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# Release Your App on Sunday Eve: Finding the Best Time to Deploy Apps

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**Abstract**

Mobile application stores such as Apple's App Store and Google's Android Market enable researchers to use App Stores as a platform for user studies. Because successful studies can require a large number of users researchers might need to attract a large audience. The right timing when releasing or updating apps can considerably increase the number of installations. Using a game that is published in the Android Market we analyze when people install games. Furthermore, we determine when developers deploy games in the Android Market. We combine data from 157,438 installations of the game and the observation of 24,647 published apps. Our results suggest that the best time to deploy a game in the Android Market is on Sunday evening GMT.

**Keywords**

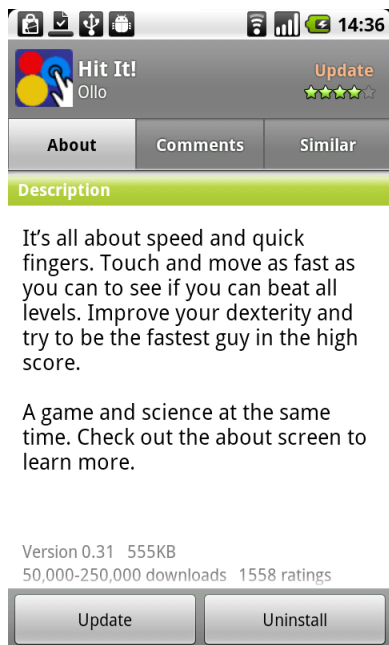
App Store, study, field study, in the wild, mobile application store, apparatus, Android Market

**ACM Classification Keywords**

K.1 [Computing Milieux]: The Computer Industry - Markets, J.7 [Computer Applications]: Computers in Other Systems - Consumer products

**General Terms**

Human Factors, Experimentation



**figure 2:** The description of Hit It! in the Android Market.

## Introduction

Mobile application stores such as Apple's App Store and Google's Android Market radically altered the distribution of applications for mobile devices. It opened the market for small companies and engaged hobbyists. Mobile application stores – for the first time – enable virtually any developer to reach hundred thousands of mobile users. Recently researchers also discovered this opportunity and began to publish prototypes via mobile application stores. It has been argued that the *"easy access to such a potentially wide audience could radically alter the nature of many UbiComp trials"* [1]. E.g. researchers distributed an app to collect qualitative feedback [2] or conducted a controlled experiment using a casual game [4]. It became crucial for some researchers – as for any mobile application developer – that their apps get installed often.

When publishing an app to the Android Market or updating an app, it appears in a list of the most recent apps. Users can browse this list in addition to searching for apps or browsing popular apps. Submitting a new app can result in some thousand initial installations even if only a few users install it in subsequent weeks. In order to maximize the number of initial installations we assume that it is important to submit an app when most potential users are active but the fewest number of apps get deployed by other developers.

Understanding what users do with their mobile phones has been studied over the last decade. As the market for mobile devices radically changed over the last years we consider early work as mostly outdated. Recent studies (e.g. [5, 6]) provided detailed insights but the scope is limited to a small geographic area. By using an app as an apparatus that get installed by thousands of

users the scope could be enlarged beyond a small number of users that share a similar background and originate from the same location.

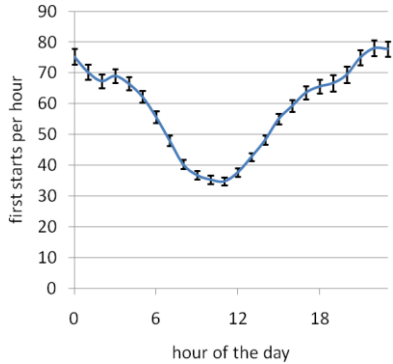
In this paper we use a game that we published in the Android Market as the apparatus to investigate when people install casual games. We also investigate when apps are submitted to the Android Market. Combining both sources of information enables to estimate the best time to publish or update apps.

