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HEURISTIC GUIDELINES AND ADAPTIVE USABILITY MODEL FOR MOBILE COMMERCE APPS

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Abstract

Mobile commerce is a fast-growing area of research in this era of technology where a country's economy majorly depends on the revenue earned by e-commerce. With the technology advancement, e-commerce is being replaced by m-commerce applications due to portability. Yet most of the applications are developed for the general public without taking into consideration the context and needs of different user groups and their literacy level. There are hundreds of mobile shopping applications currently available online. In this work, we perform a systematic review of currently available shopping apps present on android and iOS platforms. We also perform participant-based usability analysis of mobile shopping apps using different categories of participants i.e., educated, digitally literate, digitally illiterate, illiterates, and people with physical hand deformities. Different usability problems are identified and reported as a result of this usability evaluation. As a result, we propose domain-specific usability heuristics using the PROMETHUS tool. We also propose a preliminary version of the personalized usability model for m-commerce applications which is an extension of PACMAD model with additional attributes i.e. navigation adaptability, personalization for tactile disabilities (visual magnifier), and versioning. The PACMAD model and the proposed attributes are integrated into the new model.

Keywords: Systematic review, M-commerce, Usability, Mobile shopping applications, PACMAD usability model, Usability evaluation

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1. INTRODUCTION

In this era of technology, everyone owes a smartphone respite the fact of affordability [1]. Technology made a very big change in the area of shopping with the passage of time user's move from traditional shopping to mobile shopping making it easy to shop anywhere anytime. But still, there are a lot of factors due to which people from developing areas fear shopping online. The main issues of these people are illiteracy, digital illiteracy, and fear to use technology due to overwhelming interfaces. In most cases, mobile device developers fail to consider all usability parameters needed when there is an interaction with mobile devices [2].

The simplicity of using these applications encourages the developers of mobile applications to include usability in their design process so that the applications' use will be adaptable, distinctive, user-friendly, and successful. Furthermore, it was discovered that an application's usability cannot be attained without a proper evaluation. There are numerous usability evaluation frameworks and models available to gauge the usability of any software, but limited work is found on mobile applications especially m-commerce applications [3]. The existing model's explorer usability in one or two dimensions and the rest are left for future use. These models are not intended to assess the m-commerce application-specific usability aspects for mobile devices. Most of these models lack the capacity to be extended to other domains and have not been tested for real-time applications. [3]. Moreover, very limited guidelines are available which relates the usability criteria and the definitions in a systematic way.

In this work, we intend to propose usability guidelines for mobile shopping apps by performing a very detailed usability evaluation using a variety of participants. The real intent is to find actual usability problems by exploiting the user experience of a variety of customers, especially for participants with physical tactile deformities and illiterates.

The major research objectives of the presented work are described below:

- To perform a systematic review of mobile commerce apps,
- To identify the major usability problems in selected mobile shopping applications by using usability testing techniques,
- To propose heuristic evaluation guidelines for mobile shopping applications.
- To propose an initial draft of an adapted usability model for mobile commerce apps.

In this paper, our main objective is to do a systematic review of available mobile shopping apps available on android and iOS play Store and propose heuristics as well as an initial draft of an adaptive usability model. The paper is organized as follows: Section 2 provides the related work in mobile commerce and usability models. Section 3 consists of a systematic review of all shopping apps and filtering criteria. Section 4 provides the participant-based usability evaluation according to different user groups and analysis of

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results. Section 5 consists of proposed usability heuristics for solving those problems and for a better usability experience, Section 6 provide the personalized usability model for m-commerce application, especially for people with low literacy or digital literacy

2. RELATED WORK

Over the past few decades, technology has made significant advancements. Until the advent of mobile devices, the true potency of the Internet and social media was a subject of debate. Now, however, it is undeniable that these platforms are powerful. Taking e-commerce as an example, it is widely known that many concerns were voiced over the rise of the idea of e-commerce. The query "Would people adopt it?" "How would they behave?" "What did they want?" etc. were the most frequently asked [3]. But as mobile Internet becomes the most widely used type of the internet today, the term "e-commerce" has been replaced with the term "m-commerce." Like e-commerce, mobile commerce has enormous potential for both consumers and business owners. While there are many mobile shopping apps available to customers and m-commerce is developing at a rapid rate, there are still several issues that require attention. In this work, we focus on one such issue—usability and the user interface experience—that has received little attention from researchers and developers alike. Usability is widely acknowledged to be the largest source of annoyance for Internet users. [3]. Therefore, it is important to realize that in mobile commerce, the user experience of mobile applications is directly tied to annual revenues because a user's decision to stop using a mobile shopping app due to a negative user experience will immediately damage the business owner's annual income. The usability of mobile apps has recently garnered the attention of many researchers, and many have attempted to propose usability recommendations and usability models. [7]

