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Enhancing the Usability, Visibility, and Responsiveness of an Airline Reservation System: A User-Centered Design Approach

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Abstract: This paper presents the idea, design, and prototype of a flight search and airline booking system based on the perspective of user-centered design. The system is first sketched roughly on paper in the form of a sketched plan and implemented through the proper system by connecting with the rapid API to develop a responsive web application. Booking travel tickets is a hassle and quite stressful because there is a chance that the webpages take time, and several decisions to make, hard to choose a discounted or less expensive flight, and the user will have to put in a lot of effort with many browser tabs may leave open. If a user is looking for the lowest travel options within a range of dates, they need to search a lot of websites looking for better options. As UX designers, it is our responsibility to do some user research and identify the problem areas, then we will recommend some design options based on the research findings. After that, we will create a wireframe and prototype before jumping into web design by collecting all the requirements and analyzing the problems. We will be focusing on UI controls such as location picker, date picker, color contrast, accessibility, and so on. In this paper, we present the design and development of a user-centered flight search and booking system for the airline industry. Our goal is to create a system that would meet the needs and preferences of a diverse set of users. This paper will summarize the design, development, and implementation of an airline reservation system. We have used bubble.io to design the overall system and MYSQL as the database management system for this webpage. Our objective is to upgrade the current website by improving the usability, visibility, and responsiveness of the functions that the user will experience while buying a flight ticket. We have generated and managed the design documentation and a perfect user-based online flight booking system.

Keywords: User-centered design, Rapid API, UX designer, Wireframe, Prototype, Airline reservation system, Usability.

1. Introduction

In recent years, the airline industry has seen a significant shift towards online booking systems, with many travellers looking to book their flights directly through airline websites or third-party travel agents. This trend has led to an increase in competition among airlines, as they seek to attract and retain customers through user-friendly and efficient booking systems. However, the current state of the online booking system is often far from ideal. Many systems are complex and confusing, with a high number of steps and a lack of transparency in pricing and fees. This can lead to frustration and a poor user experience for travellers, particularly for those who are infrequent flyers. In addition, current systems often lack the ability to effectively tailor the booking experience to the individual needs and preferences of different users. To address these issues and improve the overall flight booking experience, we propose a user-centred design (UCD) based flight search and booking system. To achieve this goal, we followed a UCD process that involved extensive user research, prototyping, and testing. User research is a crucial step in the UCD process, as it allows designers to understand the needs, goals, and behaviours of the target users. Through reviews and surveys of potential users, we identified key user requirements and pain points in the current booking process.

Based on these insights, we designed and prototyped a new system that would address these issues and provide a seamless and intuitive experience for users. The resulting system includes features such as a flexible search interface that allows users to easily find and compare flights, a streamlined booking process that minimizes errors and confusion, and an accessible design that meets the needs of users. In this paper, we describe the UCD process we followed to develop the system and present the key features of the resulting prototype. We also evaluate the system through usability testing with representative users and discuss the feedback we received. Our findings suggest that our UCD-based approach has resulted in a system that effectively meets the needs of a diverse set of users and improves the overall flight booking experience. Overall, the development of a UCD-based flight search and booking system has the potential to significantly enhance the user experience for travellers and increase customer satisfaction for airlines. In an increasingly competitive market, such a system could provide a competitive advantage for airlines that adopt it.

This paper is structured as follows: Chapter I covers the introduction of User-Centered Designs in flight booking system that meets the needs of users. Chapter II presents the literature reviews of similar papers with their findings, limitations, and outcomes. Chapter III describes the system planning, prototyping, and designs principles of our proposed system followed by tools and techniques that have been used. Chapter IV presents the results and analysis and the conclusion in chapter V.

2. Literature Review

In recent years, the development of user-centered design (UCD) approaches has become increasingly important in the field of airline booking systems. UCD is a design methodology that focuses on creating systems that are tailored to the needs and preferences of the users, rather than the needs of the designers or developers. This approach has been shown to lead to more effective, efficient, and satisfying systems for users. In the context of flight search and booking systems, UCD can help to improve the overall user experience by ensuring that the system is easy to use, intuitive, and relevant to the needs of the users. In this literature review, we will examine the existing research on UCD-based flight search and airline booking systems, with a focus on the key findings and implications for practice and future research.

