

## Identifying and Categorizing User Tasks on Smartphones

Anwar Alhenshiri, Mohammed Abuzgia and Hoda Badesh

Department of Computer Science, Faculty of Information Technology, Misurata University  
alhenshiri, m\_abouzgia91, h.badesh@it.misuratau.edu.ly

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**Abstract:** The study presented in this paper is an attempt to develop a contemporary model that identifies and categorizes tasks performed by people on smartphones. The paper discusses a study in which activities performed on smartphones were collected, categorized, and classified into tasks. The requirements for developments in applications and services available on smartphones were highlighted as a result of the study. Further research would survey more users and modify the model further. The model created is useful for a particular environment under the current circumstances of phone available technologies.

**Keywords:** Smartphone, task, user, interaction, computer, study, behavior, human, factors.

### Introduction

The World Wide Web permits for performing a large number of activities such as browsing a web page, buying an item, submitting an email message, and the link. Any combination of activities meant for the same goal can be called a task. Paternò et al. (1997) defined tasks as "*activities that have to be performed to reach a goal*" and indicated that the goal is either to adjust the status of an application or to retrieve a particular information from an application (Ankita and Kumar, 2012).

Users on the web may use search engines to look for a piece of information or gather information to learn about something. They also share information on their blogs and communicate with each other using email and various social networks. The aforementioned activities form meaningful tasks. Several studies have investigated the activities performed on the web and identified meaningful tasks such as in the work of Broder (2002) and Thatche (2006).

Kellar et al. (2007) performed a field study to examine user activities on the

web using personal computers and classified web information tasks into: information seeking, information exchange, and information maintenance. According to the study, the tasks identified were: information gathering, fact finding, communications, performing transactions, and browsing. Those tasks were identified back in 2006 and using personal computers, an era where smartphones were not as popular as in today's world. Nowadays, smartphones are playing a vital role due to the ease of connectivity they support, the usability they provide, and the variety of applications and services they permit. Smartphones have changed the way users interact with their environment. They are no longer only for making phone calls and texting messages. They support the use of a wide range of tools and applications. For instance, one can access Twitter and other social networking sites using a smartphone. People also use smartphones tools in a wide range of web activities such as sending emails, selling or buying online, monitoring stocks and more.

Nonetheless, smartphones have significant differences from desktop computers. For example, due to their screen limitation, smartphones permit the use of smaller screen real-estate. Therefore, many features available in the web browser used on computers are not available on smartphones (Sellen et al., 2002, and Law et al., 2009). Even with their flexible mobility, they are limited in many ways. Smartphones may also be used for performing different tasks than those performed on computers. They also require the implementation of their own applications.

The use of smartphones to perform different tasks has increased over the years. According to a report by GSMA Intelligence Corporation (2016), it was shown that 84% of Libyans use smartphones among different areas and cities, approximately 5.3 million of the population. Moreover, a report by Hootsuite Agency (2019) indicated that 66% of the Internet users in Libya are mobile users. Of those, 66% use social networking media while 21% perform various transactions such as buying and selling online.

Research concerning modeling tasks performed by users on the web on smartphones is still in the crib. Very little, especially in Libya, has been done on identifying the kinds of tasks users perform on the web on smartphones. Having a framework in which tasks and subtasks in addition to the underlying activities users perform on the web on smartphones would lead to valuable recommendations regarding the design and implementation of mobile apps. Hence, the goal of the study described in this paper was to build a model that illustrates which tasks users perform on smartphones and what features they still need for supporting those tasks.

The remainder of the paper is constructed as follows. Section 2 explores some related work. The study methodology is explained in Section 3. The results of the study are presented in Section 4. They

are further discussed with future recommendations in Section 5. Section 6 concludes the paper.

### **Related Work**

Broder (2002) discussed the differences among informational, navigational, and transactional web tasks. The author conducted a survey for some people asking them to answer multi choice questions describing which task a user would perform of the following tasks: navigational, transactional or informational. Then, they created a log analysis of a random set of 1000 queries. The analysis showed that informational tasks gained the highest proportion of use with 48% leaving 30% for transactions and only 20% for navigational tasks.

