MemoriesSharing: The value of personal experience and stories in social connectedness for the elderly

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ABSTRACT

Because of declining physical and mental condition, the living range of elderly people decreases continually, which leads to the negative effect on the social connectedness of the elderly. The development of the Internet and technology brings new opportunities to help elderly people improve social connectedness and reduce the risk of social isolation. This paper presents the design process of MemoriesSharing, a sharing story project for the residents in the senior apartment which is based on the crowdsourcing way and geographic location information. Through 2 iterations based on basic design cycle, interaction installations in senior apartment environment and online website are developed, which creates a new experience of sharing the story for residents in senior apartments.

Author keywords:

Elderly people; Crowdsourcing; Sharing Story; Geographic location information.

1. INTRODUCTION

MemoriesSharing is a story sharing project based on the crowdsourcing way and geographic location information. The target group of this project is residents in senior apartments. Through this project, the elderly in senior apartments provide information include their stories, the story happened location and things they want to see, and then the information will be uploaded to the Internet. Other people can read stories from the elderly online, and through a tutorial "stories map" they can search stories happened near them or at particular locations. According to these stories, they take photos, make comments and send feedback to the elderly users. The content combination of stories and photos will be presented through the Internet (website, application) or public installation (Slideshow).

This project aims to explore the design solutions to bring elderly people a new experience of story sharing and increase their feeling of being connected and concerned. It collaborates with Xu Lin (Ph.D. in Tu/e), Vitalis Woonzorg Group, and Summa college.

In this report, preliminary study and investigation are described firstly, including the literature review, observations in local senior apartments, and the interviews with the staff and elderly residents. Then, the development from the initial concept to the present demo through 2 iterations is recorded, significant improvement and the working prototype is made in the 2nd iteration. The study also explores the future plan of the project.

2. BACKGROUND

2.1 Researches about ageing

Aging has become a serious global problem nowadays [1,2],

• Today the number of people who is 60 or over has doubled since 1980.

• The number of people who is 80 or over will increase to 395 million before 2050.

• The number of the Elderly aged 65 and over will be more than the number of children under the age of 14 before 2050.

Currently, most attention of design and technological solutions for the growing aging population is paid to physical health, mobility and safety. In the field of social well-being, emotion and mental health, which are also crucial in the aging process, there is however much space to explore [3,4].

Otherwise, because of the decline of the physical and mental condition, elderly people gradually have limited mobility and the ability to communicate to being connected with the outsides environment, which makes their living span become smaller and increase the risk of social isolation. And social isolation is linked to poor physical and mental health [5,6]. So the prevention of social isolation seems to be an important step in increasing the quality of life of older people and reducing public expenditure on medical costs for this group. Giummarra et al. [7] interviewed health professionals and older people to shed more light on the relationship between aging and social isolation. Older people found social connectedness and social activity to be strongly associated with overall health. They described social and mental health as being even more important than physical health. In particular, older people associated with loneliness with poorer overall health. In addition, Giummarra et al. note that health professionals reported mental and physical health deteriorating when older people are socially isolated. They found social health to be at least as important as mental and physical health. ''Social health is dependent on social connectedness as well as the extent to which communities value diversity, are supportive and inclusive, and provide opportunities for each person to participate in community life, as well as the number and quality of social supports and relationships that a person maintains".

2.3 Stakeholders

There are 2 main clients of this project, Vitalis WoonZorg Group, and Ph.D. Xu Lin. Vitalis WoonZorg group has senior apartments and care homes in Eindhoven, and it provides services in the field of living, care, and welfare for the older adults in Eindhoven and Heerlen. As a kind of service for its residents in senior apartments, it often collaborates with organizations or designers outsides to hold activities or make projects related to the elderly to enrich the daily lives of its residents. And for this project, it provides senior apartments and residents to do design and researches and the project is expected to bring improvements to its residents' daily lives.

Xu Lin is a Ph.D. student in Industrial Design of Tu/e. Her research direction is building up the connection between the elderly and other people through interaction design in the care home environment. In this project, she provides expert's suggestions to support the design and research process, and the final project will be a research case of her direction.

Considering of requirements from 2 clients, the project should provide a working prototype to bring activities or services for the residents in the senior apartments of Vitalis WoonZorg group, and collect research cases for Xu Lin.

2.2 Context in Vitalis Berckelhof

To get a better understanding of elderly people and senior apartment, I made user studies in Vitalis Berckelhof, a senior apartment in Eindhoven where includes more than 200 elderly residents and collected feedbacks and requirements from the elderly and staff there. Elderly people in Vitalis can be mainly divided into 2 kinds, one is people who have serious physical or mental decline and have very limited ability to move or communicate and need particular care such as serious dementia people, the other one is those who have much better body conditions, and are still active on activities or communicating with others although with declined mobilities. For the latter group, I went to the senior apartment and interviewed 26 residents and staffs there, and collected some feedbacks from interview recording and user observations,

When interviews are related to their personal experience and stories, many residents are more interested and can talk for a longer time. Many residents told me that they are willing to share some personal memories and stories with their kids, grandkids, volunteers, or other residents, and if others are interesting in listening to their stories, it can make them feel being concerned. In fact, many residents are willing to attend activities to share their personal photos or letters on a bulletin board in Vitalis. (See Figure 1)

Figure 1. Photo wall in Vitalis that present photos shared by residents.

1. Most residents there are not familiar with new techniques such as computers, the internet, while traditional media such as books, newspapers, photos, and televisions are prevalent there.

2. Many residents still have motivations to create or perform something. Activities such as playing musical instruments, chorus, painting workshops, making crafts are welcome among residents.

3. According to staffs from the Vitalis, happiness, and excitement can also be observed on the elderly when their family members or familiar volunteers come to see them, while mood depression can always be found after their family members leaving. They think communicating with the outside is needed and can have a positive effect on the residents.Many resident still have motivations to create or perform something. Activities such as playing music instruments, chorus, painting workshops, making crafts are welcome among residents.

2.5 UITKIJKPOST

UITKIJKPOST [8] is a project from the industrial design department of TU/e, which is Xu Lin's past work. It is a design research project, looking into how design and technology can help in improving social connectedness for senior residents living in care facilities.

It starts with an initial platform, which consists of a group of specially designed camera kits and gallery-like interactive installation, aiming to facilitate social connections between older adults and local communities from neighborhood through a real-time view-sharing experience (See Figure 2).
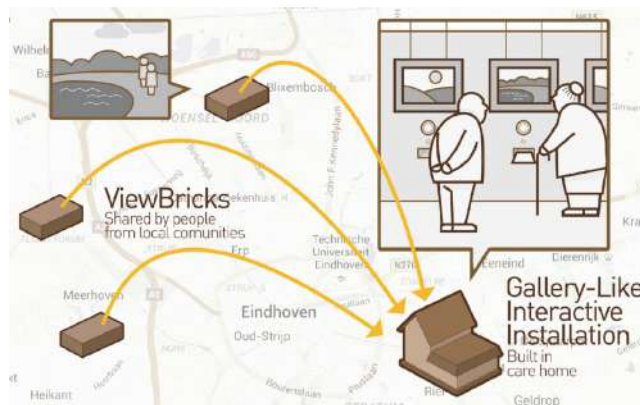

Figure 2. Working process of UITKIJKPOST.

This project provides a connection between the residents in senior apartments and the city environment, using the media that most older adults are familiar with (television, photos), bring them a new experience of social interaction. But according to interviews with the designer Xu Lin, during the user tests, problems such as residents cannot choose the photo resources and volunteers are lack of motivations to attend the activities are still needed to be improved.

2.4 Design briefs

According to user researches and interviews with clients, design briefs are made. The development of this project should consider these aspects,

1. The project should provide new activities or services for the residents in senior apartments to enrich their daily lives.

2. As this project is related to Xu Lin's research direction, social connectedness is an important aspect when I make the design project. I should focus on how to improve the connection between residents and outsides.

3. A working prototype should be made for stakeholders to provide activities for residents in senior apartments and research cases for Xu Lin.

3. RELATED WORK

Project in this study is related to these areas, interaction design in the senior apartment environment, the social connectedness

of elderly people, and crowdsourcing in social interaction.

3.1 interaction design in senior apartment environment

The Photostroller[9] is a device designed for use by residents of a care home for older people. It shows a continuous slideshow of photographs retrieved from the Flickr image website, and designers of this project suggest that the Photostroller balances constraint with openness, and control with drift, to provide an effective resource for the ludic engagement of a diverse group of older people with each other and the world outside their home.

In the photostroller, the Internet provides abundant resources for photos, which provides inspiration for the project in this study. But residents in this project are just audience, they are lack of control of the photo resources. More interactions could be constructed for residents to decide what they see.

Figure 3. The photostroller device.

3.2 Crowdsourcing in social interaction

This project [10] makes design explorations in neighborhood collaborative storytelling. It focuses on blogs and citizen journalism, which have been celebrated as a means to meet the reporting needs of small local communities. These bloggers have limited capacity and social media feeds seldom have the context or readability of news stories. And designers make NewsPad, a content editor that helps communities create structured stories, collaborate in real time, recruit contributors, and syndicate the editing process (Figure 4).
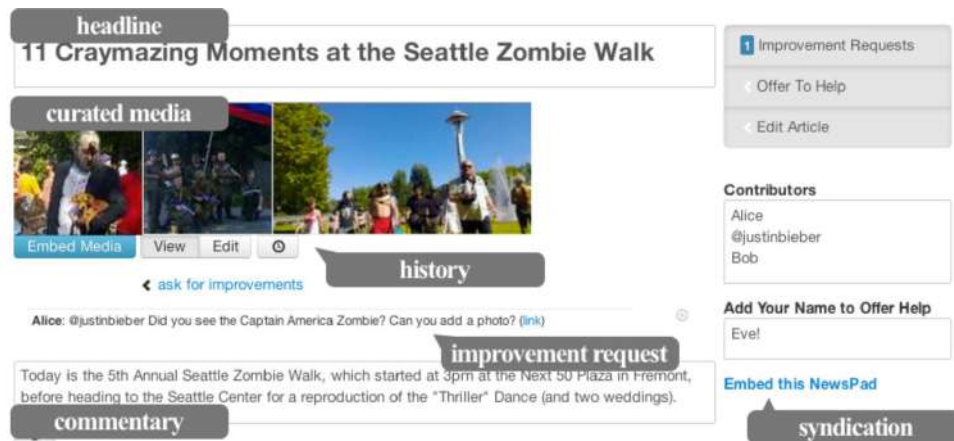
Figure 4. NewsPad Edit View (left), and improvement request (right)

3.3 social connectedness of the elderly

Elderly people usually have a risk of being socially isolated because of increasing online and offline thresholds. This phenomenon especially happens on those elderly people living in care institutions [11,12]. Online thresholds are mainly caused by the high learning load of modern technology [11]. With the fast development and change of modern technology, it is more difficult for most elderly people to learn and use those new products or medias compared to the young generations. Offline thresholds are mainly due to the decline of physical condition and change of social cycles with the ageing process [12]. In the background researches, both thresholds are recorded. Solutions to increase elderly people's social connectedness can focus on how to reduce online and offline thresholds, which becomes an important design direction in this project.

3.4 Motivations of users to attend crowdsourcing work

Elderly people usually have a risk of being socially isolated because of increasing online and offline thresholds. This phenomenon especially happens on those elderly people living in care institutions [11,12]. Online thresholds are mainly caused by the high learning load of modern technology [11]. With the fast development and change of modern technology, it is more difficult for most elderly people to learn and use those new products or media compared to the young generations. Offline thresholds are mainly due to the decline of physical condition and change of social cycles with the aging process [12]. In the background researches, both thresholds are recorded. Solutions to increase elderly people's social connectedness can focus on how to reduce online and offline thresholds, which becomes an important design direction for this project.

3.4 Motivations of users to attend crowdsourcing work

According to other research, if crowd work platforms have a social element, participating in crowd work may be particularly appealing to older adults, as keeping in touch with family members and friends is an important goal in older adulthood [13]. Moreover, seniors may derive a sense of self-worth from helping their social contacts or volunteering for tasks that have the social impact [14].

The feeling of contribution and creating is considered as a potential motivation to stimulate volunteers to attend the activities. [15,16]. There are similar platforms like Waze and Street View on Google Maps, users upload information themselves as a contributor for others. According to other researches, many online communities (e.g. Blogs, Chat rooms, Electronic mailing lists, Internet forums, Imageboards, Wikis), are not only knowledge-sharing resources but also fads. Studies have shown that committed members of online communities have reasons to remain active. As long as members feel the need to contribute, there is a mutual dependence between the community and the member [15,16].

