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A Mobile Application Design for Retail Fuel Ordering

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Abstract

Purpose: The design of a mobile application to enhance the fuel ordering process is a crucial step in optimizing user expectations and satisfaction in a relationship with the user interface and user experience. This research aims to identify practices in mobile application design, explore design solutions, evaluate their impact on user experience and propose a design solution for a mobile application design to be used in retail fuel ordering process in Thailand. **Research design, data and methodology:** A design-based approach with a multi-phase process is adapted to propose a design solution in collaboration with color theory, user interface and user experience. By leveraging analysis of practical problems in fuel ordering pain points, a system solution will be developed to enhance the overall user experience. Then, the proposed solution will be tested and evaluated through the collaboration of a group of diverse users. Finally, the outcome of this design-based research is reflected and documented for further reference. **Results:** Mobile application design prototype that can fulfill user requirements, improve user efficiency, and gain user acceptance. **Conclusions:** A mobile application with user-centric employment of color theory, user interface and user experience has a constructive impact on users through enhancing human interaction and simplifying tasks.

Keywords: Mobile Application, Retail Fuel Ordering Application, User Interface Design

1. Introduction

The proliferation of mobile devices and the rapid advancement of technology have significantly transformed how retail fuel businesses anticipate in terms of fuel replenishment. Mobil applications, in particular, can provide a form of support in daily-life operational activities. A well-designed user-oriented mobile application with proper usability, user interface and user experience could accelerate user adaptation and productivity of the user's tasks. The competition in the retail fuel business in Thailand has become increasingly intense for faster and easier ways to execute orders, while the importance of leveraging mobile applications is recognized to streamline operations and enhance the work processes, especially for fuel ordering. However, certain users are still familiar with performing fuel orders via more traditional channels; phone calls, e-mail or web portals while resisting to move to a mobile application platform. Moreover, some oil companies do not provide this mobile application solution to their customers for facilitating the fuel ordering process. Without the adoption of mobile applications for fuel orders, the companies could lose sales to competitors and not optimize flawless operations in the fuel ordering process.

This study adapts Reeves's 4-phase design-based research model (Jayatilleke et al., 2018) by starting with an in-depth literature review across various domains, including color theory, user interface-user experience and color employment in mobile applications to design and develop a user-centric mobile application prototype that effectively meets user requirements and enhances operational efficiency for the retail fuel business to facilitate the fuel ordering process. The researchers also push forward the

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Technology Acceptance Model (Davis, 1989) and the 7-element questionnaire (Patil, 2016) to allow the potential user to evaluate the user acceptance of the proposed design prototype.

This research will provide procedural steps to investigate and develop a design solution for a new user-oriented mobile application that can fulfill users' requirements as well as improve their efficiency in daily operations in the retail fuel ordering process for the retail fuel business. The result of this design-based research has practical implications for mobile application developers, designers, stakeholders and oil companies, who aim to develop or enhance a mobile application to serve their customers while improving the customer experience.

2. Literature Review

2.1 Mobile Application Design Process

The designing process is one of the critical initial steps for the mobile application to ensure the success in a mobile application development project. According to Reeves's design-based research model (Jayatilleke et al., 2018), the design process is separated into 4 main phases. In the first phase, the target audience's or user's pain-point is analyzed to identify practical problems and the objectives of the mobile application development project. The second phase is to develop and design a solution in response to the problems that are identified in the first phase. The solution must address the problems and serve the project's purpose. The initial prototype is created at this step. To ensure user-oriented design, application layout, navigational structure, appropriate colors and fronts must be taken into consideration. Adobe XD, Adobe Illustrator, Figma, and Sketch are some examples of popularly used software platforms for designing interactive interfaces, layouts and mock-ups of mobile applications. Then, the design is tested and evaluated in the third phase. The evaluation method can be via qualitative/quantitative research, focus groups, interviews, surveys, and observation. Finally, reflections and documentation are to be produced based on development principles, guidelines and design specifications from the first to the last step.

The user-oriented design of mobile applications helps improve and facilitate the human connection between the physical world and the virtual system. During the designing process, designers and developers must focus on the intended users and ensure that their expectations are met throughout the design phases.

