenting on the selected navigation application for outdoor use. This group was chosen to provide information about the application's user experience and overall user satisfaction. The population of the study includes the comments of users on the Reddit platform, while the sample consists of 314 posts and 2,381 comments collected from user discussions on Reddit filtered by the application name. The data was collected on November 7, 2024, with the oldest post dating back to April 20, 2014 and the most recent post dated October 23, 2024.

Data collection tools

The data was programmatically collected using the Python Reddit API Wrapper through the Reddit API. This tool allows for the rapid and systematic extraction of comments related to specific topics on Reddit and formats the text data directly for analysis.

Data collection/processing method

This study is based on a content analysis model aimed at examining the emotional tendencies formed in users towards a navigation application used in outdoor activities, specifically one of the most preferred applications, through the analysis of data gathered from discussions on the Reddit platform. The data was collected from Reddit using the Python Reddit API Wrapper with the "application name" filter. The application's name is not provided to adhere to ethical principles. However, the application is one of the most popular choices worldwide for navigation in nature. The collected data consists of a total of 314 posts and 2,381 comments. The data was programmatically collected on November 7, 2024, using the Python Reddit API Wrapper. The oldest post dates back to April 20, 2014 and the most recent post was made on October 23, 2024. The data, gathered through the content analysis method, was analyzed using both qualitative and quantitative methods. The qualitative analysis was conducted solely to support the quantitative findings and identify prominent themes. Prior to the quantitative analysis, the data underwent preprocessing using various text mining techniques to prepare them for analysis. Subsequently, sentiment analysis was performed using NRC and VADER and the emotions in the comments were classified. Sentiment classification was also conducted using models such as Naive Bayes, SVM, Neural Networks, K-Nearest Neighbors and Decision Tree. Furthermore, key topics were identified through LDA topic modeling and correlation analysis was performed to explore the relationships between emotions. An overview of the methodology is presented in Figure 1.

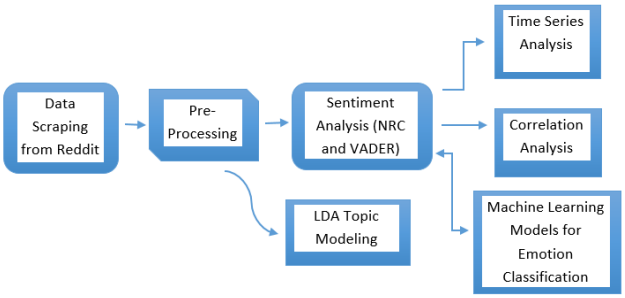

Figure 1. Methodology process template

Data analysis

After the data was collected, various preprocessing steps were applied to make the text in the comments more meaningful and focused before proceeding with the analysis. First, irrelevant information such as the number of likes, number of comments and URLs, which were not needed for the analysis, was removed, allowing the core content of the text to be preserved and making the analysis process easier. This reduced the text to only the content that needed to be focused on in the analysis. As part of noise cleaning, usernames, timestamps and unnecessary symbols were removed from the text, making the comments more meaningful for processes such as sentiment analysis and topic modeling.

Following this, Sentiment Analysis, Time Series Analysis, Correlation Analysis, LDA Topic Modeling Analysis, Sentiment Classification with Machine Learning Models and Phenomenological Research Method and Technique in Analyzing Qualitative Data and Content Analysis were conducted.

Sentiment analysis

In the sentiment analysis process, both the NRC Emotion Lexicon and VADER analysis tools were used. The NRC Emotion Lexicon scored specific emotional tendencies for each comment, resulting in emotion scores for feelings such as “Anger”, “Anticipation”, “Disgust”, “Fear”, “Joy”, “Sadness”, “Surprise” and “Trust” in the comments.

The VADER analysis tool was used to determine general emotional tendencies in Reddit comments, as it demonstrates effective performance, particularly in social media and short texts. In VADER analysis, for each comment, positive, negative, neutral and compound (overall) scores were calculated, along with polarity and subjectivity scores. The compound score, ranging from -1 to +1, represents the general emotional tendency of the comments from negative to positive. Meanwhile, the positive, negative and neutral scores allowed for a more detailed analysis of the sentiment intensity and content bias of the comments. The polarity score indicates whether the comment expresses a positive or negative sentiment, revealing how positively or negatively the user expresses their opinion. The subjectivity score, on the other hand, determined how personal or objective the comments were, providing insights into whether users tended to evaluate their experiences from a subjective or objective perspective.

Time series analysis

Time series analysis was used to examine the trends in emotions over the years from the comments on Reddit. This method analyzed how users’ emotional responses to the application

changed over time by investigating the intensity of emotions that emerged during specific periods. In the time series analysis, emotional scores obtained for each month were visualized and interpreted to understand the emergence of positive or negative trends during certain periods. Time series graphs for each emotion type were presented on both an annual and monthly basis; these graphs illustrated the fluctuations of emotional variables over time, enabling the identification of long-term trends, sudden changes and seasonal variations. In this analysis process, particular attention was paid to how each emotional score calculated by VADER and NRC changed over time. In the VADER analysis, metrics such as compound, polarity and subjectivity, which indicate general trends, were examined, while in the NRC analysis, more specific emotions like "Anger," "Anticipation," and "Trust" were analyzed individually. This allowed for the identification of years when the emotional intensity towards the application increased or decreased and periods when positive or negative emotions were more concentrated. The contribution of time series analysis to the findings was to enable the periodic analysis of emotional changes, revealing how updates made to the application or events affecting user experience impacted users' overall emotional tendencies.

Correlation analysis

Correlation analysis was conducted to examine the relationships between different emotions in the comments on Reddit. This analysis method helped us understand how users' emotional responses are related to one another by determining whether certain emotions tend to increase or decrease together. For example, it was determined through correlation analysis whether users tend to feel "Anticipation" and "Trust" together, or whether negative emotions like "Fear" and "Sadness" are often seen together.

In the correlation analysis process, Pearson correlation coefficients were calculated for each pair of emotional scores obtained from the VADER and NRC analysis tools. The resulting correlation matrix was visualized and examined to identify the presence of positive correlations (approximately +1), negative correlations (approximately -1) and weak correlations (approximately 0). This analysis revealed that when there is a strong relationship between emotions, these emotions tend to appear together in user comments, allowing us to determine which emotions are more frequently expressed together in users' emotional responses to the application. Thus, correlation analysis helped us better understand how certain features of the application emotionally impact users by identifying the tendency of users to feel specific emotion combinations together. This analysis served as a significant tool in the findings

section, supporting the identification of when users experience negative or positive emotions together and how strong these emotional relationships are.

LDA topic modeling analysis

Latent Dirichlet Allocation (LDA) topic modeling analysis was applied to identify prominent themes in the comments on Reddit. This analysis method allowed us to better understand users' common interests, needs and concerns by dividing user comments into specific topic categories. In the LDA analysis, the frequency of words co-occurring in each comment was used to determine the topics users focused on most. This process broke down the comments into their core components, revealing which topic or theme each component was associated with. The LDA model grouped the user comments into a specified number of topics, identifying the key terms and content associated with each topic. Features and needs frequently mentioned by users were grouped together and categorized under different themes.

The topic modeling results obtained in this analysis process are detailed in the findings section to understand whether specific themes emerged in the comments and to identify the main points users focused on. The LDA analysis revealed users' demands for the application, the issues they encountered and the features that contributed to their satisfaction, presenting these as key themes. In this way, a broader perspective was provided, showing how users gathered around specific features such as nature hikes, route planning and offline maps, while analyzing their expectations and experiences related to these areas.

Sentiment classification with machine learning models

In this study, five different machine learning models were applied to classify emotions in user comments: Naive Bayes, SVM (Support Vector Machines), Neural Networks, K-Nearest Neighbors (K-NN) and Decision Tree. These models were used to accurately determine the emotional tendency of each comment and were evaluated using performance metrics such as accuracy, precision, recall and F1 score. During the application of the machine learning models, each model was trained using training data and tested for accuracy on test data. A wide range of algorithms, from simpler models like Naive Bayes to more complex ones like Neural Networks, were used to predict which emotion class each comment belonged to. The models were evaluated separately for each identified emotion category and success rates in detecting emotions were compared.

In this analysis, the classification performance of the models was compared to determine the model with the highest accuracy and F1 score. The use of machine learning models in this

study enabled the automatic classification of emotions in the comments, allowing for a comprehensive analysis of users' overall emotional distribution and tendencies towards the application. This method contributed to the findings section of the study by showing how user emotions were distributed according to each model's classification accuracy and performance.

Phenomenological research method and technique in analyzing qualitative data and content analysis

The phenomenological research approach used in this study aims to deeply examine user experiences related to navigation applications in nature, obtained from Reddit. Phenomenology is a research method focused on understanding the essence of participants' experiences. In this context, the researcher seeks to understand the participants' experiences not from their own perspective, but from the participants' own viewpoints. The study adopts the interpretative phenomenology (Hermeneutic Phenomenology) approach. This approach not only describes the participants' experiences on a superficial level but also combines the meaning of these experiences within context, along with the researcher's interpretations. Developed with contributions from philosophers such as Heidegger, Gadamer and Ricoeur, this approach analyzes individuals' experiences in-depth while incorporating the researcher's perspective and interpretation into the process (Ali and Abushaikha, 2019; Norlyk and Harder, 2010). This is important for gaining a more meaningful understanding of users' experiences and deeply exploring what these experiences truly mean.

