

Comparision of Usability Metrics: A Case Study on IRCTC

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Abstract—Context-The usability software quality characteristic strives to optimize the ability of users to effectively and efficiently interact with a system and improve the system's user performance. We are testing the usability metrics like efficiency, effectiveness and satisfaction of the IRCTC application and also finding the various issues which are faced by users while using the IRCTC application and making a prototype that almost solves the pertinent issues and also has better efficiency than the existing IRCTC application. **Objective-**We use a two-survey method the first survey being the one in which a wide audience answers and the questionnaire addresses the usability concerns and issues, and the second survey, which is an in-person survey that measures the usability metrics of each task that has been made to perform by the user. A total of 246 people took part in the surveys. **Results:** We were able to design a prototype/wireframe which solved many usability issues which were reported by the users. The readings of usability metrics i.e. efficiency, effectiveness, and user satisfaction of the IRCTC application and our prototype were compared to prove the results.

Index Terms—Usability, application Evaluation, IRCTC,

I. INTRODUCTION

Usability is a user-centered approach that enhances the efficiency, effectiveness, and satisfaction of a user's experience in a given context. It measures the quality of user experience when interacting with a product or item, such as a website, software application, mobile technology, or any user-operated device. In the web context, usability is crucial for survival, as users may leave if they become lost or cannot locate the information they require. Failure to adopt a user-centered approach during the development process can cause issues later when intended users engage with the system. Adopting usability practices can benefit providers by reducing development time, support costs, user errors, and training time, and they can also impact the return on investment. The concept of usability is closely related to the design of the user interface and the interaction between the user and the system. Researchers in the field of Human-Computer Interaction (HCI) have proposed various recommendations for achieving a suitable level of usability in software systems. It is important to note that some

of these recommendations impact the system's interface and functionality. Therefore, it is necessary to consider the overall impact of usability mechanisms on the system's performance, functionality, and user interface.

IRCTC is a derivative of the Indian Railways, which stands for Indian Railways Catering and Tourism Corporation. It is one of the largest e-commerce portals in India and mainly functions through its application. The application's content and features are designed to cater to a wide range of users from different backgrounds and levels of society. This paper presents the results of surveys conducted to test the acceptability of the application and its features by the user community. The survey focused on the suitability and relevance of the application's content and features, the design of the user interface, visual appeal, application capabilities, and overall impression of the application. The responses and sentiment analysis of the comments have been analyzed, and the results indicate that the application has above-average capabilities and usability. However, certain features such as speed, performance, mobile interface, and placement of useful features on the application require improvement. The paper includes conclusions and graphs that provide a mathematical overview of the opinions and a more detailed review of the public perception of the application's content and features through sentiment analysis.

In this study, the goal of the experiment is to design a prototype of the IRCTC application which resolves a majority of the issues which the users stated through the online and offline surveys and also improve the usability of the application. To evaluate the usability of the IRCTC application, three metrics were used, which were based on the usability definition specified in the ISO/IEC 25010 standard. These metrics included efficiency, effectiveness, and user satisfaction. So we consider these three response variables as the primary metrics of our study and apply these metrics to the IRCTC application, take surveys from the users of the IRCTC and find the issues which were pertinent during the use of the application and design a wireframe that tries to solve the issues or concerns which were raised by the users in the survey.

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The base survey had about 192 participants for the online survey, which was conducted to check the IRCTC application's content and features. Our primary goal after obtaining results is to analyze the users' issues and make a prototype that resolves at least some of them. In the Offline Survey where people performed a certain set of tasks we conducted to test the usability of the application, a total of 54 participants took part in which we made them do a specific set of tasks to test the usability metrics (efficiency, effectiveness, and user satisfaction).

This research paper [?] aims to improve the user experience of the Indian Railway Catering and Tourism Corporation (IRCTC) application. The motivation for this study is derived from the recent paper by Ferreira (2022), which emphasizes the importance of usability mechanisms in enhancing the user experience of e-commerce websites. In his study, Ferreira conducted a series of experiments to evaluate the usability of several e-commerce websites and analyzed the results using different metrics. The usability mechanisms assessed by Ferreira included ease of navigation, clarity of information, and the efficiency of checkout processes. His research revealed that incorporating these usability mechanisms can have a significant impact on the overall user experience of e-commerce websites, which can in turn, increase customer satisfaction and usage of the platform. Building on this work, the current research will evaluate the usability mechanisms of the IRCTC application, such as ease of navigation, clarity of information, and efficiency of checkout processes, through a series of experiments. The evaluation of these mechanisms will be based on several usability metrics, including efficiency, effectiveness, and user satisfaction. Specifically, efficiency will be measured regarding the time taken to complete tasks, effectiveness will be evaluated based on the success rate of completing tasks, and user satisfaction will be assessed through surveys and user feedback. The findings of this study will provide insights into how usability mechanisms can be leveraged to improve the overall user experience of the IRCTC application, which can increase customer satisfaction and usage of the platform. Overall, this research aims to contribute to the broader understanding of how usability mechanisms can be utilized to enhance the design of e-commerce websites, specifically in the context of the IRCTC platform.

II. CONTRIBUTIONS

A. My Individual Contribution

- I(V K S Sandeep,201901286) was responsible for designing the online and offline surveys that will be used to collect data from IRCTC users.
- Made questions that provided useful insights into how users currently use the application and what changes they would like to see in the UI.
- Collectively created a redesigned wireframe for the IRCTC application with Aditya.

B. Other Members' Contributions

- Aditya Arya, 201901472 was responsible for analyzing the data collected from the surveys and using it to recommend a new UI design for the IRCTC application.
- He carefully reviewed the survey data, looking for trends and patterns that could inform UI design decisions
- Collectively created a redesigned wireframe for the IRCTC application with Sandeep.

III. OBJECTIVE

The paper's primary objective is to improve the usability of the IRCTC application by using the three usability metrics which we have chosen i.e., Efficiency, effectiveness, and User Satisfaction, while redesigning it. The ultimate goal of the IRCTC has a wide audience who use the application and the application multiple times. We felt that the design could be way easier and effortless in which the application could be designed. By considering the usability metrics, we are proposing a new prototype/wireframe of the IRCTC application, which almost resolves the issues were in the survey result.

IV. MOTIVATION

We created surveys on the current usability of the IRCTC application to gather user feedback and evaluate their experiences with the platform. The primary idea behind choosing IRCTC was that an enormous crowd who used the application faced issues like the booking process on the IRCTC application being complex and lengthy. Some users reported difficulty navigating through the different steps required to complete a transaction.

The IRCTC application is a complex system requiring users to navigate multiple steps to complete a transaction. Therefore, evaluating its usability from the users' perspective is important. By conducting surveys, we could gather data on users' interactions with the platform, identify areas of difficulty or confusion, and determine how much the IRCTC application meets users' needs and expectations.

Through the surveys, we could collect information on various usability factors, such as the interface's intuitiveness, ease of navigation, clarity of instructions, and overall satisfaction with the user experience. The survey data allowed us to quantify the user experience and assess the usability of the IRCTC application, helping us to identify specific areas for improvement and develop usability mechanisms to address the usability issues.

Overall, creating surveys on the current usability of the IRCTC application helped us to gain insights into users' experiences with the platform, identify usability issues, and provide empirical evidence to support the effectiveness of usability mechanisms in enhancing the performance and usability of the platform.

V. PROCESS

The steps of the process we followed for this project are as follow:

- 1) Read the research paper- We read and understood the research paper by Ferreira (2022) and made it a base of our project
- 2) Finding an application- Now, we started finding an application to apply the basic principles of the research paper.
- 3) Finalizing the application- We decided to go with IRCTC-Rail Connect mobile application. We chose the IRCTC application as the subject of study for three usability metrics due to its widespread use in India for booking train tickets. As a result, it serves a diverse user base with varying levels of technical expertise. The application boasts a complex user interface with multiple features like train search, seat availability check, ticket booking, and cancellation. Therefore, the study of IRCTC can provide insights into how the three usability metrics, efficiency, effectiveness, and user satisfaction, can be used to improve the overall user experience of a complex application. Additionally, the IRCTC mobile application has gone through several updates in the past, making it an ideal candidate for analyzing the impact of changes on usability.
- 4) Empathize-Here, we try to empathize with users. We try to gain knowledge about the issues faced by the users. We used two methods to do the same.
 - a) Online Survey- We sent out a Google form with desired questions needed for the research.
 - b) In-person interviews- To gain more in-depth knowledge and perspective.
- 5) Usability metric- We calculated the three usability metrics i.e. efficiency, effectiveness, and user satisfaction, by performing the tasks in the in-person interview.
- 6) Results- We plotted the graph based on the results obtained from Online Surveys and In-person interviews. We made a table on the results obtained from usability metrics.
- 7) Analysis- We analysed the results and concluded certain issues from the IRCTC application
- 8) Prototyping- We made a prototype in FIGMA addressing the issues.
- 9) Test- We tested our prototype by conducting surveys, interviews and usability metrics to confirm the improvement in usability of IRCTC application.

