Research on Improving the UI/UX Design of Nepal Stock Exchange Trade Management System (TMS)

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Abstract-

This research paper presents an analysis of the Nepal Stock Exchange Trade Management System (TMS) and proposes improvements to its user interface (UI) design. Using Schneiderman's Eight Golden Rules, the study addresses usability challenges including inconsistent sidebar alignment, the absence of a discussion forum, limited accessibility of the FAQ section, disappearing navbar icons, lack of user feedback during market closure, separate user manual, absence of a dark mode feature, non-functional search client link, and the lack of transaction feedback. The proposed design enhancements aim to resolve these issues by establishing consistent alignment and labeling, integrating a discussion forum, improving FAQ accessibility, ensuring persistent navbar icons, providing user feedback, integrating the user manual, introducing dark mode, removing non-functional links, and implementing transaction feedback. The anticipated outcome is an improved UI design for the Nepal Stock Exchange TMS, contributing insights to human-computer interaction and achieving a higher standard of UI design in financial trading systems.

Keywords: Human-Computer Interaction, User Interface Design, User Experience Design, Nepal Stock Exchange, Trade Management System, Schneiderman's Eight Golden Rules, Usability Challenges, UI/UX Improvements, Comprehensive Design, User Feedback, Dark Mode.

I. INTRODUCTION

The Nepal Stock Exchange (NEPSE) is the only stock exchange in Nepal. It was established in 1992 and is headquartered in Kathmandu. NEPSE has a trading system called the Trade Management System (TMS). The TMS is a computer-based system that facilitates the trading of securities on the NEPSE. The TMS was first developed in 1992 and has been upgraded several times since then. However, the TMS is still considered to be outdated and in need of improvement. The UI/UX design of the TMS is not user-friendly and can be difficult to use, even for experienced traders. This can lead to errors and delays in trading, which can have a negative impact on the performance of the NEPSE. [1]

The Nepal Stock Exchange Trade Management System (TMS) plays a pivotal role in facilitating stock market activities within Nepal. However, the existing system faces various challenges that impede its efficiency and user experience. These challenges encompass issues such as misaligned sidebar navigation, the absence of a discussion forum, limited accessibility of the FAQ section, erratic behavior of navbar icons, lack of user feedback during market closures, a separate user manual, lack of a dark mode feature, non-functional search client link, and the absence of transaction feedback. Addressing these challenges is crucial to ensure a seamless and user-friendly trading experience for market participants. This research aims to enhance the UI/UX design of the Nepal Stock Exchange TMS by leveraging Shneiderman's Eight Golden Rules of Interface Design. These principles provide a solid framework for improving usability and user satisfaction in interface design.

The scarcity of comprehensive research focusing on the UI/UX design of stock exchange systems specifically within the context of Nepal serves as the primary motivation behind this research. By incorporating best practices from successful international trade management and stock buy/sell applications, this research aims to address the challenges faced by the Nepal Stock Exchange TMS. The proposed enhancements, such as

integrating a discussion forum, improving FAQ accessibility, ensuring consistent navbar icon visibility, providing clear user feedback during market closures, integrating the user manual within the system, introducing a dark mode feature, and removing non-functional links, seek to create a comprehensive and improved UI/UX design for the Nepal Stock Exchange TMS.

The anticipated outcome of this research is an enhanced trading system that offers smoother transactions, improved user engagement, and contributes to the overall development of the Nepalese stock market.

A. Related Works

For reference and motivation, we searched for related works. We found a lot of international applications. Some of the most popular are mentioned below.

1. *Zerodha*: Zerodha is an online trading platform in India that offers commission-free trading on stocks, ETFs, and options, along with a user-friendly interface, extensive research tools, educational resources, and excellent customer support, making it an ideal choice for both novice and experienced traders. [2]
2. *Upstox*: Upstox is an Indian stockbroker that provides investors with a range of investment products and services, such as stocks, mutual funds, futures and options, and IPOs. Notable features of Upstox include a user-friendly platform, competitive brokerage fees, and adherence to regulatory standards set by the Securities and Exchange Board of India (SEBI). With a significant customer base and a commitment to offering diverse investment opportunities, Upstox emerges as a reliable choice for investors seeking a streamlined and regulated platform. [3]
3. *TD Ameritrade*: TD Ameritrade, based in USA, is a well-established online brokerage firm offering a wide range of investment products and services, including stocks, bonds, mutual funds, options, and futures. Known for its competitive brokerage fees and commitment to customer service, TD Ameritrade is regulated by FINRA and SIPC, ensuring reliability and compliance in the investment industry. [4]
4. *Robinhood*: Robinhood, headquartered in Menlo Park, California, is a commissionfree stock trading app that enables users to trade stocks, ETFs, options, and cryptocurrency. Founded in 2013, Robinhood has gained popularity for its user-friendly platform, low fees, and educational resources. The company is regulated by FINRA and SIPC, ensuring trustworthiness and compliance. [5]