In this context, traditional content analysis is applied as a method for classifying Reddit comments into meaningful categories and themes. Content analysis is a qualitative data analysis technique that allows for the systematic examination of specific themes or keywords within texts. The use of traditional content analysis here enables the identification of key themes and emotions emerging in Reddit comments and their categorization. This approach contributes to the phenomenological research process by classifying the content of the comments, allowing for a better understanding of user experiences (Creswell, 2013; Moerer-Urdahl and Creswell, 2004; Reiners, 2012). This process includes stages of coding, categorizing and theme development, thus enabling the identification of patterns and themes (Lapadat and Lindsay, 1999). Thematic analysis is a widely used technique in analyzing qualitative data, such as individual interviews and focus group studies and helps in identifying key themes and patterns (Embregts et al., 2020; Nardi et al., 2020).

Coding is the process of assigning labels or codes to specific sections of text based on their content. These codes can then be organized into categories (Neale, 2016). In this study,

different colors were used to create categories for similar codes in interviews and to synchronize these categories. Categorizing involves grouping the coded sections under broader themes, providing a structured analysis of the data (Lapadat and Lindsay, 1999). Theming defines the overarching themes that emerge from these categories, offering a deeper understanding of the content of the data (Chung et al., 2022; Nardi et al., 2020). This systematic approach helps researchers define key findings and insights (Embregts et al., 2020; Keikelame and Swartz, 2016). The analysis process, consistent with the nature of phenomenological research, focused on coding qualitative data and conducting thematic analysis. Specific themes and categories were developed based on the participants' experiences.

In this study, various themes and categories related to maps and navigation applications used for hiking and exploration were addressed. A total of 5 main themes and 14 categories were identified. First, under the theme of Reliability and Accuracy, it was highlighted that maps contain errors such as incorrect distance and elevation measurements and misleading directions can harm users. Additionally, the misrating of trail difficulties can lead users to attempt overly challenging trails unprepared, exposing them to potential risks. Another important issue is the Lack of User Knowledge, resulting from users relying solely on digital maps and applications. This situation can put users in difficult positions by neglecting the use of traditional maps and compasses. In the Accessibility and Usability section, it was noted that applications provide quick access to popular trails without the need for guidebooks, but the ability to download maps for offline use in areas without an internet connection was also highlighted as a crucial feature. Under the theme of Environmental and Social Impact, the issues of environmental damage caused by harm to natural areas and the unauthorized creation of social trails were discussed. Additionally, the influence of social media led to overcrowding on popular trails and the Community Pressure and FOMO (Fear of Missing Out) phenomena, directing users to specific trails, can result in the overuse of natural habitats. The User Experience and Application Design theme pointed out that subscription fees and paid content pressures could negatively affect the user experience. Furthermore, the lack of user-friendly maps and interfaces was identified as Visual Interface Issues, which complicate finding trails and these design problems were noted to make the application harder to use. Finally, the Alternative Solutions and Advanced Navigation Needs theme emphasized the importance of alternative map sources and applications. Some alternative applications are preferred by users for providing more accurate navigation. Moreover, the importance of Backup Equipment was stressed, with a recommendation to carry traditional maps and compasses alongside digital maps for safety.

These findings highlight the importance of both the convenience offered by digital maps and applications and the security and accuracy provided by traditional methods.

In this study, content analysis was also conducted to identify the prominent themes in user comments and to support the quantitative findings. The collection of Reddit comments through archival searching as a qualitative data collection tool was used as a key component in this study. The comments obtained from discussions on Reddit formed a dataset reflecting users' experiences, expectations and critiques regarding the application. These qualitative data were associated with both NRC and VADER sentiment analyses, providing an additional perspective on the emotional aspects of user experiences. These analyses contributed to the interpretation of the content and the identification of main themes and emotional trends, aiding in the findings section.

The qualitative data obtained through archival searching were presented in tables, providing a broader perspective on the study's findings. The information in these tables allowed for the evaluation of users' expressed emotions and thoughts about the application in alignment with the results of the quantitative analysis. In this way, emotional and thematic trends were examined together; users' experiences with the application were analyzed more deeply, enriching the findings. Content analysis, therefore, served as an effective tool in this study, detailing users' emotional responses.

FINDINGS

NRC sentiment analysis results

A total of 314 posts and 2,381 comments were analyzed using NRC sentiment analysis. The results of this analysis, regarding the overall sentiment scores for the application, are shown in Table 1. The emotions with the highest scores, "Trust" and "Anticipation," indicate that users have a positive sense of trust and expectation towards the application, while the high score for "Joy" signals user satisfaction. However, the presence of emotions such as "Fear" and "Sadness" suggests that certain aspects of the application may cause concern among users, pointing to potential areas for improvement in reliability.

Table 1. NRC total sentiment scores

Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust
737	2688	468	1327	1693	1020	959	2912

Figure 2 visualizes the total sentiment scores obtained from Reddit comments. The total score for each emotion reflects the intensity of the emotions expressed by users in their comments.

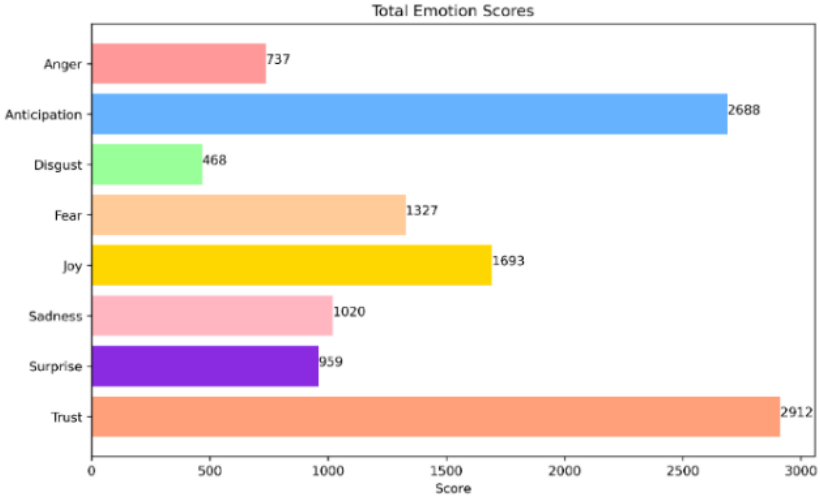

Figure 2. Total sentiment scores from NRC analysis of reddit comments

The emotion with the highest score, "Trust," with 2,912 points, indicates that users have developed a general sense of trust towards the application or have strong expectations of trust from it. The second-highest score, "Anticipation," with 2,688 points, suggests that users have certain expectations or demands regarding the application's performance. Another prominent emotion, "Joy," with 1,693 points, may indicate that the application brings happiness or satisfaction to users. Following this, "Fear" and "Sadness" emotions suggest that certain deficiencies or unexpected situations within the application may be sources of anxiety or sadness for some users. The emotions with lower scores, "Surprise" and "Anger," show that users occasionally encounter surprising or anger-inducing situations, but these emotions are less dominant compared to others. Finally, the emotion "Disgust," with one of the lowest scores, suggests that users generally do not feel significant dissatisfaction with the application.

Figure 3 shows the changes in each emotion over time. These eight graphs, illustrating the monthly emotional intensity trends between 2014 and 2024, are used to analyze how specific emotions have evolved over time. Each graph represents the change in a different emotion, such as Anger, Anticipation, Disgust, Fear, Joy, Sadness, Surprise and Trust. In the Anger graph, distinct fluctuations are visible, with anger reaching high peaks during certain periods, suggesting that specific events or times increase the intensity of anger. Anticipation shows a highly fluctuating pattern, reaching higher intensities compared to other emotions, with peaks reaching up to 2.5, indicating the impact of rising hope or expectation at certain times.

The Disgust emotion generally shows low intensity but stands out with sudden spikes during some periods. The Fear emotion also follows a fluctuating trend, reaching up to 1.2 during certain times, which may indicate that some events increase the intensity of fear. Joy shows a more consistent upward trend, with notable increases at specific times. Sadness remains relatively stable, with fluctuations at certain intervals, but generally stays at low intensity. The Surprise emotion typically remains at low levels, although significant increases occur during specific periods. Trust, compared to other emotions, follows a more stable upward trend, gradually increasing over time.

