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ENHANCING SOFTWARE QUALITY THROUGH USABILITY EXPERIENCE AND HCI DESIGN PRINCIPLES

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ABSTRACT

Usability refers to a software product's capacity to be unstated, erudite and appealing to the user when used under convinced conditions. Human-computer interaction (HCI) is one of the most significant fields in usability. For the past few years, e-commerce has been a hot area. E-commerce is the practice of buying and selling products online. Many e-commerce businesses aim to build a following of devoted customers. Several elements affect e-commerce website success, but usability—or the website's usability—is a crucial component in online company success. The significance of evaluating the usability of e-commerce websites is well recognized, and this area of study attracted a lot of attention in the previous ten years. The main goals of the dissertation are to evaluate the usability of the e-commerce websites for Amazon, Flipkart, Alibaba, Daraz, and Walmart through survey evaluation, compare the usability using Nielson's usability heuristics to discover the most usable website among these E-commerce websites, and discover the most effective website between these E-commerce websites to complete tasks faster. This research aims to design, develop and evaluate a web base application related to E-Commerce to provide a better user experience. Here studied the most significant usability issues, according to HCI design patterns. The usability tests are run to see how users react to adaptive user interfaces and systems in terms of effectiveness, efficiency, and satisfaction. The usability of the e-commerce websites for Amazon, Flipkart, Alibaba, Daraz, and Walmart was evaluated by a survey, and the results were used to compare the usability of e-commerce websites. The users were given a list of six tasks, some of which included registering and placing an order for a product on five different e-commerce websites, and the time it acquired to complete

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those tasks was recorded. The average time needed to complete each job on these websites will be compared to determine whether an e-commerce site is more effective at completing tasks quickly. According to survey results and analysis results, Amazon is more useable than other e-commerce websites and offers greater efficiency to complete tasks in less time.

Keywords: Software quality, Usability, interactive system, HCI design principles, E-commerce, Amazon, Agile, DevOps

1. INTRODUCTION

In terms of scientific study, this chapter offers the background of software quality through usability experience and HCI design principles states. In addition, we address the thesis goals and our key contribution, as well as the structure and environment in which this work was conducted.

For a variety of objectives ranging from health research to amusement to accessing instructional resources, software applications are now available on an extensive assortment of devices, including computers, tablets, mobile phones, digital TVs, refrigerators, and so on. These advancements have a noteworthy influence on user engagement because they provide novel opportunities for everyone to communicate anywhere, at any time. Usability, on the other hand, has become an even extra vital aspect of software eminence in recent years [1]. Although there is a lot of advice on how to design usable software systems in the literature, there isn't much research that shows how effective it is. The shift that organizations make from creating only graphical user interfaces (GUI) to also addressing usability and, more recently, UX is rarely examined or reflected in current research on user experience (UX) integration. Thoughtful the transition offers a more comprehensive and accurate picture of integration, and it can be a useful resource for software engineers aiming to improve UX integration. It is no longer enough for software to perform a wide range of operations to be economically successful; instead, various software quality aspects must be considered during design and development [2]. Quality is becoming increasingly important in a competitive software market. There is a lot of effort to be done in terms of getting good results from software development initiatives, as the Chaos report1 points out: Only 29% of projects were effectively completed, which means they were done on time, on budget, and to a satisfactory standard [3]. Online shopping is possible due to the development of e-commerce sites. Ease of use has become a critical element in developing a good website that provides users with an excellent shopping experience in a highly competitive environment. Due to the popularity of online shopping and selling, ease of use is becoming more and more important for an online store. Vendors should check that their websites are user-friendly to attract customers. Product usability is an indication of the ease with which a user can find the means to achieve their goals. Ease of use is measured by user happiness. User objectives may include survey analyses.

E-commerce is the practice of selling goods and services online. To purchase something, a customer simply goes to an e-commerce website, browses the offerings in the browser catalog, chooses several items, and adds them to their shopping cart. When they are finished shopping, they can check out and move on to the payment section, where they

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can choose from several online payment methods, including credit card payments and internet banking. When a customer orders a product, the order is shipped to the address they provided, and if payment is made, they are notified of the purchase.

A large number of firms have made considerable investments in information technology (IT) and associated innovative technologies such as computers and the Internet since their inception. IT is reshaping the foundations of businesses and has made most corporate activities heavily reliant on it [4]. Every website is created with a certain goal in mind. In their contacts with the World Wide Web, almost every user has come across illustrations of good and bad sites. Users become frustrated when they can't find the material they're looking for or complete the tasks they've set out to achieve, and this dissatisfaction might lead to them abandoning the site. In almost all cases, having people depart a website is undesirable, as it defeats the goal of providing services, selling items, or simply distributing information. Organizations that establish a good website can get a competitive advantage over their competitors. Information distribution, portals, social networking/community, search, e-commerce, company information, and entertainment are some of the most regularly seen sorts of websites. Each of these kinds of websites is tailored to achieve precise objectives or aims and has its own set of characteristics. Usability should be considered in the design and development of websites from the start. Inspecting case studies in which the return on investment is enormous demonstrates the importance of designing for web usability. Hourly, daily, weekly, monthly, and yearly changes can be made to web resources. As a result, the website must be kept up to date to deliver the correct information and remain highly usable. As new technologies arise, web designers should stay on top of the latest trends and be willing to experiment with new ideas in this ever-changing world [5].

Its rating determines the quality of a website. Usability testing has benefits for ergonomics, website quality, and quality management review procedures. The advantages of defining usability concerning ensuring the quality of use and the satisfaction of user needs are highlighted when different methods of use are compared. One of the benefits of usability testing is its ability to predict, guarantee, and improve the website quality. Regulation and improvement of production methods and the choice of site approval. The user interface definition can be evaluated automatically, empirically (using real users to test the interface), technically (using exact models and formulas to determine usability measures), and informally (using rules of thumb). And general skills, knowledge and experience of the appraisers). Testing, testing, questioning, analytical modeling, and simulation are usability testing methods. All evaluation methods have one thing in common: they are all based on the user's judgment [6]. Over the last few years, smartphone functionality and usage have evolved dramatically [7].

In 2021, it is estimated that there will be over 6.3 billion smartphone contributors [8]. According to statistics, one out of every three individuals owns a smartphone. Smartphones are modern phones with advanced computing and connectivity capabilities. A touch-sensitive display provides them with a variety of input options. The rapid and growing number of smartphone apps available on Google Play and Apple App Stores has

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aided and compelled software developers to create higher-quality apps to compete in the market. Usability is one of the most crucial of the many quantifiable qualities of software product quality. Numerous technologies have recently changed the way we communicate, have fun, and go about our daily lives. Several devices, including PDAs, smartphones, and tablets, have been created concurrently as a result of the idea of digital convergence and can integrate different types of human-computer interaction (HCI) [9]. A smartphone is a cutting-edge technological advancement. A straightforward, graphical, finger-based interface has many benefits, including instant communication and access to information from any location.

