

DESIGN PROPOSAL: SPAM CHECKER

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Tan Yi Jia

Department of Communications and New Media, National University of Singapore

Dr Dennis Ang

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According to a Straits Times article, in the first half of 2021, scam victims in Singapore lost \$168 million to conmen in the top 10 scam categories, up from \$63.5 million in the same period last year (Low, 2021b). Of these scams, many were conducted via advertisements on social media platforms and “unsolicited WhatsApp messages” offering fake jobs and investment opportunities. These results come despite existing efforts to combat text scams such as the National Crime Prevention Council’s scam prevention mobile app ScamShield which “uses artificial intelligence to identify and filter scam messages... (and) block phone calls” (Low, 2021a). Though ScamShield has blocked more than “8,600 phone numbers” and “about 1.4 million SMSes have been reported via the app”, scams remain rampant today. Hence, I propose the design of a Spam Checker mobile application that can help users identify spam messages, preventing them from falling for such scams that are missed by existing measures while also keeping them from mistaking legitimate messages for spam.

Data Sources

To inform the design, two relevant news articles regarding scams in Singapore are used to justify the need for this design. In addition, two datasets are used: a dataset of SMS labelled messages collected for mobile phone spam research to provide a starting base for the design, and the mobile operating system market share dataset in Singapore to inform what platform the design should be made for.

Relevant News Articles

The two news articles written by Donald Low (2021) are used to highlight the prevalence of scams in Singapore, revealing a glaring need for scam prevention in the country. As mentioned earlier, the amount of scam victims continues to increase yearly despite current

efforts, as more people begin to assimilate communication devices and technologies into their daily lives without much education regarding scams. One particularly vulnerable population in Singapore is the elderly, who – according to Lions Befrienders chairman Anthony Tay – are “often targeted by scammers as they are more susceptible to trusting strangers and often lack confidence in using the Internet” (Menon, 2021). This reveals that not only is there a need for increased efforts in scam prevention in Singapore, but this need is also amplified among the elderly. Hence, the proposed mobile application should be designed to be elderly-friendly as well, keeping it accessible and easy for them to use so that they can use it to avoid getting scammed.

SMS Spam Collection Dataset

Donated in 2012 and published on the UCI Machine Learning Repository, this public dataset consists of 5,574 SMS messages collated from various sources, labelled as “ham” or “spam” depending on whether they are legitimate or irrelevant/unsolicited messages respectively (Almeida et al., 2012). Specifically, the dataset includes 3,375 randomly selected SMS ham messages from the NUS SMS Corpus (NSC), 425 SMS spam messages from the Grumbletext Web site (a UK forum where users report SMS spam messages), 450 SMS ham messages from a Caroline Tag’s PhD Thesis, and 1,002 ham and 322 spam SMS messages from the SMS Spam Corpus v0.1 Big which has been used in multiple academic studies (Almeida et al., 2012). This dataset will be used in the proposed mobile application’s algorithm to detect whether submitted messages are likely to be spam or not and will provide the app with a strong starting base. As more spam and legitimate messages are submitted to the Spam Checker app, its database will grow, and the algorithm should thus be able to detect spam messages more accurately.

Mobile Operating System Market Share Dataset

This dataset by StatCounter detailing the market share of the different mobile operating systems used by Singaporeans reveals that as of September 2021, 70.36% of mobile phone users in Singapore use Android devices whilst 28.54% use iOS devices (StatCounter, 2021). This raises a big issue since the ScamShield application mentioned in the introduction is only available for iOS devices, meaning that Android users would not be able to receive the same protection from scams. While a few spam blocking applications exist on the Google Play store for Android, their functionalities are extremely limited (e.g., only text, email, or calls) and they are overall not very polished with a sub-par user experience, impeding upon their usefulness for scam prevention and adoptability by the elderly. Furthermore, these applications solely rely upon their algorithm's detection of spam and do not allow for human discernment of what is spam or not, leading them to possibly detect a legitimate message as spam or miss some spam messages. Hence, knowing that most Singaporeans use Android devices and that iOS users have the option of ScamShield for some level of scam protection, the proposed mobile application would be designed for Android devices, with iOS support only to be considered after the Android version is polished enough.

Interviews

As highlighted by the news articles, the elderly are especially susceptible to scams in Singapore. Hence, to better understand the elderly and the context surrounding their handling of spam messages, interviews were conducted with my parents – a 63-year-old Chinese male (Interviewee S) and a 68-year-old Chinese female (Interviewee D). The former holds a masters' degree and is a civil engineer in a management position, while the latter holds a diploma and is a homemaker. Both use messaging apps on their smartphone daily. Other non-familial elderly

interviewees would have been preferred to avoid a conflict of interest during the interview, but these were the only accessible interviewees within the time frame and my reach. Hence, explicit reminders were made before the interview to answer the questions honestly. The interview transcripts and notes can be found in Appendix A and B. From these two interviews, the following key findings were observed.

Education is Key

While both interviewees had an acute awareness of spam messages on their mobile phones and were generally able to detect scams easily, this may have been influenced by their high levels of education. Both interviewees were relatively educated compared to the rest of the elderly in Singapore, with one holding a diploma and the other holding a master's degree. In contrast, according to the 2015 General Housing Survey, only 8.2% have a university degree and 6.4% have a diploma or professional qualification respectively among residents aged 55 years and above (Singapore Department of Statistics, 2015, p. 14). Both interviewees agreed on the importance of education in preventing people from falling for scams, with S pointing out that “(even) in the old days, people can be fooled by cheats and many scams as well (though it wasn't the) digital age”.

Knowledge Gap between What to do and How to do it

While S had no problems dealing with spam messages due to his tech literacy level from his experience with programming and as an engineer, there was a mismatch between D's knowledge of what to do and how to do it. While D was able to identify spam messages and knew what to do in response, she did not know how to do everything that was recommended – in this case, blocking the spam contacts (see Table 1).

D:	Must learn how to block. That is very important. If not it (the spam) keeps on coming, then (I keep needing to) exit.
I:	Do you know how to block?
D:	I don't know. That's why (I) have to find out.

Table 1: Interview transcript portion with D on blocking spam contacts. "I" represents the Interviewer, myself.

There is a gap between D knowing to block spam contacts and how to do so, revealing that education regarding dealing with spam messages should go beyond what to do, also teaching how to do what needs to be done. Therefore, the spam checker mobile app should teach users not only what to do in response to a spam message but also how to do so.

Skipping of Unsure Messages

Both interviewees were confident in their handling of spam messages, especially S who lay out specific ways to detect whether a message is spam or not by checking the sender's contact number. However, when D was asked what she would do if unsure whether a message was spam or not, she said that she would just skip it (see Table 2).

I:	Then if you're not sure whether it is (a) scam or not – especially fake news all that – how do you check whether it is true or not?
D:	Normally I will just skip it.
I:	Skip it, like just ignore?
D:	Just ignore it.

Table 2: Interview transcript portion with D on what they do when unsure if a message is spam or not.

This may pose a problem if the suspected message is legitimate, causing D to dismiss a potentially important message. Hence, some way for users like D to check the legitimacy of a message more definitively would be useful.

Reliance on Messaging Software's Spam Handling

In their handling of spam messages, both interviewees used the existing apps' scam handling software on their phones extensively (see Tables 3 and 4).

S:	I will just so call “block” them. Block the phone number, block the people. It can block. Software can block.
I:	By “software” you mean...
S:	The apps! The apps can block, including SMS can block, including telephone call can block. But these people always change their number.

Table 3: Interview transcript portion with S on what they do in response to spam messages.

D:	They (WhatsApp) have an indication “Report Scam” or whatever... so I just press “Report Scam”. Then when you report scam it is already deleted.
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Table 4: Interview transcript portion with D on how they report spam messages.

However, these functions still require users to discern for themselves whether the suspected messages are spam or not before they can indicate them as such. While this may not be an issue for D and S due to their ability to detect scams, other less-educated elderly users may wrongly report legitimate messages as spam when prompted by messaging apps, causing them to not only miss out on potentially important messages but also block a legitimate contact. On the other hand, an over-reliance on these messaging apps’ detection algorithms may cause problems, such as if a spam message manages to get past the algorithm. If a user is too reliant on the apps’ ability to detect spam, they may accept these messages as legitimate and fall prey to the relevant scams. Therefore, a way to more definitively detect whether an message is spam or not would be useful for such users to better discern what messages are spam.

Design Problem

Based on the above data sources and interviews, I have conceived of the following design problem statements:

- A. Elderly Android users need an accessible way to confidently verify the legitimacy of messages to avoid being scammed.**
- B. Elderly Android users need to be educated on how to recognise and deal with spam messages to avoid being scammed.**

The mobile application must therefore meet these five primary goals:

1. Users must be able to verify the legitimacy of messages through the app
2. The app must teach users how to recognise scam messages
3. The app must teach users what to do in response to scam messages and how
4. The elderly must be able to use the application easily
5. The app must meet Android application design guidelines and be optimised for it

Proposed Design Solution

To address the design problems, I propose the following features for the design of a Spam Checker mobile Android app, which would not only allow elderly users to verify the legitimacy of questionable messages but also teach them what to do in response to spam messages and how.

Upload to Check for Spam

Understanding that elderly users who may be especially wary of new technology may not feel comfortable having an application read their private messages, the Spam Checker app will not read any of the user's messages or emails. Instead, if a user is unsure whether a message or advertisement from any platform is a scam, they can upload it to the application which will then inform them whether it is spam or not. This determination will be informed via an algorithm that checks the message against messages in the app's database, consisting of not only the SMS Spam Collection Dataset but also user uploads to the application when they check for the legitimacy of a message. These messages will be added to the database on an opt-in basis in case users do not want their private messages to be stored in the app. To further enhance the accuracy of the app in detecting spam messages, there could be a collaboration with ScamShield and the Singapore Police Force to share data and integrate their existing scam detection systems with the Spam Checker app's, which may also enhance their systems as well.

Multiple Modes of Input

To encourage users to use the application to check for whether something is a scam or not, the process should be made as convenient as possible. Furthermore, spam messages today may take on forms beyond text, extending to images. Being able to detect whether both texts and images are legitimate or not would thus enhance the application's ability to detect spam for users. Therefore, the application would not only support textual inputs but also images that can be analysed with textual recognition, allowing also for the analysis of questionable image advertisements or promotions received by users.

Spam Checking Collaboration

If the application is unable to confidently detect whether something is a scam or not, other users using the application can help to identify it via a "Spam or Not" page on the application. These will last there for a short duration (maybe a few days) before being taken down. The votes are then tallied by the application and registered in its machine learning algorithm based on the votes by the majority, while the user will be informed of the vote numbers and the application's decision as to whether it is a scam or not.

To help the application better detect spam messages, users will also be able to upload known spam messages to the app. This will grow the application's database of spam and legitimate messages, enhancing its ability to detect spam messages. However, if the application detects that these alleged spam messages may be legitimate, they will still have to go through a vote by other users to verify whether it is spam or not, preventing users from uploading legitimate messages as spam which may ruin the database.

Suggested Response to Spam

Recognising a spam message is important but knowing what to do then and how is vital as well. Following the receipt of a spam message, many users may simply choose to delete and/or ignore it. However, this would mean that future spam of a similar nature may still be received by the target user. The application will thus recommend actions to be taken in response to the spam detected, such as reporting the spam message to the application (such as on WhatsApp and Telegram) and blocking the relevant numbers to avoid receiving such messages from the same number. For users who do not know how to do these, the application will provide a step-by-step visual guide on how to do so through popular messaging applications such as WhatsApp, WeChat, and Telegram. The application will also encourage users to continue uploading spam messages to the application in the future even if they can identify them as spam to refine the app's database and help it to better detect spam messages for other users.