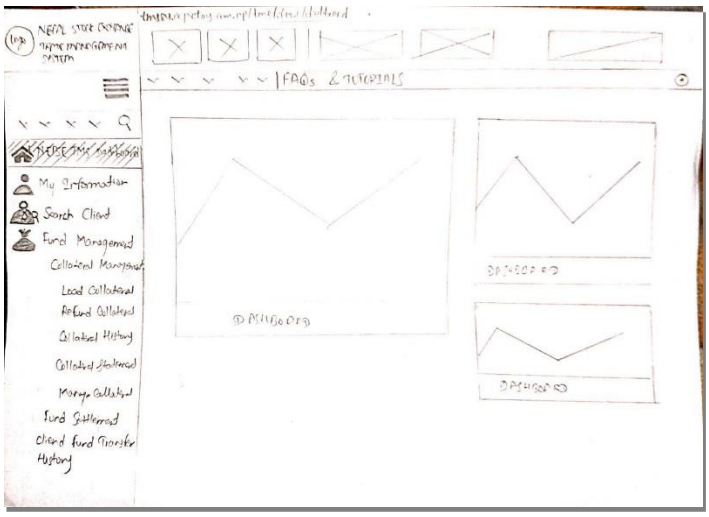
II. METHODS

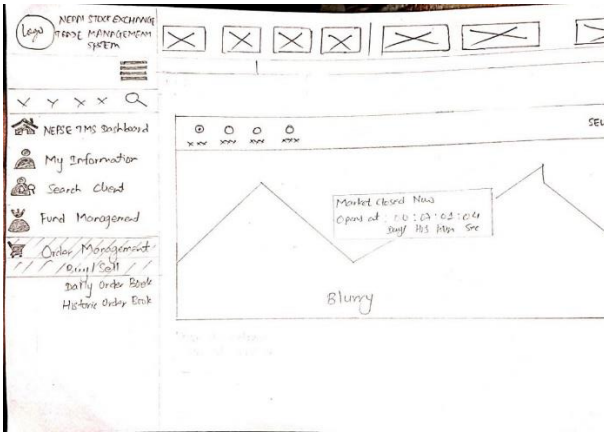
A. Survey

We started our research with a survey to collect information about people's needs and demands regarding international payment gateway. Brainstorming was done to prepare the questionnaire. As our targeted users were from a wide range of age groups, we surveyed people from every group. As our problem statement was very relatable to most of the users, a large number of people participated in our survey.

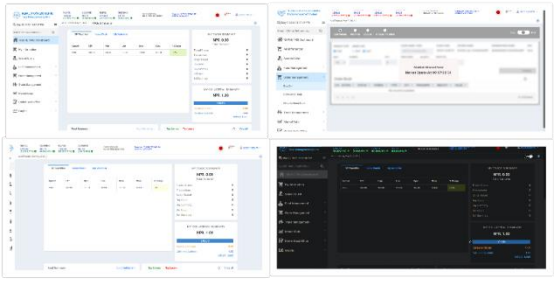
B. Digital Prototype and its Survey

In the beginning, we completed a paper prototype with the implementation of new design features.





After getting feedback from the survey, we prepared the final digital prototype using Figma.



C. User Persona

The ideal user of NEPSE Trade Management System is anyone who wants to trade in the Nepal Stock Exchange, provided they have Demat Account and Broker Account. This includes business persons, employees, students, etc. The majority of them fall in any of the following age groups viz. 18-25 years, 26-35 years, 36-45 years, 46-55 years and over 55.

The general behavior patterns of these users are as follows:

- Users of trade management systems engage regularly, monitoring investments and executing trades.
- They actively seek out information, relying on trade management systems for real-time data and research tools.
- Users spend time developing trading strategies and continuously analyze market trends.
- Risk management is a priority, employing techniques like diversification and stop-loss orders.
- Users strive for continuous learning, adapting to changing market conditions and networking with other investors.

The major needs and goals of the users are:

- Efficient Execution: Users expect fast and accurate trade execution for maximizing profits.
- Real-Time Data and Analysis: Users rely on up-to-date market data and analysis tools for informed decision-making.
- Portfolio Management: Users need comprehensive features for tracking investments and managing risk.
- Risk Management Tools: Users require tools to protect investments and minimize potential losses.
- Education and Learning Resources: Users value access to educational resources and market insights for improving their trading skills.

Some of the issues they are currently facing are:

- Navigation Alignment: The trade management system experiences issues with the sidebar navigation menu not aligning properly, impacting user accessibility and ease of use.
- Enhanced FAQ Accessibility: Users find it inconvenient to manually download the FAQ document, suggesting a need for improved accessibility by integrating the FAQ directly into the website for easy reference.
- Navbar Icon Disappearance: Users encounter a problem where the icons in the navigation bar intermittently disappear after continuous clicking, leading to a suboptimal user experience and confusion.
- Market Closure Feedback: When the market is closed, the buy/sell portal displays a blur, but users desire clear feedback within the user interface to indicate the market's closed status.
- Improved User Manual Placement: Users request that the user manual be readily available within the website itself, ensuring convenient access to important instructions and guidance.
- Dark Mode Feature: Introducing a dark mode option within the trade management system is sought after by users for improved visual comfort, reduced eye strain, and customization preferences.
- Non-functional Search Client Link: The link to search for clients does not work, leading to user frustration. As a result, the

decision was made to remove this non-functional feature.

- Transaction Feedback: Users lack immediate feedback on whether a stock purchase or sale has been successfully executed, indicating a need for real-time transaction feedback to enhance transparency and confidence in trading activities.

D. Ethnography

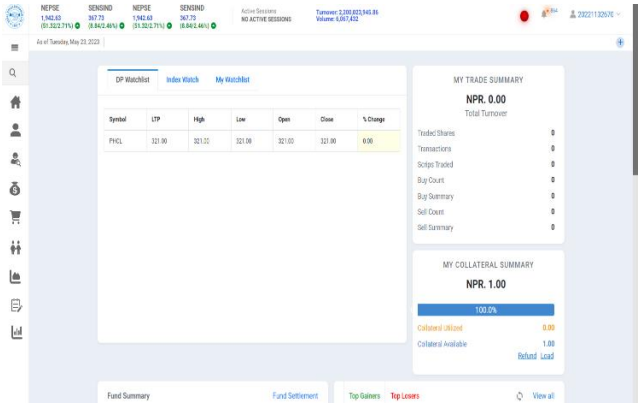
We focused on the following factors while doing the observation and we used the same person that we have described in the user persona: Was the user able to use all the features available in the TMS website?