Carrying multiple gadgets such as a phone, camera, speakers, WIFI adaptor, and GPS is no longer necessary. The user of a smartphone can download and execute software (apps) [10]. Rapid technological development at the turn of the century led to significant changes in handsets: battery life and standby time increased, the global positioning system (GPS) and multimedia message service (MMS) were enabled, and the 3G network was introduced, and so on. The growth of mobile phones changed, and the smartphone era started as a result of internet connectivity and technological advancements. The operating system of smartphones, as well as several other aspects, have become more important for consumers as a result of technological advancements [11].

The operating system is a program that aids as a link between the computer user and the hardware. Both the abbreviation OS and the full designation operating system will be used. An operating system has three basic goals: first, it must execute user applications and make troubleshooting easier for users; second, it must make the computing system simple to use; and third, it must make efficient use of the computer system's hardware. Most modern operating systems have graphical user interfaces (GUI - Graphical User Interface) to make it uncomplicated for users to use them [14]. Smartphones are capable of alerting users to many types of digital interruptions utilizing a variety of modalities and modulation. The capacity of a smartphone to select the user's preferred type of alert in specific scenarios utilizing the entire lexicon of notification modalities and modulations is known as smart notification [15].

Technology has already surpassed our wildest expectations. Interactive art is notably important to HCI concerns of experience design and comprehension of user involvement [16]. The volume and sort of phone and app usage are heavily influenced by age and gender. Younger people utilize social and communication applications more frequently as a result of their increased communication. Additionally, they engage in more gaming than the general populace, especially kids. Older people have different needs, and they commonly use their smartphones to stay informed. Either by reading the news or conversing with friends on their smartphones [17].

Launchers have been proposed as a potential method of improving older folks' adoption of smartphones and assistive technologies (ATs). Launchers can be created to make it easier for older persons to use smartphones by addressing perceptual, cognitive, and motoric changes that may make it difficult for them to do so [18]. Smartphone users can

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install software, sometimes known as "apps," on their devices. Apps are self-contained apps for smartphones that are meant to accomplish a specific task [19].

HCI principles are used to investigate how to properly map computing functions to use competencies to gratify users in the situation of their use. To create an incredibly productive environment for learners, the developer can employ HCI evaluation methodologies to construct and assess instructional Technology tools and platforms. Examining the Human-Computer Interaction features in the specific platform is the first step toward optimal student engagement in educational Technology tools. The degree to which the learner and the tool interact is measured by user engagement. To assess the level of user involvement using HCI principles and evaluate the user's responsibility to see in what way they interact with the tool and techniques [20].

In the field of usability, contemporary HCI research has mostly focused on UI ergonomics and user experience [21]. When evaluating those apps, the HCI research community advocates taking into account a variety of factors, including quantitative data (metrics), subjective evaluation (user impressions), and context data (e.g., environment and device settings) [9].

A significant role is played by HCI principles. We examined the fundamentals of human-computer interaction (HCI) from many articles. They are the fundamentals for designing and developing all user interfaces, including web interfaces and graphical user interfaces (GUIs). The following are the design principles that we examined as part of this research:

1. Accessibility
2. Operability
3. Simplicity
4. Aesthetics
5. Clarity
6. Availability
7. Consistency
8. Control
9. Safety
10. Flexibility
11. Predictability
12. Efficiency
13. Familiarity
14. Obviousness
15. Directness

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HCI significance

Human-Computer Interaction (HCI) examines human-computer interaction and its factors. HCI is primarily interested in the design, evaluation and deployment of interoperable software systems. All thoughts, words and symbols are built into forms of communication. It identifies aspects of usability that are closely related to user profiles and human characteristics. Thus, it is closely related to computer science, artificial intelligence and psychology. HCI is about understanding ease of use and users' needs. To be successful, you need to be smart, intelligent and thoughtful. The effect of night lights (LAN) on people and the environment is now known. It has long been recognized that the harmful effects of light on human health far outweigh the benefits of light to humans1, 2. As mentioned earlier, people exposed to LAN (especially blue light at night) are more prone to many health problems, including sleep and thinking problems, obesity, diabetes and many others. Cancer, due to day or night changes in shortwave (blue) light from ambient light (natural or artificial) [21]. HCD demands collaboration with social scientists working in the fields of cognitive psychology, sociology, and cultural anthropology as well as a greater understanding of their methodologies. Our task and opportunity is to learn as much about human values as we do about technological and analytical issues once we have mastered the social sciences. This makes it possible for us to provide products, services, and culturally significant experiences that people value both individually and collectively [48].

The term "usability" was coined as a "proxy" for the term "user friendly," which had come to be associated with a variety of subjective connotations and confusing applications [5]. Brain Shackel was one of the first to identify the importance of usability and of putting the user at the heart of the computer system rather than as a mere peripheral. The usability of mobile apps is one of the most important components of app development. Usability refers to techniques used to improve an application's usability. Contrarily, usability testing is the process of assessing an application's usability in terms of a variety of functional elements from the perspective of its users. Usability engineering is a major research field in software engineering and one of the core principles of human-computer interaction. Usability engineering is concerned with all aspects of the user's interactive experience, including web, mobile, and gaming usability. Usability engineering is a subject that makes available systematic approaches for achieving usability in user interface design during the creation of a product [22].

According to the IEEE.610.12-1990 standard, usability is clearly defined as "the ease with which a user can learn the operation of a system or component, prepare its inputs and understand its outputs". Users, technology, activities and environments are affected by usability aspects. ISO 9126-1 is a standard that measures readability, learnability, portability and aesthetics. The usability of smartphone apps can be managed in several ways. Qualitative evaluation, user testing, field trials, laboratory experiments, system usability ladder analysis, and user research are some of the most common methods. Ease of use is important because customers will abandon your app if it's difficult to use. Proper usability testing at the right time and under the right conditions can reduce the risk

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of product defects. Usability testing is important for evaluating smartphone apps so developers can learn how to use them and take into account the changing nature of mobile contexts [9].

While usability is critical to any product's success, the design's usefulness is also a vital factor in determining its excellence. Although usability and usefulness are closely related, they are not the same thing. As Nielsen points out, one of the most useful usability engineering techniques is thinking aloud. Nielsen also recommended that the same user research methodologies that increase usability might be used to investigate a system's utility.

In HCI, usability is the most important notion. It has the following characteristics:

It is simple to learn,

It is simple to recall how to utilize,

It is fruitful to utilize, and

It is well organized to utilize [23].

Usability is one of the most important needs for mobile learning systems in terms of software quality [24]. Online services, desktop, and mobile software applications, and electronic appliances with poorly designed and difficult-to-navigate and understand user interfaces (UI) would appear to be a thing of the past in today's world. However, there are several examples of usability failures that can be found within apparent success stories. Some argue that we are on track with the implementation of usability principles, or that there is a visible asymmetry in the application of usability practices among different hardware and software vendors, with some having already established standards, principles, and best-practice recommendations, while others have only recently become acquainted with them [2]. However, many various groups of stakeholders still find some of them underutilized and difficult to comprehend. This is due to a variety of factors such as usage situations, cultural differences, and domain complexity.

The ISO has created various usability criteria, which can be divided into two categories:

(1) Product-oriented requirements

(2) Process-oriented requirements

The ISO 9241 standard lays forth a collection of usability heuristics that apply to people's interactions with computers. A user interface (UI) is defined as "a planned arrangement of indicators (components) that typically take the shape of words, images, sounds, or videos." Furthermore, usability testing is one of the most extensively utilized approaches in practice for improving usability. Usability testing can be used by software engineers to upgrade user interfaces and software functionality. This is not always an easy task, however [25].