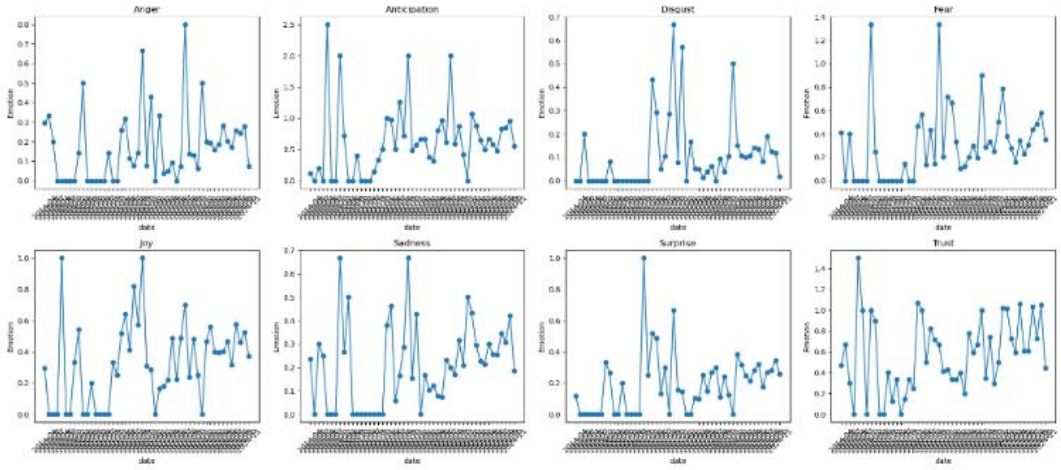

Figure 3. Emotion distributions by year

Figure 4 shows the intensity trends of various emotions on a monthly basis between 2014 and 2024, with each line reflecting the changes of a specific emotion over time. Notably, the emotion of Anticipation frequently reaches peaks, rising to levels as high as 2.5, standing out as one of the strongest emotions in the analyzed texts. The emotion of Trust, in contrast, follows a more balanced trend, reaching higher levels in 2019, 2022 and 2023. The emotion of Fear exhibits sudden increases in 2019 and 2023. Both Joy and Sadness emotions fluctuate over time, with sadness showing an increase during specific months, while joy maintains a more consistent intensity. Although Surprise typically remains at low intensity, it peaks in 2021 and 2023. Anger and Disgust generally remain at lower intensity levels, but anger saw a noticeable rise in 2019. Overall, Anticipation and Trust are observed at higher intensities compared to other emotions, standing out as dominant emotions in the texts. In contrast, emotions like Fear, Surprise and Sadness show more irregular distributions with increases during specific periods. This graph highlights the emotional fluctuations over the studied period and identifies when these emotions were experienced more intensely.

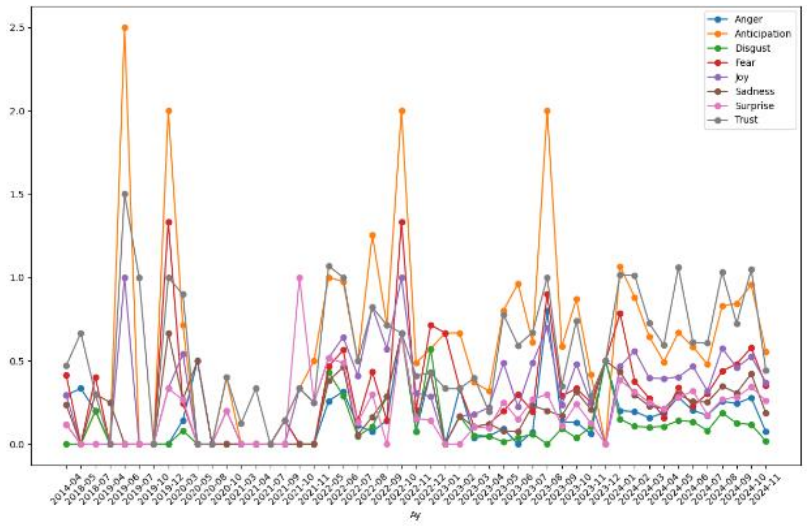

Figure 4. Monthly NRC sentiment trend over time (2014-2024)

Table 2 contains examples of user comments related to emotions. Since it is not possible to share all of the findings, comments that include a range of different scores have been selected as examples.

Table 2. Examples of user comments related to emotions

Comment	Sentiment Score
One reason for this is that users encourage other users to venture off the trail by sharing unofficial hiking routes on the platform. This is a situation that park rangers prefer not to intervene in. Rangers promote the use of official routes that provide accurate distance and elevation information, as this helps minimize the time, cost and effort spent on rescue operations. At the same time, this preference is crucial for preventing damage to sensitive natural areas that need protection.	Anger: 2, Anticipation: 6, Fear: 4, Joy: 4, Sadness: 2, Surprise: 3, Trust: 5
While it is not possible to share your location or current route in real-time, you can add a marker to your current location and share it as long as you have an internet connection. You can find detailed instructions on how to share via the app here.	Anticipation: 5, Joy: 3, Trust: 3
This is a highly effective application that lists trails approved by land management agencies. With its user-friendly interface, it provides comprehensive data on almost all public lands across the state.	Anticipation: 5, Joy: 2, Surprise: 1, Trust: 3
This application attracts a wide user base by offering offline map capabilities. The ability to access maps even in mountainous areas where communication is disrupted is considered a significant advantage for users.	Anticipation: 5, Fear: 2, Joy: 2, Trust: 4
Some features are only available for Premium users, but even the basic features provide sufficient functionality for hiking. However, a Premium subscription may be a sensible option for accessing more detailed information.	Anticipation: 5, Joy: 3, Trust: 2
The variety of routes offered by the application is quite good, but some issues may arise when the GPS signal weakens. Therefore, using a backup GPS device alongside the application might be a safer option.	Anticipation: 5, Fear: 3, Trust: 3
This application offers the ability to examine terrain maps in detail and it could be particularly useful for hikers who prefer long and challenging routes.	Anticipation: 5, Joy: 2, Trust: 4
The application's interface is user-friendly and quite intuitive, making it especially practical for checking routes during long hikes. However, it could become a much more functional tool if supported with additional features.	Anticipation: 5, Joy: 3, Trust: 2
The application's GPS accuracy is generally sufficient, but signal loss can occasionally occur in forested or mountainous areas. For such situations, providing stronger signal support or alternative map options could be beneficial.	Anticipation: 5, Fear: 2, Trust: 3

Comment	Sentiment Score
The offline map feature is quite useful, as the application provides access to maps without an internet connection. However, offering additional route information and guidance options could further enhance the application's functionality.	Anticipation: 5, Joy: 4, Trust: 3
The application is a very useful resource for mountaineering and hiking. While the route options are extensive, adding more detailed descriptions and user feedback for specific trails could be more guiding, especially for beginners.	Anticipation: 5, Trust: 3
The application's updates are generally helpful, but some features feel lacking. In particular, displaying more detailed routes and providing more accurate elevation information could further improve the user experience.	Anticipation: 5, Trust: 2
It could be beneficial for the application to update its maps more frequently. Especially when new information is added to popular routes, users will have the opportunity to start their journeys with more up-to-date and reliable data.	Anticipation: 5, Trust: 3
The application's offline usage feature is quite useful, but some details are missing. If notifications about the current status of routes are provided, the user experience could be safer and more informative.	Anticipation: 5, Fear: 1, Trust: 4
I use the application frequently for hiking, but there is missing information on some routes. If details like water sources or camping areas were shown on the routes, the user experience could be much more useful.	Anticipation: 5, Joy: 2, Trust: 3
The routes offered by the application are quite diverse; however, if more detailed information about the difficulty levels of some routes were provided, it could be a much more effective guide for users.	Anticipation: 5, Trust: 2
I enjoy using the application; however, the terrain information can sometimes be insufficient. If more detailed topographic information were added, it could become a much more useful resource for professional hikers.	Anticipation: 5, Trust: 3
I find the application's offline mode really useful. Being able to access maps when my phone battery is low or when there is no connection enhances our safety in nature. I can use it confidently, especially on challenging routes or in areas with weak GPS signals.	Anticipation: 5, Fear: 3, Joy: 3, Surprise: 1, Trust: 7
I went on a night hike using the offline mode. Overall, I liked it and managed to reach my destination; however, at one point, the direction arrow veered off and this surprised me a bit.	Disgust: 1, Trust: 1

Looking at user comments overall, it is evident that the application is considered a strong guide for hikers and outdoor activities, but some shortcomings have been highlighted by users. Users emphasize the offline mapping feature as a significant advantage, while requesting more detailed information on GPS accuracy, terrain data, difficulty levels and water sources. Additionally, the sharing of unofficial routes is considered risky, with park rangers recommending the use of official trails. Most users believe the current features of the application are sufficient for hiking, but the premium features could be beneficial for those seeking more information. The comments, where anticipation and trust emotions stand out, suggest general satisfaction with the application's user-friendly interface and wide variety of routes, while also highlighting the need for more reliable and detailed information.

VADER sentiment analysis results

Figure 5 shows the monthly average sentiment score trends from 2014 to 2024, indicating users' emotional tendencies from positive to negative through the compound score of the VADER analysis. High positive values at the beginning of 2019 and mid-2023 suggest that users had more positive emotions towards the application during these periods, which may be

linked to new features or updates that improved user satisfaction. In contrast, the declines at the end of 2019 and late 2023 may have been due to negative experiences or unmet expectations; particularly, the scores that dropped into negative values indicate shortcomings in the application or unexpected issues. Overall, while the graph shows a positive trend over the years, notable fluctuations at certain periods reveal that application updates and events have affected user emotions.