In a paper of [1], they have explained the design of user interfaces for platform management systems that include information about complex systems and specialized knowledge beyond the expertise of UI/UX designers and standard user-centered design (UCD) methods. They have proposed a system-centered process that complements UCD approaches in the design of command-and-control systems by taking the detailed functioning of underlying systems as input and providing structured information to inform UCD methods. In addition to improving usability, this integrated process also addresses reliability and safety considerations that are often overlooked in UCD approaches. The demonstration of the effectiveness of this proposed process by applying it to the design of a large commercial aircraft warning system and discussing its potential to be generalized to other domains. In the past, application developers often encountered difficulties when building applications using distributed system technologies due to their inflexibility in adapting to business processes, high costs of revisions, and low reusability. The traditional approach to designing and implementing software is compared to the service-oriented approach in the creation of web services. In this case, the authors of [2] used the IBM Service-Oriented Methodology (SOMA) in the domain of airline reservation services because of its high reusability. They implemented the service engineering process and created a client program to invoke and combine the deployed airline reservation web services. This report [3] presents the results of a study that aimed to design and implement an airline reservation system. The system was developed using PHP, JavaScript, HTML, and MySQL as the programming languages and database management system, respectively. Data collection for the study involved interviews and questionnaires to gather information about the existing reservation system. The development process included the use of case tools and data flow diagrams to simulate the process of airline reservations and ticket booking. The final product of the study was an online airline reservation system that was tested and implemented in Rwenzori Airlines for booking, scheduling, and reserving flights. It is important for websites to be user- friendly to attract customers. This study [4] analysed the features of three Malaysian airline websites (AirAsia, Malaysia Airlines, and StarAir) and developed a theoretical framework highlighting the importance of convenient booking flow, efficiency, ease of use, interactivity, and attractiveness in attracting customers. The results of this research provide a foundation for evaluating the usability

of airline websites from the perspective of the customer and offer suggestions for improving the user experience through customer-centered design.

The author of [5] discussed the importance of designing web accessibility features that accommodate cultural differences in a multicultural world that examined how the User-Centered Design (UCD) approach can improve the web accessibility features of educational websites for multicultural users. The review identified various cultural factors that should be considered during the design process and emphasizes the importance of user involvement and continual evaluation. The author of [6], presented a concept for the Agile usability patterns for UCD in the architectural planning process, [7], [8], within agile usability. Another similar paper on the UCD method for modelling software architecture [9] provided development support that can be integrated with various design approaches. In the report of [10], they have developed a LESSA application for the use case design. The framework of architectural paradigms for UCD of the virtual environment is presented by [11], better digital library [12] and acoustics analysis of a quiet helicopter for air taxi operations [13]. This [14] paper represented the revisiting of the UCD contribution to the design of complex command and control systems.

3. System Planning

User-centered design (UCD) is a design process that focuses on the needs, wants, and limitations of end users as the primary consideration in the design of a product, service, or system. It defines involving the users in the design process to ensure that the resulting product or service meets their needs and is user-friendly. We have planned the system before designing a prototype in the following steps:

3.1 Define the Problem

The booking process may be confusing or difficult to navigate for the user due to unfamiliar patterns, and unclear pricing tickets with additional fees and charges that are not immediately visible. The user may encounter problems with the payment method such as declined credit cards or an error, unclear terms, and conditions of the cancellation policies, and such as changing the dates and destinations of the flight.

3.2 User Research

After defining the problem, we did some user research based on the reviews and ratings of existing websites and mobile applications for flight booking platforms and found that the problems of users are similar to what we have explained like unclear, unfamiliarity, lack of visibility, and usability.

3.3 Defining User Requirements

User requirements are the characteristics and features that a product, service, or system must have to meet the needs of its users. When defining user requirements for a flight booking system prototype, we should consider the following [15]:

1)   Ease of use: The system should be easy to navigate and use, with a clear and intuitive interface.