With similar intentions to the work of Broder (2002), Kellar et al. (2007) conducted a field study to categorize the tasks of web users based on their goals. The study resulted in developing a classification of web information tasks based on three information goals: information seeking, information exchange, and information maintenance. Furthermore, Alhenshiri et al. (2012) continued the work on task categorization by investigating one type of those tasks, namely information gathering. The study resulted in a model in which the subtasks and activities comprising this sophisticated task were identified.

Thatche (2006) investigated strategies of how web users seek information and interact with the search engines to obtain the required information. The author conducted the experiment with 80 participants from different educational and occupational backgrounds. The participants engaged in two researcher-defined tasks and two participant-defined information-seeking tasks. The study was conducted by analyzing the participants' log files and conducting a structured interview. The tasks that were selected consisted of two directed fact-finding tasks and two general-purpose browsing tasks.

Dumais et al. (2014) developed a method for gathering user behavior on web browsers and the tasks they do. The authors investigated the methods used to gather users' activities within the browser. They identified the tasks in which users engaged as: find-simple, find-complex, explore/learn, locate/acquire, play, Meta, navigate and other. This study, as well as the ones discussed earlier, were meant for tasks performed on the desktop computers. Smartphones have had other considerations as discussed next.

Malinen and Ojala (2012) discussed the daily use of social media applications within smartphones. The authors conducted a survey on 30 people who use their smartphones frequently in social networking sites. The findings of the study showed that most of the activities were reading news and checking for the latest updates. In addition, there were more browsing activities than content creation. A personal computer was chosen to accomplish this job due to some usability issues within smartphones. Finally, the authors indicated that there was a lack of features for effective selection, storing and filtering of content found on certain websites.

Tossell et al. (2012) studied web browser usage in smartphones with 24 participants. The research was aimed at investigating the user behavior on different browsers within the iPhone. The findings showed that the average number of browsing sessions per day was 3.86% among all other sessions. They also found that 85% of the sessions on smartphones were for searching with Google being used most for those tasks.

Lin et al. (2013) investigated the usage patterns of the Internet on mobiles and PCs. A survey with 1875 participants took place in this study. A factor analysis was conducted to identify different dimensions of Internet activities for both mobile and PC. As a result, three dimensions emerged, namely: a task-based dimension, a recreation-based dimension,

and an information and communication-based dimension. The findings showed that mobile internet was essentially used for recreation purposes.

Shirazi et al. (2013) collected app and sensor data on random users from around the world. They categorized the most popular mobile apps in six types: media, social, mail, browser, messaging, and navigation. They showed that web browsers are rarely used on mobile phones. They also found that users kept switching back and forth between apps and the web browser. Hence, they suggested the need for smooth integration between the app and the mobile browser to improve usability.

Amin (2015) divided tasks used on phone browsers as either basic or advanced. They showed that information seeking was the most common task. Sending and receiving emails, reading news, using social networks, and opening links received through SMS (Short Messaging Service) or email have similar percentages of use.

In the above studies, the categorization of user tasks on the web while using personal computers have been thoroughly investigated. However, the rapid changes that continue to occur on the web necessitate continuous investigations for any further developments. On smartphones, the investigations were limited to certain features on the browser or app usages. In this study, the focus is on building a complete model using real data of everyday use of the smartphone for accomplishing different web-related tasks. The model would lead to meaningful and valuable design recommendations for different applications.

### **Methodology**

A user study for investigating tasks accomplished on smartphones was conducted. The study was intended to collect information about activities users perform on their smartphones in their own environment. Then, those activities

would be used for developing a model in which tasks are identified, their interactions are explained, and further design recommendations for future mobile applications are developed.

### **1. Study Design**

The design of the study was complete factorial and counterbalanced. A random sample of the population was drawn at random. Equal numbers of females and males were involved to avoid the effect of gender. There was no effect of order since users were asked to work normally on their phones in their own environment. A special application was installed on those phones which logged all events related to any applications they used. The information logged included the apps users used over the period of the study, the length of use for each app, and the use patterns of the web browser.