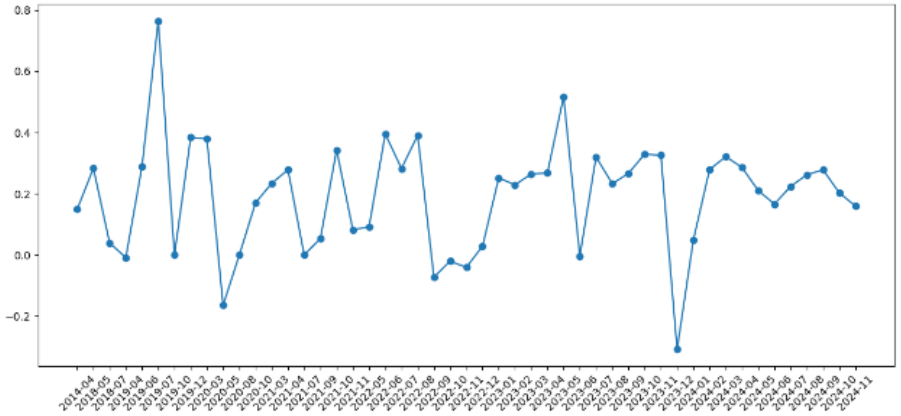

Figure 5. VADER Sentiment Analysis Monthly Emotion Trend Over Time (2014-2024)

Figure 6 shows the monthly emotion trends from 2014 to 2024, based on the VADER compound score, polarity and subjectivity values. The compound score expresses the overall emotional tendency from positive to negative, while the polarity value indicates whether the comments are positive or negative and the subjectivity score reflects how personal or objective the comments are.

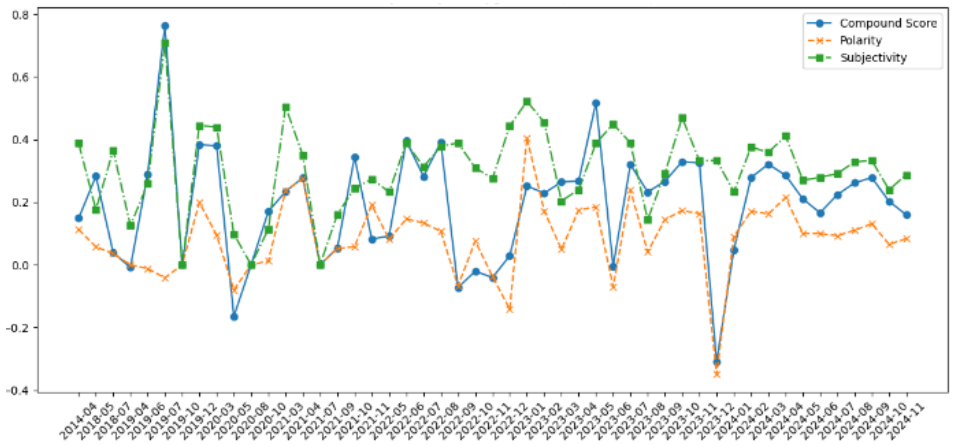

Figure 6. VADER sentiment analysis monthly emotion trend over time: VADER compound score, polarity and subjectivity values (2014-2024)

In the compound score, positive peaks are observed at the beginning of 2019 and mid-2023, indicating that users developed a more positive attitude towards the application during these periods. The polarity and subjectivity values also fluctuate during similar periods,

showing that in certain months, there was an increase in highly subjective comments and users expressed stronger emotional reactions. When there were declines in the compound score during specific periods, polarity approached negative values and subjectivity decreased, indicating that there was an increase in negative and more objective criticisms of the application. Overall, the graph reveals the changing positive or negative emotions of users over time and the intensity levels of these emotions.

Correlation analysis results

In the correlation matrix of emotions shown in Figure, the relationship levels between different emotions are visualized. Red and blue tones represent positive correlations (approximately 1.0) and lower or negative correlations (approximately 0.0), respectively. It can be observed that as the color shifts towards red, the correlation strengthens, while the shift towards blue indicates a weaker correlation and a weaker relationship between the emotions.

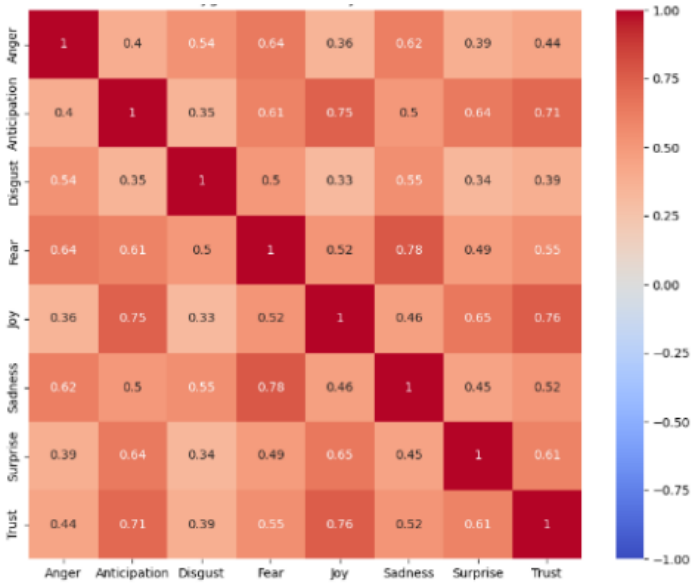

Figure 7. Emotion correlation matrix

This correlation matrix shows the relationships between eight different emotions and reveals an overall positive relationship between the emotions. There are strong positive correlations, such as 0.71 between Anticipation and Trust, 0.78 between Fear and Sadness, 0.76 between Joy and Trust and 0.75 between Anticipation and Joy. This suggests that, for example, anticipation and trust, or fear and sadness, often increase together. We also observe weaker, but still positive, relationships between other emotions. Notably, negative emotions like fear and sadness have lower correlations with positive emotions such as trust and joy, providing important insights into how emotions changed in relation to one another over the analyzed period.

LDA topic modeling results

The word clouds shown in Figure 8 visualize the key words and terms related to two separate topics. This overview helps us understand how the application is used by different user groups for various outdoor activities, which features users focus on and provides insights into the usage scenarios of these features.

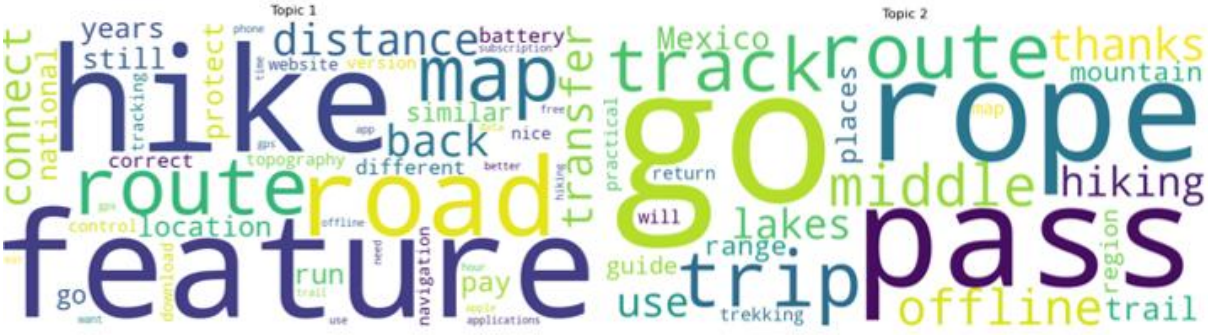

Figure 8. LDA topic modeling results

In Topic 1, words such as “hiking,” “distance,” “location,” “share,” “connect,” and “transfer” stand out, indicating that the application offers features such as distance measurement, location tracking, route sharing and data sharing, particularly for hikers. It appears that users frequently discuss these features and emphasize their importance during outdoor hikes or travels. Expressions like “pay,” and “free” suggest that users are evaluating the paid and free versions of the application. In this context, Topic 1 represents a focus on the application’s technical features and how users benefit from these features, as well as their satisfaction or dissatisfaction with them.

In Topic 2, words such as “mountain,” “trip,” “route,” “pass,” and “go” stand out. This suggests that the application is used for activities such as mountaineering, hiking and route planning on various trails. It appears that users are evaluating the app, especially for planning outdoor activities, mountaineering and trail hiking. Words like “offline,” “guide,” and “area” indicate that users need features like offline maps or guide options for these activities. This cloud demonstrates that the application’s route planning, navigation in natural areas, guidance and offline map functions are valuable to users.

Looking at both topic clouds, it can be seen that the application covers features such as route creation, location tracking, distance measurement and offline access for users’ hiking, mountaineering and trail activities. The first topic focuses more on the technical aspects of the application (location, distance, data transfer), while the second topic shows that the application

is centered around more specific activities (mountaineering, trails, route planning) from a user experience perspective.

