Interactive UI for Smartphone/ Web Applications and Impact of Social Networks

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Abstract

In today's digital world, smartphones and web-based applications have gained remarkable importance throughout the globe. These smart applications are playing a very significant role in maintaining a powerful business. As well as, they are helping a lot to expand these businesses via social networks. Social media networks such as Instagram, Facebook, Twitter, and LinkedIn are playing a prominent role to promote the companies. In the hospitality sector, most of the companies are running their hotel booking systems by utilizing mobile applications and a web-based infrastructure, but usability issues still exist. This study has been conducted specifically to tackle the usability issues of hotel booking systems and the best utilization of social networks to promote the business. TripAdvisor was selected as an authentic source for selecting those systems and two international hotels are selected for this study. The first step is to identify different hotel booking systems. In the second step, the user's satisfaction level was measured for the selected systems by performing the System Usability Scale (SUS, Quick & Dirty) approach. Additionally, by which source (social media or personal relations) they found these hotels. It is found that the SUS rating for both systems is below the acceptable level of usability. The Mean SUS for hotel 1 is found at 55.25 and 51.2 for hotel 2. The third step was to identify the user interface (UI) issues, and heuristic evaluation is performed for this. The experts identified the UI issues on the basis of their experience. The major issues were related to the visibility of system status, error prevention, flexibility and efficiency of use. Depending upon the identified issues, an interactive UI (prototype) for the selected web-based applications was proposed. This prototype is mainly based on the user's perspective. This prototype can be used for improving the UI of the selected systems which is based on the user's perspective. During the process of verifying the satisfaction level, it is revealed that the targeted audience is not able to use these systems efficiently and effectively. The reason behind this is the negligence of usability guidelines throughout the process of design and development of these hotel booking systems. Therefore, it is highly recommended that the usability of these systems should be evaluated and redesigned, based on expert opinions. It has also been observed that the reviews/ feedback of customers has spread a negative impact through social networks.

Key words:
Social network, smartphone applications, web applications, interactive user interfaces, user-centered design, hotel booking systems

1. Introduction

This is the era of the digital world, technology, and the internet have now become an essential part of everyone's life. The internet today is available to almost everyone worldwide and it is affecting the way people interact and communicate with each other [1]. Any news can be spread through social networks in a very short span of time. There are a lot of examples of social media networks, like Facebook, Instagram Twitter which is playing a vital role in propagating information quickly. In most fields, technology is in use and our dependency on the internet and technology is increasing day by day. As innovation proceeds with its quick development across all businesses throughout the planet, the hotel and tourism sector is becoming progressively important. With the rapid development and enhancement in technology, new user requirements are emerging day by day[2],[3]. Hotels, internationally, are taking advantage of the innovation to catalyze their deals and to further develop client relations. This makes it apparent how the web is assuming a critical part in the improvement of the hotel and tourism business today [4]. The most popular and emerging technology in the field of IT is WEB 2.0 [5]. Web-based applications have gained remarkable importance and play a very significant role in maintaining a powerful business. Now, most of the companies are running their businesses on a web-based infrastructure. With the rapid increase in the use of the internet, web-based applications have become a very essential part of the business community and due to this, the end users' involvement in web technology is increasing day by day [5]. We have a variety of pretty examples around us like all kinds of booking systems, social media products, online learning portals, e-commerce systems, and much more. With the rapid increase in demand for web and smartphone applications, there is a huge concern with the design and user interface which makes a web application more attractive.

When a system has an interactive and user-friendly interface, then it increases the end user's interest in the product [2]. While browsing the data on Internet, we see a lot of problems related to usability concerns in web applications [3]. In order to make it simple to manage the client's present undertaking, it is needed to streamline the UI. The user interface is a way of communication between users and the system in order to perform the tasks and to manipulate the application. Interactive UI designs and user-

friendly applications are the main concern because an interactive system not only focuses on time factors but also improves responsiveness, efficiency, and accessibility of the system by the end-users to achieve the specified goals [6],[7]. The main purpose of usability is to figure out the end users' satisfaction with a specific application [14]. From this, we observed that the user interfaces have high importance because they are the main bridge of communication, and users are involved throughout the application usage process. For the framework development measure, usability and HCI are arising as the core angle to increment and supplement the framework ability and to fulfill the client's interest [8]. Ondrej krejcar, explains that the context of accessing any application from the user's perspective can be determined by usability [9]. Therefore, it becomes an extra opportunity for the business to grow faster in the marketplace. Usability is considered one of the major aspects of any software application [10]. The interactivity of any application can be increased by using different usability techniques [11]. So, keeping in mind the importance of interactive user interfaces, it is the demand of the current time that the web applications which are our main concern, must be developed on the basis of some interactive UI model which will be purely according to the user's perspective. The objectives for this research work include the improvement of the smartphones/web development process from the user's perspective by developing a prototype. More, it is to check the satisfaction level of the targeted audience for selected hotel booking systems using SUS evaluation. Furthermore, it is to find out usability issues in currently available hotel booking systems through heuristic evaluation and to observe the propagation of information through social networks.