No. According the portrayal, s/he was able to utilize the essential features like buying and selling of stocks along with other highlighted features. NEPSE TMS offers many services which s/he was unaware about.

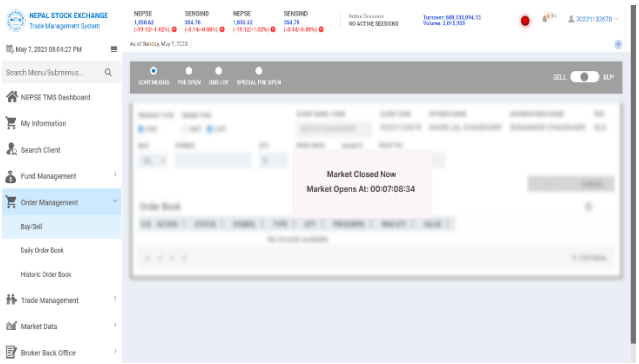
- Was the user able to achieve the action they wanted to accomplish by ease?
  Yes, the user was able to perform needed action with ease.
- Was the user in need of the improvement in user interface?
  Yes, the user was in need of the improvements as mentioned above

E. UI design using Figma

After modeling and finalizing our prototype, we continued towards the development of UI. We used Figma for this purpose which is a browser-based UI and UX design application, with excellent design, prototyping, and code-generation tools. We were able to exhibit the major part of the significant screens which were designed using HCI design principles.

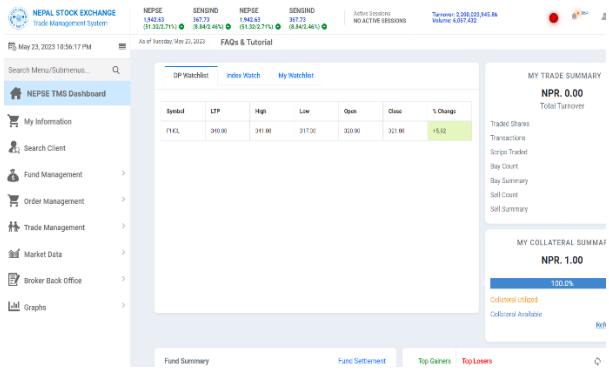


Significant enhancements have been implemented in response to user feedback, specifically addressing the alignment issues of the sidebar navigation menu and the intermittent disappearance of icons in the navbar of the Nepal Stock Exchange Trade Management System. These improvements incorporate a minimalistic design approach, which prioritizes simplicity and clarity in the user interface. The realignment of the navigation menu ensures proper placement and a streamlined visual hierarchy, while the resolution of the disappearing icons issue promotes consistency and maintains a clean and uncluttered interface. These design modifications align with established principles of minimalistic design and contribute to an enhanced user experience by providing users with a visually pleasing and intuitive interface.

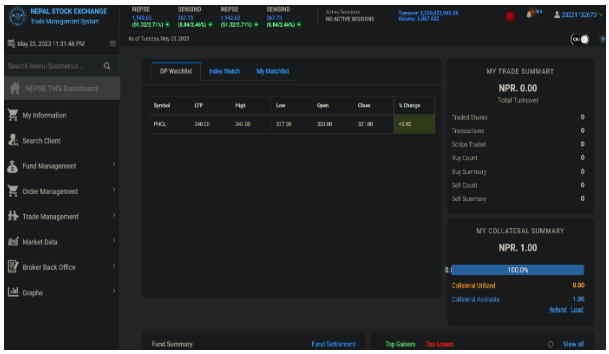


To address the lack of user feedback in the UI regarding the blur in the buy/sell portal when the market is closed, we implemented a comprehensive feedback system. This system now provides real-time updates and notifications indicating the market's status, whether it is closed or open. Additionally, a countdown timer has been incorporated to display the time remaining until the market opens. These improvements ensure users are informed and allow them to plan their trading activities accordingly, enhancing their overall experience and supporting more efficient decision-

making within the Nepal Stock Exchange Trade Management System.



We have made significant improvements to the FAQ section of the Nepal Stock Exchange Trade Management System. Previously, users had to download the FAQ separately, but now it is seamlessly integrated into the website itself. This integration allows users to access the FAQ instantly without the need for manual downloads. Additionally, we have addressed the issue of non-functional links by removing them from the system. These enhancements aim to improve user accessibility and ensure a smoother browsing experience.



In response to user feedback and to enhance the user experience, we have introduced the feature of dark mode to the Nepal Stock Exchange Trade Management System. Dark mode offers users an alternative visual display option characterized by a darker color palette, predominantly using dark backgrounds and light text. This feature aims to reduce visual fatigue, improve readability in low-light environments, and provide a visually appealing interface. Users now have the flexibility to switch between light and dark modes based on their preferences and environmental conditions, resulting in a more comfortable and customizable trading experience.

F. Schneiderman's eight golden rules

In the development of the Nepal Stock Exchange Trade Management System, we have employed Schneiderman's Eight Golden Rules of interface design to ensure a user-centered and intuitive experience. These design principles serve as a guide for creating effective and efficient interfaces that promote usability and user satisfaction. The following is a summary of how we applied Schneiderman's principles:

1. Strive for consistency: We have maintained consistency throughout the system, using consistent and minimalistic language, icons, and interaction patterns. This allows users to easily understand and navigate the interface.
2. Enable frequent users to use shortcuts: We have improved the navigation panel, and added feedback mechanisms for users to use shortcuts and keep track of where they are.
3. Offer informative feedback: We have incorporated informative feedback mechanisms, and visual cues such as feedback when market is closed and highlighting to user location to provide users with real-time feedback on their actions, ensuring they are aware of the system's response.
4. Design dialogues to yield closure: Our interface design ensures that interactions with the system have a clear starting point, progression, and conclusion, providing users with a sense of closure and reducing ambiguity.
5. Provide error prevention and simple error handling: We have implemented preventive measures to minimize errors, such as clear validation messages.
6. Support internal locus of control: The system provides users with a sense of control by providing them more feedbacks and customizable light mode / dark mode.
7. Reduce short-term memory load: To alleviate cognitive load, we have ensured that important information, options, and actions are visible and easily accessible, eliminating the need for users to rely heavily on memory.
8. Provide aesthetic and minimalist design: Our design approach focuses on presenting essential information while minimizing visual clutter. By adopting a minimalist

design, we enhance the aesthetic appeal of the interface and improve user focus and attention.