The user was asked to install the special logging application on their phones, continue using their phones in normal settings for two more weeks, and finally submit the data using the special application to the researcher. The data was collected from the phones and stored for further analysis.

### **2. Study Location and Population**

The study took place in the Faculty of Information Technology in Misurata University. The field settings required that every participant uses their phones in their own environment. All phones were Android-based. The population involved in the study consisted of university students. Sixteen participants took part in the study.

### **3. Study Data**

Participants in the study were asked to download the special application on their phones. The application was intended to collect the history of activities performed on all kinds of other apps on the phone during the period of two weeks. The special application sent this data to a server where it was collected by the researcher. The data was noisy and had to be preprocessed for further analysis. Second, the

data of the web browser was also intended to be collected. Google would collect the data on behalf of the researcher. That was done by asking every participant to leave a specific email connected to their browser in an open status. This way, the data would be collected by Google and stored on Google Drive. Since the researcher has access to those emails, they would be able to access the data.

Nonetheless, the second approach for collecting the data did not succeed. The reason was mainly the privacy of the participant. Participants did not feel comfortable around the idea of having them monitored all the time for the period of the study. As a result, this part was cancelled and the study ended with data collected from the special application installed on the participants' phones.

### **Results**

The study resulted in different types of data. However, the research discussed in this paper is concerned with only the data regarding the types of applications used and the time consumed using each application. The goal is to identify the different tasks performed by users of smartphones. The tasks identified for the new model are discussed as follows.

#### **1. Socializing**

The socializing tasks are the most widely performed during the study as shown in Table 1. The proportion of those tasks is approximately 82%. That may reflect the case in the actual population of smartphone users. Those phones are used everywhere and can easily be the main tool for connecting with family and friends. In addition, participants indicated that they use social networks for work-related groups and other groups with different purposes such as local news and events.

**Table 1** Socializing Activities: Time spent in Minutes

Application Name	Total Time (Minutes)
Facebook	9437
YouTube	3327
Messenger – Text and Video Chat for Free	876
Instagram	549
Viber Messenger - Messages, Group Chats & Calls	183
Messages	34
WeChat	12
Twitter	41
VK — live chatting & free calls	1
<b>Total</b>	<b>14460 / 17646= 82%</b>

## 2. Acquiring Services

This type of task involved activities such as using a calculator, setting up phone features, downloading an app on the phone, setting up an application, looking up an address on a map, and booking online. This kind of tasks is more of a self-service task for the participants themselves. As much as they are considered independent tasks such as tracking a flight, some can also be a part of another type of task. An example of the latter type is booking hotels online which can be a part of managing a whole trip.

This kind of task can actually either be a fact-finding task such as looking up a phone number or information gathering such as booking flights, or even a transaction task such as using a banking app for checking the balance of a bank account. Examples of those tasks are shown in Table 2. This type of task accounted for 14% of all tasks performed in the study.

**Table 2** Acquiring Service: Time Spent in Minutes

Application Name	Time (Minutes)
Samsung One UI Home	347
Nova Launcher	184
Onet	157
Samsung Calculator	65
Facebook Pages Manager	56
Telegram	52
Google	48
CallApp: Caller ID, Call Blocker & Call Recorder	18
Maps - Navigate & Explore	16
SHAREit - Transfer & Share	15
Opera browser with free VPN	12
Truecaller: Caller ID, block fraud & scam calls	11
Account Manager - Personal Ledger Book	11
BCD Digital Banking	7
Yemeksepeti - Order Food & Grocery Easily	6
MyLTT	3
Calculator	3
Mi Calculator	2
Booking.com: Hotels, Apartments & Accommodation	1
Photo Translator - translate pictures by camera	1
Libya Mobile Lookup	1
Flightradar24 Flight Tracker	1
Medium	1
Slow motion Video	1
<b>Total</b>	<b>1019 / 14460= 14%</b>

## 3. Gaming

Games are widely used on smartphones. Since most games are online, playing a game is a complicated task that requires special setup on smartphones. Even though smartphones have comparatively small screens, they seem to intrigue people to use them for gaming. The percentage of time spent on gaming among all other tasks counted for 14% as shown in Table 3.