In the LDA topic modeling analysis, key words were obtained under 10 topics. Based on these topic modeling results, it is evident that the application is used by a wide user base for various activities such as outdoor activities, hiking, mountaineering and route planning. Key features that attract users' attention include distance tracking, location identification, route sharing and offline map usage. In groups like Topic 1, the technical aspects of the application (location, distance, route transfer) and how it meets users' needs are emphasized, while other groups like Topic 2 and Topic 4 focus on activity-specific elements such as mountain hiking, passes and route creation in natural areas. Topics like Topic 5, Topic 6 and Topic 9 focus on offline map options, GPS integration and compatibility with other navigation tools, while groups like Topic 7 and Topic 10 highlight how users evaluate the app on social media, information sharing and community interactions. Keywords in different languages show that the application is being discussed among international users and serves similar needs across different cultural contexts. Overall, this modeling demonstrates that users view the app as a guide and navigation tool for outdoor activities, with a strong interest in features such as location and route tracking, offline access and community support.

Performance of machine learning models in sentiment classification

According to the results in Table 3, the sentiment classification performance of each machine learning model is compared. The performance of the machine learning models in sentiment classification was evaluated based on accuracy, precision, recall and F1 score. Accuracy represents the proportion of correctly predicted examples out of all the samples, while precision shows how accurate the model is when predicting a specific emotion. Recall indicates how many of the actual examples of a particular emotion the model can correctly predict. The F1 score, as the harmonic mean of precision and recall, reflects the overall performance of the model. In this comparison, the performances were evaluated using F1 scores.

Table 3. Performance of Machine Learning Models in Sentiment Classification

Emotion	Naive Bayes F1-Score	SVM F1-Score	Neural Networks F1-Score	K-NN F1-Score	Decision Tree F1-Score
Anger	0,06	0,94	0,99	0,81	0,9
Anticipation	0,87	0,98	1	0,96	0,98
Disgust	0	0,91	1	0,6	0,91
Fear	0,25	0,98	1	0,83	0,82
Joy	0,33	0,96	1	0,89	0,95
Sadness	0,84	1	1	1	1
Surprise	0	0,88	1	0,81	0,77
Trust	0	0,92	0,97	0,85	0,92
AVERAGE	0,84	0,98	1	0,96	0,97

These results compare the classification performance of five different models on various emotions, using F1 scores and accuracy rates. The Neural Networks model delivers the best results with near-perfect accuracy (0.99), while the SVM and Decision Tree models also demonstrate high accuracy (0.98 and 0.97, respectively) and consistent F1 scores, showing successful performance. The Naive Bayes model, however, has a lower accuracy rate (0.78), particularly performing poorly in categories like "Anger," "Disgust," "Sadness," and "Surprise." The K-Nearest Neighbors (K-NN) model shows a strong accuracy rate (0.96) and effective performance in most emotions, though it exhibits lower F1 scores in certain categories like "Disgust." Overall, the Neural Networks model provides the most successful classification performance with high accuracy and F1 scores for all emotions, while the SVM and Decision Tree models can also be considered as alternatives.

As a result of the classification analysis, the most prominent emotions were identified in the following order: Anticipation (1175), Trust (847), Joy (262), Anger (265), Fear (208), Surprise (139), Sadness (116) and Disgust (84). These results show that the most intense emotion users experience in relation to navigation applications in nature is anticipation, which is linked to the process of route planning and discovery through the application. The fact that Trust ranks second suggests that users tend to view these applications as guides in nature, but their trust may be shaken when they encounter incorrect information or misleading directions. The similar proportions of Joy and Anger imply that while the conveniences and moments of success provided by the application make users happy, technical issues or complex directions can lead to disappointment and anger. The lower intensity of the other emotions (fear, surprise, sadness and disgust) indicates that users rarely experience these feelings during their use of the application, though concerns about safety or unexpected situations in nature could lead to such emotions. Details about how the classification results were obtained are presented in Table 4.

Table 4. Examples of findings from machine learning models in sentiment classification

Comment	*Anger*	*Anticipation*	*Disgust*	*Fear*	*Joy*	*Sadness*	*Surprise*	*Trust*	*Label*
Many less experienced visitors consider what they see there to be 100% reliable. If the map is incorrect, it could lead to them getting lost or doing something beyond their abilities because of how the application evaluates the route. However, the real issue, in my opinion, is people sharing "unofficial" trails there. At the Arches where I work, there wasn't a maintained path to a specific arch structure, but this point was added to the app a few years ago. Previously, visitors wanting to see this arch were mostly locals and they would follow a low-impact creek bed to get there. Now, however, due to people hearing about this point in the app and trying to find it with poor GPS data, an irregular and scattered social trail network, footprints and erosion have developed. People are getting lost here and the local vegetation and biological soil have been severely damaged. I don't think everything should remain secret, but allowing tourists with no prior knowledge of the area to access trails, hidden points and neglected hiking routes that were once known only by locals has caused significant damage to natural and cultural resources and has created serious dissatisfaction among the local community. Information that used to only be available to those who were knowledgeable or had the experience to do research is now largely accessible to the public through a simple Google search, thanks to the app.	4	2	5	3	1	7	0	5	Sadness
I think the critics of the app are exaggerating its accuracy issues. I've done over 110 days of hiking and running. Are there sometimes small discrepancies in distance or elevation gain? Yes, but it's usually no more than 10% and most of the time I'm adding extra routes myself. Furthermore, any trail with over 500 comments (and especially those with over 1000 comments) is already a very popular route; you can find this trail in any guidebook, hiking website, or park website. Also, the app provides a much better idea about distance by combining different trail segments, compared to looking at a paper map. I haven't seen any significant issues even for trails with fewer than 500 comments (especially those with fewer than 150 comments). These trails may be more overgrown or rocky, but the reviews usually mention that and it's not hard to figure out what kind of hike it is by looking at the topographic map and turning on satellite view. A trail that is not already popular is by nature a less-used trail, so the issues arising from that trail are also limited. As for the "social trails" issue, many	2	3	0	4	4	4	0	5	Trust

Comment	***Anger***	***Anticipation***	***Disgust***	***Fear***	***Joy***	***Sadness***	***Surprise***	***Trust***	***Label***
other apps show the same information. The only serious issue that comes to mind is people illegally visiting Native American ruins and causing damage; however, the solution to this is to create real trails and protective infrastructure for these areas, not to ignore or close off access to these historic sites. Overall, the benefits provided by the apps far outweigh the limited and specific disadvantages.									
The only issue I've encountered is that the difficulty level can vary depending on the person. A trail that is considered "difficult" for one person could be an almost life-threatening experience for someone else. We went to Wells Gray Provincial Park in BC, Canada and completed a trail loop. Although the trail was marked as "difficult," looking back, I think there could be a risk of death for some people on this trail.	1	1	1	1	0	1	1	1	Anger
A great resource for general searching, but once you decide on a trail, it's best to find local park information. The problem is, most of the time, this information is not easily accessible.	0	1	0	1	0	1	0	1	Anticipation
The app is great, but it directs me on automatic routes through busy and fast (70 mph) main roads and two-way streets, rather than scenic and peaceful rural roads in my area.	0	0	0	0	0	1	0	0	Sadness
Color standards may vary depending on your location. Where I live, boundary markers are usually bright orange, while blue is used for water lines.	1	0	0	1	0	1	0	1	Anger
This road is marked as a "private" road according to the app, but I have direct access from where I'm temporarily staying, just like everyone else in my neighborhood. Additionally, after a few turns, you can also access this road from the main state highway.	0	0	1	0	0	1	0	0	Disgust
I followed your suggestion; I exported the GPX track from the app and imported it into another app and the results are shown in the main post. I can say that the app is indeed not entirely accurate.	0	0	1	1	0	1	1	0	Disgust
You can use the app to search for caves. I found some amazing places there!	0	0	0	0	1	0	0	1	Joy
I recently bought a Garmin Venu SQ 2. I have a limited budget, but I chose this watch because I need GPS navigation functionality while hiking. However, I learned that the Navigation in Nature app is not compatible with this watch. Is there another compatible alternative app I can use, or is it possible to send route data from the app to the watch via another method to use for navigation? Ideally, I'm looking for a free solution or something with a one-time payment (I can't add a monthly subscription fee right now).	0	2	0	2	1	0	0	2	Anticipation

