Investigation of Tilt Gesture Interaction to Manipulate Text Property in Mobile Device

by

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ABSTRACT

The objective of this study is to design and evaluate tilt gesture interaction to manipulate text property in mobile device through experiment. The function of changing the font size is added to the mobile phone information input, it can change the font size of the sent text to enhance the emotional effect of the message. The experiment evaluated performance and usability of four methods prototypes, including three new interactive methods (Shake, Leaning, and Accel) and a traditional button method. The experiment explored whether the new interaction method is comparable to the traditional button method by evaluating the workload and subjective usability of these methods. The results showed that in terms of task completion time, accuracy and subjective work, the Shake and Leaning methods can be equivalent to the button method. However, the Accel method is lower than other prototypes in these aspects.

Subjective comments indicated that these new interactive methods are useful. After a period of practice and adaptation, these methods can replace traditional methods, add more functions to mobile phones and improve user efficiency. At the same time, participants expressed that changing the font size can help them express their emotions in the message to a certain extent.

Even though the three new interactive methods are not superior to the button method in changing the font size of the message, these methods can still be added into the functions of mobile phone to provide users with convenience and higher practicability.

CHAPTER 1. INTRODUCTION

1.1. Phone Chat Text Property

Mobile phones have become an indispensable thing in people's lives. People's long-distance communication methods have changed from old-fashioned written letters to online chats using different software on mobile phones, and it is even slowly replacing sent email on computer. Most people will choose simpler and more convenient online chat instead of offline chat in their daily life. However, the drawbacks of phone chats have gradually appeared. One of a main problem is that it is impossible to observe the other's facial expressions or body movements, and the emotions expressed through words alone. Although many emotions may spread based on the topics of chat conversations, they still cannot be compared with the emotional reactions in face-to-face situation. People may misunderstand the meaning of the message and some emotion behind the text.

To solve this problem, online chat application and phone system companies will add Emojis to chat software or input methods. Emojis, as a kind of pictograms, ideograms, appear in text messages, emails, and other social media platforms, help users to express their feelings when communicating with mobile phones remotely (Stark & Crawford, 2015). Because the Emojis can help message senders to express their emotions and feelings much better than text only, so it is accepted and liked by more and more people. At the same time, people have gradually forgotten another way to help people express their emotions in text: Text Property (Abbasi & Beltiukov, 2018). Before Emojis were invented and used in phone chat, people used to express emotion or emphasize what they mean by changing the font type or font size of words and sentences.

Changing the text property to express emotion or emphasis is often used in advertisements, blogs, and letters. According to research in recent years, people can feel the emotions conveyed by the text more clearly by changing the text property and keep deeper impression of the message. In Mareike Bayer, Werner Sommer, and Annekathrin Schacht's experiment (Bayer, Sommer & Schacht, 2012) of the influence of emotional and neutral words in different font sizes on human emotional effects, concluded that the early emotional effects of larger fonts are usually more obvious, that is to say, large fonts can effectively improve the emotional factors conveyed by the text. At the same time, the experiments, how different text properties (large and small fonts, font styles, etc.) affect the memory of different age groups, concluded that no matter what the font style or the participants' age is, large font size texts are usually have a higher recall rate than normal font size (Price, McElroy & Martin, 2016). A study from Choi, and Aizawahas shown that adding more types of fonts to mobile messages in the chat will cause more positive reactions and more active emotional feedback. As mentioned above, it is worthwhile to change the text property of a message to express some feeling when chatting on a mobile phone. The easiest and fastest way to accomplish this goal without affecting typing speed is to add the ability to change text properties to phone's input method.

1.2. Phone Gesture

With the increase and popularity of various sensors on mobile phones, phone gestures other than taps and touches have become an important part of the smart phone operation. The user can use gestures make the phone complete some simple operations by shaking the wrist, tilting the phone, shaking the phone, etc. Researchers (Jahani & Kavakli, 2018; Jain & Kanhangad, 2015; Yi, et al., 2016) are also constantly exploring new features that use mobile phone gestures, and some of them

try to find more effective gestures function to help people improve typing speed and text editing usability on smart phones.

Although the mobile text input speed on smartphones is comparable to hardware keyboards, many hardware keyboard shortcuts cannot be applied to fully touch smartphones because the screen and interactive space of smart phones are relatively small. At this time, researchers are planing to add gestures other than touch to increase the text editing function of the smartphone. Le (Le et al., 2020) founds that the most important 22 of more than 800 available hardware keyboard shortcuts were selected and added on smartphones through gestures. The results of usability experiments show that these prototypes are more intuitive and faster than existing commercial methods.

Wigdor and Balakrishnan (Wigdor & Balakrishnan, 2004) designed a prototype that can help improve the input efficiency of the T9 phone input method by tilting the phone: "TiltText". They installed a motion sensor on the back of the phone to help them capture the movement from the users. This sensor can help the phone to determine the tilt angle of the phone and make the phone system to enter the letters that user needs. The results show that, because it is a new interactive method, TiltText's error rate is a little higher than the original input method, but the input speed is 23% faster than the current input method. Another research prototype "TiltWriter" even directly abandoned the touch function of the smartphone, turning the entire input process to tilting the phone (Castellucci, MacKenzie, Misra, & Arif, 2019). If touch action is not possible, the usability of this prototype is very high, and the error rate is just as low as normal Qwerty input method.

These studies show that if cell phone input methods can be designed with proper gestures to manipulate text property, it will help people to perform more operations and provide more functions and possibilities for existing input methods without affecting normal text attribution.