2.2 Color Theory

Humans encounter the world as a colorful place. Color is perceived on essentially every object that we view in our daily lives; it is even present in our dreams. (Elliot & Maier, 2014) Color is an integral aspect of human perception, influencing emotions, cognition, aesthetics, and communication. Color theory seeks to unravel the intricacies of how humans perceive and interpret colors, offering insights into their psychological, physiological and cultural dimensions.

Color theory was first studied by Sir Isaac Newton in 1666, where he introduced the first invented color wheel based on an experiment that split a white light beam into 7 rainbow spectrums. Later in 1810, Johann Wolfgang von Goethe denied Newton's color theory approach and published the theory of color (Agoston, 2013) with a new color wheel based on the interaction of light and dark (Popova, 2012).

Color is systematically categorized into 3 groups: Primary (Red, Blue, Yellow), Secondary (Mixes of the primary colors) and Tertiary (mixes of primary and secondary colors. A color is described with 3 properties (Fairchild, 2004):

- Hue is how a color appears to human perception
- Chroma measures the purity of a color with intensity
- Lightness refers to brightness or darkness

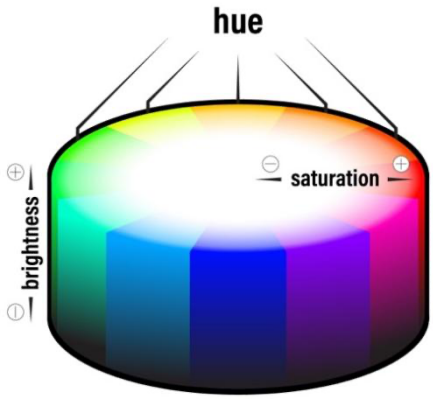

Figure 1: Hue, Saturation, and Brightness
Source: Kimmons et al. (n.d.)

A color can be specified with a hexadecimal value (HEX), starting with the hash sign (#) followed by 3 sets of 2-digit numbers. Each set shows the values of red, green and blue respectively, where the value 00 shows the absence of the color and ff shows the highest level of the color. For instance, the pure red color is coded as #ff0000 where red is at the highest value in the absence of green and blue.

The interaction and association of colors in a harmonic and aesthetic way create color schemes as per illustrated in Figure 2.

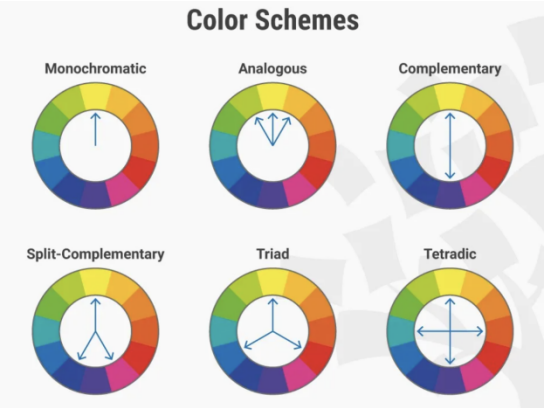

Figure 2: Six color schemes
Source: Interaction Design Foundation - IxDF. (2016).

Color psychology explores the psychological and emotional effects of colors on human behavior, perception, and cognition. By investigating the intricate connections between colors and human emotions, color psychology sheds light on how colors can be strategically used to create desired outcomes and experiences. Red can represent love, power, energy and danger. It enhances metabolism and draws the viewer's attention as well as energy to take action. Blue is a calm and relaxing color which can be used to represent trust, intelligence, and communication. Referring to the example from Figure 3, users tend to feel more secure to put their credentials in the blue color interface. Seeing a red prompt might make users stop and consider.

Figure 3: Four interface examples
Source: Kimmons et al. (n.d.)

2.3 Color in Mobile Application Design

Color is also one of the significant parts of User Interface (UI) and User Experience (UX) design for mobile applications. Colors also play an important role in the user's perception of usability, aesthetics and engagement. Mobile application designers start the design phase with a black-and-white scale to force the focus on application layout and interface rather than aesthetics (Kennedy, 2014). This is a reliable and easy way to keep the application looking clean and simple by starting with making the application beautiful and usable in every way, but without the aid of color. It will force the designers to focus on spacing, sizes, and layout first. If an application is beautiful and easy to navigate even in greyscale, it will also be more attractive and easier to use when it is colored.