People's experiences are influenced by social categories, such as the acknowledgment they receive, the support they receive, the challenges they face, and how their behavior

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is viewed by others. To improve HCI experts' entire work experience, employers should address the larger dynamics of power that dictate how value is well-defined in IT organizations, as well as concerns of social status, gender, and how they structure and manage HCI professionals [26]. The Usability Requirements Catalog (USB-CAT) is based on the SIREN directive (Reusability of Software Requirements). SIREN is a way to promote reuse requirements based on software engineering standards. Requirements are organized into catalogs that follow international recommendations on IEEE 1233 principles and requirements, such as IEEE 830-98 or the latest ISO/IEC/IEEE 29148:2011. With the introduction of mobile technologies in learning environments, there is a growing need to create appropriate usage patterns for mobile learning applications. Although mobile learning has been studied from various angles, including pedagogy, technology adoption, and usability, there is little scientific and published research on the use of mobile learning applications. The use of mobile applications is essential to their success. Usability, also known as "ease of use", refers to the ease with which products and systems can be adapted to student needs [27].

The adaption of mobile user interfaces provides significant assistance for user satisfaction when these problems are solved at the design level. The advantages of AUI are currently being realized in the development of interfaces in the context of the user. Because it provides an appropriate adaptation methodology and can manage usability difficulties of user interaction, the AUI is a more viable adaptation approach than adaptable. AUI offers the user the flexibility to create an interface at the design level, as well as the ability to make modifications during execution. This gives the user autonomy and frees the engineers and designers of the system to choose the best solution for each user. The system may adjust to the user's needs via AUIs, and it can also help with future adaptations by storing a history of previous adaptations [28]. The Graphical User Interface (GUI) design process is an essential step in the software development lifecycle since the GUI will be in direct contact with the end user. Although there are resources to help the interface meet specific usability standards, there are no tools specifically for GUI design [29].

New research ideas are welcome in building intelligent and flexible user-centered systems for the Internet of Things (IoT). When implementing behavioral models, traditional decision tree models create a series of leaves where decision nodes represent important contextual decisions. But the bottom line is that you may need a contextual system to accurately capture actual user behavior [30].

UCD is a method and process framework that is not limited to interfaces or technology. It is concerned with the product's understanding of the user's requirements, wants, tasks, environments, preferences, and limits, and is given considerable attention at each stage of the design process. It is the process of creating software with user interfaces and then solving multi-stage problems from the user's point of view. Rather than adapting or learning the specified system, the system might be designed to complement users' existing beliefs, attitudes, and behaviors relevant to their work. The UCD method is used to create basic models, mock-ups, or prototypes for sections or all of the designs,

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including graphical design, information architecture, interaction design, and data visualization. The UCD requires designers to not only evaluate and predict how consumers will use a product but also to validate its validity in terms of user behavior. Testing a product is vital, but understanding the user's experiences is a difficult task for designers. UCD has a complete life cycle to develop high-usability, low-cost goods. UCD's main purpose is to provide an optimized, efficient, and user-friendly product that improves user usability and satisfaction. Prototypes are extremely valuable in UCD for translating user needs into the contextual experience. The User-Centered Design (UCD) strategy to integrate adaptivity in mobile device interfaces is used to improve the usability, satisfaction, and optimization of adaptive mobile user interfaces [28]. Human-Computer Interaction (HCI) was crucial in the development of an interactive system. Improving the usability of a design is perilous to its success. Effective, efficient, safe to use, easy to understand, and memorable for future usage are all characteristics of usable design. Fun, pleasurable, and aesthetically pleasing software should be the goal of usable and interactive software [13]. Incorporating usability engineering into the software design phase is one way to achieve a user-centered design and reduce software complexity. This strategy comprises capturing the requirements specification before beginning application development [31].

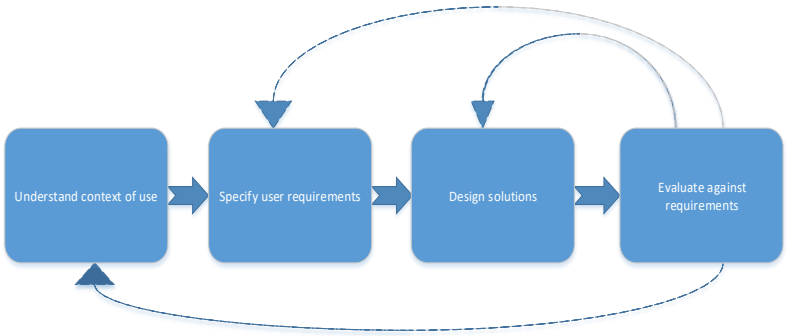

Figure 1: UCD model in HCI

Software Engineering is a field of science and technology that teaches people how to create high-quality software. The program is being created to meet the needs of the customer, and it should also be provided quickly. The basic goal of software engineering is to create software and other products that are both cost-effective and useful. Each element of the SDLC (Feasible Study, Analysis, Design, Coding Testing, Implementation, and Maintenance) is equally critical, with maintenance taking the most time and money [32]. One of the many topics in software engineering is SDLC and STLC. Agile software development is such a successful approach. Software Engineering is a discipline that has undergone many changes to keep pace with technological breakthroughs and current business needs by developing effective strategies to achieve the latest software product. Agile software development is a lean methodology designed to overcome the limitations of traditional development methods, reduce costs and expenses, and provide flexibility to meet changing work schedule demands. This is achieved by guiding and linking activities according to a set of values and principles [33].

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As a substitute for producing new software, we can use re-engineering techniques to achieve the goals of software re-engineering and human-computer interfaces, such as dependability, cost reduction, reusability, and productivity. The adoption of software interfaces is leading to reengineering rather than new systems or program development. The software re-engineering (SRE) process, often known as reverse engineering, is a reverse software development method. Human-computer interaction (HCI) and software re-engineering (SRE) are like two twigs of a tree having the same root and seed. The goal of both fields is to develop and design appropriate systems using a proper requirements analysis approach (RAP). The adoption of "iterative or incremental" techniques and quality assurance were two of the most important features. There may be numerous approaches to addressing the problem, adopting practices, and creating the procedure for each stage. The initial portion of HCI is focused on humans, whereas SRE's major goal is to produce software products at a low cost within a set time frame while also adding new and advanced features to current products. As an evaluation sign, consumers are involved from the beginning to the end node of evolving and reconstructing an existing product. Some of the features are not visible to consumers, but they are important to the overall quality of our system, as they should be dependable, safe, confident to use, cost-effective, and simple to use (GUI). To solve difficulties, the system should enhance throughput while increasing accessibility. It demonstrates that work may be completed quickly with a low rate of error and in a safe manner [34].

