Explore a new book discovery experience in the public library

Master Thesis

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Preface

This project is the graduation project of my two-year study in the master programme Design for Interaction at the Delft University of Technology. In the past half-year, I worked on this project with Westfriese Bibliotheken to explore a new book discovery experience in the public library. This project is the end of my student life and it has really helped me to know myself better as a designer. I want to thank all people who supported me along the way.

Firstly, I would like to thank my supervisory team who have walked me through this project with patience and guidance. Thank you, Alessandro, for challenging me with your critical thoughts and helping me to communicate the research and design more clearly. Although I have to say I am not very good at that yet, this experience has definitley encouraged me to take actions. Thank you, Pieter Jan, for inspiring me with your professional knowledge in the design field. Your heuristic guidance really opened my mind especially during the research phase. Thank you , Himanshu, for your supportive insights and always kindly listen to my thoughts.

Also, great thanks to clients from the Westfriese Bibliotheken for offering the graduation opportunity and help. Without your help, it would be much harder for me to conduct the research. Thank you, Sandra and Ruud, for giving feedback and introducing your colleagues to me. Thank you, Sebastian, for nicely and patiently discussing the design concept with me. It's a pleasant experience to work with you and I am very glad to see that you are satisfied with my final outcome.

Special thanks to all people who participated in the user research, creative session, iteration test, and evaluation test of this project especially under the covid situation. Thank you all for your generous sharing of experiences, opinions, and suggestions in this project. Nice to meet you all sincerely and let's keep in touch.

Additionally, I would like to thank all my friends who accompanied me during the past half-year. Thank you for always listenning to my frustrations and encouraging me patiently.

Last but not least, I want to thank my parents who always supporte my decisions and let me have this precious experience.

Thank you all again for supporting me in this journey and I hope our paths can cross again in the future.

Executive summary

Nowadays, a public library is no longer a place just for the collection of books. It has offered multiple functions to take the responsibility of being a public cultural institution for all citizens. However, in the Netherlands, libraries are losing their members, especially young adults. With the development of technology, a public library is no longer the only choice for books. Libraries are encountering a challenge to attract young people back. They need to strive for providing new kinds of public services to attract this potential new audience.

Westfriese Bibliotheken is one of these libraries which has 10 decentralized community libraries in 6 places in the north of the Netherlands. Westfriese Bibliotheken is facing a challenge to reach a bigger group of the generation of youngsters who think a public library is a dull place to go. To narrow down the scope, the book discovery experience for young adults between 18-25 years old was focused. Augmented reality as the technology this project worked with has been proved to benefit the library context.

Hence, the objective of this thesis is to explore a new book discovery experience for young adults in the public library in Stede Broec.

From the theoretical study (chapter 2) about the book discovery behavior, the behavior pattern was investigated and worked as the design requirements. A user research (chapter 3) was conducted to understand the current book discovery experience in the context through contextmapping. It discovered users' concerns and expectations about the book discovery experience. Moreover, the opportunity of this project: designing a new book discovery experience to facilitate serendipity was concluded based on user research findings. Under the framework of the serendipity theory (chapter 4), design opportunities of facilitating serendipity in the current library were gathered. The study on augmented reality (chapter 5) helped to define design qualities and technologies that this project can make use of.

With the research insights, a design goal with three design qualities (fascinating, playful, and inviting) and relevant design requirements were formulated (chapter 6). They contributed as a guideline to the design solution.

Ideas were gathered through a creative session, and based on these ideas three initial concepts were generated. Concepts were evaluated and iterated with users, clients, and fellow students. The final design outcome is a phone-based AR application with two main parts: exploring and browsing parts. It offers both basic and additional information about books to stimulate users to experience serendipity in the public library.

Finally, an evaluation test was conducted to validate if the final design can fulfill the design goal. The final design achieves a good usability and desirability performance evaluated by 6 participants in the library. The evaluation test demonstrated that the additional information about books and interaction between the physical and digital world can let users feel fascinated, invited, and playful during the book discovery experience.

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Chapter 1
Introduction

The chapter introduction will give a general overview of the project including the background of the project, the client this project collaborates with, the assignment of the project, and the project approach.

Chapter overview

1 Introduction

1.1 Background

Traditionally, a library is a collection of sources, resources, and services, and the structure in which it is housed; it is organized for use and maintained by a public body, an institution, or a private individual. The term "library"has itself acquired a secondary meaning: “a collection of useful material for common use." Libraries most often provide a place of silence for studying.

Nowadays libraries offer more than books. The Public Library Facilities System Act (Wsob) specifies five social functions that every library organization must fulfill: making knowledge and information available, offering opportunities for development and education, promoting reading and getting acquainted with literature, organizing meeting and debate and getting acquainted with art and culture. However, young people are going to the library for books less and less.

In the Netherlands, public libraries have been losing their members since 2000. The number of members of public libraries has been decreasing annually since 2000 till 2019 from around 4.3 million to around 3.6 million. However, the number of online users has been increasing since the inception in 2014 and more than 427 thousand members had an ebook account at the end of 2019 (Van de Burgt & Van de Hoek, 2020; CBS, 2020a.).

Young adults are less likely to be members of the library in the Netherlands. 63% of the library's total membership base are youth members however only 21% of young people aged 18 to 20 are members. This drops to 14% for 21-25 year olds, compared to more than a third of 12-17 year olds. The proportion of members is smallest in the age groups of 18 to 40 years (Peters & Van Strien, 2018).

The number of physical collections lending has been declining fairly consistently since 1999. In 2019, 63.8 million materials were lent, of which 61.1 million physical books; this is approximately 4% less than in the previous year (Van de Burgt & Van de Hoek, 2020; Statistics Netherlands, 2020a). This decrease in physical loans is offset by an increase in the number of e-books lending: from 1.6 million in 2015 to nearly 3.9 million at the end of 2019 (Van de Burgt & Van de Hoek, 2020; CBS, 2020b).

People buy more ebooks than physical books in recent years. The number of books sold was keeping similar these years at around 41 million from 2016 to 2020, but the physical book market had been losing around 9% annually since 2016. The number of ebooks kept increasing during these years and got a dramatic increase at 27.4% in 2020 (KVB Boekwerk, 2021).

With the development of the internet, library is not the only choice for books to young people any more that is the background problem in this project. However, as the British expert in library architecture Brian Edwards states: **“IT does not destroy the library but liberates it into providing new kinds of public services attracting a potential new audience”** (Edwards, 2009).

1.2 Assignment

Westfriese Bibliotheken is one of the libraries that wants to seek future possibilities to attract a new audience. It’s the center of knowledge and experience, collecting literature to develop reading pleasure, and a social hub in the local. They have 10 decentralized community libraries in 6 places in the north of the Netherlands.

Westfriese Bibliotheken is **facing a challenge to reach a bigger group of the generation of youngsters from 18 to 40 years old.** This group of people thinks the library is a dull place to go to. In this project, the public library in Stede Broec is taken as an example to design for. The target group in this project is narrowed down to **young people from 18-25 years old** for the reason that it's easier to approach this group of people.

Westfriese Biliotheken as the client in this project expects **a new and different way to experience the book for all those who visit the library.**

The book-related experience in the library typically consists of the following steps: searching the catalog for books of interest, physically retrieving the books from the shelves, and reading the book for the desired content. The first and third steps have been well studied; **the step of retrieving the book from the shelves has been overlooked as being of less significance to the book selection process**(Cunningham, 2013). Leckie and Given (2005) pointed to the need for more studies on how information seeking is carried out in physical libraries. What's more, the experience in the physical library as the personal interest also determines it to be the focus in this project.

This thesis focuses on understanding the current book discovery behaviours in the physical library and finding the needs of the young adult in discovering books, in order to

"design a new way of discovering books in the physical library that fits with the young adults (18-25 years old)"

Figure 1. Library in Stede Broec

1.3 Target Group in the project

The target group of this project is aged from 18 to 25 years old and belongs to Generation Z. Generation Z refers to those individuals who were born in the decade following the widespread emergence of the World Wide Web, from the mid-1990s to the early 2000s (Dimock, 2019).

Generation Z grew up in social networks, they are digital-centric, and technology is their identity (Singh & Dangmei, 2016). They were born and raised in the digital world that this group of people is impatient having a short attention span. The difference between them and other generations is that their existence is more closely connected with the electronic and digital world.

Generation Z spends much time evaluating the commodity through various information before purchasing (Singh & Dangmei, 2016). **The experience of consuming is as essential as the commodity itself.** A seamless purchasing experience between online and offline environments is their favorite. This value on the experience also works for the brand of a company. They are seeking a unique product or service that fits with the norms of groups and individuality that helps them stand out. The traditional advertisement has a weaker impact than the advice from their social bubbles.

1.4 Library as a place

A future public library model (Jochumsen et al., 2017) identifies four locations: the inspiration, learning, meeting, and performative space in the library that meet four future goals: experience, involvement, empowerment, and innovation. The four areas should not be viewed as physical rooms; rather, they should be viewed as possibilities that can be realized both in the physical library and in the digital library. The four spaces model can be a concrete tool for designing, developing, and redesigning the public library. **The inspiration space and learning space are the focus of this project that creates an experience to transform people's perceptions and empower people's learning.**

The Inspiration Space

The space is for meaningful experiences (i.e. experiences that transform our perception). The inspiration space should encourage people to explore unfamiliarities. This can happen through creating aesthetic experiences that are irrational, emotional, and chaotic.

The Learning Space

The space is for people to discover and explore the world with free access to information and knowledge. The experience and empowerment are supported through play, artistic activities, courses, and other activities.

The importance of experience

Jochumsen et al. emphasized the concept of "experience society" for the inspiration space which the experience dimension is increasingly taking up more space in our everyday lives. The importance of experiences can also be connected with the concept of the experience economy which describes how any business wanting to survive in a market. The market nowadays is full of competition for attention and **success can no longer be achieved by just offering goods and services but instead need new experiences.**

1.5 Augmented Reality as the technology to work with

The mission of teachers in today's classroom is to create the proper conditions to determine the shift from the static transmission of knowledge to student-centered learning. Students are now active participants in the learning process. In order to be successful and to ensure the engagement of students, teachers must use adequate methods common to the current generation of "digital natives" (Nanu et al., 2013).

This concept is similar to the context of a public library that Generation Z raised on electronic devices. All of the enrichments that technology could offer could get benefit from a strengthened level of knowledge and understanding of the virtual world (Massis, 2015).

Augmented reality was chosen as the technology to work with in this project based on the suitability to the target group, the physical context, and my personal interest.

The detailed introduction and study about augmented reality can be found in chapter 5.

1.6 Project approach

This project followed the double diamond model with four phases (Design Council, 2019). The process of the project can be summarised as four phases: Discover, Define, Develop and Deliver. Since the initial design goal is quite broad with no clear direction that what kind of this new way of discovering books remain unknown both from the client and my personal ambition. To find a new way of discovering books in the physical library, it's crucial to figure out what's the current situation and find the potential opportunity to design a new one. The discover and define phases of the double diamond model can help much to achieve this requirement. There were sprints going back and forward between activities to iterate insights during the project.

Discover

The goal of this phase was to understand the current context, discover the unmet needs, and define the design opportunities. Due to the fact that the project was done under the covid situation, it's impossible for me to go to the library and observe the current context. It's also hard for me to find young adults who go to the library in Stede Broec. As an alternative way, literature research and one-on-one contextmapping (see chapter 3.) with users who have the experience of going to a community library for books in a small town were taken.

Literature research about the book discovery, target group, and augmented reality were done to generate design requirements and get inspiration for the define and the design phase. For the context research with users, method Contextmapping was applied to understand user behaivors and needs. As mentioned before, the process is not completely linear. The literature research findings together with the user research insights showed that facilitating serendipitous experience in the physical library was the opportunity direction to go in this project.

Define

In the define phase, the research results from the previous phase were synthesized to generate the problem definition with three problems and design goal with design requirements.

Develop

Ideas and concepts were generated in this phase. First, an ideation session was done through co-creation to get the first several ideas. Based on those ideas, three initial concepts were generated and went through quick evaluation with target users, clients, and design students to select a direction to develop further. Prototypes were made and tested with users for iterating design concepts. At the end of this phase, a final design concept was made.

