User Experience Guidelines for Improving Retention Rate in Mobile Apps

Master Thesis

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Abstract

The mobile app industry is growing at a rapid pace. More and more apps are coming into the app stores each day, but only a handful of them make the cut, come on top and stay at the top position. Most of the app might do well in terms of features provided, but when it comes to user experience they fail. Through this study, the idea is to find out the list of issues which causes the decrease in the user experience in mobile apps and building a set of easy-to-use user experience guidelines for mobile app so as to improve user satisfaction level and user experience and thereby increasing the app retention rate.

To achieve this, we will be learning about the common user experience problems affecting mobile apps and conduct a survey among the frequent app users to study the main problems affecting mobile user experience. Based on the result, a study will be conducted to tackle this issue and based on the result, build up a set of guidelines that can be followed by mobile app designers and developers to improve the user satisfaction level for their mobile apps and there by improving the retention rate of the app.
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1. Introduction

In the current smartphone era, the mobile app usage is growing at an exponential rate. With the increase in the smartphone usage, the number of the mobile apps used is also increasing. In earlier times, how the application functioned was mainly taken into consideration. But now as the industry is growing and the user base is spreading all over the world, the need for developing an application which can be used by all should also be taken into account. This corresponds to building apps which not only functions well but also captures all the essence of user experience factors.

There are various factors which can cause a decrease in the user experience level while using mobile apps. Through this study, the idea is to find a list of issues which typically causes a decrease in the satisfaction level of the user and find suitable guidelines which can be applied to those scenarios to improve the user experience while using mobile apps and thereby improving the app retention rate.

In chapter 2, we will be discussing what is User Experience, what is the need for UX in applications and devices and the main UX components. We will also be talking about why UX in mobile apps are highly relevant and there is a need to develop a set of UX guidelines to improve the retention rate of the mobile apps.

In chapter 3, a state of the art approach has been detailed for figuring out the list of UX problems in mobile apps, compile guidelines for figuring out the problems in mobile UX and validate the guidelines against successful apps and finally classify the guidelines by category.

In chapter 4, the list of UX challenges faced will be studied based on analysis of usability heuristics, factors affecting user interface and user experience. We will also be mentioned in iOS and Android Human Interface Guidelines and why our work is relevant in this scenario.

In chapter 5, a survey is conducted among mobile app users based on the value obtained by the analysis of usability heuristics, user interface, and user experience factors. This is conducted to find out the pressing issues in mobile UX which decreases the level of user satisfaction while using mobile apps.
In chapter 6, we use various resources including journals, publishings, and UX related books to find guidelines for UX problems which we have found in the previous chapter. A template will also be developed to show the different guidelines that have been developed.

In chapter 7, 24 most used apps will be selected for testing the guidelines developed to confirm if the guidelines hold well against the apps and the result of the tests conducted will be recorded.

In chapter 8, the tested guidelines are classified based on the app category. App categories are clustered together and the guidelines that are commonly found among them during testing will be displayed. These results will be some of the factors which improve the retention rate of the mobile apps.

In chapter 9, we will be summarizing the whole study and the results obtained, how we can move forward with the existing results to bring up more interesting and useful details for improving the retention rate in mobile apps.

In chapter 10, we will be displaying the entire list of references used during the study.
2. User Experience - Introduction

2.1 What is User Experience?

User Experience (UX) is the process of enhancing customer satisfaction and loyalty by improving the usability, ease of use, and pleasure provided in the interaction between the customer and the product and it encompasses all aspects of the end user's interaction with the company, its services, and its products [1]. This implies that regardless of its medium, UX encompasses any and all interactions between a potential or active customer and a product.

UX focuses on the overall design and how it makes the user feel and live the product. For creating a beautiful and well-working design, we need to focus on user experience and design implementation behind it.

During software development, techno-centric practices are given more importance than user-centric practices. Indeed both are pressing factors and need to be given equal importance. Both should technocentric and user-centric practices when given equal significance lead to successful projects. The picture below shows the components of UX.

![Figure 1: Components of User Experience (2)](image-url)
In this study, we will be focusing on the usability, design, accessibility and human computing interactions to build up important and necessary mobile UX guidelines that can be easily used during design and development phases of a project to improve the user satisfaction while interacting with the mobile app.

2.2 Smartphone Users and Mobile App Industry

The worldwide smartphone usage grew by more than 300 million users between 2014 and 2015 and the reports predict that more than 2.6 billion people will own a smartphone by 2019 [3]. With this growing trend in smartphone usage, it means that the number of app users will be increasing as well. As of 2016, 102 billion apps have been downloaded worldwide and the number is expected to reach 268 billion by end of 2017 [4]. The upward trend is not just limited to the number of smartphone users, but also across app usage. A growing trend in app usage will simultaneously affect the growth in revenue in the app industry as well. According to Statista, the worldwide mobile revenue for 2016 amounted to 88.3 billion $ which is expected to reach 188.9 billion $ by 2020 [5].

2.3 Why UX in mobile apps is highly relevant?

Mobile phones come with strengths, but also limitations. Compared with desktop and even laptop screens, mobile phone screens accommodate a lot less content. The number of chrome elements should be limited in a mobile device, so designers must downplay the chrome to make space for essential content [6].

UX incorporates all aspects of end user interaction with the mobile application. For the success of a mobile application, it is utmost important that the users have a pleasurable experience while interacting with the mobile, as well as they are captivated by the visual appeal of the mobile application. UX gives an overall impression of the business which includes navigation, structure, content as well as the layout of the app. If user experience through an app is good, you’re bound to attract more users and the chances of users uninstalling your app will be minimal.
2.4 Need for Mobile UX Guidelines

Even though the need for UX on mobile applications is highly significant, we don’t have a concrete set of UX guidelines, best practices or tips for mobile applications that can be applicable to both iOS and Android and can be easily followed. The primary problem is that people try to focus more on finding the available list of problems, but spends less energy on how it can be solved using current approaches. This creates the need for building a set of easy-to-use mobile UX guidelines that can be checked against the design created by the design team of any mobile application powered by both major platforms to improve the satisfaction of user while using the app and thereby increasing the conversion rate of the application. Through this study and findings, the idea is to get the best practices that designers and developers can follow to create a seamless user experience for mobile app users. It should also be noted that we are only taking into account all the mobile apps which won’t include games.

2.5 Limiting Research to iOS and Android

Based on current trends in the mobile operating system, iOS and Android account for 83% of market share in early 2016, in terms of how many mobile devices they have been installed into [7]. The figures have grown further up to 99% of total market share by late 2016 [8]. Other competitors have either given up or have 1% market share, which means we can focus our findings and limit our research to iOS and Android. Furthermore, the guidelines will be developed in such a way that even if any new players come into the mobile OS market, they will still be able to adapt to and use the guidelines being developed.
3. Approach

Figure 2: State of the art approach followed for getting UX Guidelines
Step 1: Analysis of UX Challenges

The initial step in the research starts with studying the obstacles, dilemma and the issues which decreases the level of user satisfaction while using mobile applications. Studies conducted by prominent contributors in the mobile user experience field are taken to analyse the decline in the user satisfaction level while using mobile apps in this step. We will also be analyzing the iOS and Android Human Interface Guidelines in this Section and based on the analysis of both, where the thesis is heading towards and the need for the thesis will be discussed.

Step 2: Survey of the Users

We carried out an analysis of books and articles in the previous section. The result of the analysis was taken up in this step and a survey was carried out with people using mobile apps on a daily basis. The result of the findings is collected and analysed in this step to find which areas of mobile user experience require attention, and thus for such areas the guidelines need to be developed. The idea of this step is to narrow down the topics which require attention rather than trying to find all the possible problems that can be thought of or obstacles which are already been solved.