2)   Search functionality: The system should allow users to search for flights based on various criteria, such as destination, departure and arrival times, and ticket class.

3)   Booking process: The system should allow users to easily book a flight, with clear instructions and a secure payment process.

4)   Flexibility: The system should allow users to make changes or modifications to their booking, such as changing the dates or destinations of their flights.

5)   Price transparency: The system should clearly display the total cost of a flight, including any fees or charges, to help users make informed purchasing decisions.

6)   Customer service: The system should provide users with   easy access to customer service, such as live chat or phone support, in case they encounter any issues or have questions.

By considering these user requirements, we will design a flight booking system in bubble software that meets the needs of users and provides a seamless and enjoyable booking experience.

3.4 Create a prototype

Our approach involves creating a paper sketch that includes all the required elements, followed by developing a real-time interface using Bubble.io's visual editor. This includes adding components like buttons, text boxes, and images to the page and arranging them through a drag-and-drop interface. Furthermore, we have the capability of adding features such as database management, user authentication, and integration with external APIs to our application.

3.5 System Requirements

User-centered design (UCD) is a design philosophy and process that focuses on the needs, wants, and limitations of the end user of a product or service. The goal of UCD is to design products and services that are easy to use, effective, and enjoyable for the intended users.

We are involving users in the design process by looking at their needs, preferences, and behaviors to inform design decisions and iteratively improve the product or service. It can also

help to reduce development costs by identifying and addressing potential usability issues early in the design process.
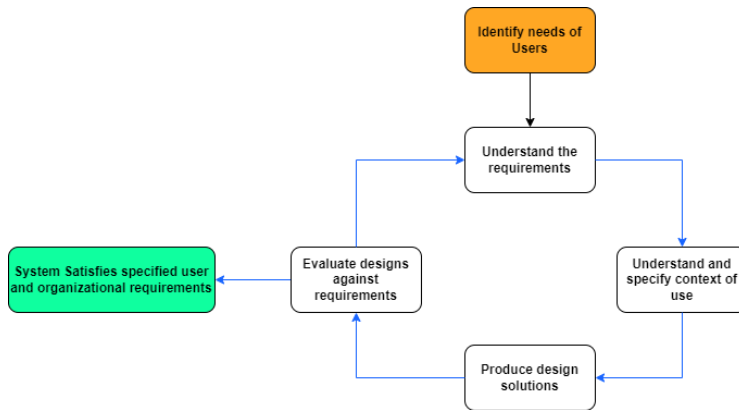
Figure 1. User-centered Design Principles

There are 5'S of UCD that is used to guide the design process:

1)   Strategy Plane: The strategy involves defining the goals and target audience for the product or service by providing clear direction for the design process. Our target audience is all the users who use online flight booking systems for their travel.

2)   Scope Plane: This element involves defining the boundaries and limitations of the product or service, including the features and functionality that will be included. It will ensure whether that is feasible to develop and will meet the needs of the users within the given constraints or not [16]. Some of the boundaries and limitations that we may face in our systems are API server may go down sometimes, data fetching, and may decrease latency rate.

3)   Structure Plane: This plane helps organize the content and functionality in a logical and intuitive way. The objective of the structure element is to make the product or service easy to use and understand for the intended users.

4)   Skeleton Plane: We create a basic framework or outline for design, including the layout, navigation, and interaction design in this stage. The objective of the skeleton element is to establish the basic structure and functionality of the product or service.

5)   Surface Plane: This element involves refining the appearance and aesthetics of the product or service, including the visual design and branding. The objective of the surface element is to make the product or service visually appealing and consistent with the brand.