Deliver

Deliver was the final phase of the project, which aimed at delivering the final design and results of the evaluation. An interactive prototype was created for users to experience and thus give feedback for the evaluation purpose. The results of the evaluation were analyzed and demonstrated by qualitative and quantitative results. System usability scale (SUS) (Bangor et al., 2008), AttrakDiff (Hassenzahl et al., 2003) were used for assessing the usability and design goal from the quantitative perspectives while interviews and observations were used to gather qualitative insights.

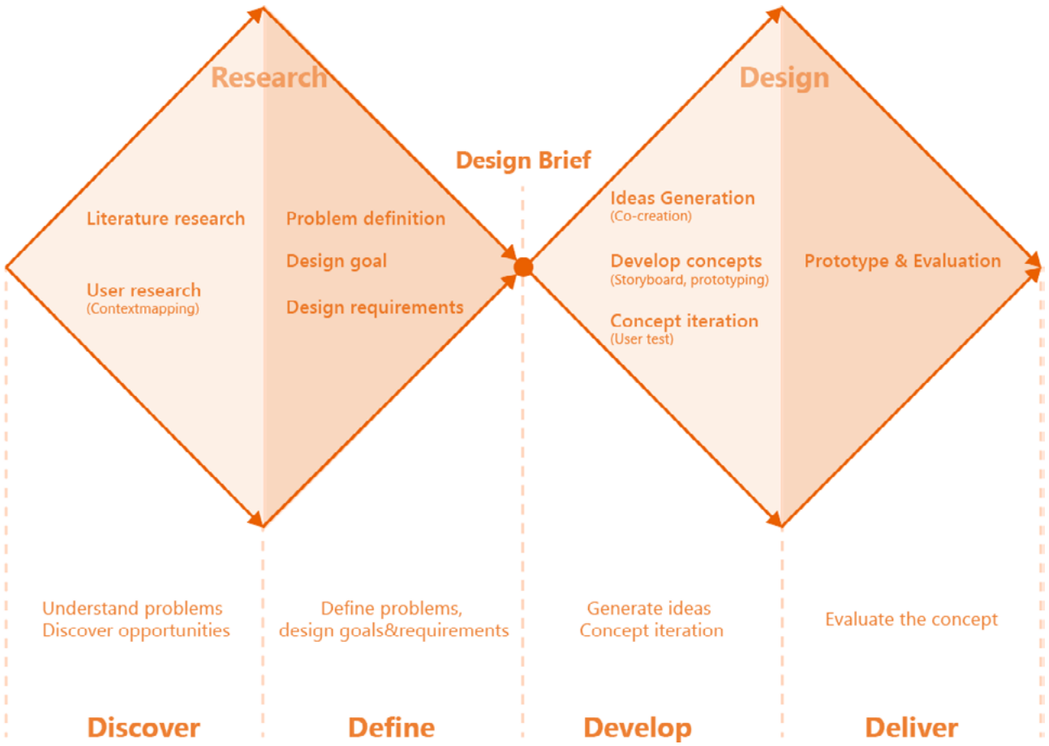


Figure 2. Overview of the project process (Design Council, 2019)

Chapter 2
Theoretical background on book discovery behavior

To know how to design a new book discovery experience for young people in the library, the behavior itself including the motivation and behavior pattern needs to be learned from a theoretical perspective. As motivation will influence people's behavior, different reading motivations were studied to select one as the target to narrow down the scope. Since the covid situation, people's behavior patterns can not be studied by observing in the real context, literature research about the book discovery behavior pattern as the information seeking behavior from a fundamental perspective was done.

Research questions:
1. Which reading motivation is the most suitable to design for in the project?
2. What's the pattern in a book discovery experience?
3. What are factors (design objects) that influence an information seeking behavior?

Chapter overview

2 Theroetical background on book discovery behavior

2.1 Reading motivation

Nicola and John(2007) demonstrated four dimensions of adult's reading motivation:
1. reading as part of the self: can be interpreted as reading as part of one's integrated self.
2. reading efficacy: to optimize the ability of reading.
3. reading to do well in other realms: readers make use of reading to achieve desired outcomes in a functional dimension rather than inherently reward.
4. reading for recognition: desire for others to acknowledge their reading.

There are two types of intrinsic motivation to read: object-specific and activity-specific intrinsic reading movation(Schiefele et al, 2012). The object-specific intrinsic reading motivation defines that a reader is motivated to read becasue of the interest in the topic. The activity-specific intrinsic reading motvation defines that a reader is motivated to read because of the reading activity brings positive experiences. Thus only reading as part of the self could be categorized as intrinsic reading motivation since the other three types of reading motivation are all energized by their expected consequences.

In this project, the fact that young people see a public library as a dull place, and the design assignment of a new book discovery experience is going towards an interesting and fun direction. Reading motivation will define the focus of book discovery, and thus people who read as part of the self are more likely to be attracted by the discovery process. **Therefore, people who consider the first type as the main motivation were considered as the target group.** This criteria helped to select participants for the user research and concept tests in chapter 3 and 7.

2.2 Dynamic and evolving information seeking (berry-picking)model

Information seeking behaviour (ISB) arises from information needs and to fulfill the needs of a person who interacts with the system for information(T. D. Wilson,1999). In this project, people's book discovery in a public library could be seen as an information seeking activity.

Bates (1989) introduced a dynamic and evolving information seeking model called berry-picking. Users may start from a feature or a topic to various information sources. **They constantly follow new directions of searching based on the pieces of information encountered.** The query is satisfied by the integration of information found in the search process rather than one single best retrieved set.

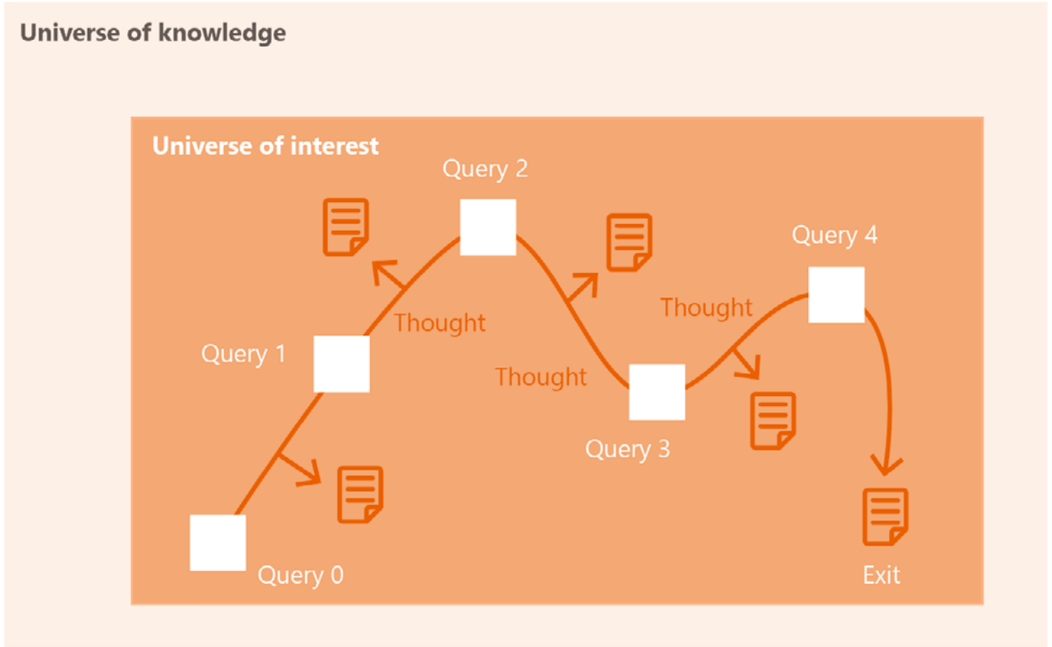


Figure 3. Berry-picking model (Bates, 1989)

2.3 Convergent and divergent information behavior

Convergent goal-directed and divergent explorative information behavior were conceptualized by Ford (1999) in information retrieval systems. The convergent information behavior is aimed at searching for work tasks, studies, hobbies, etc. The divergent information behavior is aimed at enjoyable and pleasureable browsing for inspiration, experience, and relaxation.

In real life, these two types of information behavior are mixed (Björneborn, 2008) and can interplay with each other. For instance, a user goes to the library for a science fiction book that he has done convergent serarch in the online catalogue. This user also browses other science fiction books close to the target book that is a disvergent information behavior. Moreover, he is triggered by the topic about time travel and then goes through a convergent information behavior for Hawking's "A Brief History of Time". This shifting between convergent and divergent information behavior can be explained by the berry-picking model. In this way, the physical and digital library spaces can supplement each other.

Björneborn (2008) illustrated that there are subconscious and conscious interests as information diet from Pirolli & Card's work (1999). **The subconscious interests take a bigger part than conscious interests** and these latent interests can be triggered when encountering information afforded by the information environment.

Seven ways of finding materials in the library were studied by Björneborn (2008) to show convergent and divergent information activities: planned finding, favorite spot finding, substitute finding, supplement finding, systematic browsing, impulsive browsing, and incidental encounters . From the study, nearly 50% of interviewed users found materials only through the convergent information activities.

This gives the implication to my project that it's important for libraries to **meet both convergent and divergent information behaviour** of users when designing a new books discovery experience. Both divergent and convergengt information activities should be supported and users should be supported to switch between these two activities freely. From the user research insights (see chapter 4.), the serendipitous experience was focused, this indicated that supplement, incidental encounter, impulsive browsing, and systematicbrowsing should be more relevant to focus on since it can trigger users' latent needs and thus add to the serendipitous experience in the library.

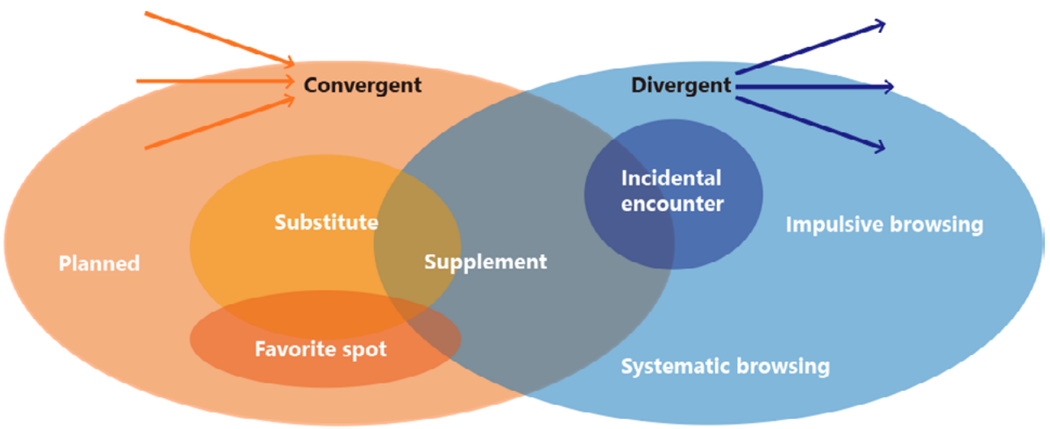


Figure 4. different types of convergent and divergent information behaviour (Björneborn, 2008)

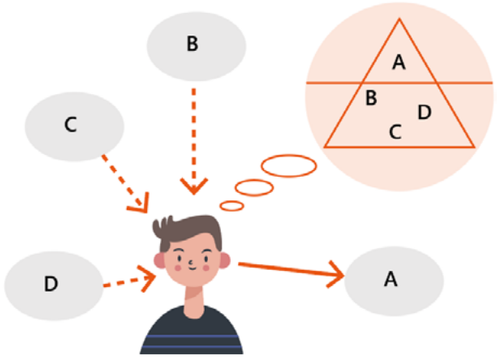


Figure 5. A user encounters potentially triggering items B, C, D while searching for A (Björneborn, 2008)

2.4 Causal-leisure information behavior

Besides the task-based information behavior, a casual-leisure information behavior that people engage in searching behaviors for pleasure rather than find information with a hedonistic needs was described by Elsweiler (2011). Three differences between work-task and casual-leisure information behavior were concluded: different motivation, different focus, and different kind of importance. Implications for design and user evaluation were learned as well.