Step 3: Compilation of Guidelines

The outcome of the analysis in the previous step is taken up for study to investigate and review what can be done to reduce the lack of user satisfaction level while using mobile apps. A common template is built to present the UX guidelines collected from various sources to present in a common format for easy representation and understanding.
Step 4: Validation of Guidelines against 24 Successful Apps

The compiled guidelines need to be validated to see if it holds against most used apps. This step takes care of selecting common and most used apps in the App store. 24 successful apps have been chosen and each of the guidelines compiled in the previous step is tested against the apps.

Step 5: Classified Set of Guidelines By App Category

In the final step, the guidelines were classified by the app category i.e. for each set of app categories, which all guidelines hold were found out. The number of guidelines used in the top testbed apps, average number of guidelines used in the test bed apps were also found out.
4. Analysis of UX Challenges

Reaching a set of mobile UX guidelines that can be followed for improving user experience and satisfaction starts with finding out the elements causing the problems in UX which need to be solved. In the initial phase of the study, an introspection is done to find frequent dilemmas arising in UX in general and also specific mobile UX issues. iOS and Android design guidelines are also taken into study for

4.1 Analysis of Usability Heuristics, Factors Affecting User Interface and User Experience

The initial phase of the study focused on findings of people and groups working closely with user experience field, which included Jakob Nielsen and Raluca Budiu from Nielsen Norman Group [9, 10, 11] and Ben Shneiderman [12].

To study about what causes the decrease in user experience, an inceptive learning was needed. I started with the analysis of heuristic evaluation created by Jakob Nielsen mentioned in his Usability Engineering book [9]. Heuristic evaluation is a usability engineering method for finding the usability problems in a user interface design so that they can be attended to as part of an iterative design process. Heuristic evaluation tries to explain each observed usability problem with reference to established usability principles. The heuristics as published in Nielsen’s Usability Engineering book are as follows:

- Visibility of system status - Recognition rather than recall
- Match between the system and the real world - Flexibility rather than recall
- User control and freedom - Aesthetic and minimalistic design
- Consistency and standards - Help users recognize, diagnose and recover from errors
- Error prevention - Help and documentation

These are called heuristics as they represent broad rules of thumb and not any specific usability guidelines. All of these heuristics can still be applied to mobile devices.
On further exploration of what caused the decrease in user experience in mobile devices, the study from Jakob Nielsen and Raluca Budiu on mobile UX comes into play [10, 11]. Considered the most prominent in the user experience field, they acknowledge that mobile devices come with strengths and weaknesses. According to them, the most prominent flaws that affect the experience and satisfaction level of a user are:

- Small screen size where all the information should be handled
- Touchscreen typing a problem
- Variable connectivity
- Tiny click targets
- Bad error messages
- Asking for the same information multiple times
- Inadequate system visibility status
- Improper error handling
- Reducing short-term memory load
- Lack of learnability

The work done by Ben Shneiderman from his book “Designing the User Interface: Strategies for Effective Human-Computer Interaction” [12] offers practical techniques and guidelines for interface design. His eight golden rules of interface design are:

- Strive for consistency
- Enable frequent users to use shortcuts
- Offer informative feedback
- Design dialogue to yield closure
- Offer simple error handling
- Permit easy reversal of actions
- Support internal locus of control
- Reduce short-term memory load

Based on the examination of the books and articles we have taken by Jakob Nielsen, Raluca Budiu, and Ben Shneiderman, the following are the major issues which decreases in the user satisfaction level of the mobile apps are:

- **Not handling information aptly in the small screen**
- **Touch screen typing problems**
- Tiny click targets
- Bad error messages
- Unavailability of system status
- Short term memory load issues
- Not checking if the app is easy and learnable
- Not conveying the usefulness of the product
- Not providing help and documentation
- Not giving easy reversal of actions
- Reduction in feedback
- Not maintaining design consistency

This result obtained will be taken up for use in the survey to be conducted among mobile app users in Section 4. The knowledge acquired from each of the studies can be practically applied to any current mobile devices. All the books and articles taken up for the study had in some way touched the core areas of user experience including where exactly a designer needed to focus on improving the user experience. The prime intention of bringing together these articles and publishing were to find out the common problems a mobile user faces and which areas required attention in terms of user experience so that we can look for and find strategies to improve those areas.

4.2 Review of iOS and Android Human Interface Guidelines

Human Interface Guidelines (HIG) are software development documents which offer application developers a set of recommendations about how to use a development platform. The aim is to improve the experience for the users by making application interfaces built on the platform more intuitive, learnable and consistent.

iOS and Android are two distinct mobile operating system with each having their own set of standards and features. Both the platforms have designed HIG development documents and the prime purpose of iOS and Android HIG is to create a consistent experience across both the platforms, including the applications and tool being used. This includes both applying visual design and
creating consistent access to and behaviour of common elements of the interface from simple ones such as buttons and icons up to more complex instructions, such as dialog boxes [13]. In short, they are recommendation and advice helping developers create a better application.

4.3 Why We Need a New Set of UX Guidelines?

Study on usability heuristics, best practices on user interface and user interaction as shown in section 4.1 are available for at least two decades and the HIG guidelines provided by iOS and Android as mentioned in section 4.2 are available since the time both the platforms were launched. Even though these books and documentation are publicly available for all developers and designers, the percentage of apps which makes the cut stays on top of the app store and gets used continuously by customers are still low.

This can be reasoned by pointing out to the lack of detailed guidelines, which are not at an appropriate level of abstraction. Any guide or documentation which is hard for developers to understand and use gets rejected instantaneously.
The primary objectives of this study are to develop a set of UX guidelines which improves mobile app retention rate. Through this research, we take into account the important things to think about when developing smartphone apps, in order to identify what and how to improve the user experience and optimize retention rate. The study will serve as an easy to use user experience guidelines which are organized, well documented and detailed thereby increasing the user retention rate if followed.

As shown in figure 3, our works come in between the study on usability heuristics, factors affecting user interface, user experience and iOS, Android Human Interface Guidelines. The abstraction level is apt for users so that they can quickly relate to the product being developed and if needed can be quickly used in the product.

When an app being developed is used by a large demographic of users, making it simpler and easy to use is important, especially when we have an alternative for almost all apps out there. Being a designer or a developer means having to take care of a lot of tasks. There exists a good chance that details which enhance the user experience might go missing. The guide also stands as a reminder for the both designers and developers, so that the existing app designs can be compared with the UX guidelines we are going to develop to check and compare how the user satisfaction while using the product can be increased.
5. Survey of the Users

The response obtained in section 4.1 was too abstract where issues which can affect the mobile UX had been discussed. In order to find out what exactly turn down the UX in mobile for app users, how they felt in term of their satisfaction while using mobile apps and the problems they faced, a survey had to be conducted. A **top-down approach** was followed in this section based on the results of section 4.1 to create the survey.

Questionnaires were used for conducting the survey. Questionnaires related to user satisfaction help to discover how they feel and gives us the option to get their opinion. The result of the studies done in the previous step was used to formulate the questionnaire for the survey. To maintain simplicity and easiness for the participants of the survey, it was made sure that questions were aptly prepared and only to the point to analyze what issues bothered them while using mobile apps turned off users. Each of the questions used was designed carefully so that any normal participant will be able to understand and provide an apt response.

It should be noted that no specific mobile apps were taken into consideration for this survey, but rather it was meant to collect a more generalized user experience problems on mobile apps.