Once the design in black-and-white can satisfy usability, color can be added. Color choices should take into account users with visual impairments and users with low vision. The World Wide Web Consortium (W3C) and the Web Accessibility Initiative (WAI) guidelines recommend using high contrast and avoiding color combinations that can be difficult to distinguish for individuals with visual impairments (Trichter, 2022). According to the W3C Web Content Accessibility Guideline (WCAG), there are 3 levels for the minimum contrast ratio guideline (Understanding success criterion 1.4.3): A, AA and AAA. The text should have a color contrast ratio of at least 4.5:1 , while the larger text should be at least 3:1 (Dannaway, 2023) as recommended by ISO 9241-3. The highest level is AAA with a 7:1 contrast ratio. Proper color contrast improves the readability of the content (Grainer, 2018). Figure 4 illustrates the different contrast ratios between the text and background at the different WCAG levels.

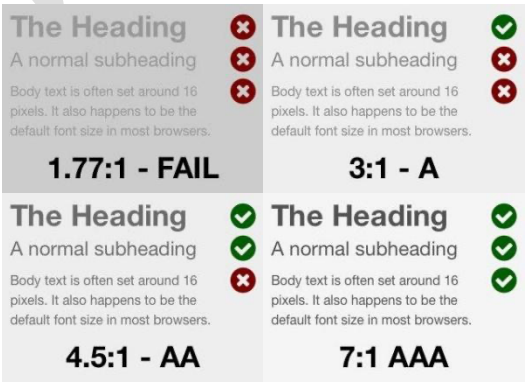

Figure 4: Difference in Contrast Ratio
Source: Grainer, S. (2018)

3. Research Methodology

In this research, Reeves's 4-phase design-based model is applied to the mobile application design for the fuel ordering application based on the literature review conducted.

3.1 Analysis of Practical Problem

Some oil companies in Thailand do not have a mobile application for placing orders, and the mobile applications employed by some oil companies are not user-friendly and have extra functions that are not in use. Based on the researcher's observation, certain oil companies use phone calls, email and web-based portals and do not have mobile applications to facilitate the fuel ordering process. On the other hand, some oil companies provide a mobile application for placing orders, but it is not well accepted by the users. Upon interview with the above-site and on-site managers, retail-fuel dealers and service station owners as a focus group who is using mobile applications to order fuel, it shows that some of them do not use the mobile application at all because they perceive that it is too difficult to order fuel via mobile application and some others use only certain 2-3 functions in the mobile application like fuel order and price check. The fuel order is the main functionality that is used as the main purpose of the application. The onsite managers also need to verify the current selling pump prices for each fuel grade, as the fuel price can vary day by day and different service station locations can have different selling pump prices for each fuel grade. Dealers and service station owners would like to stay up to date on the oil price trend because they need to anticipate a decrease and increase in onsite stock.

3.2 Development of Solution

3.2.1. Conceptual and Scoping

The scope of this application is to introduce a new order application process to support the fuel ordering process and enforce collaboration between customers as application users and customer service teams. In Figure 5, 3 main functions are to be offered; fuel order to place orders as a purpose of this application, order status to check the delivery status of the order and price check for verifying actual pump price with the oil price trend. Figure 3 depicts the use diagram based on these 3 functions. The scope of this research focuses mainly on the application frontend design for the users only.

