

Analysis of Task Success Rate for Classifying 2D-Touch and 3D-Touch through Threshold

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Abstract— Since input interfaces using a touchscreen device appeared, some of 2D-Touch methods have been available such as Single Tap, Long Press, and Pinch Zoom, etc. Later, a technology called Force Touch or 3D-Touch was introduced that receives inputs for 2D-touch and touch force. In other words, 3D-touch is an interface that has Z coordinates as strength of touch force in addition to the X and Y coordinates on a screen used in 2D-Touch. Apple has manufactured iPhone 6S and later models which are 3D-Touch interface in use and it implemented force separation with two levels: peek and pop. The forces intensity for pick and pop interactions are divided into 200g and 400g respectively based on the maximum input of 400g that the 3D-Touch screen can measure the pressure.

In order to define the range of both touch and peek in two levels provided by Apple, we first should specify an area where touch and peek areas can be distinguished. Previous researches show that the criterion for separating two areas is 200ms. In addition, when the strength is up to 66g, we may identify an action as touch and as force when the strength is more implying that 66g is a boundary for two areas. We need to perform experiments to make sure whether a task can be succeeded with the defined threshold. Then, we may be able to define new ranges for peek and touch and for peek and pop. Furthermore, we will search those ranges as large as possible and provide a basis for how to apply them.

Keywords— 2D-Touch, 3D-Touch, peek, pop, etc.

I. INTRODUCTION

As the input interface using the touch display has introduced, 2D-Touch interfaces such as ‘single tap’, ‘long touch’ and ‘pinch zoom’ have emerged [1 2]. Later, a technique called Force Touch or 3D-Touch was introduced to use the force of touch with the 2D-Touch method [3]. In other word, 3D-Touch is an interface in which the Z-axis is inputs as the force in addition to the X-axis and Y-axis used by 2D-Touch.

The 3D-Touch interface currently in use is typically used in Apple's iPhone 6S and later, and is implemented by dividing the force into two stages, ‘Peek’ and ‘Pop’ [4]. The force for ‘Peek’ and ‘Pop’ interactions are divided into two groups based on the maximum input value of 400g of force that a 3D-Touch display can measure. However, in order to define the range of ‘Touch’ and ‘Peek’ in the two steps suggested by Apple, should specify an area that can distinguish the ‘Touch’

area and the ‘Peek’ area. This is because when a general touch (2D-Touch) is performed, the force becomes 200g that ‘peek’ interaction response. of the ‘pick’ interaction becomes 200 g. However, it has been proved that this can be distinguished by a threshold of 200ms based on previous study [5]. In addition, the force can be divided into the touch area when the maximum force is 66 g, and when the force is greater than 66 g, the force can be divided into the force area and the force area. Experiments are needed to distinguish between touch, peek, and pop through the set thresholds.

Therefore, in this paper, we want to make sure that the threshold obtained from previous studies can actually distinguish between 2D-Touch and 3D-Touch, that is ‘touch’ and ‘pick’. As the result, we can define new areas to distinguish ‘peek’, ‘touch’, ‘pop’. Furthermore, it will be possible to find areas of force that will satisfy each area as much as possible and provide a basis for how to apply them.

II. RELATED WORKS

In the previous research, he found thresholds that can distinguish 2D-Touch and 3D-Touch on 3D-Touch enabled display [5]. He measured the time to reach 400g when touch the display by Slow-touch and Fast-touch. When touch the display by slow touch and fast touch. For the Slow-touch, it took 200ms to reach the 400g, and for the Fast-touch, it took 100ms. That is, in the case of 2D-Touch, 200ms can be a threshold that distinguishes 2D-Touch and 3D-Touch because it terminates in less than 200ms.

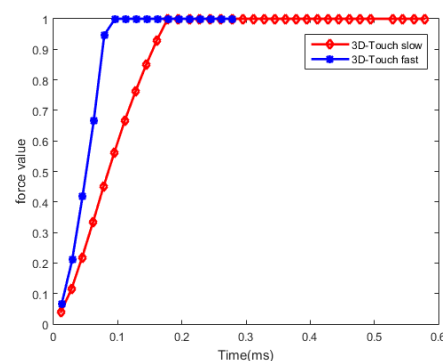


Figure 1. Comparison between slow Touch and Fast Touch on 3D-Touch

In the previous research, we found thresholds that can distinguish 2D-Touch and 3D-Touch on 3D-Touch enabled display [5]. We measure the force when 2D-Touch performed on 3D-Touch enabled display. Figure 2. shows the distribution of force applied to the display when 22 subjects touch the display 10 times with 2D-Touch. Based on this, the mean, standard deviation, and standard error are shown in figure 3. The average is 60.42g and when the standard deviation is applied, is ranges 0 to 141.79g. the standard error is 5.49g which range from 54.92g to 65.92g when applied to the mean value. That is, if the force applied to the display is 66g or less, the threshold can be classified into 2D-Touch and 3D-Touch.

