Apple's 3D Touch Technology and its Impact on User Experience

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November 21, 2016

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Abstract

Approximately 2 years ago, Apple Inc. introduce the first of its lineup of devices to include 3D Touch, the iPhone 6S. This touchscreen technology is responsive to the amount of pressure that users apply on the screen, and thus developers can use it to add contextual functions to the present-on-screen software. This study presents three different experiments that test 3D Touch as: (a) a input device to accurately set a parameter, (b) a less disruptive way to interact with notifications and (c) an alternative error recovery mechanism. The experimentation phase will require implementing an iOS application to use as the base interface to test the effectiveness of 3D Touch. This project has received funding from the Student Research Grant committed at Union College that will allow for testing on human subjects.

1 Introduction

On September 25, 2015 Apple Inc. released the latest version of its flagship smartphone. This improved device, the iPhone 6S, implemented the company's newest touchscreen technology: 3D Touch. This technology allows users to interact with an iPhone application based on how hard they press the display. From a user experience standpoint, the introduction of 3D Touch is revolutionary. Software developers working on the iOS platform can now make use of this technology to create applications and games that are responsive to how deeply users press the display. For instance, a user can now press on items within an app's view to see previews of additional content. 3D Touch is ideal for creative applications. For example, Autodesk improved Sketchbook–a digital painting mobile application–so it includes pressure-sensitive brushstrokes on 3D Touch devices. Apple's first-generation iPhone brought multi-touch screen technology to the consumer market, and revolutionized consumer expectations in terms of user interface for hand-held devices [2]. The goal of this research project is to develop an iOS application with 3D Touch capabilities in order to establish whether it has a positive impact on user experience. This project aims to evaluate the effect of 3D touch on a mobile application by comparing its performance to that of a traditional multi-touch interface. This entails the implementation of two versions: (a) one that uses 3D Touch to improve the user experience, and (b) one that runs on older devices and aims to simulate the experience without pressure sensitivity. This report covers the design section of this project. It present three different scenarios which may show that 3D Touch increases user performance. These experiments single out 3D Touch in such a way that users are forced to use it to complete each of the designated tasks. Further, each task provides a clear metric which will be use to quantify user performance, not preference in regards to either multi-touch or 3D touch interfaces.

2 Design Requirements

The objective of this project is to analyze the impact of 3D Touch on the user experience of iOS devices. Indeed, this project requires a 3D Touch enabled device. In this case, an iPhone 6s will be used as the testing device. Further, assessing the performance of 3D touch involves an interface that has been designed with the aim of testing particular features of 3D Touch. This study will test the following: (a) an assessment of 3D-Touch's accuracy, (b) 3D Touch notifications and cognitive overhead, and (c) 3D Touch as an error recovery mechanism. The following section provides a breakdown of how each experiment will be conducted and what metrics will be obtained. The interface implemented for testing these features will be a part of a larger application for assessing the accuracy and cognitive overhead and as an standalone game-like application for error recovery. Splitting the experiments into these two categories increases the external validity of this study, since the users will be interacting with an interface that's not too different to that of a regular application. The implemented application will be a meal-tracking application. A user may use this application to track recent meals along with a location and rating. The 3D Touch features implemented within this application can be seen in Figures 1 and 4.

Part of the data collection section of this project will be done within the data layer of the application; i.e. user events will be recorded with a time component in order to measure the time between different events. Nonetheless, the experiments will be conducted in the CROCHET lab, which is properly equipped for such experiments. There will be around 25-30 test subjects, and thus it is important to film their interactions to be able to carefully analyze user performance. An additional way in which data can be collected is by releasing the application publicly; however, the only metrics available will be time between events and there will be no recording of the interaction.

3 Design

3.1 Assessment of 3D-Touch's Accuracy

Previous work has determined that Fitt's Law does not apply to three-dimensional interfaces. Ramos et al. showed that appropriate visual feedback was a critical factor of user performance. They published a study in 2004 investigating the human ability to use pressure-sensitive styluses to perform discrete target acquisition tasks. Their findings show that users were not able to effectively perform pressure selection without visual feedback unless they had received at least an hour of training [3]. These findings regarding 3D interfaces establish that assessing the performance in terms of accuracy of 3D-Touch entails providing the user with visual feedback—the rating bar on the left of each view in Figure 1 will serve such purpose.