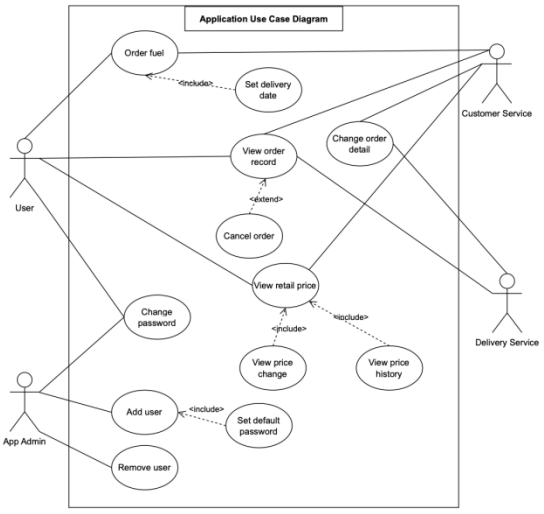

Figure 5: Application Use Case Diagram

3.2.2 Data Flow Design

The application system is to process fuel quantity and expected delivery date as a data input from customers and to process finalized fuel orders as a data output to customer and delivery service teams to proceed with the order, as illustrated in Figure 6. Process 1 is to call the fuel price data store for each fuel grade from the fuel pricing database. When the customers input quantities for the product they wish to order and the expected delivery date. Process 1.1 is to calculate the subtotal fuel amount for each fuel grade and to sum the total order amount in local currency. Then, the data flows to Process 2 to finalize the order by assigning the order reference number. The finalized order data is to be updated in the fuel order data store and also to flow to customer and delivery service teams to proceed with their processes. The processes at the customer and delivery service teams are out of this design scope.

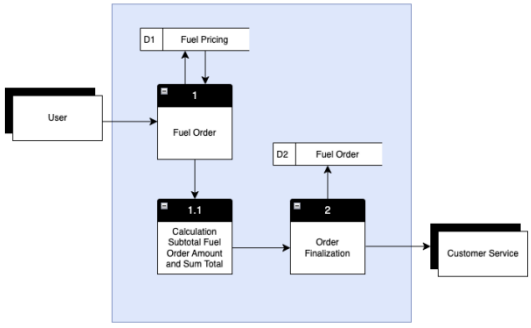

Figure 6: Logical Data Flow Diagram

3.2.3 Application Functionality Design

This application provides 3 main functionalities: order fuel, view order status and view price information. After the user log-in with the credential successfully, the authorized user with the correct username and password can access to 3 pages to perform these 3 functions. Figure 7 shows the user journey when different users use the application at the same time. The service station manager could place a fuel order in the 1st functionality while another service station staff is verifying the order status for the stock planning purpose with 2nd functionality and the service owner is parallelly checking the fuel price on 3rd functionality at the same time.

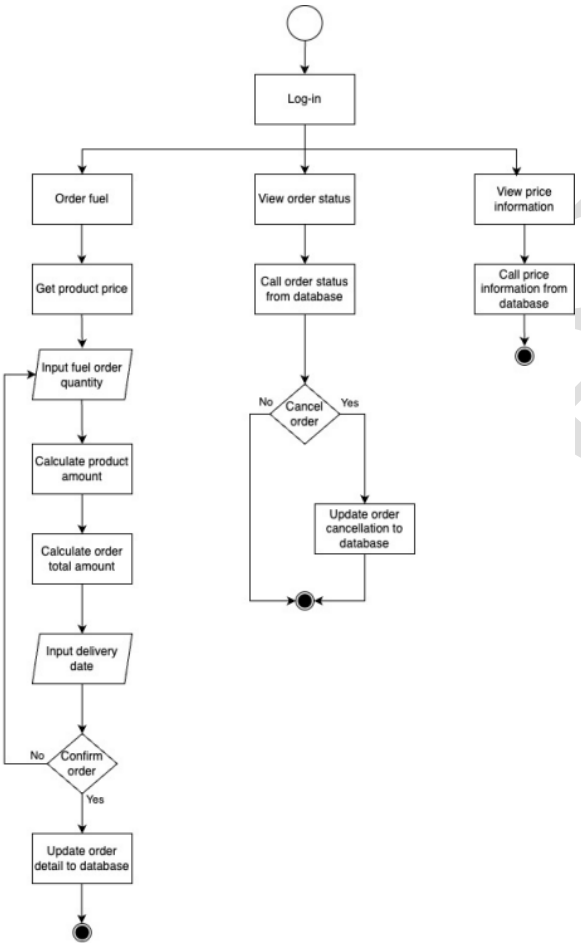

Figure 7: Process Flow Diagram

3.2.4 Color Selection for the Application

Monochromatic color schemes have gained popularity as users across genders and ages tend to prefer minimal design (Mudita et al., 2022). The researchers selected the blue color to be the dominant color in the design as it is a relaxed color that can well represent trust, intelligence, and communication. 3 different shades of blue color are applied using different levels of intensity and lightness as shown in Figure 8: #0090FF, #5075BF and #D1E0FF. The text is in black #000000 on white background #FFFFFF.