## When do they play?

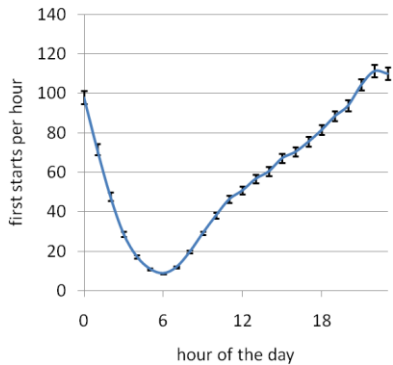
In the following we investigate at which time most people are active using the simple casual game "Hit It!" that we mainly developed to collect information about the users' touch behavior (see [8] for more details).

### *The Apparatus: Hit It!*

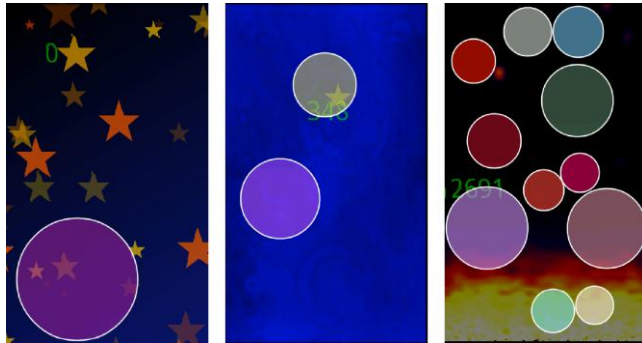
The game play of Hit It! is inspired by the controlled task used by Park et al. [7]. Circles are displayed on the screen (see Figure 1) and the player has to touch these targets. During a level different constellations of circles need to be touched. If a target has not successfully been hit in a certain time frame it is counted as a miss. We tried to make the game visually appealing in order to motivate intensive usage. We integrated different animated backgrounds and a star highlights the score a player received when a target is successfully hit. The total score is also shown in the background and continuously moves across the screen. Furthermore a player receives a "badge" when successfully completing a level. To increase the long term motivation we also implemented a global and a local high. A modal popup, shown when the game is started for the first time, tells the player that data is collected for research purpose while the game is played.



**figure 5:** The hour of the day the game has been started for the first time relative to GMT. The first hour is at midnight GMT. Error bars show standard error.



**figure 6:** The hour of the day the game has been started for the first time. The first hour is at midnight local time. Error bars show standard error.



**figure 1:** Three in-game screenshots of the game Hit It!.

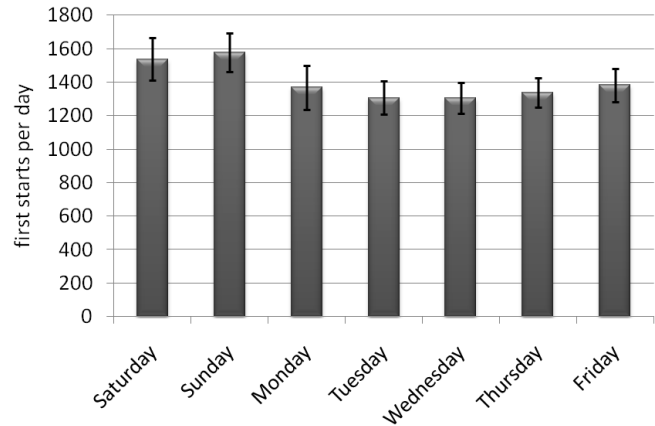
Data about the used device and the performance of the players is collected by transmitted the data to our server. We only transmit data after the users confirmed the initial modal dialog. A unique identifier for each installation is derived by hashing the device's "Android ID". Furthermore, we collect the user's locale (e.g. "en\_GB"), the device's type (e.g. "GT-I9000" for the Samsung Galaxy S), and the time zone. Most importantly for this paper we log the time when the game is played and started for the first time.

*Published in the market*

We first published Hit It! in the Android Market on October 31, 2010. Figure 2 shows the description of the game in the Android Market. Until April 8, 2011 the game was installed 195,988 times according to the Android Developer Console. The first version that records the time the game is played and started was published as an update on December 18, 2010. We received data about the starting times from 164,161 installations but only use the data received after the 20<sup>th</sup> of December from 157,438 installations.