Differences

Different motivation: The casual-leisure information behavior can have vague motivating factors such killing time, changing mood, etc. often with no requirement for a specific goal.

Different focus: The information encountered acts as a trigger to facilitate emotional or physical responses that these responses experienced by a user is more important.

Different kind of importantce: The failure of resolving a need is unlikely to cause a long-term and negative impact on people in casual-leisure situations while it's not the case in work-task situations.

Implications for design

Besides providing the approprite information, the interaction with the information system should be well designed to spark users' desires such as **being engaging, entertaining, fun** etc. Explicit support for encountering books of interest in an unconcious way is beneficial in casual-leisure situations where users usually only have a vague idea, such as **a desire to find something "interesting".**

Implications for user evaluation

The efficiency (time taken, task complete, etc.) is not the and main metric to assess system performance. The subjective metrics such as engagement, relaxation, etc. would be useful although in some cases, people still want accurate information in a quick and efficient way. **The balance between objective and subjective metrics should be well considered to use for a user evaluation.**

Animal Foraging		Information Foraging
Food	**Goal**	Information
A site containing one or more potential sources of food	**Patch**	A source of information
Search for food	**Forage**	Search for information
The animal's assessment of how likely it is that a given patch will provide food	**Scent**	How promising a potential source of information appears to the user
The totality of food types that an animal may consider in order to satisfy hunger	**Diet**	The totality of the information sources that a user may consider in order to satisfy an information need

Figure 6. Analogies between information foraging and animal foraging (Pirolli & Card, 1999)

2.5 Information foraging theory

Information foraging theory (Pirolli & Card, 1999) is based on the assumption that people will adapt searching strategies to gain valuable information through making the most of the effort paid in the searching process. The theory is an analog to the optimal food foraging theory. Three models described how the searching strategy can be modified: information patch model, informaiton scent model, and information diet model.

Information patch

The environment of an information seeker is usually structured in a patchy way. Often the information forager has to navigate from one information patch to another e.g. from one bookshelf to another in the context of a physical library. Two different decisions that will improve the rate of gaining valualbe information are encountered: between-patches enrichment and within-patch enrichment.

Between-patches enrichment aims to **lower the cost of switching different information patches.** As could be observed in the library, collections of the same or similar categories would be placed close to each other.

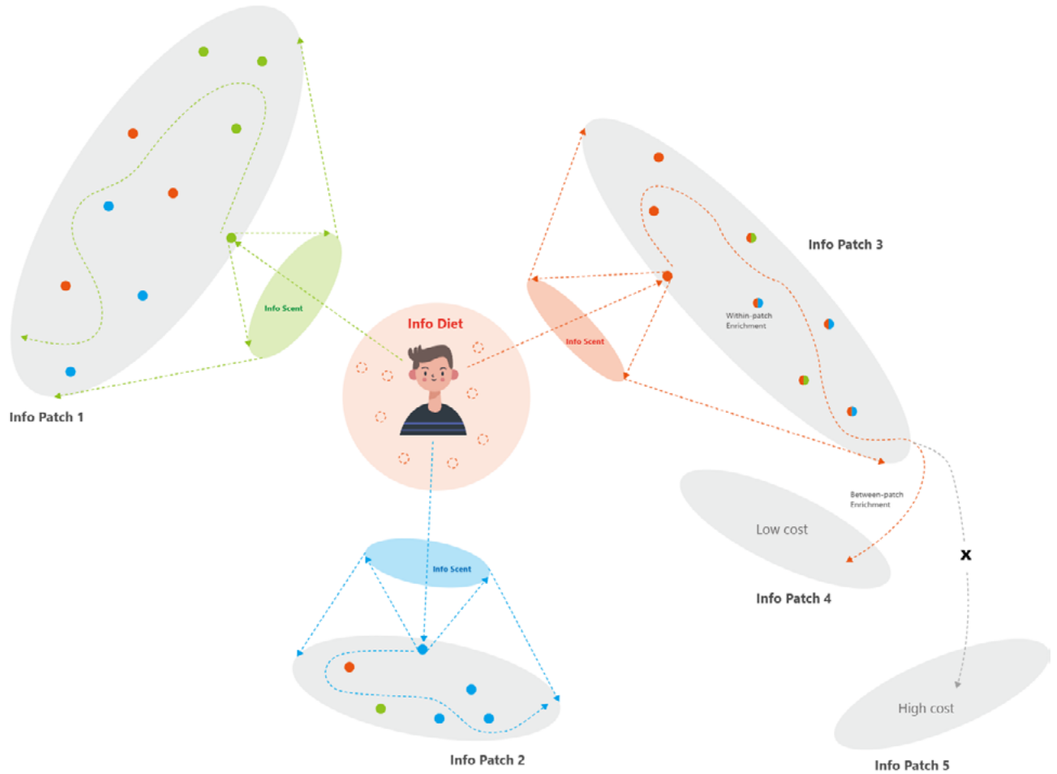


Figure 7. Information foraging theory (Pirolli & Card, 1999)

Within-patch enrichment aims to **raise the possibility of gaining valuable information by modifying the information environment** (e.g. filtering and refining keywords).

Information scent

Information scent is the (imperfect) **perception of the value, cost, or access path of information sources obtained from proximal cues**, such as bibliographic citations or icons representing the category. Information scent is made use of by an information seeker to judge if searching an information patch has the potential of low effort to pay and high valuable information to get.

Information diet

During the searching process, an information seeker is aimed at maximizing the rate of gain of imformation relevant to his/her needs and tasks. **The lower efforts and higher profitability are the key criterias** whether an information seeker decide to search in one specific information set.

Conclusion

1. Which reading motivation is the most suitable to design for in the project?

Reading motivation will influence the criterias of book selections. Reading as part of the self was chosen in this project to design for as more likely to be attracted by a fun book discovery experience.

2. What's the pattern in a book discovery experience?

Book discovery can be categorized as an information seeking behavior. Seeking information is a dynamic process where users constantly shift between information resources. Divergent and convergent information behavior can trigger each other in one information seeking activity. Users' information needs evolve as well since the latent needs might be evoked during the seeking process. **The design in this project should support users' transition between these two information behaviors and thus spark the latent needs.**

Casual-leisure information behavior is different from work-task information behavior from the motivation, focus, and perceived value. For this project, **both two information behaviors are involved** as users go to the library for books to borrow but also enjoy walking around to browse different books without a clear book in mind.

Users' **emotional desires** should be sparked by the information system together with pursuing **search efficiency**. The **subjective metrics** should be included in the user evaluation of the design concepts.

3. What are factors (design objects) that influence an information seeking behavior?

The information needs are met by the integration of information encountered from the seeking process. Users rely on a clue from the information resources to identify the benefit and cost of seeking information. Thus it's crucial to help users to **judge the value of a book quickly and reduce the cost of discovering** both in one category but also among different categories. **The clue in this project that e.g. book title and author name on the book spine is one of the objects to design for.**

Chapter 3
The current book discovery experience

Insights from the real world and users need to be collected to bridge the gap between the theory and context. The book discovery as an information seeking behavior needs to be learned in detail in the real context with insights gathered. The user research results reveal the insights into 4 cluster: social interaction in the library space, how people want books to be displayed, interior space qualities, and book discovery journey. These 4 clusters together answered the research questions below. The results from the user research were applied to be analyzed within the framework of serendipity in chapter 4 and define problems in chapter 6.

Research questions:
1. What motivates young people to discover books in public libraries?
2. What do they care about when discovering a book (concerns, feelings, and attitudes)?
3. What do they expect if there is a new book exploration experience?

Chapter overview

3 User research

The context in a public library remains unknown to guide a new book discovery experience. To gain a deep understanding of the user group and their current book discovery experience and expectations, a user research through contextmapping was done in this section.

3.1 Research goal

To learn
1. What motivates young people to discover books in public libraries?

2. What do they care about when discovering a book (concerns, feelings, and attitudes)?

3. What do they expect if there is a new book exploration experience?

3.2 Approach

The method contextmapping was used as the way of user research in this project which let people construct a view on the context, by calling up their memories of the past and eliciting their dreams of the future, and thus elicit contextual information and serve the generation of human-centered designs (Visser & Stappers, 2005). In this project, participants followed this path and their needs and expectations about the book discovery experience were generated.

A contextmapping study typically involves a sequence of research steps including preparation, sensitization, session, analysis, and communication.

Participants

Five participants were recruited aged from 20-25 years old, Dutch, see reading as part of self, and go to public community libraries for books (before covid). Due to covid situation, I was not able to go to the libray in Stede Broec and recurit young adults there. Instead, I recurited participants via social media and reading club in a student housing. Participants were selected based on the requirements mentioned above with questions asked online.

3.3 Procedure

Preliminary mapping

The research starts with a preliminary mapping of the current understandings and assumptions to prepare for the sensitizing exercise.

Sensitization

A sensitizing exercise on Miro was conducted with participants and they were given one week to complete. The goal of this exercise is to let them think about past experience, and make them “reflective practitioners” of their present experience.

In total, 6 exercises with images of libraries and bookstores for inspiring were formulated: About me, This is why I read, Books I like, A good public library/bookstore, My special habits with books, and My recent journey of visiting a public library/bookstore(before covid). A pilot test was conducted with a person outside the design genre to check if both the exercise and operation on Miro were understandable.

After participants completed the sensitizing exercise, they were asked to participate in the generative session.

Figure 8. Representative pages of the booklet, the full booklet see Appendix

Generative session

The sessions were conducted with five participants (4 offline and 1 online) individually. The participants were encouraged to express their thoughts and ideas by using the tools provided to them around the topic of the book discovery experience in a public library. The session includes four parts: go through the sensitizing exercise, cognitive map, collage exercise, and Lego serious play(drawing and building with stickers for the online session). The consent form was agreed upon by participants for audio recording the session.

Figure 9. Participant doing collage exercise

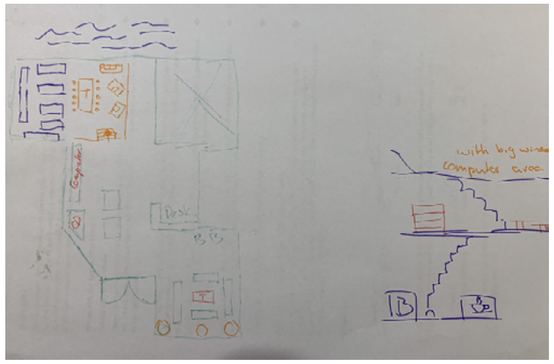


Figure 10. One cognitive map example

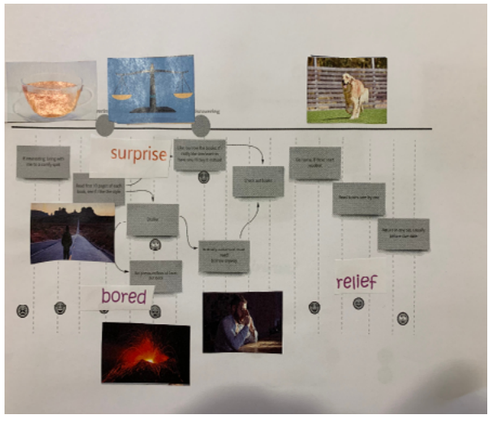


Figure 11. One collage exercise example

Figure 12. One lego serious play example

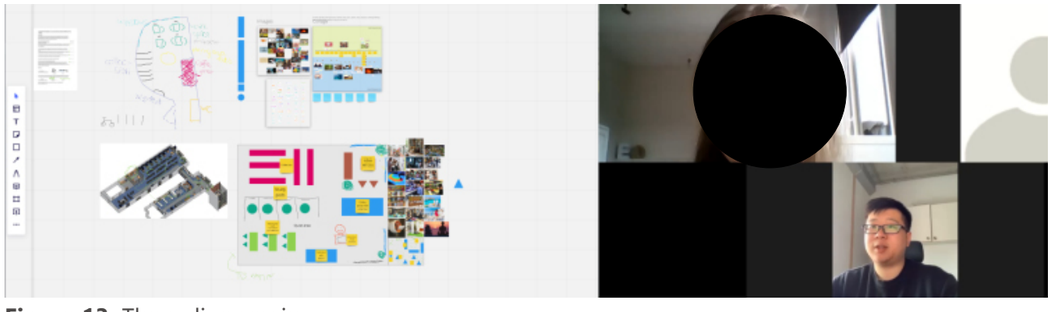


Figure 13. The online session

Introduction 2 min	Self introduction to each other would be done first. Then participants were informed of what will be done during the session, the goal of this session and time schedule of the session.
Discussion about the sentization exercise 10min	Let the participant tell the story of the booklet and ask him/her questions related to discovering books to guide him/her into the mood.
Cognitive map 10 min	Let the participant draw a map of the public library which he/she usually goes to and tell the journey of visiting.
Collage instructions 2 min	By following the order of before, during and after discovering, participants were asked to make a visualization to express how the book discovery experiences were: good versus bad experiences. Words and images were prepared to help participants to tell their stories, they can use them (or not) as they want.
Make a collage 10 min	Context of discovering books: where, what, who, when, why, situation, seeing, feeling, hearing, smelling, texture, mood, concerns?
Discussion about the collage 20 min	Participants were asked to tell the story of discovering books and questions related to research questions and collage content were discussed.
Model making instructions 2 min	Use the Lego, paper, glue, scissors to make a model to represent the ideal scenario of discovering physical books without thinking about the technology limitations.
Build a model 10 min	Context of ideal scenario: where, what, who, how, interaction. What is important? How do they want to feel in this scenario? How to create those feelings?
Discussion about the model 20 min	Participants were asked to describe the model of discovering books and questions related to research questions and collage content were discussed.
Wrap up	Feedback about the session.