Elderly-Friendly Features

Noting that the target user group consists of mostly the elderly who are most susceptible to scams, design decisions would be implemented surrounding them such as having adjustable font sizes, larger buttons, and a simple user interface. A comprehensive yet intuitive onboarding process via an interactive tutorial will also be implemented the first time the app is launched, and it can be recalled any time the user forgets how to use the application.

Support for Multiple Languages

The 2015 General Household Survey found that among residents aged 55 years and above, only 24.1% of Chinese, 6.8% of Malay, and 39.1% of Indian residents most frequently spoke English at home (Singapore Department of Statistics, 2015, p. 20). Most of them spoke their native language(s) instead. Hence, it would be necessary for the Spam Checker mobile app

to support multiple languages – primarily Chinese, Malay, and Tamil. While the option to allow users to change language will thus be made available, elderly users may find it hard to navigate to this setting if they cannot understand the application. Therefore, this selecting of a preferred language for the interface will be done at the very start of the onboarding process.

Android Design Guidelines

To allow the application to be published on the Google Play store and ensure a quality user experience, the design guidelines from the Android developers' website at <https://developer.android.com/design> will be adhered to. Having it published on the Google Play store will allow more users to be able to find and download it, increasing accessibility as compared to having to download and install it on an external website via a separate file which the elderly may not know how to do.

Low-Fi User Testing

To gain insights into the intuitiveness and usability of the Spam Checker application's interaction flow, two think-aloud usability tests were conducted with my parents – a 63-year-old Chinese male (Participant S) and a 68-year-old Chinese female (Participant D). The former holds a masters' degree and is a civil engineer in a management position, while the latter holds a diploma and is a homemaker. Both use messaging apps on their smartphone daily. It is worth noting that S has developed software for work before and is much more tech-savvy than D, who struggles with the use of smartphone applications daily and requires continuous guidance for basic functions.

Methodology

Both participants were given a brief introduction to the Spam Checker application and its features then asked to go through a low-fi prototype of the application and perform a series of

tasks. The prototype can be found here: [Low-Fi Prototype](#). Participants were asked questions about the layout and their understanding of features throughout the testing as each task was completed, followed by a few post-test questions to ask about their overall experience, inclinations to using the application, and other suggestions.

The full testing guide can be seen in Appendix C. Other non-familial elderly participants would have been preferred to avoid a conflict of interest for the user testing, but these were the only accessible participants closest to the elderly within the time frame and my reach. Hence, explicit reminders were made before the user testing to participate in the testing honestly and both participants' feedback was considered carefully. The user test findings for S and D can be found in Appendix B and C respectively or from the respective documents.

Findings

From the user testing, the following key findings were observed.

Confusing Icons

Both participants found the menu icons at the bottom of the screen confusing and struggled to figure out what they were for (see Figure 1).



Figure 1: Menu Icons for Collaboration, Check Spam, and Archives from left to right.

From the user testing, S was at first confused about the Collaboration icon but quickly figured out that it was for Collaboration after some thinking, while D was completely unable to figure out what it was and thought it was for a “Locked” function of sorts. Both participants could not understand both the Check Spam icon and the Archives icon at all, with S even mistaking the icon to be for “Mail” (see Table 1).

Apart from the Menu icons, when trying to find the Settings menu cog icon located at the top right-hand corner of the screen to change the application’s font size, S found it almost instantly and tapped on it instinctively while D could not recognize the icon at all (see Table 1).

Table 5: Reactions from S and D regarding the menu icons.

Feature	Reaction from S	Reaction from D
Collaboration icon	At first was confused by the Collaboration icon, but quickly figured out that it was for the Collaboration function.	Did not understand the Collaboration icon. <i>“Locked it?”</i>
Check Spam icon	Did not understand the Check Spam ‘+’ icon. <i>“Plus icon is a what?”</i>	Did not understand the Check Spam ‘+’ icon. <i>“Plus message... Can add info? Plus message is what?”</i>
Archives icon	Mistook the Archives icon as a “Mail” icon.	Did not understand the Archives icon at all.
Settings Icon	Easily found the settings menu and changed the font size. <i>“Settings ah, this one. Everybody understands settings.”</i>	Not familiar with a settings menu, did not recognise the Settings icon.

Unclear Onboarding Experience

Both participants experienced some level of confusion from the Onboarding screens and did not understand them. Interestingly, the onboarding experience confused S’s understanding of the applications as he thought the screens were being shown in a chronological sequence instead of showcasing the application’s features, wondering why he had to vote for whether messages were spam or not when the application had already determined that a submitted message was spam. D was completely confused by the onboarding screens and did gain any understanding about the application’s features from the screens, remarking that the animations moved too quickly.

Unwieldy Collaboration Experience

Both participants faced some confusion while interacting with the application's Collaboration feature. S struggled to understand the Collaboration feature and initially did not understand that he was supposed to vote on the cards despite viewing the tutorial screen – likely also because the tutorial video was just a placeholder. Furthermore, the collaboration confused S's understanding of the application, thinking that the collaborated checking of spam completely replaces the algorithm's checking of spam. S suggested that informing the users of this Collaboration feature before downloading the application may remove this confusion (e.g., through the application store page screenshots). D, on the other hand, was completely lost and could not understand the Collaboration feature even after explanation. Both participants were confused by the voting card and were confused when asked to cast their votes for whether the message was spam or not.

Confusing Archives Page

Both participants were confused by the functionality of the Archives page. S misunderstood the Archives page, thinking that it was displaying all the messages submitted by all users to the application rather than just the user's own messages. However, after figuring out the page's function, S was able to navigate it with ease and was able to complete the task of deleting a submitted message without much difficulty. D, on the other hand, completely did not understand the Archives page and struggled to delete a message.

S suggested that the delete button could be bigger and coloured “red” to match his mental model of a destructive delete button and that the number of people who have voted on pending messages should be displayed as well.

Collaboration Reward System

S noted that there were no incentives for users to use the Collaboration feature and suggested that to entice users to use it, the application should thank users “for helping the community” or a similar message. S then also suggested a points and ranking system, whereby users can gain points from voting and level up to different ranks as they gain more points. However, S also noted that there should be punishments to prevent users from gaming the system and voting mindlessly just to earn points. S also suggested that for the Collaboration feature, a page like the Archives could exist whereby users can view a whole list of Unknown messages submitted by the community and vote on them if they are familiar with some of the messages.

Font Size

D found that the default font size was too small for her and struggled to read most of the text despite wearing her reading glasses, impeding upon her ability to navigate through the application. Interestingly, when asked how she would change the font size for the application, D pinched the screen to zoom in instinctively. In line with her mental model, the screen did enlarge because the Adobe XD prototype allowed for it though it was not an intended feature.

Though S liked that the font size could be changed, he mentioned that smartphones’ limited screen sizes should be taken into consideration when considering the largest font size in the settings.

Unclear Button Affordances

Both participants faced some confusion when interacting with buttons and figuring out what elements of the application were interactive. After checking a text message for spam, he could not understand what the “Share for Collaboration” button would do. D, being much less tech-savvy, was unfamiliar with the “Upload Image” button and did not recognise it. Both S and

D did not think to tap on the “What should I do” hyperlinked text to find out more about what to do in response to a spam message and did not know that they could tap the “?” icon beside the result to learn more about the result and the “Share for Collaboration” feature. S, therefore, suggested that the “?” icon should be coloured red to let people know that they can tap on it. Overall, when D was confused, she tended towards tapping the primary buttons which ended up performing an unintended action.

Amateur VS Advanced Users

While S was able to understand the application’s features by the end of the prototype testing and was able to navigate through it with relative ease during the test, D struggled heavily and was still lost after the experience despite extensive explanations. D completely could not understand how to use the Archives and Collaboration features and was only able to understand the basics of the Check Spam feature while S had a comprehensive understanding of the application after exploring it through the prototype testing. This highlighted that not every aspect of the application must be used by every user, and less tech-savvy users may only utilise the simplest and most necessary part of the application – the check for spam feature. In essence, while a user like D may only use the application to check for spam, users like S may use it to not only check for spam but also help others check messages and review their past messages as well. That said, D did not even know how to copy messages from WhatsApp, which made them unable to properly use the check spam feature anyway.

Confused by Low-Fi Prototype Limitations

Both participants were confused by missing screens and placeholder elements from the Low-Fi prototype. This was most noticeable from the prototype’s spam image checking feature whereby both participants were confused as to why the uploaded image was blank – it did not

make sense to them to check it for spam. S was also confused by the Upload Image button since screens were not added for him to choose an image from his device to upload like regular image uploading features in other applications. Instead, the image was instantly uploaded after he tapped “Upload Image” to his surprise.

Facebook and Google SSO Login

S expressed discomfort over the idea that he had to log in using Facebook or Google citing concerns over these corporations’ control over the application and hence chose to continue as a guest, disappointed that he could not create an account by the usual password system via email to save his data. D, on the other hand, was unfamiliar with the Single-Sign-On (SSO) login feature and asked for guidance on how to log in, afraid to press any buttons. This was exacerbated by her inability to read the login buttons due to their small size.

Mid-Fi Prototype

Based on the findings from this iteration of user testing, the following changes were made for the Mid-Fi prototype, which can be found here: [Mid-Fi Prototype](#).

Icon Changes and Labels

The “Check Spam” menu icon has been changed to an eye icon to communicate its function better, and the settings icon has been replaced with the word “Settings” (in blue so users know that it is clickable) so that elderly users who are unfamiliar with application icon conventions can find it easily. To make the icons even clearer, menu icons are now accompanied with labels as well to remove potential confusion in understanding the icons (see Figure 2).



Figure 2: Updated menu icons

Also, the “Archives” heading has been changed to “My Archives” to make it clear that messages there belong to the user. Within each card in the archives, the delete button is now also accompanied by a “Delete” label to make it easier to find and recognise.

Revised Onboarding Experience

Noting that the initial onboarding screens only served to cause confusion rather than inform users, they have been shorted to simply inform the user what they can do using the application. A dark-grey background behind the screenshots on the onboarding screens has also been added to show users that they are not interactive.

Instead of relying on a tutorial for the Check Spam feature – noting that very tech-illiterate users may get confused by tutorials – the steps are now made clearer using more obvious instructions and better styling of buttons to lead users to the correct action. Hence, there is also less reliance on the “?” icons for users to find out more, and instead, the relevant information is displayed instantly for users to see.

Instead, a comprehensive tutorial has been added for the Collaboration feature, noting that it is not only more complex but also not targeted towards the most basic users who only seek to use the application to check their spam messages.

Revamped Collaboration System

Instead of going straight to a voting card, the first screen in the Collaboration feature is now a dashboard screen showing the user’s level, experience points (XP), their submitted messages that are still undergoing community voting, and a “Start Voting” button leading them to the voting cards. Users can gain XP by helping other users to check if their messages are spam via voting cards, whereby correct votes will give them 3 XP. To disincentivise users from voting carelessly, incorrect votes will give them 0 XP. Noting that users may not remember everything

from the tutorial, prominent information “?” buttons have been added to the Collaboration dashboard that they can tap to reveal guiding tooltips providing information about the different parts of the Collaboration experience.

Number of Votes for Pending Messages

Submitted pending messages now also show the number of votes cast for the message (out of 50) to provide users with feedback as to how soon they can expect their pending messages to be ready. Upon garnering 50 votes, messages will then be classified as “Spam” or “Not Spam” based on the majority vote. If a vote has only a small majority of less than 55%, the message will be marked as “Unknown”.