VI. MARKET COMPETITORS

Analyzing rival companies can give you useful information about the advantages and disadvantages of their parts and features. Although the IRCTC Rail Connect app doesn't have any direct rivals, a number of other sizable apps provide comparable services for other needs, including local railway ticket purchasing, metro ticket booking, live train status, and PNR checking.

Some of the competitors of the IRCTC application in India's online travel and ticketing market are MakeMyTrip, Yatra, Cleartrip, Goibibo, and Expedia. These applications offer similar services such as online train ticket booking, flight

booking, hotel booking, holiday packages, and other travel-related services.

- MakeMyTrip-MakeMyTrip is one of the largest online travel agencies in India. It offers a wide range of travel services, including flight and hotel bookings, holiday packages, bus and train tickets, and car rentals. The train booking feature on MakeMyTrip allows users to search for trains, check availability, and book tickets online. They also provide a live train tracking feature, which allows users to track their train's current location and expected arrival time. It offers additional features such as seat selection and cashback offers.
- Goibibo- Goibibo is another popular online travel booking website in India that offers flight, hotel, bus, and train bookings. They have a user-friendly interface and offer a seamless booking experience. The train booking feature on Goibibo allows users to search for trains, check availability, and book tickets online. They also offer features like PNR status check and train schedule information. It provides a more user-friendly booking experience with features like seat selection and payment options.
- Yatra- Yatra has a dedicated customer support team that is available 24/7 through various channels, including phone, email, and live chat. IRCTC also has a customer support team, but it may be more difficult to reach and have longer response times. Yatra also allows users to pay through EMIs (Equated Monthly Installments), which can be more convenient for some users. Yatra is a travel booking website offering various travel-related services, including flight and hotel bookings, holiday packages, bus and train tickets, and car rentals. The train booking feature on Yatra allows users to search for trains, check availability, and book tickets online. They also provide a feature called "railway inquiry," which allows users to check the status of their booked train and get information on train schedules and routes.
- Paytm- Paytm provides a more convenient and user-friendly train booking experience than IRCTC. Paytm and IRCTC have a refund policy in place, but Paytm's refund process is relatively faster and more convenient than IRCTC.

VII. DEMOGRAPHIC

Here is the list of questions we asked to get an overall view of the details of our test subjects

- 1) What is your age?
- 2) What is your gender?
- 3) What is your occupation?
- 4) What is your screen time?
- 5) How often do you travel?
- 6) What do you use to book a train?

For online survey:

- Gender:
 - 1) Male: 109 respondents (56.68%)

2) Female: 83 respondents (43.32%)

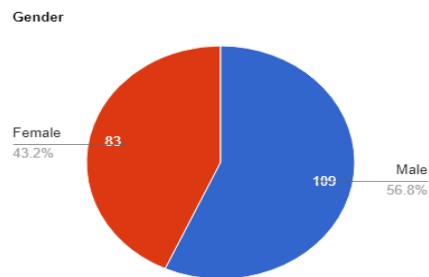


Fig. 1. Results of online survey based on Gender

- Occupation:

- 1) Students: 58 respondents (30.16%)
- 2) Professionals: 103 respondents (53.56%)
- 3) Others (e.g. homemakers, unemployed): 31 respondents (16.18%)

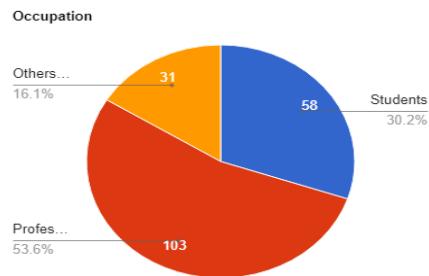


Fig. 2. Results of online survey based on Occupation

- Age group:

- 1) Under 18 years old: 32 respondents (16.64%)
- 2) 18-24 years old: 51 respondents (26.52%)
- 3) 25-34 years old: 46 respondents (23.92%)
- 4) 35-44 years old: 37 respondents (19.24%)
- 5) Over 44 years old: 26 respondents (13.52%)

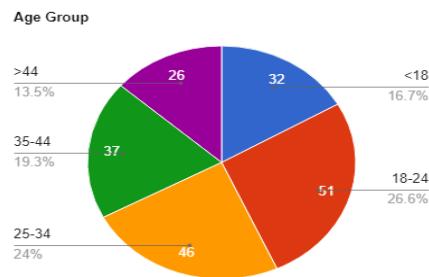


Fig. 3. Results of online survey based on Age Group

- Travel Frequency:

- 1) Regular commuters: 32 (16.64%)
- 2) Occasional travelers: 30 (15.6%)
- 3) Infrequent travelers: 18 (9.36%)
- 4) Seasonal travelers: 63 (32.76%)
- 5) Tourists: 49 (25.48%)

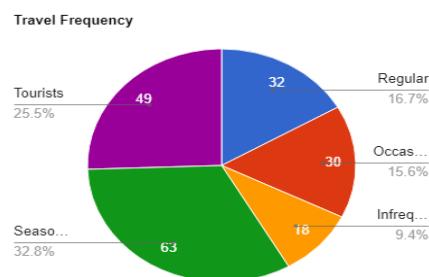


Fig. 4. Results of online survey based on Travel Frequency

- Screen time:

- 1) Under 18 years old: 33 hours 21 minutes per week
- 2) 18-24 years old: 28 hours 59 minutes per week
- 3) 25-34 years old: 26 hours 29 minutes per week
- 4) 35-44 years old: 23 hours 12 minutes per week
- 5) Over 44 years old: 18 hours 06 minutes per week

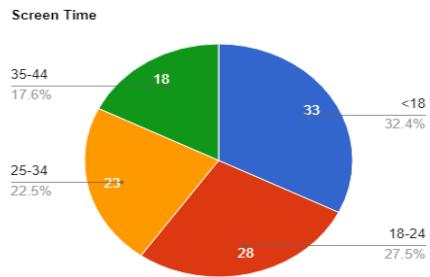


Fig. 5. Results of online survey based on Screen Time

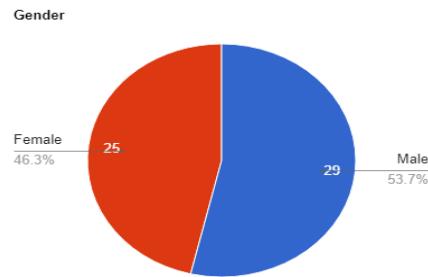


Fig. 7. Results of in person survey based on Gender distribution

- Booking Method:

- 1) Online on IRCTC website or app - 93 (48.36%)
- 2) Offline at the railway station counter - 33 (17.16%)
- 3) Through travel agents - 32 (16.64%)
- 4) Other - 34 (17.68%) (This may include booking through third-party websites or apps, booking through mobile wallets, etc.)

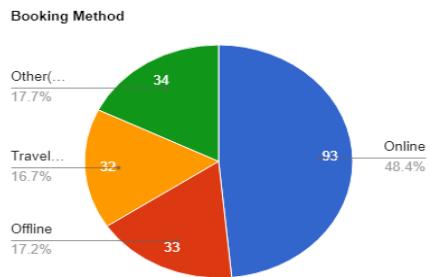


Fig. 6. Results of online survey based on Booking Method

For In-person interviews:

- Gender:

- 1) Male: 29 respondents (53.65%)
- 2) Female: 25 respondents (46.25%)

- Occupation:

- 1) Students: 16 respondents (29.6%)
- 2) Professionals: 24 respondents (44.4%)
- 3) Others (e.g. homemakers, unemployed): 14 respondents (25.9%)

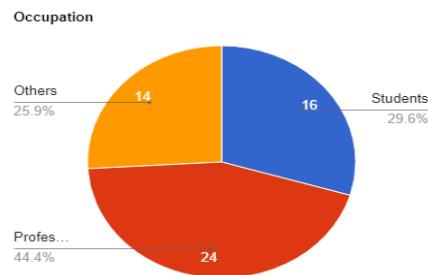


Fig. 8. Results of in person survey based on Occupation

- Age group:

- 1) Under 18 years old: 8 respondents (14.8%)
- 2) 18-24 years old: 12 respondents (22.2%)
- 3) 25-34 years old: 13 respondents (24.05%)
- 4) 35-44 years old: 11 respondents (20.35%)
- 5) Over 44 years old: 9 respondents (16.65%)

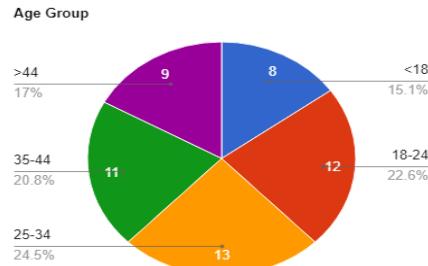


Fig. 9. Results of in person survey based on Age Group

- Travel Frequency:

- 1) Regular commuters: 8 respondents (14.8%)
- 2) Occasional travelers: 13 respondents (24.05%)
- 3) Infrequent travelers: 9 respondents (16.65%)
- 4) Seasonal travelers: 12 respondents (22.2%)
- 5) Tourists: 12 respondents (22.2%)

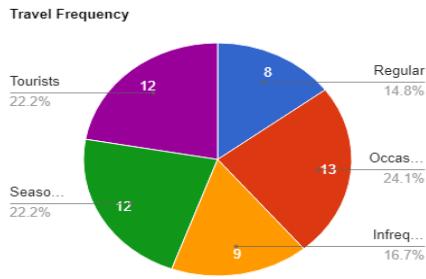


Fig. 10. Results of in person survey based on Travel Frequency

- Screen time:

- 1) Under 18 years old: 32 hours 47 minutes per week
- 2) 18-24 years old: 28 hours 19 minutes per week
- 3) 25-34 years old: 26 hours 03 minutes per week
- 4) 35-44 years old: 24 hours 32 minutes per week
- 5) Over 44 years old: 17 hours 31 minutes per week

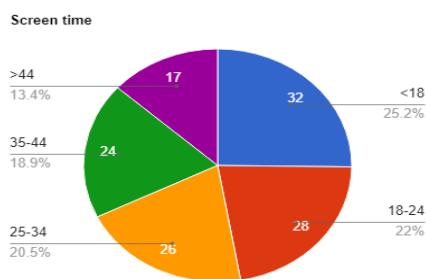


Fig. 11. Results of in person survey based on Screen Time

- Booking Method:

- 1) Online on IRCTC application or app - 23(42.55%)
- 2) Offline at the railway station counter - 12 (22.2%)
- 3) Through travel agents - 9 (16.65%)
- 4) Other - 10 (18.5%) (This may include booking through third-party websites or apps, booking through mobile wallets, etc.)

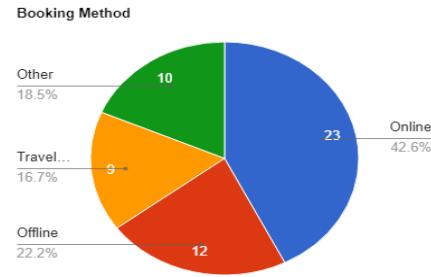


Fig. 12. Results of in person survey based on Booking method

VIII. USABILITY EVALUATION

A. Online Survey

We asked two types of questions in the survey. We asked them to rate the given question on the following basis:

- 1) extremely dissatisfied
- 2) dissatisfied
- 3) slightly dissatisfied
- 4) neutral
- 5) slightly satisfied
- 6) satisfied
- 7) extremely satisfied

The first part was centered around the application's content and features. The questions asked are as follows:

- 1) The IRCTC application presents information about its services clearly and straightforwardly.
- 2) The content on the homepage is both visually appealing and informative.
- 3) Users can easily locate the information they need on the application.
- 4) The information provided on the application is helpful and relevant.
- 5) Contact information for the company is readily accessible.
- 6) Clicking on links takes users to the expected destinations.
- 7) The information on system screens is well-organized and easy to understand.
- 8) The language used on the application is appropriate for the intended audience.
- 9) The application is logically structured and easy to navigate.

Part 2 was dedicated to the User-Interface and provided details on the aesthetic qualities of the IRCTC application.

- 1) The legibility of the application, including the typeface, font size, and contrast of colors.
- 2) Whether the terms used on the application are appropriate for the task at hand.
- 3) Whether the application provides information about its progress.
- 4) How error messages are presented on the application.

- 5) The overall appearance of the application.
- 6) How easy it is to navigate the application.
- 7) Whether the application is easy to use for first-time visitors.

B. In person interview

1) *Tasks:* To test the usability of the IRCTC application, we asked the test subjects to perform the following tasks:

- 1) Registering a new account on the application: This task can be used to evaluate the ease of creating a new account on the IRCTC application.(T1)
- 2) Searching for a train ticket: This task can be used to evaluate the ease of searching for a train ticket on the application.(T2)
- 3) Booking a train ticket: This task can be used to evaluate the ease of booking a train ticket on the application.(T3)
- 4) Cancelling a train ticket: This task can be used to evaluate the ease of canceling a train ticket on the application.(T4)
- 5) Checking the status of a booked ticket: This task can be used to evaluate the ease of checking the status of a booked train ticket on the application.(T5)
- 6) Checking the status of a train: This task can be used to evaluate the ease of checking, current position of the train, expected arrival and departure times, and any delays or cancellations on the application. We can also use the "Live Station" option to check the status of trains arriving or departing from a particular station.(T6)
- 7) Providing feedback on the application: This task can be used to evaluate the user's overall satisfaction with the application and the ease of providing feedback.(T7)
- 8) Updating personal information: This task can be used to evaluate the ease of updating personal information on the application.(T8)
- 9) Retrieving forgotten login credentials: This task can be used to evaluate the ease of retrieving forgotten login credentials on the application.(T9)
- 10) Making a payment: This task can be used to evaluate the ease and security of paying for a train ticket or other service on the application.(T10)

C. USER PERSONA

A user persona is a fictional character representing a particular type of user for a product or service. It is created by analyzing user demographics, behaviors, motivations, and goals. A user persona helps to ensure that the design of a product or service is focused on the needs and goals of its target users. These user personas are created through surveys, interviews, and other research methods that gather data on user demographics, behaviors, and preferences. User personas can then guide the design of a product or service by helping designers understand the needs and goals of their target users. When studying the users of IRCTC, it is important to create user personas that represent different segments of the population.

User persona for IRCTC who want to make group bookings

Name: Rajesh Singh
 Age: 35
 Occupation: Businessman
 Location: Delhi, India
 Travel frequency: Occasionally

Goals:

- To book train tickets for a group of 10 people traveling together
- To ensure that everyone in the group is seated together during the journey
- To get the best deal on the train tickets
- To make the booking process as smooth and hassle-free as possible

Challenges:

- Finding available seats for a group of 10 people can be difficult, especially during peak travel seasons
- Coordinating with everyone in the group to ensure that they all arrive at the station on time and board the train together
- Understanding the different train fare options and choosing the best one for the group
- Dealing with any last-minute changes or cancellations

Behaviors:

- Rajesh is comfortable using technology and is familiar with online booking systems
- He prefers to do things himself rather than relying on a travel agent
- He is willing to spend time researching and comparing different options to get the best deal
- He communicates regularly with the members of the group to keep everyone informed and on track

Needs:

- A user-friendly booking system that can handle group bookings with ease
- Clear information about available seats, fares, and any applicable discounts
- The ability to choose seats for the entire group at the time of booking
- A reliable customer support system to handle any issues or changes during the booking process

Here's a user persona for a traveler who uses the IRCTC application for daily commute to work

Name: Suresh Sharma
 Age: 32
 Occupation: Software Engineer
 Goals:

Book train tickets quickly and easily for his daily commute to work. Ensure the tickets are confirmed, and he has a seat on the train. Receive updates on train schedules and any changes or delays. Check his PNR status to confirm the booking status of his ticket. Have a hassle-free experience with the IRCTC application. Challenges:

The booking process can be complex and time-consuming, especially during peak hours. The availability of seats on the train can be limited, and waiting lists can be long. Train schedules can be irregular, and delays can occur frequently. Technical errors on the application can prevent him from booking or canceling tickets. Lack of customer support or assistance can be frustrating if he encounters any issues. Values and Behaviors:

Values punctuality and efficiency in his daily commute to work. Prioritizes a comfortable and convenient experience while traveling. Appreciates technology that simplifies and streamlines his daily routine. Willing to provide feedback and suggestions to improve the application. By understanding the needs and behaviors of this user persona, IRCTC can design solutions that cater to his specific requirements, such as a more streamlined booking process, real-time updates on train schedules, and efficient customer support. This can enhance Rajesh's overall experience with the application and encourage him to continue using it for his daily commute.

D. EMPATHY MAPPING

Empathy mapping is a technique used in research to gain a deeper understanding of users' needs, behaviors, and motivations. It is a tool that helps researchers and designers to develop empathy for the user and to create user-centered solutions. Empathy map for the user persona for IRCTC who wants to do group bookings:

What they Say:

- "I want to plan a trip with my family and friends."
- "It would be great if we could all travel together and sit together."
- "I don't want to go through the hassle of booking multiple tickets separately."
- "I wish there was an easier way to manage group bookings."

What they Think:

- "I hope the application can handle group bookings efficiently."
- "I don't want to miss out on booking seats together."
- "I hope the pricing and discounts are favorable for group bookings."
- "I wish there were a simpler process for managing changes or cancellations."