1.3. Research Challenge

Although there has been a lot of designs to apply different kinds of gestures to smart phone operation, so far there is no mature input method that uses tilt gestures to make font editing in messages. The gestures of tilting and shaking the phone are usually not able to complete complex editing, but according to the previous section, adding some shortcut functions of tilt gesture control to the smartphone has pretty good outcomes (Le et al., 2020). This indicates that the font size changing needs to be simplified so that it can be done by tilting gestures. At the same time, these gestures should not interfere with the user's normal smartphone input method usage. If more gestures are added, the possibility and difficulty for users to multitask must be considered, as adding more features will increase the user's workload and cause more errors. Because people are used to simple touch gestures, it is more challenging to try to find other operations that can replace touch gestures for additional text property changes.

To evaluate the use of gestures in smartphone message input, it is necessary to consider how to minimize external influence factors and the credibility of usability experiments. The research requires multiple trials and ensures that each variables of each gesture prototype are constant. Because everyone has different smartphone habits, experimental text differences, and prototype use order, a single experiment cannot get accurate prototype usability conclusions and final results.

1.4. Research Objective

The objective of this research is to evaluate and compare different tilt gesture interaction method used in manipulate text property in mobile device. In addition, the new tilt gesture operation will be compared with traditional touch editing methods to explore whether tilt gesture can be qualified to replace the traditional touch button operation in text property manipulation.

CHAPTER 2. METHODS

2.1. Prototypes

The experiment application prototypes are developed based on the Android input system which add a variety of additional tilt gestures to change the input font size. As shown in Figure 1, each button on the main interface of the application corresponds to an interaction method. From top to bottom are “Manual-Button”, “Gesture-Shake”, “Gesture-Flip”, “Gesture-Leaning”, and “Gesture-Accel”. User can click the button to enter the corresponding input method prototype.

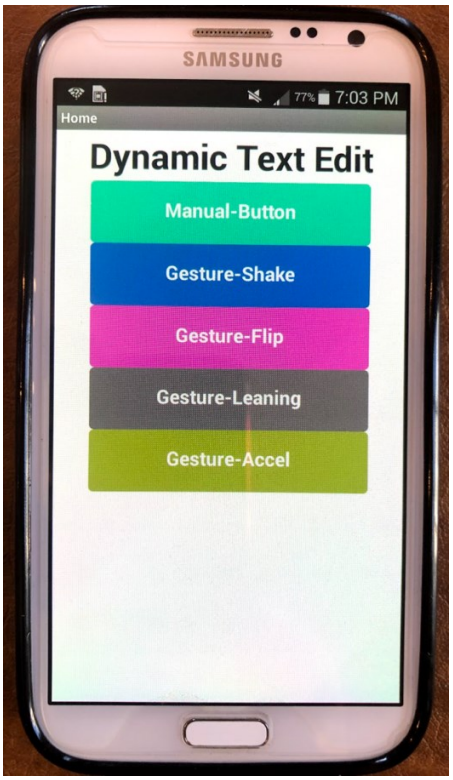


Figure 1 The main interface of prototype application

After clicking the button on the homepage to enter any prototype interface, the five input method prototype interfaces are the same except the prototype name that displayed on the top bar. The default size of the text font when open each prototype is "Medium". Take the prototype "Manual-Button" as an example (Figure 2), the prototype interface includes the Android Qwerty keyboard below, and the font size level is displayed in the middle (the font size is divided into five levels, from left to right are "X Small", "Small", "Medium", "Large", and "X Large"), user can see the font size they select. It also includes an input box and a send button right on top of the font size level block to simulate mobile phone message sending. At the top of the screen is the message display area, all messages sent by the user will be displayed in this area. After clicking the "Enter" button, the message will be sent in the selected font size.

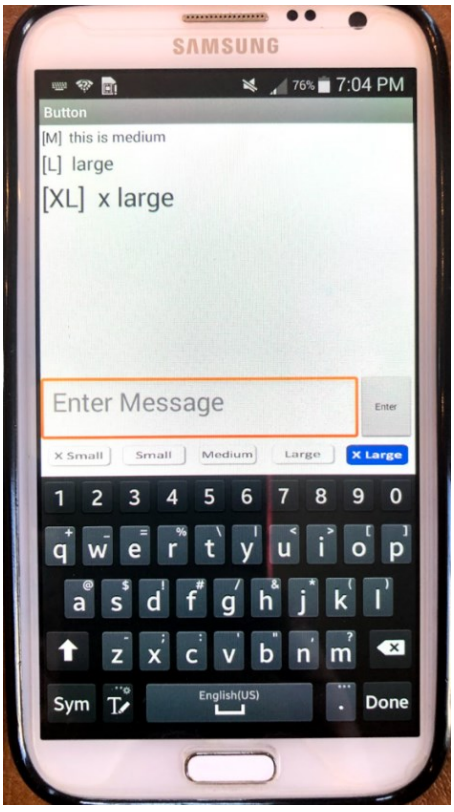


Figure 2 The interface of "Manual-Button" prototype

The following are the introductions of four methods:

Manual-Button

This is a traditional touch button prototype, using only touch gesture to change the font size. Users can click the middle five font size buttons to modify the font size of the current editing message when they need.

Gesture-Shake

In this prototype, the user can make text property manipulation by shaking the phone. Every time users shake the smartphone; the message font size will increase one level up ("X Small" to "Small" to "Medium" to "Large" to "X Large"). If you shake the phone once when the font is "X Large", the font size will change to X Small.

Gesture-Flip

When flipping the phone forward and backward, the message font will change accordingly. Each time the phone flips forward, the current message font size level will be increased one level up. Conversely, every time the phone flips backward, it will decrease one level. But this prototype is not working properly, it was deleted from the final experiment.