Figure 1 depicts the design of a 3D-Touch enabled rating system that addresses the user necessity for constant visual feedback and has a non-pressure enabled alternative (shown in Figure 2). In order to test the accuracy of 3D Touch users will be given the task of creating a new rating for a given meal:

1. User begins on the "Meal Details" view, which contains information about a previously had meal.

2. In order to add a rating to the selected meal, the user needs to apply pressure over the button labeled "3D."

3. As the user applies pressure, the rating begins to fill up.

4. Upon user release, the rating is fixed to the last position that the bar had reached. This number is shown as a percentage.

The non 3D-Touch version of this application (shown in Figure 2) operates in the same fashion, but the user needs to swipe up from the bottom of the rating bar until it reaches the desired rating. In both cases, when the user releases from the screen, a percentage rating proportional to the filled out version of the bar appears. As a testing mechanism, the user of each interface will be given the task of accurately approximating the proportional rating to a given percentage value; i.e. the user needs to apply pressure or swipe up such that the bar fills up in proportion to a specified percentage. We will compare the result of each approximation as well as the time taken for each rating in order to establish which of the two interfaces performs more accurately.

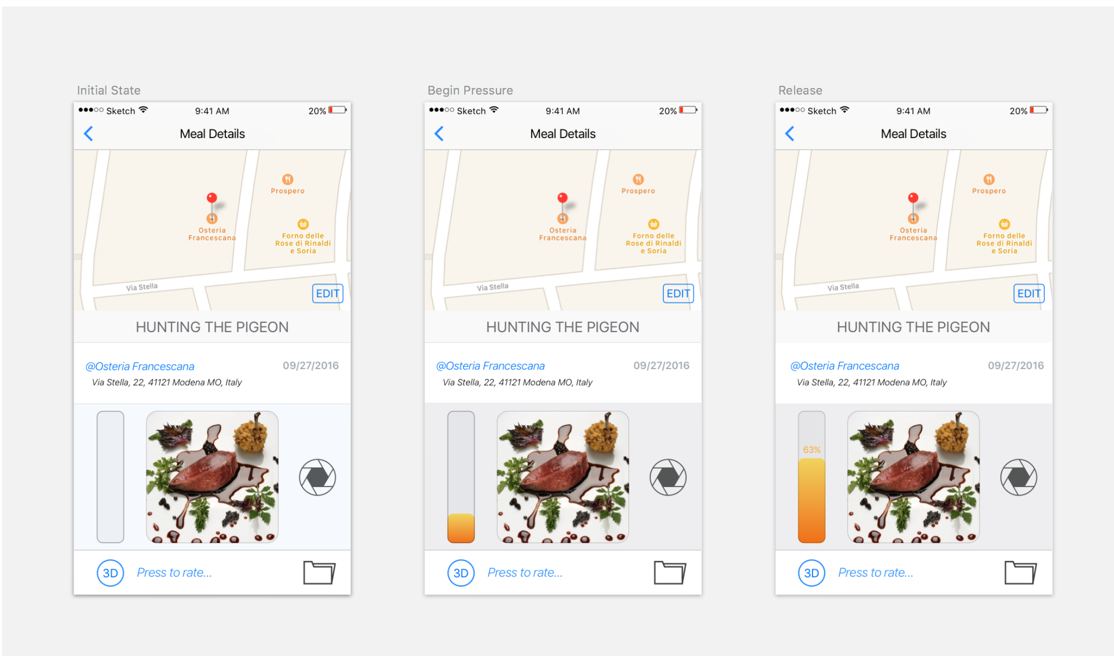

Figure 1: 3D Rating

The 3D touch version of this interface needs to ensure that the user understands that the rating will only be set upon “Quick Release” from the screen, this leads to the hypothesis that users may apply the largest amount of pressure possible, release in order to achieve the desired value and “Quick Release” in order to set the rating. A similar interference issue which could arise from the non-3D Touch version of the interface is that a user’s finger is likely to overlap with the top-most part of the rating, which may lead a user to misjudge rating value. Nevertheless, accuracy and time data is likely to allows to single out which it the most effective implementation of the same interface in terms of accuracy when setting parameters.