Figure 8: Adobe Color Wheel and Palette

The color contrast checker is used to help identify the proper text color contract and compliance with the W3C Web Content Accessibility Guidelines. Black text #000000 on the white background obtains a contrast ratio of 21:1 that passes WCAG AAA as per Figure 9. All the major graphical objects and the user interface components are also verified to obtain the minimum WCAG A.

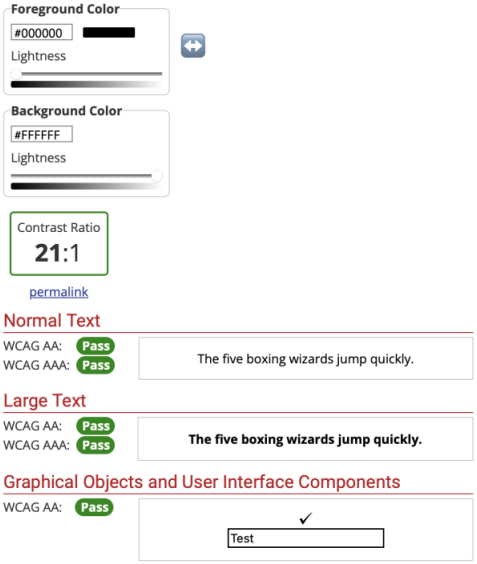

Figure 9: Text Color Contrast Ratio

3.2.5 Color Selection for the Application

The application design was initially started on a black-and-white scale to ensure that the layout, interface and navigation are focused on user concentration. The Figma Application is used in this layout design phase as a software platform for designing interactive interfaces. After successfully log-in, the user is navigated to the main menu page that list 3 buttons for major functions of this application:

Fuel Order, Order Status and Retail Price. Figure 10 shows the design in 2-color scales with navigations in blue lines.

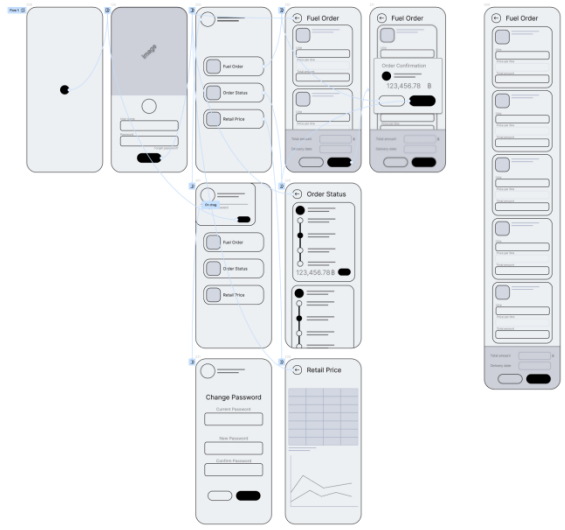

Figure 10: Layout and Interface Design

3.2.6 Color Selection for the Application

After the layout and interfaces are settled to ensure accessibility and usability, meaningful colors, icons, shapes and images are added to the design prototype to make the application more attractive to the users. The image on the log-in page can be dynamic and changeable, depending on the business requirement. Solid linear shading color from #5075BF Blue to #0090FF Blue is applied to the solid button, so it looks more interesting button design and easier for the user to distinguish between solid forward and white backward buttons. Fading is also applied to the buttons and fields that are not allowed to be used. Each fuel grade carries a different color icon to avoid confusion between different fuel grades. These colors align with the color on the dispensers and tank labels.