Gesture-Leaning

This prototype need the user to tilt the phone to changing the font size. When the user tilts the phone forward, as the tilt angle gradually increases, the font size of the text entered in the input field will gradually increase. When the phone is tilted backward, the font size of the text will

gradually decrease. The user needs to keep the tilt angle of the phone with corresponding text font size when sending a message.

Gesture-Accel

Like "Gesture-Leaning", this method also need user to tilt the smartphone. The differences are, tilting the phone forward to the default angle will continue to increase the font size until “X Large”, then back to “X Small. Tilting it backward will continue to decrease the font size until “X Small” then back to “X Large".

2.2. Task

The task presented to the participants were asked to using a given prototype to prepare a short document, each document containing ten sentences. The entire experiment contains 4 trials, corresponding to four interactive prototypes and four different documents. Before each test trial, participants have up to 5 minutes of practice time, and the practice document is the experiment document of the previous trial (the practice document of the first trial of the participant will use the experiment document of the last trial for practice). Each Task Documents contain 67 words, and they were divided into 10 sentences that simulate daily message conversations, each font sizes were correspond to two of the sentences. During the experiment, participants need to input the sentences from task documents one by one into the prototype and send messages according to the font size requirements at the front of each sentence.

For the fairness of the evaluation of the usability experiment, participants can only choose the font size through the fixed operation method of each prototype (see Appendix F).

2.3. Participants

A total of 24 participants were recruited for this research. Participants need to have experience in using smartphones, including mobile text editing and message sending, also need to be able to use English for conversation and text input. The age range of participants in the experiment is 18-35 years old with average of 25. All participants are recruited on campus via email (see Appendix B).

Before the experiment begins, the participants are required to complete a basic information questionnaire to determine whether the participant meets the criteria for this experiment. They were asked about smartphone using, smartphone chatting, and Qwerty input method using experience (see Appendix C).

2.4. Variables and Measurement

The independent variable (IV) of the experiment is the text editing operation method used in the prototype. Dependent variables (DV) include task completion time (TTC), number of errors, subjective workload, and subjective user satisfaction rating. The task completion time refers to the time required that participant produce the text document using each method as quick as possible. The number of errors is divided into two aspects: the number of messages which font size is not correctly selected, and the spelling or typing errors that occur in the message. Therefore, participants need to copy the content of the document to each prototype accurately and quickly. Each participant needs to fill in the NASA-TLX scoring form after each time they finished a trial. The NASA-TLX demand ranking form will be filled out after completing all four trials. These data will be collected to investigate the subjective workload of the participants. At the end of the

experiment, no more than 10 minutes interview of will be conducted to collect relevant data on subjective satisfaction and suggestions for the prototype and examination.

2.5. Experimental Design

The experiment is following the within-participants design. All the participants will be exposed to every condition. Entire experiment includes a total of 96 trials (24 participants * 4 trials). The experiment started with the introduction of the research and the prototype. This section gave participants opportunity to ask questions and understand the experiment. Participants signed the informed consent letter after they have sufficiently understood the research and carefully read through it. After the introduction section, the participants practiced the prototype for the first trial about 5 minutes. The trial starts after the participant is ready and comfortable with the prototype, each trial lasts about 4 minutes. Each time a trial is completed, the participants were required to complete the NASA-TLX rating form. After that, repeat the above steps 3 times. After completing all 4 trials, participants were asked to fill in the NASA-TLX ranking form and have a short interview.

Experiment Procedures Detail

The participants completed the experiment within one day in accordance with the following requirements and procedures:

1. The 5 minutes experimenter's explanation of the prototype, process, tasks and equipment of the experiment.
2. Sign the informed consent letter.
3. Fill in the participant survey form in 3 minutes.
4. The 5 minutes of equipment, prototype, and function practice time.

5. The 5 minutes experiment.
6. Fill out NASA-TLX Rating form in 5 minutes.
7. Repeat steps 4-6 three times, each time a different prototype will be used for that trial.
8. Fill out NASA-TLX Ranking form in 3 minutes.
9. The 5 minutes short interview.

CHAPTER 3. DISCUSSION

3.1. Time to Task Completion

The data of the TTC was converted into typing speed of milliseconds per word for each participant. According to the results of Analysis of Variance (ANOVA), the TTC result of the four prototypes is significantly different ($F(3,54)=5.12$, $p=0.003$). A post-doc analysis using Tukey (alpha=0.005) revealed two groups, Button (M=2865.88 msec), Shake (M=3006.29 msec), and Leaning (M-3057.66 msec) are relatively close. The other group includes Shake, Leaning, and Accel (M=3178.49 msec). It can be seen that although the conventional Button method has a better TTC result than other gesture prototypes, the results of the Shake and Leaning methods are also comparable. However, Accel gesture significantly degraded task completion time (M=3178.49 msec). This is due to the fact that Accel increases the difficulty of typing, which leads to longer typing times.