What they Do:

- Research travel options and routes that can accommodate their group size.
- Look for information about discounts or special deals for group bookings.
- Check the availability of tickets and seats for their desired travel dates and times.
- Coordinate with their group members to finalize the travel plans and preferences.
- Use the IRCTC application to book the tickets and seats for the entire group.

What they See:

- The IRCTC application interface for booking tickets and managing reservations.
- Travel and tourism applications advertising group travel and packages.
- Social media posts and reviews from other group travelers.
- Advertisements for travel deals and discounts for group bookings.

What they Feel:

- Excited about planning a trip with their family and friends.
- Anxious about the booking process and ensuring everyone is accommodated.
- Frustrated with any complications or issues that arise during the booking process.
- Satisfied when they successfully book tickets and seats for the entire group.

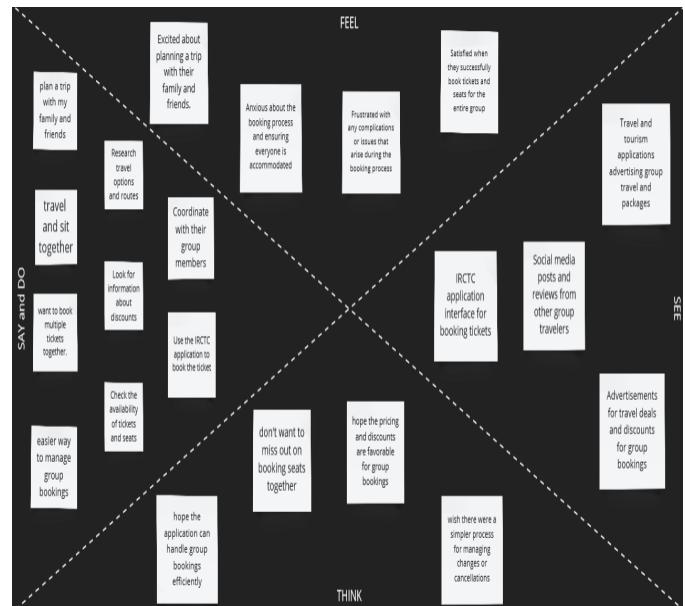


Fig. 13. Empathy mapping

IX. USER JOURNEY MAP

Here's a general idea of a user journey map for IRCTC:

- 1) Awareness: The user becomes aware of the need to book a train ticket through personal travel plans or business requirements.
- 2) Consideration: The user researches various travel options and platforms, such as IRCTC, to find the most suitable one for their needs.
- 3) Decision: The user uses IRCTC and visits the application or mobile application to book the ticket.
- 4) Booking: The user enters the journey details, such as departure and arrival cities, dates, and passenger information. They also select a train and class of travel and make the payment.
- 5) Post-booking: The user receives a booking confirmation through email or SMS. They may also check their

booking details and make necessary changes through the IRCTC application or mobile app.

- 6) Travel: The user travels on the booked train and experiences the services and facilities provided by IRCTC.
- 7) Feedback: After the journey, the user may provide feedback on their experience, which IRCTC can use to improve its services.
- 8) Repeat: If the user has a good experience with IRCTC, they may use the platform again for future train bookings.

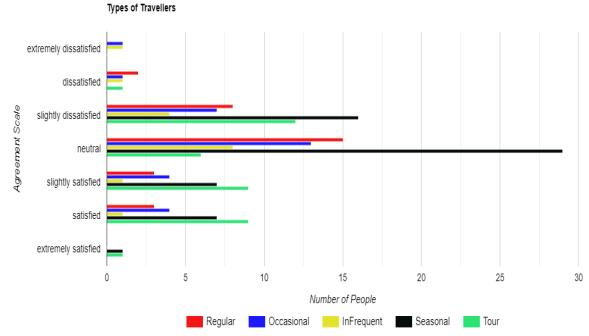


Fig. 16. Results of online survey based on Frequency of Travel

X. RESULTS OF IRCTC APPLICATION

A. Online Survey

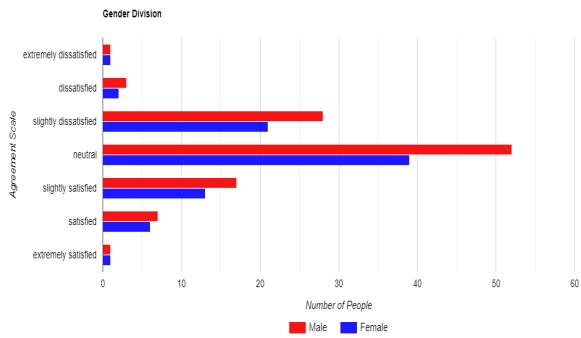


Fig. 14. Results of online survey based on Gender distribution

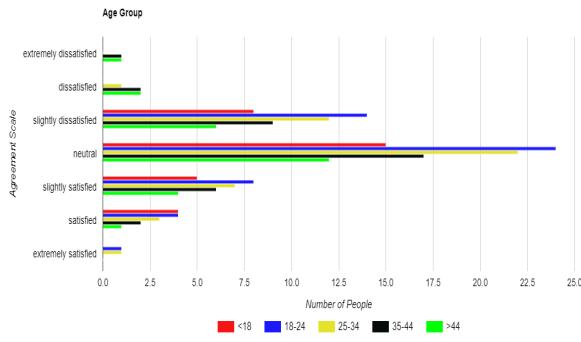


Fig. 15. Results of online survey based on Age distribution

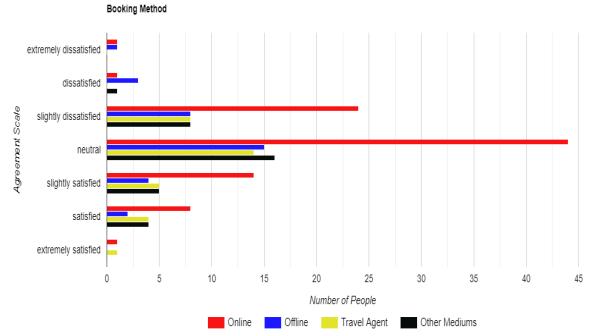


Fig. 17. Results of online survey based on Mode of Booking

B. 3 mechanisms

The concept of usability comprises three mechanisms: efficiency, effectiveness, and satisfaction.

- **Efficiency**- It pertains to the speed and ease with which users can accomplish tasks on a system or website. Metrics such as task completion time and clicks required to finish a task can be used to measure efficiency.

- 1) We measured the participant's time to complete a task using a stopwatch.
- 2) We measured the participant's tapping behavior by manually recording the number of clicks for each task during the experiment.

However, these results are subject to human error. The outcomes of the efficiency analysis are presented in Table. We calculated each task's mean, standard deviation, minimum, and maximum to measure efficiency.

Data Type	Task	Mean	SD	Min	Max
Task completion time in seconds	T1	490.8	123.62	331	863
	T2	427.74	48.71	44	586
	T3	162.02	36.17	27	209
	T4	64.23	26.37	37	196
	T5	75.4	39.88	28	214
	T6	97.59	31.65	27	198
	T7	162.54	52.94	20	389
	T8	204.82	28.68	128	311
	T9	120.54	52.94	48	389
	T10	67.82	28.68	31	187
Tapping Behavior	T1	27.26	8.68	18	43
	T2	12.82	5.77	7	24
	T3	14.45	2.26	5	37
	T4	7.69	2.76	4	19
	T5	9.77	3.17	5	17
	T6	11.77	4.65	6	19
	T7	9.61	2.86	7	20
	T8	13.58	4.37	8	18
	T9	12.93	2.86	8	20
	T10	10.43	4.37	5	18

- Effectiveness-** Effectiveness is a usability metric that measures the degree to which users can accomplish their intended tasks using a system or interface. In other words, effectiveness measures users' success rate in achieving their goals while using a system or interface. Effectiveness can be measured in various ways, such as the number of completed tasks, the time taken to complete tasks, and the error rate of users. It is an important usability testing and evaluation metric, providing insights into users' performance while using a system or interface.

Data Type	Task	Mean	SD	Min	Max
Number of Attempts	T1	1.64	0.49	1	3
	T2	1.93	0.75	1	3
	T3	1.34	0.39	1	2
	T4	1.48	0.43	1	3
	T5	1.17	0.37	1	2
	T6	1.23	0.31	1	2
	T7	1.19	0.94	1	2
	T8	1.53	0.28	1	3
	T9	1.84	0.76	1	3
	T10	1.32	0.24	1	2
Number of times help asked	T1	0.67	0.49	0	2
	T2	0.83	0.36	0	2
	T3	0.36	0.21	0	1
	T4	0.69	0.45	0	2
	T5	0.47	0.11	0	1
	T6	0.53	0.59	0	2
	T7	0.91	0.37	0	3
	T8	0.38	0.43	0	1
	T9	0.84	0.37	0	3
	T10	0.41	0.34	0	1

- Satisfaction -** User satisfaction is a usability metric that measures the extent to which users are satisfied with a system or interface after using it to complete their tasks.