3.6 System Design

A transaction processing system is a combination of hard- ware, software, devices, and communication data processes that can be used for storing, retrieving, and transforming data for a specific purpose. In the context of a ticket booking system, the transaction processing system helps to confirm tickets by performing necessary payment transactions and confirming the ticket to customers [17]. The booking system also enables airline companies to track passengers' purchasing habits and offer unique flight packages or last-minute discounts. This system can also increase passenger satisfaction and loyalty by providing excellent service and quick reservations. The system was developed using a model that involves determining requirements, analyzing the system, designing it, and testing and validating it. The user interface of the system is likely to include elements such as data entry fields, a navigation bar, buttons, and hyperlinks.
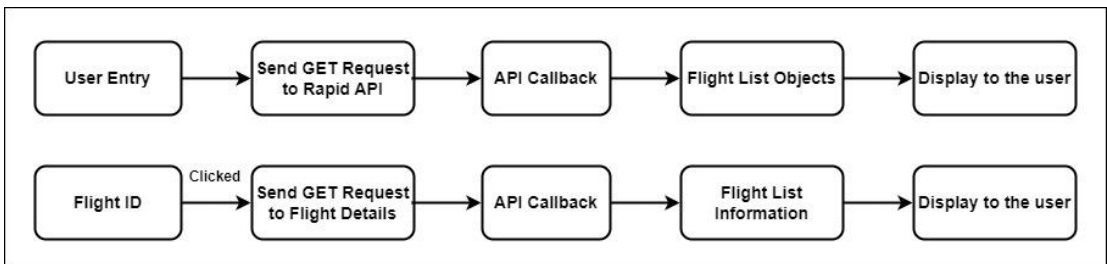
Figure 2. Working Principles of API and the System

From Figure 2, we can see that there are two APIs used, one for getting the list of flights to users and another after clicking on the one flight id, it will display that specific flight list with full information. Once users search the destination or flight name that they want to travel to while booking the online tickets, the system sends the get request to the respective **API** and the **API** receives the request, it will call back to the system displaying all the necessary information to the user.

How API Works?

An **API** is a set of rules and protocols that allows different software systems to communicate with each other. It acts as an intermediary between two systems, allowing them to exchange information and perform actions. Here's an example of how an API works:

- A client (such as a website or mobile app) sends a request to a server, asking for specific data or to perform a specific action.

- The server receives the request and processes it. This may involve looking up data in a database, performing calculations, or interacting with other systems.

- The server responds to the client's request with the requested data or the result of the action, or an error message if something went wrong.

APIs often use a specific syntax, such as HTTP (Hypertext Transfer Protocol), to structure the request and response. They may also require the use of specific keys or tokens to authenticate the client and authorize access to the requested data or actions. APIs are a common way for different systems to integrate and share data and functionality, and they play a crucial role in modern web and mobile development.
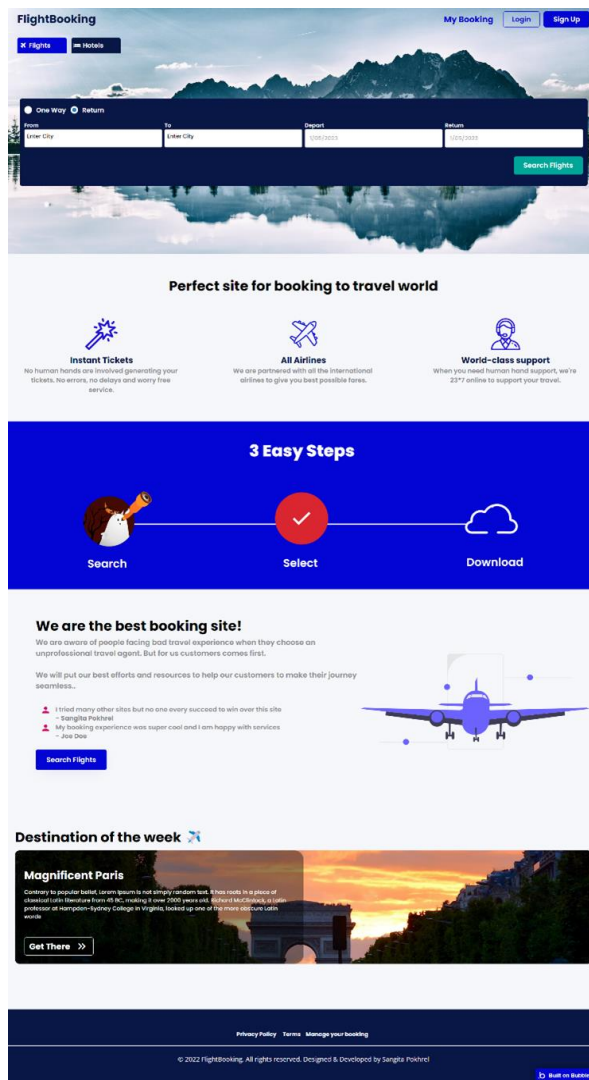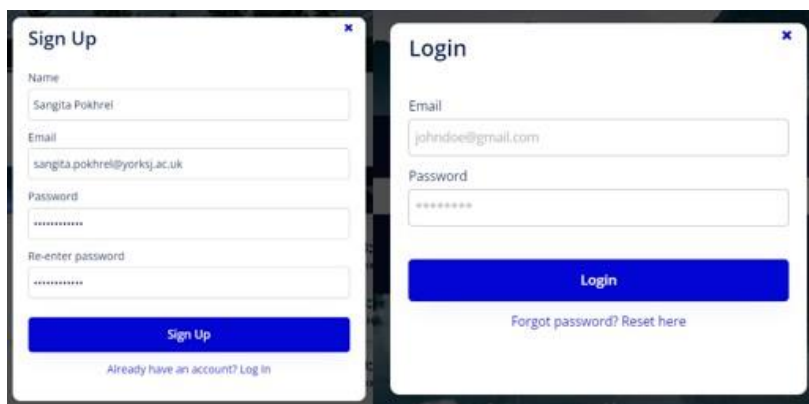