Otherwise, payment is also a considerable motivation. Younger crowd workers tend to be motivated by finances [17]. According to other research, compared to elderly people, younger crowd workers tend to be motivated by finances [18]. And I made a survey on 24 adults who are considered as potential volunteer users, and 16.7% of them said that they are willing to take photos for elderly people because of interesting stories or feeling of contribution and creation. But 62.5% of them said they are willing to take photos with a payment. And if payment is available, taking photos or translation or recognition for a

story can be regarded as a particular task with payment and released on some existing crowdsourcing platform such as Zhubajie & Witmart & michanical turk [19,20,21] which has enough existing users to attend the activity.

In my project, the whole platform can be regarded as a kind of crowdsourcing solution to collect photos for the elderly and to create interesting content. How to use these motivations is an important aspect of this project.

4. METHODOLOGY

4.1 Design Cycles

A basic design cycle includes 5 steps, analysis, synthesis, simulation, evaluation and decision, designers produced results from each step, and make iterations among the cycle [22]. In this project, based on context researches on target group and stakeholders, list of requirements and design criteria were made. According to those results, different design plans were constructed, and 2 iterations were produced through synthesis, stimulation, evaluation, and decision. And through the 2nd iteration, the working prototype was made and used for stakeholders' requirements.

4.2 Interaction prototyping and evaluation

Interaction prototyping and evaluation is a method that helps designer evaluate the concept in the early stage of the process. Designers simulate and test how users will experience future interactions with their designs [23].

In different iterations of this project, the design process was developed through storyboard set up, interaction prototyping, evaluations based on user studies and feedbacks analysis, which provides results for the next plan.

4.3 Interviews

To get the better understanding of the requirements of the target group and stakeholders, and to collect feedbacks for different iterations, interviews were made on residents in senior apartments, caregivers, experts, and stakeholders. Because of the language barrier, interviews for residents are done by Dutch student assistants with designer besides, and all interviews are based on outlines made by the designer.

4.4 Wizard of OZ

A Wizard of Oz experiment is a research experiment in which subjects interact with a computer system that subjects believe to be autonomous, but which is actually being operated or partially operated by an unseen human being [24]. In this project, prototypes were made for different iterations, because of time or technology limitation, some steps are manually but completed user experience was achieved to the target group, and based that, design evaluation was made.

4.5 A process overview

An overview design plan was made based on discussions with coach and stakeholders. Time planning, project goals, methodology were built and adjusted during the design process to take control of the design process.

5. DESIGN PROCESS

Based on a basic design cycle [22], the design process mainly developed in steps such as analysis, synthesis, simulation, evaluation, and decision. Connections between steps are shown in the picture (Figure). Firstly, according to user studies and interviews with stakeholders, a list of requirement and design criteria is built. Based on that, a simple original design concept is made through brainstorms and 2 iterations were made based on interaction prototyping and evaluation.

5.1 1st iteration: design concept

The 1st iteration described the development of design concept. Through brainstorms and discussions, a primary concept was created. Then based on the concept, posters, photos and a video were made to describe the concept for concept evaluation on 4 residents.

5.1.1 Brainstorms

Based on context researches, brainstorms were made and several concepts were produced.
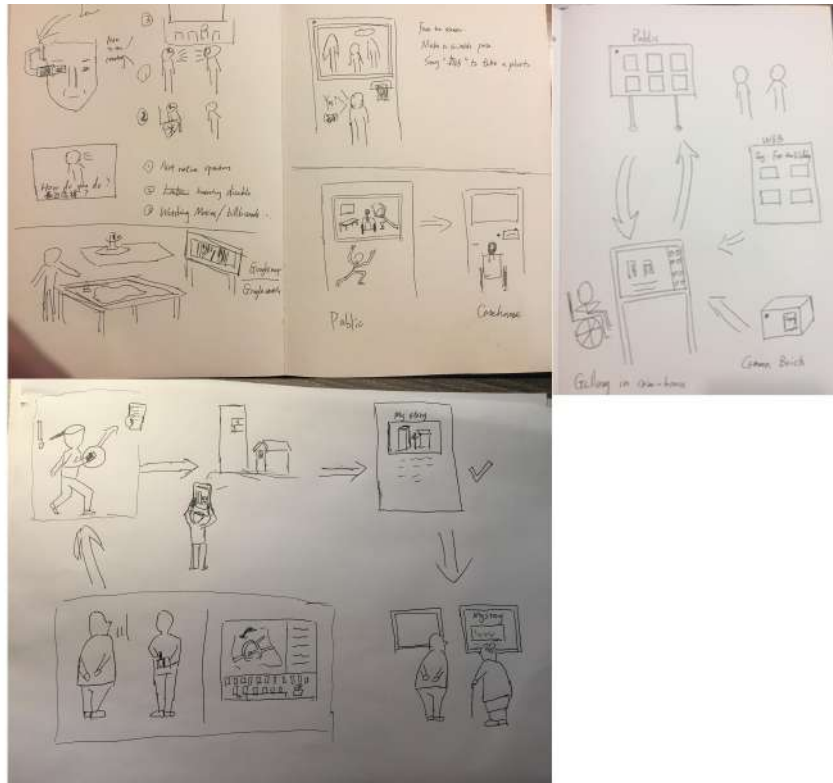

Figure 5. Brainstorms were made to built original concept

Discussed with the stakeholder Xu Lin and coach Jun Hu, considering of design key points such as interaction design in the senior apartment environment, improving social connectedness, sharing stories, etc. an original concept is decided which can be explained in the following steps (Figure 6),
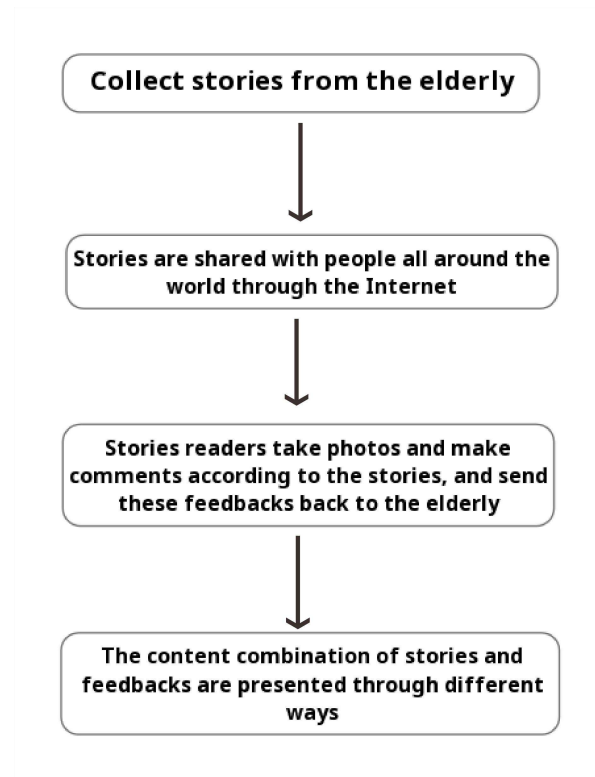
Figure 6. Steps of the original design concept

1. Residents in the senior apartments record their stories, and these stories can be collected through suitable ways. In the stories, residents recorded key information such as what they want to see and where the stories happened, etc.

2. The stories will be shared with other people outsides the senior apartments through the Internet, and people all around the world can read stories from the residents.

3. According to stories from the residents, other people take photos or make comments and send these feedbacks to the residents.

4. The content combination of stories and feedbacks will be presented to residents and people outsides the senior apartments in suitable ways.

5.1.2 Prototyping

The prototype was based on different props to present the process of the concept. And scenarios were created to assistant residents to understand the concept.

I used photos of different places and map to describe the concept to the residents.

Figure 7. Photos of different places and map were used to describe the concept to residents.

And I created 2 stories happened in Paris or England to build scenarios and designed a poster for the story in Paris and a video for the other one.
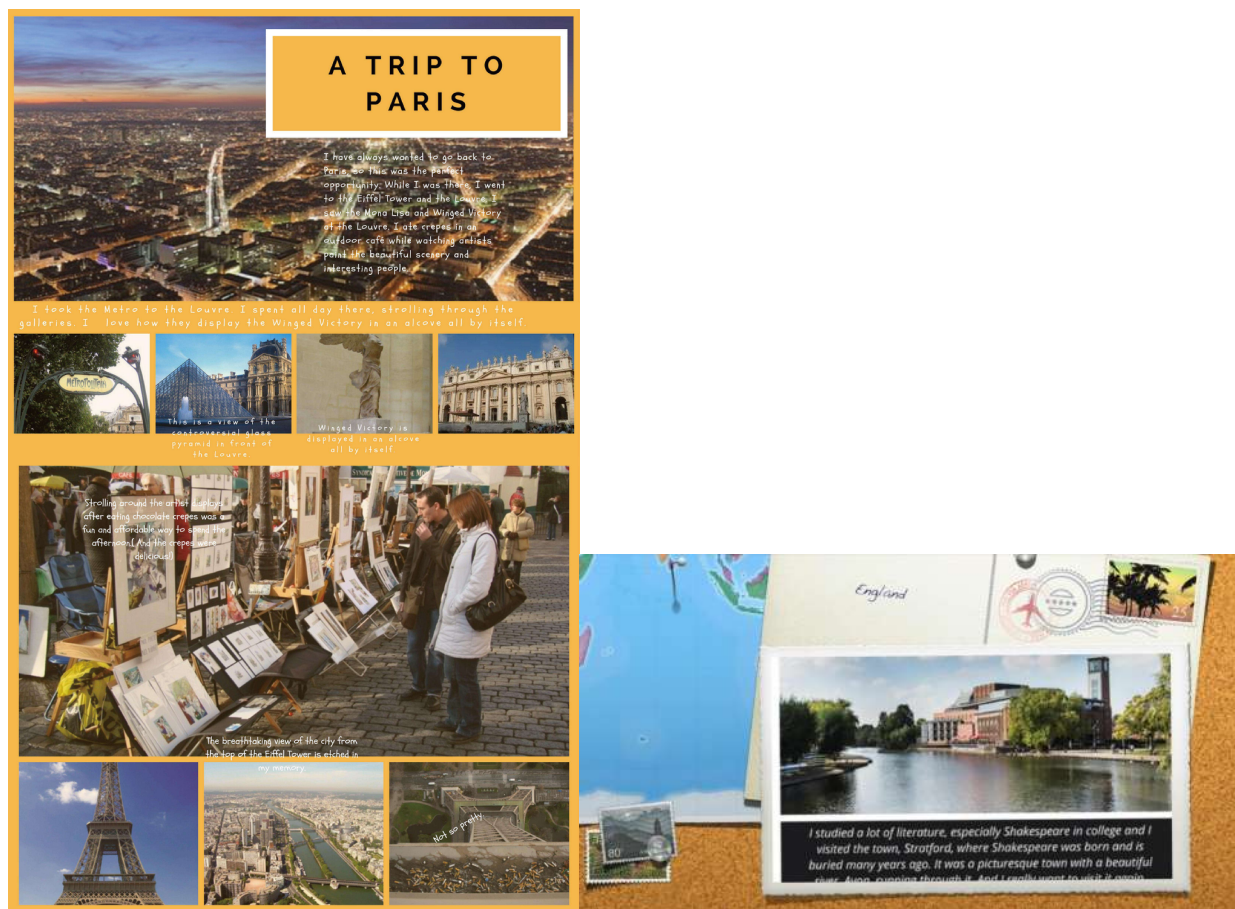

Figure 8. A poster and a video were designed to describe scenarios to the residents.

5.1.3 Concept Evaluation

To get the feedback about the design concept from the target group, 4 residents were interviewed. They are residents living in Vitalis Berckelhof senior apartments and were chosen randomly in the canteen of apartments. 1 interviewee is female and 3 interviewees are male.

Figure 9. Interviews were made on residents for concept evaluation

Pictures of different places were shown during interviews as assumed feedback in this concept, posters and videos were also made as the assumed content combination of stories and feedback. After the introductions, student assistant asked questions according to the outline

- How do you like this concept?
- Would you like to share some stories to others and get photos or comments from them?
- Did you ever travel to some places before? Do you want to go there again?
- Do you have some unforgettable experience?
- Do you want to go to some places / see something?
- Do you have any suggestions for this idea?