Removal of Image Uploading

Noting that the image uploading feature could confuse the more tech-illiterate users like D, the feature – though a nice addition – had to be reconsidered. After all, most spam messages sent to mobile devices via messaging apps come in the form of text, and even those with images are accompanied by text that can be submitted through the application to check if the message is spam or not. This also factors in the consideration that if elderly users like D don’t even know how to copy and paste messages, would they know how to take a screenshot with their phone? Overall, the decision to have an image uploading feature that is potentially confusing and rarely used may not be viable, and hence it was removed.

Larger Default Font Size & Adjust font size on First Launch

Elderly users like D not only have visual impairments but also phones with smaller screens as larger phones may be too expensive and heavy to carry around. Hence, accounting for different phone screen sizes and different levels of visual acuity among the elderly, users are now able to adjust the font size when they first start up the application, ensuring that they can

navigate the application comfortably from the beginning. Also, the default font size has been increased to allow even the login screen to be accessible and ensure that the visual aesthetics of the application's UI is maintained for larger font sizes.

Clearer Interactive Elements

Noting that D and S frequently missed interactive elements like the “?” icons as they could not tell they were interactive from their design on the low-fi prototype, these elements have been not only made larger but also stylised to stand out more to make it more obvious that they can be interacted with. For instance, buttons are now larger, have more striking colours, and have a drop shadow to provide an illusion of “3D” space as if they are raised above other elements. This thus separates them from other elements and makes it clearer to users that they can tap on these elements.

Revised Login Experience

Noting D's unsureness as to which button to press and S's discomfort with the default login being done via Google or Facebook, the login buttons have been rearranged such that the default action is for users to login without having to sync their accounts. This not only makes the fastest way into the app clearer for less tech-literate users who may be confused by SSO login functionality but also makes it clear that Google and Facebook syncing is optional.

Clearer Help Screens

Noting that less tech-literate users like D may not even know how to copy and paste messages and may need extra guidance to use the application, the help screens now display more detailed step-by-step instructions to guide the user to perform actions from blocking and reporting users to copy messages from messaging applications. Access to these screens have also been made more obvious with buttons instead of hyperlinks, noting that elderly users like D and

S may find it more obvious to interact with buttons than hyperlinked text like the initial “What should I do?” underlined hyperlinks. This is also noting that users who need such help are normally less tech-literate, hence it makes sense to make the help screens more accessible.

Mid-Fi User Testing

Understanding that the elderly may not be so familiar with many important aspects of mobile applications, to gain more critical insights into the intuitiveness and usability of the Spam Checker application’s interaction flow, a think-aloud usability test was conducted with a 23-year-old Chinese male (Participant E), a computer science student who has experience with designing mobile applications and interfaces. The methodology is similar to the low-fi user testing, except the mid-fi prototype was used instead of the low-fi prototype. The full testing results can be seen in Appendix F.

Findings

From the mid-fi user testing with E, the following key observations were noted.

Help Screens Toggling Issue

E raised an issue whereby if a user wants to follow the guides provided step-by-step on the same phone as their messaging app, they will have to “keep toggling” between both applications. This may be difficult for elderly users, as they may not only struggle when switching between the two applications but may also get lost when returning to the Spam Checker application to find the next step. E also found himself a bit confused after reaching the end of the help page regarding what to do next and took a while to realise that he had to either tap the “Back” icon on the top left or one of the menu buttons at the bottom.

Unaware of Community Sharing Implications

E also mentioned that elderly users may not be familiar with the concept of a community, unaware that they are sharing their potentially private messages with other users in public. He mentioned that “they might not... have the intuition that... whatever they share can be seen and interacted with by other people”. Hence, this raises some privacy concerns as the elderly may unknowingly share private information via the collaboration feature which would be detrimental for them. E also questioned the effectiveness of the collaboration feature since the elderly would vote for each other as if the blind leading the blind.

Abuse of Community Voting

E raised an important note that if the community voting feature is “unregulated”, it could be abused by users with malicious intent who may vote spam messages to be not spam and vice versa. If a sizeable number of malicious users – or programmed bots – uses the application to vote spam messages as not spam, this is “dangerous” for the elderly users who may end up having their spam message identified as “Not Spam” by the application.

Archives Card Layout

E noted that the word “Archives” may be misleading as the word implies that all the messages there are “already completed” or “shelved”, but there are messages pending verification as well, revealing a mismatch between the system and the real world.

Furthermore, E mentioned that the card layout used might become an issue if there are too many messages, saying that “if (there are) too many cards, scrolling left and right might not be the most ideal”.

Unclear Font Size Affordance

While E had no issues finding the Settings menu to change the font size, he mentioned that elderly users unfamiliar with mobile application conventions may not know what's inside the settings menu and thus may not know that they can change the font size there. Hence, he suggested that the elderly users be made aware upon first using the application.

No Language Setting During Onboarding

While E appreciated that there was the ability to change the font size during the onboarding, something similar was not available for languages. Hence, non-English speaking users may struggle through the onboarding and may not even be able to find the settings menu after changing the language.

Colours for the Menu Icons

E noted that switching across the application's pages was "not... so obvious" due to the monochrome colour scheme of the bottom menu, especially for "people with not so good eyes" like the elderly. He suggested using "more colours" to help differentiate the current screen icon from the other icons, and possibly colouring the entire box instead.

Refined Mid-Fi Prototype

Based on the mid-fi user testing findings, the following changes were made to the mid-fi prototype. The refined mid-fi prototype can be found here: [Refined Mid-Fi Prototype](#).

Change from "Collaboration" to "Learn" feature

Noting the privacy issues surrounding the collaboration feature and its susceptibility to harmful abuse, the feature has been instead changed into a gamified learning feature. Each day, five "spam" and/or "non-spam" messages from the database that do not contain any private data will be featured on the Collaboration feature. Users will be able to access the "Learn" page to try

their hand out at identifying these spam messages. This feature aims to facilitate learning among the elderly, which supports S' view that education is most important for the elderly when tackling spam messages. Like the collaboration feature, for each correct answer, the elderly will be able to gain experience points to rank up, an incentive to use the "Learn" feature. Having the messages released daily encourages long-term learning by encouraging users to practice identifying applications over many days and not just in one sitting. By educating the elderly with this feature to help them recognise spam messages, they may then be less susceptible to scams from such messages.

This time, to encourage users to try out the "Learn" feature even if they may get some answers wrong, wrong answers will give users 1 XP while correct answers will give 3 XP. Hence, either way, users will be able to make progress to ranking up.

Now, if the algorithm is unable to detect whether the message is spam or not, it will be sent to an internal team for verification. This team could potentially be in partnership with the Singapore Police Force to share information about spam messages and help to identify them as well.

Language Setting for Onboarding

Users are now prompted to select their language before adjusting their font size during the onboarding process, allowing them to navigate through the onboarding and the application in their preferred language.

Reminder for Settings Affordances

After adjusting their language and font size, users are informed by a screen that they can change them again in the future via the settings menu, accompanied by a screenshot so they know where to find the menu.

Archives Layout and Name Change

To avoid confusing users, “Archives” has been changed to “Collection” to indicate a collection of the users’ messages, including pending messages. Furthermore, the archives card layout has been revamped to be sorted by month in a vertical order combined with the horizontal scrolling. This was done considering that users will unlikely receive excessive amounts of spam messages within a month, noting how users like D only receive them 2-3 times a month.

Help Screens Layout to Page

Instead of having the help screens on a scrolling, to help elderly users keep track of which step they are at when they toggle between their messaging application and the spam checker application, the steps are now sorted by pages. Furthermore, at the end of the pages, there will be a “Done” button which brings them back to the application’s main screens to prevent users from getting lost, not knowing how to get back after completing their task.

Coloured Menu Icons

When on a page, the respective menu icon at the bottom will now be highlighted in blue, making it clearer that it is the current page being accessed. An indicator line has also been added to let the elderly know which menu they are on.

Heuristic Evaluation

A heuristic evaluation of the refined mid-fi prototype was conducted using Jakob Nielsen’s 10 usability heuristics for user interface design (Nielsen, 2020), first published in 1994 but recently updated (see Table 6).

Table 6: Jakob Nielsen's 10 usability heuristics (Nielsen, 2020).

No.	Heuristic
1	Visibility of System Status
2	Match between system and real world

No.	Heuristic
3	User control and freedom
4	Consistency and standards
5	Error prevention
6	Recognition rather than recall
7	Flexibility and efficiency of user
8	Aesthetic and minimalist design
9	Help users recognise, diagnose, and recover from errors
10	Help and documentation

Based on these heuristics, usability problems that were found were rated on a severity scale of 0 – 4 in terms of how frequently they occurred, the impact they had, and how persistent the issue was. Then, the scores were averaged out into an overall severity score. The interpretations for each level of the scale are as follows:

In total, 24 usability problems were found from the evaluations. The findings also include observations by friends and designers and can be seen in Table 7 alongside the proposed solutions. The scores for Frequency, Impact, and Persistence can be found in the full testing document in Appendix G.

Table 7: Heuristic evaluation findings

No.	Description of Issue	Heuristics Violated	Overall Severity	Proposed Solution
1	While the application is checking for spam, users can still enter the “Settings” menu (and from there enter other menus), possibly interrupting the checking process. This would be an issue if an elderly	5, 6	3	Remove the Settings menu from the “Checking” loading screen.

	user accidentally tapped on “Settings” and did not know how to go back to check the results of the most recently checked message.			
2	Users may not know where to access pending messages from the “Unknown” result screen as nothing is telling them where they can do so. It is not immediately known to them that they may be able to access the message in the Collection.	1, 2, 6	3	Inform users that they will be notified when their message has been checked and that they can track the message status in their Collection. Also, add a button for them to view their collection.
3	There is no feedback for users who do not have any message in their clipboard after they tap to paste a message. Hence, elderly users unfamiliar with the concept of copy-and-pasting may be confused if they tap on the box to paste a message and see nothing happen. This may confuse them and lead them to think that the application is spoilt or not working.	1, 6, 9	3	If a message does not exist on the clipboard when the user taps to paste their message, add a pop-up notifying the user of such. The pop-up should allow the user to head over to the “Need Help” section as well so they can know what to do.
4	Having the “Settings” menu button in primary blue made it stand out too much, making it look like the primary actionable for some pages. For instance, on the “Help” pages, the primary “Next” button may be hidden on phones with smaller screens. Users may then instinctively tap “Settings” since it is in primary blue, causing them to get lost.	4, 5	3	Change the “Settings” button to dark grey, noting that the tutorial at the beginning of the screen can help inform users that they can access the settings menu there. Yet, recognition is still promoted as users can still find the button by its name “Settings” on the top right-hand corner if they do not remember the onboarding.
5	Users may not understand the difference between the “Start” and Google / Facebook Sign-In options. From the start screen, they are unaware of the need to sign in via SSO, and what the different outcomes will be if they tap “Start” and the SSO sign in options, which may cause some confusion right at the beginning for elderly users. This confusion is further exacerbated by the “Login” heading, as users may not think that “Start” and logging in support the same functionality. This	2, 4, 8	3	Add a text label for the SSO sign-in options to inform that they can sync their data to the cloud if they sign in via Google or Facebook while changing the “Start” button to “Continue as Guest”. Also, reduce the size of the SSO login buttons compared to the “Continue as Guest” button so the primary action of continuing without signing in is clear. The “Continue as Guest” label makes it clear for more tech-savvy users familiar with SSO login that they are not syncing their