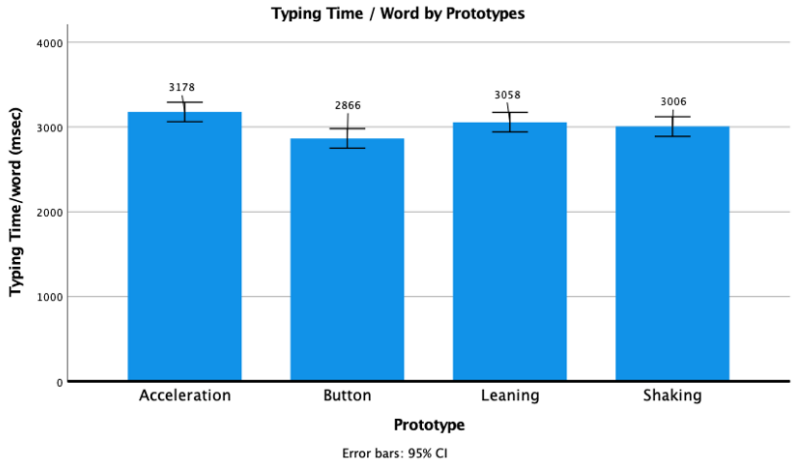


Figure 3 The typing time/word by different prototype

3.2. Number of Text Editing Errors

Text editing error, include size error and typo error, will be recorded during each trial. Every time the font size of the user's Enter message is different from the task document, it will be recorded as a size error. Every time a text input error, such as a spelling error, will be recorded as a typo error. A non-parametric test was performed to analyze the influence of the prototype on the number of text editing errors. First, the number of errors is not related to the order of prototype testing and different task documents. In the descriptive Statistics form, the analysis results show that the size setting errors ($x_3^2 = 11.44, p = 0.010$) and typing errors ($x_3^2 = 9.74, p = 0.021$) of each prototype are very different.

In terms of font size settings error, buttons and shake methods perform better, but Accel and Leaning methods are much more than them. According to the observation of participants and their feedback, there are two main reasons for this situation: 1. Accel and Leaning are relatively novel gesture methods, and short-term practice cannot significantly improve proficiency. 2. Compared with the Button and Shake, the Leaning and Accel methods have higher accuracy because the currently selected font size will not be changed without touching the button or shake the phone.

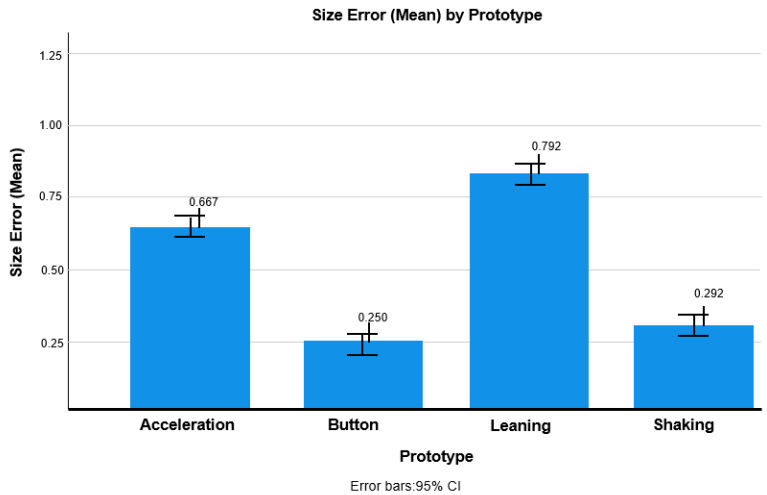


Figure 4 The Size Error (Mean) by different prototype

Interestingly, while shake methods yielded lower typo errors (Mean=0.333), the button method was associated with substantially high typing errors (Mean=1.042). This phenomenon may be attributed to the participants may accidentally pressing a letter on the keyboard when they trying to click on the font size button. Another possible reason for this situation is that participants are more familiar with the button as a common interaction method, so they usually speed up their typing, which also makes the spelling error rate of this prototype significantly higher than other prototypes.

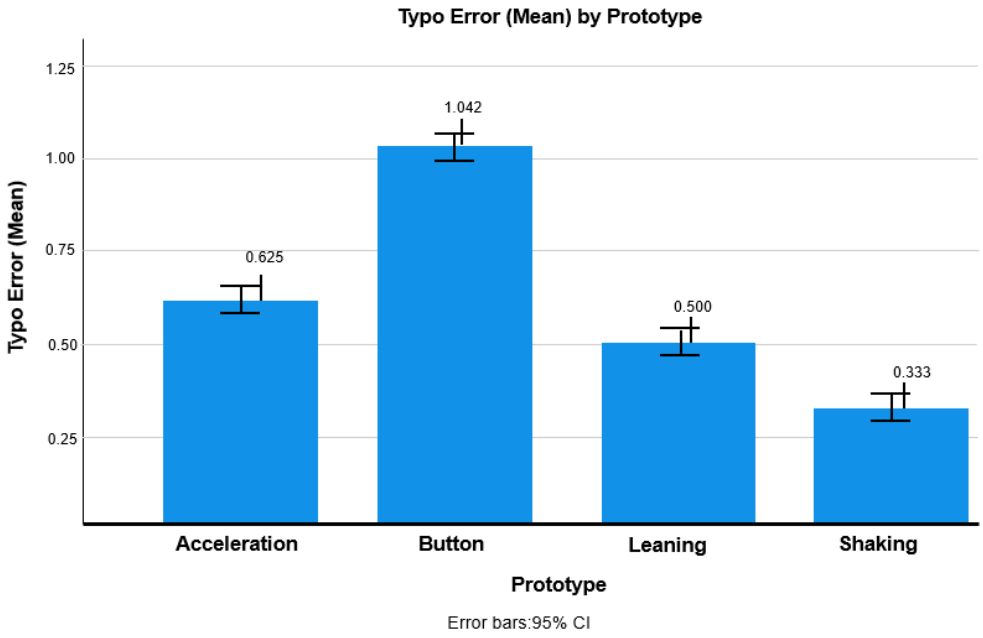


Figure 5 The Typo Error (Mean) by different prototype

3.3. Subjective Workload

ANOVA was used to analyze the effect of prototypes on each dimension of NASA-TLX workload. The Physical demand ($F(3, 54)=7.57$, $p=0.000$), Performance ($F(3, 54)=2.90$, $p=0.043$), and Efforts ($F(3, 54)=10.79$, $p<0.001$) results shows differences between methods. Among the results of Effort, the difference between prototypes is the biggest, especially Accel (Mean=4.98)

get higher Effort workload than Button (Mean=3.18) prototypes. But as a new interactive method, the Effort result of the Leaning prototype (Mean=3.79) is close to the Button (Mean=3.18). Although the Button prototype has better scores than other prototypes in every dimension of workload. But post-hoc analysis revealed that Button, Leaning, and Shake methods are similar. In other words, Leaning and Shake methods are comparable to traditional touch button methods. It is really interesting that the Leaning and Button methods are the same, both of them have lower physical demand and effort than other methods.