Figure 10. Semi-open interviews are made based on the outline

All interviews were voiced-recorded and translated to English texture version by Dutch student assistants. And some feedback are analyzed and used for iterations,

1. An interviewee said he doesn't have stories to share with others, but he likes Germany and hates England for personal reasons. He wants to know more German history from local people, not only the knowledge from books.

Considering of his feedback, more personas of the concept could be built up. Residents not only share their own experience but also share some requirements because of personal interests to ask for feedback.

2. An interviewee said she likes the idea but she doesn't need this one. She went to a lot of places in the past but she hurt her hips seriously once so her mobility is limited at present, but her daughter often goes travels with her daughter's husband and shows photos to her, and she said she prefers photos from her daughter.

For this female interviewee, it can be found that the concept is accepted by her, while she has another way to achieve it (Through her daughter). But compared to the crowdsourcing way (people all around the world), individuals' power is weak (places her daughter goes to are limited), so this kind of residents are still potential users.

3. An interviewee said he went to a lot of places such as Bali, Singapore, Spain, and Mexico. He is willing to see photos from those places. Moreover, he has never been to China and Indonesia, but he wants to see other's stories and photos about these two countries.

Considering of this feedback, others' stories and feedbacks may be also attractive to a resident, and this can be also stimulation for a resident to attend the activity, so it may be a potential way to present stories and feedbacks in public for all residents.

5.2 2nd iteration: website and application

The 2nd iteration designed a website (with mobile phone app version) with basic functions to achieve the conceptual process. Interfaces on a public interaction screen were designed, which are considered for residents to operate the website. Demos of the interaction screen were made through Mockingbot and are used in a Wizard of OZ experiment to evaluate the design plan. Based on the feedback from the evaluation, the next iteration was developed.

5.2.1 Analysis

The background researches show that most residents there are not familiar with computer and Internet. But for two considerations, firstly, because the concept is based on the Internet, a project related website should be constructed with basic functions as a core part to deal with information from different aspects. Secondly, through the interviews with project coordinator of Vitalis Berckelhof Sylvia van Aggel, she gave suggestions in these aspects,

1. According to past projects in Vitalis Berckelhof, some residents can use interaction screen with simple buttons, she suggested interaction screen might be feasible with simple operations.

2. Residents often sit and chat with each other during the coffee time, she suggested a public installation for residents to use together and provides them with various topics (culture\histories\hobbies) to communicate.

So for the 2nd iteration, the design direction is focused on the development of a website with basic functions to achieve the whole conceptual process and an easy-operated interactive screen to use the website in public area of senior apartments.

5.2.2 Prototyping

A website for the tablet for the residents and a mobile phone app for other users are designed and made on Mockingbot. The demo only achieves 2 basic functions, interfaces switch through related operations and text editor but shows a completed process of the website.
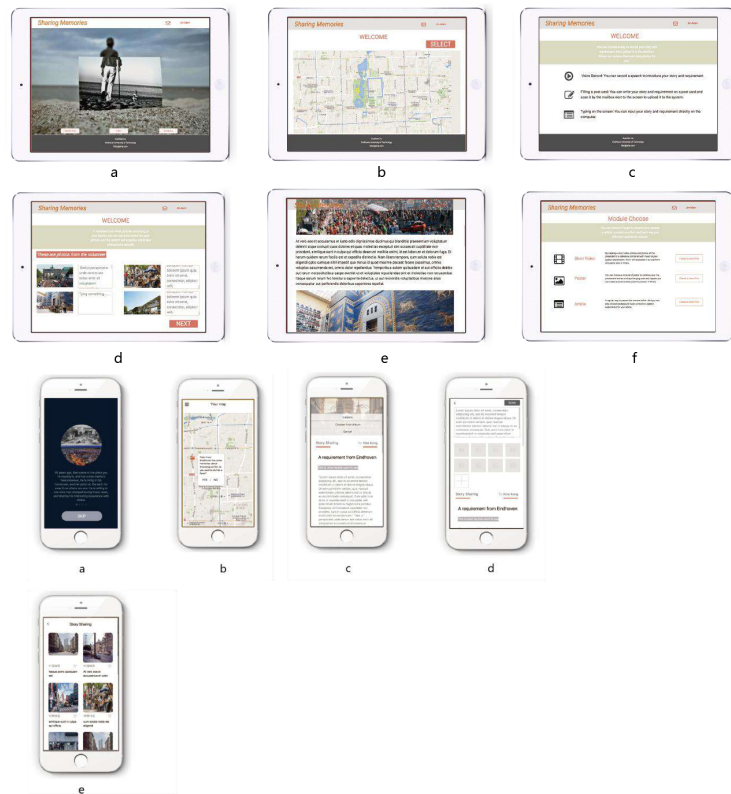
Figure 11. Demonstrations of website and app are made on Mockingbot.

The style of the interfaces on the tablet PC is simple and clear, and most pages are fixed without sliding bar, so it is easy for elderly people to read and operate like reading a booklet. The interaction process of the website is shown in figure 12.

Figure 12. A basic interaction process of the website.

At the beginning is a slideshow to introduce the whole process with a typical example. And 1 button links to an instructive page and 1 button links to showcase page to help users know more information. Click the start button to start recording a story, firstly, users should point out a location on the digital map, and then he can choose 3 ways to input his story, typing an article with a fixed structure, writing a diary on paper forms and taking photos of them, or recording a speech including key points. All content will be uploaded to the platform and volunteering users can see the remindful icon on a digital map of the app and read them. After receiving photos, elderly users can use the editor to add content for photos and then an article with photos will be produced, and users can add background music such as a speech of himself for the article. This article can be a normal way to present the content. Moreover, the content has as suitable structure because each photo has its own words content, so a slideshow film or a poster can be also produced with modules.

5.2.3 Storyboard

The character is a female resident named Mrs Jassen living in the senior apartment. She went to an Indian city named Kerala 20 years ago, and she had a lot of nice memories there. Today she still remembers the city and wants to go back for a travel, but because of limited mobility, it is difficult for her to go for a long distance. She uses the website of MemoriesSharing on the iPad, she finds and chooses the location of Kerala on the story map and input her stories into the system. After that, her stories are shared through the Internet, and volunteering users can read her story through the mobile phone app for MemoriesSharing. Anamika is a girl living in Kerala. One day she reads Jassen's story on the app and she feels interesting of Jassen's experience. According to the story, Anamika takes photos of locations Jassen arrived and sends those photos and her comments back to Mrs Jassen. On the website, Mrs Jassen reads an article combined with her story and feedbacks from Anamika.
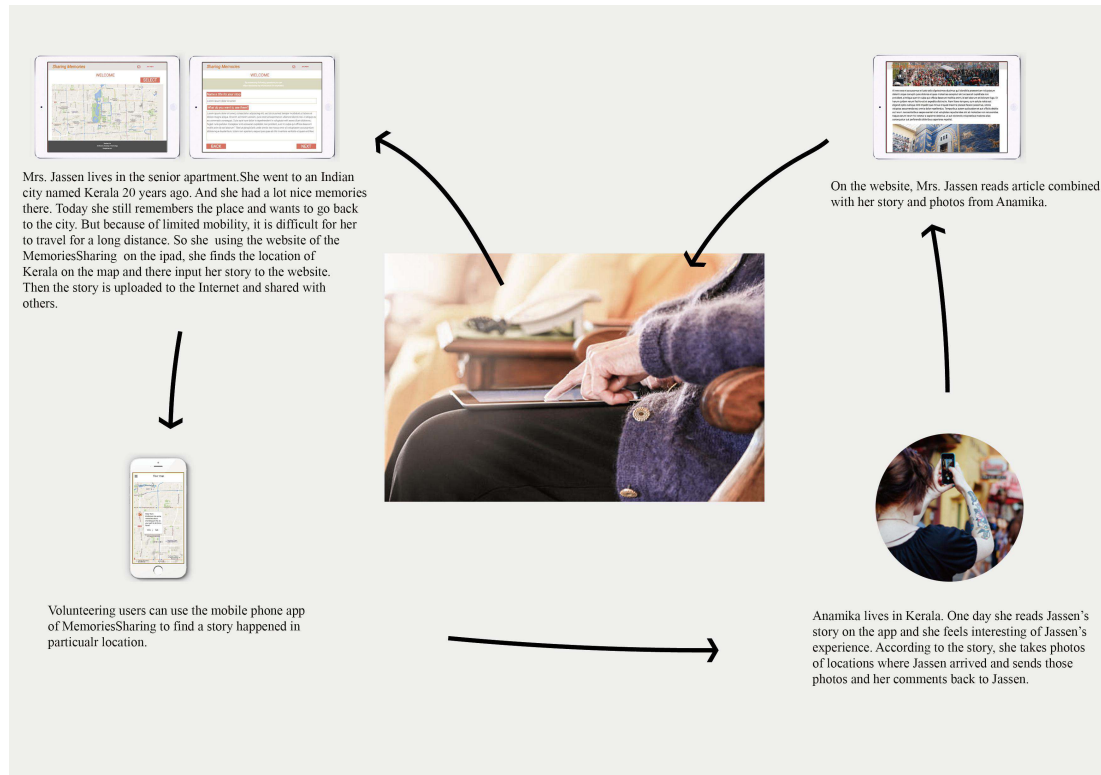

Mrs. Jassen lives in the senior apartment. She went to an Indian city named Kerala 20 years ago. And she had a lot nice memories there. Today she still remembers the place and wants to go back to the city. But because of limited mobility, it is difficult for her to travel for a long distance. So she using the website of the MemoriesSharing on the ipad, she finds the location of Kerala on the map and there input her story to the website. Then the story is uploaded to the Internet and shared with others.

On the website, Mrs. Jassen reads article combined with her story and photos from Anamika.

Volunteering users can use the mobile phone app of MemoriesSharing to find a story happened in particualr location.

Anamika lives in Kerala. One day she reads Jassen's story on the app and she feels interesting of Jassen's experience. According to the story, she takes photos of locations where Jassen arrived and sends those photos and her comments back to Jassen.

Figure 13. A storyboard of the 2nd iteration

5.2.4 Prototype evaluation

To get feedbacks of user acceptance and usability of this prototype, interviews and user tests were made on 4 residents (3 female and 1 male), all interviewees are chosen randomly in the Canteen of the senior apartment. 2 of them are not familiar with computer and Internet, 2 of them said they once used computer and Internet before. An interview and user test outline (Figure 14) is designed and 2 student assistants did the interviews according to the outline. All text on the interfaces were translated into Dutch by student assistants.

Tasks:
1. Firstly ask them to use the website by themselves, and record what they don't understand;
2. Explain all functions to them, and ask them:
- Did they use computer/Internet before?
- Can they use the website?
- What suggestions else do they have for this present version?
- Are they willing to learn how to use the tablet?
- For the final results, a booklet, a article on website, a poster presented in public, a short slideshow, which do they like most?
- What do they think of this sharing stories idea?

Figure 14. Semi-open interviews were made based on the outline.

Figure 15. Pictures of interviews in senior apartments.

At the beginning of the interview, a scenario was introduced to the interviewee to help them understand the design,

"Assume that you went to a place many years ago, and you had a lot of memories there. Now you want to go back there to have a look, but it is far away from you. Now we designed a website, that you can share your stories with local people, and they may take photos according to your stories and send these photos to you. Based on those photos and your stories, you can make an article, a poster or a short slideshow to share your stories with others."

2 residents reflected that they did not use the computer before (2 residents),

1. Interviewee 1 refused to use the tablet PC because she said she doesn't know how to use it, and with the help of student assistant, she switched pages by click buttons. She said it is hard to for her to learn how to use the tablet. She said she went to a lot of places in Europe, and stories and memories are still on her mind. She prefers to see places by herself.
2. Interviewee 2 cannot read normal text clearly because of weak sight, and she said it is hard for her to learn to use the tablet PC. She lives in Eindhoven all the time and did not go to many places. She said she did not know what she can share with others, but she is interested in horses and dogs, and she wants to see some related content of them. And she said she doesn't care about booklet, posters or articles.

2 residents are brother and sister, they both use computers and the male interviewee is a retired engineer (which is thought to be familiar with computers).

1. 2 interviewees can use the website themselves. The male interviewee said when the soft keyboard (system keyboard of iPad) causes trouble for him to read interfaces, and he said the normal PC is more familiar for him.
2. 2 interviewees talked about personal experience during the interview, and tried to record stories by typing. Through user observations, both 2 interviewees cannot record completed stories and only typed simple descriptions in 10-15 minutes.