Software testing is carried out to ensure that the software is of high quality. Software Testing, on the other hand, isn't merely a feature of the finished product. The quality process starts at the moment of conception. The testing procedure matches the entire SDLC procedure. A phase's output becomes the next phase's input. For analysis and requirement analysis, testing is essential; only tested and verified SRS will provide the correct design; bad design will result in incorrect code, and so on. It spirals into a vicious circle that stymies the entire development process. A phase's output becomes the next phase's input. For analysis and requirement analysis, testing is essential; only tested and verified SRS will provide the correct design; bad design will result in incorrect code, and so on. It spirals into a vicious circle that stymies the entire development process. Although software testing is an expensive undertaking in and of itself. In today's marketing environment, the primary cause of software failure or difficulties is a lack of time allocated to the testing phase of the SDLC. As a result, most software does not function properly due to software defects. A bug is a term used to describe a software flaw. Other words for software problems include flaw, fault, bugs, error, anomaly, and inconsistency. For systematic testing in STLC, numerous models are employed, including;

(i) V Model

(ii) Model

(iii) Butterfly models.

Each model's goal is to test software in a short amount of time at the lowest possible cost while achieving the best possible results [32].

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Agile refers to a collection of software development approaches. It is a conceptual framework for software engineering that starts with planning and goes through incremental and iterative cooperation in the implementation phase throughout the project life cycle. Agile approaches enable modifications to be made without jeopardizing the process or necessitating excessive iterations, lowering the overall cost of the software development process. The "Agile Software Development Manifesto," which offers a set of ideals and principles for software and system adaptability, was issued in 2001 as a formal partnership of 17 software engineering consultants striving to create and promote light-adaptive approaches. Four values and twelve principles are used to support and articulate the essence of competence in this idea. These principles and concepts are the basis of the orientation of the software development process and the recognition of any approach including an aspect of agility. Agile techniques are the processes that support the agile philosophy, which consists of agile ideas and principles. Each Agile technique consists of a unique set of practices that define how software development is done daily. Each method differed from the others in the vocabulary and methods used. Test Driven Development (TDD), Feature Driven Development (FDD), Extreme Programming (XP), Scrum, System Dynamic Development Model (DSDM) and Crystal Methods are just a few examples of many agile methods. Each technique has its own set of guiding principles, life cycles, roles, advantages, disadvantages, etc. All of these agile software development methodologies use incremental and iterative processes to produce software [33].

Agile software development firms require tools to test and improve software quality continually [34]. Agile User Experience (also known as Agile-UX) is a software development project management methodology based on the Agile Manifesto principles in terms of UCD methods and best practices [35]. Software quality has been a hot topic for quite some time. When we consider it, we might recall the difficulties that experts faced with software quality when the waterfall process was the most frequent strategy, owing to the difficulty of meeting market deadlines. Quality assurance is a difficult and ongoing task that necessitates significant attention. Software Engineering (SE) is a strategy for developing high-quality software that incorporates the product, the process, and the product in its business context. The development method has evolved significantly over time. The Manifesto for Agile Software Development was published in 2001, and as a result, various agile methodologies were developed.

DevOps is a collection of patterns derived from agile approaches that aim to increase communication between development and operations teams [35]. Continuous Testing is one of the DevOps techniques, which is a large set of concepts. DevOps is a lean and agile software development method that allows firms to quickly incorporate client feedback into the delivery cycle and adapt to new technologies. DevOps is a software development methodology that focuses on automating repetitive processes. As a result, how firms build and deliver software has changed.

The following are some of the advantages of DevOps

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High velocity: When opposed to the Waterfall paradigm, the DevOps model allows teams to add apprises to software at a faster rate. This aids in gaining a competitive advantage and capturing the market more quickly.

Reliability: By leveraging Continuous Integration and Continuous Delivery techniques to make sure that each update is sound and functional before being distributed, it verifies the quality of application changes.

Scalability: In the DevOps paradigm, scaling the application is easier because most procedures are automated and system changes can be done quickly and safely.

Enhanced collaboration: The DevOps methodology aids in the development of better-functioning teams and the acquisition of competitive advantage.

Continuous Testing is a CI/CD pipeline component that includes automated test execution. This process seeks to continuously gather input on the level of software quality provided with each release. Enhances test automation as part of the DevOps strategy to deal with the accelerated speed and increasing complexity of modern application development. Continuous testing can be defined as giving the appropriate information to the appropriate individuals at the appropriate time. In the past, testing was carried out near the finish of the creation process. This would result in a scenario where either quality or time would be sacrificed. Early input from continuous testing allows the team to produce better software in a shorter amount of time [36].

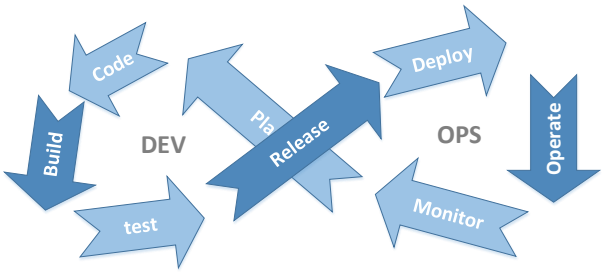

Figure 5: DevOps

2. LITERATURE REVIEW

2.1 Modernization in technology

An Ada-HAR (adaptive recognition and real-time monitoring system) for human activities utilizing a smartphone was presented by Wen Qi et al. in this study. The effectiveness of the developed approach was verified by experiments involving 25 participants. The online learning approach was the most distinctive feature. It was able to dynamically update the classifier in a dynamic environment, thus if a new action is discovered, the HC classifier will be updated to include the new class. It is an unsupervised online learning method that dispenses with the need for labeling data. In addition to the adaptive method, an automatic labeling strategy based on the Hk-mC algorithm was developed to increase the effectiveness of labeling raw signals. The smartphone was placed in various angles and directions during the testing to demonstrate the device's durability. No matter where the

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smartphone is positioned, the signal preprocessing method given delivers stable inputs to the classifier. The results revealed that the DL-based HC classifier performed more accurately when it came to classifying 12 different activities (95.15 percent waist and 92.20 percent pocket). Furthermore, updating the previous HC classifier for detecting new classes is faster with the k-NN and DT algorithms-based HC classifier. The Ada-HAR system performs better than current systems in terms of both the volume of activities it can identify and the accuracy of its recognition [37].

2.2 HCI practices

HCI is important in the creation of interactive software systems, according to Farman Ullah Khan and Wajeeha Researchers Darko Brodic and Alessia Amelio are looking at how quickly humans and robots respond to the image-based CAPTCHA. The ARs used statistical tools to assess the data. ARs discovered notable co-occurrences of feature values and their association with a certain response time when they solved the face expression image-based CAPTCHA. Despite the similarity of the outcomes, the AR approach was successful in identifying minute differences in processed values. The results demonstrated that computer users can recognize CAPTCHAs with moving characters more quickly. The data reveals which emotions the users are most vulnerable to by containing implicit information about their psychological states. It turns out to be both an invention and a significant technological study [23].

Muhammad Waseem Iqbal et al. studied various ideas and strategies used in context models. User modeling research is suggested as a way to solve these difficulties. Semantic modelings, like complicated situations and computer models, have supplied a solution. To model these complex scenarios, semantics and ontologies might be used. Moreover, the user interface process model recommended that AUIs be created based on the concepts outlined in this survey article [38].