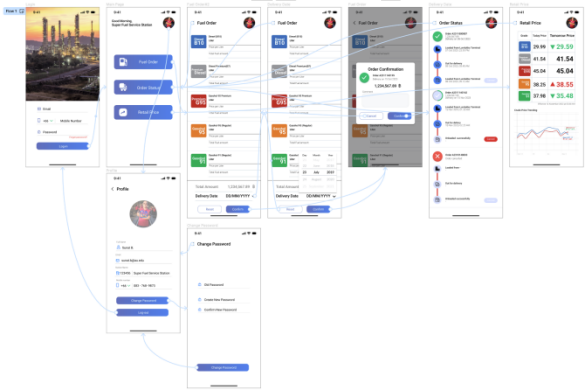

Figure 11: Application Prototype with Navigation and Interface

4. Results and Analysis

The design prototype is simulated with an iPhone 15 Pro Max mock-up to show how the application appears on the actual device for user evaluation (see Figure 12). The application design prototype is tested within a closed group of users who are in the retail fuel business in Thailand. Each user is requested to complete a user survey to measure their perception based on the Technology Acceptance Model (Davis, 1989). To avoid subjective measures and leading questions in this evaluation and testing phase, the new user survey is developed by adopting the 7-element questionnaire (Patil, 2016) for measuring the acceptance of the proposed application prototype based on perceived usefulness, perceived ease of use, attitude toward adoption, trust and intention toward adoption of the users.

In the user survey, there are 10 statements on the acceptance of the new application prototype. The researcher also added 4 screening questions asking about the role in the retail fuel value chain and the working experience of the users to ensure that the respondents are in the retail fuel business, and 5 supplementary questions on color preference to measure how the users perceive the color employed in the application. The survey provided each statement to the users, and they were asked to rate their perception based on a scale from 1 to 5 where "1" is for "Extremely Unlikely" and "5" is for "Extremely Likely" The statements are:

- This proposed application could allow speedily completion of tasks.
- This proposed application would increase my job effectiveness.
- This proposed application would make job easier.
- This proposed application will be useful in my job.
- This proposed application could do what I want it to do.
- I would find this proposed application effortless to use.
- Using mobile application in fuel ordering is beneficial.
- This proposed application is beneficial.
- This proposed application could be used on a regular basis.
- I intend to use this proposed application if released in the near future.
- I feel comfortable with the colors in this proposed application.
- The employment of colors suitable for this proposed application.
- I am satisfied with the colors in this proposed application.
- The colors in this proposed application convey some meaning/indication to me.
- I like the colors of this proposed application.

The responses are consolidated for analysis. The participants are randomly selected to represent potential users within a retail fuel company. The user survey involved

a closed group of 35 participants; 14 service station owners, 12 service station managers, 7 sales-related managers, 1 project advisor and 1 bulk fuel buyer. There are 31 participants who have been working in this field for more than 5 years, 3 participants have 3-5 years of experience, and only 1 participant has less than 1 year of experience. All of them work in the retail fuel business or have related activities to the retail fuel business in Thailand and are familiar with mobile application usage of smartphones. Based on the result, the users are substantially positive about the proposed mobile application prototype in terms of usability, usefulness, willingness to adapt the solution and color employment.

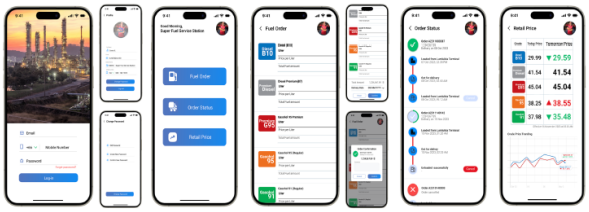

Figure 12: Application Prototype

The responses from the user survey are analyzed based on the 5-point Likert scale interpretation (Pimentel, 2019) by comparing the mean scores from the responses to each question with Pimentel's 5-point Likert scale interpretation table (see Table 4.1), using an interval where results in verbal description. According to Pimentel, the 5-point scale contains 5 - 1 = 4 ranges and the interval between each point is from the total number of ranges divided by the total number of scale points: 4 ÷ 5 = 0.80 interval.