Comment	***Anger***	***Anticipation***	***Disgust***	***Fear***	***Joy***	***Sadness***	***Surprise***	***Trust***	***Label***
I recorded a hike using the watch with the app and the app created the hike as an exercise in Apple Health. So, I was expecting it to pull health data the same way the Apple Watch exercise app does. Is this normal? Am I doing something wrong?	0	4	0	1	1	0	1	2	Anticipation
It requires sharing the GPX file or completing the route itself and then sharing it. To be honest, I'm not looking for an alternative to the app; there are plenty of alternative apps available. However, if there is no way for me to access the app's API and get route information and GPX files for free, I would need a modified version of the app.	0	3	0	0	2	0	0	2	Anticipation
...When hiking alone in nature, the sense of peace and meditation that comes from connecting with nature is experienced. As hikers, we often enjoy getting lost in our thoughts during the hike. In challenging or rugged terrains, we turn to the map to find the best route. Often, we use various apps to find the route; however, on less known trails, we rely on tools like Google Maps to examine the geography. We create cairns as trail markers, much like the tracks we leave in a game. On long hikes, we lighten our load by leaving a water bottle on the path and pick it up again on the way back, similar to collecting dropped packages in a game. As environmentally conscious hikers, we collect litter we find in nature, like water bottles; in the game, the player tracks help others find the correct path. In real life, people use navigation apps for hiking to look at routes uploaded by others, then add their own routes and update them with various changes...	5	13	6	9	14	13	6	18	Trusth
Due to COVID, I've turned to outdoor activities, so I bought a 6XPRO for myself. This is my first smartwatch and I'm a complete beginner while trying to understand this ecosystem. I managed to download an 80 km trail from the Navigation in Nature app to the watch. This was challenging because my watch doesn't connect to any Wi-Fi networks and seems to only respond to my phone's data connection. My question is: How can I use this trail as a bike activity? I know how to use it for navigation. I also know how to start the bike activity. However, I can't find the option to use this specific trail in the bike activity widget. Is it not possible to load the trail directly into the bike activity widget? Or do I need to start the activity and then launch the navigation app separately? Is it possible to run both apps simultaneously?	1	8	0	3	0	1	0	1	Anticipation
I've been using the Navigation in Nature app for the last two years; I didn't know any other app and chose this one because it's widely used in my country. The subscription fee is also quite	1	1	1	1	3	1	1	5	Trust

Comment	*Anger*	*Anticipation*	*Disgust*	*Fear*	*Joy*	*Sadness*	*Surprise*	*Trust*	*Label*
reasonable, only 10 € per year. Overall, I'm satisfied, but I frequently lose the GPS signal. I'm not sure if switching apps would help, or if it's a hardware issue (I'm using an iPhone 12 Pro). Additionally, sometimes it gives incorrect altitude and distance measurements. I haven't found another app with as many trails. I recently heard about another alternative app, but I don't understand why it's better than the one I use. Also, the 60 €/year subscription fee discourages me from switching. Which app do you use? Why do you think it's better than the others, or what makes it more advantageous for you?									
Yes, definitely. I think I might be the first person (or one of the first) to hike this trail this year. These types of plants grow incredibly fast...	1	1	0	1	2	1	0	2	Joy
Gorbeia has introduced the first official route collection specific to the Basque Region in the app.	0	0	0	0	0	0	0	1	Trust
Yes, I'm using the app right now as well. However, I tend to feel a bit lost while searching for a route until I find something valuable. Whenever I've gone with a guide and didn't have to find the route or lead the group, I felt much more at ease.	0	0	0	0	0	0	0	1	Trust
When I tried to create a route in the app, it connected the points directly with lines, ignoring the actual paths. Then, when I tried to follow the route on my watch, it only displayed it on the map and didn't give any alerts when I strayed off the route.	0	1	0	2	1	0	1	1	Fear

Looking at the distribution of emotions in the document, the most frequently encountered emotion is Anticipation, which was used a total of 228 times. Trust comes in second with 109 mentions, holding a strong position among the positive emotions in the document. Fear appears 52 times, making it another significant emotional expression. On the other hand, Joy appears 43 times, while Anger is mentioned 17 times, Disgust 18 times and Sadness 18 times, occupying a smaller portion among the negative emotions in the document. Finally, Surprise was expressed 16 times, indicating it was used less frequently compared to the other emotions. This distribution shows that Anticipation and Trust are the dominant expressions in the document, with the other emotions being expressed at lower rates.

Phenomenological research method results

Theme 1: Reliability and accuracy

Map Errors: Users emphasize that the accuracy issues in the maps and directions provided by the app could have serious safety implications. Errors in frequently encountered

information, such as distance, elevation and trail names, can lead hikers to get lost on trails that are much longer or more difficult than they had planned. These misdirections, especially for inexperienced users or those unfamiliar with the area, pose a risk and can cause them to be caught unprepared. While users acknowledge the value of the app in increasing accessibility, they also criticize it for over-reliance and insufficient accuracy. It is noted that the app needs to improve the accuracy of its data to provide users with better directions.

"Wrong maps are a big issue."

"I once hiked a trail listed as 6.5 miles, but it was actually 8 miles. That's a significant difference."

"There are known errors that could be dangerous, but the app refuses to remove this input."

"The app has made hiking much more accessible... But people have become overly dependent on the app, going on hikes unprepared and not using common sense."

"When I first moved to Las Vegas and started my hiking adventures, the first thing I did was download the app. But the first thing it did was get me lost. The trail names and distances were wrong."

"There's nothing like hiking 8 miles on a trail you planned for 5 miles! This happened to me and I can see how this could put people in a tough situation if they're unprepared."

Difficulty Level Issues: Based on user experiences, it is evident that the difficulty level assessments in the app are inconsistent and this can lead to serious problems. Users report that certain trails labeled as "difficult" vary significantly depending on experience level and sometimes this rating does not reflect the actual difficulty of the trail. For instance, some trails are labeled "difficult," but are described as almost dangerous or "deadly" for inexperienced individuals. Additionally, situations where the planned distance far exceeds what was anticipated can catch users off guard and potentially increase safety risks. These types of evaluation issues can lead users to misjudge their own abilities and potentially face dangerous situations.

"Based on my experience, 'easy' and 'moderate' levels are accurate, but 'difficult' is relative..."

"What is difficult for one person can be life-threatening for someone else. We went to Wells Grey Provincial Park in British Columbia and did a loop; this trail was marked as 'difficult,' but looking back, it could have been truly deadly for some."

"There's nothing like hiking 8 miles on a trail that was planned for 5 miles and realizing there's still a long way to go. This happened to me personally and I can see how this could be a real danger for those who are unprepared."

Lack of User Knowledge: These user comments highlight the risks that come with the convenience provided by modern navigation apps. Some users, who rely entirely on phone apps, struggle with navigation when they experience signal loss or technical issues. This emphasizes the importance of basic navigation skills, such as using a map and compass. While apps improve the user experience, it is clear that carrying a backup plan or tool for unexpected situations would enhance safety. Such feedback suggests that technology should be viewed as a complementary tool for a safer experience in nature.

"We lost the signal on the trail we were on and lost our direction, I should have had a compass with me."

"When the app lost signal, I couldn't find my direction, this is where the importance of relying on a traditional map and compass is understood."

Theme 2: Accessibility and usability

Access to Information for Everyone: These user comments show that apps provide easy access to popular trails, allowing users to plan their routes without the need for guidebooks. It is highlighted that these apps are quite practical for short hikes, but for longer hikes, traditional topographic maps are still preferred. Users can access information via digital maps independently of guidebooks and even discover hidden trails or new paths. These experiences demonstrate that technology-supported hiking not only makes planning easier but also enhances safety through various map options.

"I rely completely on the phone app without using a map and I haven't had any issues so far."

"I use the app for short hikes, but for longer hikes, I heavily rely on topographic maps."

"The app showed me a pedestrian or hidden bike path I wasn't aware of before."

"The app worked great for me. I work as a guide, so I have some experience in this area. I'm also a complete map enthusiast, so if a map is available in the area, I always carry one."

Offline Usage: User experiences highlight how valuable offline maps are as a feature in outdoor sports apps. The ability to download routes in GPS format through apps and use them without an internet connection provides great convenience for travelers, especially in remote areas where connectivity issues may arise. Users point out the benefits of the app's offline functionality; in some cases, they find the additional payments for this feature worthwhile due to the accessibility it provides. These experiences demonstrate the popularity of offline map downloading options, which enhance both safety and ease of navigation for users during hikes and explorations.

"I use the app frequently. It's free to just view others' tracks and download GPX files, but you need to pay an annual fee for offline navigation and route creation options."

"I bought all the world maps for offline use in the app with a one-time fee and they are mine forever. I think these tools are worth the price you pay."

"I'm familiar with the app and you can download GPX files for offline use and save them to your phone, so no data connection is needed. This is quite a basic feature and many apps allow you to do this."

"I use the app to have offline maps. After recording, I can export GPX files and track the route on the map."

Theme 3: Environmental and social ımpact

Environmental Degradation: User experiences show that the formation of social trails and unauthorized paths is causing damage to natural habitats and leading to environmental degradation. These trails often emerge as alternative routes created by people seeking better views or easier passage in areas that are not officially maintained or permitted. Especially in sensitive ecosystems, off-trail movements can lead to erosion and, due to heavy use, can cause significant harm to vegetation, soil structure and local ecosystems. In this context, users recognize these damaging tendencies and express that authorities need to implement more control.

"Social trails are forming due to heavy use by people, which damages natural habitats. Particularly outside of the trails, situations where people widen paths or deviate to get a better view are frequently observed."

"Some popular trails are not officially maintained, but people use these trails, leading to environmental degradation."

"Going off-trail, especially in sensitive ecosystems, causes erosion. As a result, in some areas, people frequently go off the trail to view the scenery or take a shortcut, damaging the environment."

"In some areas, creating unauthorized walking paths is causing harm to natural habitats. I believe authorities need to provide more control to limit this issue."