The questionnaires developed for this survey using the top-down approach based on the result obtained from Section 4.1 were:

1. Name of User
2. Problems faced as a mobile app user in terms of experience while using mobile apps
   - Inconsistency in design
   - Sign up/Sign in Issues
   - Touchscreen typing issues
   - Lack of Clarity in error messages
   - No real time communication of errors
   - Unable to confirm if an action has happened or not
   - Asking for same information twice
   - Lack of visibility of system status
   - Lack of help feature
- Readability issues
- Tiny click targets
- Lack of default values while filling up forms
- Confusion regarding how a feature will be used
- Information is shown in a single window not handled properly
- Search box not efficient
- Internet Connectivity issues

3. Any additional unsatisfactory user experience you faced while using mobile apps?

The survey was conducted with the help of Google Forms and 36 users participated in the survey to give insights of user experience issues they faced while using multiple mobile applications [14].

All the data of respondents collected from the survey was analyzed to check which areas required more attention i.e. to which specific areas of mobile user experience we needed for focus for finding best practices in order to improve the user satisfaction. The main response from 36 people participated in the survey has been represented as a chart below.

![User Experience Issues Faced While Using Mobile Apps](chart.png)

Figure 4: Survey result to confirm the features causing decrease in user experience in mobile apps
From the above chart, we can understand that certain factors outnumber the rest of the problems. The responses were analyzed based on the percentage of each factor. Every factor which had at least 30% and above were considered critical and were taken up for analysis to the next stage. Based on the survey response and the analysis of the chart, the following are the most common problems which turn off mobile app users when it comes to satisfaction and ease of use:

- Sign up/Sign in Issues
- Touchscreen typing issues
- Lack of clarity in error messages
- Unable to confirm if an action has happened or not
- Lack of help feature
- Readability issues
- Tiny click targets
- Information is shown in a single window not handled properly
- Search box not efficient

The results obtained based on the survey will be taken up for study in the next section and the UX guidelines will be developed to solve these primary issues in mobile UX.
6. Compilation of Guidelines

6.1 Main Resources Used

Based on the results of the analysis conducted on the findings from experts in the user experience fields and from the results of the findings based on the survey, the main issues which affect the mobile user experience have been found in the previous phase. This step focuses on the main resources used to arrive at the solutions to the main obstacles in mobile UX.

The primary resources taken for the study are:

- Mobile App UX Principles [14] which is a result of the findings done by Google to improve and optimize the app conversions mainly focused on e-commerce applications.
- Mobile & Multi-Device Design: Lessons Learned Building Polar [15], a study on the learnings, tricks, and techniques used by Polar app team for improving the user experience in their mobile application.
- Mobile Usability [16] which is a book published by the Nielsen Norman group focusing on usability. It offers certain cues to improve the user experience in mobile applications.
- Principles of Mobile App Design: Engage Users and Drive Conversion [17], a study conducted at Think with Google team detailing certain strategies and principles for building great mobile apps.
- Mobile Design Pattern Gallery: UI Patterns for Smartphone Apps [18], a book which studies common problems in mobile user interactions and suggests common mobile app design patterns.

The suggestions, recommendations, and best practices followed in these resources were established as the underlying structure of the study for improving user experience and satisfaction in mobile applications.

6.2 Guideline Template

The study conducted based on the findings of major sources in the previous section lead us to conclusions to improve user satisfaction during mobile app usage. Each of the sources conveys the ideas dissimilarly about different issues affecting mobile user experience and how each of the concerns can be decoded.
6.2 Guideline Template

To achieve that we need a common template to speak about the different concepts in mobile user experience in the same language, how each can be used to put into action and notifying the reason why we are selecting the guideline and giving importance to the concept. The following template has been used for specifying the guidelines.

**Guideline Template**

- **Heading**
  
  I will consider the app to be compliant with the guideline if .........................

- **Reason:**
  
  ........................................................................................................................................
  ........................................................................................................................................
  ........................................................................................................................................

*Heading:* The title of the guideline

*Description:* A brief explanation of the context of use of the guideline.

*Reason:* A more descriptive and scientific reasoning behind why the guideline will be important, how it can improve the user experience and the resource used for arriving at the conclusion.
6.3 Guideline Compilation

6.3.1 Make Application Load Fast

I will consider an app to be compliant with the guideline if the app content loads in 5 seconds or less.

Reason:

More than 80% of the mobile apps are used only for 2 mins during a single session [20]. So it is highly necessary that the users don’t have to wait for long periods of time to get access to the data they are looking for. Initial loading time being high (in all app categories) is a problem a high percentage of mobile apps are facing [21]. Avoiding the lag in the initial loading time using caching, compressing and resizing images, reducing http requests, reusing data templates, loading data when needed strategy will reduce app loading time and help in increasing the app retention rate [15].

Figure 5: Medium iOS app on iPhone SE fetches and loads the data in less than 4 seconds
6.3.2 Provide a Non-Signed Journey

I will consider an app to be compliant with the guideline if the user is being provided a non-signed journey initially through the app and be able to access few app features.

Reason:

Asking to sign-up as soon the user starts using an app can be quite daunting as there is a chance that user might drop off the app without coming back to use again. Apps should initially demonstrate their worth even before the app has been adopted by the user [15]. It is preferably better to give the user a non-signed journey with access to limited features and making them understand the need for a sign-up [16]. E.g. ESPN app as shown in the image below provides the option of optional sign-up with limited access to content.

Figure 6: ESPN iOS app provides the feature of signing up later on initial load. For obtaining featured content, users need to sign up to avail the facility.
6.3.3 Fast and Multiple Sign-Up Option

I will consider an app to be compliant with the guideline if the user will be able to quickly sign up for the app and also be provided at least 2 sign up options (e.g. Facebook and Email).

Reason:

Asking too many details during signup can be intimidating for users and there exists a chance of a drop in conversion rate. To overcome this problem, it is preferably better to ask for the bare minimum requirement to the user, provide easy signup options and needs to be notified of the reason as to why the sign-up is necessary [15, 16]. Taking such an approach gets the user to join the app and start using the core features and if needed in future, the user can be asked to provide additional details according to the context of use.

Figure 7: Medium iOS app allows users to log in to the app with four possible signup options i.e. with account from Twitter, Facebook, Google or email
6.3.4 Persistent Sign-In

I will consider an app to be compliant with the guideline if the user won't be asked to sign-in on each app usage unless highly necessary.

Reason:

Once signed in, the user shouldn't be asked to sign-in again i.e. whenever the user starts the application, he/she should be redirected directly to the home page. Access tokens can be provided by the app natively or using social login which can live up to months or until the user manually log out of the application, so that the user shouldn't have to sign-in every time during app launch [22, 23]. For applications which need the user to sign-in on every new visit to the app (where high security is necessary like banking apps, finance apps), make use of fingerprint reading technology the latest mobile models are providing as an alternative, fast and easy sign-in option [17].

Figure 8: Uber iOS app after initial sign up won't prompt user to sign in each time the user exits from the app and comes back to use the service again
6.3.5 Reveal/Hide Password during Sign-Up & Sign-In

I will consider an app to be compliant with the guideline if the option of revealing/hiding the password during sign-up and sign-in is permitted as they type.

Reason:

An average person logs in at least 15 times a day in a mobile app and 86% of US companies still use a password for authentication [16]. Using * at each password field can increase the chance of mistake as the users are not able to see what they are typing. Instead, users should be given an option as to if or not, they can see the password as they type. This will significantly reduce the mistakes during sign-up and sign-in [15].

Figure 9: Snapchat iOS app gives the option to the users while sign up to see the password while typing instead of dots. On tapping the “Show” field in the screenshot, the password stated as dots will change to readable characters.
6.3.6 App Permission

I will consider an app to be compliant with the guideline if the user is asked for permissions that provide a value, at the appropriate time (in context to what user is doing) and along with a clear benefit statement.

Reason:
Certain features of the app might need extra functionality the mobile device provides to function correctly. In order to get access to these features, users should be notified as to what feature of the device the app needs to access. Users are most likely to accept permission requests when they are made aware of why the app needs that extra information. Showing a clear benefit statement at an appropriate time improves the chance that the user understands why the permission is needed and grants access [15, 24].