	may adversely affect their first impressions of the application, thinking that it will be confusing.			data. As for less tech-savvy users, having the “Continue as Guest” as the main primary actionable will lead them into the app despite them possibly not being familiar with the SSO login features. Also, remove the “Login” text to avoid confusing users and de-clutter the main login screen.
6	The Dissolve transition for most screens can be disorienting for elderly users as the text blends, especially for the onboarding screens. This may cause them to struggle when navigating across pages. Furthermore, the existing transitions do not quite support the user’s mental model of breadcrumb navigation, and users may get lost easier.	1, 2, 8	3	Remove the dissolve transitions and add push transitions for the onboarding and help pages to symbolise going through a set of cards from left to right, supported by the dot navigation indicator. Change other transitions to either instant or slide transitions. The direction of slide and push transitions will help support the user’s mental model of the navigation, whereby sliding left will signify going deeper into a flow whilst sliding right will signify retracing steps.
7	On the onboarding pages, the text within the preview screens alongside the bright colours and seemingly tappable buttons draw the user’s attention away from the main text and the primary button. This confuses the user, which may be worse if the user is elderly. This is especially bad since these are the first screens the user sees when using the application for the first time, which can affect their overall impression of the application. Furthermore, the dark background ends up cluttering the screen and making the main actionable button less obvious.	4, 8	2	Replace the onboarding images with fewer and more abstract items to avoid cluttering the interface for the user.
8	While the result for a message the algorithm is unable to determine is labelled “Unknown” on the result screen, it is labelled “Pending” on the Collection page, which may confuse	2, 4	2	Re-label the “Unknown” message as “Pending” instead to inform users that checking is still in progress for their message and keep the wording consistent with the

	users due to the difference in wording. “Unknown” may also imply to the user that the application has been unsuccessful in checking if the message is spam or not and it may not be clear to them that it is still being determined. This confusion may be further exacerbated by how the label text underneath says “Unable” to detect if the message was spam or not, making the user think that the application was ultimately not able to check if their message was spam or not when actually, the application is still in the process of checking.			Collection page. Also, re-word the label to inform users that there is a team still checking the message.
9	What “Sync with Google” and “Sync with Facebook” do in the settings menu is unclear, and users unfamiliar with the concept may not know what it does and why they would want to sync with these platforms. This may thus confuse users and they may not be inclined to use the syncing feature even though they may be open to it.	2, 6	2	Add a label explaining that syncing data would allow data from Learn and Collection to be synced to the cloud so users can keep their data when changing phones.
10	The “SPAM”, “Not Spam”, and “Pending” boxes look like they are interactive elements that can be tapped (like buttons). Although the actual buttons are more prominent, to the new user it makes it look like there are two types of buttons – or even inconsistent buttons – which can confuse users and affect their perception regarding the application.	4, 6, 8	2	Remove the borders around the “SPAM”, “Not Spam”, and “Pending” statuses to make them more distinct from the buttons and clearer that they are not tappable.
11	Compared to the Results page, the screen space for messages from the “Collection” feature is very small. Users who want to view past messages may therefore find it difficult to read them especially if they are long messages as they have to scroll a lot and are only able to see a few lines at once.	4, 8	2	Increase the text box size for each message when accessed from the Collection page to the same size as that from the results page.
12	Advanced users are unable to select multiple messages for deletion at	7	2	Allow users to tap-and-hold messages in the Collection page to

	once from the Collection page. They may thus get frustrated if there are many messages they want to delete, having to delete them one by one, especially if a user wants to clear all their data from the application.			access a delete view, similar to that in a phone's Gallery. Then, users can tap on more messages to select them all at once for deletion. Also, add a "Clear all messages" functionality on the Settings page, alongside a confirmation dialogue whereby users must type "confirm" into a box as friction to prevent accidental deletion. This allows them to quickly clear all their messages from the application without having to tap one by one.
13	Users may not be familiar with the tutorial screens on the Learn page, not knowing that they must tap the screen to continue. Hence, users may think they are supposed to tap the highlighted elements, which may confuse them if they tap it and see that nothing has happened – except that the onboarding screen has changed which may disorientate them.	6	2	Add a "Tap to continue" text to the tutorial screens.
14	After tapping and holding to paste a message, the message instantly appears which may disorientate some elderly users. There is a lack of feedback provided for the elderly user, which may cause them to get disoriented. This problem also occurs after messages are deleted – users are led back to the Collection main page but have no feedback that the deletion was successful, and must manually check if the message has been deleted.	1	2	Add a pop-up notification letting users know when their message has been pasted in the Check Spam page or when a message has been deleted from the Collection page.
15	Some users may be confused by the "Delete" functionality for messages on the Collection page, thinking that the message will be deleted from their phone as well. This may occur more frequently for elderly users who are unfamiliar with how application data is separate from phone data. Hence, they may	2, 6	2	Add a disclaimer to the "Delete" confirmation dialogue informing users that the actual message on their phone will not be deleted.

	mistakenly think that deleting the message from the application is sufficient to delete the message from their phones as well.			
16	The header bar text is unnecessary on the Results page as there is already a “Result” on the screen. This adds needless clutter to the page, which can potentially confuse the elderly user who may have visual and/or cognitive impairments.	8	1	Remove the “Result” header on the page and keep the “Result” header on the top bar.
17	Under the “Notifications” settings menu, there are options for “Message identified”, “Spam news”, and “Software updates”. However, users may not understand what these terms mean. Hence, they may be wary of turning on notifications for them, possibly causing them to turn off important notifications like the “Message identified” notification which lets them know when a pending message has been identified.	6, 10	1	Add a text label under each option explaining them.
18	The round buttons across the application may make the application look cartoonish and less professional, which may influence the user’s view of the application’s reliability and authenticity. This may affect users’ willingness to trust the application’s interpretation of whether their message is spam or not.	8	1	Change the round buttons to rounded rectangle buttons which look more sleek.
19	Inconsistent help button styling – the “Need Help” button on the Check Spam page is styled a light white colour whilst the “What should I do” is styled the dull-blue info button colour. Hence, users may not immediately associate both of them with the help menus.	4, 6	1	Change the “Need Help” button colour to the info colour.
20	Having to tap and hold to paste a message on the Check Spam page is an unnecessary functionality for the check text message feature which unnecessarily slows down the process. It also makes it more	7	1	Change the Tap and Hold action to a simple Tap action.

	difficult for elderly users to use the feature as those with impaired motor functions may find it slightly more difficult to tap and hold.			
21	In the Collection feature, while users are informed of how many checked messages they have, they are not informed by month. Hence, they do not know how many messages they checked in a month. Furthermore, there is no scroll bar indicator to let them know how far they must scroll to see the earliest message in the month.	1, 6	1	Add the number of messages from the month beside the month label, and also add a scroll bar for each row.
22	Although the “Tap to paste message here” action on the Check Spamscreen is prominent and most users do not miss it, it is still not obvious that it is the primary actionable. This is due to how most of the app’s primary actionables are in primary blue while the former action is simply coloured black. The most obvious actionable available on the screen is the “Need Help?” button, which users may thus mistake as the primary button and get confused when they are led to the help screen.	4, 6	1	Recolour the “Tap to paste message here” action to primary blue to push it up the visual hierarchy, drawing users’ eyes there first and letting them know that the primary action is to tap to paste a message.
23	Users who forget how the Daily Test cards function works after the tutorial have no way of refreshing their knowledge other than trying out the cards themselves. From the daily test screens, users are unable to check how much XP each correct or wrong answer gives unless they go back to the main Collection screen. This may deter users from coming back to the Daily Test cards after prolonged periods of not using the application.	6, 10	1	Add a Help icon at the bottom of each card that provides a tooltip to guide the user regarding what to do and how much XP correct and wrong answers give.
24	The menu buttons are very jarring. Having the inactive icons in deep black makes them stand out a little too much, conflicting for attention with other elements on the screen.	8	1	Make the menu icons a lighter shade of black to prevent them from fighting for the user’s attention with the other elements on the screen.

	Hence, the interface becomes more cluttered, distracting the user from other elements onscreen and possibly overwhelming the elderly user with cognitive and visual impairments.			
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High-Fi Prototype

After implementing the proposed solutions from the heuristic evaluation, the final prototype was developed. It can be viewed here: [High-Fi Prototype](#). On top of the proposed solutions, minor visual tweaks were also performed to bring the prototype as close to the final product as possible. Furthermore, placeholder elements (except the privacy policy page) have been filled in such as the screenshots in the WhatsApp help pages and spam messages. Minor bugs in the refined mid-fi prototype have also been ironed out.

Limitations of High-Fi Prototype

These minor issues from the high-fi prototype should be noted when navigating through the prototype. They are not an intentional aspect of the design and mostly occur due to limitations of the prototyping software used.

1. When a pop-up appears (e.g., “Message Pasted!” or “Message deleted!”), it must be tapped away before other elements can be interacted with. The intentional design was for the pop-up to disappear on its own after a 3-second delay and users should be able to interact with the application while the pop-up is still shown.
2. As Adobe XD is unable to support tap-and-hold functionality, the tap-and-hold functionality to delete multiple objects on the prototype cannot be implemented into the prototype. For reference, it should be like that of a phone gallery’s multiple-selection and deleting functionality.

3. For the prototype, the onboarding screens for the “Learn” page appear every time it is accessed. It should only appear when the user accesses the feature for the first time.
4. The “Back” buttons for some screens (e.g., the Settings) are intended to lead to the previous screen accessed just before that screen. However, using Adobe XD’s “Previous Artboard” functionality causes issues such as an unintentional infinite loop at times since it does not support breadcrumb navigation. Hence, some back buttons – such as on the Settings menu – lead back to the main “Check Spam” screen.
5. The scroll bars within messages and the Collection page, though present, are static elements and don’t work due to Adobe XD limitations. However, their intended function is like that of a normal scrollbar which moves as the user scrolls, allowing them to track where they are in the scroll view.

Concluding Remarks

Overall, while the application is targeted at elderly users, it is still tailored to users with differing levels of technological expertise. The user unfamiliar with mobile applications will likely only use the basic functionality of checking for spam, hence, the syncing of user data may not be so important for users who simply want to use the application to check whether messages are spam or not. On the other hand, the more tech-savvy user may use the Learn feature to get better at recognising spam as well. These users may want to retain their progress from the Learn feature and review past messages in Collection to better detect spam, thus they may want to sync their data to the cloud.

This application therefore not only reduces users’ susceptibility to scams from spam by providing a convenient platform for them to verify messages but also educates users to help users recognise common scam tactics, helping them to avoid similar scams in the future. Functioning

with a dynamic database and live humans back-end to identify whether messages are spam or not, the application can continue to keep up with scam tactics as they evolve.

As Singapore continues to become more digitally reliant amidst the country's pursuit to become a Smart Nation, the elderly should not be left behind due to their fear of the many scams that come alongside the benefits of digital devices. Hence, the availability of the Spam Checker app to supplement existing efforts should help to alleviate these fears, encouraging the elderly to more willingly and confidently adopt new technologies to reap their benefits, thus improving their quality of life and integrating them into the nation's increasingly digitised society. The number of elderlies falling victim to scams from spam messages – both textual and visual – should hopefully be reduced as well, reducing the strain on the Singapore Police Force in having to deal with such incidents and allowing them to focus on other issues.

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Appendix A

Interview with S

STATEMENT OF INFORMED CONSENT

NM3221 Mobile Interaction Design

AY2021/2022 Semester 1

Project Description

A design student from the module NM3221 Mobile Interaction Design in the Department of Communications and New Media, National University of Singapore is conducting an interview to understand people's perceptions of and habits surrounding spam messages. This information will be used to inform the design of a mobile application to tackle spam messages as part of an individual class project.