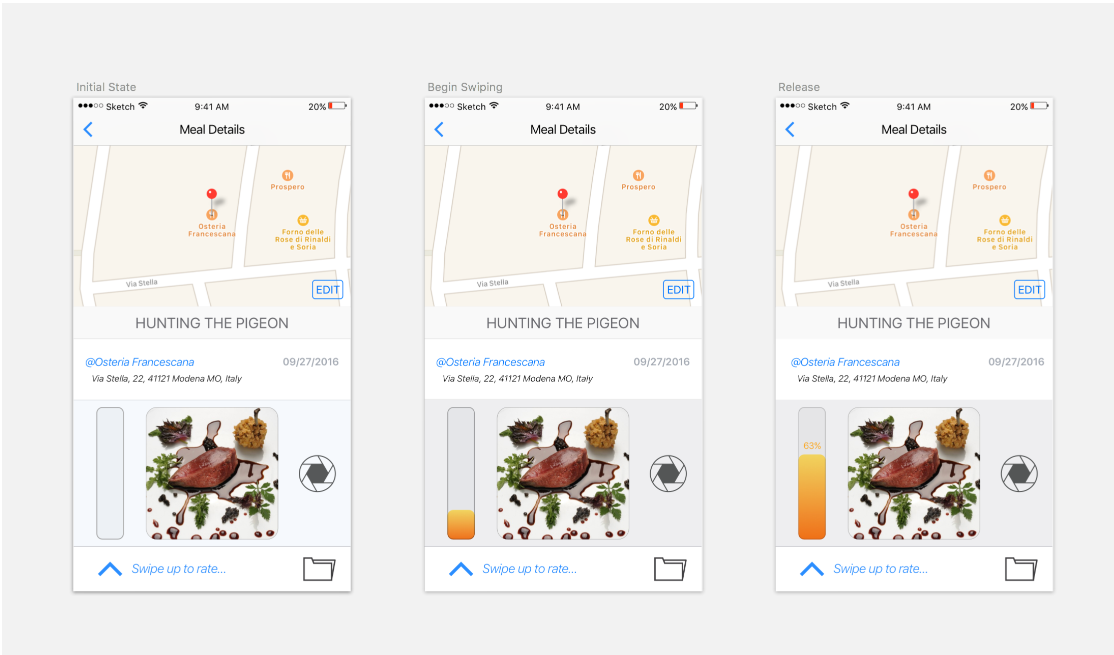

Figure 2: Swipe-based rating system.

3.2 3D-Touch Interactions and Cognitive Overhead

iOS 10's new notification systems allows developers to extend what a notification is in complex ways. For instance, a user no longer needs to open the iMessage application when he or she receives a text message. With this new system, a user can simply apply pressure over the notification until a complete view of the notification along with a keyboard appears. Note that this interaction is not based on a screen tap, but on the user applying pressure over the notification pop-up until the device's haptic feedback mechanism confirms that the current view has been locked (see Figure 3). 3D Touch adds an invisible layer to the interface that can be accessed by applying pressure on the screen. This feature, in combination with the new notification environment provides a more streamlined access to the content (not the features or tasks) of an application. Further, the ability to 3D Touch a notification in order to reach a pop-up allows the user to take action on a notification without having to open the application that received it. In a sense, 3D Touch provides users with the ability to easily go back to what they were doing without breaking the flow of their previous task.

Additionally, 3D touch can be compared to the "control" button on a Mac computer. 3D Touch lets you peek a little deeper inside applications and find out something interesting–rather than just clicking on them to get a menu. This idea is important given the that the nature of mobile applications is more about consuming content than performing tasks. This idea of "consuming content" is fitting for 3D touch—it allows the user to take care of whatever content needs their immediate attention without leaving their current screen. It is important to emphasize that consuming content refers to the ability to scroll through all the messages from a previous conversation while still on the 3D Touch enabled notification environment, and thus being able to return to the previous application without having to navigate.

Figure 3: iMessage notification "locked."