*Distribution over the week*

For each day of the week we computed how many installations were started for the first time using the data from the 157,438 installations. Figure 3 shows the average number of installations for each day using the data from 15.5 weeks. The large standard error mainly results from long-term effects. E.g. we counted 17,066 first starts in the first week we consider but counted only 6,495 in the 10<sup>th</sup> week.



**figure 3:** Number of installations that have been started for the first time (GMT). Error bars show standard error.

*Distribution over the day*

We further looked at the time of the day the game is started for the first time. Therefore, we determined the average for the 24 hours of the day over the 108 days in the dataset. Figure 5 shows the results relative to GMT and Figure 6 relative to the installations' local time. The peak of activity is between 23 and 24 o'clock GMT. The peak of activity for the installations' local time is similarly also around 23 o'clock.

*Discussion*

Looking just at the data collected from the players we see that the game gets most often started for the first time on Saturdays and Sundays. The most active hours of the day are around shortly before midnight GMT. Surprisingly the results for GMT show the same tendency as the results relative to the installations' local time. We assume that players from Far East (e.g. Japan) partially cancel out the players from the US.

The relevance of the results is limited because we only consider a single game. Nonetheless the results are based on 157,438 installations and we assume that other casual games would show similar profiles. Furthermore, we do not measure when the game is installed but instead when the game is started for the first time. We, however, also assume that the first start of the game strongly correlates with the time it is installed.

**When get apps published?**

Knowing when games are installed can be important when submitting an app to the Android Market. In order to find the best point in time to submit a game it is, however, also important to know when developers submit new games or update existing ones. Therefore, we implemented a script that monitors new and updated apps in the Android Market.

*Monitoring the Android Market*

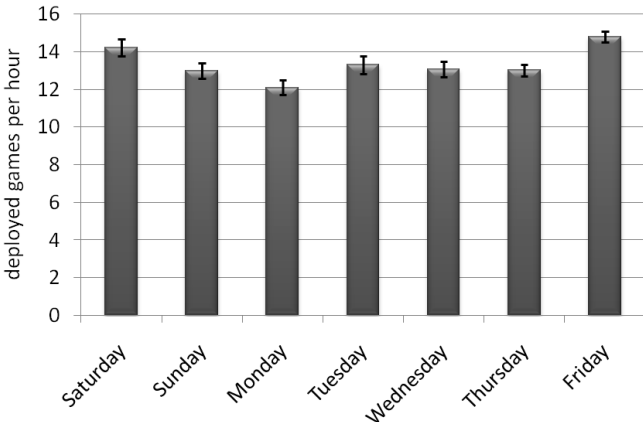
We implemented the monitoring script using the android-market-api<sup>1</sup> an open-source API for the Android Market. The script retrieves the 10 newest or updated apps

<sup>1</sup> android-market-api: <http://code.google.com/p/android-market-api/>

from one category of the Android Market once per minute. We run the script for each of the eight categories for games in parallel. We started the scripts on March 11, 2011. Until Jun 9, 2011 the script recorded 24,647 newly installed or updates games. As the script needs to provide a locale and an Android version, just as a real Android device would use to access the Market, we did not recorded all deployed apps. The locale en\_US and the Android version 2.1 are used because we expect that this combination is one of the most common ones. Due to different reasons the script did not return results for the complete period and we only recorded reliable data for 86% of the time period.

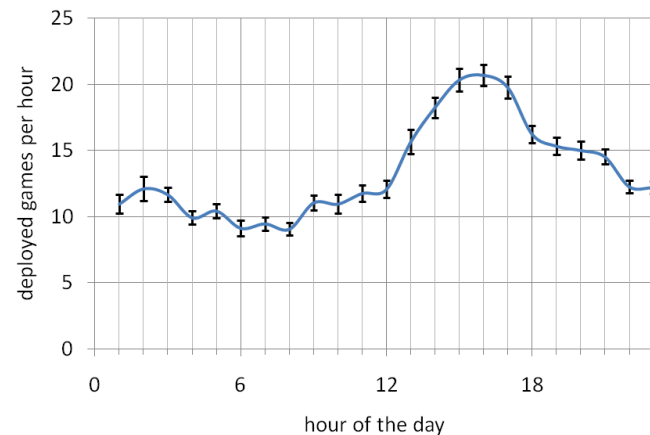
*Point in time games get deployed*

To determine when games get published we took the average over the eight categories and the twelve weeks we monitored the Market. Figure 7 shows the average number of deployed games per day.