Figure 10: Snapchat iOS app (left) on initial app usage asking permission to users to allow accessing the camera. Uber iOS app (right) giving a detailed description of what they are accessing user location. While asking each permission, a clear message is given as to why the feature should be granted access.
6.3.7 **Logout/Delete from App**

I will consider an app to be compliant with the guideline if the user is provided a way to log out, disconnect or delete their account altogether.

**Reason:**

Once a user is signed up to an app, the details of the users are stored permanently in the servers in most cases. In an economy where the user has the rights over his/her data and content, it is a good practice to let user erase their data at their discretion. Protecting the privacy of users should also be given importance in case the user at any time wants to log out and remove all the details from the app [24]. E.g. The social media app Facebook and the dating app Tinder gives the option to log out or delete the account entirely to prevent people from finding the user.

![Settings screen from Tinder iOS app]

Figure 11: Tinder iOS app gives the users the power to delete all the user details off their platform at any time.
6.3.8 Progressive Disclosure Technique

I will consider an app to be compliant with the guidelines if the app displays the primary content and functionality as promised on app load.

*Reason:*

A mobile app doesn’t have the luxury of a web app where you can show all the features on screen during initial page load. The app, therefore, should prioritize and display the primary content and functionality on the home screen and put secondary functionalities available through a menu or from a swipe to above or below or aside the screen. Progressive disclosure is a technique which can be used to show the most important feature and options the application stands for and then offer a large set of specialized options upon request [17]. Information and actions are sequenced across several screens thereby the user stays focused on completing individual tasks and doesn’t feel overwhelmed [25].

Figure 12: Instagram is one of the most photo sharing apps in the world and their primary purpose is to allow users to view the photos of their choice which is displayed on app load. Instagram has other features also like sharing a private picture, editing pictures, etc. but only the main feature is visible on app load. The rest of the features are displayed progressively.
6.3.9 Just In Time Teaching Technique

I will consider an app to be compliant with the guideline if context tips are used for showing new features (if necessary) to users.

Reason:

When there is a feature in the app which is not commonly known among users or if the app is built for solving a specific problem which the users are not aware of and how to use it [15], a good practice will be to add context tips near that feature telling what it does. Instead of teaching everything up front and all at once, teach in the moment when specific information is actually useful. If your application has a new/special feature which is solely available to your product or a tip which needs to be shown to avoid confusion, then it is good enough to show context tips [17, 26].

Figure 12: Snapchat app on initial load lets users know what are the main features of the app using context tips rather than giving a full app tour at the start itself. The advantage of this feature is that users will understand at the specific moment the functionality of a certain feature. Similarly, when a release is made with a new feature, a context tip is provided next to the new feature.
6.3.10 Transient Navbar

I will consider an app to be compliant with the guideline if

- the menu in use will be a side drawer which could slide from one of the either sides of the app or a hamburger menu which on tap will open up the menu contents and links or a navigation bar across top/bottom
- the menu will be accessible from all levels of the app
- on first app use, an animation effect should be given at the menu position
- each option (links) in the navbar should have adequate spacing

for handling the real estate of the app efficiently.

**Reason:**

Providing all features of an app in a single window is not wise in-app designing due to limited screen space. Moreover, users at all-time should be able to move to secondary features the app is providing (if any). The side drawer/hamburger menu/navigation bar across top or bottom helps tackle the problem where all the secondary functions can be placed in and can be accessible at a maximum of two clicks. Usage of the transient navbar helps in tackling the limited space in a mobile application [15, 18, 19].

![Figure 14: Uber iOS app (left) using navbar at the top left corner for saving the real estate of the app. On tapping, the secondary functionalities will get pushed to the side for user access. Facebook iOS app (right) using the navigation bar at the bottom to provide access to the secondary features it provides.](image-url)
6.3.11 Hit Target Size

I will consider an app to be compliant with the guideline if the touch target’s size used in apps should be accessible in a single click for all users.

Reason:

Tapping targets, especially the buttons can be difficult if those buttons are small and small touch targets makes users work harder to reach the goal. Small touch targets make users work harder because they require more accuracy to hit. Buttons that are tiny and crowded pose a challenge for the users. Not only do they take longer to reach the target, but users are also more likely to make mistakes [17]. As specified by Apple HIG guidelines, in order to reach the specific target in a single tap a button size of at least 44 points x 44 points is advised [27, 28].

![Figure 15: The screen from Amazon iOS app gives the option to add items to the checkout cart by tapping the yellow button. The button size is way over 44 pt x 44 pt. All the buttons and icons over that width are found to be easy for the user to touch and interact.](image-url)
6.3.12 Prominently Display Search Field

I would consider an app to be compliant with the guideline if search field is prominently displayed in app home page.

**Reason:**

The important trait of a successful app is to make sure that the required information a user wants should be quickly available to him in the minimum amount of time. As we have noted that mobile phones don’t have the luxury of too much real estate on the screen. As a result, not all the information available can be shown on the screen. To overcome this situation placing a search feature right on the home page will increase the chance of users getting towards the information needed as It can be the fastest route to discovery of content or necessary information [17, 18].

![Image of Medium app home page](image)

**Figure 16:** Medium is a popular app for sharing stories and text content. Search is an important feature of the app. When a user needs to search for a specific story, he/she needs to perform single tap at the right-top search button to get the content from the database rather than performing multiple actions.
6.3.13 Effective Data Search Indexing

I would consider an app to be compliant with the guideline if, in the search field auto-suggestions are used to reduce data entry and provide immediate results and highly relevant first few search results are shown.

Reason:
Search results change all the time due to new documents, changes in user interests and discovery of new ranking algorithms. Therefore, dynamic nature of search result needs efficient techniques which provide auto-suggestions as quickly as possible (such as after the second character is entered) to provide immediate results. This reduction in data entry effort will have a high advantage as they could reduce the mistakes being made while typing. With the screen size of smartphones being so limited in a number of search results, the first few search results are highly relevant. Make sure the top search results to be shown should be the highly relevant. Avoid giving dead ends in the user experience when the search produces no matching results. Employ an intelligent search feature that covers singular, plural and misspellings [15, 29].

![Figure 17: In the destination search option of Airbnb iOS app as soon as you type 'bar', all the top destinations around the world currently are listed. This significantly reduces the user to type anything more than 3 words improving the experience.](image-url)
6.3.14  **Sorting and Filtering in Search Result**

I will consider an app to be compliant with the guideline if sort and filter features are provided along with the search bar.

**Reason:**

Acquiring information through apps have been easier than ever before. In response to the trend, searching for specific content in an entire data set of an app has also become rather simple. Depending on the user need, their need to be given provision to use either of the two i.e. sort and filter to reach the desired information. Therefore, providing the user with sorting options or filtering options that are relevant for the search enable them to select/deselect multiple options each time they apply to filter and get the desired result as quickly as possible [15].

![Figure 18: Once you type the desired product in the search box of In Amazon iOS app and there appears a list of content from which you want to filter again, the button towards the right lets you add more information to it filter and find the desired product rather than searching through the whole database one by one.](image-url)
6.3.15 Organize User-Friendly Menu Labels

I will consider an app to be compliant with the guideline if the menu labels align with the mental models of the app for easy user understanding.

Reason:

Not all features of an app can be shown on the homepage due to lack of space. This leads us to split features of the app into different pages linked by the menu. Users usually struggle to interpret and distinguish menu labels that do not align with their mental models for categories and what it means in the context. Menu labels should be clear and understandable with no overlap so that any user while reading the label understands where it’s going to lead them to. This is particularly important when a user turns to a menu as a last resort after exhausting options through search [15, 18].