Generally, usability is a term that comprises system aspects like user-friendliness and ease of use of user interfaces. Over time, usability has been defined in different ways. These definitions are not contradictory but can instead be viewed as complementary. Usability thus involves the context of use, the users and the goal suitable to specific circumstances [11]

In 2013 Harrison et al. [6] presented their framework of usability model called People At The Center Of Mobile Application Development (PACMAD), which consists of 7 attributes ‘‘Effectiveness, Efficiency, Satisfaction, Learnability, Memorability, Errors, and Cognitive load,’’ the main objective of this model was to extend the existing models (ISO 9241-11 Nielsen [15] and [16]) to the environment of mobile applications usability (i.e. to allow the addition of extra services during the development process to facilitate user). The main contribution of this model was the inclusion of ‘‘Cognitive load (context in which application is being used)’’ as a measuring attribute. The author’s defined new definitions and the measuring criteria for each attribute specifically cognitive load as for the first time, it’s used as a dependent variable in conjunction with other attributes

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3. SYSTEMATIC REVIEW OF M-SHOPPING APPS

3.1 Search and Screening Strategy

For the review and usability evaluation of mobile commerce apps, the collection of data is the fundamental step. The collection of data for these specific apps is mainly focused on the Android operating system. Google Play Store is used to collect apps related to Android OS. Our major targeted apps are mobile commerce shopping apps that provided English as their language.

To start with, the keywords have to be identified to provide the surety of selecting every app related to e-commerce or online shopping. Hence the following English keywords were chosen “online shopping apps in Pakistan”, “free shopping apps” and buying & selling apps. Every app was reviewed according to its relevance to avoid misleading/spam descriptions. The first step toward systematic review is to define the categories and subcategories to perform a comparative analysis. All the specifications related to these categories are given in Table 3.1. All the information related to apps given in both OS has been tried to address

It was noticed that for some apps the structure of information provided by these two platforms differed, so the information was critically analyzed while making the categories. The date of release or the updated date for apps given in android OS is specific. However, in iOS, it is mentioned in terms of years (e.g., updated 1 year before). In that case, a one-year earlier date is used according to the date of collecting data.

Table 1: Categories and corresponding specifications for mobile shopping Apps

Categories	Specifications
General information	Name (Name of App) Language (Available in English or multi-language App) Latest Update (Specific information is available for android but not for the iOS)
Operating systems	App for the Android only App for the iOS App for both Android and iOS platforms
Developers’ information	The Name of developer or company that created the app.
Acquisition costs	Freeware In-App Purchase Cost in SAR Exact price in SAR
Popularity and the user ratings	No. of the downloads Users rating No. of the user ratings

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The Range of Effective functions	Registration Product search View and reviews Offers for customers Communication Placing orders & payment options Product related services
Interfaces	Availability of external sensor(s)/ devices Type of external sensor(s)/ devices
Target user groups	Educated Digitally literates Digitally illiterates illiterates Physical deformities (especially hands)
Description of apps	All in one Fashion shopping Grocery & Electronics Clothes brand

Table 2: Function Names and their detailed specifications.

Sr. No	Function	Sub-Function	Description
1	Registration	Without no	It is a registration feature without any identity
		with no	It is a registration feature with a cell number
		with mail id	It is a registration feature with an email address or Fb ID
2	Product Search	categories	Feature of Searching Products with filtration according to price and product category
		QR/Bar code scanner	Feature of Searching Products with QR Code
		image search	Feature of Searching Products with Image Search
		voice input	In this feature, Voice Input is used to Searching products
3	View and Reviews	360 views	This feature provides a 360-degree view of products
		virtual view	This feature provides a Virtual View of products
		AR view	This feature provides an AR View of the product
		reviews and recommendations	In-app Review and Recommendations for products by users
4	Offers for customers	sale discounts	In this feature Different Offers like sale discounts displayed
		vouchers and coupons	In this feature Vouchers and Coupons are given
		gaming points	Points to avail offers
		loyalty rewards	In this feature, Reward System has been integrated
		payment in installments	Secure Payment Method via application
		chat boxes	For communications chat boxes availability