In other words, user satisfaction measures the degree to which the system or interface meets users' expectations and needs.

Data Type	Task	Mean	SD	Min	Max
Overall Satisfaction	T1	2.98	0.49	2	5
	T2	3.18	0.75	2	5
	T3	3.46	0.48	2	5
	T4	3.71	0.26	3	5
	T5	3.49	0.48	2	5
	T6	3.21	0.31	2	5
	T7	3.59	0.94	3	5
	T8	3.78	0.33	3	5
	T9	3.16	0.94	2	5
	T10	3.63	0.34	2	5
Easy to Use	T1	3.24	0.26	2	5
	T2	3.41	0.23	2	5
	T3	3.57	0.46	2	5
	T4	3.25	0.78	3	5
	T5	3.39	0.59	3	5
	T6	3.46	0.31	2	5
	T7	3.69	0.73	2	5
	T8	3.52	0.51	3	5
	T9	3.28	0.73	2	5
	T10	3.37	0.49	2	5
Easy to Learn	T1	3.81	0.93	2	5
	T2	3.37	0.57	2	5
	T3	3.42	0.81	2	5
	T4	3.49	0.74	2	5
	T5	3.22	0.52	3	5
	T6	3.74	0.59	3	5
	T7	3.17	0.68	2	5
	T8	3.46	0.19	3	5
	T9	3.15	0.26	2	5
	T10	3.43	0.38	2	5
Recommend Others	-	3.49	0.38	2	5

C. Main Issues

When using the IRCTC website/app, users face several challenges.

- The website has too much unnecessary information, leading to customer confusion, and visual clutter makes it difficult to find important information.
- Additionally, the options are not well-organized, making it difficult for users to use the information on the screen.
- The website layout is unorganized, with many unused spaces in various parts of the webpage.
- New users may have difficulty comprehending the acronyms and technical terminology.
- Users often face server-down issues while booking tickets, and they have no way of checking the running status of their train.
- The user experience is reportedly very poor, with too many ads making it difficult to book a ticket.

- The application has some minor bugs, such as issues with generating usernames and failing to store details entered while filling out forms for registration.
- In 2020, the app added a bot named DISHA to find trains, but its slow speed makes it less preferable than manually entering the details.
- The website's homepage has various options like trains and buses, but each section is a drop-down box without any indication that it is a drop-down box.
- Users also face challenges with distorted captchas, especially when the letter 'O' and the number zero look alike.
- Some users find it impossible to book tickets due to delays in receiving one-time passwords

XI. GOAL

To enhance the user experience of the website, several tasks can be undertaken during the design process.

- User-Centered Design:** Adopting a user-centered design approach where the website is designed based on the target users' needs, expectations, and behaviors. This can involve conducting user research, creating user personas, and incorporating user feedback throughout the design process.
- Clear and Intuitive Navigation:** Designing a clear and intuitive navigation structure that allows users to easily find and access the information they need, including prominent and easily identifiable buttons, menus, and links.
- Consistent and Simple Design:** Maintaining a consistent and simple design throughout the website, with a clean layout, clear typography, and consistent use of colors and icons. This can help users quickly understand and use the website interface.
- Efficient Search Functionality:** Implementing a search functionality that is efficient, accurate, and easy to use, allowing users to quickly search for trains, check availability, and make bookings without encountering difficulties.
- Streamlined Booking Process:** Simplifying the booking process by reducing the number of steps, providing clear instructions, and minimizing unnecessary input requirements.
- Responsive Design:** Ensuring the website is fully responsive and adapts to different devices and screen sizes, including mobile phones, tablets, and desktop computers. This can ensure a consistent and optimized experience for users across different devices.
- Error Prevention and Recovery:** Implementing error prevention mechanisms, such as validation checks and real-time error notifications, to help users avoid making mistakes during the booking process. Additionally, providing clear error messages and guidance on recovering from errors can help users resolve issues smoothly.
- Help and Support Options:** Providing comprehensive help and support options, such as FAQs, tutorials, and a

customer support hotline, to assist users in resolving any issues they may encounter while using the website.

- User Testing and Feedback Integration:** Conduct regular user testing and incorporate user feedback into the website design and development process to identify and address usability issues and continuously improve the website based on user needs and preferences.

After extensive research and analyzing competitors, we have decided to implement a "Minimal Style" for the entire app. This decision was made based on the following reasons:

- A minimalist design approach focuses on simplicity, ensuring that users of any age can easily comprehend how to use an application and access its functionalities.
- A design approach that focuses on minimalism simplifies the user experience, enabling users to quickly locate their desired content and complete tasks with less time and effort.
- Simplistic design approach can have a visually attractive and soothing effect, thus making it attractive to users of all generations.
- Minimal design emphasizes meeting the user's needs, making it a favorable option for designers who seek to develop effective and user-centered apps.
- Minimal design has a contemporary appearance attractive to all age groups of users who desire their applications to appear current and fashionable.

XII. DESIGN AND DEVELOPMENT

1) Registering a new user:

- Current IRCTC application design:

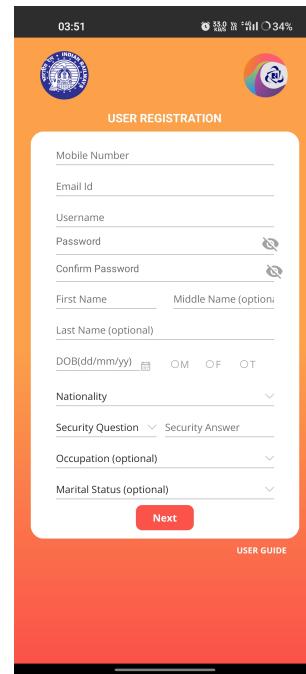


Fig. 18. Registering a new user

- a) The website or application is hard to navigate due to small buttons and insufficient spacing between elements.
- b) Lack of clear instructions or feedback during the registration process causes confusion and frustration for the user.
- c) No feedback is given for logging in and signing in.

- **Redesigned prototype:**

Register
Individual Registration

User Name

Password

Confirm Password

Security Question

Select Security Question

Security Answer

Preferred Language

Select Preferred Language

NEXT >

Fig. 19. Registering a new user

Register
Personal Details

First Name

Last Name

Gender

Male Female Others

Date of Birth

05/05/2020

Occupation

Select Occupation

Mobile Number

+91

Email Address

Nationality

India

< BACK **NEXT >**

Fig. 20. Registering a new user

- a) Increased the size of the buttons to make them

- more clickable and increased spacing between elements to make it easier to navigate.
- b) Made clickable options more visible and prominent.
- c) Added confirmation messages after successful login or sign in.
- d) Displays an error message with the reason for the login/sign in failure to help the user troubleshoot.

2) **Login Page:**

- **Current IRCTC application design:**



Fig. 21. Login Page:

- a) Users face challenges with distorted captchas, especially when the letter 'O' and the number zero look alike.

- **Redesigned prototype:**



Fig. 22. Login Page:

- b) Cluttered and disorganized layout, making it difficult for users to quickly find the information or features they need.
- c) The homepage is not customized or personalized to the user's preferences or previous search history and so it may not provide relevant information or suggestions.

- Redesigned prototype:

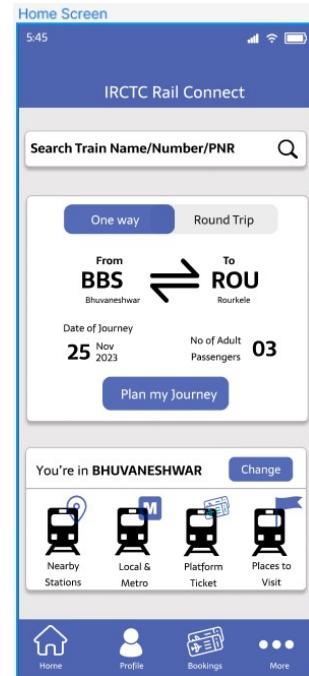


Fig. 24. Home page

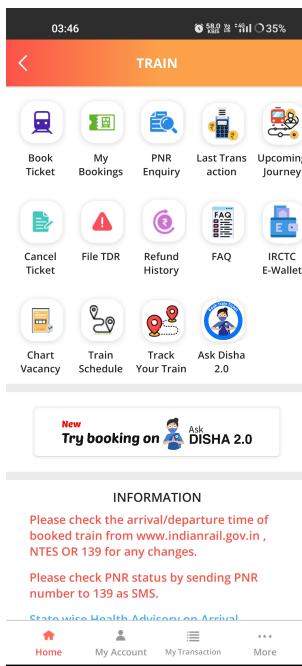


Fig. 23. Home page

- a) Excessive graphics or content.