It is found that on 2 interviewees who don't know use computers, the willingness to try the prototype or learn to use it is low. And on 2 interviewees who use computers, typing is still a difficult method for them to record a complete story. And another factor (weak sight) also increases the difficulty for 1 interviewee to use the prototype, which may also happen on other residents (physical condition).

In general, according to the results, on the 1st iteration, basic process and functions were designed, but the prototype is not feasible for most potential users which means other design solutions need to be constructed.

5.3 3rd iteration: Public installations and website

In this iteration tangible public installations including a mailbox for collecting stories and a slideshow system to show stories and feedbacks were designed. Because residents only use the public installations, the website is no longer used by them, the interfaces of the online site were adjusted to fit normal Internet users. And based on the design plan, a working prototype is made, although some steps are manually or achieved by other ways (Using the Twitter and emails to collect feedbacks), a completed using process is achieved for residents. Finally, prototype evaluation experiments were made and according to feedbacks analysis future plan is adjusted.

5.3.1 Analysis

According to feedback from the evaluation of 1st iteration and background researches, tangible installations are considered to reduce the difficulty to use the computer or Internet for most residents. From the background researches, it is found that all residents have the experience of sending and receiving mails, while every resident in the senior apartment has a mailbox and most of them still have the habit of sending and receiving mails. So a mailbox-like tangible interaction is familiar by most residents and it reduces the barrier of technology learning and using.

Television is a common media and familiar to most residents. Each senior apartments of Vitalis WoonZorg group have televisions in public area, so it is convenient to install and use slideshow system. Otherwise, slideshows are much easier to use for residents compared to reading stories and feedbacks on a website page. Public installations also provide chances for residents to communicate.

5.3.2 Prototyping

5.3.2.1 Mailbox-installation for collecting stories

Considering of space to put laptop insides , and construction for the camera and Arduino parts to take photos of paper completely, a primary mailbox was designed and made.
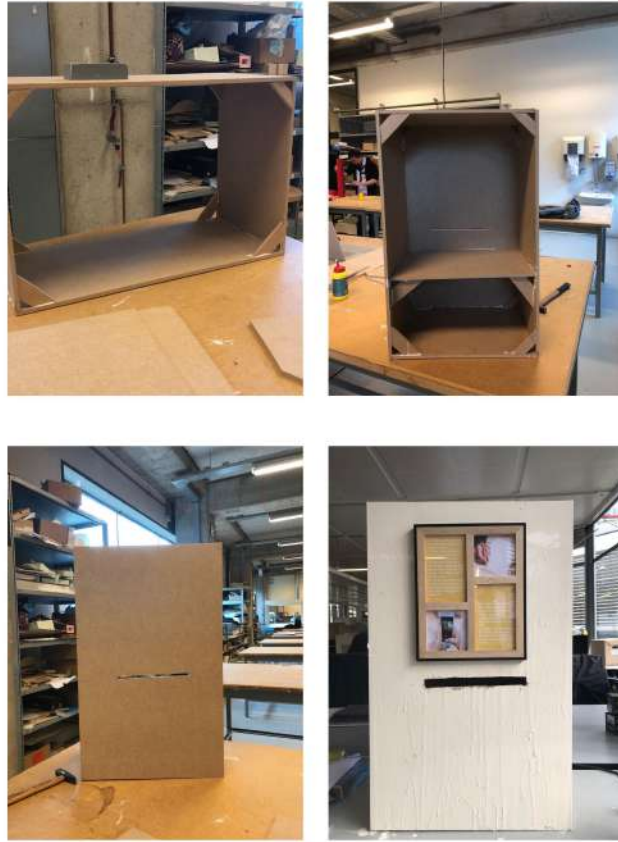
Figure 16. The construction of the mailbox

During the past interviews, two residents were required to recorded personal experience and stories on the paper and interviewed needed to remind them to record key information such as related location although they had been introduced a design scenario. An interviewee suggested some simple questions such as "where did it happen?" can be printed on the paper as an outline for information collecting. Based on that, postcard-like paper with simple questions was designed. (Figure 16)

Figure 17. A Postcard-like paper is designed for recording stories

Otherwise, considering of the environment of senior apartment and suggestions from stakeholders, the white color used on the mailbox is monotonous, so wooden texture factor and brown color were used for appearance adjustment (Figure 18).

Figure 18. Picture of the final version of mailbox installation.

Based on the electronic system insides the mailbox, the content on the paper would be recorded and uploaded to the Internet. The details of technology realization are described in the next chapter.

5.3.2.2 Slideshow system in public area

Several versions of slideshow interfaces were designed on Sketch, and the d version was chosen at last after communications with stakeholder Xu Lin, which is bright and concise.
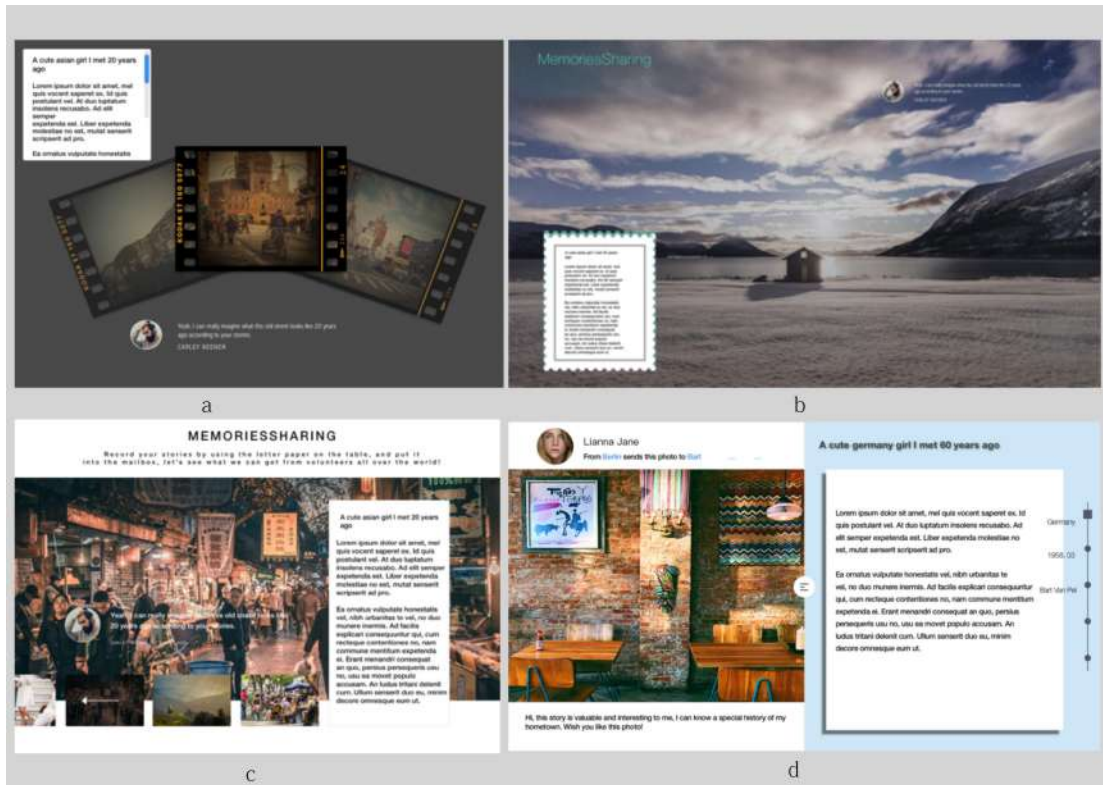
Figure 19. Iterations of slideshow interfaces

The interface present information of stories, feedback content and user information of the feedback provider.
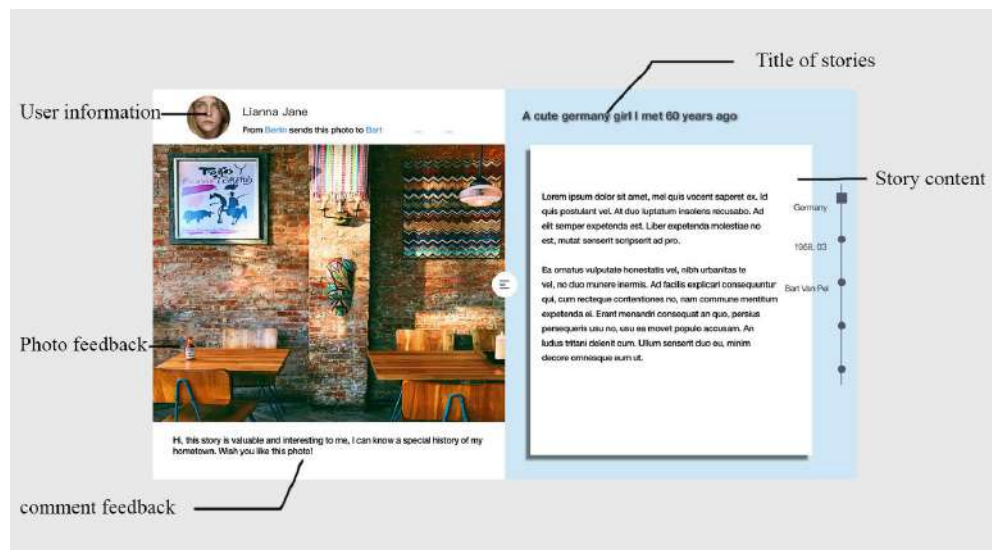
Figure 20. Construction of the interface.

And slideshows are shown on the screen in the public area of senior apartments, residents can watch them like watch television programs.

Figure 21. Two residents are watching slideshow examples.

5.3.2.3 Online website and application

Based on html5, the online website memoriessharing.com is built. It includes the cover page, list of stories page, story map page, particular story page, volunteering user introduction page and project introduction page. For the limitation of the backend system, the renewing of content is manual at present.

The cover page is the home page of the website, with a photo of an elderly couple as background to indicate the theme. In the center of the page is the menu with links to other pages.

Figure 22. Picture of the cover page

List of stories page lists all collected stories, for each story, a feedback photo, story title, and name of the storyteller is used as introductive information to indicate the critical content of the story.
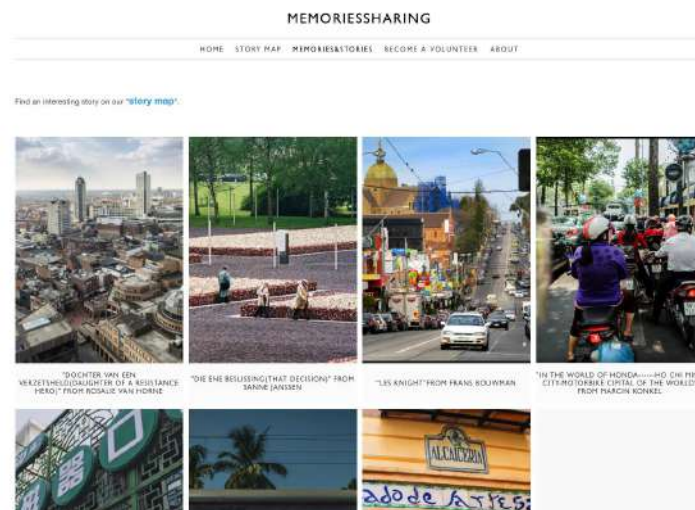
Figure 23. Picture of the List of stories page

Story map page is a search page built on Google Maps Javascript API. According to the geographic location information (latitude and longitude) of the location where the story happened, the icon represents each story is created at the related point on the map. Putting the mouse on the icon can see a short introduction of the story or double-clicking the icon can go to the particular story page.
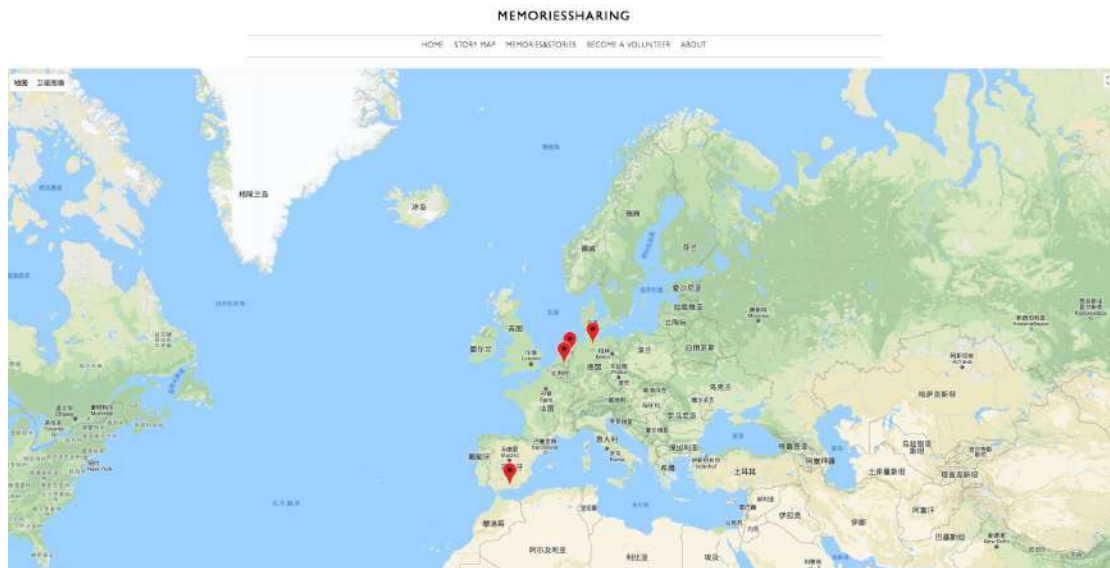
Figure 24. Picture of the story map page