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5	Communication	social integration	social integration of application usability
		helpline	helpline no regarding issues or order placement
6	Placing Orders	Auto-fill info	Auto-fill options available for the ease of users
		payment methods	Secure Payment Procedures end-to-end encrypted
7	Product-Related Services	order tracking	Tracking order that where it has been reached
		Return& replace	Availability of returning the order
		refund	Refund Options for customer

3.2 Search and Selection Criteria for Android Apps

The obtainable data in the Google Play Store helped to analyze apps available on Android. Until now, there is no specific criterion for filtering or screening apps according to one's needs. The search was made based on the selected keywords, after which each relevant app was reviewed for its relevance. Moreover, mobile shopping apps in the English language were addressed. The apps are collected from the Android Play store and the mobileaction.com site. From that site top, 100 apps were taken and compared with the android play store apps, so we can be able to choose all the top-ranking apps. The total number of mobile shopping apps found on Android is 894. (From the collected data of 1332 apps (894 apps in android (659 top free 226 groceries 9 paid) and 100 from mobile action site). 338 apps in iOS (200 from the Apple play store, 100 top free, and 38 paid from the mobile action site). 187 apps are selected from both android and iOS. Out of 187, 124 apps are selected from android, and 63 are selected from iOS. The proportion of selection is based on the ratio of available apps on each platform. And the availability of iOS devices as in Pakistan very fewer no of people have the apple iPhone). Following is some of the screenshots for m-shopping apps search on the android platform (Figure 1).

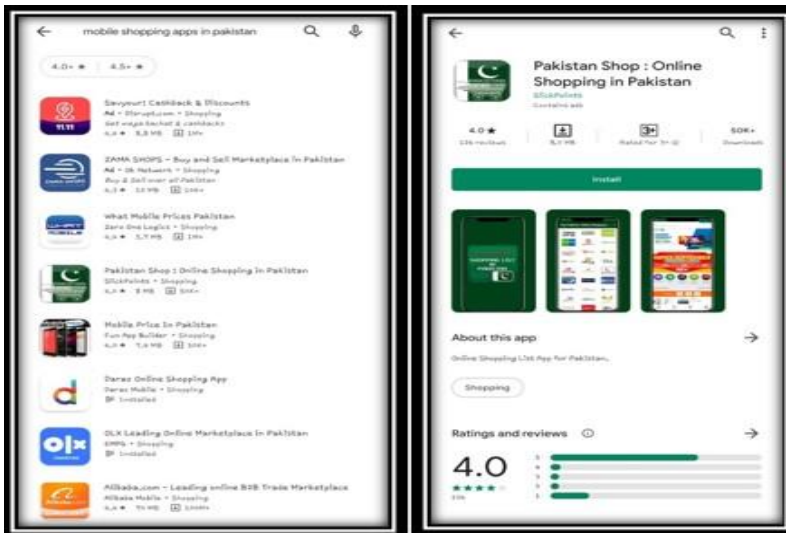

Figure 1: Search of m-shopping apps on the android play store

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3.4 Search and Selection Criteria IOS Apps

For searching mobile shopping Apps on iOS and OS two different types of devices were used, iPhone and Android phones. It is noticed that very few apps are available on the App Store MacBook as compared to the iOS of iPhone. The following figure 4 displays the apps available on iPhone when searched with the keyword “Shopping”. Figure 2 this place the apps available on iPhone, when searching with the keyboard mobile shopping Apps, the total number of mobile shopping Apps found on iOS is 138. The available apps were crossed checked in Android and OS. 56 Online Shopping Apps are available on both platforms. Figure 2 is the screenshots of Online Shopping as collected on iPhone 6.