**figure 7:** Number of games published in the Android Market per day (GMT). Error bars show standard error.

We also looked at the time of the day games get installed in more detail. Figure 8 shows the average over one day. The peak is at 16 o'clock GMT. At this time more than twice the number of games get published than at less populated times. Less frequented hours are between 23 o'clock in the evening (GMT) and 8 o'clock in the morning (GMT).



**figure 8:** Number of games published per hour in the Android Market over the day (GMT). Error bars show standard error.

#### *Discussion*

Our results suggest that the most popular days to submit games are Friday and Saturday while the least popular days are Sunday and Monday. Furthermore, we learned that most games get deployed between 13 o'clock and 18 o'clock while less active hours are between 23 o'clock and 8 o'clock (all GMT).

We were surprised that almost the same amounts of games get deployed at the weekend as at weekdays. The data still suggest that the best time to submit a game is at Sunday evening (GMT) because at this time

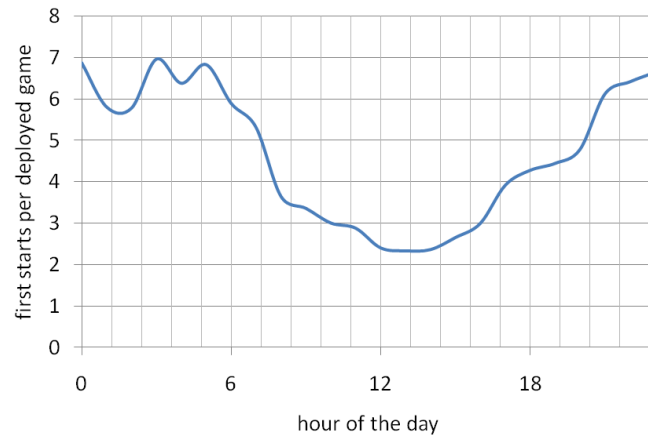
and on the following Monday the fewest number of games get deployed.

The results of the study are limited because we collected the data for only 86% of the twelve weeks. Furthermore, we accessed the Android Market using an US locale and could not record games that are not available to users from the US. As the US is currently the most important market for Android apps we consider this as only a minor limitation.

#### **Conclusions and Future Work**

We analyzed when people play casual games using a game as an apparatus. Based on 157,438 installations we found that the most active hours are around late Sunday evening (GMT). By monitoring the Android Market we found that fewer games get deployed around Sunday evening than at other hours.

We combined both analyses by dividing the number of started games by the number of deployed apps. The average over the day is shown in Figure 8. The peak is between 23 o'clock and 5 o'clock. Three times more games per deployed game get started at this time compared to 13 o'clock. Taking also the day of the week into account it might be expected to get 4 times more installations from being listed as a most recent app when deploying a game on Sunday evening compared to Tuesday noon (all GMT). As the absolute number of players is higher in the evening than in the morning we conclude that the best time to deploy a game in the Android Market is on Sunday evening GMT.



**figure 8:** Number of installations that have been started for the first time divided by the number of games published in the Android Market over the day (GMT).

While we monitored all game categories over twelve weeks we only looked at the usage data of a single game. Future work should therefore not only extend the monitoring of the Android Market but also look at the usage profile of other games and applications. Furthermore, approaches that monitor the installation of all apps on the users' devices, such as AppAware [3], could provide more data about the time apps get installed.

Augmenting our results with other sources of mobile device usage could also provide a better picture about what users do with their mobile phones. Our group, for example, has currently around ten different active apps that serve as an apparatus in the Android Market. Examples are a navigation system [9], a live wallpaper, different games (e.g. [4, 8]), and a widget (see [10] for an overview). Combining the usage data of all these

apps could already provide interesting insights about mobile device usage in general.

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