- ☒ I have read the above project description.
- ☒ The researcher (Tan Yi Jia) has explained the purpose of the research to me.
- ☒ I have had an opportunity to ask questions about the project.

Freedom to Withdraw

Your participation in this project is voluntary. You can refuse to participate or quit the interview at any time. You can request to take a break at any time. You can ask questions at any time.

- ☒ I understand that I can withdraw from the interview at any time without giving a reason

Benefits and Risks

There are no benefits to you for participating, other than perhaps helping to contribute to the design of a useful spam-tackling mobile application and the learning process for the student involved. We hope that the project will benefit users susceptible to spam messages. This research poses no risks to you other than those normally encountered in daily life.

- ☒ I understand that there are no direct benefits, nor abnormal risks involved.

Data Collection

We will be collecting data through the interview by taking notes, asking you questions, and recording your comments, actions, and/or reactions. The recordings may involve audio recordings of the session along with notes taken.

- ☒ I understand that the design student may be observing me during the interview.
- ☒ I understand that my voice may be audio recorded.

Privacy and Confidentiality

The data collected is strictly confidential. The data may be used for class presentations and submitted to the lecturer as part of the project submission process. Any data presented to the class will be anonymized. Any audio recorded during the session may be transcribed as part of our notes, and the recording will be destroyed after transcription and project submission. A copy of the recording may be submitted to our

lecturer as part of the project for grading and verification purposes, and all recordings will be destroyed after the grading process is over.

- ☒ I understand that the design student may view my recorded data in the future.
☒ I understand that the data collected from me will be kept confidential.

Further questions or concerns

If you have questions about the project, you may contact the researcher Tan Yi Jia via phone at 9678 4612, or by email at tanyijia@u.nus.edu.

Informed Consent

To take part in the project, please indicate your agreement to the following statements and sign the form below, showing that you consent to the above terms.

- ☒ I agree with the above terms, and hereby consent to participant in the study.
☒ I agree / ~~do not agree~~ (please delete accordingly) to an audio recording during the session.

Participant Name:

Tan See Chee

Researcher Name:

Tan Yi Jia

Participant Signature:**Researcher Signature:****Date:**

10/10/2021

Date:

10/10/2021

Interview Notes

Question	Answer
Interviewee Details:	Male Chinese, 63, Civil Engineer in a Management position. Masters degree holder.
<i>Background Information</i>	
What language(s) are you proficient in?	English, Mandarin, Cantonese, Hokkien, Teochew, Malay
What language do you normally speak at home?	English, Cantonese
What mobile phone do you use?	Huawei P40
How often do you use your mobile phone daily?	Very very often
What do you normally use your mobile phone for?	Chatting via Whatsapp/Wechat/Telegram
<i>Regarding Spam Messages</i>	
Have you received spam messages before?	Yes
How often do you receive spam messages?	Daily
What do you normally do when you receive such messages?	Delete
Have you ever been unsure of whether something is spam or not?	Never
How do you normally check whether something is spam or not?	Normally deal with familiar phone numbers; just by a glance of the phone number country code (+65 is likely scam)
Have you done anything to prevent receiving this spam?	Block the numbers using the relevant apps (Whatsapp/SMS/etc.) but they always change their number
<i>Regarding Current Efforts</i>	
Do you know of any current efforts to prevent people from falling for scams?	Government – some sort of anti-scam software coming up, just announced
Do you feel that current efforts are sufficient?	It will never be enough, we must ourselves be educated and aware. The problem lies with people who are unaware, uneducated with technology.
Is there anything else you would like to add?	Education – people's awareness of scams and how they work – is the most key in preventing people from falling for scams, digital or not. Anti-scam technology will never be enough since scams always change.

Interview Transcript

I:	Ok, so... I'll begin the interview. What languages are you proficient in?
S:	English, Chinese, Malay? Chinese including Cantonese, Hokkien, Teochew.
I:	So you're proficient in all of them?
S:	Dialects, yes.

I:	Then... Mandarin also?
S:	Of course!
I:	So, what languages do you normally speak at home?
S:	English and Cantonese.
I:	What mobile phone do you use?
S:	Huawei P40
I:	Is that one Android?
S:	Yes.
I:	And how often do you use your mobile phone?
S:	Very very often
I:	For what?
S:	Mainly for chat.
I:	What do you mean by chatting?
S:	Chatting means WeChat, WhatsApp, Telegram.
I:	Have you received spam messages before?
S:	Yes, daily.
I:	Oh! What do you normally do when you receive (these messages)?
S:	Just delete.
I:	Have you ever been unsure whether something is a spam message or not?
S:	Never.
I:	Oh. So how do you normally check whether something is a spam (message) or not?
S:	Quite easy, like reading. Just look at it we know, because normally I only deal with phone number(s) that I know; people that I know. (I) never chat with strangers.
I:	When you say just by "reading", what do you mean by that?
S:	By a glance of the phone number. Sometimes you see – in Singapore we have this "65", if you see "65" it's from overseas! But it is as if it's (from) Singapore so these sort of chats we know it is a spam call or spam message.
I:	Have you done anything to prevent receiving this spam?
S:	I will just so call "block" them. Block the phone number, block the people. It can block. Software can block.
I:	By "software" you mean...
S:	The apps! The apps can block, including SMS can block, including telephone call can block. But these people always change their number.
I:	That's true. They always change. Ok, do you know of any current efforts to prevent people from falling for scams?
S:	Recently, the Singapore government wants to come up with an anti-spam or anti-spy type of software. And many software companies also have, like my

	company also have anti-spyware, anti-scams efforts. So we are very well aware of scamming and phishing.
I:	(For) the government, do you know what the anti-scam software is?
S:	It's coming up. Just announced. Anti-phishing also.
I:	Do you feel that the current efforts are sufficient at the moment?
S:	Well, being a programmer myself, I would say that it would never be enough. We just have to be vigilant; we just have to be thinking persons. The problem is (that) this sort of people are not many, because most people are not highly educated. Software, Internet, and all these do need a lot of knowledge, to be on guard.
I:	Okay. Is there anything else you would like to add?
S:	I think, to be an Internet digital economy in Singapore, we need all the citizens of Singapore to be highly educated. That's the only way not to fall into any scam or any phishing, because these are all knowledge-based systems. Knowledge is necessary to counter (scams). Unfortunately, not many people are knowledgeable, and secondly, a digital person (is) likely to be science-based so you need to know science and mathematics well. That is the main problem, but I think overall the key part is still knowledge. Singaporean has to be educated to a large extent, as large as possible, so that they will not fall into any digital scams.
I:	So education is the most important?
S:	Yes, education. Not only government effort – it is a personal education into this area. Because it is just like in the old days, people can be fooled by cheats and many scams as well without even digital age. These are basically people who are not aware of issues and ways that people can fool them. They are – in that sense – not so-called “intelligent” enough. But how to prevent all this? As I say, it's basically education and making sure that the citizens are well-educated. That's it. Thank you!
I:	Thank you! That's all!

Appendix B

Interview with D

STATEMENT OF INFORMED CONSENT

NM3221 Mobile Interaction Design

AY2021/2022 Semester 1

Project Description

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Benefits and Risks

There are no benefits to you for participating, other than perhaps helping to contribute to the design of a useful spam-tackling mobile application and the learning process for the student involved. We hope that the project will benefit users susceptible to spam messages. This research poses no risks to you other than those normally encountered in daily life.

- ☒ I understand that there are no direct benefits, nor abnormal risks involved.

Data Collection

We will be collecting data through the interview by taking notes, asking you questions, and recording your comments, actions, and/or reactions. The recordings may involve audio recordings of the session along with notes taken.

- ☒ I understand that the design student may be observing me during the interview.
- ☒ I understand that my voice may be audio recorded.

Privacy and Confidentiality

The data collected is strictly confidential. The data may be used for class presentations and submitted to the lecturer as part of the project submission process. Any data presented to the class will be anonymized. Any audio recorded during the session may be transcribed as part of our notes, and the recording will be destroyed after transcription and project submission. A copy of the recording may be submitted to our

lecturer as part of the project for grading and verification purposes, and all recordings will be destroyed after the grading process is over.

- ☒ I understand that the design student may view my recorded data in the future.
- ☒ I understand that the data collected from me will be kept confidential.

Further questions or concerns

If you have questions about the project, you may contact the researcher Tan Yi Jia via phone at 9678 4612, or by email at tanyijia@u.nus.edu.

Informed Consent

To take part in the project, please indicate your agreement to the following statements and sign the form below, showing that you consent to the above terms.

- ☒ I agree with the above terms, and hereby consent to participant in the study.
- ☒ I agree / do not agree (please delete accordingly) to an audio recording during the session.

Participant Name:

Doris Hoe Wai Fong

Participant Signature:**Date:**

10/10/2021

Researcher Name:

Tan Yi Jia

Researcher Signature:**Date:**

10/10/2021

Interview Notes

Question	Answer
Interviewee Details:	Female Chinese, 68, Homemaker. Diploma education.
Background Information	
What language(s) are you proficient in?	English
What language do you normally speak at home?	English, Cantonese
What mobile phone do you use?	Huawei, Smartphone (don't know model)
How often do you use your mobile phone daily?	Daily
What do you normally use your mobile phone for?	Messages
Regarding Spam Messages	
Have you received spam messages before?	Yes
How often do you receive spam messages?	2-3 times a month
What do you normally do when you receive such messages?	Report as scam via the messaging app (deletes it automatically)
Have you ever been unsure of whether something is spam or not?	Not really, will normally notice because it is abnormal
How do you normally check whether something is spam or not?	Don't normally check, just ignore if unsure
Have you done anything to prevent receiving this spam?	Report, nothing else
Regarding Current Efforts	
Do you know of any current efforts to prevent people from falling for scams?	Not really, but warnings are shown on TV to remind the elderly
Do you feel that current efforts are sufficient?	If they don't watch TV, they won't be able to learn. Warnings are important.
Is there anything else you would like to add?	Don't know how to block messages, must find out some way to learn how to block

Interview Transcript

I:	Alright. What languages are you proficient in? That you can confidently speak, can read very easily.
D:	English.
I:	English, ok. And what languages do you normally speak at home?
D:	English, ah.
I:	Anything else other than English? Or just English?
D:	Cantonese, with Papa.
I:	Alright. Then, what phone do you use? Do you know?
D:	Huawei.
I:	Do you know what kind of Huawei phone?
D:	Don't know. Normal one.

I:	Is it a smartphone?
D:	It's a smartphone.
I:	Ah. So how often do you use your handphone?
D:	For messages only.
I:	How often?
D:	Everyday, daily.
I:	Ok. Now I'll ask you some questions about spam messages. Do you know what are spam messages?
D:	Messages that you never come across, which (are) alien to you.
I:	Ok. So, spam messages normally include messages that like... make you go to websites that are bad, or offer you money that sort of thing but actually is fake one
D:	Or it'll offer some discount, or anything. Sometimes they offer discount... I also don't know. Sometimes they give you benefits...
I:	So... have you received these messages before? Spam messages?
D:	Not very often.
I:	But you got receive before ah?
D:	Ya. Once in a while.
I:	Not very often as in generally like how often? Once a week? Once a day?
D:	Sometimes... one month – two or three times only?
I:	Oh, ok. What do you normally do when you receive these messages?
D:	I will either report as scam or just delete off.
I:	Oh, how do you report as scam?
D:	They (WhatsApp) have an indication "Report Scam" or whatever... so I just press "Report Scam". Then when you report scam it is already deleted.
I:	Ok. Then have you ever been unsure – like not sure, when you see something, don't know whether it is scam or not.
D:	Not really lah. Normally I will notice it because it is always something that is not normal; messages that (are) not normal.
I:	Not normal as in...
D:	That you never receive such information before.
I:	So... the message is not what normal people send you?
D:	Ahh, correct.
I:	Ok. Then, say, if you receive a message, how do you normally check if it is spam or not?
D:	Normally I don't (get) scam(med). I can recognise, because the way they put it... which I never receive such message before. Not from my own chat group, ah.
I:	Then if you're not sure whether it is (a) scam or not – especially fake news all that – how do you check whether it is true or not?
D:	Normally I will just skip it.
I:	Skip it, like just ignore?
D:	Just ignore it.