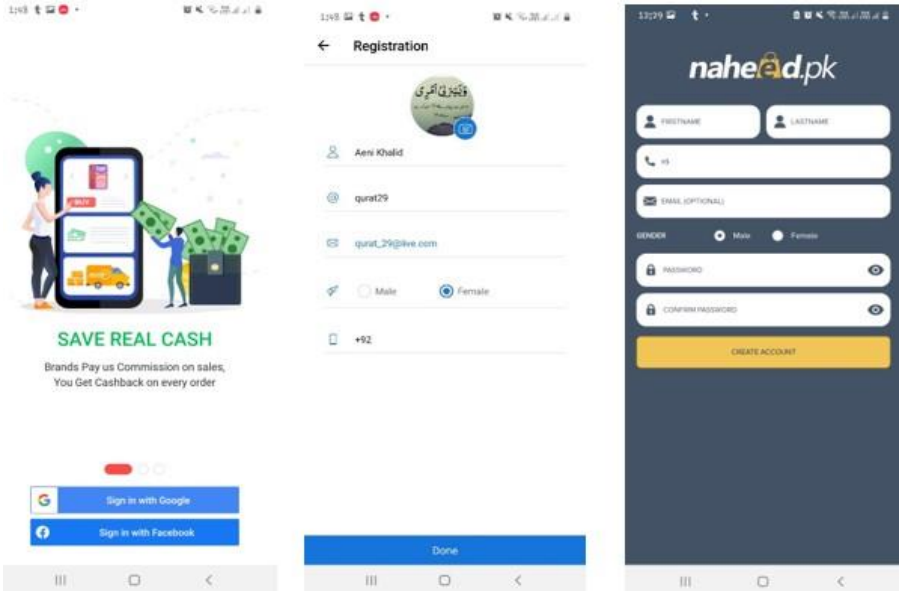

Figure 2: Search of m-shopping apps on the iOS play store

3.4 Results of Systematic Review

3.4.1 Search and Screening Strategy

In the search and screening strategy total of 187 apps were reviewed, 124 apps on the platform of Android and 63 apps on the platform of iOS. In total, three data sets were created, one sheet contains apps for the android platform (124) apps and 2 holds for apps for the iOS platform (63 apps), and the final sheet contains the apps offered on both platforms (56). For this research, the apps specific to the English language were considered.

3.4.2 Market Share of Android and iOS Apps

The below figure (figure 3) shows the market share of android vs iOS apps.

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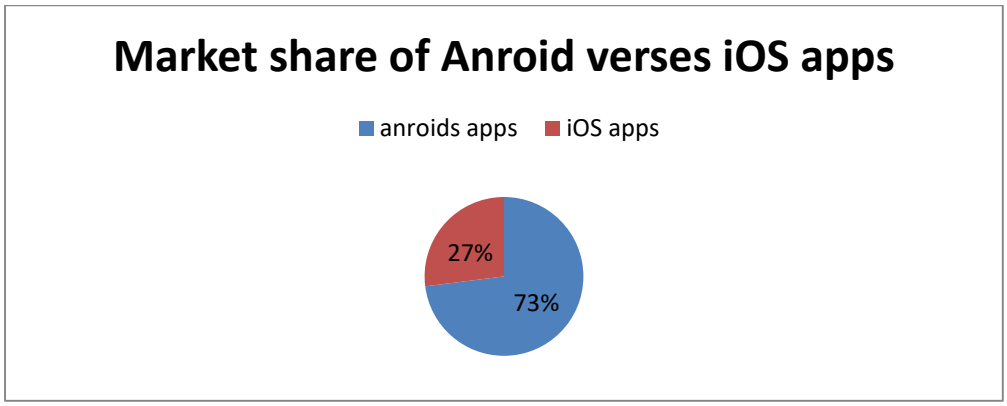

Figure 3: Market share of Android V/S iOS apps

The above pie chart illustrates the market contribution of Android versus iOS apps. It is obvious that Android plays a significant market contribution in terms of mobile shopping apps by 73% as contrast to 27% for iOS apps

3.4.2 Acquisition Cost

From the gathered results the ratio of free apps vs paid apps, the acquisition cost showed significant variance when compared between android and iOS (table 3). Android offers an almost free version of every app (661) where payment is required for many iOS apps, around 62% percent of apps in iOS are free (38/100). Thirty-eight percent of mobile shopping apps are paid apps and 23 offer a lite version, In contrast to 2 percent of paid apps on android. However, 20 percent of apps in android do offer paid/lite versions. The comparison shows that android offers demo versions of all shopping apps, which is not the case with iOS.

Table 3: Price Distribution of Mobile Shopping Apps on two Platforms

Category	Subcategory	Operating System		
		IOS(n=63)	Android(n=124)	Total(n=56)
The distribution of Price in Online Shopping Apps and the “Lite” version, n -(%)				
Free		72%	92%	29%
Paid		27%	7%	0
Paid Lite versions available		23%	36%	20%

3.4.3 Range of Functions/ Functionality

By examining the result (Table 4), it observed that among all functions there are very few apps that have effective functionalities so that users easily and seamlessly continue the online shopping experience. The availability of every function in IOS and in android are given below.