By adhering to Schneiderman's Eight Golden Rules, we have strived to create a user-centric trade management system that promotes usability, efficiency, and user satisfaction. These design principles have guided our decision-making process and have been instrumental in enhancing the overall user experience.

G. Donald Norman's 6 design principles

In the development of the Nepal Stock Exchange Trade Management System, we have embraced Norman's Six Design Principles to ensure a user-centered and intuitive interface. Norman's principles offer valuable insights into creating effective and user-friendly designs. Here's how we applied these principles in our system:

1. Visibility: We prioritized visibility by ensuring that important system elements, actions, and options are clearly visible to users. By providing visual cues and clear indicators, users can easily identify and understand the available functionalities.
2. Feedback: We integrated informative feedback mechanisms throughout the system to keep users informed about the outcomes of their actions. Through visual feedback, notifications, and status updates, users receive real-time information, enabling them to make informed decisions.
3. Constraints: We incorporated appropriate constraints to guide users and prevent errors. By limiting certain actions based on contextual factors or providing clear guidelines, users are guided towards making valid and appropriate choices within the system.
4. Mapping: We strived to create a clear mapping between the system's functionalities and the user's mental model. By aligning the system's layout and organization with familiar concepts and users' expectations, we enhanced learnability and ease of use.
5. Consistency: Consistency was a key principle we followed throughout the design process. We maintained consistent language, icons, and interaction patterns to ensure a coherent and predictable user experience across different sections of the system.
6. Affordance: We designed the interface to provide clear affordances, allowing users to easily understand the available actions and functionalities. By utilizing intuitive icons, buttons, and visual cues, users can quickly grasp how to interact with different elements in the system.

By incorporating Norman's Six Design Principles, we aimed to create a user-friendly and intuitive trade management system. These principles guided our design decisions, resulting in an interface that enhances usability, promotes learnability, and facilitates efficient user interactions.

H. UI Design Survey

The UI Design was developed and sent to the targeted users with whom we had previously conducted our survey of Paper Prototype. We prepared a set of questionnaires and requested the respondents to fill the form with their honest reviews. As many of the respondents were frequent users of TMS, it became more effective to know about their feedback.

We have surveyed about 25 people, and many of their responses are in favor of the proposed system. They agreed that implementing the new UI/UX on NEPSE TMS will not only help to save their time while transacting online but can also make their purchasing experience pleasant.

I. Heuristic Evaluation

After analyzing the feedback from the targeted users and developing UI following the design principles, we conducted a heuristic evaluation proposed by Bertini et al, 2009 [6]. We also conducted the heuristic evaluation with the group of users and got various feedbacks.

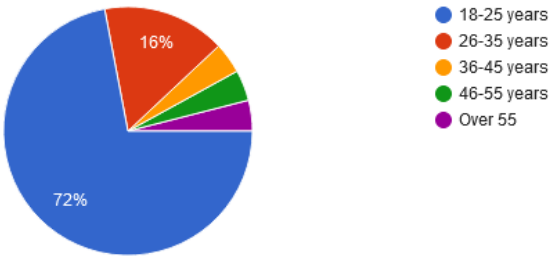
J. Cognitive Walkthrough

After heuristic evaluation, we performed a cognitive walkthrough in the UI application that we developed considering the task of performing a transaction of buying and viewing the portfolio.

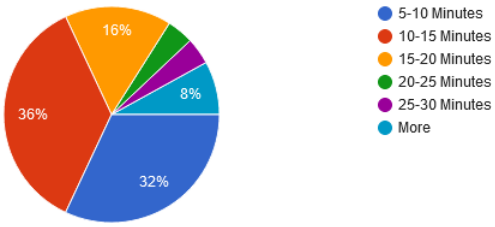
III. RESULTS

A. Results from the survey

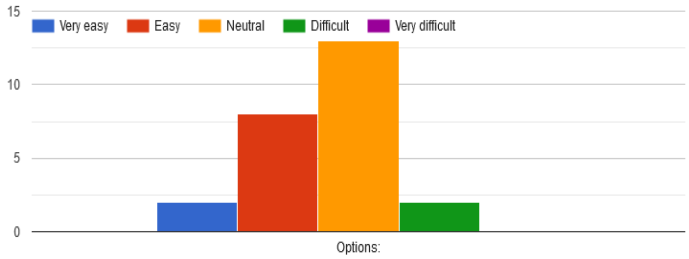
The survey was conducted in two phases. The first phase of the survey is conducted to know about the concern of the people regarding the UI/UX of NEPSE TMS. Participants from the various age groups were surveyed. Among them, most of the NEPSE TMS users were from the age group 18-25 years.