Figure 14. Generative session schedule

Analysis

The sensitizing exercise and session presented rich insights. The talks from the session were transcribed as the raw data. The raw data were then interpreted into the form of a statement card (figure 15). And then statement cards belonging to a similar category would be put together and clustered through finding the connection.

Category	**Inspiration**
Quote	Sometimes people tell me about books or she read before.
Interpretaion	People get inspired to read a book through recommendation by people around them.

Figure 15. One statement card sample

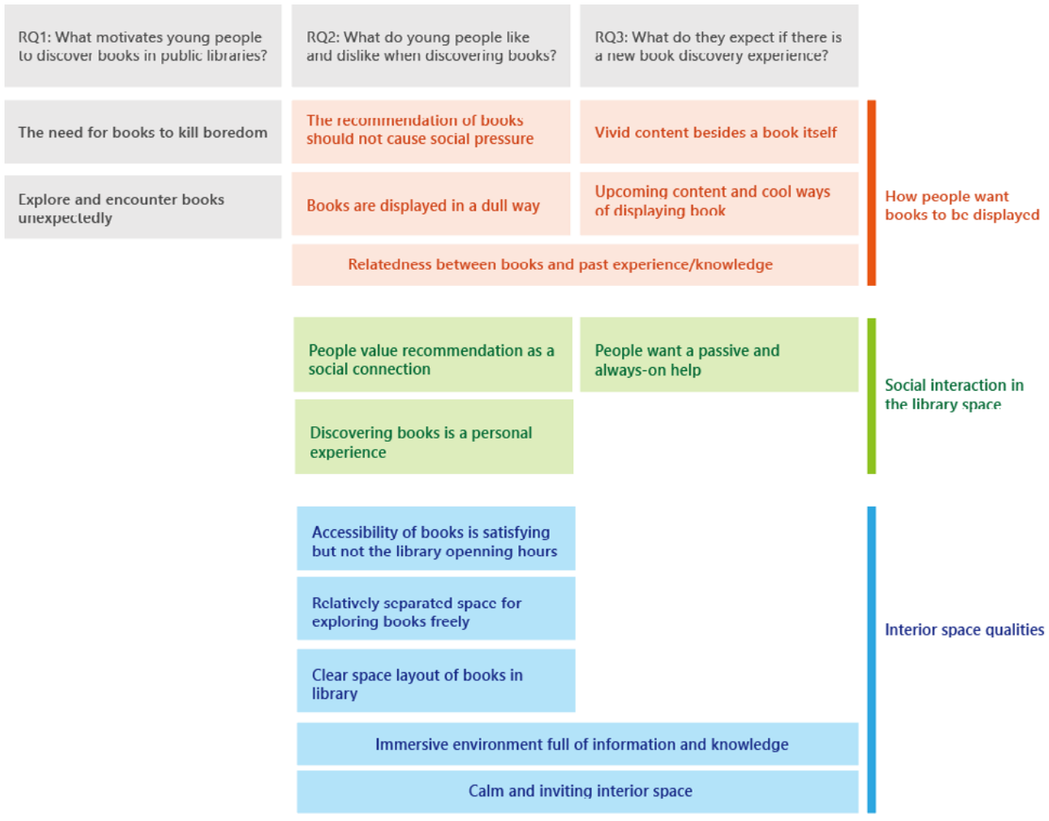


Figure 16. Overview of insight clusters

3.4 Results

The results revealed insights from four perspectives: how people want books to be displayed, the social interaction in the library space, and interior space qualities as the Figure 16 has presented, the book discovery journey was learned as well to answer RQ1 and a general behavior pattern in book discovery. questions. Since some of the insights gathered from the user research had overlaps between RQ2 and RQ3, The insight clusters were explained in detail by following the four perspectives as mentioned before instead of reacting to research questions. This way also helped to understand the context clearly and define problems later in chapter 6.

Book discovery journey

Before discovery

People feel excited when they want to read and **past reading experience is recalled at this time**. They anticipate having a good reading experience since then. They need time to make a plan e.g. search for the target book, check the availability of that book on the library website, or the balance between the opening hours and their time schedule. The desire of visiting a library usually doesn't fulfill immediately. Therefore the library is not a place where people feel they can just walk in.

The need for books to kill boredom is the main motivation to go to a public library. Participants see discovering for pleasure and relaxation in the library an important part of the journey. People do have an expectation that after browsing through shelves, they will find something interesting to read. However, participants feel they are bound to the library collection while buying books could give them the freedom of reading everything. **A public library is seen as a place to kill time and look for interesting books unexpectedly rather than just a place for books.** They will not rush into the library, grab the book and leave. Instead, they will spend a period of time in the library. This aligns with the casual-leisure information behavior.

During discovering - Target book

After getting the target book, people feel relieved and satisfied like “deal” and are more open for inspiration and look for surprising content.

During discovering - Serendipity

Roaming - People think it's a more leisure feeling of walking around shelves than finding a particular book. People would first go straight forward to the most familiar section when they enter the library also to seek comfort to prevent the feeling of being judged. They feel exploratory, open-minded, and exhilarated when discovering through shelves and desire for books and excited about the fact that there's so much they can read in the public library.

Attracted - When encountering a book possible to be interesting, people feel surprised and would go further with that book. Participants mentioned that which book to take also depends on their recent emotions and feelings. People might also be interested in other categories, but there is a lower priority. This lower priority also means lower emotion intensity and value.

Explore further - During this exploring time, they enjoy it if they could really take some time to sit down and read about it. How people judge a book: spine > cover> back cover > content on pages.

Take the book or not - A highlight moment occurs when people decide to take a book and anticipation occurs which is about the reading experience of this book in the coming days. People would feel sad and disappointed if they find the book is not what they want after reading the first couple of pages.

"it's a bit of an up and down experience, in finding a book or not finding a book and having to find a place and being a bit cranky if you don't find a good reading spot."
- Participant. S

The value of serendipity - Serendipity is considered as **a different value** from that of the target book in the discovering phase but is definitely not more valuable in the reading phase. The target book meets people's expectations and they are mostly sure that they will get that book since they have searched online before going to the library. The serendipity is beyond their expectation unintentionally and by coincidence although they do anticipate encountering some surprising books. A metaphor for this would be driving on the road towards a tourist attraction in which people would come across a beautiful lake during driving and they would not be upset for taking more time because they find something nice along the way.

"I think in the beginning, the one book that I find through serendipity through roaming around, it definitely has a higher value. It brings me more joy and more excitement, and I really found something new today. It's really a pleasurable feeling, "
- Participant. A

After discovering

People can always get something from the library. Having found books makes people feel happy because they could read them and also appreciate that they can find all those books. The expectation of the book content continues when people leave the library until they read the book.

"It's a good experience overall because you just get to let loose some books and wander through and it's just a nice run in the park. And then when you get home, you have these books you enjoy reading."
- Participant. E

How people want books to be displayed

Vivid content besides a book itself

When asked what would inspire participants to grab a book and read, they would like some visual representatives of a certain theme like a display table with decorations. The example given was a summer holiday theme with sand, beach, and coconut trees to show a vivid feeling of those books more than just books.

They would also be inspired by a quote from a book which they can quickly get the idea of the book with a glance at it. They also thought special themes should have special artworks to show e.g. a man and a woman with a pink heart to tell a romantic story. These self-explanatory ways could add more fun to the book discovering process and help people to find the book they are interested in in a more active way.

"They will put it on a table with a theme like a summer holiday. They will dress up the table with sand and sea. Books were really related to this theme. You can also see a miffy bunny next to books for children" - Participant. S

Relatedness between books and past experience/knowledge

People do have a more interested category or theme than other categories, they are attracted by this familiarity based on the previous reading experience. During the discovering journey, these reading experiences are evoked when people see triggers such as titles, author names, or content summary.

At the same time, the context of those reading experiences can also be evoked , for instance, on warm days he/she is in the sofa with a cup of tea and just feels relaxing.

There is also another relatedness that one participant mentioned that she went through a similar mental journey with a character she once read about. Gen Z would probably feel this relatedness more intensively since the pressure of social media actually fuels feelings of loneliness among them. These different types of relatedness make them willing to go a bit further with that book in the library.

"I will look at the titles of books which look interesting to me. And based on the experience before I know I like this author and way of writing." - Participant. H

"Really combine reading with a lot of things, but for me, it represents warm days where I'm just on the couch and just relaxing."
- Participant. A

Figure 17. An example of showing vivid content besides a book itself

Books are displayed in a dull way

Most of the books in the library are placed on shelves with spines showing to people usually only with a title and author name on it. This layout gives a dull feeling to people because they think spines usually don't look interesting and there are usually so many books there. Research from Gen Z that they tend to be impatient with a low attention span could also help to explain this dull feeling. Only if they are triggered by interesting titles or author names they know, they will take the book and look at the front and back cover or read the first few pages to make the decision of taking it or not. In this situation, books on shelves offer very limited information to spark people's curiosity. Popping out a book that shows its cover or having a display table would increase the possibility of people getting to know more books which they might miss before.

"And also just make sure you sometimes pop out a book and rotate it, so you can see the cover instead of just the spine because usually the spines don't look very interesting."
- Participant. H

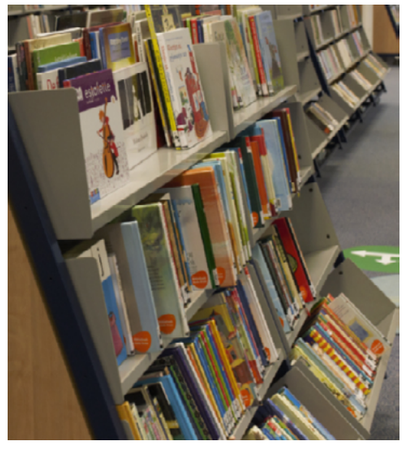


Figure 18. The way of displaying books in the library in Stede Broec

"If all the books are on shelves all the time, it's maybe hard to go for them...Sometimes you would get new ideas from the books on a display table which you usually don't look for."
- Participant. T

Upcoming content and cool ways of displaying book

Upcoming books, authors, and cool ways of displaying books are expected by young people to discover new perspectives and get fresh feelings. This longing for "new" can be explained by the characteristics of Gen Z who are called digital natives living in a digital world and constantly evaluate unprecedented amounts of information and influences from various sources. Also, the days are gone where big publishers decide who reads what, Gen Z is able to choose whatever they want to read. Last but not least, the characteristic that Gen Z tends to have acquired attention deficit disorder with a high dependency on technology answers the need for cool and new ways of displaying books. As can be learned from the field of museums that new and cool interaction can attract young people(Gofman et al., 2011).

