CallForYou: Designing an Interface for a Convenient Phone Call Application

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ABSTRACT

Nowadays, it is common for people to call a phone number written on flyers or banners to order takeaway or to make an appointment. However, making a call would consume peoples' mental energy when they try to make sure the inputted phone number is correct. To relieve this situation, we aimed to reveal which factors affect usability and to propose a new mobile application named CallForYou. CallForYou detects phone numbers on the photo and allows users to dial the number simply by pressing a few buttons. The user interface of CallForYou was designed and refined according to the result of multiple user studies. Moreover, CallForYou is comparable to manual typing in terms of the actual interaction time with fewer clicks.

1 INTRODUCTION

In our real life, we often encounter situations where we have to make a call with unfamiliar phone numbers. We make a call to reserve a table in a restaurant, to obtain information on the working hours of facilities, and to order food delivery. In particular, we have more chances to call unfamiliar numbers because of recording our visits during the COVID-19 pandemic. In these cases, we have to type the numbers one by one to call. Manual typing may cause inconvenience to users: making a wrong call because of typos, taking a long time to type the numbers one by one, and need for attention to check if the typed number is correct. However, there is no off-the-shelf application that enables users to call with less inconvenience. The goal of our study is 1) to explore which factors can cause discomfort when users are calling by using the new application, which is CallForYou and 2) to design an appropriate interface for CallForYou based on such factors.

We conducted one FGI to understand users' needs for CallForYou and two pilot tests to explore interface design issues. After the FGI and pilot tests, we redesigned the interface of CallForYou to cope with the issues. We conducted two experiments with four participants 1) to validate the efficiency of our modified interface and 2) to compare CallForYou with manual typing.

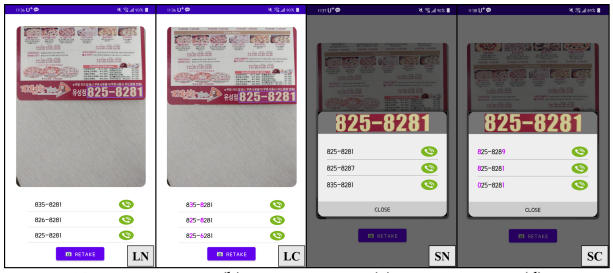
The contributions of our study are as follows:

(1) We propose a new artifact, CallForYou, which assists you to make a call with more convenience.
(2) We explore factors that can cause discomfort when users interact with CallForYou through an FGI and two pilot tests.
(3) We share additional interaction issues for future work, which were found in two experiments.

2 RELATED WORK

Some applications have similar functionality with CallForYou existing on the market. Apple Live Text is one example that can recognize text shown in the photo. If phone numbers appear in the photo, users can click on the phone number in the photo to dial the number. However, since Apple Live Text is not specialized for making a call, it has limitations on handling different phone number formats. As the format varies a lot in the real world (e.g., hyphens (010-123-4567) or white space (010 123 4567)), Apple Live Text might not be able to support all these cases.

ABBYY Business Card Reader is another mobile application that can recognize the text on a photo. ABBYY can read the information written on a business card. A paper written by Dangiwa et al. [2] demonstrated a similar idea on interacting with business cards. They claimed that the accuracy of text recognition and data detection is high, which is up to 74%. However, since the previous works above are only targeted at business cards, phone numbers written in other formats such as flyers and banners will not be acceptable to dial phone numbers with those applications.



(a) (b) (c) (d)

Figure 1: Four interfaces of CallForYou for Experiment 1. We refer to each interface as a combination of two alphabets (L: long distance, S: short distance, C: color highlight, N: no color highlight). The combinations of two alphabets are at the bottom right of each interface.

3 CALLFORYOU

CallForYou is an application that detects phone numbers in pictures taken by users and helps them make a call with fewer clicks than manual typing. Specifically, after users take a picture of the phone number, CallForYou shows the users the list of the phone number detected by phone number recognition models. The users can call by selecting the correct phone number in the list. CallForYou requires at least 3 clicks to call the mobile phone number in the best case, while manual typing requires at least 12 clicks to call the same number in the best case.

3.1 Interface Design

We found two design issues of our first prototype shown in Figure 1 (a) through a pilot test with three participants and an FGI with two

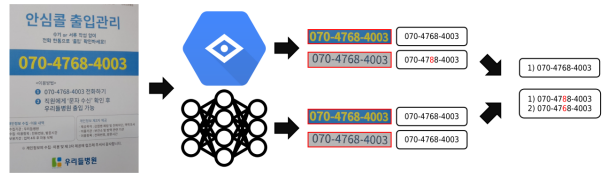


Figure 2: The process of Phone number recognition model.

participants. First, some participants had difficulty in comparing the actual numbers in the photo with the candidate numbers in the list because of the long distance between them. Second, participants responded that it would be easy to compare different digits among the candidate numbers if they were highlighted in a different color. So, we assumed that these two issues impede the usability of CallForYou. Therefore, we implemented four versions of the interface design to verify the impact of these two factors on the usability of CallForYou, which are shown in Figure 1 from (a) to (d). In addition, we implemented the final version of CallForYou based on the interface shown in Figure 1 (d), which provides the functions of editing phone numbers and area code provision.