2. Literature Review

As we can see that most of the businesses are purely internet-based run by smartphone and web applications. There are a variety of online shopping businesses, digital libraries, social media sites, online education centers, and many more. All these online businesses are showing the importance of web-based applications in our everyday life. Similarly, due to the rapid growth of technology, people are shifting their hotel booking systems to an application-based infrastructure where all of their services are just clicks away. But along the side of rapid incremental progress of internet-based applications, as a successful business, the satisfaction of the end-user is mandatory. If in case the user is not satisfied with the product, then it is not worthy to spend thousand dollars. An interactive system not only focuses on just time factors but also improves responsiveness, efficiency, and accessibility of the system [1]. When we talk about online/web-based businesses, then there is a huge concern with the usability and user-friendliness of the system as the user interface of any web application makes users able to interact with it to perform tasks. Most of the studies in the field of HCI related to usability concerns have shown that when a system has an interactive and user-friendly interface, then it increases the end user's interest in the product [12]. By having interactive interfaces of the applications, users want to perform a variety of tasks and want to learn new features of the product as well. Therefore, it becomes an extra opportunity for the business to grow faster in the marketplace. World Wide Web (www) is a vast collection of different web applications and when we browse the data on Internet, we see a lot of problems related to usability

concerns in web applications [13]. Many researchers in the field of HCI are widely devoting their research work and discussing the user interfaces of web applications from the user's perspective. Some of the research work of previous scholars related to interactive user interfaces are discussed further. De Troyer, Olga, and Corneli Jan Leune introduce WSDM mainly named as (website design method) in order to improve the user interfaces of the web applications [13]. The method was totally based upon UCD (user-centered design). They have classified the end-users into different classes and then defined a model for making improvements in the design flow of websites. Depending upon the behavioural change factors, most of the researchers have presented Interactive UI design models depending upon the user's attitude and nature for making interactive designs of web applications. For example, Fogg, Brian J. in the research study presented a design model for understanding user's behaviour and then creating interactive web designs. Fogg Behavior Model (FBM) is used to identify changes in behaviour [14]. Linaje et al, introduced a model-driven methodology for designing efficient and standardized user interfaces of RIAs (Rich Internet Applications) for better user experience [15]. Desolda et al, in their study, have introduced an actionable UI components-based model in order to facilitate the non-technical users to perform tasks easily [16]. Valverde, Francisco, and Oscar Pastor in their research have presented a RIA meta-model to deal with the web 2.0 development challenges. The major concern was the particularization of interactive UI on the basis of the triggers produced by the users [5]. Islam, Muhammad Nazrul, and Harry Bouwman in their research study have introduced a Semiotic design and evaluation framework that states the UI signs and elements are the major part of UI-based web applications [6]. In 2016, Macik, Miroslav in the research study introduced Context Modeling Method in order to introduce a flow for automatic generation of UI. This approach was specifically designed in order to lower the development and preservation cost and the extent of complexity for application development can also be reduced [2].

From the previous research studies in the field of HCI, we have seen that most of the researchers are interested to introduce a variety of UI-based models in order to improve the UI designs of web-based applications. Similarly, with the rapid increase in innovation and technology, the tourism and hospitality sector is becoming progressively important. The research work done by various researchers in the domain of the tourism and hospitality sector is discussed below.

In the year 2021, Nor Azman Ismail et al. devoted their research work to design an interactive and user-centered prototype of a traveling web application. They showed the importance of the travel and hotel industry and designed two major prototypes: web-based and mobile-based. Later on, a system usability scale was used to evaluate the interactivity of these prototypes [17]. In the year 2020, Bostjan Brumen et al. devoted their work in the field of HCI to evaluate the mobile responsiveness of tourism websites. They have used heuristic evaluation techniques to verify whether the websites are mobile-friendly or not. The results of this research study have outlined the improvements that web developers can make while developing web applications for tourism categories [18]. In the year 2020, Huang, Zhao devoted his work in the field of HCI for the evaluation of the travel industry sites by following a client-focused methodology. The main focus of the study was to

improve the ease of use of the travel industry sites from a user's viewpoint and the heuristic evaluation method was used as an evaluation technique [4]. In the year 2020, Alba-Maria et al. stated that the usability evaluation of hotel and tourism websites is not yet done properly so a standard model for website evaluation is required for this. The scholars worked on revising the past developed models and updated them with a deeper analysis [19]. In the year 2020, Elise Wong et al. devoted their research work in the hotel and tourism sector and stated that the user requirement identification for developing interactive and user-friendly hotel websites is still required. So, in their research study, they worked on filling this research gap by developing a model for evaluating mobile websites in the hotel industry [20].

2.1 Usability Evaluation Through SUS

The importance of the system usability scale in the field of HCI can be observed from the literature review where most of the researchers had used this approach for usability evaluation of a variety of systems. In the year 2019, Nur ANI, et al. used this technique in order to examine the usability of an online reservation system for traveling. The feedback was collected using a google form from 1225 persons [7]. In the year 2020, Debajyoti Pal et al. used this evaluation technique in order to find the usability evaluation of online learning management systems during the COVID-19 pandemic situation. Their main focus was to assess the usability of Microsoft Teams as an online learning system. According to them, SUS is one of the most popular techniques used in the field of HCI to evaluate system usability from the user's perspective [21]. In the year 2020, Rani Edina Kusumawati et al. used this technique in order to determine the usability evaluation of a touchscreen-based device named "kiosk" [22]. These electronic devices are nowadays becoming more popular from a business perspective and it is very necessary that these machines should have an interactive UI to make the features easy to use for the audience. In December 2020, Norshita Mat Nayan et al. conducted a study in Malaysia in order to identify the usability of online food services because due to the Pandemic situation, people prefer to order food online. The researchers, in their research, had used the SUS scale to get feedback from different levels of users [23].