Figure 19: Google Maps iOS app uses user understandable menu labels which on a single glance makes users understand to which feature each leads to. The name of each label is aligned with the mental model of Google maps.
6.3.16 Use Visual Keys With Text Labels

I will consider an app to be compliant with the guideline if visual keys (icon images) and text labels are provided together for easy interpretation.

**Reason:**

Images can be effective in enabling visual analysis because they are often rapidly processed by the human brain [30]. Visuals and iconography can be used with text labels for consistent and proper interpretation of the buttons used in the apps. Icon image of a menu, cart, account, or store locator as well as for actions like filtering or sorting when used alone are not universal and not well understood across apps. But when labels and icons are used together, the ability to easily understand what it signifies is enhanced thereby making it clearer and faster what action it does for the user [18].

Figure 20: In the Adobe Acrobat Reader iOS app, an icon along with the each of the menu labels are added. Images help to increase the chance of understanding the concept so that the user in a quick glance captures the meaning of the label.
6.3.17  Allow Users to “Go Back” Easily in One Step

I will consider an app to be compliant with the guideline if the user is allowed to go back to the previous screen easily on just one click (in the case of a mistake).

Reason:

Based on the analysis in the initial part of the study, humans are prone to make mistakes. It’s the same in mobile apps whereby users make mistakes which should be retraced to easily. While using apps, the users make mistakes and want to go back one step. Apps should grasp back functionality so that users don’t feel forced to have to start over from the home screen again, which in some cases might result in losing unsaved data. Allowing users to go back in one step eliminates the resentment and need for unnecessary looping through the app. The navigational controls which appear to be granular will be highly valuable for improving the user experience which in turn increases the conversion rate of the app [18].

Figure 21: In Snapchat iOS app, during the signup phase the user is prompted to give his/her name (left). The developer knows that there might be a chance that the user might input a wrong information and want to go back from the DOB screen (middle) so that a small arrow toward the back on the top left is added for going back and changing it (right).
6.3.18 Use Visual Feedback: Echoing Core Interaction

I will consider an app to be compliant with the guideline if a visual feedback is triggered by buttons and other interactive elements when a user performs a significant action.

Reason:

A good interaction design provides visual feedback to the user and notifies whenever a significant action has taken place. When a new user to the app doesn’t know what to expect from the app, providing the user with a visual feedback towards a significant action gives more clarity as to what action has occurred due to the trigger. Such visual echoing will make ideally mundane interactions more fun and captivates the attention of the user. E.g. When a user adds an item to a shopping cart or submit an order, lack of feedback can cause them to question if the action has been processed or not. Apps which provide an animation or any type of visuals eliminate the guesswork for the user [31].

Figure 22: While adding a product to the cart in Amazon iOS app, the app gives a feedback showing “Added to cart”. This eliminates the user’s doubt of if the product has been added or not.
6.3.19  Showing Visibility of System Status using Functional Animation

I will consider an app to be compliant with the guideline if the functional animation is used to show the completion status in a multi-step linear process.

Reason:

The functional animation is a subtle animation embedded in the UI design as a part of the functionality of that design [32]. Users want to know their current context while using an app at any given time and the apps shouldn’t make the user keep guessing. Appropriate visual feedbacks help users know what is happening. E.g. When a user is filling up a form, the percentage of completion is an important feedback the user expects. Delivering the status of completion using animation keeps the users in the loop. Letting users know the distance towards completion of the task or task progress increases the likeliness that the task gets completed.

Figure 23: In Duolingo iOS app when a class is taken to learn a new language, the top part of the app shows the "percentage completed" in the lesson under study.
6.3.20 Communicate Errors in Real Time

I will consider an app to be compliant with the guideline if the users are given clear information regarding the errors occurring (if any) in real time.

Reason:

Just like users, apps can also dysfunction (as it is designed by humans). Instead of not letting users know what happened in the case of an error or making the user wait until the end to notify the problem can be intimidating. In such cases, users might ponder over and waste time on what had caused the issue to come up in the first place which can be avoided if real-time error messages are given. E.g. Filling up a form, pressing the send button and finding out that there was an error the user committed takes the edge off from the app. Users dislike when they have gone through a series of steps only to find out at the end, that they have made an error. Providing error information in real time will help in reducing this pain point, especially in the case of filling up forms or providing details which involve more typing than usual [18].

![Image of Starbucks Rewards app with error message]

Figure 24: In Starbuck Android app while a new user has to type in the account password during signup, a real-time error message is given to let the user know if he/she has missed any of the password requirements.
6.3.21 Make Forms Short as Possible

I will consider an app to be compliant with the guideline if the user is only being asked contextual information which is highly needed for carrying out the tasks.

Reason:

As Nielsen-Norman describes, one of the most intimidating things on mobile phones is typing [17]. Virtual keyboard is hard, partly because the user needs to visually attend to the keyboard so that user can check what they typed has been correct or not. Even though haptic feedback can solve this issue to an extent, the process of attending the keyboard by touch and by vision is daunting. It will considerably be better that when forms are designed to make sure only the minimum information gathering should take place to avoid excessive typing [33].

Figure 25: Amazon app on sign-up asks only for the minimum user information including the name, contact number, email, and password. Certainly, to purchase a product, the bank account details are also needed, but for a sign-up process, they stick to the bare minimum information so as to initially hook up the user.
6.3.22 Match Keyboard with Required Text Input

I will consider an app to be compliant with the guideline if the input the user needs to provide and the keyboard which pops up is contextually matched.

Reason:

Typing with virtual keyboard takes more energy than on a physical keyboard. There might be circumstances when a large amount of information needs to be given as input to the application. In such cases, users appreciate apps that provide an appropriate keyboard for data entry depending on the context of use and the input field. Ensuring that this feature gets implemented consistently throughout the app makes entry of particular data type required by each of the input fields much easier and also improves the app usage experience [15, 33].

Figure 26: During sign-up in Snapchat app, the user is prompted to enter his/her data-of-birth. Providing with an adequate keyboard helps the user input the information quickly to the app.
6.3.23 In-App Help and Feedback

I will consider an app to be compliant with the guideline if a help and feedback section is made available and accessible at every stage of the app.

Reason:

Providing help and feedback section in an app makes sure that the user can go get some quick help or provide some feedback for product improvement in the case of emergency. Both first-time and long-time users might run into problems as to abnormal app behaviour or confusions as to what a feature of the app does. Help and feedback can to a certain limit provide assistance to issues that may arise. Both iOS and Android store use App Store Optimization algorithm to make sure the best app comes on top. If angry user fires of a bad review to the app store, this will affect the app rating. A feedback option in the app can avoid this situation and also tackle the issue, as it is better to fire an angry feedback to the customer care rather than to the app store [34, 35].

![Airbnb Help](image)

Figure 27: Designers at Airbnb know that at least some users will have doubts regarding the most common information. Instead of making users search all over the internet for the information, all the basic information a user needs to know is available in the help field and also provide a method to send emails directly to the Airbnb customer support team.
6.3.24 Show Chrome Only When Needed

I will consider an app to be compliant with the guideline if the Chrome in the app is shown only when needed.

Reason:

In a mobile app, Chrome often includes the status bar across the top of the screen and a tab bar with command icons at the bottom[17]. Sometimes there is also a navigation bar below the status bar which is also included in the chrome. Mobile phones don’t have the luxury of taking up a large amount of space on the screen to display content which makes it even more difficult than websites of tablet apps to design. Hiding parts of the chrome and revealing them when needed is the best way to make use of the available real estate in mobile apps. This technique also makes sure that more content and information is visible to the users.