Students in higher education range in age, as shown in this study by Zahra Al Mahdi, Vikas Rao Naidu, and Preethy Kurian. Therefore, it is crucial to assess each Human-Computer Interaction (HCI) concept to make sure that an efficient e-learning solution is modified with a suitable interface design. This research article investigates the function of HCI in the design of an e-learning solution. A comprehensive review of the available literature on this subject was done by the writers. The design of an e-learning solution or learning resources employing HCI principles may be quite successful once we apply a systematic approach [20].

In this essay, Myounghoon Jeon et al. discuss how interactive art and human-computer interaction (HCI) have collaborated as well as how they can impact and learn from one another. The involvement and experience of users are essential to the success of HCI, much as the involvement and experience of audiences are essential to the success of contemporary interactive art. Of course, interactive art and HCI might take different techniques and have different final goals. Art has focused on aesthetics and emotions whereas human-computer interface (HCI) has prioritized usability and optimization. However, there are advantages for both interactive art and HCI when they are combined.

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Particularly design research can give them a crucial space for interaction. HCI can offer new research and experimentation opportunities for artists as well as fresh presence experiences for viewers. By bringing fresh representations and interactions based on the embodiment, art can support the development of emotionally intelligent and interactive systems in terms of HCI [38].

Jennifer Pearson et al. have investigated the fundamental ideas and difficulties associated with eReader design in this work, backed up with real-world examples from three prominent electronic reading devices. To think about design, they applied HCI principles in their paper. This opens up a significantly broader variety of possibilities than what has come to be known as the 'traditional' style of HCI, which is based on empirical studies. Empirical experiments can only answer one issue at a time (unless they are carefully designed), and the data does not reveal design reasoning. As a result, this work was founded on a study of principles, which is a type of expert heuristic evaluation. Their research has revealed that these devices left a lot to be desired, at least in terms of HCI, if not in terms of business/usability. Many of them have placed too much emphasis on the hardware's aesthetics to guarantee that the facia has a visually pleasant symmetrical pattern. They believe the Kindle 2 matches their criterion better than the other two devices we looked at. Because of its ergonomic form, it is easy to handle and, more crucially, turn pages. It accommodates users regardless of whether they are left or right-handed. The Kindle manages to encourage active reading despite its absence of a touchscreen interface. Its design incorporates a full QWERTY keyboard, which helps with annotations and online browsing. They were also impressed with its page placement strategy, even though it could have been used better, in their opinion. The Kindle is not a perfect instance of what an eReader could be, but it, like any other device, could be vastly improved by adhering to the concepts and rules outlined here [39].

2.3 Usability evaluation

The findings of the qualitative study, according to Felwah Alqahtani and Rita Orji, show that there are significant usability problems with publicly accessible mental health apps. These problems include bugs, poor UI design, a lack of a user manual that explains how to use the app, the possibility of losing tracked individual mental health data, issues with battery and memory usage, redownload problems, and internet connectivity problems. Finally, the efficacy of mental health apps must be assessed before they are made available to the general population. Numerous mental health applications have been made available to help improve and scale up mental healthcare while reducing expenses. On the other hand, our findings indicate that numerous mental health apps fall short of their objectives as a result of usability problems [40].

According to Syed Khuram Shahzada, Nadeem Ahmad, and Muhammad Waseem Iqbal, The decision to use any adaptive features while carrying out a task is currently mostly up to the user. The experiment's findings imply that adaptability in user interfaces has a greater potential to enhance smartphone usability when used in the appropriate setting. To increase smartphone usage, we suggest adding flexible features to the user interface. Additionally, it is advised to look into or recognize the user and task context before

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switching to any adaptive environment [8]. During their analysis, Lumpapun Punchoojit and Nuttanont Hongwarittorn found a sizable knowledge gap in mobile interface design. Despite their importance, some mobile interface and interaction design areas lack research. More factors that affect usability across many categories need to be investigated because there is not enough empirical-based data to create a strong design guideline [41].

Users (professors and high school students) appreciate the CAMLS' services with an average acceptance rate of 82.4 percent in terms of usefulness, according to Alejandra Pensabe-Rodriguez et al. As a result, the investigated mobile learning system is extremely acceptable, happy, and applicable to both teachers and pupils. System developers wanting to enhance or create mobile learning systems based on current research can utilize the usability study and evaluation described in this paper as a guide [24].

Haslina Mohd, Fatima Zahra, and Azham Hussain There are no usability standards, criteria, or metrics among the available usability models described in this study. The author claims that present approaches fall short of providing a comprehensive assessment of mobile applications. Additionally, even if the number of apps is increasing, many of them are becoming less useful and have unfinished designs. On the other hand, technology has not yet developed to the point where system development is founded on a strong paradigm that guarantees usability and suits the demands of specific users. The rapid growth of mobile apps is a problem because there are many low-quality apps available with flaws and mistakes. There are several platforms, such as the Play Store and App Store, where apps are accessible (medical, education, entertainment, games, and so on). Broad usability evaluation methods are unable to measure the characteristics of these distinct apps since each application category has a unique set of functional and non-functional requirements. Therefore, it may be necessary to use customized usability models to evaluate these different applications [42].

The outcomes of the two-phase evaluation, according to Murilo C. Camargo, Rodolfo M. Barros, and Vanessa T. O. Barros, when employing the checklist, show success. Students that got the checklist were more likely to adhere to the usability criteria. To improve project quality, this visual design checklist also includes activity control and documentation input components. The research led researchers to the conclusion that adopting the checklist can help development teams and enhance the interface's overall usability [29].

Heuristic evaluation was supplemented by user testing, according to José Miguel Toribio-Guzmán, Alicia Garca-Holgado, and colleagues, and this method revealed that the social network's structure was mostly responsible for users' actual problems. The findings showed that people with unhealthy profiles had trouble using SocialNet. Even though users encountered difficulties and usability problems while completing the activities, the findings demonstrated SocialNet's remarkable user-friendliness. This is corroborated by the fact that the heuristic evaluation revealed significantly fewer problems than expected.

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Additionally, the test results showed a high level of work completion and satisfaction with the Social Network [43].

2.4 Software testing in software quality assurance

Website measurement, which is broken down into three categories: usability inspection, usability inquiry, and usability testing, is examined in this study by Nur Sukinah Aziz, Noor Suhana Sulaiman, Wan Nur Idayu Tun Mohd Hassan, Nur Liyana Zakaria, and Azliza Yaacob. While some usability assessments are solely based on the opinions of experts, others are based on feedback from actual users. The advantages and disadvantages of each method of website measurement are different. Researchers must first evaluate the breadth, context, and purpose of a website before evaluating its usability. This study found that surveys are frequently used by academics as a cost-effective method of quickly gathering data about a community [6].

The most often used fundamental elements in the construction of mobile apps are asynchronous multi-threaded code execution, rendering views and elements on the screen, and basic network connections. In this study, Robert Gyrödi et al. analyze the performance of these elements. Despite the recent development of other mobile platforms, this article compares and evaluates two well-known and well-liked operating systems: iOS and Android. As a result, two straightforward applications with comparable complexity and functionality were developed to run natively on both platforms. The program was developed using the tools and development languages of each operating system. By replicating a specific situation in the built apps and architecture for each feature, the tests carried out and presented in this article assess several key basic qualities No operating system is more effective than the others, at least not from the perspective of a general program developer, however, each platform excels at particular tasks, according to tests. In the draw performance test, iOS outperformed Android. Views and UI elements were drawn on the screen within the allotted time, maintaining the fluidity of the user interface. With iOS devices, the emulation procedure was likewise far more efficient. Because of this, it is possible to predict where the program will be slow or inefficient on each device using the performance tests that have been developed and their findings. Developers have two options for producing programs that behave and perform equally on both operating systems: they may either optimize their source code or construct functionality that works around these constraints [13].