In order to find the usability satisfaction of any system including web and mobile applications, or hardware devices, a system usability scale can be used to calculate the usability assessment of interactive UI in a short period of time due to the reason, this approach is also known as "Quick & Dirty" approach [24]. With sus, the usability can be measured so rapidly with limited users [7]. The SUS's key objective is to work for the end-client experience with the goal that the client gets the greatest results from the system [25]. There are some standardized usability measurement questionnaires such as Computer System Usability Questionnaire (CSUQ), Questionnaire for User Interface Satisfaction (QUIS), and System Usability Scale (SUS), and so on [26]. The SUS questionnaire provides a better way to figure out the user's perspective clearly [27]. As compared to other questionnaires, it is short and has high reliability of 0.91 [28]. Likert-type questionnaires provide results through a regulated statistical process [29].

2.2. Heuristic Evaluation

The heuristic evaluation is one of the widely used evaluation methods in order to identify the usability issues of any software application. Heuristic evaluation is a technique that is the accurate technique that eventually saves travel and installation costs [30]. Note that after some time, heuristic-based convenience assessment has demonstrated to be a compelling technique, so there are many examinations in writing that report on its utilization [30]. Heuristic evaluation is a conventional, cheap, and easy-to-use technique [31]. Heuristic evaluation is usually done with the expert evaluators while studying the interface and checking whether the developed interface has concurrence with the customary usability principles [32]. The heuristic evaluation method is one of the instantly used methods for usability evaluation [33]. The importance of heuristic evaluation in the field of HCI can be obtained from the previous research. Most of the researchers have devoted their research work to the field of HCI mainly for identifying the usability issues through heuristic evaluation.

In the year 2019, Matina Kiourexidou et al. used heuristic evaluation in order to evaluate the usability of forty-seven medical and anatomical websites from expert evaluators to introduce a more user-friendly user interface for such kinds of websites [34]. In the year 2020, Zhao Huang devoted his work in the field of HCI and mainly for usability evaluation of tourism websites. The main idea of his research was to evaluate the user interface of selected tourism websites using heuristic evaluation. The research study was mainly conducted from the user's perspective to ensure the user-friendly design of tourism websites. As a result of this research, proper guidelines were introduced to improve the quality of the user interface [4]. In the year 2020, Bostjan Brumen et al. devoted their work in the field of HCI to evaluate the mobile-friendliness of tourism websites. They have used heuristic evaluation techniques to verify whether the websites are mobile-friendly or not because in today's digital world, mobile technology has gained remarkable and significant importance. The results of this research study have outlined the improvements that web developers can make while developing web applications for tourism categories [18]. In the year 2020, Ger Joyce in his research study used heuristic evaluation to evaluate the tourism mobile applications and figure out a number of usability issues. They selected the tourism mobile application "Trip Advisor" for their research study [35]. In the year 2021, Ahmad Azizi et al. worked in the field of HCI to evaluate the user interface of hospital information systems. They had used heuristic evaluation in their research study, to evaluate the hospital management system deployed at the hospital of Ahvaz. Six expert evaluators were selected to perform the heuristic evaluation. The researchers have mentioned the importance of heuristic evaluation as it is the more reliable and appropriate approach to evaluate the user interface mainly in the domain of hospital systems [36]. In the year 2021, F Q Percy Santiago et al. used heuristic evaluation in their research study to evaluate the user interface of web-based portals provided by the government. According to the researchers, web-based applications are widely spreading across the world so these web portals must be user-friendly especially when it comes to the portals provided by the government [30].

From the previous research studies done in the field of HCI, we have seen the importance of heuristic evaluation. These principles are widely used by researchers. The 10 heuristic principles that are defined by Jakob Nielsen are stated below [30], [37], [4].

1. Visibility of system status.
This principle states that the system must inform users about the activity being done and should display proper feedback within a reasonable time.

2. Match between the system and the real world.
According to this principle, the system should use icons, headings, and similar objects that are related to the real world.

3. User control and freedom.
The system should empower the users to undo or redo their actions smoothly.

4. Consistency and standards.
The system should always be consistent across the pages and should use the same layouts on all pages.

5. Error Prevention.
The system should always alert the users immediately whenever they commit some mistakes in order to avoid errors.

6. Recognition rather than recall.
The system should provide the facility to reuse the information that users have previously looked for. This will help users to use the system and, in this way, they will not have to remember many things from the past.

7. Flexibility and efficiency of use.
The system should provide extra advanced features to the users. The users should be able to manipulate the interface according to their needs.

8. Aesthetic and minimalist design.
The system should display only necessary components and a clear view of the currently active tasks should be shown.

9. Help users recognize, diagnose and recover from errors.
The system should always provide proper feedback regarding error messages and these error messages should be in human-readable languages and should be exact and easy to understand.