Particular story page shows all related information of a particular story, including tasks of volunteering users, story content in different language version, feedbacks from volunteering users, a map to indicate the location where the story happened. Users can read the related information of the story and upload their works of crowdsourcing through this page. Because of limitation of the backend system, users can only upload works of crowdsourcing by replying to Twitter or sending e-mails at present.
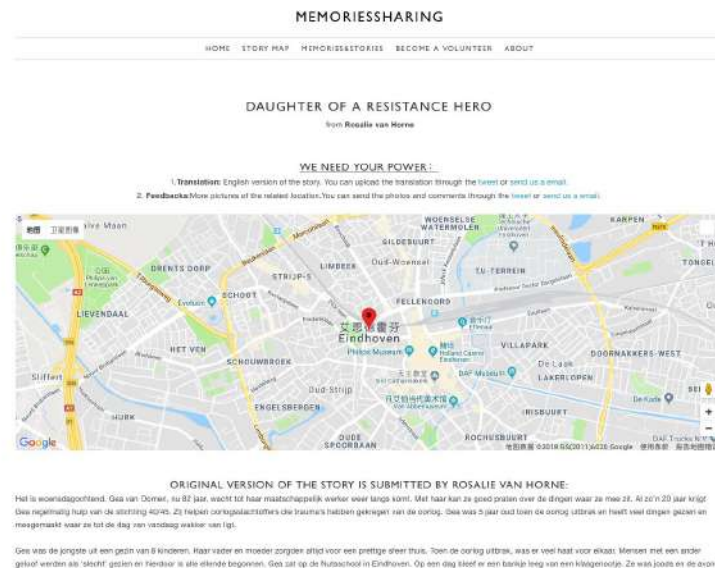
Figure 25. Picture of the particular story page

Volunteering user introduction page introduces the construction and functions of memoriessharing.com and those crowdsourcing works that can be done by volunteer users. Project introduction page introduces the process and goals of MemoriesSharing project, and users can contact project designer by email on this page.
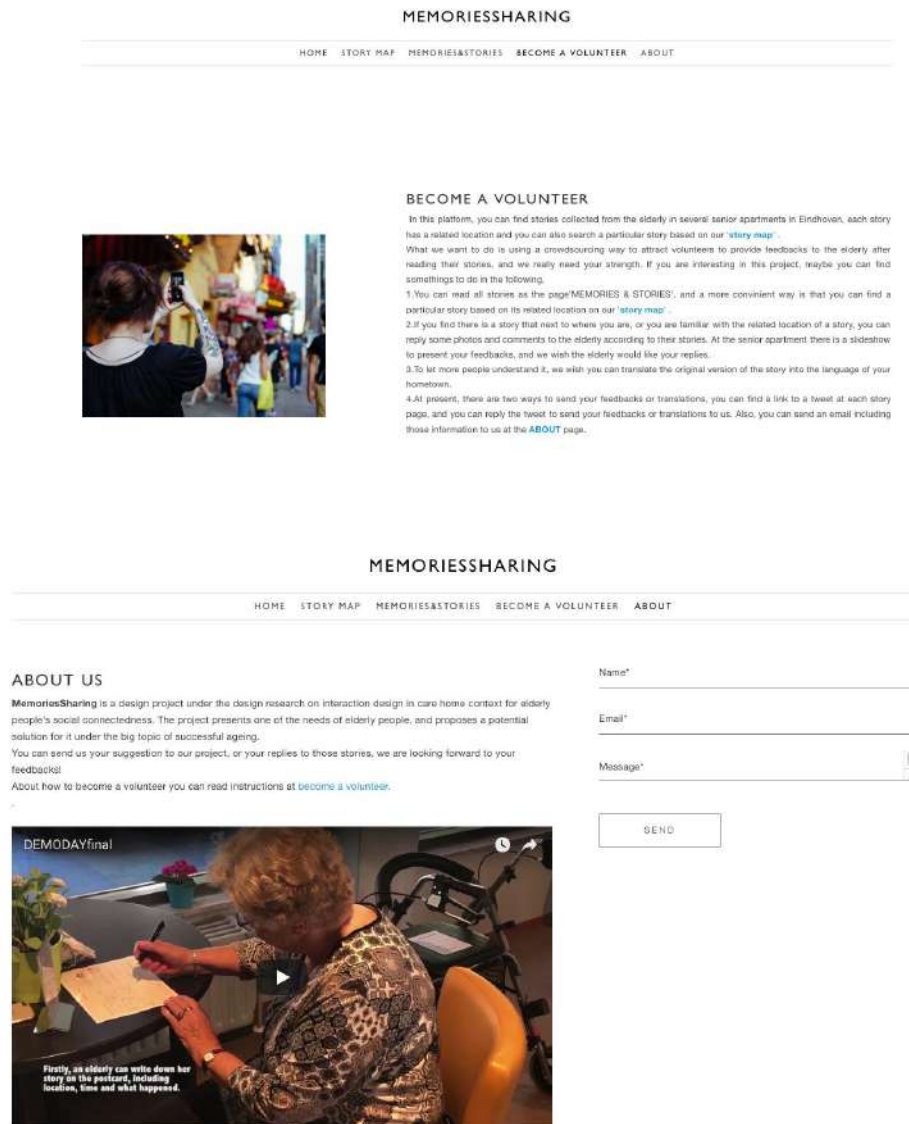
Figure 26. Pictures of the Volunteering user introduction page and project introduction page

5.3.3 Realization

The whole prototype works in 3 parts, the mailbox part to collect hand-writing stories, the online website and the slideshow system (Figure 27). The working prototype is based on Arduino, processing, Javascript, Python, and html5. With the combination of public installations and online website, it achieves a complete process for the residents, although some steps are still manual (Wizard of OZ method).
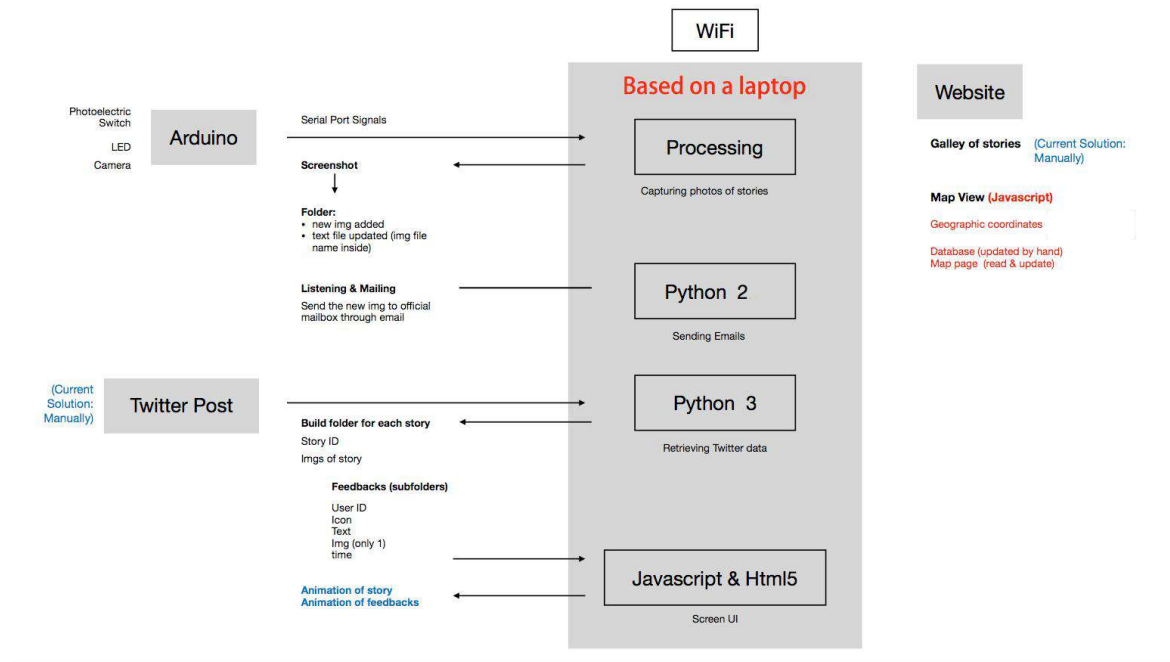
Figure 27. The workflow of programs in this project.

5.3.3.1 Installation to collect stories (Mailbox)

The mailbox installation is built on Arduino, processing, python 2.7. The work process of the mailbox is photoelectric sensor senses the paper putting insides, the camera takes a photo of the paper and the system uploads the photo to the Internet. Parts of the code is put at appendix.
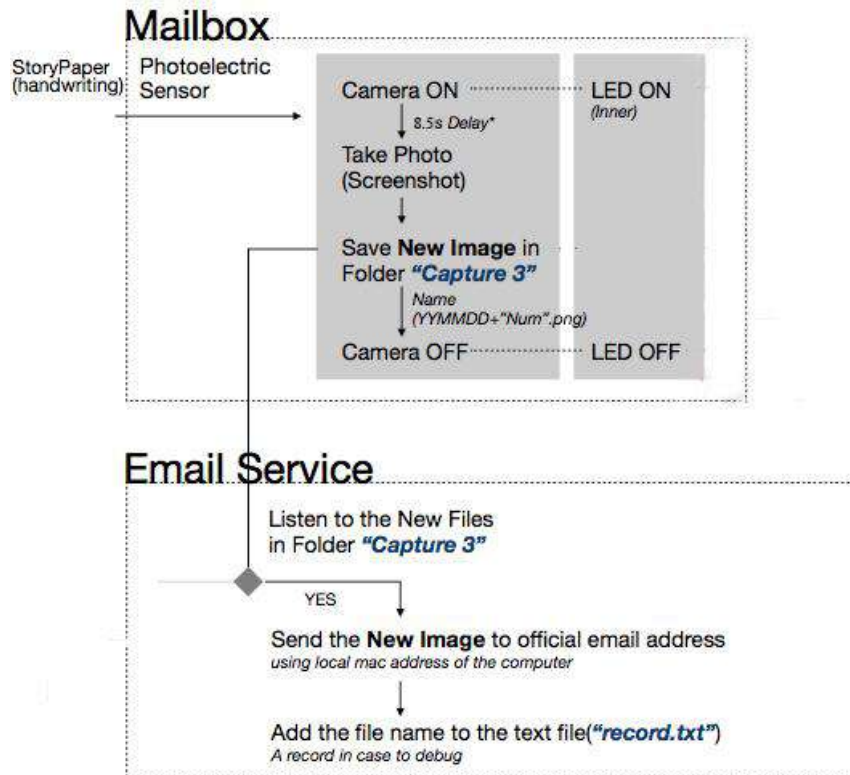
Figure 28. The workflow of programs for mailbox installations.