I:	Ok. Then, have you done anything to prevent receiving the spam messages? I think earlier you mentioned you report it.
D:	I didn't do anything... then it never come back already.
I:	Ok, that's fine. So do you know of any existing efforts to prevent people from falling for scams?
D:	I mean... the victim has to be alert and also try to discern what type of message they are receiving.
I:	But do you know any current efforts? Like, say, by the government, or by organisations?
D:	Not really. But they did some warnings from the TV regarding scams to the elderly.
I:	Ahh, ok.
D:	So you can just view from there and learn from there. Then you'll be aware of it, awareness... gives you some awareness.
I:	Mmhmm. Ok, so do you feel that this... showing on the TV is enough to remind people to be wary, in tackling these scams?
D:	Only the person who has a TV... if they don't have a TV, they won't be able to learn from any news. The government should just highlight to those users – the elderly – who use the phone, just to highlight to them, to warn them. Then, they will keep an eye on it.
I:	Alright. Is there anything else you want to add?
D:	Must learn how to block. That is very important. If not it (the spam) keeps on coming, then (I keep needing to) exit.
I:	Do you know how to block?
D:	I don't know. That's why (I) have to find out.

Appendix C

User Testing Guide

Spam Detector: User Testing Guide

NM3221 Mobile Interaction Design

AY2021/2022 Semester 1

Purpose of User Testing

Find out whether the spam checking app design is intuitive, whether people would use it, and discover any design opportunities.

User Testing Procedure

1. Inform the participant of the purpose of the user testing
2. Ask them if they have any questions or things to clarify
3. Remind the interviewee to sign the consent form
4. Ask for permission for the session to be recorded
5. Record the session
6. Conduct the session
7. Stop the recording
8. Thank the participant for their time

Pre-Testing Questions

Background Information

1. What language(s) are you proficient in?
2. What language do you normally speak at home?
3. What mobile phone do you use?
4. How often do you use your mobile phone daily?
5. What do you normally use your mobile phone for?

Regarding Spam Messages

1. Have you received spam messages before?
2. How often do you receive spam calls or messages?
3. What do you normally do when you receive such messages?
4. Have you ever been unsure of whether something is spam or not?
5. How do you normally check whether something is spam or not?
6. Have you done anything to prevent receiving this spam?

Testing Tasks & Questions

Pre-empt: Take your time to go through the tasks, and feel free to think aloud.

Task 0: Onboarding

Go through the Onboarding screens.

Q1: What do you understand about the application from these screens?

Q2: Were the screens clear to you?

Task 1: Check Spam Experience

- Check whether a text message sent to you is spam or not using the application.
- Check whether an image sent to you is spam or not using the application.

Q3: What did you think of the Check Spam experience?

Q4: How likely are you to share messages for Collaboration?

Task 2: Collaboration Experience

Collaborate to check if someone's submitted message is spam or not.

Q5: What did you think of the Collaboration feature?

Q6: Would you use this feature? Why or why not?

Q7: What would encourage you to use it?

Task 3: Archives Experience

Delete a message you submitted on the 21st of September.

Q8: Was anything confusing about the Archives layout?

Task 4: Settings Experience

Change the font size for the application.

Q9: Did you face any difficulty performing this task?

Post-Testing Questions:

1. What did you think of the overall content layout?
2. Would you use this application? Why or why not?
3. Do you have any suggestions for the application?
4. Any Final thoughts?

Appendix D

User Testing with S

Question/Task	Findings
Interviewee Details:	Male Chinese, 63, Civil Engineer in a Management position. Masters degree holder. Has developed software before and is extremely tech-savvy.
Testing Tasks (Observation & Questions)	
Onboarding Experience	<ul style="list-style-type: none"> ▪ Understood the Check Spam onboarding screen. Was pleased to find that users can upload via both text and image. <i>"Can also post image, ah? ... That's a good feature."</i> ▪ Was confused by the Collaboration onboarding screen. <i>"You mean we will decide whether it's a spam or not spam? ... You're not checking from the website (aka online databases)?"</i> ▪ Did not understand the Archives onboarding screen. ▪ Overall, misunderstood the Onboarding Experience thinking it was a chronological sequence instead of showcasing the application's features.
Check Text Message for Spam with Spam result	<ul style="list-style-type: none"> ▪ Had no trouble checking for text. Found it neat that you simply have to tap to paste the message though it was an unintended limitation of the prototype. <i>"Eh... I never paste it already... type like that? It's quite good orh."</i> ▪ Did not realise that the "What should I do" hyperlinked text was clickable and simply read it aloud. ▪ Was confused by what "Share for Collaboration" meant. <i>"Share for collaboration, meaning... what does it mean? ... Your message has been shared... what does it mean?"</i>
Check Image Message for Spam with Unknown result	<ul style="list-style-type: none"> ▪ Was confused by the prototype since there weren't screens added for him to choose an image from the device to upload – it simply uploaded the placeholder image. Also was confused by the placeholder image since it was blank. <i>"Cannot check what, what for? (Referring to the blank placeholder) No use to check, nothing. Can I actually paste something?"</i> ▪ Was a bit confused by the Unknown result but quickly figured out what it meant. <i>"The word should not be 'Unknown'. It should be 'May not be a spam'. Unknown means I also don't know."</i> ▪ Regarding the "?" icon to learn more about the result: <i>"I think this is very long. But this one ah, I think normally it is in red colour to... encourage people to click it."</i>
Overall Check Spam experience	<ul style="list-style-type: none"> ▪ Found it easy to use and good overall. <i>"Very good. This is a very good software. It make(s) it as simple as possible so everybody can check."</i> ▪ Problem raised was he did not know who determined the message to be spam or not. <i>"Who is checking, that is the key."</i>

	<ul style="list-style-type: none"> ▪ Suggested that people can visit external websites to find out more about the spam messages.
Collaboration Experience	<ul style="list-style-type: none"> ▪ Struggled to understand the Collaboration feature. Suggested that people should know about the app's features prior to installing the software (possibly on the app store) so they can better understand it when using it. <i>"I think what you need to do, is before people install the software, you have to explain already."</i> ▪ Was confused by the Collaboration voting card. <i>"This one got nothing already what? 'Spam', 'Unsure', 'Not Spam'."</i> After figuring it out, it confused his idea of the application, thinking that instead of an algorithm deciding whether messages are spam, it's just users. <i>"This is we decide, go back to the same problem... how would a user know if it is spam or not spam?"</i>. Had to clarify that these messages are those that the algorithm was unable to determine were spam. ▪ Suggested thanking the user after voting to provide positive feedback for helping check spam messages. <i>"Say thank you... for helping the community, something like that. Make people feel good in doing good work."</i> ▪ Suggested a points and ranking system to entice users. <i>"Other software give you points. You become a... level 1, level 2, level 3, but you give them name ah. Master, Super-Master, whatever. The more they contribute, the higher ranking they get."</i> ▪ Also suggested that there should also be punishments to prevent people from gaming the system and voting mindlessly just to earn points. <i>"Every time they do it wrong you also must minus points. You cannot encourage them to just (vote mindlessly)."</i>
Archives Experience	<ul style="list-style-type: none"> ▪ Misunderstood the Archives page to be a collective archive where everyone's messages are stored in. <i>"These are... it (looks) like a case whereby I have put in some of them (messages), or this is a database sent by everybody, (and) you help to decide whether it is a spam or not."</i> ▪ Suggested a collective archive of unknown messages to allow people to see outstanding messages and help people check when they are bored. <i>"Better still, eventually you should have a case like Facebook or LinkedIn – you allow them to... also look at others... So (if they) sit there, got nothing to do I say 'Ok, I help the community'"</i>. ▪ Had no issues performing the action to delete the message. ▪ Suggested that the delete button should be bigger. <i>"The thing that you want people to touch should be bigger than the thing that you don't want people to touch."</i> ▪ Also suggested that the delete button should be coloured red to suggest danger.

	<ul style="list-style-type: none"> Suggested that for the pending messages, it shows how many people have voted. <i>"I think that better still... to say how many people have collaborated... You just posted here 'Oh! 30 people have already voted'."</i>
Change the Font Size	<ul style="list-style-type: none"> Easily found the settings menu and changed the font size. <i>"Settings ah, this one. Everybody understands settings."</i> Liked that font size can be changed for the elderly. <i>"Font size is good because old people need bigger font"</i> However, cautioned screen size should be taken into consideration for the largest font size. <i>"There must be maximum minimum because the screen is limited."</i>
Post-Testing Questions	
Content Layout	Liked the overall content layout.
Would you use application?	Yes
Any suggestions?	<ul style="list-style-type: none"> Suggested also integrating Fake News checking into the application. <i>"Not only spam, but if can check fake news also good. Same ah, spam and fake news, same thing."</i> Suggested linking the application to messaging apps to inform users that they have received spam or fake news. <i>"After you determine that it's a spam and confirm 100% that it's a spam... you will link it to the WhatsApp, link it to all the apps including SMS, and then will inform the user that you have received a spam. That is more useful. Once you install the software, everytime you receive a WhatsApp message – must of course link ah, must allow this program to read the WhatsApp message – then it will tell you 'This is a spam' or 'This is a fake news'."</i>
Final thoughts?	
Other Findings	
SSO Login with Google/Facebook	<ul style="list-style-type: none"> Wary of logging in via Google and Facebook. <i>"It's good not to link to these two because they are monopoly. Your software will be controlled by them."</i> Preferred to continue as Guest, and suggested a "normal" account creation.
Confusing menu icons at the bottom	<ul style="list-style-type: none"> At first was confused by the Collaboration icon, but quickly figured out that it was for the Collaboration function. Mistook the Archives icon as a "Mail" icon. Did not understand the Check Spam '+' icon. <i>"Plus icon is a what?"</i> Suggested putting a question mark icon at the bottom for people to find out what the icons are for.
Need for software	<ul style="list-style-type: none"> Thought this software would be good for society. <i>"We really need this sort of software because there are a lot of spam around, a lot of WhatsApp message spam."</i>

Appendix E

User Testing with D

Question/Task	Findings
Interviewee Details:	Female Chinese, 68, Homemaker. Diploma education. Has had cataracts before, hence vision is impaired. Generally wary of using mobile devices and is not inclined to exploring applications. Will always ask if she should press a button and is not confident performing actions on her own especially for unfamiliar software. Normally only picks up software with the guidance of someone else.
Testing Tasks (Observation & Questions)	
Onboarding Experience	<ul style="list-style-type: none"> Found that the onboarding animations on the prototype moved too fast. <i>"Move so fast."</i> Did not understand the onboarding screens at all, and thus did not know what features were afforded by the application other than the Check Spam function.
Check Text Message for Spam with Spam result	<ul style="list-style-type: none"> Did not know how to copy and paste text from WhatsApp messages. <i>"Me: Do you know how messages from WhatsApp? D: Don't know."</i> Required guidance every step of the way to check whether the message is spam, from pasting the message to even simply pressing the "Check" button. Understood what the "Spam" result meant Did not know what to do from there. <i>"Delete ah?"</i> Did not know that the "What should I do?" hyperlink was tappable. Was confused even from the <i>"What should I do?"</i> page. <i>"Report? But they don't have the 'Report'..."</i> Did not understand the page and thought it was a page where she could take action from, like delete or report messages.
Check Image Message for Spam with Unknown result	<ul style="list-style-type: none"> Did not know how to check for images, was unfamiliar with the "Upload Image" button. Mistakenly pressed the textbox for inserting text, and could not figure out how to insert a picture. Contributing factor was that the text for the "Upload Image" button was too small. Required guidance to upload the image, but after that she instinctively knew to press the "Check" button because she had checked the text message before using the same button. Had a partial understanding of the "Unknown" result. <i>"Unknown means... not recognised ah?"</i> Did not know that the "?" beside the result could be tapped to learn more about it. Even after tapping it, the text from the tooltip was too small for her to read.