Figure 3. Home Page

4. Results and Analysis

In this section, we will see the design and implementation of our system. We have created a web-based platform using the Bubble.io software, which connects to the Skyscanner

API to access real-time data on airlines, flights, and ticket prices. The images below provide a visual overview of the system's user interface, including the home page and login page. To use the system, users must first register by providing their name, email address, and password. After that, they can simply log in to access the system. On the home screen, users can see that they need a ticket for either a one-way trip or a round trip. There are options to specify the departure and destination cities/countries, and the departing and returning dates if a round trip is selected. Users can choose between a one-way or round trip, and then search for flights. The home page is shown in Figure 3 where users can search the flights according to their destination. You can see the one way and return to search for the flights and can compare which would be more affordable and the best match for you. There are three buttons in the top right corner My Booking, login, and Sign Up.

In my booking tab, you can manage your booking and this section will allow the users to verify their booking, purchase additional baggage, and so on by entering the passport number and the booking id. It represents the overall website page if the user wants to go through it. Inside the perfect site for booking to travel worlds, we have featured the three steps of instant tickets, all airlines, and world-class support. For the user friendly, we have made a chatbot that can support all the time. There are a few introductions to our website, some reviews from previous users, and for the attraction, users can see the destination of the week which will be changing every week based on the largest number of tickets that users get to a specific place. In the end, there is a privacy policy, terms and conditions, and copyright section as the footer.

Figure 4. Log In / Sign Up Icon Box

Users don't really need to sign up or log in just to purchase the tickets but to make the system and website secure and collect the data from users, this section is a must. Users can sign up to the website through the sign-up icon and if it is already registered to our system, they can just simply log in. It will be easy when you go for payment of your tickets and once the payment is made, you will receive an email with your tickets.
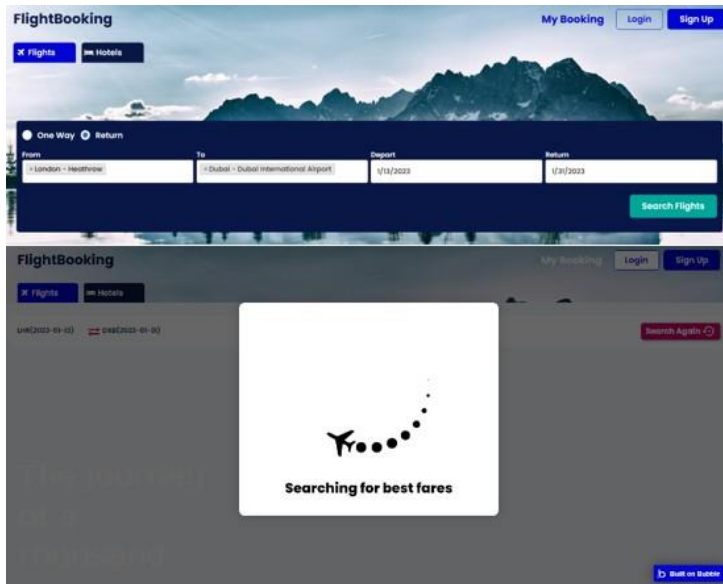
Figure 5. Search Popup