10. Help and documentation.
The system's navigation must be easy to use and it should not be necessary to read the documentation. But, in case if the user wants to read a document, then, the documentation must be available easily. Most of the researchers who have done their research work within Pakistan and mostly in the tourism and hoteling category have used Pearl Continental and Avari hotels to perform their research work. These hotels were mainly used to collect useful data to perform research in different categories. The data relating to these hotels can be found in the literature review. In the year 2017, Aasir Ali devoted his research work to find out the intentions of the non-Muslim community towards halal food in hotels. The research was conducted within Pakistan and the main purpose of the research was to find out the factors that are influencing non-muslins towards halal food. The data was mainly collected from different respondents. The major hotels which were selected to collect the data were Avari, PC and from two restaurants Gourmet and Sheezan [38]. In the year 2017, Basharat Javed et al. devoted their work to finding the impact of virtuous command in order to boost creativity at work. Their study also discussed the relation between the ethical leaders and the employees to involve them in their creative work. The major five-star hotels within Pakistan selected were Sarena, Moven stag, and Avari hotel. Some of the four-star and three-star hotels were also selected to collect the data [39]. In the year 2018, Mamoona Masood did research to find out the relationship between stress and job performance.

The study was mainly conducted to evaluate the connection between these two factors and how stress and a job's better performance are interrelated to each other. A quantitative research methodology was selected to conduct the research. The data was collected from different private organizations mainly from banking sectors, telecommunication sector, hospitality sector, airline companies and insurance companies. Selected hotels from where the data was collected include Avari hotel, PC, Hotel One, Bahria Grand Hotel [40]. In the year 2020, Aisha Sarwar and Lakhi Muhammad performed their research study in the hospitality sector. The main idea of this research was to interrogate the influence of discrimination and inequality between the employees of the organization and to find how these factors affect the overall performance of the organization. Managers from different hotels within Pakistan were selected to obtain useful information. The researchers selected different hotels for collecting data. Avari hotel and Pear continental hotel was one of them [41]. In the year 2021, Saqib Rehman et al. devoted their research work in the field of the hospitality sector. The main idea of their research was to identify the influence of emotional business strategies and the demonstration through the organizational employees to see how it will impact the success of the business sector. For this research study, they selected 190 total employees from different hotels and the top 6 six hotels were selected for this including Avari and Pearl Continental to collect data [42]. In the year 2021, Wasim ul Rehman et al. conducted research in the hospitality sector to explore the role of servant leadership. Their research work assumes the job of worker pioneers and working environment may be the critical markers to upgrade the representatives' maintenance by expanding their work commitment. The research was mainly conducted within Pakistan and major five start hotels were selected in order to gather useful data. They selected Avari, PC and Hospitality Inn hotel to collect the data from different employees [43]

3. Research Methodology

This research was mainly conducted to identify the usability issues for web-based hotel booking systems. For the purpose of this research study, two international five-star hotels were selected, and their usability issues were identified. The flow chart of this research study can be seen in Fig. 1.
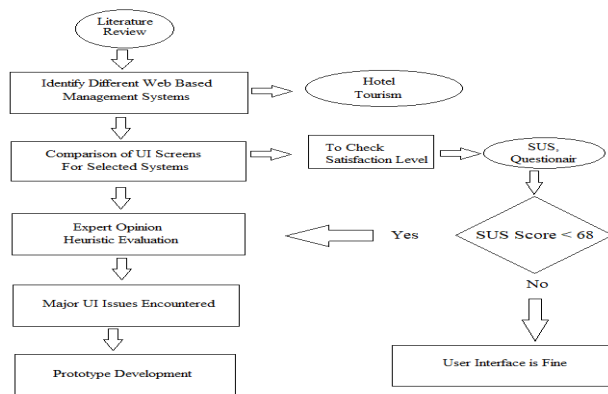
Fig. 1.   Research Study

In this research, we are going to evaluate the UI of web-based hotel booking systems. The research study has been divided into 5 different sections. Section 1 gives the introduction of the topic; section 2 explains the literature review and related work done in the field of HCI and for the usability evaluation of hotel/tourism booking systems to introduce an interactive UI. Section 3 defines the basic methodology used for the UI evaluation of selected systems and to check the satisfaction level of the targeted audience and to implement a standard UI prototype for the web-based hotel booking systems. Section 4 is the result section which contains the results of sus and heuristic evaluation. Section 5 is the main conclusion of the research and the future work related to this topic is also explained.

In the methodology section, the research is further conducted in 3 different phases. Phase 1 is the Identification of the systems through an authorized channel. Phase 2 consists of a total of three steps. The first step is to identify the satisfaction level of the targeted audience on the behalf of selected systems through SUS. Step 2 is the evaluation of the selected hotel booking systems using heuristic evaluation and step 3 is to compile the results. Phase 3 is finally related to the development of a prototype for the improved UI version

3.1 Identification of the systems (Phase-1)

The first step of the research study is to identify web-based hotel booking systems. As we are discussing the web applications so, the criteria of the selection of the systems will be different. In terms of mobile applications, we can select the systems on the basis of the number of downloads and the reviews of the apps but in the case of web applications, we have studied literature review in the field of HCI for obtaining reviews about different top-level hotels. We have found "TripAdvisor" as a better authentication source in order to identify our web-based hotel booking systems. The main focus of the study will be within Pakistan and we have selected the top rating hotel systems within Pakistan to evaluate their UI from the user's perspective.

3.1.1 Authentication of TripAdvisor

Most of the researchers have used TripAdvisor for their research study in order to obtain useful results.

In the year 2020, Maoxin Han used TripAdvisor in order to obtain online reviews showing significantly the satisfaction level of the targeted audience with respect to the hotels. The main idea of this study was to find out the effect of a person's personality on his satisfaction when the person acts as a reviewer in order to add a review regarding hotels [44].