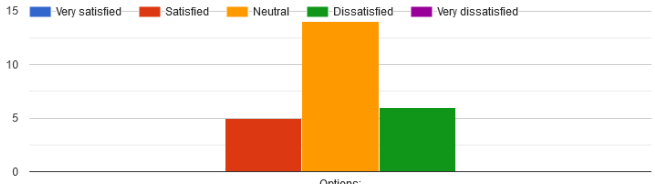
The survey conducted on users of the Nepal Stock Exchange Trade Management System aimed to gather insights into the average duration of time spent by users on the platform. The results revealed varying patterns among the participants. The majority of users, with a significant percentage of 36%, reported spending 10-15 minutes on the system. A substantial portion of 32% indicated spending 5-10 minutes, while approximately 16% allocated 15-20 minutes of their time. Additionally, smaller percentages of users, around 4% each, dedicated 20-25 minutes or 25-30 minutes to the platform. Lastly, 8% of respondents mentioned spending more than 30 minutes on the system. These findings highlight the diverse time distribution among users of the Nepal Stock Exchange Trade Management System, with the majority spending around 10-15 minutes on their trading activities.



The survey included a question regarding the ease of finding information on the Nepal Stock Exchange Trade Management System. The responses provided valuable insights into the users' experiences. Among the participants, 10% found it very easy to locate the required information, while 40% reported it as easy. A significant portion, 52%, expressed a neutral stance on the ease of information retrieval. Only 10% of respondents found it difficult to find the information they needed. These percentages indicate a mixed perception of the system's information accessibility, with a notable number of users perceiving it as neutral in terms of finding the desired information.

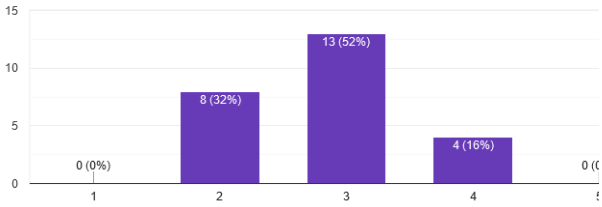


The survey inquired about the participants' satisfaction level with the overall user interface of the Nepal Stock Exchange Trade Management System. The collected responses shed light on their perceptions. Among the respondents, about 20% expressed satisfaction with the user interface, while 54% reported a neutral stance. On the other hand, 25% of participants expressed dissatisfaction. These percentages indicate a diverse range of opinions regarding the satisfaction level with the user interface of the trade management system, with a notable portion of respondents holding a neutral viewpoint.

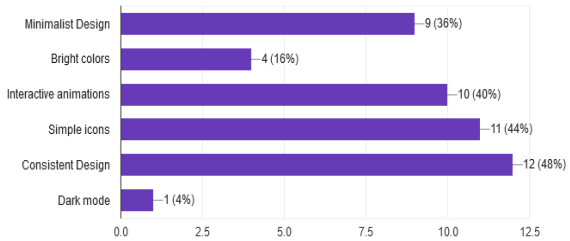


Upon analyzing the survey data, it was revealed that a considerable portion of the respondents, comprising 32%, expressed the perception of facing difficulty in locating the desired features on the website of the Nepal Stock Exchange Trade Management System. The majority of participants, accounting for 52%, reported a neutral stance regarding the ease of feature location, suggesting a lack of clarity or navigational challenges. However, 16% of the participants found the process relatively easy. These findings underscore the notable level of difficulty experienced by a significant portion of users when attempting to locate specific features on the website, thereby emphasizing the need for improvements in terms of user interface and

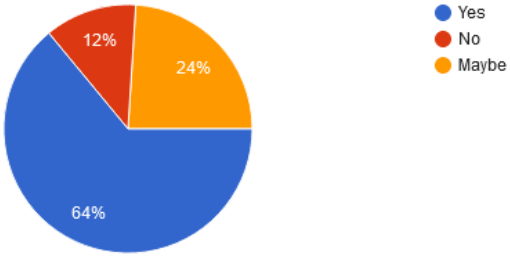
navigational design to enhance overall user experience.



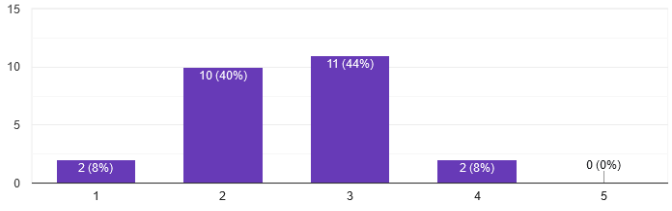
After examining the responses obtained from the survey, it was observed that the participants identified several areas where they perceived the website of the Nepal Stock Exchange Trade Management System to be lacking certain features. Notably, 36% of the respondents expressed the desire for a minimalist design, emphasizing the preference for a clean and uncluttered interface. Additionally, 16% of the participants highlighted the need for bright colors to enhance visual appeal. Furthermore, 40% of the respondents indicated a desire for interactive animations to make the website more engaging and interactive. Simple icons were identified as a requirement by 44% of the participants to facilitate intuitive navigation. A significant majority, comprising 48% of the respondents, emphasized the importance of a consistent design throughout the website. Lastly, 4% of participants expressed an interest in the inclusion of a dark mode feature. These insights provide valuable feedback regarding the specific features that users feel are currently lacking, thereby offering guidance for potential enhancements to improve the overall website experience.



Based on the responses obtained from the survey, it was found that a significant majority of the participants, specifically 64%, expressed their interest in utilizing the dark mode feature if it were available on the Nepal Stock Exchange Trade Management System (TMS). This indicates a strong preference for a darker color scheme that reduces eye strain and provides a more visually comfortable experience, particularly in low-light environments. Conversely, 12% of the respondents indicated that they would not utilize the dark mode feature, while 24% remained undecided, stating that they may consider using it. These findings suggest that incorporating a dark mode feature in the TMS has the potential to cater to the preferences of a substantial portion of users, enhancing their overall satisfaction with the platform.