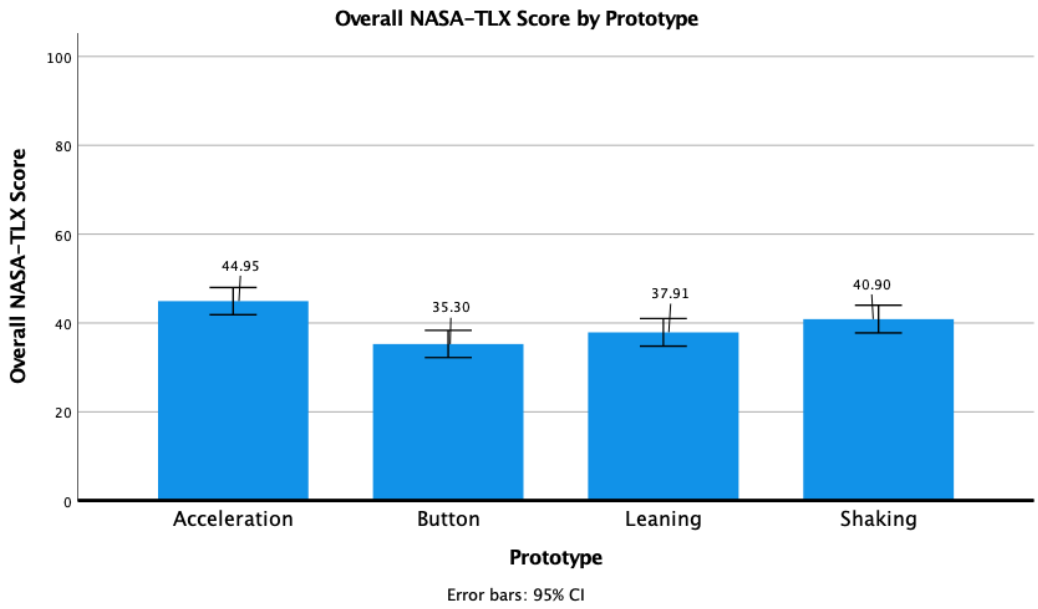


Figure 6 The overall NASA-TLX score by different prototype

3.4. Post-Experiment Interview

In the Post-Experiment Questionnaire, 24 participants rated the four prototypes in the experiment and evaluated the subjective usability of each method on a scale from 1 to 7 (1 is "not useful" and 7 is "very useful"). After calculating the average score of each prototype, the results of each prototype are quite different. The Button method score is 5.67, which exceeds the other

three new gesture prototypes. However, both Shake and Leaning scored more than 5, which proves that the subjective usability of these two interactions is also not bad.

In response to the question "Do you think that adding the function of changing the font size in the chat messages on your smartphone can help you better express your feelings?" More than 90% of the participants agreed, which means it is worthwhile to add the function of changing the font size to the smartphone input method.

After further analysis of the other interview questions, the following conclusions and suggestions to each prototype were drawn:

Button: The touch method is still a practical interactive method that users are more accustomed to. But the problem is that the added buttons will take up a lot of screen space, which violates the design of the phone shortcut keys. But if you trigger this function by adding a separate button to save space, it will increase the number of clicks for the user.

Shake: Like the Button method, Shake is designed for accurate choosing action, for that, they performed better than the other two new interaction prototypes when choosing fonts size in different levels. But at the same time, the shake operation will require users a higher physical demand.

Leaning: Overall, this is a prototype that gains more positive feedbacks. If we delete the Button method, the Leaning method is an original and effective prototype. However, when using a mobile phone, the tilt angle of the mobile phone is not always maintained, and the text font size change made by inadvertent movement of the mobile phone may affect the user's experience.

Accel: Based on the previous results, it is not difficult to see that the usability of this prototype is relatively poor. Participants always feel bad about making so many mistakes. Without

a long time of practice, users can't quickly and accurately select the font size they want using this function.

3.5. Discussion

The results of this experiment did not show significant differences from our expectations. Other new tilt gesture methods such as Shake and Leaning are still compatible with the traditional Button method, even though the usability of the tilt gesture method has not improved. Applying the new tilt gesture to the mobile phone input method requires longer training and adaptation time. Many participants mentioned that these new interactive methods need to improve the interactive experience to reduce the user's adaptation time. According to the results, the traditional button operation method is still more usable and accurate.

The experimental results show that the two methods of Leaning and Accel have a longer completion time and larger number of errors than Button and Shake. The subjective survey also showed that these two interaction methods directly or indirectly affect users mobile phone input process. One of the main reasons for this is that participants in the experiment need to accurately select the exact text size that task documents require for each piece of information entered. Precise selection is easier for the other two interactive methods, because the user only needs to click the corresponding text size or shake a certain number of times. However, for Leaning and Accel, users need longer time of practice and adaptation to be able to accurately select the font size in a short time. The fact is that, unlike experiments, users do not have specific requirements for font size when sending messages in their daily lives. From this, it can be inferred that the leaning and Accel methods will perform better in a realistic situation when the degree of freedom of font size choosing is relatively high.