3.2 Phone Number Recognition Model

CallForYou has a vision-based phone number recognition model which automatically detects phone numbers from a photo captured by a smartphone camera. The main features of our model are as follows: 1) Accurate phone number detection from the collaboration of two OCR models, Google Vision API and STAR-Net [5], 2) Phone number filtering to remove other unrelated texts, and 3) Candidate number provision to handle the performance limitation of vision models.

The process of the model is shown in Figure 2. From an RGB image captured by a smartphone camera, Google Vision API and STAR-Net detect text boxes in the image. After that, the model filters the texts whose pattern is not phone numbers. Finally, CallForYou combines the results of each OCR model. If both results from OCR models are recognized identically for a box, CallForYou determines the phone number of that box as the recognized number. However, if the results are not identical, CallForYou provides two candidate numbers for that box.

3.3 Data Gathering

We collected data generated when the users interacted with CallForYou. We gathered 13-digit Unix timestamps to measure the time taken for each stage of the task, and we collected the data about which bounding box users selected and which position on the list users clicked. More details of the data are shown in Table 1.

Name	Description
Timestamp1	A timestamp right after users execute CallForYou
Timestamp2	A timestamp right after users take a picture of the phone number
Timestamp3	A timestamp right after showing a phone number list to the users
Timestamp4	A timestamp right after users select one phone number from the list
Selected_box	The index of the bounding box selected by users
Selected_position	The position of phone number selected by users in the phone number list

Table 1: The descriptions of the collected data.

4 USER STUDY

4.1 Procedure

On the one hand, the first experiment evaluates the effect of two interfacial factors on the usability of CallForYou. CallForYou provides users the candidate numbers for the detected number in the bounded box. In this stage, users need time to consider and compare the candidate numbers with the actual number on the photo. Since such consideration is highly related to the usability of CallForYou, we evaluate user consideration time according to two factors: 1) distance between the actual number and candidate numbers, and 2) color highlight emphasizing unmatched digits in candidate numbers. From these factors, we made four different experimental conditions (Figure 1). Moreover, to give the participants equal difficulty tasks for all conditions, the applications in the first experiment always provide three candidate numbers regardless of the consistency of models. On the other hand, the second experiment evaluates the usability of CallForYou compared to manual typing. So we measured and compared the task completion time of CallForYou with the conventional calling method, manual typing.

We recruited four participants and conducted two experiments through a within-subjects approach. Moreover, we utilized Latin square to minimize the order effect. In both two experiments, the task participants have to do is to call numbers on eight printed documents. Among these documents, five documents have the phone number with an area code, and the other three documents do not contain an area code. For the missing area code, the two experiments have different policies. Since the first experiment focuses on the effectiveness of the two factors, the participants were asked to ignore the missing area code. On the other hand, we asked them to handle the missing area code in the second experiment because handling the area code could be related to the usability of CallForYou. In the second experiment, participants should find and fill the missing area code using a web search for the manual typing condition. Whereas, for the CallForYou condition, they should select the area code using the internal functionality of CallForYou. All experiments are conducted by using LG G8 ThinQ.

4.2 Results

4.2.1 Effect of Two Interfacial Factors on the Usability. The first experiment measured the user average consideration time to select the desired number from three candidate numbers to assess two interfacial factors. Then, we analyzed the effect of two factors using two-way ANOVA. Figure 3. (a)shows that the difference between LN and LC and the difference between SN and SC indicate the effect of the color highlight. There are significant reduction effect on user consideration time ($F=4.288$, $p=0.0408 < 0.05$). However, the distance between the candidate numbers and the actual number does not show a statistically significant effect ($F=0.6820$, $p=0.4106 > 0.1$), where the results are from the difference between LN and SN and the difference between LC and SC. From this result, we can find the color highlight make a positive effect on the usability of CallForYou, but the method to shorten the distance does not.