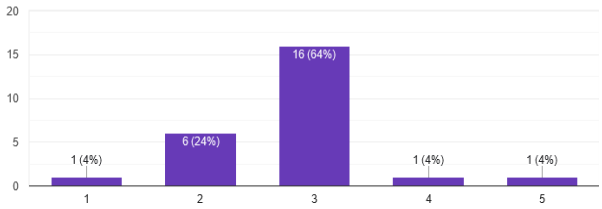


Based on the ratings provided by the participants, it can be observed that the visual consistency and feedback of the website on the Nepal Stock Exchange Trade Management System (TMS) received mixed reviews. A majority of the respondents, comprising 44%, rated it as average (3) in terms of visual consistency and feedback. However, a significant portion, 40%, rated it below average (2), indicating room for improvement in terms of maintaining visual consistency and providing effective feedback. Furthermore, 8% of the participants rated it as poor (1), while another 8% rated it as good (4). These findings highlight the importance of enhancing the visual consistency and feedback aspects of the website to ensure a more satisfactory user experience and address the concerns raised by a substantial portion of the users.



Based on the participants' ratings, the overall design of the website on the Nepal Stock Exchange Trade Management System (TMS) received predominantly positive feedback. The majority of respondents, comprising 64%, rated the design as average (3), indicating a generally satisfactory impression of the website's aesthetics and layout. A smaller proportion, 24%, rated it below average (2), suggesting some areas for improvement. Additionally, 4% of participants rated the design as poor (1), while another 4% rated it as good (4), and

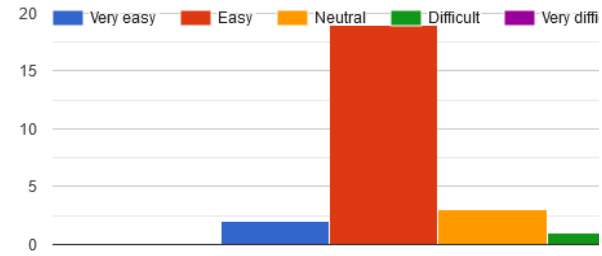
another 4% rated it as excellent (5). These findings emphasize the need to further enhance the website's design elements to ensure a more positive and visually appealing user experience for a larger segment of users.



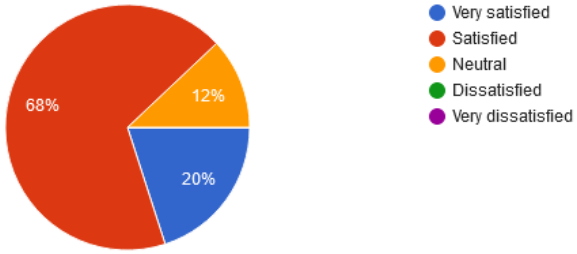
B. Result from Usability Testing

To know about the usability testing among the users we conducted a survey for usability testing of the prototype design. After all the response and feedback, we found out the improved design to be more user-friendly than the original version. We used the feedback from the initial survey and improved the features whose responses are provided below.

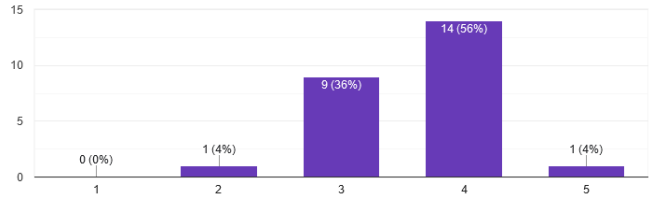
The survey on the improved design of the Nepal Stock Exchange Trade Management System (TMS) revealed that the majority of participants (76%) found it easy to locate the information they needed. This positive response indicates a significant improvement in the system's design, making it more accessible and user-friendly. While a small percentage of users (4%) reported difficulties, their feedback presents an opportunity for further refinement. By addressing these specific pain points, the TMS website can continue to enhance its usability, ensuring users can effortlessly find the information they need and ultimately leading to increased satisfaction with the improved design.



The survey conducted on the new design of the user interface of the Nepal Stock Exchange Trade Management System (TMS) reveals a significant level of satisfaction among respondents. The majority of participants (68%) expressed their satisfaction with the redesigned interface, while a notable proportion (20%) reported being highly satisfied. These results highlight the positive reception of the TMS user interface's new design, indicating that the implemented changes have effectively met user expectations and contributed to an enhanced overall experience.

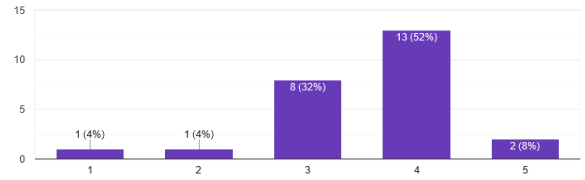


The survey results pertaining to the visual consistency and feedback of the Nepal Stock Exchange Trade Management System (TMS) website indicate a positive assessment from the majority of participants. A significant proportion of respondents (56%) rated the visual consistency and feedback as 4 out of 5, indicating a high level of satisfaction with the website's design in terms of visual harmony and effective feedback mechanisms. Additionally, 36% of participants rated it as 3 out of 5, signifying a moderate level of approval. It is noteworthy that only a small percentage of respondents (4%) expressed lower ratings of 2 out of 5, while no participants indicated dissatisfaction with a rating of 1 out of 5. These findings highlight the overall positive perception of the website's visual consistency and feedback, suggesting that the implemented design enhancements have effectively improved these aspects and contributed to a more satisfactory user experience.