	<ul style="list-style-type: none"> Was completely confused by the Share for Collaboration feature and did not know what it was for. <i>"Shared with who?... Then how?"</i>
Overall Check Spam experience	<ul style="list-style-type: none"> Was very unsure overall regarding how to check spam, needed heavy guidance. Confused by the experience and was lost throughout.
Collaboration Experience	<ul style="list-style-type: none"> Was completely lost and did not understand the Collaboration feature even after quite a bit of explanation. Did not understand the voting card layout. Was confused by the three buttons and did not know that she was supposed to press one of them to vote. <i>(Personal Note: Collaboration Experience may not be for users who are very unfamiliar with digital devices. The Check Spam feature could be tailored for them, and the Collaboration feature can be for more advanced users.)</i>
Archives Experience	<ul style="list-style-type: none"> Did not understand the Archives page. <i>"What is this? Pending? Scam?"</i> Struggled to find the message for deletion as the text was too small. Struggled to find the delete button, and required some prompting to look around the screen
Change the Font Size	<ul style="list-style-type: none"> First instinct was to pinch the screen to enlarge it instead of looking for the settings. Not familiar with a settings menu, did not recognise the Settings icon. <i>"Me: Is there any other way to change the font size? D: Don't know... only know this one only."</i> After finding the Settings menu, could find the Font Size menu. However, instead of dragging the slider, her first instinct to change the font size was to pinch-to-zoom again. When asked if there was another way, she correctly dragged the slider to the right.
Post-Testing Questions	
Content Layout	<ul style="list-style-type: none"> When unsure of what to press or what to do, participant naturally gravitated towards the primary buttons to press them.
Would you use application?	<ul style="list-style-type: none"> No. She suggested simplifying it. <i>"Maybe if you got a simple one – simple one easier to check."</i>
Any suggestions / Final thoughts?	<ul style="list-style-type: none"> Suggested a step-by-step guide, and for the checking to only require a few steps. <i>"Step 1 step 2, 3 steps can already. Give you step 1 step 2 how to do lor."</i>
Other Findings	
Default font size too small	<ul style="list-style-type: none"> Did not know what to do from the beginning because she could not read the words – the login button text was already too small.

Was not familiar with login experience.	<ul style="list-style-type: none">▪ Participant needed guidance logging and was afraid to press any buttons. <i>“Login to where? Google, ah?”</i>
Confusing menu icons at the bottom	<ul style="list-style-type: none">▪ Did not understand the Check Spam ‘+’ icon. <i>“Plus message... Can add info? Plus message is what?”</i>▪ Did not understand the Collaboration icon. <i>“Locked it?”</i>▪ Did not understand the Archives icon at all.

Appendix F

User Testing with E

STATEMENT OF INFORMED CONSENT

NM3221 Mobile Interaction Design

AY2021/2022 Semester 1

Project Description

A design student from the module NM3221 Mobile Interaction Design in the Department of Communications and New Media, National University of Singapore is conducting some prototype user testing. This information will be used to evaluate the design of a mobile application to help users identify spam messages as part of an individual class project.

- ☒ I have read the above project description.
- ☒ The researcher (Tan Yi Jia) has explained the purpose of the research to me.
- ☒ I have had an opportunity to ask questions about the project.

Freedom to Withdraw

Your participation in this project is voluntary. You can refuse to participate or quit the user testing at any time. You can request to take a break at any time. You can ask questions at any time.

- ☒ I understand that I can withdraw from the interview at any time without giving a reason

Benefits and Risks

There are no benefits to you for participating, other than perhaps helping to contribute to the design of a useful spam-tackling mobile application and the learning process for the student involved. We hope that the project will benefit users susceptible to spam messages. This research poses no risks to you other than those normally encountered in daily life.

- ☒ I understand that there are no direct benefits, nor abnormal risks involved.

Data Collection

Data will be collected through the user testing by taking notes, asking you questions, and recording your comments, actions, and/or reactions. The recordings may involve audio recordings of the session along with notes taken.

- ☒ I understand that the design student may be observing me during the interview.
- ☒ I understand that my voice may be audio recorded.

Privacy and Confidentiality

The data collected is strictly confidential. The data may be used for class presentations and submitted to the lecturer as part of the project submission process. Any data presented to the class will be anonymized. Any audio recorded during the session may be transcribed as part of our notes, and the recording will be destroyed after transcription and project submission. A copy of the recording may be submitted to our lecturer as part of the project for grading and verification purposes, and all recordings will be destroyed after the grading process is over.

- ☒ I understand that the design student may view my recorded data in the future.
☒ I understand that the data collected from me will be kept confidential.

Further questions or concerns

If you have questions about the project, you may contact the researcher Tan Yi Jia via phone at 9678 4612, or by email at tanyijia@u.nus.edu.

Informed Consent

To take part in the project, please indicate your agreement to the following statements and sign the form below, showing that you consent to the above terms.

- ☒ I agree with the above terms, and hereby consent to participate in the study.
☐ I agree / do not agree (please delete accordingly) to an audio recording during the session.

Participant Name:

Loh Hong Tak Edmund

Participant Signature:



Date:

8/11/2021

Researcher Name:

Tan Yi Jia

Researcher Signature:



Date:

8/11/2021

Spam Detector: User Testing Guide

NM3221 Mobile Interaction Design

AY2021/2022 Semester 1

Purpose of User Testing

Find out whether the spam checking app design is intuitive, whether people would use it, and discover design opportunities and flaws.

User Testing Procedure

1. Inform the participant of the purpose of the user testing
2. Ask them if they have any questions or things to clarify
3. Remind the interviewee to sign the consent form
4. Ask for permission for the session to be recorded
5. Record the session
6. Conduct the session
7. Stop the recording
8. Thank the participant for their time

Testing Tasks & Questions

Pre-empt: Take your time to go through the tasks, and feel free to think aloud.

Task 0: Onboarding

Go through the Onboarding screens.

Q1: What do you understand about the application from these screens?

Q2: Were the screens clear to you?

Task 1: Check Spam Experience

- Check whether a Whatsapp message sent to you is spam or not using the application.
- Find out what to do in response.
- What would you do if a message came back as “Unknown”?

Q3: What did you think of the Check Spam experience?

Q4: What did you think of the the guides on what to do in response?

Task 2: Collaboration Experience

- Head to the Collaboration page
- Vote on a Collaboration voting card.

Q5: What do you understand about the Collaboration feature?

Q6: Was the tutorial clear?

Q7: What did you think of the Collaboration feature?

Q8: Would you use this feature? Why or why not?

Q9: What would encourage you to use it? (if not)

Task 3: Archives Experience

Delete a message you submitted on the 15th of October.

Q10: How did you find the Archives layout?

Task 4: Settings Experience

Change the font size for the application.

Q11: Did you face any difficulty performing this task?

Post-Testing Questions:

5. What did you think of the overall content layout?
6. Do you have any suggestions for the application?
7. Any Final thoughts?

Interview Notes

Interview Questions

Question	Notes
Interviewee Details	E, Male 23. Computer Science student, familiar with application design and front-end development + basic UI/UX design. Experienced with handling mobile applications.
Testing Tasks (Observation & Questions)	
Onboarding Experience	Overall, understood the application from the information on the onboarding screens, and found it quite straightforward. <i>"This app can help me check if a message is spam or not, and if the app cannot detect if it is a spam it will check with the community, I guess."</i> <i>"I think it's pretty straight forward. It's user friendly. I appreciate the fact that you could change the font size."</i>
Check WhatsApp Message for Spam	Had no issues, found it to be very simple and straightforward. <i>"It's really straightforward... I just put it in there, and it tells me if it's spam or not."</i>
Find out what to do in response to spam	Raised the issue whereby if a user wants to follow the guide step-by-step on the same phone as their messaging app, they would have to repeatedly toggle between both applications. <i>"If I really want to follow (these steps) I would have to keep toggling between the two apps..."</i> Suggested using a video instead of step-by-step instructions. <i>"Would a video be better? A video that shows where to tap... just an idea, maybe."</i>
If message was detected as "Unknown"	Had no issues with understanding what "Unknown" meant and what it meant to share the message with the community.
Understanding of Collaboration	Raised concerns that elderly users may not be familiar with the concept of the community, that they are sharing their messages with other people. <i>"If I were to think in the perspective of someone who isn't native to social media, they might not... have the intuition that... whatever they share can be seen and interacted with by other people"</i>
Collaboration tutorial clear?	Noticed that E would tap on the highlighted buttons during the onboarding, expecting a response. However, this was not the case – though he did not notice it as an

	issue. Overall, felt that the tutorial was effective and intuitive. <i>"I think this helps them to familiar themselves with (the community aspect)... It was pretty straightforward."</i>
Thoughts on Collaboration	<p>Was initially lost – did not know how he got to Collaboration from "Share with Collaboration".</p> <p>Noted that the application can be abused by users with malicious intent who intentionally vote spam messages as not spam and vice versa, which can be detrimental for the elderly user. <i>"This assumes that when people vote for messages, they vote with the same intent... of preventing spam. I think there might be abuse to this function because, for example, if it's unregulated, people with malicious intent may vote spams as "not spam" instead which might mess with the votes, and then perhaps if enough malicious actors are into this voting then a spam message might be classified as "not spam" instead and this might be dangerous for some people who might not be that educated."</i></p>
Would you use Collaboration?	Thinks it's ok, wouldn't mind using it. <i>"I'm cool with it."</i>
Archives Layout	<p>Navigation through the archives was straightforward, and thought the layout was fine. However, noted that the card layout might become an issue if there are too many messages. <i>"If it gets too many cards, scrolling left and right might not be the most ideal."</i></p> <p>Noted that the word "Archives" may be misleading since the word implies all messages to be completed. <i>"Maybe the word "Archives" might be a bit misleading because "Archives" implies that it's already completed, that these things are shelved."</i></p>
Change the Font Size	Had no issues changing the font size. However, noted that elderly users may not know what's inside the settings and thus may not know that they can change the font size there. <i>"If it's a new user they will not know what's inside the settings, and they will not know that there's even a function to change the font size."</i>
Post-Testing Questions	
Content Layout	<i>"I think it's quite simple, actually – a good simple."</i>
Any suggestions?	<p>Suggested using more colours for the menu icons.</p> <p><i>"Maybe when switching across pages you might want to use more colours, because now it's just bolding so it might not be so obvious for people with not so good eyes... like colour the whole box instead."</i></p>

	Also suggested a list view for the archives instead to support for more messages.
Final thoughts?	Thought the application was a good idea since spam messages are very prevalent nowadays.