In the year 2021, Josef Zelenka et al. in their research study had used TripAdvisor in order to obtain online reviews of tourism services [45]. The increasing level of trust in these reviews was analyzed deeply. In their research study, they have shown the importance of online reviews and discussed the facts about how to improve the verification level of online reviews. They have discussed various methods for false reviews detection and to improve the review verification process which will surely help to increase the satisfaction level of the users on these review sites.

In January 2021, Norman Schaffer et al. devoted their work to show the importance of intermediaries in hotel and tourism [3]. In today's digital world, where technology is upgrading day by day, businesses also need to be upgraded according to the new trends. The researchers in this study have shown the importance of the improved and digitized system of the tourism industry. The results generated from this research could be helpful for the new entities to introduce innovation and to provide a better quality of tourism services. The researchers have specifically selected familiar participants of the tourism industry and their major participants were Airbnb, Booking.com, and TripAdvisor [3]. According to the researchers, TripAdvisor is one of the biggest online networks for trading and rating a large number of tourism organizations and other tourism activities [34].

After finalizing the authentication of the channel "TripAdvisor" in order to get the best rating and reviews about the hoteling services, we have identified the best rating hotels within Pakistan. From the search results generated, five major hotels were listed down and out of which top 2 rated hotels were selected. One is Avari hotel and the second is Pearl Continental

3.2 Evaluation of selected systems

In order to check the satisfaction level of the selected systems from the user's perspective, we utilized SUS (System Usability Scale).

3.2.1 System Usability Scale

The usability of the system is directly proportional to the satisfaction level of the users. We can say that; a system is user-friendly if its users are satisfied with its interactive interface. In terms of interactivity, we can say that a system has an interactive UI if users can perform specified tasks and can achieve their goals smoothly.

SUS usability measuring scale is a questionnaire consisting of 10 mixed questions having both categories of negative and positive [21]. The questionnaire is then used to get feedback from the users. SUS is a 5 Likert evaluation scale where each question consists of a scale from strongly disagree to strongly agree [7]. The calculation of the usability scale for any system depends upon the even and odd number of questions. For odd numbers,

the rule is the scale position which is selected minus 1 and for even numbers, the rule is 5 minus the scale position. This will calculate the total score and to calculate the SUS score, we will then multiply this by 2.5 [46]. According to the SUS scale, a score above 68 is considered to be average and anything below 68 is considered to be below average. According to a study in the literature review, SUS score can be classified into different levels of grades Table 1 [46].

Table 1: SUS score classification

SUS Score	*Grade*	*Adjective Ranking*
80-100	A	Highly Satisfied
68-79	B	Satisfied
53-67	C	Neutral
Less than 53	F	Dissatisfied

3.2.1.1 Targeted Audience

In order to check the satisfaction level of the selected systems, the criteria for the selection of the targeted audience where the respondent must be familiar with the internet and smart devices and secondly, the respondent should have at least the minimum experience using hotel booking systems [14]. As described by Z. Huang in his study to target the novice users as well [4] so, we have targeted novice, intermediate and expert users. In the category of expert users, we have collected feedback from Software developers, designers, and QA teams from the software house while intermediate and novice users are a mixture of respondents including teachers, students, gov. job holders, and managers.

3.2.1.2 Number of participants

According to the research study conducted by [7], the usability of the software applications using SUS can be measured so rapidly with limited users [7]. In another research study conducted by Nor Azman Ismail et al. the total number of participants was 36 for collecting the responses [17]. In this research work, a total of 65 responses was collected from the participants and most of the participants were between the age limit of 24 – 45. Out of 65 responses, 86.2% of participants were in the age limit of 24 – 45 and 13.8% of participants were in the age limit of 18 – 24.

3.2.1.3 Equipment

No equipment was provided from our end. All the participants used their own devices including mobile and laptops.

3.2.1.4 SUS questionnaire

For measuring the satisfaction level, we have created a google form [46],[21] consisting of 10 mixed (positive & negative) questions with some general demographic information. The form consists of 5 Likert scales and the respondents' selected scales for each question according to their desire.

3.2.1.5 Demographic information

To measuring the satisfaction level, the data were grouped based on gender, age, profession, and the consumption devices [7],[21].

3.2.2 Heuristic evaluation

Heuristic evaluation is the evaluation method to identify the usability issues in the user interface of any software application. In this approach, the experienced persons use their expertise to evaluate the UI of the application on the basis of some usability guidelines proposed by Nielsen in 1990 [30], [37], [4] [34], [48], [49]. Nielsen worked along with Rolf Molich to introduce the heuristics for user interface testing and the final heuristic rules were introduced by Nielsen in 1994 [47]. Heuristic evaluation is usually done by experts and heuristic assessment is hard for a solitary individual to do in light of the fact that one individual won't ever have the option to track down all the convenience issues in an interface. Fortunately, experience from a wide range of undertakings has shown that various individuals discover distinctive convenience issues. In this manner, it is feasible to improve the adequacy of the technique altogether by including various evaluators. Heuristic assessment is performed by having every individual evaluator examine the interface separately. At the end of all the evaluations, the experts then have a meeting together to discuss their individual results. The aftereffects of the assessment can be recorded either as composed reports from every evaluator or by having the evaluators express their remarks to an onlooker as they go through the interface [50].