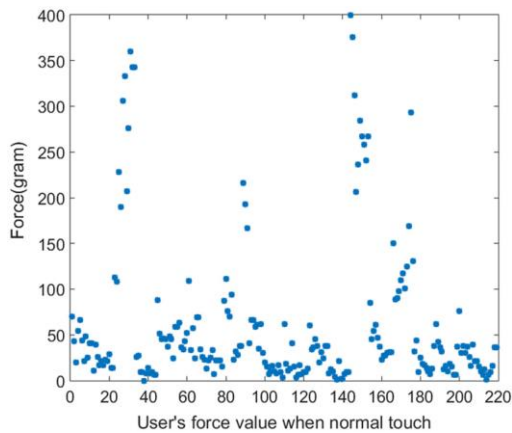


Figure 2. Force value when touching general

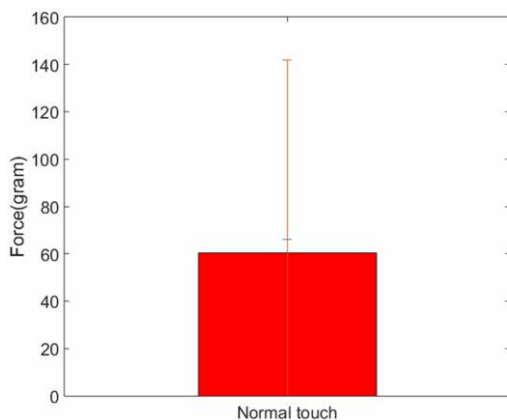


Figure 3. Standard deviation of force value at normal touch input

III. ANALYSIS OF TASK SUCCESS RATE USING THRESHOLDS

Through previous research, we found the thresholds for time and force that can distinguish 2D-Touch and 3D-Touch. In this paper, we apply these thresholds that 2D-Touch (less than 200ms, 66g) and 3D-Touch (more than 200ms, 66g) then, perform experiments to demonstrate applicability to the actual application. The experimental method was to randomly use 2D-Touch or 3D-Touch for pre-implemented button. 2D-Touch and 3D-Touch were input 10 times and input requests for 2D-Touch and 3D-Touch were arbitrarily generated. The application development for experimentation is shown in Table 1 and the application for task experiment is shown in Figure 4.

Table 1. Development Environment

	Smart Device	Development Computer
Device	iPhone 6S	Macbook Pro 2013
CPU(AP)	Apple A9	Intel Core i7
Memory	2GB	16GB
OS	iOS 9.2	OSX 10.10.3
Language	Swift 2.0	Swift 2.0
Display	4.7 inch	
Touch Type	2D-Touch & 3D-Touch	

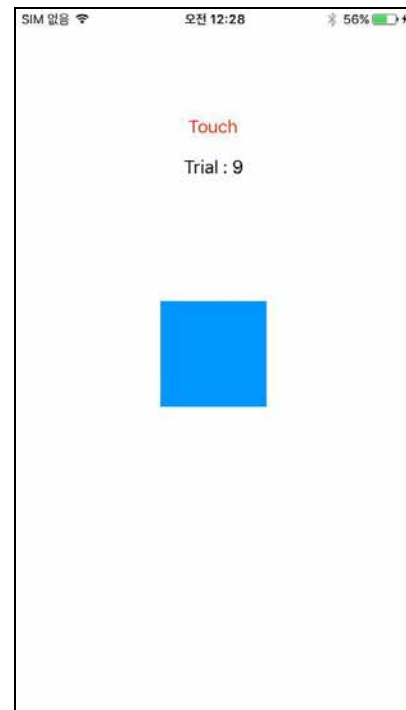


Figure 4. The user task App for 2D-Touch and 3D-Touchs

A. Analysis of Task Success Rate of 2D-Touch

Figure 5. shows the success rate according to the change of force intensity during 2D-Touch. The success rate of 2D-Touch is classified according to the force applied by the user into the case of 200ms or less based on the 200ms in previous study. As shown in figure 8, the success rate is 100% when the force can be input below 400g within 200ms. In the case of 200g, the success rate is 90.4%, 100g, 83.8%, 80g, 80.8%, respectively, when the force is 66g, the success rate is 78.3%. Based on the 200ms obtained from previous experiment, we distinguish the success rates. Therefore, it is difficult to distinguish 2D-Touch only use the force. This is because the 66g is used as a threshold for distinguishing between 2D-Touch and 3D-Touch.