Amit M. Kale, Komal Chaudhari, and Vivek V. Bandal. The many SDLC cycles, the SDLC Model, the STLC Cycle, testing methodologies, and testing levels are all covered in this document. Software engineering is a subfield of engineering that deals with developing software according to established processes and practices. They learned that a crucial phase of the SDLC is software testing. Testing only reveals errors and defects that are present. Debugging contributes to higher program quality [44].

Each development methodology has its own set of advantages and disadvantages, therefore there is no one-size-fits-all methodology for all types of projects, according to Samar Al-Saqqa et al. Each project has its own set of requirements, characteristics, and

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tasks to fulfill. Therefore, the most agile technique to use in project development must be carefully selected depending on these characteristics. Agile methodologies can be used in businesses with small staff and projects with tight budgets. They also discussed how huge data systems and cloud computing environments can leverage agile [33].

In this study, Sarker, Iqbal H., et al. developed the BehavDT machine learning technique to create a behavioral decision tree-based user-centric context-aware predictive model. Their BehavDT model makes predictions about smartphone user behavior based on many contexts, including temporal, geographic, and social circumstances. Behavior-oriented generalization was taken into consideration when designing the decision tree in the BehavDT model. They used both the inner and leaf nodes as decision-making nodes to effectively capture user-diverse actions for their numerous daily context-aware conditions. On actual mobile phone datasets of people's activity and environmental data, they tested their conclusions. The experimental findings demonstrate that, in addition to identifying the critical decision nodes, our BehavDT model can capture both typical user behavior and particular exceptions. The BehavDT model has thus proven useful in creating context-aware prediction models that are user-centric. The BehavDT paradigm may be utilized in other user-centric application areas where the surrounding conditions influence the user's various behavioral activities, even though they use a phone call behavior example to illustrate it. Future application-level testing of this machine learning context-aware model is something we plan to do [30].

Muhammad Asaad Subih and colleagues used a questionnaire survey for this study. To compare the effects of software quality on agile and scrum techniques, we gather data from employees of various software development businesses using this survey. Correctness, reliability, portability, testability, efficiency, and extensibility are only a few examples of the qualities that contribute to the quality of software. Agile techniques' primary advantage is their ability to adapt to shifting user needs at any time. The software has practically all software attributes as a result of the agile process. According to polls, implementing agile approaches enhanced the proportion of software quality [24].

Alok Mishra and Ziadoon Otaiwi claim that DevOps utilization has expanded globally in the software development industry. Finally, they examined how DevOps affected the caliber of software. In this approach, different reference programs, including Google Scholar and IEEE Xplore, were employed to research numerous papers on the subject. The study also discovered a strong correlation between software development success and the automation, sharing, and measurement aspects (features) of DevOps. Additionally, it has been found that DevOps facilitates quick feedback loops, which is essential for the quality of software. A link between DevOps software architecture and quality assurance was also discovered during the investigation. DevOps can therefore be argued to have a favorable effect on software quality assurance. Our findings indicate that the research in this study mostly focused on DevOps automation, culture, continuous delivery, and quick feedback. This study also discovered that DevOps in software quality is not just a theoretical concept; it can also be seen in action to guarantee high-quality software. Although there are more primary studies on the topic, empirical research and

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survey-based qualitative research are still required to compare various conditions in various businesses and countries [45].

According to Stephan Weibelzahl, adaptive systems are typically interactive systems. Because of this, they stand to gain substantially from a development lifecycle that ensures user participation from the initial design phases and supports evaluation, both formative and summative. A range of unique obstacles and threats must be handled in the choice of exact approaches, procedures, and criteria for evaluating an adaptive system. The assessment process is divided into multiple elements that can be employed at different stages of the development life cycle using a layered assessment framework [46].

Nicola Marsden and Karen Holtzblatt claim that the difficulty of expanding workforce diversity in high-tech is ongoing. They've now reviewed the results of a poll with 403 American respondents, and they've found that IT workers have a variety of experiences depending on their job responsibilities. People in other IT job roles than HCI experts regard fundamental work experience characteristics (such as having a respected team, being assigned challenges and assistance, having local role models, and experiencing personal authority) less favorably. They examine the potential causes of their less favorable work experiences, including status variations between job categories and the function HCI professionals play in a product team, based on the preliminary findings of our poll. To further understand these dynamics and the possible steps that organizations might take, more study and analysis with product teams are required [47].

Indika Perera, Roshali Silva, and Pulasthi Perera This study's main objective is to explore and ascertain whether DevOps enhances software quality. Finding cost-effective ways to raise quality is the other objective. To find out more about DevOps techniques used in business, a literature review was done. Five hypotheses were produced from the conceptual research model that was developed based on the literature review. To meet the objectives of the research, Pearson correlation was used to test hypotheses. A linear model is produced using the linear regression methodology. Data were collected using online surveys and conversations with DevOps experts in the software development industry. Data collection and analysis revealed a positive correlation between the DevOps methodology and software quality. If you use DevOps, the caliber of your software will increase. The fact that software quality has a significant positive association with culture, automation, measurement, and sharing suggests that streamlining procedures and sharing data will improve software quality. The results of this study will aid DevOps and quality engineering teams in their decision-making regarding how to enhance testing procedures. Research has shown that culture, automation, monitoring, and sharing all affect product quality. DevOps will boost software quality if the following factors are appropriately taken into account [35].

3. METHODOLOGY

This section explains how to evaluate e-commerce websites using a survey evaluation approach and how to identify the most effective e-commerce sites among Amazon, Flipkart, Alibaba, Daraz, and Walmart to complete tasks faster. To distinguish between

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Amazon, Flipkart, Alibaba, Daraz, and Walmart more useable e-commerce websites. Additionally, a statistical methodology was employed to locate more effective websites that could complete the tasks faster. Due to time limits, only 500 users participate. Users were given a list of six tasks to accomplish, such as signing up and placing an order for a product on five different e-commerce websites. After finishing the exercises, users answered the questionnaire. To determine which e-commerce website offers the most efficiency to complete operations in less time, the average amount of time it took each user to complete six tasks on each website was computed. Large samples of the population were gathered. In addition, tasks were done by the users, and beneficial to know the attitudes and behavior toward the usage of E-commerce sites.

Different software development companies and educational institutions participated in the study. In software houses, we meet the technical people and there were more chances to get the relevant data according to our requirements. We include students from the IT field as well Hence, there is a possibility of obtaining all necessary and relevant data from these offices and educational institutes.

3.1 Sampling and Experimentation

The website "Ecovisionsllc.com" was created to conduct the identical chores as those performed on Amazon, Flipkart, Alibaba, Daraz, and Walmart to determine the average time and efficiency, effectiveness, and level of participant satisfaction. The study used a sample size of 500 respondents, 250 of who were men and 250 of whom were women. 250 males.

