

Children’s Interaction with Tablet Applications: Gestures and Interface Design

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Abstract—This research aimed to investigate how children aged two to twelve years interact with gestures and interface design on touch screen applications. Given that children love to explore and also that applications (apps) need to be age-and-gesture-appropriate to be effective, this new study focuses on how children of different ages use a range of applications on the tablet (iPad) and gestures such as tap, drag-and-drop, slide, pinch, spread, spin/rotate and flick have been used in a range of applications on the iPad.

Keywords-children; tablet; gestures; applications (apps)

I. INTRODUCTION

Child Computer Interaction is the part of Human-Computer Interaction where the humans are children and Child Computer Interaction is defined as a discipline concerned with the design, evaluation and implementation of interactive computing systems for children’s use and with the study of major phenomena surrounding them [1]. Children interactions with tablet are increasingly popular and have a place in the hearts of children. Tablet is also known as an expensive toy amongst parents but fortunately the price becomes cheaper with the very fast technological development and the large market value. Various kinds of tablet emerging market such as iPad, Samsung Galaxy, Toshiba Android Tablet, Microsoft Surface, Archos, Google Nexus and many more from different suppliers and these tablets are growing everyday in the market. Based on characteristics of the children who love to explore [2], apps need to be age-and-gesture-appropriate to be effective. In this study, seven common gestures were found from 100 children apps which are downloaded from Apple Store [3, 4, 5]. The seven common gestures which always used in children applications are tap, drag-and-drop, slide, pinch, spread and rotate [5]. A new study focuses on how children by age use these seven gestures for touch-screens and interactive surfaces needs to be done due to appropriate application development purposes.

Touch screen technological revolution creates new usability issues such as the lack of physical feedback on soft buttons compared to traditional hard buttons and the changes in interaction styles that the user needs to become familiar with

[6, 7]. This also applies to the interaction of children. Children are different from adults and their motor skill abilities are not mature enough because they are still growing up [8]. There are many studies that considered children interaction with touch-screen devices such as [7, 9, 10, 11, 12, 13, 14].

Current research by [7] used an application that can recognized single click (or touch), double click, click-and-hold and click-and-drag using iPhones, iPad and Surface touch screen devices. [7] also identify that children from the age of 6 can be comfortable with touch screen technology and distinguish between a range of common gestures.

Reference [9] has designed the mathematics game Fingu for iPad aimed at 4 to 8 year old children using multi-touch interaction. They found that children developed different arithmetic skills over time when playing Fingu such as improve their recognition of larger patterns, improve the ability to represent a number on their fingers and improve the precision in placing their fingers at once.

Children’s participation has been studied in [10] to design gesture-based interactions for mobile device applications using Clear Panels prototyping were helping children to design their own gesture-based interaction such as tap, scroll and flick.

Other study by [13] investigate input methods for touch-screens with children aged 7-10. Part of the guidelines are 1) finger-based touch interfaces for children need large buttons, 2) a stylus should be considered as an alternative to finger interaction where accuracy is required, 3) software solutions may help with increasing accuracy in finger interaction, 4) hardware designers should leave adequate space at the edge of the device for it to be held without touching the screen and if this is not possible, software designers should aim to compensate for this, 5) visual feedback should be given on all touches on the screen and 6) usability testing with children should be sensitive to the difficulties of accurately evaluating their opinions and allow for repeat-testing.

Recent studies have investigated children interaction with touch screen, computer and pointing devices [7, 9, 10, 11, 12,

13, 14, 15, 16, 17, 18, 19, 20] but they have not investigated the relationship between the age of a child and the type of gestures they can master except [7, 10] who investigate gestures for children age s 6 years old onwards.

II. METHODOLOGY

A. Experiment Set Up

This research was carried out in three phases. The first phase identified the common gestures used in children’s apps. The selection of the appropriate apps for the experiment was carried out in the second phase. The third phase was the main experimental study with thirty three children in the United Kingdom aged from two to twelve years.

B. Seven gestures were selected for this experiment:

Tap, Drag/slide, Free Rotate, Drag & drop, Pinch, Spread and Flick.

C. The five selected apps are:

3D Shape Sorter, Buzzle Lite, SquishyFruit, ABC Animals and AlphaBaby Free.

D. The ages of the children are:

33 children age two to twelve years (3 children for each age).

E. Procedures:

The study prepares a suitable environment for children to use the tablet. The camera/video is setup for recording images and video. The researcher together with the parents or teachers guides the children to play and familiarize themselves with the applications. It has been suggested by [11] that the children become comfortable after using the tablet for a total exposure of one hour or less. They [11] also suggest that researchers need to observe children closely and teach them at least once on how to use gestures in applications to avoid unintended contacts in any experiment.

F. The information recorded:

In the experiment the age, the gesture that child could used, the child finger movements while using each gesture and the problems faced while using gestures and the apps.

G. Applications Selection:

With so many games and educational apps on the App Store, it was not possible to survey all to choose the best. The five apps that were selected for this pilot study are Shape Sorter, Buzzle Lite, SquishyFruit, ABC Animals and AlphaBaby Free [3, 4]. There are three reasons why these apps are chosen. Firstly they contain the desired gestures, secondly

they are age-appropriate and thirdly, they have sufficient ratings from reviewers and iPad stores.