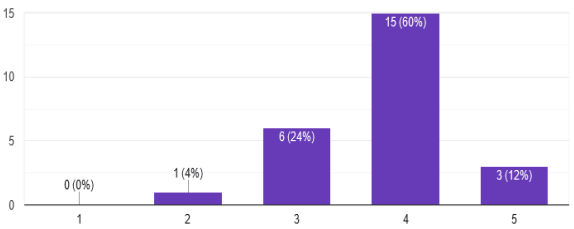


The survey results regarding the overall new design of the Nepal Stock Exchange Trade Management System (TMS) website reveal a largely positive reception from the participants. A significant majority of respondents (52%) rated the new design as 4 out of 5, indicating a high level of satisfaction and approval. Furthermore, 32% of participants provided a rating of 3 out of 5, signifying a moderate level of satisfaction with the overall design. It is

worth noting that a small percentage of respondents (4%) expressed lower ratings of 1 and 2 out of 5. Conversely, 8% of participants rated the new design as 5 out of 5, reflecting an exceptional level of satisfaction. These findings underscore the positive impact of the new design on the website's overall aesthetic and user experience, with a majority of users finding it highly favorable and visually appealing.



Finally, the results regarding the likelihood of recommending the new website design of the Nepal Stock Exchange Trade Management System (TMS) indicate a high level of positive endorsement from the participants. A substantial majority of respondents (60%) expressed a strong likelihood, rating it as 4 out of 5 on the scale. Furthermore, 24% of participants provided a rating of 3 out of 5, indicating a moderate likelihood of recommending the new design to others. It is worth noting that a small percentage of respondents (4%) expressed lower ratings of 1 and 2 out of 5, suggesting a lower likelihood of recommendation. Conversely, none of the participants rated the likelihood as 1 out of 5. Additionally, 12% of participants provided the highest rating of 5 out of 5, signifying a strong inclination to recommend the new design. These findings highlight the positive reception of the new website design, with a significant proportion of users indicating a high likelihood of recommending it to others.



C. The Result from Cognitive Walkthrough

After performing cognitive walkthrough for the NEPSE TMS after mentioned problems have been resolved, we got following results:

1. Sidebar Alignment: Upon accessing the TMS website, users will notice that the navigation menu, specifically the sidebar, is now properly aligned. This improvement ensures a visually pleasing and consistent layout, allowing users to easily access various sections of the website.
2. Improved FAQ: The FAQ section of the TMS website has been enhanced for user convenience. Previously, users had to download the FAQ manually, but now it is directly accessible on the website itself. This improvement eliminates the need for additional steps, enabling users to quickly find answers to commonly asked questions.
3. Navbar Icon Stability: The issue with icons disappearing from the navbar after continuous clicking has been resolved. Users can now interact with the navbar seamlessly without experiencing any disruptions or inconsistencies.
4. Buy/Sell Portal Feedback: Users will now receive clear feedback when accessing the buy/sell portal during market closure. The previous blur effect has been removed, and an informative message is displayed to notify users about the market closure. This enhancement ensures users are informed and prevents any confusion or frustration.
5. User Manual Integration: The user manual is now seamlessly integrated into the TMS website itself. Users can easily access the manual, which provides comprehensive guidance and instructions on utilizing the system's features effectively. This integration streamlines the user experience and eliminates the need for users to refer to external resources.
6. Dark Mode Feature: A new feature has been introduced to the TMS website, offering users the option to switch to a dark mode interface. This feature caters to user preferences and enhances usability, especially in low-light environments. Users can now navigate the website comfortably with reduced eye strain.
7. Search Client Link Fix: The non-functional link to search for clients has been rectified. Users can now utilize this search functionality seamlessly, allowing for efficient access to client information and improving overall system usability.
8. Transaction Feedback: Users will now receive real-time feedback when buying or selling stocks. Notifications or confirmation messages will be displayed,

providing users with clear indications that their transactions have been successfully executed. This improvement ensures transparency and enhances user confidence in their trading activities.

By addressing these issues and incorporating the mentioned improvements, the Nepal Stock Exchange Trade Management System offers users a more seamless, intuitive, and user-friendly experience and provide more locus of control.

IV. DISCUSSION

Our final UI design with all the enhancements was developed using Jakob Nielsen's Usability Principle. [8]

1. Visibility of System Status: After the update in UI, the visibility has increased even more as we limited the showcase of services in the homepage which previously made confusion among the users according to our survey. For every action there is sufficient feedback provided to the user. For example: there was no feedback when the market is closed, but new design includes the feedback along with time remaining for the market to open.
2. Match between system and real world: The UI design follows real-world conventions making information appear in natural and logical order. The icons are repeated and some icons were contrary to what they did which was improved in new design.
3. User Control and freedom: Our UI is designed in such a way that when the user performs any action by mistake then they can easily navigate back to the previous state. For example: One of the resolved problems was the alignment issue with the sidebar navigation menu. By ensuring proper alignment, users can easily access different sections of the website and navigate back to the previous state if they accidentally click on the wrong option. This improvement empowers users to have control over their navigation choices and easily recover from any unintended actions.
4. Consistency and standards: We have created a user interface that adheres to the heuristic of maintaining consistent language and design elements throughout the Nepal Stock Exchange Trade Management System. By ensuring clarity and consistency in the use of words, icons, and symbols, we aim to eliminate any confusion for users during their interactions with the product. Our interface follows established conventions and employs consistent interaction patterns across different contexts, allowing users to easily understand and navigate the system. With a cohesive and uniform design language, we treat similar elements consistently, providing a seamless and intuitive user experience.
5. Error Prevention: We have implemented the Nielsen heuristic of error prevention in the design of the Nepal Stock Exchange Trade Management System. Our goal is to proactively identify and address potential issues to prevent user errors and enhance the overall user experience. Through careful consideration and thorough testing, we have implemented intuitive workflows, clear instructions, and informative feedback to guide users and minimize the occurrence of errors. By anticipating user needs and providing a robust and error-resistant design, we aim to ensure a smooth and frustration-free interaction for users, allowing them to confidently navigate the system and achieve their desired tasks without encountering unnecessary difficulties or errors.
6. Recognition rather than recall: According to Nielsen's heuristics, our design approach focuses on minimizing users' cognitive load and considering their limited memory capacity. To address this, we have ensured that options and actionable components are clearly visible rather than solely relying on users' memory. For instance, we have incorporated visual cues and reminders throughout the system to assist users in navigation. As an example of our improvement, previously, there was no feedback provided when users clicked on navigation elements, which could have resulted in uncertainty. However, in our revised design, we have added subtle visual feedback, such as highlighting the selected menu item to provide users with immediate confirmation and support their understanding of their current location within the system. By reducing the need for users to rely solely on memory, we aim to enhance usability and improve the overall user experience.