"I think what also really help in this browsing part is just having a cool, new way of presenting books rather than just a bunch of books on it. A square table with 12345, because it's Top Five. This is boring."
- Participant. A

"I think a combination of upcoming books, authors, and current-day authors will attract me."
- Participant. H

The recommendation should not become social pressure.

Young people are living in a world where they are recommended all the time and they get both benefits and negative influence from it. On the one hand, they think books recommended or borrowed/ bought many times by a large number of people have more possibilities to be good. On the other hand, they also feel pushed by the social pressure.

People feel there is social pressure that they need to read what everyone around them read which is popular among them. They are actually not interested but they don't want to lose interaction with others. And sometimes there is a social pressure that one book is very popular generally but they haven't read it.

"You see a shelf with Top Ten borrowed books. That might be interesting because they're in the top ten, then they should be good."
- Participant. S

"I pick up a book and I read the first few pages but I'm not really impressed. I know it's one of those books that everybody says you have to read it. I don't want to read but I have to. Maybe that's the relief that comes when I finish it."
- Participant. A

Figure 19. One example of top 10 books in the library

Social interaction in the library

Discovering books is a personal experience

Visiting a public library for books is a personal experience and people always go to a public library alone. They won't go there even with friends. People don't see borrowing books from the library as the only goal of the library but also a trigger to walk around, discover a bit in the library. People avoid social interaction and enjoy doing their own activities in the public library. They want to have a feeling that it's okay to just look around, stay as long as they can, and have no idea what they are looking for without being judged by others in the library.

"I usually just like to be left alone and do my own thing. " - Participant. H

People want a passive and always-on help

People think that employees in the public library should be friendly, open-minded, and show welcome and inviting feelings. People want help from employees in a passive way. Without trying to get people's attention yet always-on, this can let them feel not being watched or pushed to make a decision quickly. This feeling of ease can reduce the difficulties for them to come to the library and is seen as a prerequisite for getting inspired in the library.

"I think the employees should make you feel welcome and they're not trying to get your attentio, that's important." - Participant. S

People value recommendation as a social connection

Talking about books is seen as a very intimate and perosnal communication which usually happens in a close relationship. People are willing to recommend books and talk about books based on the situation that they know each other very well especially in reading habits. Sometimes the chatting topic would work as the trigger for recommendation of books. In other situations, people would recommend books when they think the book has a relation with the target people who might be interested at that theme or have similiar experience with the story in the books. A connection between these two people has occurred since the moment of recommendation which would strengthen the relationship and create some topics for chatting. Different from the value of official recommendation or reviews based on the culture value, interesting content, unique perspective, etc. the value of the recommendation between friends based on the understanding of each other is considered more valuable by people.

"I have some friends who read a lot and my family members read as well. We just exchange books to read. A lot of my colleagues read, so we recommend each other books as well. The reason I do like those recommendations as opposite to reading Linda's blog or whatever on the internet because they know what I like." - Participant. T

"I do feel that after reading the book highly recommended by my friends, I really feel bonded with them and with that book."
- Participant. H

Interior space qualities

Relatively separated space for exploring books freely

People like a relatively separated space to show different categories/themes. The sight is not blocked to prevent people from seeing other areas of the library. At the same time, they can physically stand in a bubble of a certain category/theme. Highly separated space for different themes or categories decreases the motivation of people to discover other areas in the library since it takes more effort to reach there and it's hard to trigger people from a distance. In the current library, there is an inconvenience of checking on the computer and going to the target area which creates a gap within this continuous discovering journey since people are pulled out of their discovering experience.

"So this would be done in other ways like you can see from this part, you can see that part. And preferably, you can see all the parts here , but you also feel like you are in your own part."
- Participant. A

Clear space layout of books in library

In the library, people need an intuitive interior layout to quickly find their areas of interest. They want to get the vibe that books are attracting them to discover such as display units to show the theme or special content. While browsing through shelves, people think books have different heights, font styles, and font sizes which make it a bit difficult to browse. One of the participants suggests that having books spinned around so people see the front cover of the book and then put similar books or books of the same author behind it. By saying so, people actually want to have a more intuitive understanding of the books on the shelf and quickly get to know the idea of the book. One participant gave an example to describe an ideal situation: in the supermarket, the smell of the bread pulls you in and you are exposed to some expensive items. Then you first do shopping in the vegetable area and go to meat areas that you are guided step by step.

"Like usually, the books all have different sizes, different heights, and stuff like that. But it would be great if you could kind of outline it and all the books would kind of be like in a nice line." - Participant. T

A place for encountering books unexpectedly

The library is mainly seen as a place for books and there is a lack of service focused on young people. People who make use of the library for books tend to feel satisfied with the current library. However they have talked a lot about their expectations and want to remove the stereotype that a library is a place where you just grab a book and leave. People like going to a public library because they can find something new and interesting besides borrowing the book they have searched online. Thus the experience of discovering what people don't know yet would be the potential focus within the scope of books in the library.

"Maybe it helps in removing the stereotype that a library is a place where you go and grab a book." - Participant. S

Immersive environment full of information and knowledge

Going through shelves creates an immersive experience and separates people from the outside world. An enclosed space where people can hide helps people better dive into the world of reading books. When talking about the comparison between a physical library and a digital environment, participants' opinion is that physical space is more inspiring and immersive where they value the physical interaction with books while online is more accurate and efficient to them.

People feel they are small standing in the sea of books and going on an adventure in the library. They admire the collections and feel immersed in this physical environment by surrounding knowledge, stories, and thoughts offered by books.

"I'm not sure where I put big windows, but initially I thought big windows were not that important to me in the library. And then I started thinking about it. I actually think they're important because the natural lights help in getting that quiet and peaceful atmosphere."
- Participant. T

"And depending on the way that the library is laid out, my curiosity is inspired. I see something and I wanna go to it, touch it, feel it, and read it. I think I picked up admiration because I just can admire the way that they do draw me in that library and show me into the world of knowledge. " - Participant. A

Calm and inviting interior space

People enjoy the library with a quiet space. They like having comfortable chairs next to the shelf which offers the opportunity for them to make the choice of taking a book or not. They described it as "always could grab a book and sit down to read". People are in favor of a calm atmosphere in the public library that they could feel at ease and roam within books. A chair or a coffee machine would let them feel calm and inviting even though they probably never use it but they know there is a possibility there. An example that has opposite atmosphere to this calm feeling is when it's 6 pm in the supermarket, a lot of people do the shopping and you mingle in between people to get what you want, feeling rushed with no idea what to eat for dinner and there are so many products there.

"Just like a chair or something. It's like a chair I would never sit in but there's a possibility for you to do that. It adds the atmosphere of slow, calm, and chill. " - Participant. H

"Initially I thought big windows were not that important to me in the library. And then I started thinking about it. I actually think they're important because the natural lights help in getting that quiet and peaceful atmosphere."
- Participant. A

Accessibility of books is satisfying but not the library openning hours

The location of the library brings convenience where people could go to the shopping center for shopping and return the books at the same time. However, not inviting entrance and not appealing facade inside the shopping center make this location less beneficial. On the other hand, this weakness to some extent makes sure a library is still a quiet place. Nowadays, people can always find the book they want to read from various channels so the library is not the only and even not the main choice for books anymore. Also, the opening hour doesn't fit young people's time schedule and thus young people go to the library less and less.

"The library is always closed when I have time to go there." - Participant. H

3.5 Discussion

As can be learned from sessions and results, people going to a public library for books mainly have two intentions: **finding the target book and walking around to find something new.** However, finding the target book is supported way better in the digital environment since people could get unlimited access to books whenever and wherever they are which is especially important for young people. What could be the opportunity in this project is to explore how to make a better experience for young people to browse in the library besides getting the target book. This behavior could be categorized as serendipity (Foster & Ford, 2003). Thus the design opportunity in this project is to

"design a serendipitous book discovery experience in the current library".

Serendipity is defined in the Oxford English Dictionary as: "The faculty of making happy and unexpected discoveries by accident". The literature on information retrieval and information seeking has also provided some support for the view of serendipity as a purposive or active phenomenon. Serendipity is often considered as a by-product of browsing as Morse(1971) noted that "browsing may be defined as a search, hopefully serendipitous". The connection between browsing and serendipitous retrieval was indicated by Rice et al.(2001) that "Serendipitous findings are one of the consequences of browsing in the library and through journals is finding something of interest or some things that are not originally sought".

Conclusion

How do people want books to be displayed

Participants gave several examples of how they would be inspired in the library such as vivid triggers adding fun to the discovery process and helping them get the idea of books intuitively. Participants want to break the layout of books on shelves which is static and offers limited information by highlighting a book from time to time. What's more, people long for upcoming books, authors, and cool ways of displaying books to get fresh feelings about a library. This helps to break the stereotype that a library keeps the same setting all the time. On the one hand, participants value the recommendation as more possible to be interesting. On the other hand, participants don't want to feel social pressure that they have to read recommended books. Insights about how to make a library not a dull place are gathered. **These insights were transferred into problem definition in chapter 6.**

Social interaction in the library

A public library as a physical building contains social interaction. Unlike other discovery experiences that people would go to with friends, participants tend to agree that discovering books in a public library is a very personal experience to them. They avoid the social interaction that interrupts them by others in the library. Yet they still want help when they need it. **The design thus needs to go for a personal experience and can support individual operation.**

Interior space qualities

Participants appreciate the library as a physical space to let them feel immersed within books and have physical interaction with books immediately. What's more, participants have expectations for the space to be relatively separated and have a clear layout. This is taken as an advantage of the current library that can offer clear and free exploration. The physical library can not compete against the digital environment for books in terms of diversity of books and convenience. The experience of **finding new and interesting books** through exploring and browsing is the key value. **Space qualities were analyzed within the serendipity framework in chapter 4.**

Book discovery journey

A public library is seen as a place to kill time and look for something interesting rather than just a place for borrowing books. People feel more open to being inspired and surprising content after they find the book that they have planned to borrow. The serendipity part of the book discovery lets people feel leisure. The value of serendipitous encountering books is different from finding the target book. There is no higher value to be compared with these two activities yet they are both valued.

As the serendipitous experience of encountering books out of expectation has more potential to design for in this project. In the next chapter, a study on how to design a serendipitous book discovery experience in the public library was done. The insights gathered in this chapter worked as the ingredients for analyzing the serendipity in the project context.

Chapter 4
Serendipity in the context of library

In this chapter, literature research about how to make use of serendipity for a new book discovery experience was conducted: the process of serendipity, the influencing factors of facilitating serendipity, and a case study. The theoretical findings were applied to analyze the current context together with the findings gathered from the user research in chapter 4.

Research questions:

1. How does a serendipitous experience happen?
2. How to facilitate serendipity?
3. How well is serendipity supported in the current library?

Chapter overview

4 Serendipity in the context of library

Browsing can be described as undirected information seeking allowing for serendipitous discovery of useful resources(Cooksey, 2004). Here in this project, the word "useful resources" refers to the books which people think would be interesting based on their past experience or knowledge after getting the idea of them.

4.1 How to understand serendipity?

An empirical model of serendipity by Stephan and Ann (2012) with a focus on the mental connection. This connection is sparked by unexpected circumstances. This model is used as a base in this project to understand serendipity. Elements of the serendipity process would be complemented by the work from McCay-Peet and Toms (2015). In this project, the first four stages would be focused as relevant in the context of that people discover books in the library.

Noticing

What is missing from the serendipity model by Stephan and Ann (2012) is that there is a lack of triggering for noticing moment which is introduced by McCay-Peet and Toms (2015). Experience of serendipity needs a trigger that can be a verbal, textual, or visual cue to be initiated or sparked. Rich triggers and highlighting triggers can increase the possiblity of noticing happen (McCay-Peet & Toms, 2015).

Make new connection

A new mental connection is made between a need and something that has the potential to address that need. Both an information need or a non-informational need are possible to be addressed. From the user research that participants want to seek relatedness with books either it's about their interesting themes or their memory of the reading context.

Being open and prepared can enable the connection. These two factors are categorized as openness and prepared mind by McCay-Peet and Toms (2015).