The 3DShape Sorter app contains a drag and drop, slide and tap gesture in 3D form. Children need to drag the object and place it into the corresponding hole. The shape does not always match the visible side of the cube. The children have to rotate the cube to find their place (they have to slide their finger to rotate the cube). Once a shape is in place, the children can tap on it to hear the sound and to change the color. This app is suitable for testing children, particularly in the use of drag and drop gesture.

Buzzle Lite app ranked in top 100 Kids Games in the US and in the top five in many countries. Apple claims, the game-play will refine the children motor skills and hand-eye coordination. Just like 3DShape Sorter, children need to drag the object and drop it into the correct shape for Buzzle Lite app. The difference is Buzzle Lite app built in 2D form. The purpose of this app selection is also to see how far a child can do drag and drop gesture in 2D and 3D form.

SquishyFruit app is a simple game using only the tap gesture. Apple claims this app is suitable for all ages and the tap gesture used is the reason for selecting it for this study. ABC Animals app is also using tap as the main gesture to learn the alphabets, change background and add more alphabets and toys. The children may use slide and rotate gesture for each object that appears on the screen. This app focuses on young children two years and older.

AlphaBaby Free app focuses on young children. The children have to use tap gesture on the touch screen to show and hear letters and shapes and flick to send them flying across the screen. The children also have to do pinch and spread gesture to make the letters shrink and grow. There are 6 gestures in this app and suitable to be tested and to investigate how far a child can use a lot of gesture on one interface.

III. RESULT AND DISCUSSION

From the overall observation, children love iPad, games and do not bother about the gestures and apps’ content. Children who interact with the iPad, have different abilities depending on their age, cognitive level and experience. The children’s ability by age level was identified and are shown in Table 1.

TABLE I. GESTURES THAT CAN BE USED BY CHILDREN

Age (years)/ Gesture	2	3	4-12 (3 children each age)
tap	xxx	xxx	xxx
flick	xx	xxx	xxx
slide	x	xxx	xxx
Drag &drop		xxx	xxx
rotate		xx	xxx
pinch	x		xxx
spread			xxx

The first column in Table 1 shows the list of gestures and the following columns show the number of children aged two to twelve years who can use the gestures.

Table 1 show that all children of age four years and onwards can use all seven gestures. Table 1 also shows that only children age two and three years are struggling to do certain gestures.

Children ages two years were struggling to do flick, slide, drag & drop, rotate, pinch and spread gesture. Meanwhile, children ages three years are struggling to do rotate, pinch and spread gesture. However, there were only three children participated in the experiment for each group. The experiment needs to be repeated with more participants.

Children's interaction towards touch screen applications by age level is discussed below.

A. Children aged two years

- were able to tap, slide, flick on the touch-screen
- have problems with pinch gesture but sometimes able to pinch with two fingers
- were unable to do drag-and-drop, spread and rotate/spin gesture
- have difficulty to focus on the given app
- love to tap or touch anything they want on the touch-screen
- did not concern with the gestures on the interface

B. Children aged three years

- were able to tap, slide, flick, on the touch-screen
- have difficulties to do drag & drop gesture at the beginning
- can easily dragging a 2D object as compared to 3D objects on the touch screen
- took a long time to drag and drop object located far apart but successfully after 3 to 4 attempts
- have problems with pinch and spread gesture
- did not concern with the gestures on the interface
- learned from brother/sister or friends

C. Children aged four years

- were able to tap
- have difficulties to do drag & drop gesture at the beginning of the session
- took a longer time to think about shape for drag & drop gesture

- found it easier to drag a 2D object as compared to 3D objects on the touch screen
- did not concern with the gesture on the interface
- learned from brother/sister or friend

D. Children aged five years

- were able to use all the gestures
- if the children facing difficulties to do drag & drop gesture at the beginning, they manage to think of a way out and take less time to learn
- found it easier to drag a 2D object as compared to 3D objects on the touch screen
- have no problem using a lot of gesture on one interface

E. Children aged six years

- were able to use all the gestures
- will be successful after keep trying if they encounter problems using any gesture
- have no problem dealing with 2D or 3D objects on the touch screen
- have no problem using a lot of gesture on one interface

F. Children aged seven to twelve years

- were able to use all seven gestures
- can rank the gestures according to their preference
- less time spent for each apps
- have no problem dealing with 2D or 3D objects on the touch screen
- have no problem using a lot of gesture on one interface
- love to play games like Squishy Fruit
- children aged ten to twelve require more fun and challenging apps

IV. CONCLUSION

The results from this study show that all gestures can be used by children at all ages except children aged two and three. This initial study showed that only children aged two to three years have problems using certain gestures. Therefore, the next study will focus on how children by specific aged two to three years use the same seven gestures with more children participated in the experiment for each group. Children aged four years might also be included in the study since it is presumed that if the children aged four years can use all the seven gestures, older children should also be able to do the same.

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