3.2.2.1 Expert evaluator selection

The first step of heuristic evaluation will be the selection of expert users. The heuristic evaluation can be performed with the help of both expert users and novice users. The number of evaluators for evaluating the system can be just one, or the researchers can have many evaluators for their research work. The evaluation results will be efficient when the number of evaluators is in large number [4]. Nielsen's considerations show that we don't need a large number of experts for usability evaluation because according to his thoughts, more evaluators will eventually find the same errors. It is therefore recommended to have 3-5 evaluators for heuristic evaluation [51]. The previous studies from the literature review have shown the total number of evaluators for various research. Ahmad Azizi et al. selected six evaluators for the evaluation of hospital management systems [36]. Hussain, Azham et al. selected two evaluators for performing heuristic evaluation [37]. F Q Percy Santiago et al. selected four evaluators in order to perform heuristic evaluation [30]. So, depending upon previous research work done by the scholars, we have selected four expert evaluators. These expert evaluators are from the IT sector/Software house including developers, designers, QA engineers and team leaders who have been working for many years in the domain of hotel booking systems.

Table 2: List of expert evaluators

SID	Gender	Designation	Experience
1	Male	Web Developer	4+year
2	Male	QA/Marketing Expert	3+year
3	Male	Graphic Designer	4+year
4	Male	Team Lead Developer	5+year

3.2.2.2 Heuristic evaluation approaches

To perform the heuristic evaluation, two approaches can be used; the first is the Task-based approach and the second one is the Free Flow approach [52].

Task-based Approach: In this approach, each expert evaluator needs to perform predefined tasks to appraise the UI of the selected systems.

Free Flow Approach: In this approach, the user interface of the selected systems is inspected multiple times. The first session is the development of perception and interaction with the system to define the basic scope of the system. The second session is mainly for the specific UI elements while focusing on the fact that how they are adjusted in the UI design. So, in these sessions, each expert can evaluate the systems freely with no specific restrictions.

In this research study, a task-based heuristic approach has been used to evaluate the UI of hotel booking systems [4], [34].

The tasks selected for heuristic evaluation are based on criteria; users-based tasks and system-based tasks [32]
The users-based tasks are further classified into two categories:
1. Navigation: Users scrolling through different screens
2. Data Input: When the users enter some input select options or radio buttons and so on
Similarly, the system-based tasks are also further classified into two categories:
1. Data Validation: System validations for different fields when the user input some data.

2. Feedback of system after user's input: System feedback which it gives back to the user especially when the users perform some tasks.

The selected tasks are listed below:

• Find and read the feedback about the best available rooms [4]

• Find the best deal of a single room with a specific date range [4]

• Register an account [53]

• Create a reservation by selecting an upcoming date range [53]

• View the contact details and find the hotel location contact detail section [20]

3.2.2.3 Severity ranking scale

The expert evaluators selected for the usability evaluation of the identified systems observed the systems individually to figure out the usability issues. To identify the usability issues, the expert evaluators have used the checklists. On successful identification of usability problems, the expert evaluators ranked each usability issue individually using Neilsen's severity ranking scale, and later on, they rated each issue in a joint session from 0 to 4 [36],[52]. Neilson's severity ranking scale has been shown in Table 3.

Table 3: Neilsen severity ranking scale

Rating	Description
0	This does not seem to be usability problem at all
1	Cosmetic issue: This need not to be fixed unless some extra time available on the project
2	Minor issue: This issue at low priority
3	Major issue: This issue at high priority
4	Catastrophic issue: This issue should be fixed before product release

In order to remove the conflicts and personal biases, two evaluators, the Web developer (E1) and the QA expert (E2) evaluated the web application of Pearl Continental and the other two evaluators, Graphic Designer (E3), and Team Lead Developer (E4) evaluated the web application of Avari hotel [54].

4. Finding and Discussions

In this section, the overall results generated by applying the methodologies are mentioned below.

4.1 Results through sus

The results of the user's satisfaction level have been shown in Tab. 4.

Table 4: User's Satisfaction level

Factor	Category	Percentage	Mean SUS score
Gender	Male	44.28%	55.17
	Female	55.71%	44.88
Age	18–24	13.84%	41.38
	24–45	86.15%	53.52
	Above 45	0%	0
Consumption Devices	Laptop	30.76%	43.625
	Mobile	3.07%	35
	Both Devices	66.15%	56.45
Internet Usage	Weekly	26.15%	58.82
	Once a month	12.30%	54.687

	Every 2-3 months	15.38%	61.25
	2-3 times per year	46.15%	44
Profession	Software Engineer	29.23%	59.21
	Designer	12.30%	49.68
	QA	12.30%	52.5
	Teacher	21.53%	43.39
	Student	10.76%	51.785
	Gov. Employee	10.76%	48.92
	Managers	3.07%	57.5

According to the SUS grading table scale defined in the above graph Fig. 2 & Fig. 3, it can be clearly observed that both the systems have a usability scale that is below the average i.e. below 68. So, it means that the users are not satisfied with these systems for making reservations online. To extend the results on the behalf of further factors, the mean SUS score and overall percentage of the selected systems are given below:

The results on behalf of gender show that mean SUS for females is 44.88 (Fig. 4) with a percentage of 55.71% and in terms of males, the mean SUS is 55.17 with a percentage of 44.28% (Fig. 5).