The objective of this section is to test whether 3D Touch allows for a less disruptive notification system. Cognitive overhead is defined as how many logical connections or jumps you brain needs to understand or contextualized the present-on-screen software [1]. This experimental section will require the user to be engaged in a not-so-trivial task when a notification will overlay over the current screen. The user will be instructed to deal with the notification and perform a recall task. The steps for this task are the following:

1. User is engaged in filling out a registration form—a task that will not be unfamiliar to most users.
2. A notification appears on the top of the screen, and the user to applies pressure over until a pop-up view of the extended version of the notification notification "locks" screen.
3. User can consume the notification information from the pop-up; i.e. read the meal details Further, the user can interact with the pop-up and "Like" the meal.
4. User is able to return to the previous screen by pressing on the blurred areas surrounding the notification.

The task above (shown in Figure 4) requires two features of 3D Touch that may be unfamiliar to a user: (a) applying a gradual amount of pressure until the pop-up locks and (b) navigating back to the previous screen by tapping on the blurred side areas. Assuming that the users will be trained on these features, it is possible to measure cognitive overhead by determining the time between closing the notification and how long it takes for the user to continue typing on the registration form. Part of the time difference may arise from the easier navigation associated with this 3D touch interaction; however, a one tap "back" button is located on the top left of the screen for all applications. Figure 5 shows the interaction path for the user of a 2D version of this interface. Therefore, since it is almost as easy to navigate back in both interfaces, the time difference, if any, can serve as a measurement of cognitive overhead.

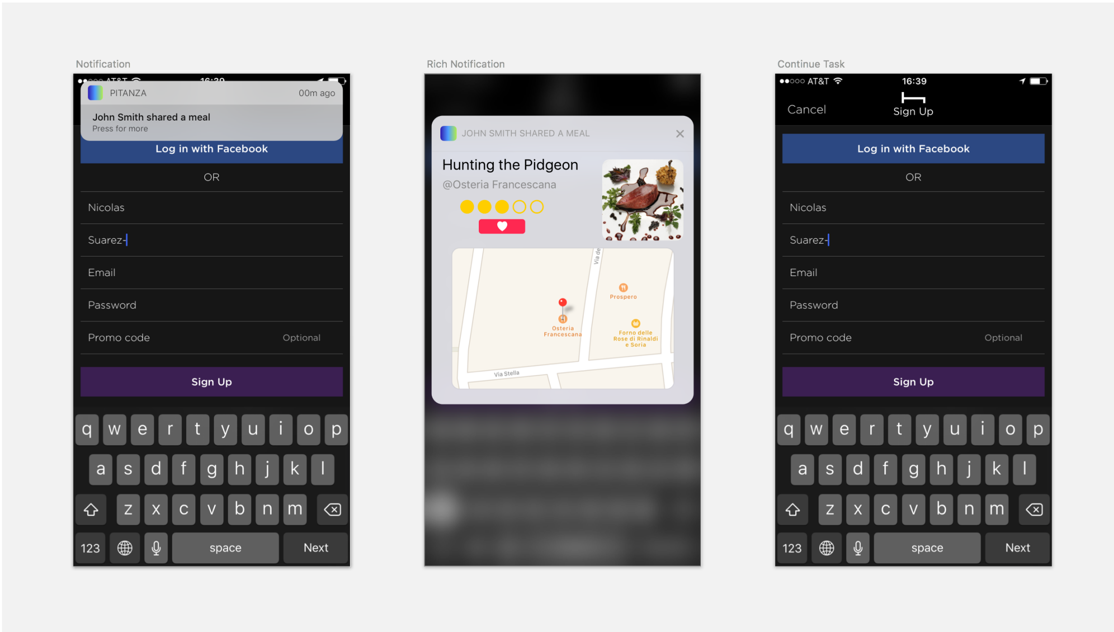

Figure 4: 3D Touch Enabled Notification

3.3 Performance of 3D-Touch as an Error Recovery Mechanism

3D touch interactions tend to be marked by the usage of a pop-up that gradually grows as a user applies more and more pressure on the screen. This provides a “preview” environment in which the user can abort the 3D action without being forced to navigate back to the previous screen. This idea will be tested by implementing the interface shown in Figure 6, which contains three 3D touch enabled buttons. As the user starts to apply pressure, a pop-up of a given color begins to grow. The user is given the task of finding a specific color, and we will measure the time whenever they choose the wrong button to see how fast it takes for them to recover and pick the right one. The task for this experiment is the following:

1. User beings to apply pressure on one of the buttons on the bottom part of the screen–labeled A, B and C. The user has been instructed to find a particular color.