- a) The homepage is simplified by removing unnecessary elements and highlighting the most important features.
- b) Shortcut icons added to the most commonly used features.
- c) We included an additional function that utilizes the location services on your device to offer you more railway-related details about the city you are currently in. This feature provides you with the local and metro rail routes to facilitate your navigation within the city.

4) Search Trains:

- Current IRCTC application design:

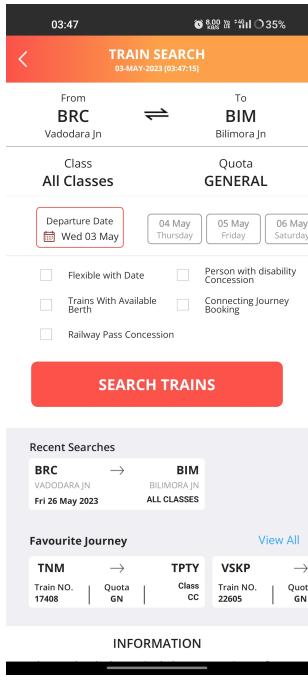


Fig. 25. Search Trains

- a) Lot of blank space on the page
- Redesigned prototype:

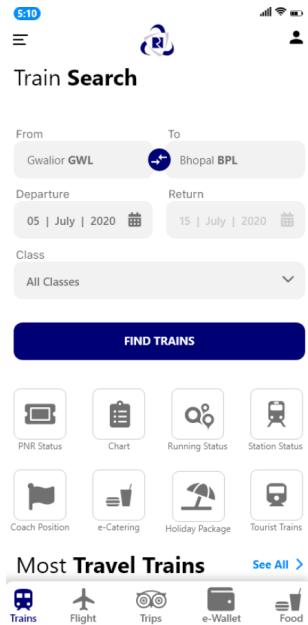


Fig. 26. Search Trains

- a) Utilized the whole screen and increased the size of the buttons to make them more clickable and increased spacing between elements to make it easier to navigate.
- 5) List of trains:
 - Current IRCTC application design:

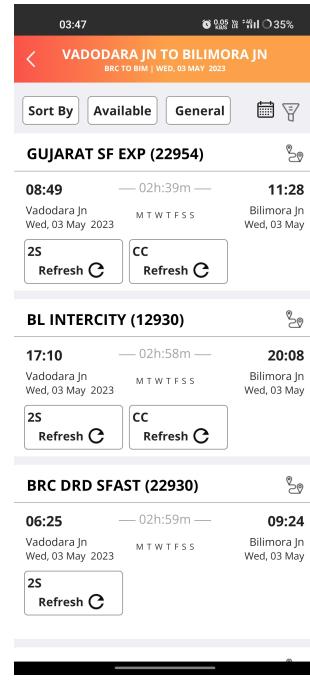


Fig. 27. List of trains

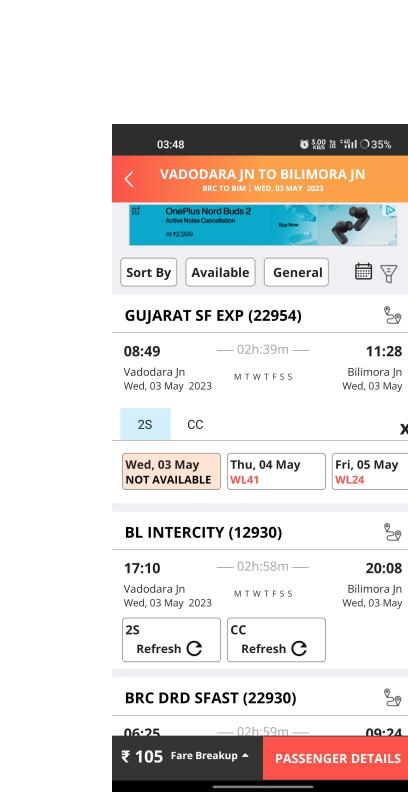


Fig. 28. List of trains

- a) Extra steps to check train availability
- Redesigned prototype:

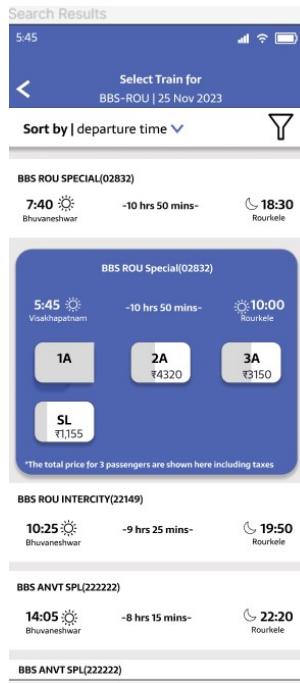


Fig. 29. List of trains

- a) It shows train availability and respective prices beforehand.
- 6) Live tracking:

- Current IRCTC application design:
 - a) Does not have any feature regarding station status or running status.
- Redesigned Prototype:

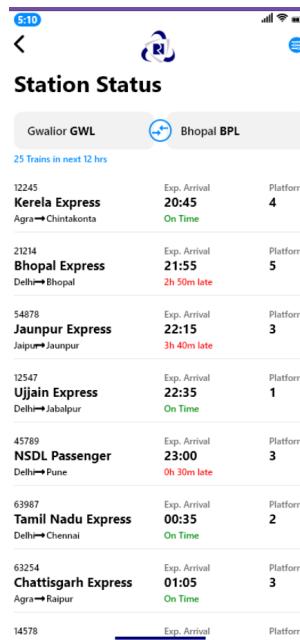


Fig. 30. station status

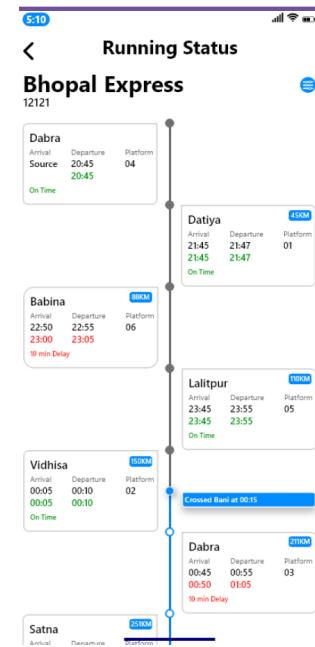


Fig. 31. running status

- a) Added the station status feature and running status feature.
- 7) PNR:

- Current IRCTC application design:

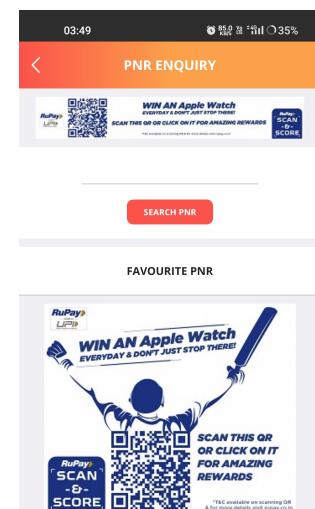


Fig. 32. search PNR

- a) Difficulties entering the PNR number correctly due to unclear or poorly designed input fields
- Redesigned Prototype:

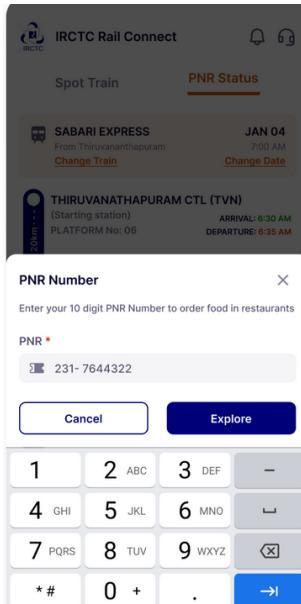


Fig. 33. search PNR

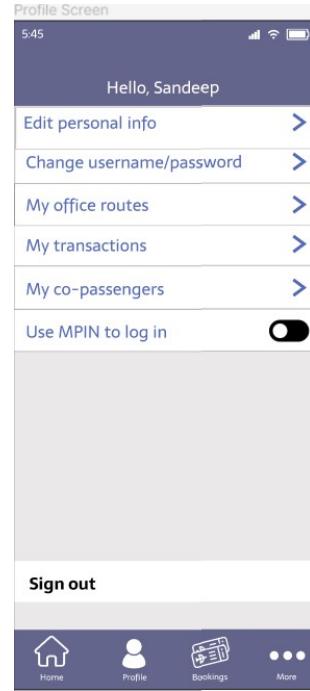


Fig. 35. Profile screen

- a) Will show sample PNR in transparent colours to show users a sample
- 8) **Profile screen:**
- Current IRCTC application design:

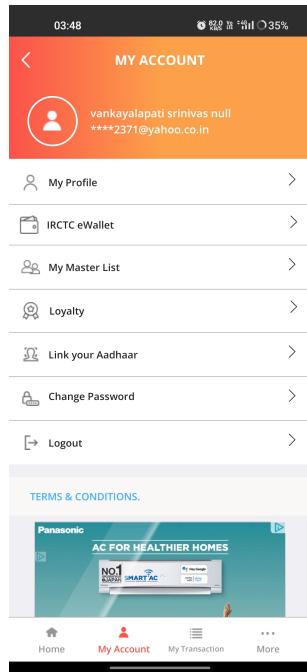


Fig. 34. Profile screen

9) Ticket details:

- Current IRCTC application design:

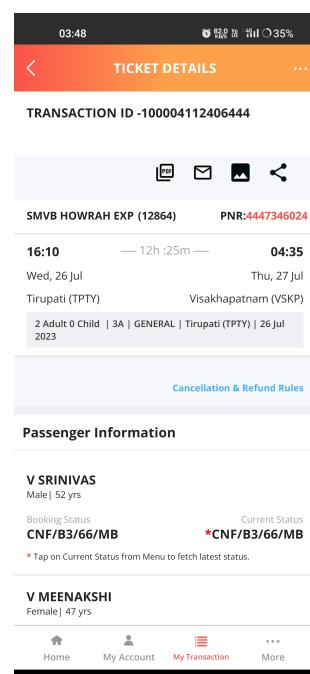


Fig. 36. Ticket details

- a) Size of the features to download the ticket and others are very small.
- Redesigned prototype:
- Redesigned prototype:

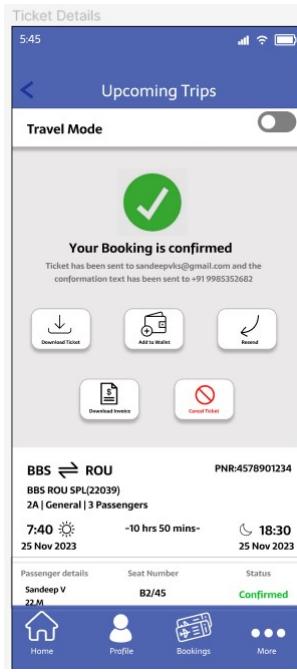


Fig. 37. Ticket details

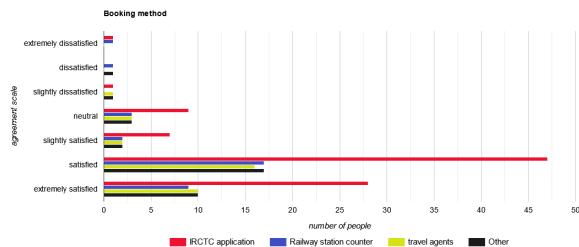


Fig. 40. Signup Page

Types of Travellers

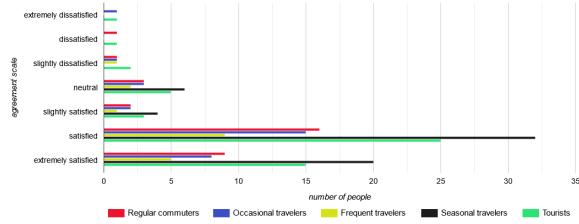


Fig. 41. Ticket Details

- a) Size of the features made more visible and prominent.

XIII. RESULTS OF PROTOTYPE

A. Online Survey

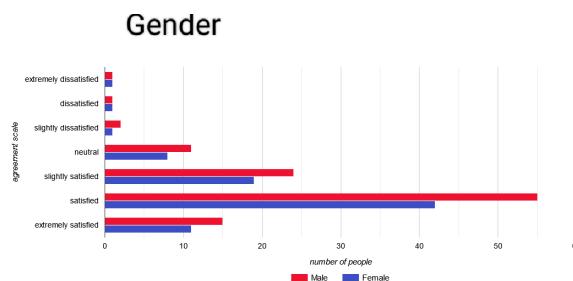


Fig. 38. Home screen

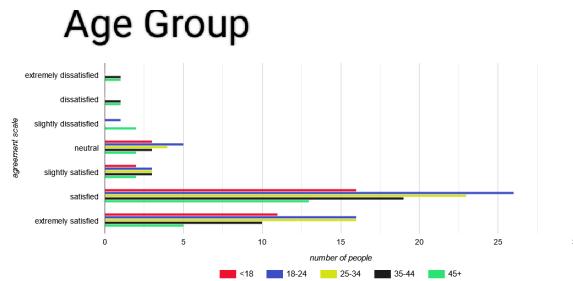


Fig. 39. Train Search Results

B. In person interview

Here's the result of our usability metrics of our prototype:

- Efficiency

Data Type	Task	Mean	SD	Min	Max
Task completion time in seconds	T1	421.72	106.53	298	776
	T2	379.56	54.13	39	548
	T3	143.42	36.43	34	213
	T4	53.29	16.37	36	196
	T5	69.32	24.19	29	197
	T6	82.61	38.64	36	201
	T7	137.18	39.25	21	279
	T8	169.34	27.98	108	312
	T9	117.43	49.32	58	366
	T10	53.05	19.54	29	203
Tapping Behavior	T1	24.57	7.25	16	43
	T2	10.86	2.23	7	29
	T3	13.49	3.17	8	31
	T4	6.54	2.39	4	17
	T5	8.96	2.87	5	16
	T6	11.14	3.92	7	21
	T7	9.07	2.16	6	19
	T8	12.87	3.93	8	22
	T9	11.59	3.47	7	21
	T10	10.03	4.06	6	20

- Effectiveness

Data Type	Task	Mean	SD	Min	Max
Number of Attempts	T1	1.37	0.36	1	3
	T2	1.68	0.71	1	4
	T3	1.15	0.19	1	2
	T4	1.29	0.85	1	3
	T5	1.09	0.92	1	2
	T6	1.01	0.54	1	2
	T7	1.16	0.75	1	2
	T8	1.22	0.80	1	3
	T9	1.62	0.23	1	3
	T10	1.21	0.68	1	2
Number of times help asked	T1	0.49	0.32	0	2
	T2	0.47	0.78	0	2
	T3	0.18	0.97	0	1
	T4	0.44	0.24	0	2
	T5	0.31	0.53	0	1
	T6	0.26	0.72	0	2
	T7	0.73	0.47	0	3
	T8	0.12	0.28	0	1
	T9	0.58	0.69	0	3
	T10	0.23	0.16	0	1

- Satisfaction

Data Type	Task	Mean	SD	Min	Max
Overall Satisfaction	T1	3.22	0.23	2	5
	T2	3.28	0.17	2	5
	T3	3.76	0.65	2	5
	T4	3.91	0.46	3	5
	T5	3.73	0.28	2	5
	T6	3.61	0.55	2	5
	T7	3.79	0.62	3	5
	T8	3.58	0.49	3	5
	T9	3.46	0.74	2	5
	T10	3.93	0.88	2	5
Easy to Use	T1	3.62	0.26	2	5
	T2	3.71	0.46	2	5
	T3	3.90	0.28	2	5
	T4	3.46	0.17	3	5
	T5	3.69	0.93	3	5
	T6	3.78	0.27	2	5
	T7	3.89	0.84	2	5
	T8	3.72	0.58	3	5
	T9	3.57	0.94	2	5
	T10	3.67	0.35	2	5
Easy to Learn	T1	3.96	0.36	2	5
	T2	3.64	0.27	2	5
	T3	3.81	0.31	2	5
	T4	3.78	0.26	2	5
	T5	3.66	0.12	3	5
	T6	3.89	0.95	3	5
	T7	3.34	0.32	2	5
	T8	3.69	0.59	3	5
	T9	3.52	0.54	2	5
	T10	3.69	0.88	2	5
Recommend Others	-	3.71	0.63	2	5

XIV. COMPARISON OF SURVEYS

Comparison between IRCTC application and our prototype:

- 1) Online surveys - As shown in the graph, we can clearly see that most people were satisfied with the prototype's functioning over the IRCTC application as it almost solved a huge part of the concerns raised by people.

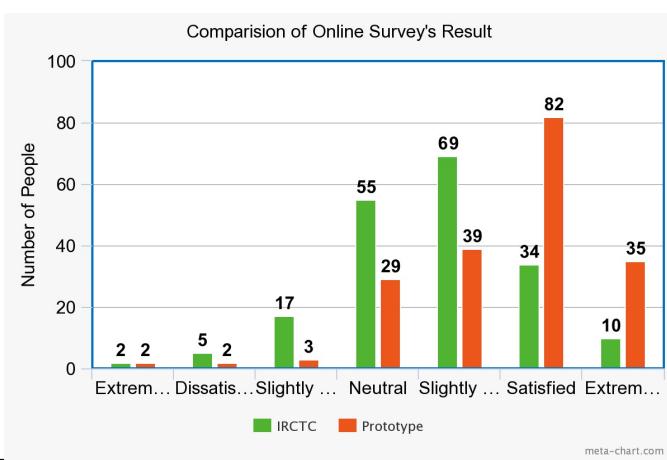


Fig. 42. Overall comparison

- 2) Usability metric:

- a) Time taken to complete tasks- As we can see from the graph that the time taken to complete the tasks is comparatively less than that of the original application. This clearly shows that the prototype is more efficient.