To obtain a large enough sample that is representative of the target population, sampling processes are used. Because it is frequently impractical to gather data from the whole population of interest, a subset of the population or sample is used to estimate population responses (e.g., all individuals). The target population must be precisely identified as a result. In terms of all demographic factors (such as sex, socioeconomic position, and symptom experience), individuals in the sample should ideally reflect the intended population and have a similar distribution of those traits.

The duties were carried out. Through the internet, respondents answer a series of predefined questions. Usually, you can do this by filling out a form. The obtained data can also be kept in a database and utilized by experts for upcoming studies. Males and females of all ages made up a large portion of the participants. These target demographics include a certain group of young, tech-savvy individuals.

3.2 Tasks carried out by users

This section outlines the user tasks that were completed on E-commerce websites to evaluate the survey.

Task 1: The user must register on E-commerce websites by completing the registration form.

Task 2: Using their login information, the user should access both websites.

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Task 3: Requires the user to look for a necessary item and add it to their Wishlist.

Task 4: The user should review the suggested products based on their previous searches.

Task 5: The user should visit their wish list and put one item in their shopping cart.

Task 6: The user should update the personal data.

3.3 Calculating the average time for efficiency comparison

This section explains how to calculate the average time needed to complete the tasks given to users so that you may determine which e-commerce site, between Amazon, Flipkart, Alibaba, Daraz, and Walmart, has effective features to complete the tasks more quickly and smoothly.

Each user's time spent on each job on each of the two e-commerce websites was recorded, and an average amount of time was calculated for each task.

The average time taken to perform the task

$$(n) = \frac{\sum_{k=1}^{z}(timetakentoperformtask(n)byuser(k))}{z}$$

n = nth task (task-1, task-2, task-3, task-4, task-5, and task-6) given to the user k = kth user (user-1, user-2, user-3……user-k)

z = total users contributed

On these e-commerce websites, the average time needed to complete each task was compared.

Table: 1. Average duration to accomplish tasks

Tasks/Platforms	Amazon (Average time taken)	Flipkart (Average time taken)	Alibaba (Average time taken)	Daraz (Average time taken)	Walmart (Average time taken)
Task 1	170.48	199.98	184.82	181.4	178.26
Task 2	107.36	112.6	110.58	110.82	107.84
Task 3	167.18	161.54	169.48	161.98	160.72
Task 4	78.7	81.12	81.16	82.62	78.58
Task 5	101.26	98.72	101.94	95.9	85.52
Task 6	175.26	169.58	177.02	168.5	167.4

3.4 Concerning usability heuristics of the survey questions:

The following list of Nielson usability heuristics is related to the survey questions:

Distinguishability of the system status >>Survey question 7

The resemblance between the system and the real world >>Survey question 1

Error anticipation >>Survey question 2

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User control and liberty >>Survey question 4

Reliability and standards >>Survey question 5

Acknowledgment rather than recall >>Survey question 6

Flexibility and efficiency of use >>Survey questions 9,10

Appealing and minimalist design >>Survey question 11

Assistance users identify, diagnose, and convalesce from errors>>Survey question 3

Assistance and documentation >>Survey question 8

3.5 Proposed Model

Here is the proposed UCD Model:

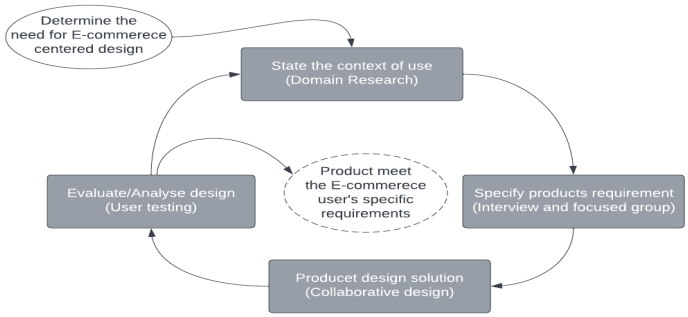

Figure 7: Proposed UCD MODEL

3.6 Design and Development of System

1) Homepage

You may think of a homepage as a digital showroom for your online business since it is the initial point of contact between you and a potential client. You only have about three seconds to make a strong first impression, so you need to be thoughtful about the design of your homepage.

Here the website's home page clearly shows the products, search bar, wish list, cart, categories, etc. which make it easier for a user to perform their chores easily.

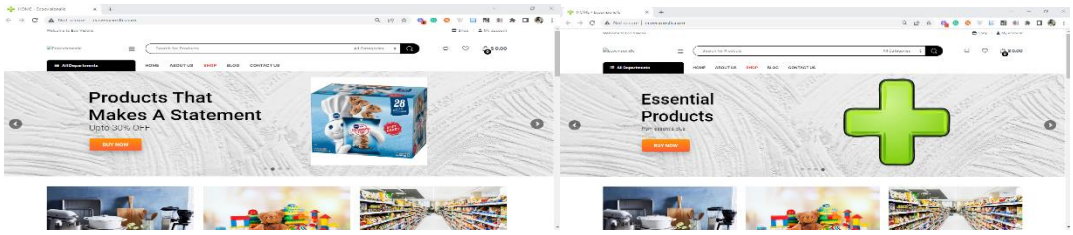

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Figure 8: Home page **Figure 9: Home page 2**

2) Register

Users have the option of creating an account with the system

to enroll. To utilize the system, you just provide basic information.

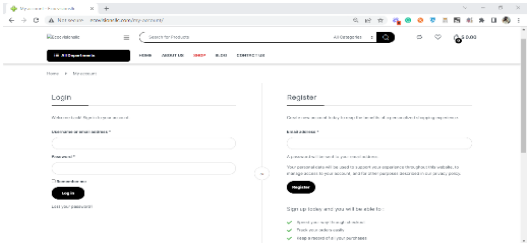

Figure 10: Registration form

3) Login

Returning users should use this screen to login into the system. The system authenticates and authorizes a registered user to use the system by providing a valid username and password.

4) Account details

The user should be able to add and edit personal information from the “My account “>>” Account details” section.

5) Search

The search bar on the top helps users to find the required product by using the keyword /product name.

6) Wishlist

Wish lists are assortments of desired goods that users save to their user accounts, indicating interest but not a strong desire to buy. Here the user can easily add a product to the wish list by just clicking on the wish list icon on the product while displaying on the product list section and also by opening the detail section of the product.

7) Recommendations

A recommendation system makes it easier for customers to find products they like. In this web app recommendations are available below the searched or viewed product so the user can easily get the relevant product results.

8) Wish list to shopping cart

While doing online shopping users get products that they like to add to their wish list or favorite list section so that they can add it to their cart later on. So, in this web app, it's simple to add a product to the wish list by just clicking on the wish list icon and later on they can open their wish list section and can add any of their favorite products to the cart and do further proceedings [48-60].

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4. RESULTS AND DISCUSSION

This section clearly and impartially summarizes what you found, without making any assumptions as to how or why these findings were made. The findings are interpreted, put into context, and the discussion explains why they are significant.