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Table 4: Range of Functions in Both Platforms

Category	Subcategory	Operating system	
		Android(n=124)	iOS(n=63)
Functions availability in both platforms, n (%)	Registration	87%	63%
	Product search	94%	71%
	View and review	77%	95%
	offers	100%	100%
	Communication	100%	100%
	Payment	90%	96%
	Return & Refund	68%	74%
Functions availability in both platforms, n (%)	Apps with 1 effective function	87%	95%
	Apps with 2 effective functions	61%	67%
	Apps with 3 effective functions	29%	58%
	Apps with 4 effective functions	20%	23%

However, average functions per app are high in iOS (2.43) as compared to an average of 2.01 in android Figure 4.

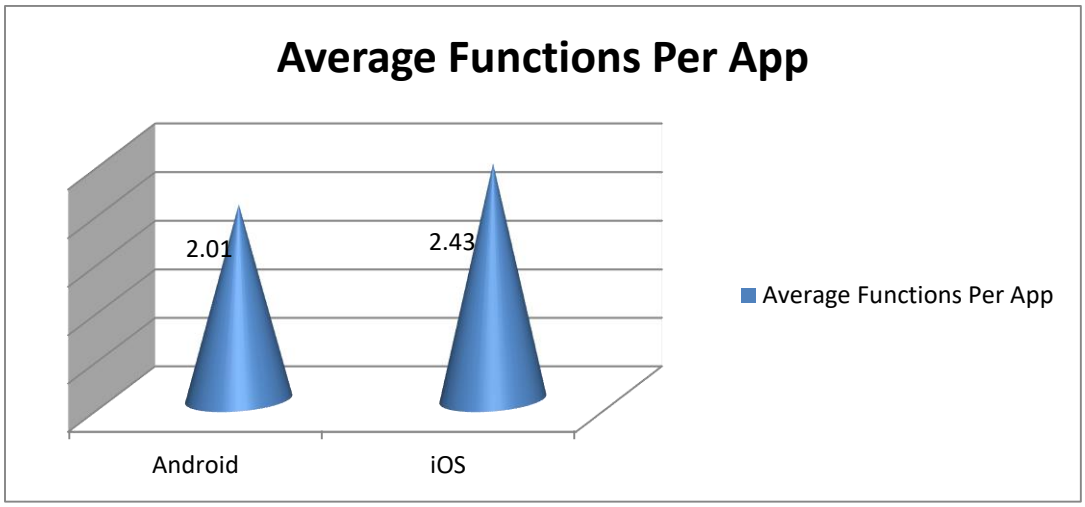

Figure 4: Average Functions per App

3.4.4 Average User Rating

From the information gathered it can be extracted that the average user rating for IOS apps is 4.25 which is quite high than the rating for Android apps.

The average rating of android apps is 4.26 and iOS is 4.28

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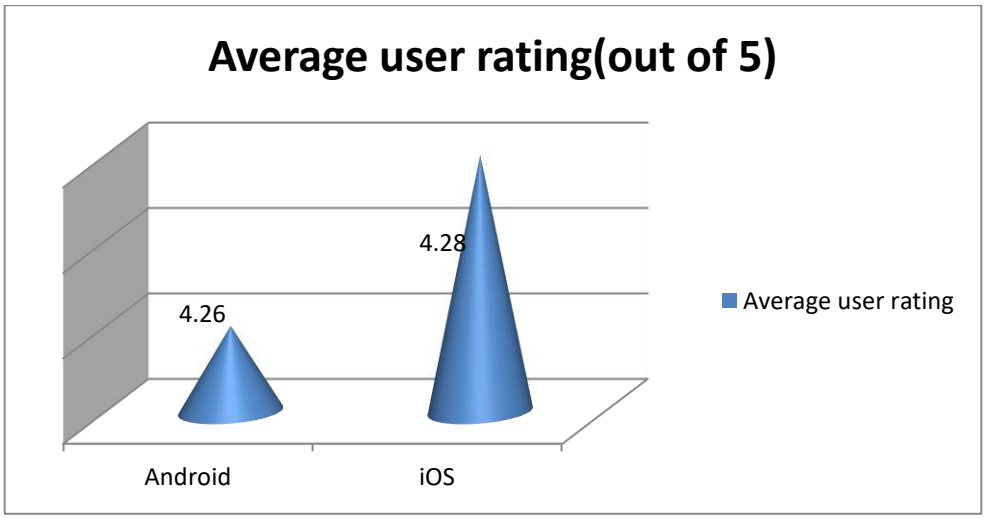

Figure 5: Average User Rating

4. Usability Evaluation of Mobile Shopping Applications

4.1. Participants-Based Usability Evaluation

The process of testing an application's interface and interactivity, by involving the Real-time users are called Participation-based usability testing [13]. In this method of usability testing, a group of users is assigned a number of tasks while being watched by an observer. The tasks performed by the user are closely monitored under a close environment, typically a lab with fitted cameras. The purpose of creating this entire scenario is to gather subjective/qualitative and objective/quantitative data that could help in usability evaluation and to figure out problematic areas with respect to the interfaces. Hence, overall user satisfaction is measured through this technique [14].