**Table 3** Gaming Tasks: Time Spent in Minutes

Application Name	Total Time (Minutes)
Bubble Shooter	430
PUBG MOBILE - NEW MAP: LIVIK	318
Clash of Clans	172
My Talking Tom Friends	20
Battle of Super Saiyan Blue Goku Warrior	14
Cookie World -- Clash of Cookie & Colorful Puzzle	14
PS2 Emulator Games for Android: Platinum Edition	11
Galaxy Attack: Alien Shooter	9
Stickman Capitaine American Rope Hero Gangster	8
Stick Z: Super Dragon Fight	2
Cheat Code Playstation 2	1
Talking Tom Camp	1
<b>Total</b>	<b>1000/ 14460 = 14%</b>

#### 4. Browsing

Browsing is a major task performed on the web in the case of personal computers. However, users tend to do less browsing on phones due to the screen size limitations. The small screen necessitates further complications for browsing a large site such as the Amazon website. The user may have to scroll in all directions and spent much time looking for information on the interface itself that is not in their current view. Browsing was shown to represent only 0.03% of all tasks performed by users in the study. Examples of the browsing tasks in the study are shown in Table 4.

**Table 4** Browsing Activities: Time Spent

Application Name	Total Time (Minutes)
Google Chrome: Fast & Secure	397
Samsung Internet Browser	67
اخبار العالم ، عاجل - Nabd	6
365Scores - Live Scores & Soccer News	1
<b>Total</b>	<b>471/14460 = 0.03%</b>

#### 5. Entertaining

Another important task identified in the study was entertaining. Users used their phones for the purpose of listening to music, watching movies, and the like. This type of tasks can have connections with other tasks such as socializing and gaming. Though, they were separated from other types because the users considered those tasks to involve less interactions with other users such as in gaming. As shown in Table 5, this type of task represented only 0.92% of all tasks in the study.

**Table 5** Time Spent on Entertainment

Application Name	Total Time (Minutes)
TikTok - Make Your Day	191
Balti - Wala Lela - No Need Internet	34
Google Play Music	9
SoundCloud - Play Music, Audio & New Songs	7
Mi Music	5
وصفاتي الخاصة للطبخ مع رباح محمد	3
Download Mp3 Music	3
<b>Total</b>	<b>252 /14460 = 0.02%</b>

#### 6. Shopping and Finance

Even with the limited opportunities of finding a shipping and delivery method in Libya, there was still another way for buying goods online. The Open Sooq was widely used on smartphones for browsing available items for sale. This application is used online for displaying goods of all kinds just by about anyone. This tool was at least opened for viewing by many participants. The task of searching and browsing on the Open Sooq may have ended up with buying. Hence, the researcher considered those activities as parts of a shopping task since this task may take several activities of searching, socializing, calling, and messaging to end up buying certain items.

Other finance related activities that were considered in the study included

opening sites for currency exchange rates, pricing sites, and other banking applications. Activities of this type counted for only 0.01% of the time spent in the study. The results are shown in Table 6. There were no transacting activities recorded in the study.

**Table 6** Time Spent on Shopping and Finance

Application Name	Total Time (Minutes)
السوق المفتوح - OpenSooq	138
Essale	4
بكم	4
تطبيق مصرفي	1
Poivy Save on calling charges	1
<b>Total</b>	<b>148 /14460 = 0.01%</b>

## 7. Authoring and Editing

Editing documents online and using a smartphone is a part of a task called information collection or information gathering. However, since the intention of the user is unknown, the researcher considered calling the larger task authoring. This task involves certain applications such as editing and modifying documents using word processors, editing photos, creating and modifying sticky notes, and the like. There were 212 activities of this kind by participants in the study as shown in Table 7. They counter for 0.01% of all tasks.