Community Pressure and FOMO: The excessive use of apps providing access to popular trails, amplified by the influence of social media, is increasing and reinforcing the "FOMO" (Fear of Missing Out) effect, creating overcrowding on certain trails. Users, influenced by social media posts, tend to gravitate towards popular trails, leading to over-concentration of frequently used routes. This situation can make users dependent on popular routes, while limiting the spirit of exploration in nature and potentially causing issues related to conservation.

"Social media FOMO is creating more people who walk the same trail and feel like they have to walk it."

"The app has made hiking much more accessible and encourages more people to spend time outdoors, which is great because hiking has countless benefits. However, making hiking so easily accessible also brings some downsides, such as people relying entirely on the app, going on hikes unprepared and not using common sense. I also think some people don't like that hiking, which is a serious activity for them, has become so easy and ordinary for others. To be fair, I believe hiking posts on social media do the same thing, maybe even more intensely; by almost advertising beautiful views, they direct people to those places just to take photos, without fully understanding what the hike itself requires."

Theme 4: User experience and app design

Subscription Challenges: Based on user experiences, the subscription system and paid content in outdoor hiking and navigation apps can sometimes be seen as complex and costly. For example, some users find it advantageous to pay for premium versions of a certain app,

while others prefer the free version of the same app or find it more reasonable to purchase maps only during specific promotional periods. While the app offers various features, users may prefer sections of the app that do not require a subscription for navigation, in order to reduce costs. Overall, despite the benefits that the apps provide, some users avoid paying for premium subscriptions on a regular basis and are looking for alternative free solutions.

"The only app I've paid for premium. It's worth it."

"It has a premium version, but it doesn't add much. Waiting for map promotions makes more sense. I bought it for 20 euros a few years ago. I haven't had to pay for anything else since then."

"I use GPS for navigation. The app's maps are inadequate for poorly mapped areas. The app is expensive, but I can usually zoom in on the map over Wi-Fi and save the data to my phone, using it without paying for a subscription."

Visual Interface Issues: The issues users face with visual interfaces and user-friendly designs emerge as a significant factor negatively impacting their experience. The app's complex and non-user-friendly interfaces make it difficult for users, especially beginners, to use the app. A similar problem occurs in alternative apps, where users encounter complex and unintuitive interfaces while searching for specific collections, making it difficult to navigate through results and find the collections. The lack of easy access to basic functions like search and filtering hinders the efficient use of the app, making it harder for users to find the trails or content they are looking for. This suggests that a better interface and more intuitive design are needed for users to utilize the app more effectively.

"The app I used before was very complex and not user-friendly."

"You can search within collections... but it's not very intuitive; when searching for trips in a region, you'll see collections among the results and most of the time these collections are in the form of multi-day tours."

"I don't understand how to filter these collections, even when I navigate through the results, there's no filtering option."

Theme 5: Alternative solutions and advanced navigation needs

Other Apps and Resources: Users' experiences include various evaluations of the features and advantages offered by different map and route tracking apps. One alternative app stands out for providing detailed information, such as showing road surface types and is highly

regarded by users for organizing and tracking routes. In its paid version, it offers additional advantages like providing offline maps for more days and segmenting routes, making it a preferred planning tool for users. Another alternative is free to download and offers maps covering a wide area, making it particularly useful for real-time navigation. This app is popular for route discovery within its large user community, while the other one meets a basic need by allowing the download of GPX files for offline use. All these comments show that users are utilizing different apps based on their needs and preferred features.

> *"I primarily use other alternative apps. They are great for organizing and tracking routes; compared to other apps, they also show road surface types (asphalt, gravel, natural, paved, etc.), which is very important to me. Another alternative stands out because it's free to download and covers any region of the world. When I go to a region, if the app doesn't cover the offline map, I use the other one for real-time navigation. I also use this app to see routes created by users, as it has a larger community compared to others."*

> *"If you just want to follow this route, choose a simple free app, like the alternative app. This app shows CAI routes and generally works well. Others work well too, each with their advantages and disadvantages. The alternative app is my choice for planning trips; the paid version includes more days and its ability to automatically segment routes with offline apps makes it a valuable option."*

> *"I know of an alternative app that lets you download GPX files and save them to your phone, so you can use it without a data connection. This is a basic feature and many apps allow you to do this."*

> *"I use an alternative app, but you have to pay for all offline maps (a one-time payment, I think around 15-20 €) and then you have lifetime access. I use it both for planning trips and for tracking the route."*

Backup Equipment Usage: The comments highlight the importance of traditional map and compass use, in addition to the convenience provided by digital maps and apps. Many users, skeptical of the reliability of digital devices, prefer the security offered by physical maps and compasses. Especially in areas with weak GPS signals or when the battery is depleted, these traditional tools provide a vital safety measure. For example, some users warn, "Learn to use a compass and a topographic map. These existed before phone apps and even if phone apps get lost, they will still be around for a long time. Plus, they don't require batteries!" Additionally,

some users emphasize the risks of relying solely on the app, suggesting that it's better to cross-check with other official maps, rather than focusing only on the app as a guide. They recommend a combination of backup maps and apps. These views underline the importance of being prepared with traditional equipment, rather than solely relying on digital maps, to ensure safety during nature hikes.

> *"Get a compass and a topographic map and learn how to use them. These existed before phone apps and even if phone apps disappear for a long time, they will still be around. Plus, they don't require batteries!"*

> *"If we don't want to focus only on the app, would it be a better idea to use it alongside another official map for comparison? I'm heading west and I don't want to put myself or others in danger with inaccurate information. I've printed maps and have apps, but I want to be as prepared as possible."*

> *"In many remote trails, I've noticed that in some areas, the starting points are wrong. I can tell whether people are using the app or not by looking at where they parked and the direction they went."*

DISCUSSION AND CONCLUSION

This study examined emotional trends and user experiences with navigation apps used for outdoor activities through user comments on the Reddit platform. The findings reveal that users exhibit various emotional responses to app usage. The highest emotion scores were associated with "Anticipation" and "Trust," indicating that users have a positive attitude toward the app, but also experience anxiety due to the app's shortcomings. Specifically, issues related to GPS accuracy and errors in difficulty ratings triggered negative emotions such as "Fear" and "Anger" among users. Notably, the feeling of trust plays a crucial role in users' willingness to rely on navigation systems and its role in the adoption of technology trust is supported by several studies (Trapsilawati et al., 2019; Walker et al., 2016). Navigation functionality significantly impacts user trust, improving emotional responses related to navigation features (Kim et al., 2012). Navigation systems based on unreliable information can severely affect user trust, leading to increased emotional distress (Trapsilawati et al., 2019). Users may experience heightened anxiety and anger when navigation apps fail to deliver the expected results (Schlösser et al., 2016).

Users' emotional responses are also influenced by their previous experiences with navigation technology. Research shows that past interactions shape users' expectations and

emotional reactions toward current apps. While specific references to support this claim are lacking, it is generally accepted that prior experiences can influence trust and emotional responses in technology use (Ha et al., 2010). For instance, if a user previously encountered significant accuracy errors with GPS navigation, they may approach new apps with skepticism, leading to increased anxiety and distrust.

Time series analysis revealed how emotional trends regarding the app changed over time. Periods when "Anticipation" peaked indicated hopeful expectations related to new features or updates. However, the increase in negative emotions such as "Fear" and "Sadness" over time points to the challenges the app faces in meeting user satisfaction. A user-centered design, which prioritizes user needs and focuses on continuous improvement, is essential for enhancing the user experience. Such an approach can encourage more positive emotional responses from users by providing apps that meet expectations and deliver a seamless experience (Lau et al., 2021). Research has shown that users' initial experiences have a significant impact on their ongoing interactions with mobile health apps (Vaghefi and Tulu Vaghefi, 2019). Users' negative evaluations can stem from various factors, including system failures and insufficient responses to user needs, leading to emotions like frustration and dissatisfaction. Another study indicates that technical issues and privacy concerns may drive users away from mobile health apps, thereby increasing negative emotional responses (Korte et al., 2018).

Additionally, the emotional dynamics in navigation apps can also be examined within the framework of human-computer interaction. A study discussing the effects of system delays on user emotions and satisfaction suggests that apps unable to respond promptly to user inputs may trigger negative emotional states (Yang and Dorneich, 2015). This is especially important in the context of navigation, as timely feedback is crucial for user trust and satisfaction. The interaction between user emotions and app performance underscores the necessity for developers to create responsive and adaptable systems that mitigate negative emotions and improve the user experience.

The findings also emphasize the importance of traditional methods, such as offline usage of navigation apps and the use of backup equipment like compasses, when GPS signal loss occurs. Users prefer to carry traditional tools, such as maps and compasses, alongside digital maps and apps to enhance safety. This can be seen as a safety measure against the limitations of digital navigation systems. Research has shown that although GPS technology is widely used in navigation systems, its effectiveness can be limited in various outdoor environments, such

as dense forests or urban canyons with signal blockages (Gan et al., 2019). When GPS signals are weak or unavailable, the integration of inertial navigation systems (INS) has been proposed as a solution to improve navigation accuracy (Guan et al., 2020). However, despite advanced systems, users often encounter situations where traditional navigation tools are needed. For example, studies highlight that users typically carry physical maps and compasses as backups, emphasizing their preference for redundancy in navigation tools to reduce the risks associated with GPS reliance (Stymne, 2020).