4.2. Participants Selection

The participant selection process in our case is a complicated process because of the nature of the problem and the questions we want answers for. The nature of our problem is such that we have to target a variety of participants for this purpose. Globally, we need the following types of participants systematically selected:

(1) Educational Literates

(2) Educational Illiterates

(3) Digitally literate

(4) Digitally illiterates

(5) Participants with physical deformities (hands)

It is also mandatory that we choose equal number numbers of participants from both genders for all these categories of participants for a fair evaluation. We need to be very careful while choosing the number of total participants because a smaller number of

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participants may not represent the opinion of the whole population while an unnecessarily large number will increase our burden. However, it is mandatory that we choose enough participants from each category of participants as listed above. Referring to the literature for a benchmark in a number of selected participants, we decide to select 6 participants for each category which makes a total number of 30 participants.

With these 3 categories of users are also considered according to their age groups i.e.

- (20-35)
- (36-50)
- (51-65)

For application selection we consider 20 percent of total apps according to the following criteria:

- Apps are relevant i.e. they are truly a commerce application and used by general audience and not by a specific group of users,
- The major language of the Apps is English,
- Apps contain the maximum number of functions as selected in the systematic review process.[12]

We take the following safety measures for all tests.

- All participants are given a briefing about usability testing before the test starts.
- All tests are conducted in a controlled environment where proper lighting arrangements are present along with a WIFI facility in case it is needed.
- All mobile apps are installed on corresponding mobile phones already.
- Participants are made familiar with mobile phones to be used for testing. They
- Are informed about phone's virtual keyboards key patterns, working of back and home buttons, etc.
- Time of start and end of each test is noted down,
- We made sure that no participant has used any of the selected apps already to avoid any learning effects on the results,
- All participants sign a "letter of consent" before their first session starts.

5. Analysis of Results and Problems

The identified usability problems as a result of the usability evaluation of mobile shopping apps are as follows

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- There is a significant difference in behaviors of men and women while evaluating mobile shopping apps because women interested more in online shopping
- The application “daraz.pk” has been rated the best in usability evaluation while the application maria.B go the lowest rating from the participants and in the play store ranking.
- It is concluded that the effective usability functions available in an app does significantly affect the usability of that app
- It is found that there is a significant difference between the usability of android and iOS shopping apps rating.
- The people in rural areas are afraid to do online shopping due to the cultural divide and not accepting the technological advances
- Usability evaluation draws the following negative features in mobile shopping apps
- No visual display for the loading process
- Access to exact category product is problematic
- Home button is not available in most apps
- Problem in selection according to exact feature or requirement
- No appropriate help was provided
- No error message in case of wrong input
- Not enough information on what functions apps provide.
- It is hard to use the app for a long time
- It is distracting to do online shopping because of many other options
- Security issues regarding payment
- Additional charges which are not mentioned
- Product quality issues
- Most apps didn’t have proper reviews about the product
- Apps icons are difficult to operate
- No return policy for defective products
- Even digitally literate people are not able to know the proper path of searching for payment.
- Apps have no information about finished products.

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Following is a list of some positive features as revealed from the ratings of participants

- Apps provide easy scrolling
- App uses easy language
- Screens throughout the app are consistent

6. Heuristics Guidelines for Domain-Specific M-Commerce Applications

The quality of any HCI system is described by a combination of different characteristics. One of the major elements is usability. The evaluation of the usability of any interactive system can signify that the system is satisfactorily understood by the end users. The most used method among evaluations is heuristic evaluation. [4]. This Evaluation is based on a set of heuristics guidelines that are widely used for evaluation. Initially, these guidelines are proposed by Nielsen and Molich in 90, s and these guidelines are called traditional heuristics.

However, we came to the conclusion that typical Nielsen heuristics weren't suitable for the unique characteristics of MSA (mobile shopping apps) systems. As a result, and taking this circumstance into account as a useful case study we choose the tool PROMETHEUS [5] for developing the domain-specific heuristics.

6.1 Usability Heuristics for MSA Apps

The final proposed heuristics guidelines integrated with the traditional heuristics of Neilson are as follows.