Project potential value of the outcome

Once the connection has been made, the judgement of the potential value of the outcome is made. The potential value of the outcome may or may not be apparent at the time the connection is made which would become apparent later.

"Chance favors only the prepared mind."
- Louis Pasteur

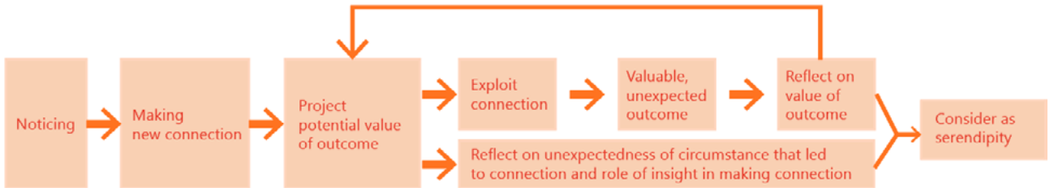


Figure 20. Process model of serendipity (Stephan & Ann, 2012) & (McCay-Peet & Toms, 2015)

Exploit connection

Once it is considered that the connection has the potential to result in a valuable outcome, actions are performed to make full use of it. Willingness and ability determines if the actions would happen. A good mood and feeling relaxed would increase the willingness and a bad mood, stress or time-pressured would decrease the willingness. In this project, this process in serendipity could be seen when people are highly interested in a book and want to read the first few pages to judge if it's satisftying as they think and then take it or not. At the same time, people have the easy access to the books that is defined as the ability.

Result in valuable, unanticipated outcome

Four outcomes: knowledge-enhancing, impactful, timely, and time-saving.

Reflect on value of outcome, unexpectedness, and insight

Reflections should be made to consider that the outcome is valuable in an unexpected way and the process itself is unexpected. The reflections can be made any time after the "make new connection" stage.

Consider as serendipity

Both the value and process are considered unexpected, an experience can be considered as serendipitous.

4.2 How to facilitate serendipity?

Björneborn (2017) introduced implications of the framework for designing physical and digital environments with affordances for serendipity. Three key affordances with 10 sub-affordances that could be learned about the environmental factors and personal factors linked to them. Trigger-rich, highlight triggers, openness, and prepare mind from McCay-Peet and Toms's work (2015) are taken as a summary.

The influencing factors were put into the first two stages the serendipity process model. This indicates that the next 5 steps are not able to be facilitated from the outside world. The next 5 steps rely on a person's internal experience and value that are too personal to design for. **Thus in this project, how to facilitate serendipity through enabling noticing and making new connnection will be focused.**

The external influencing factors were listed in next page. **These factors worked as the theoratical guidance for analyzing how well is serendipity supported in the current library** at the end of this chapter.

Trigger-rich

Diversity

How many disparate potentials of a given environment can offer.

Incompleteness

How much incompelete, inconsisitent, and "unfinalizable" the features in an environment are that leave potentials open to people.

Exposure

The capacity of an environment that can display contents to trigger people's senses.

Highlighting triggers

Contrasts

The capacity of an environment that can let contents to stand out and trigger people's sense in a surprising way.

Pointers

The capacity of an environment that can highlight contents to guide people to notice potentially interesting contents in a narrow and specific way.

Enable connections

Cross-contacts

How possible for dissimilar resources meet or collide across each other.

Accessibility

How direct and easy for resources to be accessed by people.

Multi-reachability

How many different routes does an environment has to let people reach from one spot to another.

Explorability

How well does an environment invite people to explore it.

Slowability

How well does an environment invites people to spend time on examining potentially interesting encountered resources.

Serendipity stages	Noticing		Make new connenction
Influencing factors	Trigger rich	Highlight triggers	Enable connections
	Diversity	Contrasts	Cross-contacts
	Incompleteness	Pointers	Accessibility
	Exposure		Multi-reachability
			Explorability
			Slowability
			Pointers

Figure 20. Overview of 10 influencing factors

4.3 Case study of design for serendipity in the library

Thudt et al.(2012) introduced the Bohemian Bookshelf as a way to support serendipitous digital collections discoveries through information visualization in the context of a physical library. Five design goals were formulated to achieve serendipity: 1. offering multiple visual access points by providing visualizations of different perspectives on the book collection, 2. highlighting adjacencies between book, 3. providing flexible visual pathways for exploring the book collection, 4. enticing curiosity through abstract, metaphorical, and visually distinct representations of the collection, and 5. enabling a playful approach to information exploration. From the research of serendipity(Björneborn, 2017), these five design goals could link to 1. muliti-reachability, 2. cross-contacts, 3. explorability, 4. incompleteness and exposure, 5. playfulness. The approaches they used were 1. cover color circle, 2. key word chains, 3. timelines, 4. book pile, and 5. author spiral.

The Bohemian Bookshelf is mainly designed for exploring digital collections and could be not only applied inside a physical library since its touch screen based. It is lacking in the connection with the context of a physical library in terms of the suitability of my project. However It shows a great example of making use of a touch screen and how to translate the serendipity affordances into design practice via visualization. **In this design project, the visual elements play a vital role which offers an intuitive way to browse books and playful way to explore different possibilities existing within the collections.**

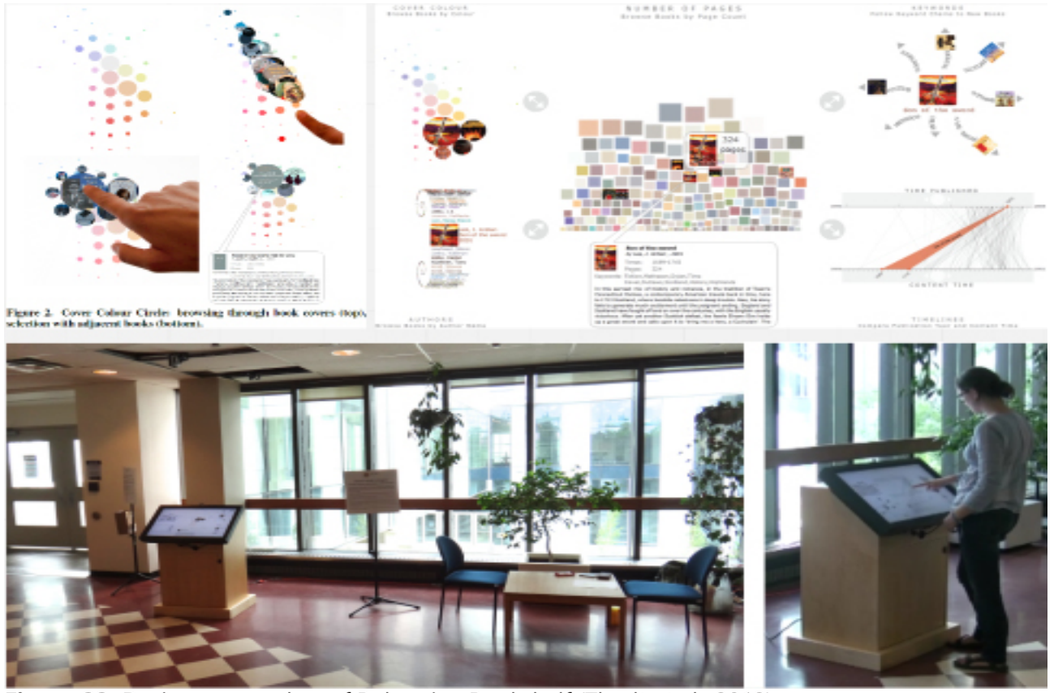


Figure 22. Design approaches of Bohemian Bookshelf (Thudt et al., 2012)

4.4 Serendipity in the current library

To know how well serendipity is supported in the current library, the insights about the serendipity experience from the user research and analysis of the settings in the current library were analyzed with the 10 influencing affordances from the serendipity theory.

Diversity of books as nature (diversity)

One of the nature of a public library is the diversity of its collections. It's more possible for people to encounter books out of box. However people usually focus on the areas of interest while showing less interest in other categories.

Broad categories and classification with less specificity (incompleteness)

The current library uses a broad category and classification with less specificity on the level of shelf such as "Information books area - Exciting & Actief - Business and Profession, Communication, Music, and etc." but indicates related theme through an icon on the book spine and put similar themes together on shelves.

Figure 23. Broad categories of books

Figure 24. Tags on book spines

Low level exposure (exposure)

As participants have said, most of the books in the library only show spines with limited information on the shelves. Besides the book itself as a trigger, there are display tables to show books related to a specific theme. Compared with how participants expect a display approach could be, the current way of displaying is relatively dull and passive. "Trigger-rich" as an element that environment contains sensory cues that have the potential to spark serendipity" is missing.

The way of displaying books is dull and static (contrasts)

The current way of lay outing the books on the bookshelf is homogenous and static. The lack of contrasts cause a lower possibility for people to notice and find interesting books. This is related to Generation Z's short attention span. There is also one small display shelf standing in front of each shelf at the inforamtion books area in the current library. It displays some random books and show covers for triggerring. This way of displaying books adds very limited randomness and can not really achieve "sharper, more suddenly".

Good access to resources yet limited access to the library (accessibility)

The library is a place where there is unhampered direct access to all kinds of information resources. As long as people are in the library, they can just grab a book from the shelf and start reading. Yet in this project, the openning hour doesn't fit very well with young people's time schedule compared with the unlimited access in online environment.

Figure 25. How books are displayed in the library

Figure 26. One book display table example

Figure 27. Display tables in front of each bookshelf

A certain degree of guidance is missing (pointers)

It's clear how different categories of books are laid out in the library by using different types of shelvs. Tall shelves for information books and low shelves for fiction books. Signs show the specific categories as well. This simplicity and clarity make it easier to notice potentially interesting contents. Yet recommendation, reminders and other channelings of contents in this environment are missing to stimulate serendipity that help people discover books they perhaps had forgotten or did not know. The example of showing a quote or asking questions mentioned by one participant could enable people to make connection in the serendipity process.

Flexible layout with good visual continuity (cross-contacts)

The layout of information books is linear and people need to go through shelves category by category however since the library is not that big, it's not hard to achieve the cross-contacts. The layout of fiction books is more flexible where the sight is not blocked and offers good visual continuity. People could move freely to different shelves. At the same time, the movement between these two areas is highly flexible and convenient as well.

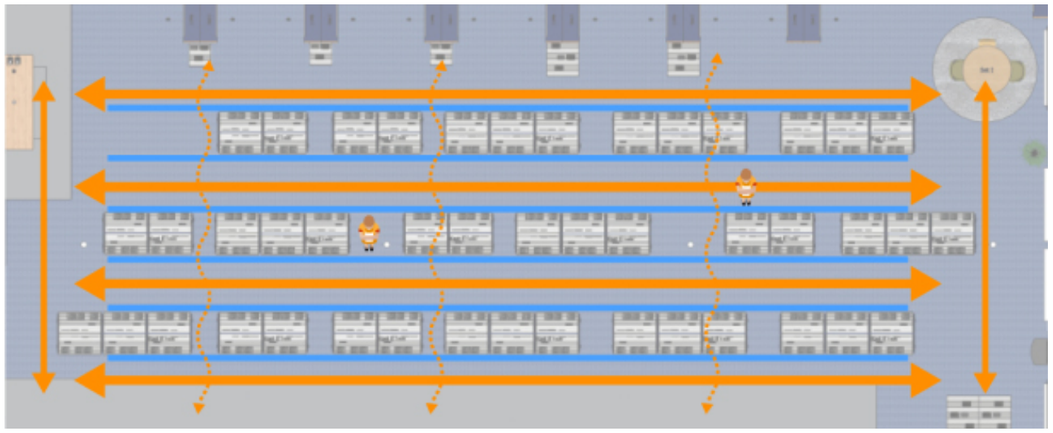


Figure 28. Flexible layout of the library

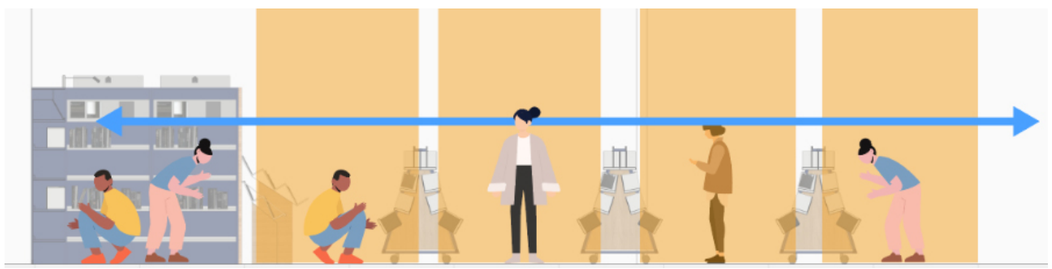


Figure 29. Good visual continuity in the library

Lacking in triggers to get the idea of a book quickly (multi-reachability)

On the one hand, the lay out of books in the current libray is to some extent free which offers the opportunities for people to reach from one spot to another along different routes. People can meet different resources and topics that in this situation more affordances are prensent to trigger users' interest spaces. On the other hand, participants mentioned a lot in the research process that they expect some triggers besides the book itself to help them to get the idea of a book quickly and easily.