The Leaning and Accel methods were designed design based on the goal that users can change the text size without interrupting the text input process of the mobile phone, thus users need to complete this operation by completing multi-task. Because the practice time is relatively short and the participants are not used to multitasking in the smartphone input process, user will have a greater workload when using these methods than the other two. Conversely, increased practice time and proficiency in multitasking will effectively reduce the workload and increase the efficiency of smartphone texting.

Also reducing the selectable font size degree from 5 to 3 is an approach worth considering, such as deleting "X Small" and "Small", which can effectively improve the availability of the Shake, Leaning and Accel methods which need to change the font size increasing or decreasing in sequence. Or remove the fixed font size degree option and use the moving linear control to modify the font size. This will make Leaning and Accel methods more convenient for users.

CHAPTER 4. CONCLUSION

4.1. General Inferences

This research compares the new tilt gesture interaction method and the commonly used touch interaction method on manipulating text property in mobile device. The experimental results show that the performance of the new gesture interaction methods - Leaning and Shake is close to the Button method. However, the efficiency and usability of the Accel method is much lower than the others. The results of subjective evaluation and discussion show that if users have enough time to practice and become familiar with new gesture interaction methods, their efficiency will increase a lot and the usability will much closer to the Button method. In short, these new tilt interactive methods are eligible to be applied to many functions on smart phones. What is most needed now is a more logical design to improve the user's ease of use and improve the user's smartphone experience.

4.2. Precautions and Future Research

The first problem of this study is the participants too familiar with the Button method, which leads to the fact that the performance of the touch-based interaction method will be much better than those other new interactive methods. To a certain extent, this is not fair to other new gesture method. The second limitation that the design of the research task is not tally with the actual daily using situation. In the daily text editing, there will be real emotional expression and a higher degree of freedom for text size choosing. There are many restrictions on the input of

mobile phone chat messages in the form of completing tasks, and these restrictions will directly affect the user's workload and subjective feelings. In the experiment process and interview, it can be found that the two font sizes "X Small" and "Small" probably need to be cut out from the prototype, not only because small fonts cannot convey emotions as effectively as large fonts, small fonts can also cause inconvenience to people who read or edit information.

In future research, I will improve the existing prototypes based on the suggestions and results to make them as useful as possible, and simulate more realistic cell phone chat scenarios in subsequent experiments to test the prototypes in use. In addition, exploring the usability of these new interactions in other cell phone features will also be a valuable experiment. For example, using tilt gesture to switch the background application or other common operations. In addition to Shake, Leaning and Accel, there are many other types of gesture interaction research on these gestures will not only be used in mobile phones, but also in remote control and other fields. Since this experiment cannot intuitively demonstrate the effect of cell phone chat font size on human emotions. Therefore, other experiments will be designed in the future to discover the effect of font size on emotions during cell phone chats and to illustrate the need to include this feature in the process.

APPENDICES

APPENDIX A: INFORMED CONSENT FORM

Informed Consent Form
INFORMED CONSENT FORM for RESEARCH

Title of Study: Research and Design the Phone Text input editing assisted by tilting
HUM00196117
Principal Investigator: Xuesen Liu Research Advisor: Sang-Hwan Kim, Ph.D

You are invited to participate in a research study. In order to participate, you must be 20-30 years old. Taking part in this research project is voluntary.

INFORMATION
If you agree to participate in this study, you will complete the experiment within one day in accordance with the following requirements and procedures:

Fill in the participant survey form in 3 minutes
The 3 minutes experimenter's explanation about the prototype, process, tasks and equipment of the experiment
The 3 minutes of equipment, prototype and function practice time
The 5 minute final experiment
Fill out two subjective questionnaires in 5 minutes
Repeat steps 2-5 three times, each time a different prototype will be used for experimentation

The task you need to complete in the experiment is to enter the text provided by the researcher in the prototype. The text will include words, sentences or paragraphs of different font sizes. The experimenter will record the experiment process and your performance. The whole experiment process is about 1 hours. The purpose of this study is to research on whether the Phone text input method editing assisted by tilting could be used and acceptable to the users and complete the tasks. At the same time, we also want to examine which of the input method is more efficient than others.

RISK
The risk of participating in this research project is very small or none. Risk maybe include Visual fatigue caused by use of prolonged mobile phones. Hand soreness caused by phone input for a long time and reversing the phone. Except for researchers, participants will not have contact with other non-researchers. If you express fatigue or discomfort during the experiment, the researcher will provide a break. If there are any special circumstances, you can terminate your participation in the experiment at any time.

BENEFIT
There are no direct benefits to participating in this project. You may get some indirect benefits, such as leaning and understanding related research, improving the efficiency of mobile phone text input, or observing the design and function of mobile text editing methods.

COMPENSATION
The experiment will not compensate the participants, and the participants will not incur any expenses through the experiment. All experiments will be voluntarily participated by participants.

CONFIDENTIALITY
All research records and data will be kept strictly confidential. All data and information will be stored safely and provided only to project researchers. After the research is completed, the record of the experiment will be permanently deleted.

CONTACT
If you have any questions about the process of this experiment, you can contact the researcher Xuesen Liu at 812-369-5440. The email is xuesenl@umich.edu. Research adviser: Sang-Hwan Kim, phone 313-593-5012, email dysart@umich.edu

PARTICIPANT
Your participation in this study is voluntary, and you can refuse to participate without any fine. If you decide to participate, you can launch it at any time without penalty or loss of any of your benefits. If you withdraw from the study before the data collection is complete. Your data will be destroyed immediately.

As part of their review, the *University of Michigan Institutional Review Board Health Sciences and Behavioral Sciences* has determined that this study is no more than minimal risk and exempt from on-going IRB oversight.
By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. I/We will give you a copy of this document for your records. I/We will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.
I understand what the study is about and my questions so far have been answered. I agree to take part in this study.