The results on behalf of age show that the mean SUS for range 24-45 is 53.52 with a percentage of 86.15% and in terms of age range 18-24, the mean SUS is 41.38 with a percentage of 13.84%.
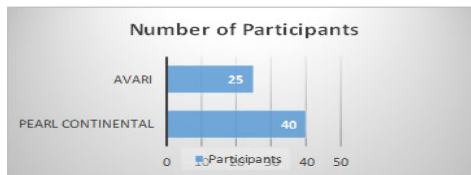

Fig. 2.   Number of participants
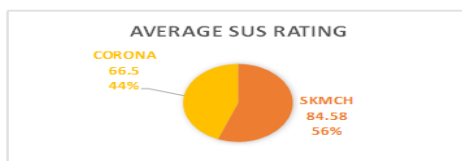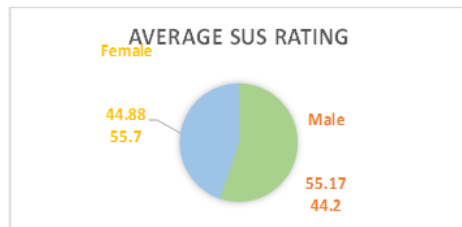

Fig. 3.   Average SUS rating

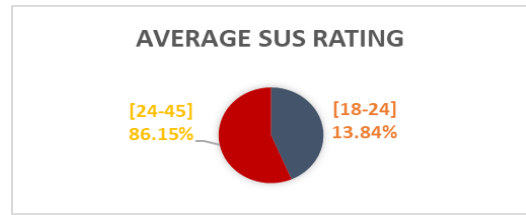Average SUS rating w.r.t Gender

Fig. 4.   Average SUS rating w.r.t Age

In Fig. 6, the results on behalf of consumption devices show that the mean SUS for mobile is 35 with a percentage of 3.07%. In terms of Laptop, the mean SUS is 43.625 with a percentage of 30.76% and in the case of both devices, the mean SUS is 56.45 with a percentage of 66.15%
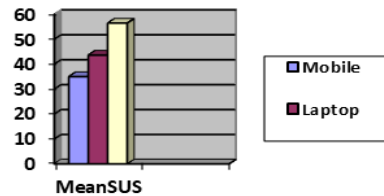

Fig. 5.   Average SUS rating w.r.t Consumption devices

4.2 Quantitative results through heuristic evaluation

The combined quantitative results of the Heuristic evaluation for the selected systems according to individual evaluators have been shown in Table 5, illustrates the number of issues identified by each evaluator for each usability principle [36].

Table 5: Combined quantitative results of the Heuristic evaluation

Hotel Booking Systems						
Heuristics	Pearl Continental			Avari		
	E1	E2	Total	E3	E4	Total
Visibility of system status	1	3	4	3	1	4
Match between system and the real world	1	3	4	3	0	3
User control and freedom	1	2	3	2	1	3
Consistency and standards	0	0	0	0	0	0
Error Prevention	0	2	2	2	1	3
Recognition rather than recall	3	1	4	2	2	4
Flexibility and efficiency of use	1	3	4	3	1	4

Aesthetic and minimalist design	0	0	0	0	0	0
Help users recognize, diagnose and recover from errors	1	1	2	1	0	1
Help and documentation	1	0	1	1	0	1
TOTAL	9	15	24	17	6	23

The combined quantitative results of Heuristic evaluation according to each individual evaluator shows the results that evaluator E1 identifies a total of 9 issues, E2 identifies 15 issues, E3 evaluator is able to identify 17 issues, and similarly, E4 has identified 6 issues for the selected systems.

After the identification of the issues individually for the selected systems, the expert evaluators had a joint session to discuss the issues in detail [30]. According to Neilsen's severity ranking scale [36], the evaluators ranked each issue properly with mutual coordination [35]. The quantitative results after applying severity ranking are illustrated in the below tables. Table 5, illustrates the results of Pearl Continental and Table 6 shows the results of Avari hotel respectively.

Table 6: Quantitative results of PC Hotel

Usability Heuristics	Pearl Continental					
	0	1	2	3	4	Total
1-Visibility of system status	0	1	2	1	0	4
2-Match between system and the real world	0	3	0	1	0	4
3-User control and freedom	0	2	1	0	0	3
4-Consistency and standards	0	0	0	0	0	0
5-Error Prevention	0	0	0	2	0	2
6-Recognition rather than recall	0	3	1	0	0	4
7-Flexibility and efficiency of use	0	2	0	2	0	4
8-Aesthetic and minimalist design	0	0	0	0	0	0
9-Help users recognize, diagnose and recover	0	1	1	0	0	2

from errors						
10-Help and documentation	0	1	0	0	0	1
	0	13	5	6	0	24
%	0	54.16	20.83	25	0	

Table 7: Quantitative results of Avari Hotel

Usability Heuristics	Avari Hotel					
	0	1	2	3	4	Total
1-Visibility of system status	0	1	1	2	0	4
2-Match between system and the real world	0	2	0	1	0	3
3-User control and freedom	0	2	1	0	0	3
4-Consistency and standards	0	0	0	0	0	0
5-Error Prevention	0	0	1	2	0	3
6-Recognition rather than recall	0	3	1	0	0	4
7-Flexibility and efficiency of use	0	2	0	2	0	4
8-Aesthetic and minimalist design	0	0	0	0	0	0
9-Help users recognize, diagnose and recover from errors	0	0	1	0	0	1
10-Help and documentation	0	1	0	0	0	1
	0	11	5	7	0	23
%	0	47.82	21.73	30.43	0	