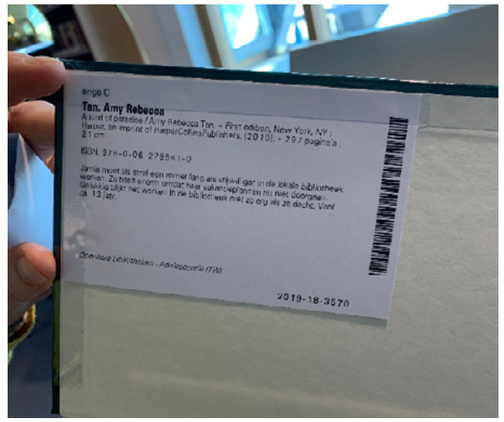


Figure 30. Summary of a book sticked to the cover

Weak trigger, less inviting (explorability)

In terms of exploraility, participants said that they see discovering books as an exploratory because something new and interesting waited to be see in the library. Also the free lay out of shelves in the current library facilitate this behavior. However, triggers are not that strong to really invite people to explore.

Seats in the library offer chances for reading (slowability)

People like the fact that they could sit down and read the book they just find which let them feel calm and inviting in the library. People do have seats at each tall shelf in the current library. Also there is a big table with four chairs next to young adult literature.

Figure 31. Seats and tables for slowability

Conclusion

1. How does a serendipitous experience happen?

An experience needs to go through 7 steps to be considered as a serendipity experience. In this project, the first two steps: noticing and making new connection are focused. **The research about how to facilitate serendipity indicates that these two steps can really be designed for.**

2. How to facilitate serendipity?

Serendipity can be facilitated through designing the influencing affordances. 10 external affordances were learned for analyzing the current context and working as the design base. The 10 external affordances can overlap each other. **Playfulness and information visualization** has been proved to succeed in sparking serendipity from Bohemian Bookshelf.

3. How well is serendipity supported in the current library?

Through applying the serendipity influencing factors to analyze the research findings from the user research in chapter 3, problems were demonstrated. The library in this project has some qualities in nature to facilitate serendipity such as the flexible layout with good visual continuity to enable users to achieve cross-contacts, broad categories with less specificity leave space for users to explore as incompleteness, and furniture offered for users to exploit books as slowability.

Yet when it comes to the displayed content of books, how people approach these content, and the diversity of books achieved by users, there is still space for improvements. These improvement spaces were defined as problems to solve in this project in chapter 6.

Chapter 5
Study on augmented reality

Augmented reality (AR) as the technology to be applied in this project needs to be investigated for the design phase. Through literature research about augmented reality, the definition, benefits, and issues were explored through literature research. How AR can be applied in the context of information seeking in a public library was studied through case studies.

Research questions

1. What is Augmented reality (AR)?
2. What kind of benefits can AR bring to this project?
3. What kind of issues should be avoided when applying AR?
4. How can AR be applied in the library?

Chapter overview

5 Augmented reality in the library

5.1 Definition of augmented reality (AR)

Azuma (1997) identified the characteristics of AR systems: 1. combines real and virtual, 2. interactive in real time, and 3. registered in 3D. Four types of augmented reality were concluded (Edwards-Stewart, 2016): Marker-based, location-based, dynamic augmentation, and complex augmentation.

Wu et al. (2013) indicated in the definitions of AR that it should not be defined restrictedly . AR can be applied through any technology that is able blend real and virtual information in a meaningful way. The additional and contextual information strengthens the affordances of the real world. This is the key to explore rather than focus on one specific technology.

5.2 AR's benefits

As Santos(2018) has conclued that 1. AR can make the library more interactive which is highly valued in today's concept of library spaces and commons, 2. AR is fun to both implement and use, 3. additional information can be overlaid to physical objects.

5.3 AR's technology and learning issues

Wu et al. (2013) concluded several technology and learning issues of applying AR. Issues related to design and the context of this project were discussed as belows.

Technology issues

Discomfort and poor depth perception can be avoided by portable technologies. In the context of this project, this can be partly avoided by making the most of the current or potential physical and natural interaction with the context.

Learning issues

One learning issuse is the possibility of being cognitively overloaded by the large of information people encountered.

Another learning issue is that it requires users the ability of multitasking. In the context of this project, Generation Z is known as good at multitasking which lowers the difficulties of applying AR.

5.4 Projection-based AR

Physical interaction with projection

Matsushita et al.(2011) developed a projection-based mixed reality tool to support the physical book searching in the physical library. The cover image of a book while a user touches the edge of the bookshelf would be projected onto the book spine.

This tool enhanced search efficiency which the benefit is to directly show the cover image which usually contains much information for users to judge. However, also evaluated by the team that it doesnt work very well when books on the bookshelf are not aligned well which is usually the case in the library since each book has different sizes and the effect is strongly influnced by the color of book spines as a background for projection. This concept enables the classical physical interaction with books which is the strengthness compared with the digital environment.

ShelfTorchlight

Löchtefeld et al.(2010) developed a mobile projection tool "ShelfTorchlight" to support searching for a target book. When the "torchlight" was projected towards the right shelf, the target book would be highlighted or the rating of the book would be shown above it.

In this way, "ShelfTorchlight" could enable users to find the target book quickly even with the help of a catelog or interior map and even when users find the right bookshelf since there are usually large numbers of books on the shelf.

Compared to using a projector, "ShelfTorchlight" has the advantange of lightweight and mobile without needing a huge amount of equipment setted. What's more, it can make use of the information from digital environment since it's connected to a mobile phone. However, one weakness of using projection based technology is that it requires a relatively dark environment while the library often offers a bright interior environment especially when it comes to information reading. Also, the need of space to be projected would hight influence the effect of the projection.

Figure 33. ShelfTorchlight (Löchtefeld et al., 2010)

Figure 32. Projection-based mixed reality tool (Matsushita et al., 2011)

Art animation

Dennis et al.(2015) from Malmo University designed a projection based interactive experience to seduce user's attention while she is browsing through the bookshelf. Art animations would be projected on the spines of several random books and thus users would pay more attention to those books and then possibly trigger users to grab that book for further step.

This design goes further or another direction compared with Matsushita et al.(2011)'s and Löchtefeld et al.(2010)'s work that additional information related to aesthestic pleasure is offered to users. As an implication, information rather than being directly related to the book could be used as a trigger here which could also be confirmed from the user research that participants want more than just text and an expectation to art related to themes. However in this project, the triggers need to be selected or designed based on the design brief rather than just random and fun elements.

5.5 Phone-based AR

AR Library Project

The AR Library Project by Mandal Public Library & Oslo Science Library is a way to find out how AR could be applied to give better services to patrons in the public library. With the help of Wikitude, this app could recognize the cover of a book and thus offer links to different pages related to this book such as a youtube video, wiki information, etc. Also it shows the conncetion with this book and other related books and users could use this to locate the similiar book in the current library.

From the perspective of serendipity theory, during the "make new connection"stage, this app could enable people to build connection between different resources and trigger them to build connection between the information exposed and past experience/knowledge. However, it to some extent lost the rich physical interaction with books which people might be too attracted to the information on their phones.

Figure 34. Projection projects art animation onto book spines (Dennis et al., 2015)

Figure 35. AR scanning the book cover to get additional information (Mandal Public Library & Oslo Science Library, 2019)

Book AR

Book AR by Yerbol Aussat(2018) is an application of pointing a camera at books and show different information based on the recognition of a book spine. By covering the bottom of the book spine, people could activate the application to select a book to know more such as rates, price, genre, and similiar suggestions. People could swipe left and right to select different content about a book they want to know about.

This project enables people to have physical interaction with books in an intuitive way and helps to build connection with different information about the book. Yet as could be imagined, the distance between the phone screen and hand and the bookshelf would a usability problem.

AR navigation

Navigation is another application in the library which helps people to find their way towards the target area. By applying the 3d model or showing the route within the real context, user could find their target areas quickly and intuitively.

AR in cities

The future of Eindhoven city and ATMOSPHERIC DATA showed an application of intergrating vitual elements into the reality through a screen in Dutch Design Week.

This project implicated that information related with books doesn't need to be just next to or attached to the book yet it could be more flexible and thus create an opportunity to build possible connection with other books and trigger people to move around. People could also interact with these elements through physical interaction input such as motion and voice.

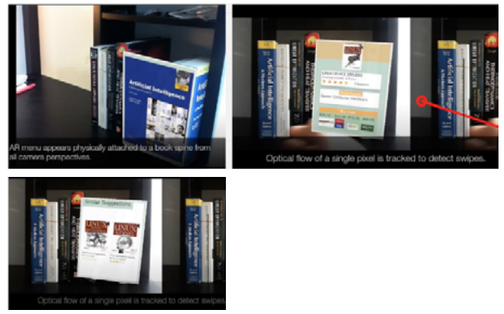


Figure 36. AR scanning the book spine to get additional information (Yerbol Aussat, 2018)

Figure 37. AR indoor navigation

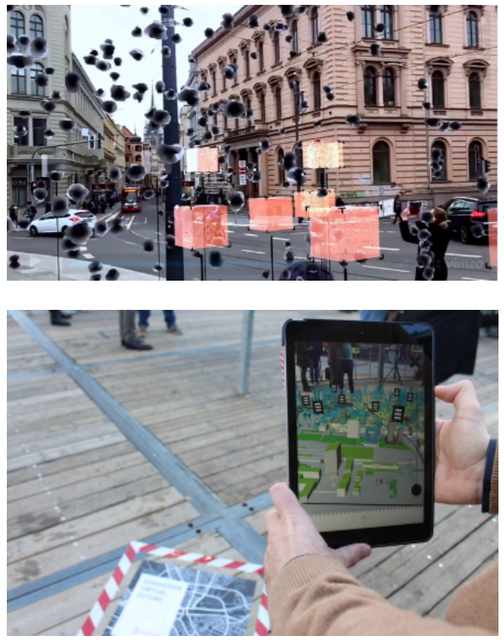


Figure 38. Integrating visual elements into the reality

Conclusion

What is Augmented reality (AR)?

Augmented reality (AR) can benefit the library from a strengthened level of knowledge. The definition of AR should not be restricted to one single technology. The key is whether **additional and contextual information** strengthens the reality. This key characteristic also benefits a lot in this project to add extra content to the book discovery experience.

What kind of benefits can AR bring to this project?

The study indicated that AR can make the library more **interactive, fun, and add additional information.** The possibility of being cognitively overloaded by the information should be considered well in the design of this project.

What kind of issues should be avoided when applying AR?

Portable technologies can avoid bringing discomfort issues. As the target group in this project is known as the digital native, the learning issues are less severe.

How can AR be applied in the library?

Using projection as the tool to offer information from the virtual world has a strengths of keeping the physical interaction and lower the gap between users and books. The book spines, ground, bookshelf, and wall could be seen as the canvas to be augmented. Projection usually requires a good canvas to be projected on and can work better as an attractive trigger instead of showing specific information.

Mobile devices such as smartphones with AR abilities are popular and easy to achieve. People can get various information linked to a book. People can manipulate interaction both in physical or virtual way which is a good way to receive precise information and more interactive. Considering today's context, nearly everyone has a smartphone and carries it every day, the smartphone is a good medium to choose for the design concept.