7. Flexibility and efficiency of use: In our design approach, we strive to cater to both inexperienced and experienced users by considering their specific needs and preferences. For inexperienced users, we understand the importance of providing detailed information and guidance to facilitate their understanding and usage of the product. We ensure that the interface offers clear instructions and intuitive workflows, helping them navigate and interact with ease. On the other hand, we recognize that experienced users benefit from customization options that allow them to streamline their interactions and enhance efficiency. By enabling features such as customizable keyboard shortcuts, we empower experienced users to personalize their experience and tailor the product to their specific workflow preferences.
8. Aesthetic and minimalist design: We have created more minimalistic interactions that present essential information without overwhelming users with unnecessary visual elements. This ensures a clean and uncluttered interface, promoting usability and allowing users to focus on core functionalities.
9. Help users recognize, diagnose, and recover from errors: The designs help the user identify and find solutions to eventual problems and errors.
10. Help and documentation: In line with Nielsen's heuristics, our design incorporates comprehensive and easily accessible help and documentation to aid users in understanding and performing their tasks effectively. We have taken measures to ensure that users can find assistance effortlessly by including a prominently displayed FAQ section on the website. This section offers clear and concise instructions, outlining concrete steps that users can follow to accomplish their goals successfully. By providing readily available and task-focused documentation, we aim to empower users to navigate the system independently and mitigate any potential challenges they may encounter.

A. Comparison with related works

A variety of different application have been made as a Trade Management System globally. As mentioned in the related works section above, Zerodha, Upstox are such platforms based in India and TD Ameritrade, Robinhood are such platforms based in USA. However, they are not native to us and we cannot trade stocks of NEPSE through them. Since there is a single stock exchange in Nepal which is regulated by government, it is mandatory that everyone use the TMS service provided by NEPSE for trading purposes. But due to the problems mentioned above, the user does not get good experience which we have tried to improve.

B. Discussion with groups

On discussion with other groups we noted down the following pros:

- The feedback and consistency of designed is improved significantly.
- The dark mode feature is suitable for low-light environments and many users seemed to like the feature according to our survey.
- The user has more locus of control.

We also listed some cons for our design:

- Since the website is run by government, it would be very hard to implement the design unless the government decides to improve the UI of TMS.

V. CONCLUSION

The research findings derived from the study conducted on users of the Nepal Stock Exchange Trade Management System provide valuable insights into their experiences and perceptions regarding the system's design and usability. The survey responses have shed light on various aspects, including user behavior patterns, primary needs, and goals, as well as feedback pertaining to specific system attributes.

The outcomes underscore the significance of addressing usability challenges and incorporating user feedback to enhance the system. Several issues, such as misaligned navigation menus, the absence of desired features like a discussion forum and dark mode, and shortcomings in feedback provision and interface consistency, have been identified. Nevertheless, it is encouraging to observe that these

concerns have been effectively tackled through subsequent design iterations, resulting in improved user experiences.

Furthermore, the research highlights the importance of core design principles, including user control and freedom, consistency, visibility of options, and error prevention. By adhering to these principles throughout the design process, our objective has been to create a user-centric system that caters to the needs of both novice and proficient users.

In summary, the research outcomes underscore the significance of user-centered design, iterative enhancements, and the integration of user feedback to develop an efficient and effective trade management system. By considering these findings and implementing the necessary improvements, we aim to provide a seamless and satisfactory user experience for traders and investors utilizing the Nepal Stock Exchange Trade Management System.

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REFERENCES

[1] A. Rijal, "The Nepal Stock Exchange – Background and Trends," in *Nepal Economic Forum*, https://nepaleconomicforum.org/the-nepal-stock-exchange-backgrounds-and-trends/

[2] Zerodha. (n.d.). *Zerodha - Online stock trading at lowest prices from India's biggest stockbroker*. [Online]. Available: https://zerodha.com/

[3] Upstox. (n.d.). *Upstox - Online Share/Stock Trading, Options Trading, Discount Brokers in India*. [Online]. Available: https://upstox.com/

[4] TD Ameritrade. (n.d.). *Online Stock Trading, Investing, Online Broker | TD Ameritrade*. [Online]. Available: https://www.tdameritrade.com/

[5] Robinhood. (n.d.). *Robinhood - Investment & Trading, Commission-free*. [Online]. Available: https://robinhood.com/us/en/

[6] "Appropriating and assessing heuristics for mobile computing." [Online]. Available: https://www.researchgate.net/publication/220944689_Appropriating_and_assessing_heuristics_for_mobile_computing/

[7] Er. Hari KC, "PERFORMANCE ANALYSIS and PREDICTION of NEPAL STOCK MARKET (NEPSE) for INVESTMENT DECISION using MACHINE LEARNING TECHNIQUES," *International Journal of Computer Science and Engineering*, vol. 18, no. 7, pp. 1-12, Available: https://www.ijcse.net/docs/IJCSE18-07-01-012.pdf

[8] AELASchool. (n.d.). "10 Usability Heuristics for UI Design." [Online]. Available: https://aelaschool.com/en/interactiondesign/10-usability-heuristics-ui-design/