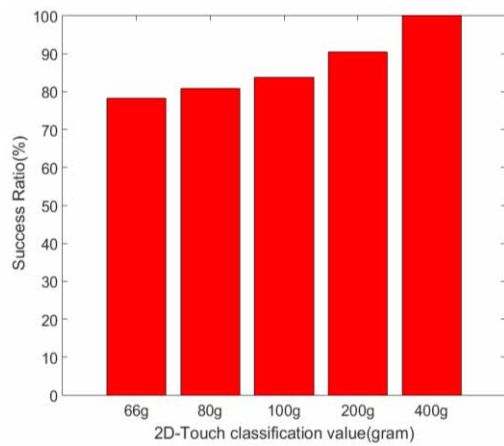


Figure 5. Success rate according to a force when 2D-Touch

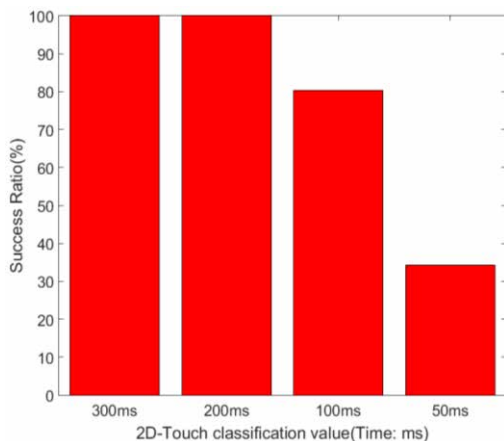


Figure 6. Success rate according to time when 2D-Touch

Figure 6. shows the success rate of 2D-Touch according to the change of time regardless of force. If 2D-Touch can be distinguished at 300ms or less, 2D-Touch success rate is 100%. However, when the time is 100ms, it is lowered to 80.3%. when the time is less than 50ms, the success rate is 34.3%, which makes it difficult to distinguish the task for the 2D-Touch. That is, necessary to designate 200ms as a threshold for distinguishing 2D-Touch from previous study.

B. Analysis of Task Success Rate of 3D-Touch

We demonstrate that the threshold at which 2D-Touch can be distinguished by time. This allows the 3D-Touch to be distinguished by force that occurred at least 200ms later. However, the force may not be distinguishable by the time at 2D-Touch. This can be represented by 2D-Touch occurring for a period of time(1 second) with a long-touch. Therefore, 3D-Touch must set a threshold for force that can be distinguished from long-touch as well as 2D-Touch(after 200ms, at least 66g).

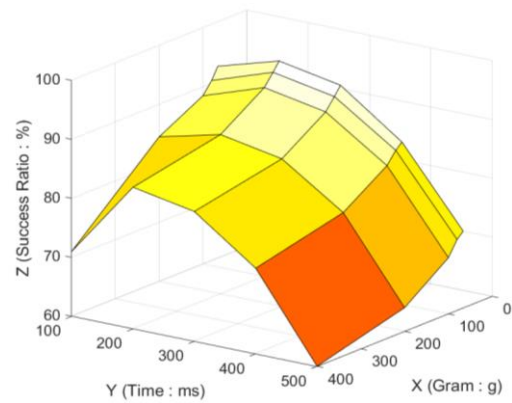


Figure 7. Success rate according to a force and time when 3D-Touch

Table 2. A comparison of success rate according to a force and time when 3D-Touch

	66g	80g	100g	200g	400g
100ms	92.5%	90.5%	88.5%	84.5%	71.0%
200ms	95.5%	94.0%	92.0%	87.0%	84.0%
300ms	93.5%	92.0%	90.0%	85.0%	82.0%
400ms	86.0%	85.0%	83.0%	78.0%	74.5%
500ms	73.0%	72.0%	69.5%	64.0%	60.0%

Figure 7. shows the success rate of 3D-Touch according to time and force in 3D-Touch. When the time is increased from 100ms to 500ms, the time that can be recognized with the 3D-Touch appears as when the force is measured over 200 ms as in the previous study. When the force is 66g, it increases to 92.5% for 100ms or more and 95.5% for 200ms or more, and the success rate decreases continuously for 300ms or more. Also, it can be seen that the success rate decreases as the force increases at 200ms. This means that the force for distinguish 3D-Touch close to 66g, the success rate is better. Therefore, the success rate to distinguish 3D-Touch can be judged to be 3D-Touch when applying more than 200ms and more than 66g of force.

IV. CONCLUSIONS

In this paper, we obtained the task success rate of the user through the application (application) which applied the threshold value to distinguish the 2D-Touch and the 3D-Touch from the devices supporting the 3D-Touch. It has been shown that the thresholds proved through user experiment evaluation can be divided 100% for 200ms or less in 2D-Touch, 95.5% for 3D-Touch over 200ms and 66g or more. In addition, 2D-Touch has shown that the increase in force can be distinguished from Long-Touch if the time does not exceed 66g.

In this study, we should experiment with how many levels of force a user can enter for a 3D-Touch that is distinct from a 2D-Touch. Through this, various input methods through 3D-Touch will be proposed.

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