Appendix G

Heuristic Evaluation Findings

Spam Detector: Heuristic Evaluation Guide

NM3221 Mobile Interaction Design

AY2021/2022 Semester 1

Purpose of Heuristic Evaluation

Find out whether the spam checking app design is usable according to Jakob Nielsen's 10 Usability Heuristics.

Jakob Nielsen's 10 Usability Heuristics:

1. Visibility of System Status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognise, diagnose, and recover from errors
10. Help and documentation

Severity Ratings

- 0 – Do not agree that this is a usability problem
 1 – This is a cosmetic/superficial usability problem
 2 – This is a minor usability problem
 3 – This is a major usability problem; Important to fix
 4 – This is a usability catastrophe; Imperative to fix

No.	Brief Description of Issue	Heuristics Violated	Frequency	Impact	Persistence	Overall Severity	Proposed Solution
1	While the application is checking for spam, users can still enter the "Settings" menu (and from there enter other menus), possibly interrupting the checking process. What happens then? This would be an issue if an elderly user accidentally tapped on "Settings" and did not know	5, 6	2	3	3	3	Remove the Settings menu from the checking screen.

	how to go back to check the results of the most recently checked message. While they should be able to check it in the Archives, this may not be immediately evident.						
2	Users may not know where to access pending messages from the “Unknown” result screen as there is nothing telling them where they can do so. It is not immediately known to them that they may be able to access the message in the Collection.	1, 2, 6	2	3	2	3	Inform users that they will be notified when their message has been checked and that they can track the message status in their Collection. Also add a button for them to view their collection.
3	There is no feedback for users who do not have any message in their clipboard after they tap to paste a message. Hence, elderly users unfamiliar with the concept of copy-and-pasting may be confused if they tap on the box to paste a message and see nothing happen. This may confuse them and lead them to think that the application is spoilt or not working.	1, 6, 9	3	3	3	3	If a message does not exist on the clipboard when the user taps to paste their message, add a pop-up notifying the user of such. The pop-up should allow the user to head over to the “Need Help” section as well so they can know what to do.
4	Having the “Settings” menu button in primary blue made it stand out too much, making it look like the primary actionable for some pages. For instance, on the “Help” pages, the primary “Next” button may be hidden on phones with smaller screens. Users may then instinctively tap “Settings” since it is in primary blue, causing them to get lost.	4, 5	3	3	2	3	Change the “Settings” button to dark grey, noting that the tutorial at the beginning of the screen can help inform users that they can access the settings menu there. Yet, recognition is still promoted as users can still find the button by its name on the top right hand corner if looking for a settings menu, in the event that they do not remember the onboarding.
5	Users may not understand the difference between the “Start” and Google / Facebook Sign In options. From the start screen, they are unaware of the need to sign in via SSO, and what the different outcomes will be if they tap “Start” and the SSO sign in options, which may cause some confusion right at	2, 4, 8	3	3	2	3	Add a text label for the SSO sign in options to inform that they can sync their data to the cloud if they sign in via Google or Facebook, while changing the “Start” button to “Continue as Guest”. Also, reduce the size of the SSO login buttons compared to the “Continue as Guest” button so

	the beginning for elderly users. This confusion is further exacerbated by the “Login” heading, as users may not think that “Start” and logging in support the same functionality. This may adversely affect their first impressions of the application, thinking that it will be confusing.						the primary action of continuing without signing in is clear. The “Continue as Guest” label makes it clear for more tech-savvy users familiar with SSO login that they are not syncing their data. As for less tech-savvy users, having the “Continue as Guest” as the main primary actionable will lead them into the app despite them possibly not being familiar with the SSO login features. Also, remove the “Login” text to avoid confusing users and de-clutter the main login screen.
6	The Dissolve transition for most screens can be disorienting for elderly users as the text blends together, especially for the onboarding screens. This may cause them to struggle when navigating across pages. Furthermore, the existing transitions do not quite support the user’s mental model of breadcrumb navigation, and users may get lost easier.	1, 2, 8	3	3	3	3	Remove the dissolve transitions and add push transitions for the onboarding and help pages to symbolise going through a set of cards from left to right, supported by the dot navigation indicator. Change other transitions to either instant or slide transitions. The direction of slide and push transitions will help support the user’s mental model of the navigation, whereby sliding left will signify going deeper into a flow whilst sliding right will signify retracing steps.
7	On the onboarding pages, the text within the preview screens alongside the bright colours and seemingly tappable buttons draws the user’s attention away from the main text and the primary button. This confuses the user, which may be worse if the user is elderly. This is especially bad since these are the first screens the user sees when using the application for the first time, which can affect their overall impression of the application. Furthermore, the dark	4, 8	2	2	2	2	Replace the onboarding images with fewer and more abstract items to avoid cluttering the interface for the user.

	background ends up cluttering the screen and making the main actionable button less obvious.						
8	While the result for a message the algorithm is unable to determine is labelled “Unknown” on the result screen, it is labelled “Pending” in the Collection page, which may confuse users due to the difference in wording. “Unknown” may also imply to the user that the application has been unsuccessful in checking if the message is spam or not and it may not be clear to them that it is still being determined. This confusion may be further exacerbated by how the label text underneath says “Unable” to detect if the message was spam or not, making the user think that the application was ultimately not able to check if their message was spam or not, when actually the application is still in the process of checking.	2, 4	2	2	2	2	Re-label the “Unknown” message as “Pending” instead to inform users that checking is still in progress for their message and keep the wording consistent with the Collection page. Also, re-word the label to inform users that there is a team still checking the message.
9	What “Sync with Google” and “Sync with Facebook” do in the settings menu is unclear, and users unfamiliar with the concept may not know what it does and why they would want to sync with these platforms. This may thus confuse users and they may not be inclined to use the syncing feature even though they may be open to it.	2, 6	2	2	2	2	Add a label explaining that syncing data would allow data from Learn and Collection to be synced to the cloud so users can keep their data when changing phones.
10	The “SPAM”, “Not Spam”, and “Pending” boxes look like they are interactive elements that can be tapped (like buttons). Although the actual buttons are more prominent, to the new user it makes it look like there are two types of buttons – or even inconsistent buttons – which can confuse	4, 6, 8	2	2	1	2	Remove the borders around the “SPAM”, “Not Spam”, and “Pending” statuses to make them more distinct from the buttons and clearer that they are not tappable.

	users and affect their perception regarding the application.						
11	Compared to the Results page, the screen space for messages from the “Collection” feature is very small. Users who want to view past messages may therefore find it difficult to read them, especially if they are long messages, having to scroll a lot and only being able to see a few lines at once.	4, 8	2	2	2	2	Increase the text box size for each message when accessed from the Collection page to the same size as that from the results page.
12	Advanced users are unable to select multiple messages for deletion at once from the Collection page. They may thus get frustrated if there are many messages they want to delete, having to delete them one-by-one, especially if a user wants to clear all their data from the application.	7	2	2	2	2	Allow users to tap-and-hold messages in the Collection page to access a delete view, similar to that in a phone’s Gallery. Then, users can tap on more messages to select them all at once for deletion. Also, add a “Clear all messages” functionality on the Settings page, alongside a confirmation dialog whereby users must type “confirm” into a box as a big friction to prevent accidental deletion. This allows them to quickly clear all their messages from the application without having to tap one by one.
13	Users may not be familiar with the tutorial screens on the Learn page, not knowing that they must tap the screen to continue. Hence, users may think they are supposed to tap the highlighted elements, which may confuse them if they tap it and see that nothing has happened – except that the onboarding screen has changed which may disorientate them.	6	2	1	1	2	Add a “Tap to continue” text to the tutorial screens.
14	After tapping and holding to paste a message, the message instantly appears which may disorientate some elderly users. There is a lack of feedback provided for the	1	2	1	2	2	Add a pop-up notification letting users know when their message has been pasted in the Check Spam page or when a message has been deleted from the Collection page.

	elderly user, which may cause them to get disoriented. This problem also occurs after messages are deleted – users are led back to the Collection main page but have no feedback that the deletion was successful, and must manually check if the message has been deleted.						
15	Some users may be confused by the “Delete” functionality for messages in the Collection page, thinking that the message will be deleted from their phone as well. This may occur more frequently for elderly users who are unfamiliar with how application data is separate from phone data. Hence, they may mistakenly think that deleting the message from the application is sufficient to delete the message from their phones as well.	2, 6	2	2	1	2	Add a disclaimer to the “Delete” confirmation dialog informing users that the actual message on their phone will not be deleted.
16	The header bar text is unnecessary on the Results page as there is already a “Result” on the screen. This adds needless clutter to the page, which can potentially confuse the elderly user who may have visual and/or cognitive impairments.	8	2	1	1	1	Remove the “Result” header on the page and keep the “Result” header on the top bar.
17	Under the “Notifications” settings menu, there are options for “Message identified”, “Spam news”, and “Software updates”. However, users may not understand what these terms mean. Hence, they may be wary of turning on notifications for them, possibly causing them to turn off important notifications like the “Message identified” notification which lets them know when a pending message has been identified.	6, 10	1	1	1	1	Add a text label under each option explaining them.

18	The round buttons across the application may make the application look cartoonish and less professional, which may influence the user's view of the application's reliability and authenticity. This may affect user's willingness to trust the application's interpretation of whether their message is spam or not.	8	1	1	1	1	Change the round buttons to instead rounded rectangle buttons.
19	Inconsistent help button styling – the “Need Help” button on the Check Spam page is styled a light white colour whilst the “What should I do” is styled the dull-blue info button colour. Hence, users may not immediately associate both of them with the help menus.	4, 6	1	1	1	1	Change the “Need Help” button colour to the info colour.
20	Having to tap and hold to paste a message on the Check Spam page is an unnecessary functionality for the check text message feature which unnecessarily slows down the process. It also makes it more difficult for elderly users to use the feature as those with impaired motor functions may find it slightly more difficult to tap and hold.	7	2	1	2	1	Change the Tap and Hold action to a simple Tap action.
21	In the Collection feature, while users are informed of how many checked messages they have, they are not informed by month. Hence, they do not know how many messages they checked in a month. Furthermore, there is no scroll bar indicator to let them know how far they must scroll to see the earliest message in the month.	1, 6	2	1	1	1	Add the number of messages from the month beside the month label, and also add a scroll bar for each row.
22	Although the “Tap to paste message here” action on the Check Spamscreen is prominent and most users do not miss it, it is still not	4, 6	2	1	1	1	Recolour the “Tap to paste message here” action to primary blue to push it up the visual hierarchy, drawing user's eyes there first and

	obvious that it is the primary actionable. This is due to how most of the app's primary actionables are in primary blue while the former action is simply coloured black. The most obvious actionable available on the screen is the "Need Help?" button, which users may thus mistake as the primary button and get confused when they are led to the help screen.						letting them know that the primary action is to tap to paste a message.
23	Users who forget how the Daily Test cards function works after the tutorial have no way of refreshing their knowledge other than trying out the cards themselves. From the daily test screens, users are unable to check how much XP each correct or wrong answer gives, unless they go back to the main Collection screen. This may deter users from coming back to the Daily Test cards after prolonged periods of not using the application.	6, 10	2	1	1	1	Add a Help icon at the bottom of each card that provides a tooltip to guide the user regarding what to do and how much XP correct and wrong answers give.
24	The menu buttons are very jarring. Having the inactive icons in deep black makes them stand out a little too much, conflicting for attention with other elements on screen. Hence, the interface becomes more cluttered, distracting the user from other elements onscreen and possibly overwhelming the elderly user with cognitive and visual impairments.	8	1	1	1	1	Make the menu icons a lighter shade of black to prevent them from fighting for the user's attention with the other elements on screen.