What should we make of the huge difference in conversion rates between desktop computers and mobile phones? There are at least two different possible conclusions:

- The mobile user experience must be horrible. (This is in fact what we find in user testing.) Therefore there are fortunes to be made if companies would only design mobile-optimized sites that are easier to use for mobile users. After all, mobile sales could be 2.5 times greater if mobile sites were as easy to use as desktop sites.
- It's not worth investing in mobile design, because mobile users don't account for very

Figure 28: For improving the reading experience in Amazon Kindle app, the Chrome in the app can be hidden (left). To increase the size of the font, going back to home page and for accessing other app functions, just tapping on the page brings up the Chrome.
6.3.25 One-Thing-Per-Page Approach

I will consider an app to be compliant with the guideline if each complex process in an app is split into multiple smaller processes, and each of the small processes is presented on a screen of their own.

Reason:

As the number of tasks to be taken care of by a user increases on a page in the app, the cognitive load on the user also increases. The idea behind this approach is that when there is less stuff on the app screen to be taken care of, the cognitive friction is reduced and thereby users stay focused on the specific task. Reading through a peephole increases the cognitive load and this makes it harder to understand the text on a mobile as compared to a desktop. The more users have to remember, the worse. E.g. In an e-commerce app, instead of placing the address form and the delivery option on the same page, it will be better to put it on dedicated and separate pages [17, 36].

Figure 29: Dropbox is a powerful tool for storing text, photos, files, etc. on the cloud. On login, the home page only displays the recently added/changed files rather than showing all the features the app can perform.
6.3.26 One Thumb Test

I will consider an app to be compliant with the guideline if primary function(s) of the app is reachable within one hand thumb click.

Reason:

In the analysis conducted by Steven Hoober, he found that 75% of the people rely on their thumb for app navigation and using the app services and 49% rely on the one-hand grip to get things done on their phone [37]. It will enhance the experience of using an app if the core feature(s) an app provides will be inside the sweet spot region i.e. the region in which the thumb can reach comfortably in the app [38].

Figure 30: Thumb-zone mapping for left- and right-handed users. The “combined” zone shows the best possible placement areas for most users. Image credit: Smashing Magazine [39]
6.3.27 Skeleton Screen

I will consider an app to be compliant with the guideline if skeleton screens are used during page load progress.

Reason:

Users don't want to see the loading status of an app, but at times developers are forced to go for this option as the data to be download is very heavy. A skeleton screen is a blank version of a page into which information is gradually loaded [40]. Such an actions create a sense that things are happening immediately, but in fact, information is only displayed on the screen incrementally. This small technique can hook up users back into the app and provide them with an intrinsic sensation that the data is getting loaded immediately.

Figure 31: Facebook App using skeleton screen during page load which gives a sensation that the data is getting loaded instantaneously
6.3.28 4.5: 1 - Text Background Contrast Ratio

I will consider an app to be compliant with the guideline if the contrast ratio of text and the background is at least 4.5: 1.

*Reason:*

A text color that is too similar to the background color is hard to read. E.g. If the text and background color are the same color, the contrast ratio is 1:1 and for a black text on a white background is 21:1. In order for the text to be readable, the minimum contrast ratio is 4.5:1 even though 7:1 is the ideal combination [29]. Apple Human Interface guidelines and Google Material guidelines also recommend this ratio for optimal reading experience [41, 42].

![Medium iOS app uses a text background contrast ratio of 14.5: 1 (background is #ffffff and the text color is #292929)](image)
6.3.29 **Offline Capability**

I will consider an app to be compliant with the guideline if app feature(s) can be used even during offline state i.e. when the internet connection is unavailable.

*Reason:*

Even though the number of apps and technology is growing at a tremendous rate forward, the growth rate of speed in mobile internet connectivity has yet to pick up the pace. A lot developing countries around the world are yet to benefit from the fast internet connectivity and sometimes the quality of service when it comes to internet connectivity by the Internet Service Provider is below par [43, 44]. Even in developed countries, the mobile network at times can get unreliable. In such cases, providing with app features which can be accessed or used even if the network down helps if the user is in a geographical location where the network stand is below average.

![Facebook Offline Feature](image)

*Figure 33: One of the main functionality of Facebook is to post textual contents or images in the app. As shown in the above image, the connection to the internet is lost, but it still is possible to post text or image which will get uploaded to their server as soon as the connection is back.*
6.3.30 Cloze Test

I will consider an app to be compliant with the guideline if the cloze test is conducted against the textual contents in the app.

Reason:

It is much harder to understand the textual information when the user is reading through a peephole. Compared to web apps, mobile apps are a peephole for reading textual information. If the app being developed has a lot of data in the form of text and to make sure the user understands the textual contents in an intended way, a good way is to conduct Cloze Test on the textual data.

Cloze Test is an empirical comprehension test. It works as follows:

- Write down all the textual information used in the app on a paper.
- Replace every Nth word in the text with blanks. A typical test uses $N = 6$.
- Ask participants to read the modified text and fill the blanks with best guesses to the missing word where each person should work alone
- The score is the percentage of correctly guessed words.

If participants get 60% or more on an average, the text is reasonably comprehensible. If the average value is less than 60%, work on the textual content so that it is comprehensible for the users [17].
6.4 Traceability

For arriving at the 30 list of UX guidelines, we have used about 30 set of references. The table below maps each of the guidelines to the corresponding references being used. Cells denoted by ‘Yes’ conveys that the guideline is coming from the specified references.

E.g. Guideline #1 is developed from details collected through reference #15, 20 and 21.

Figure 34: Traceability map of references used for each of the 30 UX guidelines
7. Validation of Guidelines Against 24 Successful Apps

7.1 Selection of Test Bed Apps

In the previous section, we have found 30 set of guidelines which can be used for improving the user experience in mobile apps and thereby help increase the retention rate of the app. In order to make sure the findings are valid and is being used among the most used apps currently, we need to test the guidelines on them.

In order to test our findings (i.e. the User Experience Guidelines), we need to carefully select the most prominent mobile app in the market. We can’t necessarily test our findings on all popular and most downloaded apps, so we need to restrict the apps that we are going to use.

Selecting the apps we are testing is quite tricky, because:

- We can’t solely rely on all the major apps categories and take one or more apps from each category because there are 25 app categories in Apple App Store and 50 app categories in Google Play Store. Taking one or more apps from each demands a lot of time and also depends on which app store you are keeping as the base.

- We can’t just take the most popular/most downloaded/trending apps because:
  - it depends on which region you are accessing the app store from
  - if we select only the apps which top the list, we might be missing apps from not so commonly used app categories.

In order to select the apps needed for testing UX Guidelines, we are going to follow the series of steps mentioned below.

**Step 1: Find the most used mobile apps**

In the initial step, we are going to find the most used mobile apps based on the findings from Time, Statista, Business Insider, Cnet and TechCrunch in 2016 – 2017 [45, 46, 47, 48, 49]. We are also only taking apps that are freely available from the App Stores and we are excluding games from testing the research findings.
The v has been plotted in the following method:

- The first column consists of the app names, followed by Reference number of the online magazines (which have done a finding on the most used/downloaded apps) as specified in the reference [45, 46, 47, 48, 49], and the last column specifying the total of mentions the app has received from all the 5 reference magazines being used.
- If an app is mentioned in a magazine, a * is recorded in the corresponding column.
- At the end, sum up the total * that an app has attained.
- If the total * is more than 3 for an app, it will be selected for testing the UX Guidelines.

Based on the steps as mentioned above, the table below shows the result of the analysis.