Table 5: Integration of Traditional heuristics with proposed heuristics

Traditional heuristics	Previous Proposed heuristics	MSA Heuristics
NH1= visibility of System status	PPH1= visibility of System status	MSAH1= visibility of System status
NH2= Matching-Real-World	PPH2= Matching-Real-World	MSAH2= Matching-Real-World
NH3= User-Control	PPH3= User-Control	MSAH3= User-Control
NH4= Error-Prevention	PPH4= Error-Prevention	MSAH4= Error-Prevention
NH5= Recognition	PPH5= Recognition	MSAH5= Recognition
NH6=Flexibility-and-Efficient Use	PPH6=Flexibility-and-Efficient Use	MSAH6=Flexibility-and-Efficient Use
NH7= Minimal Design	PPH7= Minimal Design	MSAH7= Minimal Design
NH8=consistency and standards	PPH8=consistency and standards	MSAH8=consistency and standards
NH9= Diagnoses and Recover	PPH9= Diagnoses and Recover	MSAH9= Diagnoses and Recover
NH10= Help	PPH10= Help	MSAH10= Help

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	PPH11=Dynamic Engagement [7]	MSAH11= There should be different versions of app interfaces for different categories of users
	PPH12= Natural Interaction [7]	MSAH12= There should be an AI agent who calculates the no of wrong clicks or errors and optimizes the screen according to the predicted issue
	PPH13= Make primary button (Add to cart) on each product page [8]	MSAH13= There should be VR &AR embedding in mobile shopping apps
	PPH14= Be cautious of adding images or product information on different subpages [8]	MSAH14= The main categories should be audible for users so that they can select the required categories if they feel difficulty in reading
	PPH15= Ensures the users privacy and security concerns are added[8]	MSAH15= The clear navigational tool is included on all pages of the application
	PPH16= Web standards and symbols [9]	MSAH16= There should be animation or guiding icons on the screens to guide user about the navigation or to proceed the orders
	PPH17= Interactive communication [9]	MSAH17= The content of the homepage should be kept minimum
	PPH18= Urdu mode Adaptability [10]	MSAH18= The input fields in the apps should be kept automatically filled or kept minimum by giving the drop-down menus, for reducing the chances of mistakes
	PPH19= The voice search should support Urdu keywords [10]	MSAH19= The notification should be visualized
	PPH20= Strive for legible fonts [10]	MSAH20= there should be biometric payment enabled for m-commerce apps

The suggested guidelines for the domain-specific m-shopping apps according to the usability model attributes are as follows

6.1.1 App Features

- There should be voice input and audio for help in the apps
- There should be an easy registration process like app UI ask about the person's info and fill the form accordingly so that the person with hand deformity or illiteracy can easily get registered
- The reviews and recommendations are visual and audible function so that if any1 want to speak about any product he can add the audio
- If you have any coupon vouchers or gaming points it will automatically apply to your final total instead of asking about code or link for vouchers.

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- The address locations accept the current location and voice inputs for address location
- The app should consistently send other tracking info like update you every day until u get your parcel.
- If there is any kind of damage or the customer wants to return, then there should be an option of contact # so the user easily communicates in any language

Measures the satisfaction and user experience by rating, reviews and task completion rate

6.1.2 Effectiveness

- The navigation keys are simple and understandable not too much confusing content on a single page
- Every page has the main menu and home page button which are visually highlighted
- The loading process should be viewable and tells the sec or time or percentage of how much percent app is loaded or how much is remaining

6.1.3 Efficiency

- The time for each function to complete is appropriate like times it is written that your coupon will expire within 2 minutes
- The app should be made bug free and add-free so it cannot take extended load time
- The error message is understandable visual and audible in that it clearly tells what error you are doing with voice and with a watermark that this type of info is required
- The app UI is customizable according to the needs of different people and environments.

6.1.4 Learnability

- All the icons used for different tasks are standard and like other UI so that they could easily recognizable and learnable like they should be related to a real-world similar item
- The help icon should be placed on every screen, and it is visually understandable and have audio and video captions about that page-related task. That is what you must be done on this page and how
- The app uses easy language and simple words which are common and understandable

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- There should b proper information about every function all three that are readable, audible, and visual or animated so that different category users take help accordingly.