Participant's signature_____ **Date** _____
Investigator's signature_____ **Date** _____

APPENDIX B: RECRUITMENT EMAIL

Recruitment Email

Participant: Investigation of tilt gesture interaction to manipulate text property in mobile device

A research project team from University of Michigan – Dearborn is looking for volunteers to take part in an experimental study. This study will be evaluating the tilt gesture interaction function to manipulate text property in mobile device. We are looking for participants who are 20-30 years of age. Participants need to have the experience of smartphone using and text input.

During the experiment, participants will complete the tasks assigned by the researchers on a variety of prototypes in the lab, such as tilting the phone to change the font size of the input text. The entire experiment is expected to be completed within 1 hour.

In order to thank the participants for their time and effort, the experimenters will provide each participant with $15 as honorarium. If the participant withdraws from the experiment early, the salary will be halved.

The experiment will take place from May to June 2021 in University of Michigan – Dearborn

For more information about this research, or to voluntarily participate in this research, please contact Xuesen Liu through email (xuesenl@umich.edu)

Sincerely

Xuesen Liu, Master student in HCDE program
Thesis Advisor: Sang-Hwan Kim, Associate Professor in IMSE

APPENDIX C: PARTICIPANT SURVEY

Participant Survey

Investigation of tilt gesture interaction to manipulate text property in mobile device

Participant Name:_____

Age:_____

Gender (circle one): Male Female

Handedness (circle one): Right Left

What kind of phone system do you usually use: IOS Android Other

For the below questions, please use this scale select all the appropriate choice to each statement:

Rate your smart phone experience

Excellent Very Good Good Fair Poor

Rate your smart phone QWERTY input method using experience

Excellent Very Good Good Fair Poor

Rate your smart Phone Chatting and Message sending experience

Excellent Very Good Good Fair Poor

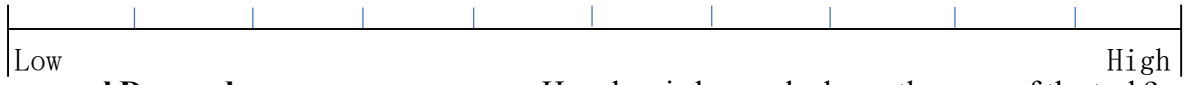
APPENDIX D: NASAS-TLX RATING AND RANKING

Subjective Comparison of Demand Factors: NASAS-TLX Rating

Indicate the level of demand experienced during the smartphone text editing task for each of following factors by drawing a straight vertical line on the scale directly below.

Mental Demand How mentally demanding was the task?

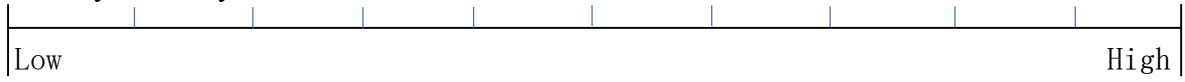
Physical Demand How physically demanding was the task?



Temporal Demand How hurried or rushed was the pace of the task?

Performance How successful were you in accomplishing what you were asked to do?

Frustration How insecure, discouraged, irritated, stressed, and annoyed were you?



Effort How hard did you have to work to accomplish your level of performance?

Subject #: _____ Trial #:_____

Subjective Comparison of Demand Factors: NASAS-TLX Ranking

Research and Design the Phone Text input editing assisted by tilting

Indicate the more important task demand by circling its label on each line directly below

Mental Demand	**Physical Demand**
Mental Demand	**Temporal Demand**
Mental Demand	**Performance**
Mental Demand	**Effort**
Mental Demand	**Frustration**
Physical Demand	**Temporal Demand**
Physical Demand	**Performance**
Physical Demand	**Effort**
Physical Demand	**Frustration**
Temporal Demand	**Performance**
Temporal Demand	**Frustration**
Temporal Demand	**Effort**
Performance	**Frustration**
Performance	**Effort**
Frustration	**Effort**

Subject #: _____ Trial #:_____

APPENDIX E: POST-TRAIL INTERVIEW QUESTIONS

Post-Trial Interview Question

Investigation of tilt gesture interaction to manipulate text property in mobile device

Please answer the following questions regarding your experience throughout the experiment.

1. On a scale from 1-7 (where 1=not useful at all and 7=extremely useful), how useful was the prototype and the method? _____

2. Do you think the method of setting a font size / property allowed you to save text editing time, as compared to other text editing method on phone you are currently using? (Circle one answer)
Yes No I don't know

3. Which trial do you think is the most efficient way of changing the text property? (Circle one answer)
T1 T2 T3 T4

4. If you think the method you used in this trial was bad, please state why? Do you have any suggestions for improving the method?

5. Are there any suggestions you would make to apply this method to another domain, which needs to be more efficient for input information?

6. Compared with other prototypes, what do you think are the advantages or disadvantages of the prototype you used in this trial?

Subject #: _____ Trial #: _____ Prototype #:_____

APPENDIX F: TASK DOCUMENTS

Task document 1

(Extra Large) Hello good afternoon!

(Medium) Have you eaten dinner yet?

(Small) Do you remember the last time your friend recommended the bar in his birthday party?

(Extra Large) You didn't finish your project?

(Large) You can ask me any question you want.

(Extra Small) I do not know how to answer this question.

(Medium) Have you watch the new episode?

(Small) You can send an email directly to the teacher.

(Extra Large) Of Course I will.

(Large) See you soon!

Task document 2

(Extra Large) Wait!

(Extra Small) I know it is hard to say, but I think the story will not end up good.

(Large) I can watch that again with you this weekend.