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Table 1: Finding most used app based on analysis done by Time, Statista, Business Insider, Cnet and TechCrunch

Based on the results in the table, we have selected the apps which have got 3 or more *. The apps selected from the table above are:

1. Snapchat
2. Facebook Messenger
3. Instagram
4. Facebook
5. YouTube
6. Google Maps
7. Netflix
8. Spotify
9. Whatsapp

57
Step 2: Find the most used mobile app categories

Apple App Store contains 25 app categories while Google Play Store contains 50 app categories. In order to select the most used app categories, we are keeping the choice of categories as in Apple App Store as a base. From step 1, we have got 9 apps for testing which are only spread among 4 of the 25 app categories in Apple App Store. The reason why we are not selecting Google Play Store as a base is that:

- In Google Play Store, there are 50 app categories. The naming of the app categories are not accurate and it subsequently brings to making us test 50 apps on both Android and iOS.
- As we need to take one app from each category (preferably the most downloaded app), the Google stock apps like Google Play, Google Music, Google Translate, Google Maps takes up the top position in its respective app categories as they are automatically downloaded and installed in all the Android powered smartphones.

According to the study by Statista [50], the most popular app categories in Apple App Store based on shares of the available app are (in the descending order):

1. Games
2. Business
3. Education
4. Lifestyle
5. Entertainment
6. Utilities
7. Travel
8. Book
9. Health and Fitness
10. Food and Drink
11. Productivity
12. Music
13. Finance
14. Reference
15. Photo and Video
16. Sports
17. Social Networking
18. News
19. Medical
20. Shopping

The 9 apps mentioned in step 1 are from categories – Entertainment, Music, Photo and Video, Social Networking which is only 4 among the top 20 categories. So we need to select at least one top downloaded the app from each of the remaining 15 app categories. For this research we are not going to conduct tests on any games as
the guidelines are not optimized for games, so we are not going to take into consideration *Games* category.

**Step 3: Selecting 1 app from the remaining 15 app categories**

Apart from app categories like *Entertainment, Music, Photo and Video, Social Networking*; the app that tops the list of remaining 15 app categories as of April 2017 in Apple App Store are:

- Business – Adobe Acrobat Reader
- Education – Duolingo
- Lifestyle – Tinder
- Utilities – Google Search
- Travel – Uber
- Book – Kindle
- Health and Fitness – Calorie Counter & Diet Tracker by MyFitnessPal
- Food and Drink – Starbucks
- Productivity – Dropbox
- Finance – PayPal
- Reference – Google Translate
- Sports – ESPN
- News – CNN
- Medical – Epocrates Reference Tools for Healthcare Providers
- Shopping – Amazon

**Selected Apps:**

Based on the result from the processes we conducted, the apps we are going to use for testing the UX Guidelines are:

<table>
<thead>
<tr>
<th>#</th>
<th>App Name</th>
<th>App Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Snapchat</td>
<td>Photo &amp; Video</td>
</tr>
<tr>
<td>2</td>
<td>Facebook Messenger</td>
<td>Social Networking</td>
</tr>
<tr>
<td>3</td>
<td>Instagram</td>
<td>Photo &amp; Video</td>
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<td>App Name</td>
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<tr>
<td>5</td>
<td>YouTube</td>
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<td>6</td>
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<td>Whatsapp</td>
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<td>10</td>
<td>Adobe Acrobat Reader</td>
<td>Business</td>
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<td>Lifestyle</td>
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<td>16</td>
<td>Calorie Counter &amp; Diet Tracker by MyFitnessPal</td>
<td>Health &amp; Fitness</td>
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<td>17</td>
<td>Starbucks</td>
<td>Food &amp; Drink</td>
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<td>Google Translate</td>
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<td>ESPN</td>
<td>Sports</td>
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<td>Epocrates Reference Tools for Healthcare Providers</td>
<td>Medical</td>
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<td>24</td>
<td>Amazon</td>
<td>Shopping</td>
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</tbody>
</table>

Table 2: List of all mobile apps and the corresponding app categories selected for conducting tests
7.2 Conducting Validation of UX Guidelines on Test Bed Apps

The final section is testing the selected apps against the compiled guidelines. How well and often the compiled guidelines are used in the apps, finding if there is any correlation between the tips and techniques used in the guidelines is also noted during the testing. To carry out the testing, iPhone SE running on iOS and Motorola G4 running on Android were used with a 3G internet connection.

A table is created for each of the applications to conduct and note the test value. The general template for each entry is as follow:

<table>
<thead>
<tr>
<th>Guideline #</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
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</tbody>
</table>

If the application holds well with each of the guidelines, it is denoted as Y (YES), if not it is denoted as N (NO) and if the guideline can’t be applied in the scenario, it is denoted by NA (Not Applicable).

Figure 35: The image shows a cell in the testing table. The top part represents the guideline number, in this case, guideline 1. The bottom part is split into 2; left part denotes if the guideline holds well against the iOS application, right part denotes if the guideline holds well against the Android application.
**1. Snapchat**

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Snapchat is the number 1 app in our list. Of the 30 guidelines, it complied with 25 guidelines. The only thing it lacks is not providing a not providing multiple signup options and a non-signed journey. If sorting and filtering features are also included, it will increase the ease in searching content across the app.

**2. Facebook Messenger**

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Facebook messenger is the best peer to peer chatting app. A skeleton screen used during loading will increase the retention rate of the app. Adding a filtering feature along with the app helps in searching the content easily.

**3. Instagram**

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The best photo sharing app if add a non-signed in the journey for demonstrating the worth of using the app will be useful.
4. Facebook

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Facebook complies with the almost all of the guidelines, but if a non-signed up journey is possible for finding the use of the app can also be added, it will prove helpful for the user. Hiding the chrome can also improve user experience to view more content.

5. YouTube

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To navigate across the different features of the app, a navbar will be useful. Sorting and filtering of search content will help in getting to the video faster. Hiding the chrome will also help in viewing more content. An offline feature will be useful for places where people can save videos to be viewed later.

6. Google Maps

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Google maps are the best application for finding the way through the city, but hiding the Chrome can be helpful during navigation. Also, it is not possible to log out once automatically logged in.
7. Netflix

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A non-signed journey if provided to know the worth of using the app might help increase the customer base. During sign up or sign in, hiding and revealing the password will also be useful for reducing the errors.

8. Spotify

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A non-signed journey if provided for at least some time in the best music app will attract more users. A context tip to provide information about the different features for new users will be helpful. The option to access help or provide feedback can also be added in the app.

9. Whatsapp

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Whatsapp is the most used chat app in the world. An option to filter and sort the search values will be helpful for users. Real-time error messages are not communicated properly during app usage.
### 10. Adobe Acrobat Reader

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Sign up or sign in while using Adobe reader is difficult as the chance to make mistake while typing password is high. Allowing to reveal and hide password can help this issue to an extent. A visual feedback and system status message can be also provided to improve the user experience.

### 11. Duolingo

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Duolingo is a fantastic app for learning new languages, but the feature to search for a new language using the search box is highly difficult, and if included will help the users.

### 12. Tinder

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The best social matchmaking app if adding the feature of displaying a search field to search for a user will be useful.
13. Google Search

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Google Search is extremely easy, but adding visual keys to the navbar menu options, providing functional animation will be helpful for new users.

14. Uber

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Providing a non-signed journey in the ride sharing app, adding visual keys with the menu options will increase the user experience of the user.

15. Kindle

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A search field actively visible on the home screen would be useful for users as they don't have to go into the menu to search for a new book.
16. **Calorie Counter & Diet Tracker by MyFitnessPal**

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Providing a non-signed in a journey through the app helps in finding the app usage and the worth of using the app. A good transient navbar for iOS would be useful for easy navigation. The initial forms used to get the values were too long also and too many details were cramped up into a single page.

17. **Starbucks**

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The Starbucks app had a lot of features which were not designed with a good usability thought. All the features have been added to the home screen. Search bar was also absent in the app.