2. As the user applies pressure, a pop-up of one of the predetermined colors appears.

3. If the user “locks” the pop-up view, a button appears that can be used to confirm the choice.

The non-3D version of this interface will be implemented such that a tap on one of the buttons opens the rightmost screen on Figure 6. From this view, the user can simply tap to confirm the color selection—appropriate feedback will be given to the user. The metric for this experiment will be the time that it takes the user to recover from choosing the wrong button. The maximum amount of different buttons that the user can try is two, and thus each test subject will be classified with his or her number of tries. This allows us to determine the error recovery time regardless of whether the second or third choices are the solution. The goal of this experiment is to test the “preview” environment of 3D Touch interactions as an effective error recovery mechanism; for instance, by preventing unwanted navigation.

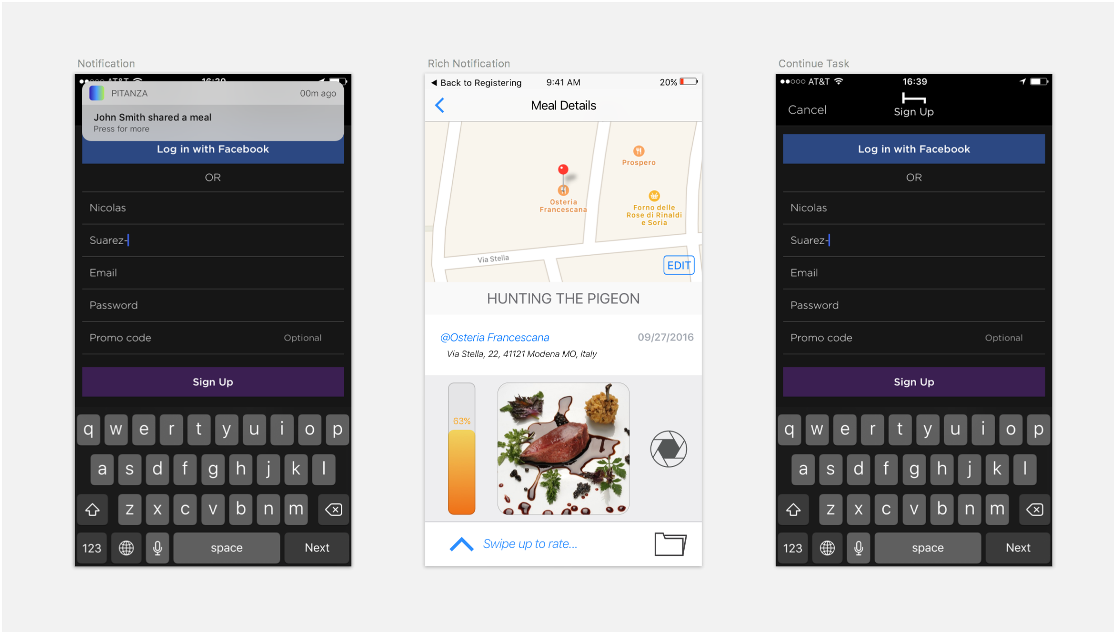

Figure 5: 2D version requires navigation (top left).

4 Project Schedule

The past 10 weeks of have been dedicated to determining a set of tasks that can be used to test the performance of 3D Touch as a user interface. This involved creating mock-ups of each interaction and also specific task descriptions for each one. A substantial amount of the implementation phase for this project needs to occur during December of 2016, which will begin by implementing the standalone application that is used to test error recovery. Winter term will have the following structure:

1. *Weeks 1-3:* Finalize the implementation of both applications.
2. *Weeks 3-5:* Prepare applications for testing on human subjects. This entails debugging both applications and ensuring that we are collecting the proper metrics.
3. *Weeks 5-7:* Testing on human subjects.
4. *Week 7:* Oral presentation and project demonstration due.