6.1.5 Errors

- Error handling should be optimized for a good user experience, the errors should be handled properly by providing users with understandable error message and there should be guide how to correct that error
- All errors should be indicated once after mistaken entries made while input rather to indicated at the end

6.2 Some other Suggestions:

- Items in a list without scrollbar and using next buttons
- Interface should be designed as that the related product comes in popups or notifications like if user choose the dress then matching shoes or handbags must be recommended by the app.
- The personalized app design trained to suggest the related outfits according to the body type of user
- Add pop ups should be avoided
- App name should be mentioned on the top head of the app
- For the aesthetic design the theme and font size and colors should be optimized.
- On Every page there should be a homepage button link to jump on that page
- There should be proper back button to go back on previous screens
- The online shopping apps should also support the filtered search so that user find the products according to their specific requirements
- Content on the homepage should be engaging.
- The available products and offers should be up to date to avoid inconvenience
- The app icons or menu content should be optimized in term of selection and font adopted
- The page layout should be top to bottom with no horizontal scrolling
- Every page has a proper interface title according to which action user is going to perform

7. Personalized Usability Model

After a comprehensive systematic and usability analysis, it has been observed that there is a need of a usability model which synthesizes all required components needed for

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mobile commerce apps in a single framework. After going through all existing usability models and after careful analysis of the results of usability evaluation, we propose a preliminary usability model adapted for mobile commerce apps according to different types of its users i.e., illiterates and people with tactile disabilities.

7.1 PACMAD Model:

The PACMAD (People At the Centre of Mobile Application Development) usability model [6] was designed to address the limitations of existing usability models when applied to mobile devices. PACMAD brings together significant attributes from different usability models in order to create a more comprehensive model. None of the attributes that it includes are new, but the existing prominent usability models ignore one or more of them. This could lead to an incomplete usability evaluation. The attributes of PACMAD model are shown in Figure below

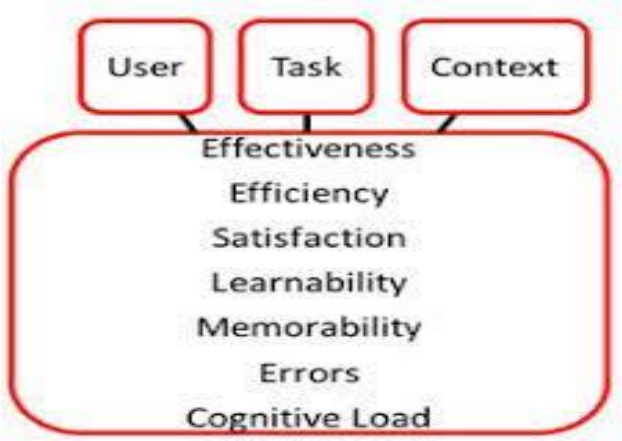

Figure 6: PACMAD model by Harrisoen et.al [6]

The proposed domain-specific attributes for mobile Apps integrated with the PACMAD model are as follows

7.2 Navigational Adaptability:

We propose a graph-based module that can be helpful in predicting the future screens a client is searching for. All possible candidate screens are magnified and are shown on the bottom of the current screen to let the client navigate to the screen of his choice in the quickest possible way.

7.3 Personalization for Tactile Disabilities:

We propose this module to tackle the problem of tactile disabilities in future mobile application developments where we focus on this problem and propose a solution by combining evidence from previous session interactions of a particular user and visual interaction. The proposed solution for this problem is magnified visual buttons based on the previous interaction history of a particular user.

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7.4 Versioning:

This module targets illiterate users whose interaction with the app can be hindered because of content that is not customized as per their cognitive abilities. For example, a localized version of the mobile app can be shown to the user in his/her own language or a more graphical version of the mobile app.

7.5 AR/VR Visualization: this module integrates of augmented and virtual reality for product displaying and better viewing

7.6 Biometric Payment: This module is used for biometric payment enabling in mobile commerce apps which increases the security and usability for diverse users to pay just by scanning their thumb.

8. CONCLUSION

Our study has shown that usability directly affects the usability of m-commerce apps while age is inversely affected. But according to the review literature, there is no usability model or guidelines which specifically target m-commerce apps so to identify the domain-specific problem and their solution in the context of different contextual factors. Also, no usability model for mobile apps which targets illiteracy or digital illiteracy. In this paper, we conducted a systematic review and usability evaluation of mobile shopping applications for android and iOS operating systems. In a systematic review of apps, we identify all the possible features of mobile shopping apps, their rating, and user type analysis. We also performed the participant-based usability evaluation of selected shopping apps for checking the functions of available features and different kinds of usability-related problems in the context of different participants i.e. educated, digitally literate, digitally literate, and digitally illiterate, illiterates, and people with physical hand deformities. Then list out some major usability recommendations to improve the usability of these apps in the context of different users and personalized usability model for m shopping apps.

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