18. **Dropbox**

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Adding an option of filtering the content in the search bar helps in reaching to the required content fast, which at the moment is not present in the app.
## 19. PayPal

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PayPal doesn’t ask for any app permissions in the Android app. Data search indexing is not present. Visual keys are not available for the menu options and the system status is absent. Errors is also not shown in real time.

## 20. Google Translate

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Google translate doesn’t provide any context tips on first app load to show what are the features available in the app. For a first time user, this will be useful. Hiding the chrome also can help in improving the user satisfaction.

## 21. ESPN

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Reveal/hiding password during sign up helps in reducing the mistakes during the start of app usage itself. Adding a search option in the news app helps in reaching the content faster. No context tips are provided to notify what each of the features are as it is quite hard to figure out for a first time user what each of the different functions are.
CNN news app was pretty simple, but lacked in the visual feedback it was giving. No real time communication of errors was also provided.

The app was not designed properly even though extremely useful. It will better if the app adds a sign in option and provide some real time context tips for first-time users to notify what each of the different functions does. Usage of filter for search box will be helpful for users. An offline information access will also be good.

Hiding or revealing password during signup will be helpful for the users. Providing a small tip on where each of the features is and what each does will also increase user satisfaction. Providing a visual key with the text labels of the menu will be helpful for users.
8. Classified Set of Guidelines By App Category

In the previous phase, the 24 testbed apps were taken for analysis against the composed guidelines. All the guidelines were studied, picked carefully and are equally important, but each of them needs to be used depending on the context. The primary objective of the evaluation was to find which all guidelines contributed more towards the apps under trial and subsequently classifying guidelines by app category. Also, we have also found out:

- number of guidelines used in the top apps, average number of guidelines used
- if the apps under consideration followed any design pattern

The following are the set of guidelines classified by app category:

I. **Photo & Video, Social Networking, Entertainment, Music**

1. Make Application Load Fast
2. Persistent sign in
3. Reveal/Hide password during sign-up sign-in
4. App Permission
5. Logout/Delete from Application
6. Progressive Disclosure Technique
7. Just in time teaching technique
8. Transient Navbar
9. Hit size target
10. Prominently display search field
11. Effective data search indexing
12. organize user-friendly menu label
13. Use visual keys with text labels
14. Use visual feedback: echoing core interaction
15. Communicate errors in real time
16. Make forms as short as possible
17. Match keyboard with required text input
18. In-app help and feedback
19. One thing per page approach  
20. One thumb test  
21. Skelton screen  
22. Text background contrast ratio  
23. Offline capability  
24. Cloze Test  

II. **Business, Education, Lifestyle, Utilities, Travel, Book, Health & Fitness**  
1. Make Application Load Fast  
2. Provide a non-signed journey  
3. Fast and multiple signup options  
4. Persistent sign in  
5. App Permission  
6. Logout/Delete from Application  
7. Progressive Disclosure Technique  
8. Just in time teaching technique  
9. Transient Navbar  
10. Hit size target  
11. Prominently display search field  
12. Organize user-friendly menu label  
13. Use visual keys with text labels  
14. Allow users to go back in one step  
15. Use visual feedback: echoing core interaction  
16. Showing visibility of system status using functional animation  
17. Communicate errors in real time  
18. Make forms as short as possible  
19. Match keyboard with required text input  
20. One thing per page approach  
21. One thumb test  
22. Text background contrast ratio  

III. **Finance, Productivity, Shopping, Reference**  
1. Make Application Load Fast
2. Fast and multiple signup options
3. Persistent sign in
4. Reveal/Hide password during sign-up sign-in
5. App Permission
6. Logout/Delete from Application
7. Progressive Disclosure Technique
8. Transient Navbar
9. Hit size target
10. Prominently display search field
11. Effective data search indexing
12. Sorting and Filtering
13. Organize user-friendly menu label
14. Use visual keys with text labels
15. Allow users to go back in one step
16. Communicate errors in real time
17. Make forms as short as possible
18. Match keyboard with required text input
19. In-app help and feedback
20. One thing per page approach
21. One thumb test
22. Text background contrast ratio

IV. Sports, News, Medical

1. Make Application Load Fast
2. Provide a non-signed journey
3. Fast and multiple signup options
4. Persistent sign in
5. Logout/Delete from Application
6. Progressive Disclosure Technique
7. Transient Navbar
8. Hit size target
9. Organize user-friendly menu label
10. Use visual keys with text labels
11. Allow users to go back in one step
12. Make forms as short as possible
13. Match keyboard with required text input
14. In-app help and feedback
15. Show chrome only when needed
16. One thumb test
17. Text background contrast ratio

On an average, at least 22 guidelines were used by the testbed apps. For the top 10 apps in the list, 24 guidelines were in use on an average. Another interesting discovery noted among the top 15 apps in the list was that both iOS and Android development teams of those apps managed to design the app on both the platforms exactly similar both in terms of design and functionality. In our observation, this is an excellent technique so as to manage only just one design for the app in both the platform so that the extra energy can be used productively to improve the app functionality rather than app design.
9. Conclusions

9.1 Conclusions

The aim of the thesis was to find a set of mobile UX guidelines which can be easily followed by app developers and designers to improve the quality of mobile apps and enhance user satisfaction while using mobile apps and thereby improving app retention rate. The key element of the study was to conduct a study based on the findings from the industry experts in UX and based on the findings, conducting a survey among mobile app users to check which factors served as the root cause towards the decrease in user experience and involvement while using apps. The objectives were to compile a set of guidelines based on the tips, tricks, and techniques used in the mobile app industry and the big players in the market to solve the issues found during the initial analysis and survey.

The analysis and survey part of the initial study and the guideline compilation were closely related. The introductory investigation focused on going through the findings done by industry experts mainly Jakob Nielsen, Raluca Budiu and Ben Shneiderman and how their take was on usability, user interface, and user experience, what are the major factors contributing towards the decrease in user satisfaction and how it can be solved. Based on the investigation, a questionnaire was prepared and a survey was conducted among mobile app users to find the main cause of decreasing the satisfaction level in UX. The problems in mobile UX were related mainly to:

- Touchscreen typing
- Readability issues
- Lack clarity in information provided
- Lack of clarity in response
- Sign-up sign-in issues
- Inefficient search box
- Tiny click targets
- Navigation issues

In the guideline compilation part that followed a set of research findings conducted by industry experts were taken as the base for a study to solve the problem and 30 guidelines were built to address and solve the above-mentioned issues. A guideline
template was also constructed for easy understanding and interpretation of each of the guidelines being framed.

A set of testbed apps were taken based on the use and popularity among mobile app users and a test was conducted on the guidelines formulated. Based on the result of testing, a set of 18 guidelines were found to be extensively used in the testbed application. On an average at least 22 guidelines out of the 30 were being followed by the testbed apps. In the final section, the set of UX guidelines were classified and grouped based on the app categories.

These guidelines can be used by app development teams which have already rolled out a couple of version of their app by comparing the guidelines with their in-house app design and making required changes. Also, app development teams which are just getting started can also take the guidelines and see how it will fit with their product design in order to create mobile app which will be acceptable by users and will enhance their user experience.

9.2 Future Works

The work we have done lists the common set of problems in mobile UX based on analysis of industry experts and conducting surveys. Based on the result, a set of guidelines have been developed for improving UX in mobile apps and has been tested on mobile apps. For the future, we can extend the scope of the thesis by:

- Studying more clearly how the high-level heuristics we have taken in section 4.1 are linked to the 30 list of guidelines developed.
- Enforcing the set of guidelines on mobile apps and conducting analysis to note the progress in the retention rate in an application.
- Apply the guidelines to already existing apps and noting the before and after progress.
- Working with the designers and developers to find out how valuable and easy it is to apply the guidelines developed and obtaining a rating based on the easiness of usage.
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