The photoelectric sensor and camera are built on Arduino and processing. The Arduino part consists of an Arduino Nano board, TCRT5000 photoelectric sensor module, WS2812B LED ring. A webcam is connected to the laptop and controlled by the processing program. The TCRT5000 photoelectric sensor module is fixed at the slit of the mailbox and the webcam and LED ring are fixed at the top of the top of the mailbox (Figure 29).
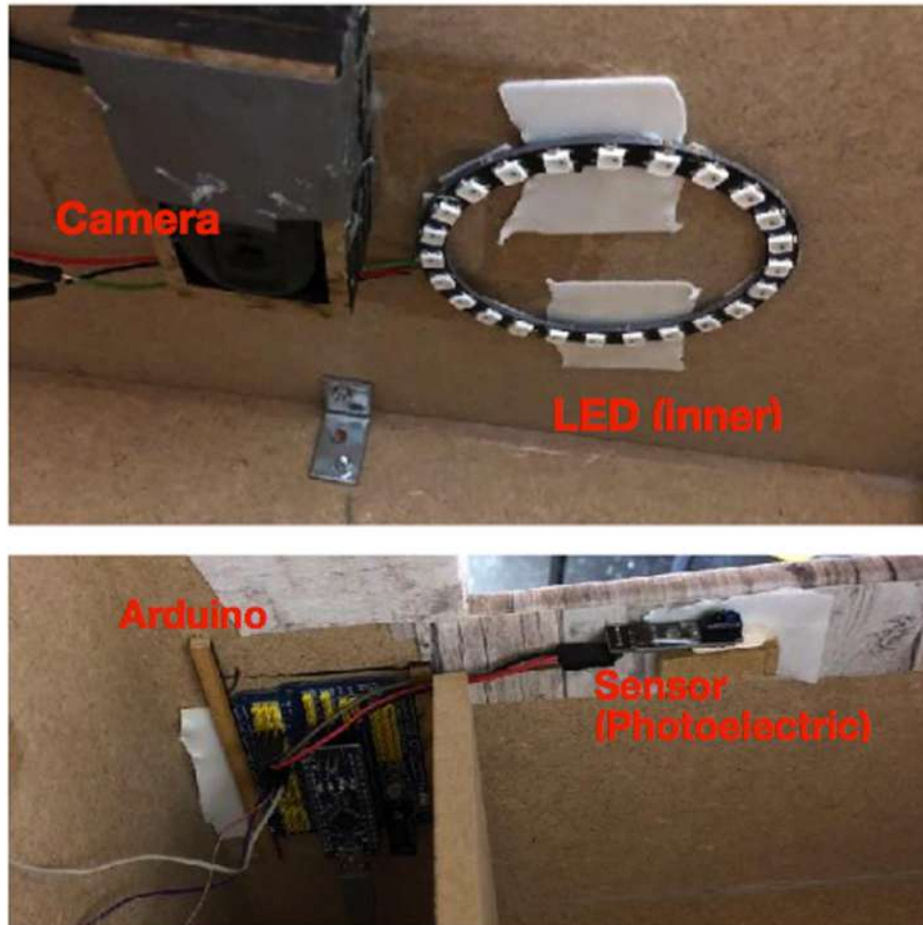
Figure 29. Electronic parts insides the mailbox.

When a user puts a paper through the slit, the photoelectric sensor senses the change of environmental light and sends the signal to the Arduino program, and then the LED ring and webcam are turned on. After 8500 milliseconds, the processing program takes a screenshot from the scene of the webcam and then the screenshot picture is saved into a particular folder. After 2000 milliseconds, the LED ring and webcam are turned off. Because there is a time duration to put a paper inside the mailbox entirely through the split, time delay (8500 milliseconds) is set between turning on the webcam and taking a screenshot.

A program on python 2.7 monitors the renewing of the folder where screenshots are saved. A txt file is built by the program. When the program monitors a picture while the filename of the picture is not recorded in the txt file, the program will send this picture to a particular email address and then the filename will be recorded in the txt file.

Based on 3 computer programs and electronic parts, the process including collecting papers with story content, taking photos of the papers and uploading photos to the Internet is built. And then the recognition and translation of hand-writing content will be done manually (crowdsourcing tasks).

5.3.3.2 Story map page

The online website is based on html5 and content renewing is manual at present. The story map page is built on the Google map API. A google map API is applied and loaded.

```
<script async defer
 src="https://maps.googleapis.com/maps/api/js?key=AIzaSyC00Jp906-F0hFVQQ_1ZCh5Y54Wor2ZSDg&callback=initMap">
</script>
```

Figure 30. Loading the maps API.

A list named stories is defined, and icons represent stories can be constructed by adding factors to the list. Each factor includes information story introduction, geographic location information, and link to the particular story page.

```
var stories = [
["SPECIAL BEIJING SNACK" from Steven Ye', 39.888844, 116.412853, "http://www.memoriessharing.com/stevenye"],
["DAUGHTER OF A RESISTANCE HERO" from Rosalie van Horne', 51.443745, 5.478679, "http://www.memoriessharing.com/rosalievanhorne"],
["DIE ENE BESLISSING (THAT DESICISION).." from Sanne Janssen', 53.434426, 10.223290, "http://www.memoriessharing.com/sannejanssen"],
["LES KNIGHT" from Sanne Janssen', -37.834619, 145.071697, "http://www.memoriessharing.com/fransbouwman"],
["LES KNIGHT" from Sanne Janssen', 52.465421, 6.495640, "http://www.memoriessharing.com/fransbouwman"],
["IN THE WORLD OF HONDA----HO CHI MINB CITY-MOTORBIKE CIPITAL OF THE WORLD" from Marcin Konkel', 10.782323, 106.609353, "http://www.memoriessharing.com/marcinkonkel"],
["A trip in Kerala" from Javi Lorbada', 10.879277, 76.979119, "http://www.memoriessharing.com/javi"],
["GRANADA---An Arabic Influence on Spanish Culture" from Fiona Bai', 37.178286, -3.596594, "http://www.memoriessharing.com/fionabai"],
```

Figure 31. Icons on the map are defined in the list named stories.

A function named initmap() is defined to set the original center of the map (center), the size of the map (zoom) and build icons on the map according to the list (stories).

```
function initMap() {
    var myLatlng = {lat: 51.448646, lng: 5.488835};

    var map = new google.maps.Map(document.getElementById('map'), {
        zoom: 4,
        center: myLatlng
    });
    setMarkers(map,stories);
```

Figure 32. Construction of the function initmap()

5.3.3.3 Installation for slideshow

Stories and feedbacks will be presented on a screen in the public area, which is supported by the slideshow system. The interface on the screen is built on html5 and Javascript, and a python program provides content resources for the interface by monitoring the project Twitter account and capturing data from Twitter.

The interface is constructed of story content, feedback photo, feedback comment and account information (information of the user who provides feedbacks).
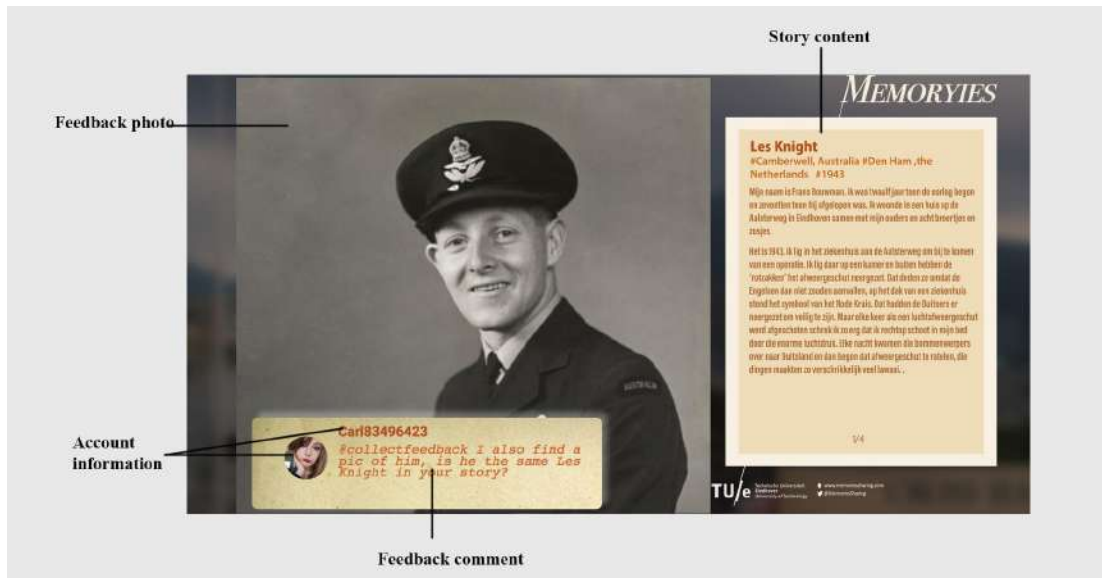
Figure 33. The construction of the slideshow interface.

At present, Twitter is the main way to collect feedback. A Twitter account named MemoriesSharing is created, and this account will release a new tweet when a new story is collected. Volunteering users can send their feedbacks by replying particular tweet. The python program uses the Tweepy API to monitor the twitter account and capture data from it. For each tweet, a folder is built by the python program, and tweet content (description and photo of story content), the content of replies (comment, photo, account information) will be captured and saved into different folders or files under the tweet folder (Figure 34). These data will be read by the Javascript program and used as content resources on the html5 interface.
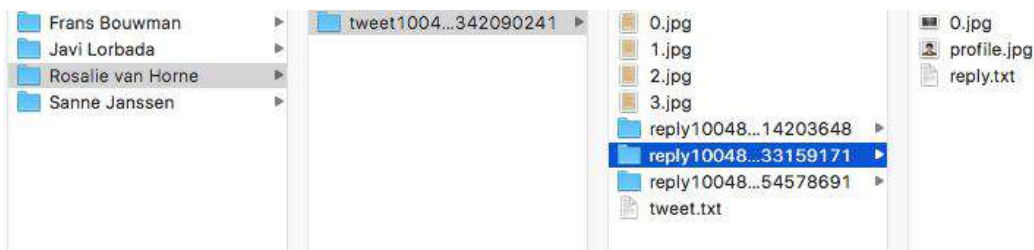

Figure 34. Data captured from the twitter is saved into different folders or files.
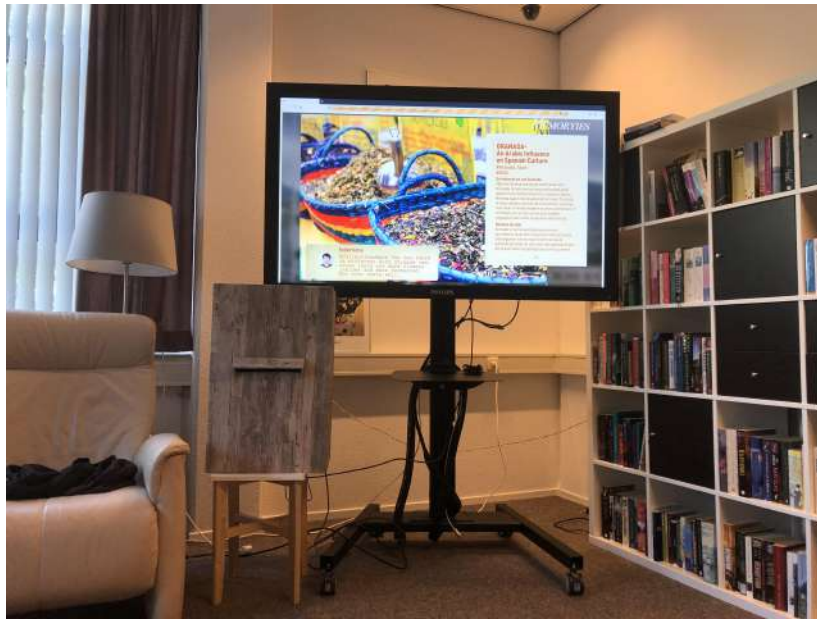
Figure 35. Picture of the slideshow installation in senior apartment.