(Medium) I have some question from the class I want to ask you.

(Small) I think the exam is much harder than the last one.

(Large) Let's have a Meeting.

(Small) See you during the class.

(Extra Large) Byebye

(Extra Small) Sorry, I don't think so.

(Medium) This is what I think.

Task document 3

(Large) Do you want to have dinner with me?
(Small) I don't feel so well.
(Large) You have not watched that yet?
(Extra Large) Cool!
(Extra Small) I don't want to eat chicken. I had chicken 4 times last week.
(Medium) They give me feedback for your part.
(Extra Large) Thank you very much!
(Extra Small) I only got 80 points on my midterm exam.
(Medium) How about the Korean food bar we eat last time?
(Small) We still need to have minor changes.

Task document 4

(Large) How Are you!

(Extra Small) Sorry I wont be able to join the meeting.

(Extra Large) Everything need to be done.

(Medium) We have a presentation tomorrow.

(Small) Can someone share the link to me.

(Extra Large) Enjoy!

(Large) You will be fine!

(Extra Small) I guess we need to do it again, it is not good enough.

(Medium) I will be really busy before Monday afternoon.

(Small) Just remember we need to bring our gift to the party.

Task document: Task content for Practice

(Extra Large) Thank you so much!

(Small) It is not good.

(Medium) I have to go.

(Extra Small) Nothing Special.

(Large) I have heard so much about you.

(Medium) Keep in touch !

(Extra Large) You made my day!

(Extra Small) I need some sleep.

(Medium) How do you like your new job?

(Small) Are you making progress on your project?

LITERATURE SUMMARIES

Bayer, M., Sommer, W., & Schacht, A. (2012). Font size matters—emotion and attention in cortical responses to written words. PLoS One, 7(5), e36042.

Objective:

The study sought to investigate the event-related potentials effect of larger images which are emotion-inducing. The study is cognizant of the fact that it is not a must for pictures to be incorporated in any media. Words alone are perfectly capable of explaining an entire scenario. In fact, images cover more space on computer devices, and demand better ink quality to facilitate their printing. In that regard, it is vital to investigate the actual impact that images as well as their sizes have on the readers' emotions.

Method:

The experiment employed the use of primary source of data. 24 participants were recruited to partake in the study. They all had common characteristics in a bid to ensure that there no external factors that influenced their reaction during the experiment. For instance, they all spoke German, had vision deemed to be normal or corrected to be so, and had no disorders with respect to neurology pr psychiatry. Different nouns were selected from German words, each being graded differently with respect to its degree of arousal. The participants were made to read the words in two font sizes, one being large and another small. The participants had a button they would press if they felt the word they read had a similarity with that which preceded.

Results and Conclusion

It emerged that words which were large in size would be associated with more negative sentiments in comparison with their small letter's counterparts. The results in turn prove that indeed font size does matter in emotion inducing. When one writes a word and they make it larger than the rest, it tends to stand out, and it is easy for it to move a section of the society.

Remarks

The experiment was undertaking under the supervision of experienced experience control. It is a steppingstone to better and more robots studies to be undertaken in the future. It was a fulfilling experience at the end of the day.

Wigdor, D., & Balakrishnan, R. (2004). A comparison of consecutive and concurrent input text entry techniques for mobile phones. Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems

Objective: the study is cognizant of the fact that the manufacturing tendency of mapping the 24 letters of the alphabet onto the 12 letters of the keyboard in cell phones poses a daunting task upon the phone users. There are various typing techniques, including the use of one or two

hands. They all affect the experience of the cell phone users. The study therefore sought to compare the different styles and their impact on phone users.

Methodology

The study employed the use of primary data. a group of participants were engaged to partake in the experiment. It was necessary that human beings with common traits are used so that it may not be claimed that underlying differences between them influenced the variation in results. They were made to use different phones at different points in time. each of the participants spent time having a feel of the phone design and employed their typing technique to see how different or same they would feel.

Results and Conclusion

It emerged that the phone users found the concurrent chording technique to be the most suitable for them. it was clear that the best way to design the keyboard of the phone is one. The study made it clear that the way letters of the alphabet are arranged on the 12 keyboard numbers is vital as it has an impact on the typing experience of the users.

Remarks

The experiment was a low cost and quick undertaking that bore credible information. It is poised to make phone users enjoy their experience. It is also vital in informing phone manufacturers on how to design their products so that they attract more clients.

Castellucci, S. J., MacKenzie, I. S., Misra, M., Pandey, L., & Arif, A. S. (2019). TiltWriter. Proceedings of the 18th International Conference on Mobile and Ubiquitous Multimedia. https://doi.org/10.1145/3365610.3365629

Objective

The experiment is cognizant of the fact that not all mobile users are capable of touching the screen while entering data. They need an alternative which needs to be as close to the original as possible. It also acknowledges that when the screen is tilted, there is a better feel of the keyboard and data is entered better than when it is in the upright position. It therefore presents users with the tilt-like keyboard that uses manual data entry technique. It sought to compare the touch and non-touch keyboard entries, and the experience that their users have.

Method

The study involved the use of participants selected to partake in an experiment. They were granted the two sets of phone entries and required to use them to type. The speed with which they typed was recorded and the average for those who used both variant of keyboard entries was computed.

Results and Conclusion

It emerged that the speed of entering data using Qwerty system was much less than that of the custom keyboard. The latter allowed data entry at 15.2 words per minute, while the former allowed the entry of 12.5 words per minute. Clearly, the customized keyboard is much better when it comes to speed and customer experience.

Remarks

The study was undertaken in a low-cost fashion and within a short span of time. The participants cooperated and they made the process successful. It in turn stands a chance of changing the way data entry is done in the world.

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