Table 1 : Pimentel's 5-point Likert scale interpretation

Likert Scale	Interval	Description
1	1.00 - 1.79	Extremely Unlikely
2	1.80 - 2.59	Unlikely
3	2.60 - 3.39	Neutral
4	3.40 - 4.19	Likely
5	4.20 - 5.00	Extremely Likely

According to the result from the user survey, the respondents strongly support the proposed application design prototype for fuel ordering based on the average score of 4.55 from respondents against Pimentel's 5-point Likert scale interpretation. 28 or 80% of respondents strongly agree that this proposed mobile application is beneficial and most of them perceive that it is easy to use. There are 31 respondents who desire to use this proposed application in the near future if it is launched. In addition, all the respondents feel positive about the overall colors employed in the application. Thus, the proposed mobile application design obtains the user's acceptance and support to be further developed and released for real use because it could well address the user's pain-points identified in the analysis stage of the practical problems.

5. Discussion and Conclusion

This study has presented an in-depth design-based approach to investigate and develop the design solutions focusing on mobile application design, color theory and user interface along with user experience of a mobile application and proposed a mobile application prototype to fulfill retail fuel business requirements for placing fuel orders. Through the comprehensive user survey with the focus group, we gathered valuable insights into the user acceptance of this proposed application and areas for further investigation.

5.1 Discussion

The results from the user survey indicate that this proposed application design is well-received with the majority of 35 respondents relating to perceived usefulness, perceived ease of use, attitude toward adoption, trust and intention toward adoption. The proposed application prototype obtains the highest rating scores for its effortlessness to use, usefulness and benefit to facilitate users' tasks, and user satisfaction with the colors used in the application. The navigation of this proposed application was well designed by limiting the motions required by the users to complete their desired tasks. To create a fuel order, a user can merely perform Select, Input and Confirm. Within a click, a user can view order history or price trends. From the result, the perceived usefulness and benefit of the proposed application highlight the significance of the first step in the analysis of practical problems in this research to address the status quo and the pain-points.

The understanding of color theory and color psychology assist this application design in fulfilling the user's satisfaction of the color employed in the design functionally and aesthetically. Different colors can evoke different emotional reactions and responses from the users; for instance, blue is often associated with security and communication while red can stimulate a sense of issue and danger in the application interface. Users proceed each interface step with blue buttons and avoid red button. The psychological effects of color are also utilized in various fields, such as marketing and logo design. Red is popularly used in company logos in the energy sector to stimulate feelings of power and performance. However, certain energy companies strategically inject more green shades in the logo design to convey a message of environmental-friendly energy.

Thus, the overall score explains well the reason why 31 respondents or 88% of all respondents desire to use this proposed application in the near future if it is launched. The evidence proves that this design gets accepted by users and should be pushed into development for the benefit of retail fuel companies and their customers in the future. However, certain aspects in the color selection are still debatable and subjective as it depends on each user preference. It should require further investigation with a greater number of potential users to accomplish a consensus on a best color palette agreeable by the majority of users.

5.2 Conclusion

In conclusion, the new mobile application design has achieved significant milestones with users' support to implement for practical utilization. Adapting the knowledge in user interface UI and user experience UX in the application design helps designers and developers in gaining considerable user's acceptance and willingness to adopt in a expeditious manner. Color also has a significant impact on human-computer interaction and interface design. Understanding the impact of color can enhance the effectiveness of virtual communication and application interaction. For fuel companies who wish to adopt this application, they could perform further investigation and refinement with a greater number of users to explore supplementary evidence on user acceptance of their own users. Application administrator requirements and new fuel order handling processes should also be studied to accompany the implementation of this application and ensure flawless operations when handling fuel orders using the application. Communication protocols like API or HTML between the application and other related systems should be investigated to ensure collaboration between front-end and back-end systems.

Additionally, this study offers an idea for designing a mobile application that the user will find acceptable. In order to prevent users from refusing to utilize the finished product, fundamental principles that are occasionally not intensive in the design phase have been suggested and revealed to the development team for consideration at the beginning. However, certain aspects are still debatable and subjective. It would require further investigation to accomplish a common consensus on best practices that are suitable for the majority of users.

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