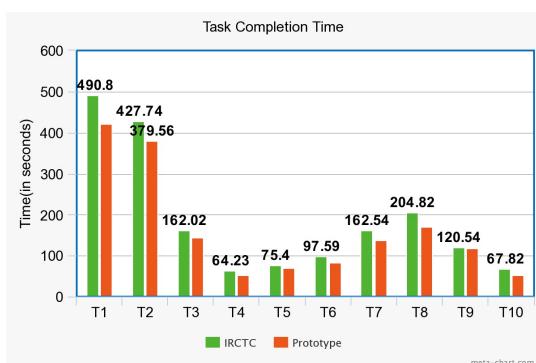


Fig. 43. Time taken to complete tasks

- b) Tapping behaviours- The graph clearly states that the number of taps used in the prototype is less than those in the original IRCTC application. This clearly shows that the user has found the functioning of the prototype pretty easily when compared to the original IRCTC application.

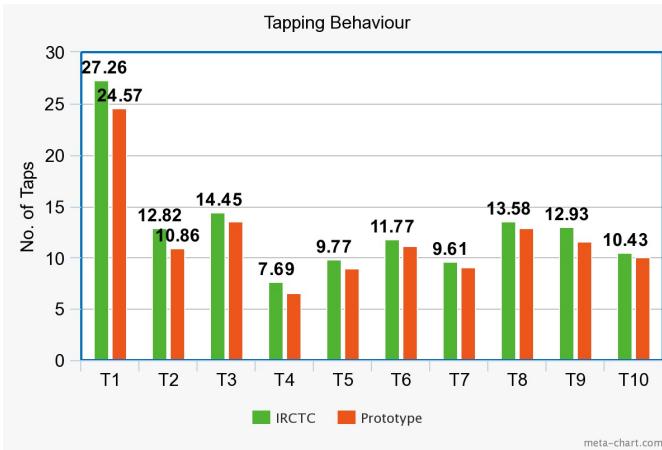


Fig. 44. Tapping behaviours

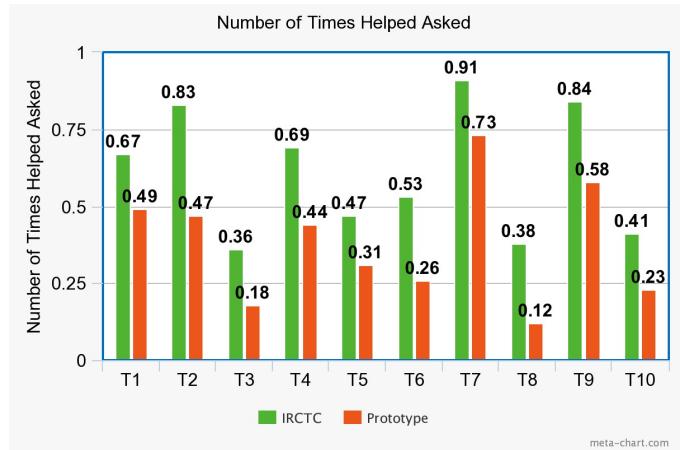


Fig. 46. Number of times help asked

- c) Number of Attempts Made - The number of attempts made is an effectiveness metric. Here in the graph, it is clearly visible that the prototype took fewer attempts while performing a specific set of tasks.

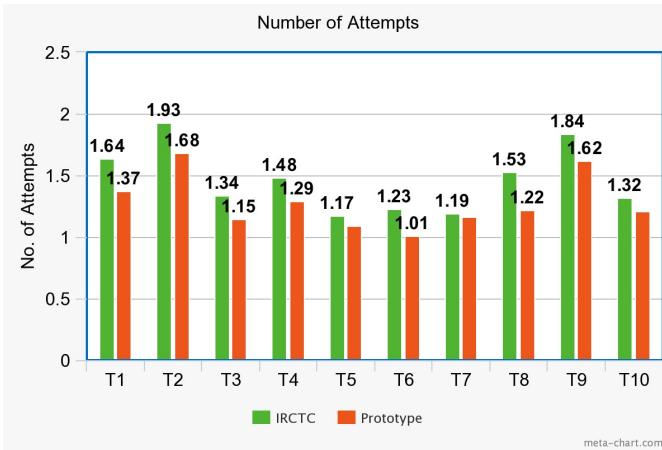


Fig. 45. Number of Attempts Made

- d) 'Number of times help asked- It is clearly visible that the person using the prototype asked for help fewer times while performing a specific set of tasks.



Fig. 47. Overall Satisfaction

- f) Ease to use - According to the graph mentioned below, there is not much difference in the easy to use, but the re-designed application had better usability, due to which there is a slight betterment in the prototype than the original application. The prototype displayed error messages which were absent on the IRCTC website, due to which the prototype is easier to use than the present application.

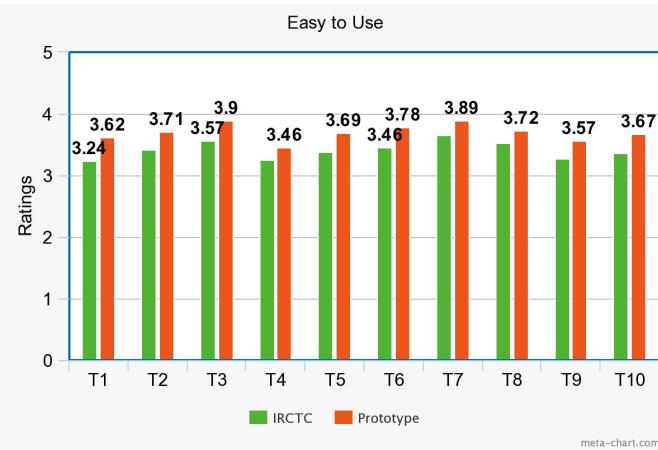


Fig. 48. Easy to use

g) Easy to learn-

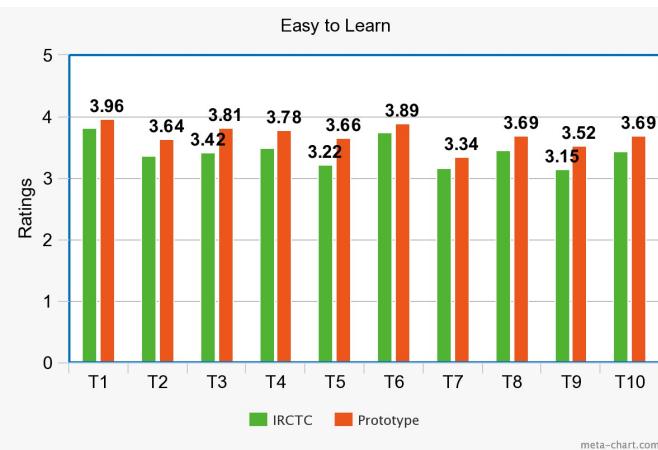


Fig. 49. Easy to learn

As you can see from the above graphs, all the parameters naming Time taken to complete the tasks, number of taps, number of attempts made and number of times help asked have reduced, meaning the improvement in the usability of the application design. You can also see from the tables that the satisfaction of the test subjects have increased.

XV. CONCLUSION

In conclusion, the correlation between the redesign of the IRCTC application and the impact of usability mechanisms has been explored through a family of experiments on efficiency, effectiveness, and user satisfaction. The study found that implementing usability mechanisms such as simplified interfaces, faster loading times, and error prevention techniques improved the overall usability of the application. Furthermore, the redesign of the application resulted in increased user satisfaction and decreased user error rates. These findings demonstrate the importance of considering usability mechanisms during software development and the potential benefits of redesigning applications to improve their usability. The study provides

valuable insights for software engineers and designers, highlighting the importance of usability metrics and user-centered design principles in creating effective and efficient software systems.

XVI. LEARNING OUTCOMES

- We chose IRCTC as our subject of interest as it is a platform widely used by people of all ages and backgrounds. It was certainly something that needed a little tweaking as it had some features which really annoyed the users.
- The surveys really took a lot of effort as the offline surveys were tedious. This paper helped us to understand how to take surveys and the factors which need to be considered while designing the UI of any application. We also learned how to enhance the user experience by providing a more modern and visually appealing design, which could lead to increased user satisfaction.
- The repetitive and exhaustive method of making a better UI has familiarized us with FIGMA software. Another major thing we learned in the process is that while designing, we must consider the user's needs, including their goals, preferences, and limitations. A user-centric approach can help ensure the UI is intuitive and easy to use
- We got to learn about basic practices of UI designing (do's and don'ts)

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