The detailed quantitative results above show the overall expert evaluation of both the selected systems. Two evaluators evaluated the website of Pearl Continental and the other two evaluated the website of Avari hotel. The evaluators found a total of 24 issues for Pearl Continental out of which, 6 issues were major issues which make 25% of the total issues, 5 were minor issues which make the same percentage of 20.83% of the total issues, 13 issues were identified as cosmetic issues scoring a percentage of 54.16% of the total issues. For the category of catastrophic issues, no usability violation was found. Similarly,

the other two evaluators evaluated the UI of Avari hotel and as a result, the evaluators found a total of 23 issues for Avari hotel out of which, 7 issues were major issues which make 30.43 % of the total issues, 5 were minor issues which make the percentage of 21.73% of the total issues, 11 issues were identified as cosmetic issues scoring a percentage of 47.82% of the total issues. For the category of catastrophic issues, no usability violation was found.

4.3 Qualitative results through heuristic evaluation

Each heuristic principle was broken down to define a set of checklists. This set of checklists were used to conduct the usability inspection. During the investigation, the expert evaluators identified some problems as well as some successful UI features of the applications. According to each heuristic guideline, the UI features which were proved to be successful interface elements were reported as common strengths, and similarly, the frequently experienced problems according to each heuristic were reported as common weaknesses of the identified systems [52].

To sum up the subjective outcomes, the normal qualities and shortcomings for the interfaces assessed are illustrated below.

4.3.1 Common strengths

• Aesthetic and minimalist design
As a result of the interfaces evaluated, only the fundamental components were displayed on the screens. Icons for each section were specific with a clearly defined title. The front layout of the system is very clear to the visitors to express what the website is all about and the system does not show irrelevant information for the generated dialogue boxes.

• Consistency and standards
After the UI evaluation of the selected systems, the evaluators noticed consistency across the pages of the system. The evaluation results showed that the layouts are similar across all the pages, the menu is logically consistent and the section headings are similar across all the pages.

4.3.2 Common weaknesses

• Visibility of system status
After finalizing the evaluation of user interfaces, the evaluators identified that while creating a new reservation, the system does not indicate, on which specific step of reservation we are. They identified, if the close button is pressed incidentally during the time of creating a reservation, then there is no feedback generated for the user to show that they have clicked the close button. Similarly, the results also showed that if the system is loading or rendering some data, then there are no proper animations type feedback provided by the system to actually show the users about the current system state. For the same heuristic principle, the expert evaluators also identified that the system does not provide proper feedback for the search feature with a properly defined search section. The search option is also not clearly visible on the screen. In the case of Avari hotel, the search feature does not exist in the system.

• Error Prevention

As a result of the interfaces evaluated, the evaluators identified that the system does not prevent the users if they try to enter wrong information for the fields that will cause errors in further processing the request. This issue was specifically identified for different kinds of promo codes. The system must prevent the user at the same time if some wrong value has been entered for this. The evaluators also identified while filling the personal information section, the system either does not prevent the user when they enter wrong data or the system shows some wrong information as feedback that becomes ambiguous to understand.

• Flexibility and efficiency of use

After the UI evaluation of the selected systems, the issues identified to judge the flexibility and efficiency of the systems were related to the shortcut menu layouts for the frequently visited menu items and a link for showing users' past reservations. The search filter options also need to be introduced to make the search feature easy to use. There is no convenient way of scrolling through the calendar to change the date range. Similarly, time zone flexibility needs to be introduced to the systems.

5. Conclusion

To check the satisfaction level of the targeted audience for the selected systems, a system usability scale was used. As a result of user satisfaction, it is found that the targeted audiences are not much satisfied with the current UI of the selected hotel booking systems. According to the SUS rating scale, the score for both systems is below average, i.e 68. Furthermore, their reviews/ feedback is negatively impacting social media networks. So, to find out usability issues in selected hotel booking systems, a heuristic evaluation method was used to accomplish the objectives of this research. The expert evaluators identified the UI issues for the selected systems, it is to improve the UI development process from the user's perspective. This was mainly achieved by developing an interactive prototype based on the expert's recommendations.

In this study, different hotel booking systems were identified for the sake of usability evaluation. TripAdvisor was selected as an authentic source for identifying the hotel booking systems. For this purpose, the systems of two international hotels are observed. After the identification of the systems, SUS (Quick and Dirty) approach was applied to check the satisfaction level of the targeted audience. After the identification of the satisfaction level, the Heuristic evaluation method was applied to identify the UI issues. To proceed with this, four expert evaluators were selected from the industry and the expert evaluators on the basis of their experience identified UI issues. After the identification of the issues, the expert evaluators ranked each issue on the basis of Nielson's severity ranking scale [36],[52] and provided the recommendations for the identified issues. During the results compilation phase, the qualitative and quantitative results were deduced. On the basis of the results, some common strengths and weaknesses of the selected systems were identified. Depending upon identified issues, an interactive UI (prototype) for the selected internet-based applications was proposed that based on the user's perspective. In the future, this research study can be further performed by capturing multiple five-star hotels and/or to

find more usability issues besides the heuristic approach, usability testing, user testing, methods can also be used.

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