4.1 Usability Evaluation

Usability is a crucial factor to be measured. There are 3 measuring factors of usability e.g., effectiveness, efficiency, and satisfaction. There is a standard termed ISO/IEC 9126-4 and ISO 9241-11. Metrics that appreciate usability i.e., efficiency and effectiveness. To know the satisfaction level at the end we follow a questionnaire technique. Errors may be accidental acts, slips, errors, or omissions made by a user while attempting a job.

Effectiveness is about the accomplishment of goals. We use the efficiency formula below:

Effectiveness= $Effectiveness = \frac{\text{Number of tasks completed successfully}}{\text{Total number of tasks undertaken}} \times 100\%$ ……. (i)

Efficiency is the capability to do something well. The efficiency formula is as below:

Time-based Efficiency $= \frac{\sum_{j=1}^{R} \sum_{i=1}^{n} \frac{n_{ij}}{t_{ij}}}{NR}$ ……. (ii)

N = The total number of missions

R = The figure of users

nij = The outcome of task i by user j, if the user productively completes the task, then Nij = 1, if not, then Nij = 0

tij = The time spent by user j to complete task i. If the task is not productively completed, then time is measured till the instant the user quits the mission.

Users' satisfaction with each task is evaluated using the After Scenario Questionnaire (ASQ) [1]. IBM Computer Usability Satisfaction Questionnaires from Lewis, J.R. (1995) were used. It consists of three questions about how easy things are to complete, how quickly tasks may be completed, and how well tasks are supported.

4.2 Effectiveness

The effectiveness while doing registration is calculated as 95.5 % successful while 4.60% as unsuccessful which shows quite a high registration success rate. The login feature here shows a 90% success rate while 10% unsuccess. With the recommendation, the success rate is 90% while 10% caught the unsuccessful. While updating the personal information /users detail the success rate is 70 while 25% was unsuccessful. The add to the cart feature shows an 80% success rate because it felt simple to the users to just click on the add to the cart to buy the desired product so only 20% were unsuccessful. The most effective feature find by here is 100% because it is easier for users to just click on the icon and add any product to the wish list.

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This Figure shows the effectiveness of the task performed by the user on the proposed website.

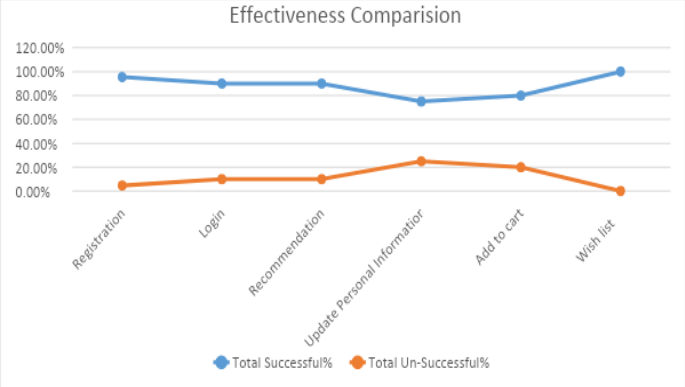

Figure 22: Effectiveness comparison

4.3 Efficiency

This figure shows the efficiency while performing the tasks. Here the registration shows 95.4% overall efficiency. Login shows 90% of overall efficiency. and 60% of efficiency observed while updating personal information. Add to the cart feature shows 95.4 % overall efficiency. The wish list shows 100% overall efficiency because this feature is quite clear and simple for users.

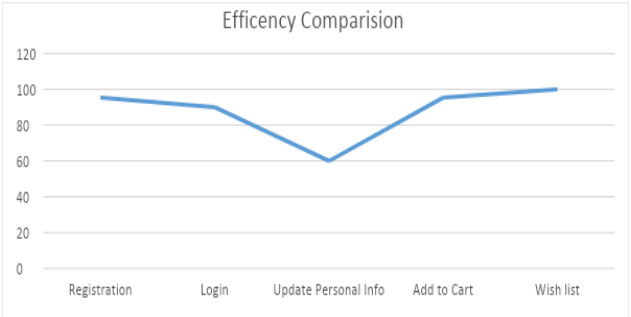

Figure 23: Efficiency comparison

4.4 Satisfaction

The figure shows the usability comparison in terms of user satisfaction for the tasks performed on the proposed E-commerce website. The evaluation had been taken through ASQ. The satisfaction level in the registration task was about 95.4% while during Login it is 96%. While updating personal information the satisfaction observed was 80%. Satisfaction level while adding a product to the cart was 95.4 %. The wish list feature shows a 100% overall satisfaction level.

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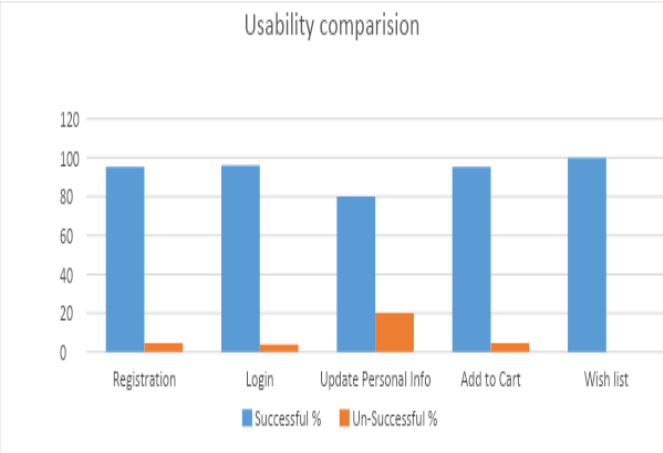

Figure 24: Usability comparison

5. CONCLUSION AND FUTURE WORK

5.1 Conclusion

Usability is crucial for shopping websites because it makes users more comfortable with technology and makes purchases easier. Good and straightforward websites are profitable for businesses as well as for users. Building highly usable retail websites are therefore crucial for the company.

For the websites of Amazon, Flipkart, Alibaba, Daraz, and Walmart, Nielsen's heuristic principles are applied. To compare the usability of Amazon, Flipkart, Alibaba, Daraz, and Walmart, a survey evaluation is conducted. In this case, customer opinion is a crucial factor, and most users believe that Amazon is the website with the finest user interface out of the ones we've chosen. Amazon has a higher rating, and the majority of people have prioritized it in most areas.

Amazon was shown to do better than others, according to the poll results, but that does not imply that the other websites chosen are awful at these heuristics. Compared to other e-commerce websites, Amazon and Walmart offered consumers additional features to do three activities faster (tasks 1, 2, and 4). Additionally, Walmart offered users greater tools to complete three chores more rapidly (tasks 3, 5, and 6). We conclude that Amazon offered a superior user experience compared to Flipkart, Alibaba, Daraz, and Walmart. We conclude that Amazon offered greater efficiency to complete the tasks in a shorter amount of time. Based on the aforementioned findings, a UCD model was created, and an e-commerce website (Ecovisions) was designed, developed, and offered to various users to determine the usability evaluation's effectiveness, efficiency, and degree of satisfaction. By implementing the norms of design principles and learning about their significance, we have updated the website.

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5.2 Future work

By conducting surveys more correctly and using trickier tasks and questions, we can further advance our work. More users will be included in the survey. There are additional platforms like Android and iOS devices where this study can be done. The goal of this thesis's ongoing work is to realize all the design criteria for an interactive system.

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