Given that the presentation and project demonstration are due on Week 7, it is essential to begin the implementation over Winter break. The first three weeks of the term will not be sufficient for implementing an application of this size.

5 Project Budget

The total budgeted amount adds up to a total of $339. The Student Research Grant Committee (SRG) has provided a $240 grant to cover the costs associated with testing on human

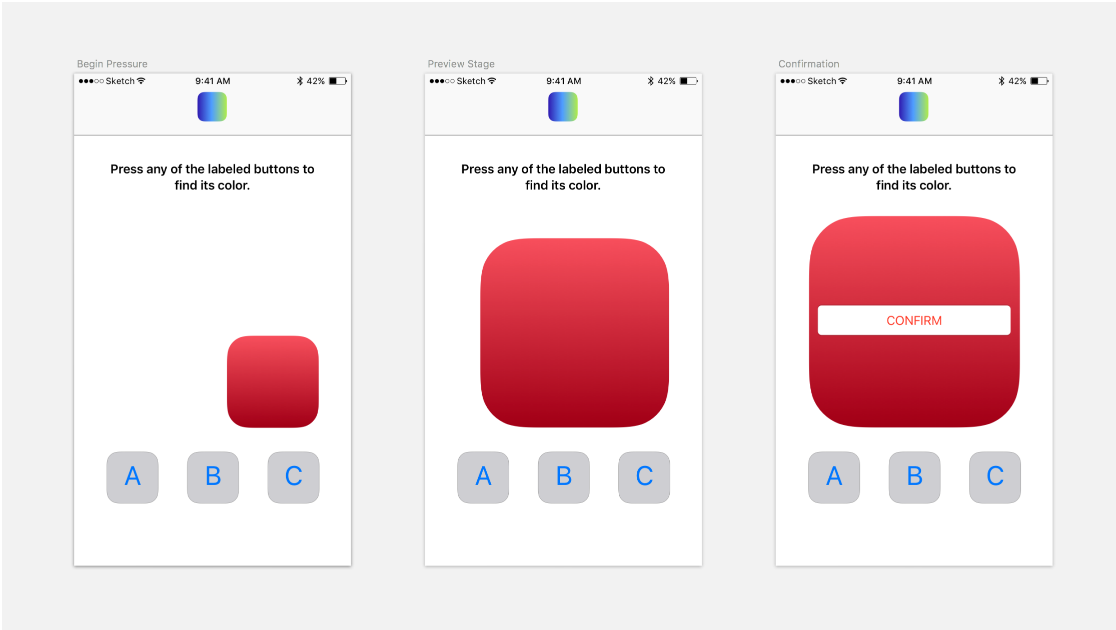

Figure 6: Error Recovery Experiment

subjects. In order to release the application publicly, it is necessary to purchase an Apple developer account. Its price is $99 and will only be necessary in order to release the application to the App Store.

Table 1: Project Budget

Item	Description	Quantity	Price ($)
Test Subjects	Necessary for HCI experiments with 3D touch interface.	30 ($8 in cash per subject)	$240
Apple Developer Membership	An Apple Developer subscription is necessary for distributing an iOS application.	1 ($99 per year)	$99

6 Conclusions

Assessing the impact of 3D Touch on user experience is a complicated task. This new technology allows developers to craft interfaces that are pressure-sensitive; however, this sensitivity does not necessary grant a better user experience. It may provide a more streamlined way to access certain features within an application or as a way to preview items within a list view. It can simply serve purpose of extending the present-on-screen software. Indeed, this has been a recurring issue throughout the experiment design phase. Some of the proposed designs aimed to facilitate the navigation within an application without having a clear metric of performance. In other words, early designs will aimed to use 3D Touch in order to build an "animated" interface that was responsive to touch, but the designed tasks could have been achieved with simple tapping. The three tasks described above have been designed with this idea of data collection in mind. When the user performs the given task, the experiment will provide metrics that can be compared across both the 3D and 2D versions of this application.

References

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[3] Gonzalo Ramos, Matthew Boulos, and Ravin Balakrishnan. Pressure widgets. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 487–494. ACM, 2004.