For example, when the user searches for tickets from London, and Heathrow airport to Dubai International Airport choosing the departure and return date, a pop-up will arise to load the flight's data searching for the best fares which you can see in Figure 5.

As seen in Figure 6, the flight list is displayed on the screen, complete with the flight times, transit numbers, airport names, duration of the journey, and ticket prices. To engage the users, there is a picture on the left-hand side with the quote" The Journey of a thousand miles begins with a single step."
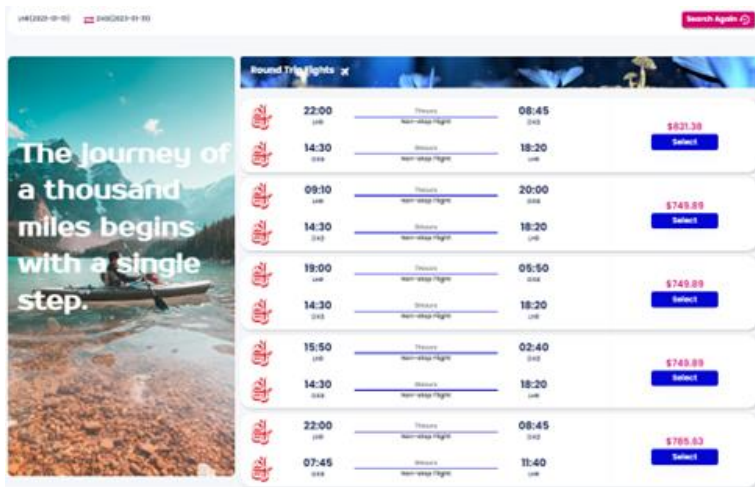
Figure 6. Flight List Display

This highlights the priority of offering the best and shortest route options first, followed by the cost of the tickets based on the highest number of tickets for that specific week. To accommodate budget-conscious travelers, there is a filter option available to identify the most affordable flight options.
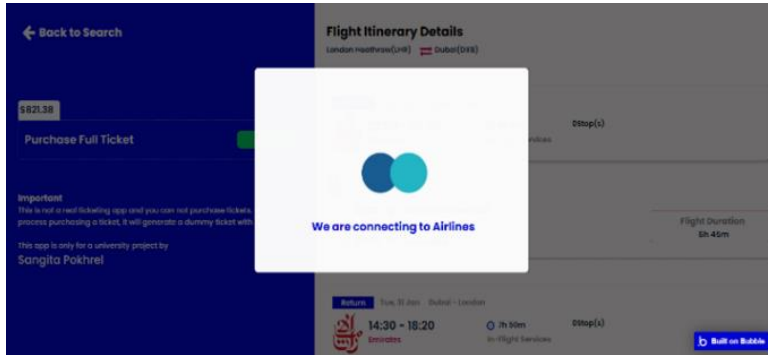
Figure 7. Connection to Airlines