5.3.4 Storyboard

The character is a female resident named Mrs Jassen living in the senior apartment. She went to an Indian city named Kerala 20 years ago and she had a lot of nice memories there. Today she still remembers the city and wants to go back for a travel, but because of limited mobility, it is difficult for her to go for a long distance. So she records her story on the paper and puts into the mailbox installation. The electronic parts insides the mailbox takes a photo of the paper and uploads it to the Internet. And the content in the photo is recognized manually (crowdsourcing task) and the story is released on the memoriessharing.com website. Anamika is a girl lives in Kerala. One day she reads Jassen's story on the website and she feels interesting of Jassen's experience in Kerala. According to the story, she takes photos of locations where Jassen arrived and send those photos and some comments from her to Mrs Jassen through the website. The slideshow system captures those feedbacks and makes slideshows. Finally, on the screen in the senior apartment, Mrs Jassen watches feedbacks from Anamika with other residents.
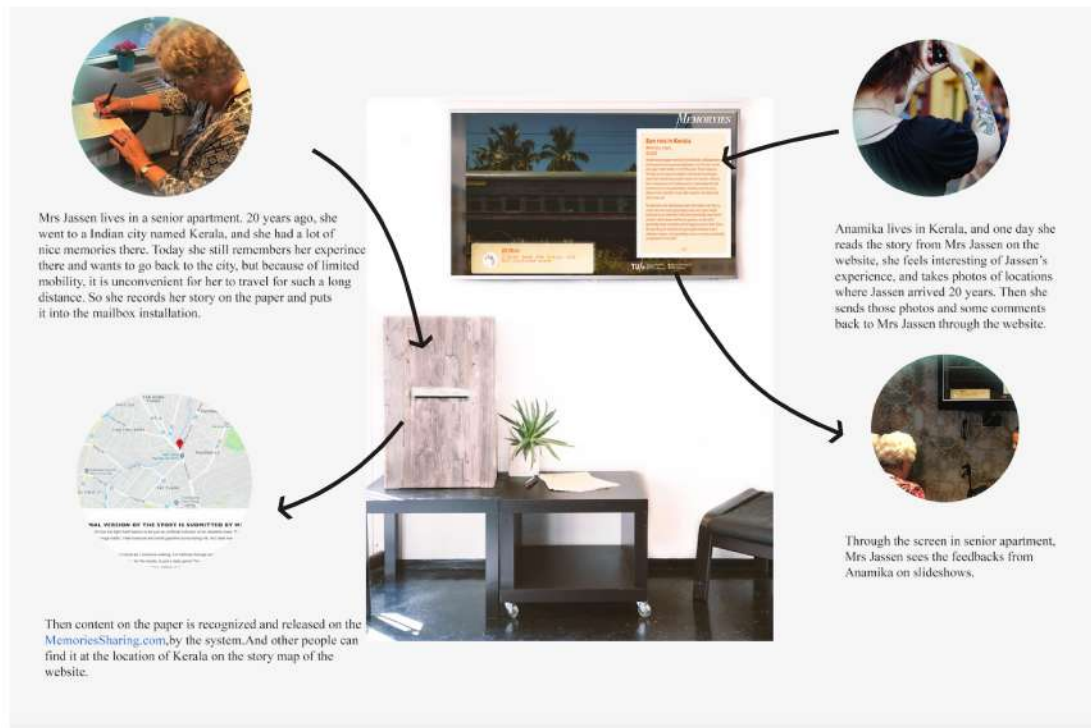
Figure 36. A storyboard of the 3rd iteration.

5.3.5 Demonstration Evaluation

The installations were built in senior apartments and 19 residents were invited for interviews. They were introduced the design concept, the mailbox installation and watched the slideshow. 7 examples are presented in the slideshow, 3 examples are stories collected from residents and 4 examples are created by the designer. After the introduction, semi-open interviews were made by Dutch student assistant based on the outline.

1. From 1-10, can you give a score to show the level that how much you like the design?

1---------2--------3--------4--------5--------6--------7--------8--------9--------10
Very much   Very Much
Dislike   Like

2. Which aspects do you think are good in this design?
Which aspects do you dislike?

3. Do you have some experiences, stories or memories else well? Would you like to share your stories to others?

4. If you share a story (tell a story on this platform), are you interested to see others' feedback to your stories? (knowing how other people like or what they think, or receive some new photos or pictures about this experience)

5. Currently the recording method is hand-writing on the paper, we also have typing on the computer or voice recording, which would you prefer? Or would you prefer talking to someone face-to-face.

6. If you share a story through our design, how long do you think you can wait for feedbacks from others?

7. If a screen is built in the Vitalis apartment, are you willing to share your stories and feedbacks to other elderly in the Vitalis? Or are you interesting to see others stories?

8. Photos and comments to your stories can be printed and made to a booklet, do you like it? Or do you think it is interesting or necessary?

Figure 37. Interview outline for prototype evaluation

For 11 interviewees, interviews were made individually, and 8 interviewees were interviewed with others (1 couple, 2 ladies and 4 ladies). Some interviewees did not answer all questions.

1. 7 interviewees gave a grade about how much they like the concept, and the average value is 6.86. Some interviewees reflected their feedbacks about the feasibility of the project, how to attract resident to start use it and difference compared to other projects.

"I am not sure if the installation would actually work."

"It's funny, but you have to have something to talk about to start it. "

"8 It's a nice idea, I only wonder how new this idea is related to other developed projects. Like the project we have that different people are coming together and talk with each other once a month about one specific topic. In this way, they are also connecting with each other but without technology."

2. About the way to record stories, 1 interviewee reflected his worries about the feasibility of handwriting for some residents,

"He wonders when people, especially older people, who are not able to write properly and correct are not being bullied because of their grammar."

And voice recording is chosen by some interviewees because of "efficiency", "easier and faster than writing", and face to face is chosen by 1 interviewee because "she can do it during the coffee time".

3. Some interviewees reflected the switching speed of the slideshow is too fast, and the size of the feedback photos should be bigger.

4. Examples on the slideshow are "*too far away*", " *hard to connect with*" for some interviewees, they want to read stories happened near them.

5. 1 interviewee said that "*It is easy to use*" but other elderly people may be afraid of use it at the beginning and he suggested that a "*Just create some groups in the beginning and let them use the concept together with a caregiver to get familiar with it.*"

Based on those feedbacks, some adjustments were made,

1. Introductive flyers were designed and introductive activities were organized with Summa college to make more residents know and understand the project.

Figure 38. Pictures of introductive flyers.

Figure 39. Introductive activities for residents were collaborated with summa collge.

2. Social activities are organized with students from Summa college to collect stories from residents by interviews. And more examples from residents are presented on the slideshow which may provides more topics and emotional resonance for residents and attract them to attend the activity.

3. The interface of slideshow was adjusted, the switch speed is lower and the size of the feedback photo is enlarged.

Figure 40. Adjustments of the slideshow interface according to the feedbacks.

5.3.6 Acceptance test for mailbox installation

In fact, through the social activities with Summa college, we have collected many stories. So in this test, we focused on how to increase the user-acceptance of the mailbox installation as another method for collecting stories. The test was organized in the Vitalis Krone Hoef senior apartment. Firstly, to let more residents know our project, we made an introductive video and played it on the public television for 3 days. In the video, we introduced the process of the project, the operation of the installation, and related activities time(The time of workshop and project).
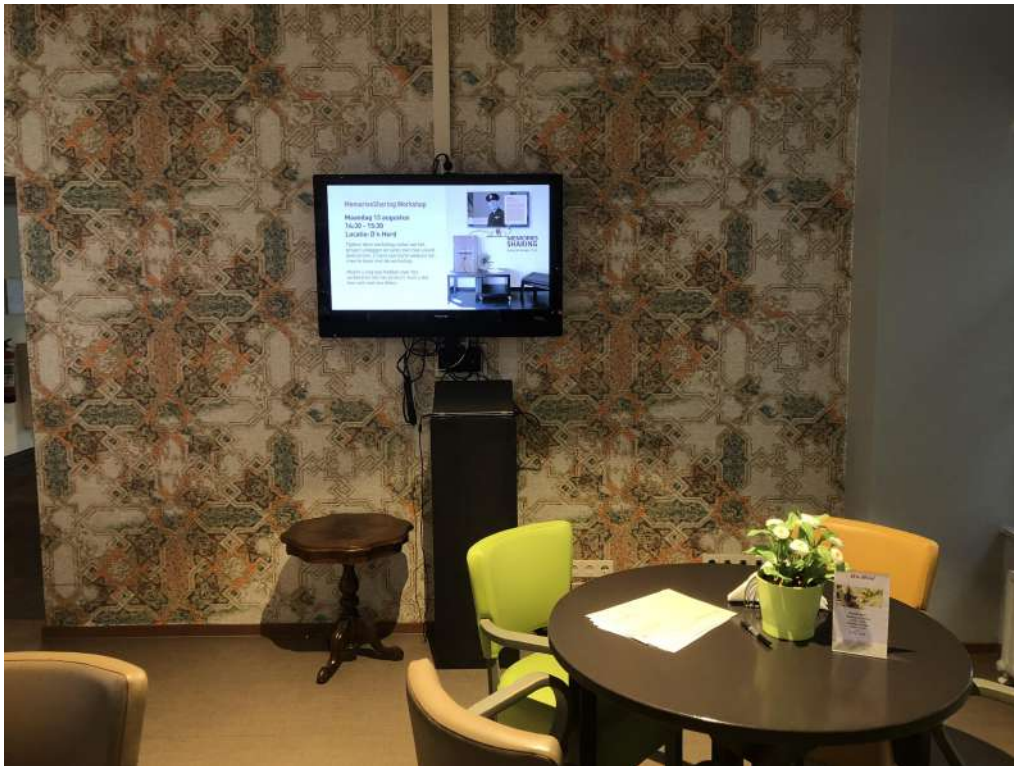
Figure 41. We made and played an introductive slideshow for 3 days in the public area.

We also made user flyers and project posters. The user flyers introduce the process of the project and the operation of installation including a Dutch version of the following words,

"MemorySharing is a design research project from Industrial Design, TU Eindhoven.

This installation is used for story and personal experience sharing with other people. On the big screen of the installation, you can read the life experience and memories shared by other people. There might be stories with a totally different life from yours, there may be someone sharing a similar experience with you as well. Together with the stories, you can also see the fresh comments with nice photos replied from other readers.

Meanwhile, you are welcome to share your own stories or give comments on the stories you like, named or anonymous. You can write down your stories and replies, and send them out through our mailbox. When we are there in the canteen, you can also tell your stories and comments to us. We will post them for you.

In August, we are going to set up the installation and our online service for people to use. We sincerely invite you to come and try our design and help us to make it better. You are welcome to give us any feedback and suggestions towards the design."

The project posters introduce the activity time of the workshop. With the instructions from caregivers, we distribute user flyers into residents' mailboxes and put up posters on the bulletin board.

Figure 42. We posted posters on the bulletin board and distributed flyers into residents' mailbox to inform potential users.

Before the set-up of the installations, we organized a project workshop in the senior apartments. A presentation was made by a Dutch student assistant to introduce the project, and some existing examples collected by social activities were presented to attract residents and prove the feasibility of the project. And questions from residents were answered after the presentation.

Figure 43. We organized a workshop with the help of Dutch student assistant before the start of the project.

Then we start to set up the installations. The installations are running from 9 am to 5 pm every day, with the mailbox installation and slideshow part. User flyers and postcards are put on the table next to the installations. When a picture of a new story is taken and shot by the mailbox installations, I will recognize it and make a digital version to send a Tweet. And according to the story, several replies with photos will be made by designers and student assistants. And then the digital version of stories and replies will be shown in the slideshow. In the first 5 days, many postcards on the table were taken away

and we collected 6 stories through the mailbox installation, 2 stories were sent to Xu Lin's email address directly by residents themselves. Those 6 hand-writing story providers chose to take the postcards away and wrote a story in other places according to our observations. 1 of the stories provider who sent the emails provides a very long story and he said that the typing is faster for him for such a long story and another one who sent the email has Parkinsonism and he said he can not writing well but typing is feasible.

We can find that, for different residents, feasible methods are different. Social activities(Interviews) are feasible for many residents (although in the past interviews we know that some residents want to record their stories in a private way) but students for social activities cannot last for a long time. Typing is not feasible for those who are not familiar with computers, but in the future, the computer will be more common among potential users so typing and website will become the main method. Handwriting is designed for most potential users at present, but because of disease or weak muscle control, some residents cannot write stories themselves. For the present, the combination of different methods is used to construct enough user cases for Xu Lin's research.

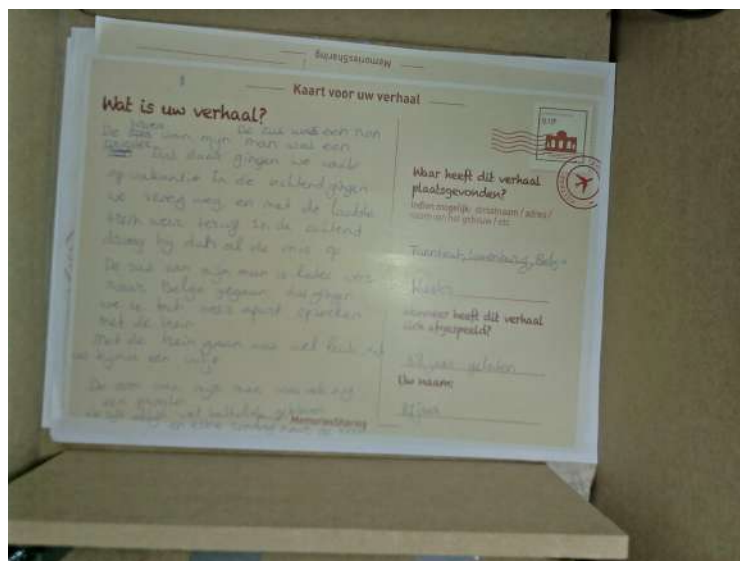**Figure 44. A picture of installations during the test.**

Figure 45. A picture of a handwriting postcard was taken by the mailbox installation and sent to the particular email address.