## 8. Miscellaneous

The remaining tasks were hard to identify. They included using certain websites and webservice for very specific purposes. Those purposes depended exclusively on the individual who used such services. They are shown in Table

8. They counted for a very small proportion of all tasks in the study.

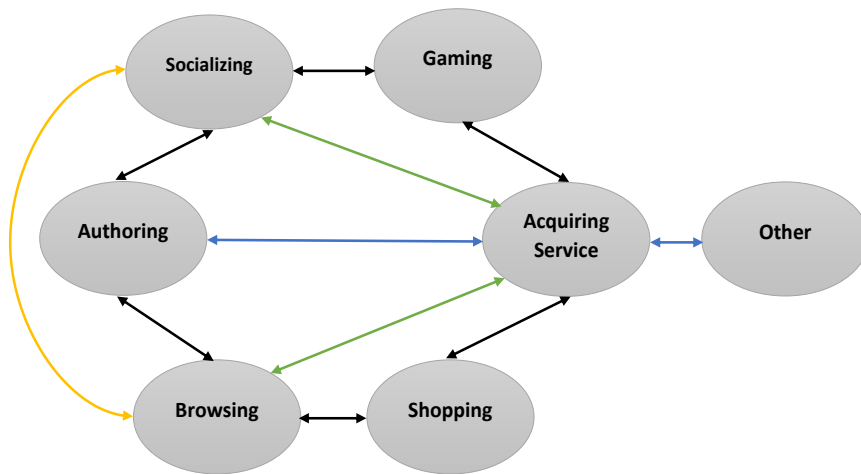
**Table 7** Authoring and Editing Times

Application Name	Total Time (Minutes)
Samsung Gallery	144
Google Photos	23
Gmail	22
Microsoft Word: Write, Edit & Share Docs on the Go	7
Microsoft Outlook: Organize Your Email & Calendar	7
Pixlr – Free Photo Editor	4
Samsung Notes	2
Microsoft Excel: View, Edit, & Create Spreadsheets	2
Adobe Acrobat Reader: PDF Viewer, Editor & Creator	1
<b>Total</b>	<b>212/14460=0.01%</b>

**Table 8** Time Spent on Other Tasks

Application Name	Total Time (Minutes)
Phone	101
المأذن - ليبيا	72
القران الكريم كامل بدون انترنت	10
VPN Free - Betternet Hotspot VPN & Private Browser	1
Sika Product Finder	1
<b>Total</b>	<b>84</b>

The results taken into account in this paper are those intended to be used for creating a task model. The model is meant for creating a framework that identifies tasks performed on smartphones by users in a certain environment. The model is shown in Figure 1. The model shows the tasks considered and any possible interactions among those models.



**Figure 1.** A Model for Tasks on Smartphone.

The connections between tasks mean that some activities are cross-listed or that the tasks may interact with each other to be completed. This interaction is a translation of the fact that activities from both tasks can be accomplished together or is built on top of the other. An example is the tasks of gaming and entertainment where a user could be playing a silent game while listening to music in the background. Another example could be authoring while entertaining. Furthermore, socializing about an item available for shopping means interacting while performing two tasks. Acquiring services is the task that may be needed at any time.

### Discussion

For the purpose of socializing, users mostly focus on Facebook, Twitter, Instagram, and YouTube. Users exchanged videos, information, news, and other links for different purposes. The current status of smartphone interfaces has weak support for complicated tasks that required interactions among those applications. User have to switch between applications to perform a particular socializing task. For instance, users may have to open links in YouTube, copy them, and

post them on their Facebook pages. Moreover, current status shows that support is required for integrating socializing with other tasks such as browsing and gaming.

Even though smartphones had small screens, gaming is a major task on those phones. Users play games for entertainment and for the purpose of competition since most of those games are online. The kind of support needed for gaming on phones is mostly HCI (Human-Computer Interaction)-related because of the size of the screen and the effect of the surround sound. That kind of support would require investigating ways to utilize the limited real-estate of the screen to offer better views or even multiple views of apps needed by two or more communicating tasks. Since gaming may involve activities from other tasks such as socializing and browsing, the support required is for conducting multiple tasks simultaneously.