4.2.2 Usability of CallForYou. The second experiment measured the average task completion time to assess the usability of CallForYou. We compared CallForYou with manual typing by using

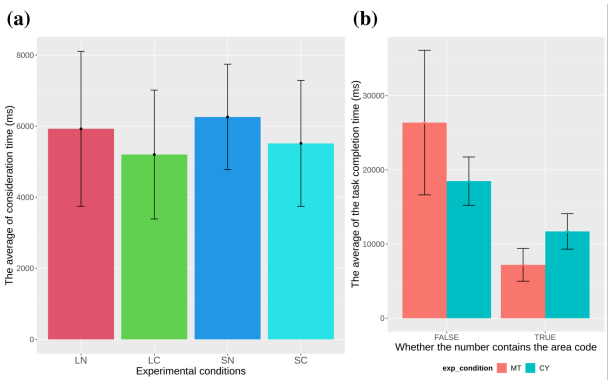


Figure 3: The bar graphs of the experimental results. (a) The average consideration time according to two interfacial factors, (b) The average task completion time of manual typing and CallForYou

one-way ANOVA in two different conditions, whether the target phone number contains the area code or not. Figure 3. (b) shows the result. When there is no area code in the given phone number, CallForYou shows better performance in terms of the task completion time, which is statistically significant ($F=38.17$, $p=3.24e-07 < 0.001$). In such a case, the additional task, searching the unknown area code via the web, can be much more costly than the area code provision functionality of CallForYou. However, when there is an area code in the given phone number, CallForYou shows significantly worse performance ($F=7.09$, $p=0.0014 < 0.05$). To reveal the cause of worse performance, we conducted further analysis by measuring how much time the users participate in actual interaction with CallForYou, which is task completion time without model latency. The gap between the manual typing and CallForYou is small when the model latency is not considered, which means that actual interaction time does not significantly differ with manual typing ($F=0.015$, $p=0.902 > 0.1$). Moreover, the call error rates are 3.12% and 0% in manual typing and CallForYou, respectively.

5 DISCUSSION

5.1 Further Interpretation

As confirmed in Section 4.2, the first factor, which is the distance between the actual number and the candidate numbers, was not statistically significant. The pop-up window, which is displayed to reduce the distance between the numbers, might be a confounding variable. Since the pop-up window occludes the existing phone number in the photo taken, users have to recheck the actual phone number in the pop-up window. It might cause additional consideration time.

The second factor, which is the color highlight on different digits, made statistically significant differences in terms of the consideration time. Moreover, some participants expressed satisfaction with the color highlight via post-survey. We interpret that color highlight assists users' selective attention [4]. The consideration time can be reduced because the color highlight helps users ignore unnecessary information and focus only on important information that is different digits between the numbers in the list.

5.2 Other Factors to be Considered

We found two additional factors that could affect the usability of CallForYou through the analysis of the experiments. First, we confirmed that the position of the target number on the candidate number list affected the consideration time. The first item has the shortest consideration time without the color highlight, while the last item has the shortest consideration time with the color highlight. Interestingly, unlike previous work related to visual search [1], [3], there is no linear relationship between the position of the target number and the consideration time. The most impressive thing is that users spend much more time when the target number is located in the middle of the list regardless of the color highlight. In addition, there seem to be some differences depending on whether the color highlight is given or not, but more thorough studies will be needed on how the color highlight affects visual search.

Second, the small size of the bounding box decreases usability. There is a weak negative correlation (-0.11) between the consideration time and the area of the box. One participant said "It took a little longer time to call the number in picture 3, this was because I couldn't click the box well." In the future, it will be necessary to come up with how to deal with the small box to eliminate the touch issues.

5.3 Limitation

We found two main issues of CallForYou through the post-survey: long waiting time and click issues. As mentioned in Section 4.2.2, the latency accounts for a large portion of the total task completion time. In the future, the development of the phone number recognition model could be an opportunity to shorten the whole task completion time.

The click issues due to small buttons were not found in the first pilot test. These click issues, which occur when multiple phone numbers are displayed to users along with the small button, were discovered during the experiment. In the future, the overall button size should be enlarged so that the click issue does not negatively affect experiments and usability.

6 CONCLUSION

In this research, we have implemented the application CallForYou based on the users' needs from the FGI and the two pilot tests. After the FGI, we have spotted two main design factors that may hinder the performance of CallForYou, such as the distance and the color highlight. The experimental results showed that the first factor, the distance, is not significant in terms of the consideration time of users. Whereas, the consideration time can be reduced significantly when the color highlight is given. We also explored two additional factors by analyzing the users' interaction logs and observing the users' behavior, which are the position of the target number and the size of the box. According to the experimental results, we argue that CallForYou is a better approach to call than manual typing because there is no significant difference between the two approaches in terms of the actual interaction time, and CallForYou requires fewer clicks than manual typing. We expect that CallForYou will help users make a call with more convenience in the real world, and the knowledge we produced will be helpful for further research related to the phone call application.

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