6. CONCLUSION AND FUTURE WORK

Based on surveys in Vitalis and literature review, I proposed a concept of crowdsourcing platform for the elderly, which aims to explore the design solutions to bring elderly people a new experience of story sharing and increase their feeling of being connected and concerned. After several demo test and design evaluation, I made the present plan include mailbox, slideshow system, an online website.

Based on the design concept and plan, to meet the requirements from stakeholders Vitalis and summa college, and support future researches for another stakeholder Xu Lin, a working prototype is developed which can achieve an ideal effect for the elderly. Social activities and mailbox installations were used to construct user cases for Xu Lin's further research. Now some steps of the working prototype is running manually, and because of lace of volunteering users, most feedback for stories were made by designers and student assistant. The feasibility for a long-time and wide range of use still need improvements, include the automatic of the whole process, and the construction of the crowds.

7.REFLECTION

Taking full control for this one-year individual project and going through different design iterations, I grow my competencies on creativity and aesthetics, technology and realization, user and society by acting as a industrial designer to raise new concepts and visions for my project, focusing on the social value and humanistic effects on the elderly, learning and implementing Python, Javascript, and Python technology and testing out different interaction possibilities around the tangible prototype, and involving the real users to the process.

7.1 Creativity and aesthetics

An significant change on me during the study in Tu/e is that I don't regard 'creativity' as a sudden inspiration on the mind, it should be a reasonable result after enough preparation and accumulation. To build the original concept, I made a lot of background research including interviews with residents and caregivers, literature reviews, and observations in the senior apartments. I got an enriched knowledge about the lives of elderly people and aging society then I started to build my design concept. And from the original concept to the final plan, I adjusted for many times and each time I collected feedback from potential users, related experts, staffs in senior apartments. Compared to the result, I start to know how to focus on the process to increase the quality of my 'creativity'.

I regard "aesthetics" as how to make a design more attractive. I used the Sketch, Photoshop, and Adobe Illustrator to do UI design of the online website and the slideshow system, warm color and concise style were used to make it more suitable for the potential users and the topic 'Memories'. Different color and patterns were adjusted for the mailbox to fit the environment of the senior apartment. And an introductive video, user flyers, and posters were designed for the project. During this process, I improved my skills in graphic design, video editing and prototyping.

7.2 Technology and realization

In this project, I did a lot of work to make a working prototype to provide a feasible plan for my clients. I learned Python and Javascript to build the slideshow system, including using Python to catch Data from Twitter, using Html5 and Javascript to automatically present the content catched by Python. Based on Html5, a googlemaps API is used to build a 'story map' as a core part of the online website. These things were totally new to me before the prototyping. And to build the mailbox, I also improved my skills on Arduino and Processing. Using a photoelectric sensor on Arduino to send signals to a processing program to control a camera in the mailbox to take photos of postcard insides the mailbox. It is not a very difficult technical issue but brings me a basic knowledge of these programming language and a better understanding of applying technology into designs.

7.3 User and society

From the building of original concept to different iterations, user-center approaches were used to make design evaluations and adjustments. Interviews with users, caregivers, related experts, and observations were made to help me have a better understanding of potential users. And feedback from residents for different iterations was collected and analyzed to help me improve my design. I made user personas for different iterations to make sure that some details won't be ignored. During this process, I think I have a better understanding of how to use the power of users to improve my design, and how to take control of the design process.

7.4 Thinking of future

I think during the process, I learned so much from technology and realization. But it was also because that I decided to achieve all functions by myself, I restricted my ideas and development for the design concept considering of technical feasibility. As I want to become a product manager or interactive designers, I should put my role in a suitable position (A designer, a manager not an engineer), and learn how to better use the resources from others in a team or a company. Otherwise, I would like to maintain my identity as a thinker, a designer and a person who find and solve the problem by using the power of technology and emotional values. In the future, I want to find a job in Tencent or Huawei as a product manager or interactive designer, during this process, I want to accumulate my understanding of Chinese market, improving my abilities to be a designer and a team leader. And with enough accumulation and growth, I will consider of build my own company and developed some products based on my vision and identity.

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Appendix

Parts of the questionnaire of context interview.

Research on Elderly's Social Connectedness in Care Home

–Social Connectedness (we focus on 3 aspects)

1) Social relationship:
   scale (how many people) / range (how many kinds) of social circle
2) Social engagement in activities and communication:
   Frequency of contact / social interaction (how many times / day, week, month…)
   Duration (how long)
3) Subjective / Perceived social connection
   feelings (perceived connectedness, trust, supported…)

–During the interview, we mainly study the elderly's relationship with

1) family and friends outside the care home;
2) other residents in care home (& maybe care givers);
3) people from outside (e.g. people from neighbourhood / volunteers / young people*, e.g. the university students who maybe visit for research or activities)

Question List

Introduction, Setup and Consent

Consent Form
Introduce the consent form [we prepare] that describes the study procedure, risks and benefits for participation and confidentiality. Read and let the interviewee to sign:
We are going to ask some questions for a better understanding on current lifestyle of the people living in Vitalis, your answers and opinions will be great helpful for us. Your participation is voluntary and your information will be confidential.
* Ask for permission to do audio recording during the interview, which is great helpful for us to do summarizing and analyzing.

Basic Information (order can be different)
Could you please tell me… Or may I ask some basic questions first?...
- Name (optional)_____
- Gender (first indicate by interviewer) _____ _____
- Age _____ _____
- Room Number (important) _____ _____
  Check the number list we have for questionnaires
  If they didn't fill the questionnaire, better let them do it during the interview
  [we prepare questionnaires]
- How long have you been living here in Vitalis?
  By yourself or with your spouse? (If not ask, we can ask care giver or indicate through conversation)
- Mobility (indicate first, wheelchair, walk, trolley or cart…)_____ __
- Work background: what did you do before you retire? (what was your job?) *
  Do you still do something related to your work now?
  This is actually trying to see the education / knowledge background, might be related to social behaviour…

(Technology)
- How do you usually get news or information?
  Newspaper? TV? Radio? Or anything else?

- Do you send emails? Or contact people via letters and postcards?

- Do you use computer? If yes, what you use it for?

Parts of the Arduino program for mailbox installation

```cpp
#include <Adafruit_NeoPixel.h>
#define PIN 6
Adafruit_NeoPixel strip = Adafruit_NeoPixel(24, PIN, NEO_GRB + NEO_KHZ800);

int val;
int isit = -1;
long tm;

void setup() {
  // initialize the serial communication:
  Serial.begin(9600);
  strip.begin();
  strip.show();
}

void loop() {
  val = digitalRead(3);

  if(isit<0 & val>0){
    isit = 0;
    for (int i = 0; i < 24; i++) {
      strip.setPixelColor(i, strip.Color(100, 100, 100));
    }
    strip.show();
  }else if(isit==0 ){
    isit = 1;
    tm = millis();
  }else if(isit>0 & millis()-tm>8500){
    isit = 2;
    delay(2000);
    for (int i = 0; i < 24; i++) {
      strip.setPixelColor(i, strip.Color(0, 0, 0));
    }
    strip.show();
  }

  Serial.print(isit);
  Serial.print(",");
  Serial.println(0);
  if(isit==2)isit=-1;
  delay(30);
}
```

Parts of the processing program for mailbox installation

```
void draw() {
  background(0);

  if (sensor0>=0) {
    cam.start();
    if (cam.available() == true) cam.read();
    image(cam, 0, 0);
  }
    if (sensor0==2) {
      img = copy();
      String name = ""+year()+"Y"+month()+"M"+day()+"D"+num+".png";
      save(name);
      num++;
      cam.stop();
      tm = millis();
    }
}

void keyPressed() {
  String name = ""+year()+"Y"+month()+"M"+day()+"D"+num+".png";
  save(name);
  num++;
}

void serialEvent(Serial myPort) {
  String inString = myPort.readStringUntil('\n');
  if (inString != null) {
    inString = trim(inString);
    int[] sensors = int(split(inString, ","));
    if (sensors.length >=2) {
      sensor0 = sensors[0];
      sensor1 = sensors[1];
      println(sensor0 + ", " +  sensor1);
    }
  }
}
```

Parts of the Python program for sending emails

```python
def record():
        list_sent = []
        try:
                filerecord = open(r'./record.txt', 'r+')
        except:
                return []
        for f in filerecord.readlines():
                        f=f[:-1]
                        list_sent.append(f)

        filerecord.close()
        for a in list_sent:
                if a == '\n':
                        list_sent.remove(a)
        return list_sent

def add(list_sent):
        filerecord=open(r'./record.txt', 'w')
        for a in list_sent:
                filerecord.write(a)
                filerecord.write('\n')
        filerecord.close()

def file_name(file_dir):
        list_original = []
        for root, dirs, files in os.walk(file_dir):
                for f in files:
                        list_original.append(f)

        list_original.remove('.DS_Store')
        list_original.remove('capture3.pde')
        return list_original


def main():
        email_address = "hilxc1993@gmail.com"
        folder_to_listen = './capture3'
        print("Service started!")
        while True:
        #       path = r'/Users/mac/Documents/Final Master Project/Python functions/图片库'

                # read sent photos
                list_sent = record()
                        # list all photos
                list_original = file_name(folder_to_listen)

                list_difference = set(list_original).difference(set(list_sent))

                if len(list_difference) != 0:
                        for f_name in list_difference:
                                b = ''.join(f_name)
                                list_sent.append(f_name)
                                photo_path = folder_to_listen + '/' + b
                                print(photo_path)
                                from os.path import basename
                                from email.mime.text import MIMEText
                                from subprocess import Popen, PIPE
                                from email.MIMEBase import MIMEBase
                                from email.mime.application import MIMEApplication
                                from email.mime.multipart import MIMEMultipart
```

Parts of the Python program for capturing data from Twitter and running the slideshow system

```python
def main():
    api, t = initialize_api()
    screen_name = 'collectfeedback'
#   screen_name = 'zmpy_2016'
    br = start_browser()
#   time.sleep(5)
    br.get("file:///Users/mac/Documents/Final Master Project/From ZMPY/memory2slideshow/web/index.html")
    while True:
        save_tweetids(screen_name, api)
        logging.basicConfig(level=logging.INFO)
        crawled = crawl_replies(t)
        print(crawled)
        if crawled:
            br.refresh()
        time.sleep(15)

def start_browser():
    from selenium import webdriver
    profile = webdriver.FirefoxProfile()
    br = webdriver.Firefox(firefox_profile = profile)
#   br.implicitly_wait(10)
    return br

@app.route("/slideshow")
def slideshow():
    if request.method == 'GET':
        u_id = request.args.get('u_id')

    path = "./replies/" + u_id + '/'
    tweets = []
    for tweet_folder in glob(path+"*"):
        with open(tweet_folder + '/tweet.txt','r') as tweet_file:
            try:
                tweets.append({})
                tweets[-1]["tweet"] = re.sub(r"http\S+", "", next(tweet_file)[:-1])

                tweets[-1]["img"] = []

                for img_idx in range(len(glob(tweet_folder+"/*.jpg"))):
                    tweets[-1]["img"].append(tweet_folder[1:] + "/" + str(img_idx) + ".jpg")

                tweets[-1]["replies"] = []
                for reply_folder in glob(tweet_folder+"/reply*"):
                    reply_file = open(reply_folder + "/reply.txt","r")
                    tweets[-1]["replies"].append({})
                    tweets[-1]["replies"][-1]["profile"] = reply_folder[1:] + "/profile.jpg"
                    tweets[-1]["replies"][-1]["user_name"] = next(reply_file)[:-1]
                    tweets[-1]["replies"][-1]["time"] = next(reply_file)[:-1]
                    tweets[-1]["replies"][-1]["text"] = re.sub(r"http\S+", "", next(reply_file))
                    tweets[-1]["replies"][-1]["img"] = reply_folder[1:] + "/0.jpg"
            except:
                tweets.pop(-1)
    return jsonify(tweets)
```