Acquiring service is a very important task. Its activities are needed while performing other tasks. An example is a user may need to socialize with friends while buying items online. Supporting this task may involve investigating ways to allow



for performing more than one task simultaneously. Most shopping sites allow interacting with other users in the form of reading previous reviews. However, interactive socializing may also be considered especially with active customers at the time of purchase.

Browsing, a frequent task on today's computers, had less consideration by users of smartphones in the study. The few browsing tasks indicate that viewing websites on the phone may have needed more design support. Since most websites are designed so that the user can see most of the page all at once, the small screen of the phone makes browsing a burdensome. The support required for this task on phones necessitates further research that may eventually lead to better browser designs. When other tasks are performed simultaneously with browsing, smartphones are very useless because of the difficulties associated with the screen size and switching among applications.

To support entertaining, smartphones should have the ability to run multiple applications at the same time. For example, the Android system should allow the user to listen to music on YouTube while working on a word document. This is actually related to the design of the operating system and its restrictions. The current status requires that one application can be active at a time. The remaining apps can work only in the background. Entertaining is a task that may involve other tasks and support is needed for simultaneous running of applications.

Shopping and finance activities are of less interest to smartphone users in the testing environment. The reasons are many, among which is the unavailability of payments methods online. That created an atmosphere that does not encourage customers to move toward online shopping. To support the use of smartphones for shopping, payment methods should be provided. Users of

smartphones may have security issues which should be improved as well.

Authoring is a task that implies editing and modification to one or more documents at the same time. That implies the use of multiple applications simultaneously. Switching between applications requires the user to lose context sometimes. For example, a user editing a word document may need to reach the web through the browser to look for a source of information. Authoring is connected with other tasks as indicated in the model.

Support for authoring is necessary for better performance and more effective completion of tasks on smartphones. That could be done by allowing the user to have multiple features in phone-based web browsers such as editing. It could also be done by modifying the editing tools themselves to allow within-context web access. Other possible improvements can be investigated as well.

### Conclusion

The current status of smartphones has little support for the framework of tasks identified and their interactions. The focus of future research should be on the following:

- Design for multiple simultaneous tasks.
- Permitting users to have access to services during the accomplishment of other tasks.
- Providing more support for browsing while conducting other tasks.
- Integrating socializing with shopping to provide better user experience.
- Supporting gaming by allowing shifting to socializing, browsing, and acquiring services without losing the context.
- Working around the privacy issue associated with similar studies to have more data at hand and end up with possibly more accurate results.

The current model is primitive yet a provider of good indications for further development. Future work may continue enhancing the current model or proceed with further development of different apps to satisfy the user needs on smartphones.

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**تعريف و تصنيف المهام لمستخدمى الهواتف الذكية**

أنور الهنشيرى، محمد أبوزقية و هدى بادش

قسم علوم الحاسوب، كلية تقنية المعلومات - جامعة مصراتة

alhenshiri, m\_abouzgia91, h.badesh@it.misuratau.edu.ly

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**الملخص:** إن الدراسة المقدمة في هذه الورقة هي محاولة للوصول إلى نموذج حديث ومواكب للتطور التكنولوجي في مجال التفاعل بين الإنسان وواجهات الهواتف الذكية، هذا النموذج يعرف ويصنف المهام التي يقوم بها مستخدمو الهواتف الذكية، كم تعرض الورقة دراسة ثم فيها تجميع ومقاربة وتصنيف النشاطات التي يؤديها مستخدمو الهواتف الذكية بشكل يومي وتم وضعها في هيئة مهام ذات تعريف واضح وهدف محدد لكل مهمة. كما تم في هذه الدراسة تسليط الضوء على متطلبات تطوير التطبيقات الخاصة بالهواتف الذكية، والجدير بالذكر أن البحوث المستقبلية في هذا المجال يمكن فيها استخدام بيانات من أعداد أكبر من المستخدمين وإجراء التعديلات المطلوبة على النموذج المقدم، كم أن النموذج الحالي تم تصميمه وفقا للمستخدمين الحاليين والتقنيات والبيئة الحالية للهواتف الذكية.

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**الكلمات المفتاحية:** الهواتف الذكية، تطوير التطبيقات و التقنيات و البيئة