When you click on the select option, it will redirect you to the airline to connect with real-time flight details. This is another use of API, we have used Skyscanner API which will connect you to the airline's details that can be seen on our website. The above Figure is the popup slide of connecting to Airlines.
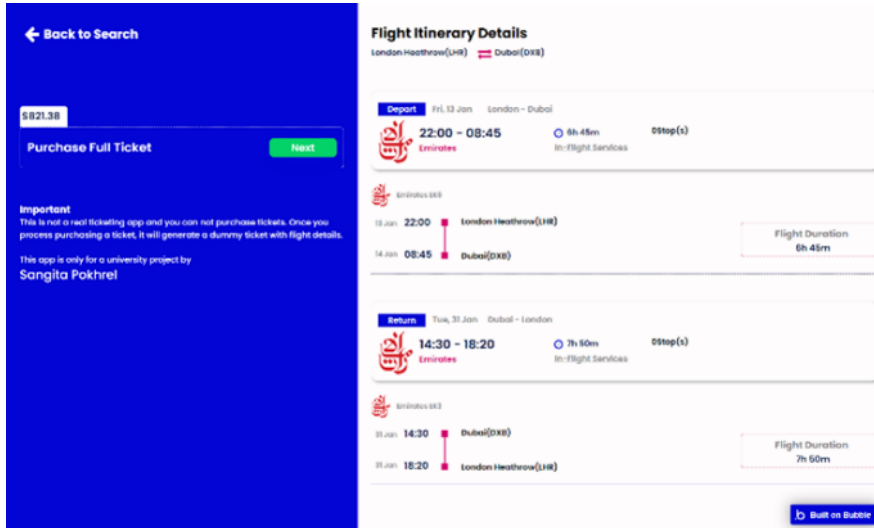
Figure 8. Flight Itinerary Details

Figure 8 is the flight details where you can see the price of tickets, the number of stops, time duration, price of tickets, and so on. There is an important notice below the purchase full ticket that the user will have some guidance and rules to understand.

Figure 9. Book Now Section

When purchasing tickets, a pop-up display comes which clearly gives information such as the email address, full name, passport number, any additional checked baggage, the number of passengers, and a comprehensive summary of ticket and baggage prices. This makes the website more user-friendly, allowing users to easily view and make any necessary adjustments. The price summary clearly indicates the total cost and what it covers, such as the inclusion or exclusion of luggage.

The primary document that customers receive upon purchasing ticket is depicted in Figure 10. This ticket is sent to the user's email address and includes essential information such as passenger details, pricing breakdown, checked and carry-on baggage allowance, flight duration, and other pertinent details. All relevant information is conveniently located on the ticket, allowing for easy access and reference.

Figure 10. Ticket With all the Details

<p align="center">Figure 11. My Booking Section</p>

Finally, in Figure 11, users can access the booking management section to make changes to their flight details such as flight time, luggage, bedding, meal preferences, and more. To do so, they need to enter their passport number and booking ID. When it comes to payment options, we use Stripe which allows users to securely enter their card details, and the payment will be processed automatically.

The system operates using two APIs that work in tandem to gather real-time data for both flight lists and flight details. Within the server of the Rapid API, various components are at work such as the response body, which includes data on the status of the operation (either true or false), message success, timestamp, origin, destination, segments, and more.

5. Conclusion

In conclusion, the development of the online flight booking system using the principles of UCD has resulted in a highly functional and user-friendly product. The system was developed through a process of user re- search and testing, resulting in a deep understanding of the needs and goals of users. For the development of this system, we have used the bubble.io software and Skyscanner API to automatically retrieve airline flight data. The resulting product includes a range of features and functionality that make it easy for users to search for and book flights and the use of UCD has proven to be a valuable approach in creating a system that meets the needs of its users and exceeds their expectations. As UX designers, we conducted extensive user research to identify the problem areas and recommend design options based on the findings. The design process involved creating wireframes and prototypes before implementing the web design while focusing on UI controls, such as location picker, date picker, and accessibility. Our goal was to create a user-centered flight search and booking system that meets the needs and preferences of a diverse set of users. The success of this system could inspire other organizations to adopt a UCD approach in their own product development. Focusing on enhancing the user

experience and persistently refining the design, we have developed a product that not only operates with maximum efficiency but also provides an enjoyable and satisfying user experience.

Overall, the online flight booking system serves as a prime example of the power of UCD in creating digital products that are both functional and satisfying for users. The paper also outlines the potential for future development, such as adding a hotel booking system and further improving the user experience.

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