Moreover, the literature emphasizes the importance of the usability of navigation apps, particularly in outdoor environments. The offline functionality of these apps is a crucial factor in many outdoor activities in areas with limited or no internet connection (Tian et al., 2022). Research has shown that offline usability is a critical factor directly affecting users' trust and safety (Nawfel et al., 2021). This is especially relevant in outdoor learning and exploration environments, where continuous GPS availability cannot be guaranteed (Stymne, 2020).

The combination of traditional and digital navigation methods can be seen as a proactive approach to safety. Users are aware of the limitations of GPS technology, which is affected by environmental factors, terrain and weather conditions (Buono et al., 2020). By carrying traditional navigation aids, users not only increase their situational awareness, but also ensure that they have a reliable navigation tool in case digital systems fail. This practice aligns with findings from various studies advocating for the integration of traditional skills with modern technology, supporting a multifaceted approach to improve overall navigation efficiency and safety (Rahok et al., 2010).

Environmental and social impacts also emerge as significant themes. Users have reported excessive congestion on certain trails due to the influence of social media and popular trails, leading to environmental degradation. Furthermore, social media posts have been observed to increase the FOMO (Fear of Missing Out) effect, directing users towards crowded trails. This results in nature walks causing harm to natural areas and contributing to social pressure among users.

Studies have shown that the FOMO phenomenon increases individuals' motivation to visit popular trails due to social media posts (Rameli, 2023). This behavior is consistent with findings that social media significantly influences users' decision-making processes, particularly among younger demographics who are more sensitive to social pressures and trends (Andoh-Quainoo, 2021; Raza et al., 2020). The need for social approval and community

belonging is often met through social media interactions, which can lead to increased visits to already crowded trails, exacerbating environmental impacts (Rameli, 2023; Raza et al., 2020).

The environmental consequences of this overcrowding are significant. Research has shown that increased foot traffic on natural trails can lead to soil erosion, damage to vegetation and overall degradation of natural habitats (Janočková et al., 2015). To mitigate these effects, the necessity for sustainable trail management practices has been highlighted, with trail design and user education being critical factors in protecting natural areas (Janočková et al., 2015). Moreover, the anthropogenic pressures on these trails require a reassessment of the effects of social media on outdoor recreation patterns and the subsequent environmental consequences. Social dynamics, however, cannot be overlooked. The pressure to conform to social media trends can create a sense of community among users, but it can also reinforce competition and anxiety related to outdoor experiences (Rameli, 2023; Raza et al., 2020). This social pressure may lead to a cycle where individuals visit certain trails not only for personal enjoyment but also to maintain their social status (Rameli, 2023). In this context, the interaction between social media use and outdoor recreation reveals a complex relationship in which environmental sustainability is at risk due to social influences.

A study on navigation applications in nature found that smart route applications (SRAs) have a positive impact on safety, but the results regarding user experience were mixed (Keskin, 2021: 88-90). Inexperienced participants using SRAs reduced their risk perception, but this limited the enjoyable aspects of the experience, negatively affecting their overall experience. On the other hand, experienced participants were able to use the SRAs only when necessary, maintaining their social interaction within the group without disrupting the experience. These findings suggest that while SRAs can be beneficial for safety, they may have negative impacts on experience and enjoyment, particularly for inexperienced participants. Therefore, to improve the effectiveness of SRAs, it is recommended that a national route database be created in collaboration with authorized institutions such as AFAD, GSGM and military units and real-time tracking systems be implemented. Additionally, it is emphasized that all individuals participating in outdoor activities should receive basic training to raise awareness and preparedness levels and that authorities should carefully plan official routes considering both safety and experience. In conclusion, while technologies like SRAs contribute to safety in outdoor activities, they should be used in a balanced manner without compromising the traditional experience.

In conclusion, this study has provided a detailed analysis of user perceptions regarding nature hiking and map applications, offering valuable suggestions for application developers. Improvements in areas such as safety, accuracy and user-friendly designs could enhance the user experience and contribute to minimizing issues encountered during nature hikes. Ultimately, the study aims to provide developers with valuable insights to offer a stronger, more reliable experience that meets user expectations and safety concerns.

Recommendations

Based on the findings of this study, several key recommendations are presented for the development of nature hiking and navigation applications. First, GPS accuracy and app reliability should be improved, particularly through the integration of accelerometer-based navigation systems to provide accurate location data in challenging terrains. Additionally, offline functionality should be enhanced to ensure that users can easily access map and navigation features in areas without internet access. User training and support are also crucial; apps should provide clear guides that emphasize the importance of using traditional maps and compasses. Regarding environmental impacts, alternative routes could be introduced to prevent overcrowding and damage on heavily used trails and users should be educated about sustainable outdoor activities. Considering the effects of social media-driven FOMO (Fear of Missing Out) and the overuse of popular trails, apps could highlight lesser-known, worthy trails for exploration. The app design should be simplified to ensure user-friendliness and offer more customization options. Future research should focus on examining the contribution of social media and environmental impacts on outdoor activities and provide a more detailed exploration of emotional dynamics according to user demographics. These recommendations could significantly contribute to improving user experience and supporting environmental sustainability in applications used for nature-based activities.

Limitations and strengths

The limitations of this study stem from the fact that the findings are restricted to the Reddit platform. User comments on Reddit only reflect the experiences of users on this particular platform and therefore may not represent the broader user population. Future research could focus on user comments from different social media platforms (such as Twitter, Instagram, or Facebook) to conduct a comparative analysis and gain a broader perspective on user perceptions.

Another limitation is that due to the large volume of data, the fluctuations of emotions over time could not be thoroughly examined. While the data was collected within a specific

timeframe, it was not possible to analyze emotional trends and changes in detail. Future research could conduct a more detailed time-series analysis to explore how emotional trends evolve year by year or seasonally. Such analyses could provide better insights into users' emotional shifts and changes in application usage over time.

Addressing these limitations would allow future research to offer more comprehensive and in-depth insights into user experiences with navigation applications, using broader datasets and more detailed analyses.

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Tasarım *Design*	Yöntem ve araştırma desenini tasarlamak *To design the method and research design.*	Muzaffer Toprak KESKİN Şevket Cihat ÖZER Nurten ULUSAY Münevver ULUSAY
Literatür Tarama *Literature Review*	Çalışma için gerekli literatürü taramak *Review the literature required for the study*	Muzaffer Toprak KESKİN Şevket Cihat ÖZER Nurten ULUSAY Münevver ULUSAY
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Tartışma ve Yorum *Discussion and Commentary*	Elde edilen bulguların değerlendirilmesi *Evaluation of the obtained finding*	Muzaffer Toprak KESKİN Şevket Cihat ÖZER Nurten ULUSAY Münevver ULUSAY

Destek ve Teşekkür Beyanı/ *Statement of Support and Acknowledgment*

Bu çalışmanın yazım sürecinde katkı ve/veya destek alınmamıştır.

No contribution and/or support was received during the writing process of this study.

Çatışma Beyanı/ *Statement of Conflict*

Araştırmacıların araştırma ile ilgili diğer kişi ve kurumlarla herhangi bir kişisel ve finansal çıkar çatışması yoktur.

Researchers do not have any personal or financial conflicts of interest with other people and institutions related to the research.

Etik Kurul Beyanı/ *Statement of Ethics Committee*

Bu çalışma, katılımcılardan anket, mülakat, odak grup tartışması, gözlem, deney veya diğer yöntemler gibi veri toplama tekniklerini içermeyen bir araştırmadır. Araştırma yalnızca literatür taramasına ve mevcut verilerin analizine odaklanmaktadır. Çalışmanın verileri kamuya açık bir platform olan Reddit'ten elde edilmiş ve analizler bu veriler üzerinden gerçekleştirilmiştir. Dolayısıyla Etik Kurul onayı gerektirecek bir veri toplama süreci içermemektedir. Çalışma, insan veya hayvanları içeren herhangi bir deneysel veya klinik araştırmayı, kişisel verilerin toplanmasını veya fikri mülkiyet haklarıyla ilgili ihlalleri içermemektedir. Bu makalede derginin yazım kuralları, yayın ilkeleri, araştırma ve yayın etiği ile etik standartlarına uyulmuştur. Makale ile ilgili ortaya çıkabilecek her türlü ihlalden yazarlar sorumludur.

This study is a research that does not involve data collection techniques such as surveys, interviews, focus group discussions, observations, experiments, or other methods from participants. The research focuses solely on literature review and the analysis of existing data. The data for the study was obtained from Reddit, a public platform and analyses were conducted based on this data. Therefore, it does not involve a data collection process that would require Ethics Committee approval. The study does not include any experimental or clinical research involving humans or animals, the collection of personal data, or violations related to intellectual property rights. In this article, the journal's writing guidelines, publication principles, research and publication ethics and ethical standards have been followed. The authors are responsible for any violations that may arise related to the article.