Due to the budget limitation, projection and smartphones are chosen as the medium to design with.

Overlaying the **additional information** about the books and **making use of fun and interactive elements** can help to know more about books. With the help of digital means, a connection with other books to trigger exploration can be built.

Chapter 6
Research Synthesis

This chapter synthesizes the findings from the contextual and theoretical research. Three problems are defined and translated into a design goal with three main qualities and design requirements.

Chapter overview

6.1 Problem definition

Based on the synthesis of research findings, there are three main problems causing it to fail in better facilitating serendipity in the current library.

Limited information in a static and homogeneous way

A trigger is a verbal, textual, or visual cue that users would encounter and help users to make sense of a book and spark their curiosity to explore further during the discovery process in the public library. For instance, the book title or the author name on the book spine. Currently, browsing through shelves depends on people's self-motivation. Triggers are not rich enough(trigger-rich) which fail in allowing people to receive ideas and information they may not have otherwise encountered that has the potential to trigger serendipity.

Current triggers like information on book spines are usually dull and with limited information to trigger people (title and author name). The display table could work as a good example to offer "extra" triggers in the library based on the theory of serendipity. However, from user research, we could tell that people want more vivid triggers than the book itself. Moreover, according to "highlighting triggers" and participants' impressions of a public library, the triggers remain homogeneous and static. While Gen Z is born and lives in a world that is multi-sensory with all kinds of information trying to seduce their attention and rapidly changing.

Therefore, triggers need to be rich and highlighted to enable users to notice the information of a book vividly, thereby triggering them to explore books. The triggers need to be:

- Outstanding to surprise people.
- Vivid more than just title and author.
- Proactive in showing information.

Way of approaching information is dull and out of fashion

One of the reasons why young people don't go to public libraries is that it's a dull and out-of-fashion place especially compared with other places where young people usually go. In the user research, participants kept mentioning cool and new ways of displaying books and wanted to have a feeling of being invited which explains why they think the public library is dull. The current way of approaching information is browsing through books on the bookshelf via book spines and then grab a book, read the cover, and flip through pages. This led to the gap between Generation Z's daily life and library life.

Play as a facilitator of creativity might also stimulate serendipitous discoveries (Thudt, 2012). This is also supported by Björneborn (2017) that playfulness is related to curiosity in the framework of serendipity and playful inventive strategies for exploring. As designed for inspiration and learning space of future libraries, the play could contribute to the "experience library" (Jochumsen et al., 2012).

The opportunity of engaging young people more in the discovery of books and making this discovery more of an experience is to encourage a playful, pleasurable, and, in turn, more thorough and persevering approach to book exploration.

Less diversity of books achieved by users due to interest preference

Diversity of books is the nature of a public library which seems to be the very few places in society that contain so many topics in a limited physical area (Björneborn, 2008). In the scope of serendipity, this whole knowledge universe of mankind is supposed to trigger individuals' interest spaces which facilitates serendipitous findings. However, although the current library is relatively small and thus offers more possibilities for people to pass by books out of interest, people do prefer a specific category or theme and when they go to the library. Their first priority is to explore this area with less effort spent on others. At the same time, their emotional intensity and value perception towards the lower priority also turn out to be less, and thus it's less possible for them to be triggered (Fogg, 2009).

An opportunity to increase this possibility is by inviting people to explore books which they usually don't.

Serendipity analysis	Defined problems	Ideal situation
Lacking in triggers to get the idea of a book quickly (multi-reachability) Low level exposure (exposure) A certain degree of guidance is missing (pointers)	Limited information in a static and homogeneous way	The design can let users feel fascinated about books and discover books in an active way
The way of displaying books is dull and static (contrasts)	Way of approaching information is dull and out of fashion	The design can create a playful experience to make the discovery more interesting and facilitate serendipity
Diversity of books as nature (diversity) Weak trigger, less inviting (explorability)	Less diversity of books achieved by users due to interest preference	The design can invite users to explore books out of their plans as well.

Figure 39. Research synthesis from serendipity analysis to defined problems to ideal situation

6.2 Design goal

"Design a fascinating, playful, and inviting book discovery experience to facilitate serendipity for young people in the Westfriese public library in Stede Broec."

6.2.1 Design goal breakdown

Fascinating

This quality deals with the first defined problem "limited information in a static and homogeneous way". As defined previously, the current way of displaying information is hard to attract young adults' attention in the library, and thus rich and highlighted triggers are needed to let young adults feel fascinated about the books.

This quality refers to the experience of an eagerness to explore something and it can stimulate focused attention and explorative behavior (Desmet, 2012). This feeling can be evoked by the novelty and incompleteness of a product. In this project, “trigger-rich” and “highlighting triggers” are expected to let people feel more fascinated about books as the desired situation than the current situation. What’s more, the designed interaction between users and the design concept or books can help, as the novelty, to contribute to the evocation of this feeling as well.

Playful

This quality deals with the second defined problem "way of approaching information is dull and out of fashion". As the research findings show, playfulness can both make the book discovery more interesting and facilitate a serendipitous experience.

This quality means the feeling of pleasure and amusement experienced by users when using the design. As defined by Korhonen (2009), the experience of discovery, simulation, control, sensation, and exploration were chosen based on the description of playfulness as a sub-factor facilitating serendipity (Björneborn, 2017). Playfulness has been proved as a facilitator for serendipity both in practice and theory. Also, playfulness is one of the elements to contribute to that experience is becoming more and more important for a public library.

Inviting

This quality deals with the third defined problem "less diversity of books achieved by users due to interest preference". In order to let users encounter more books and thus increase the possibility of experiencing serendipity, the design should let users explore more books in an active way.

This quality is relevant to the feeling of being attracted and guided through the discovering experience from the perceptual level. According to the characteristics of Generation Z and the current way of displaying information that is homogenous and static, the feeling of inviting should be created. It could be enhanced by the step-by-step guide that lowers the cognitive effort and by proactively seducing the user’s attention (highlighting triggers). Besides, usability that partly defines if the experience is seamless is another key to enhance inviting.

6.2.2 Design requirements

An overview of the requirements gathered through theoretical research and context research is provided. Listed requirements explain three design goal qualities in detail and define where the design should aim towards.

1. Fascinating

1.1 The design should not disctract people from the interaction with books too much.	P56 Technology issues
1.2 Show the upcoming books, authors in the library.	P36 Upcoming content
1.3 Recommend books by the indication of content instead of popularity.	P36 Recommendation should not cause social pressure
1.4 Users can see the additional information more than books spines without taking the book out of the bookshelf.	P48 Exposure
1.5 The content of book should not be described too complete that leave potentials for people to explore.	P48 Incompleteness
1.6 Surprise people with outstanding triggers.	P35 Books are displayed in a dull way
1.7 The design can recall users' past reading experience and knowledge.	P34 Relatedness between books and past experience
1.8 Visualize information about books.	P34 Vivid content besides a book itself

2. Playful

2.1 The physical interaction with the real world should be involved to design for interaction.	P38 Immersive environment
2.3 Real and virtual world should be combined.	P56 Definition of AR recommendation
2.4 The interaction with the design should be novelty.	P36 Cool ways of displaying books
2.5 The way of people browsing and exploring should be dynamic.	P49 Contrasts
2.6 The discovery process should be enjoyable.	P21 Casual-leisure information behavior

3. Inviting

3.1 Divergent and convergent information behavior should both be supported.	P20 Divergent and convergent information behavior
3.2 The design can be carried and hand-held.	P56 AR's technology issues
3.3 The information should not be overload.	P56 AR's learning issues
3.4 The design can guide users to explore other categories.	P19 Dynamic and evolving information seeking model P48 Diversity P51 Explorability
3.5 Users should be assisted to get the idea of a book quickly.	P51 Multi-reachability
3.6 The design offer the opportunity for users to see others' review.	P37 Recommendation
3.7 The design should not influence the calm vibe of the library too much.	P39 Calm and inviting interior space

4. Personal experience

4.1 The design is able to use individually.	P37 Passive and always-on help
4.2 Instant social interaction in the library should not be evoked by the design.	P37 Discovering books is a personal experience

Chapter 7
Ideation and Conceptualization

This chapter aims to conceptualize and design the embodiment of a new book discovery experience that facilitates serendipity in the library. A group creative session was gone through to gather concept ideas. Three initial concepts were formulated and evaluated based on the design goal. Eventually, an integrated concept with a combination of two concepts was generated that demonstrates a vision of a new way to discover physical books. An iteration test was conducted to gather improvement feedback. At the end of this chapter, the final design is presented.

Chapter overview

7.1 Creative session

One creative session was conducted to generate initial design ideas that can address the defined problems from Chapter 6 (Limited information in a static and homogenous way, Way of approaching information is dull and out of fashion, and Less diversity of books achieved by users due to interest preference). A variety of ideas were collected and clustered to inspire the concept generation.

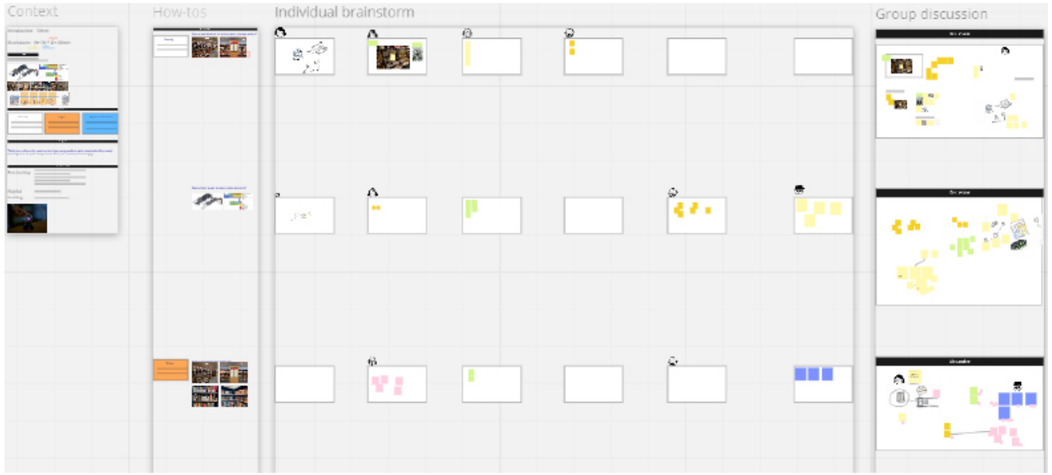


Figure 40. Overview of the creative session

7.1.1 Approach

Five design students who specialize in IPD/ DFI/SPD and read books for pleasure from time to time were recruited in the session due to the convenience of the schedule. Although they are not Dutch and have no experience in libraries in Netherlands, the experience from other countries can inspire the design phase of this project.

The session went through three sections for around one and a half hours in Miro (an online collaboration platform). The focused context, problems to address, and the design goal were first introduced to participants to be immersed in the project. Then a short discussion was carried out for participants to get a clear idea of the ideation background.

Three creative cycles were conducted to address all three defined problems and take intended interaction qualities into consideration. Each cycle consisted of two phases with a How-to question: a 5-minute individual brainstorm and a 15-minute generating initial ideas as many as possible, while the second phase emphasized the clustering of previous ideas and inspiring each other to develop or come up with new ideas.

The AR as the technology was not included in the creative session. The definition of AR should remain open and not restricted to one certain technology. An open and divergent set of ideas were expected to collect from the session.

Three How-to questions were:

- How to make books more fascinating?
- How to make the discovery experience more playful?
- How to invite people to explore different categories?

Figure 41. Procedure of the creative session

7.1.2 Seven idea clusters

Ideas from the session were clustered. 5 clusters out of 7 were taken as inspiring elements for initial concepts gengeration.

Build relevance between books both in content and as a visual clue

The books that have shared keywords have the potential to be related to each other. The example of connected papers was mentioned in the session. As also learned from the Bohemian Bookshelf, keyword chains can encourage explorative information behavior. As a visual clue, the visualization of the connection between different books can invite people to explore in a guided and fascinating way.

Figure 42. Idea of building relevance between books

Indirect and non-instant interaction between library members

Library members' reviews can work as a common trigger to each other. These reviews can recall or resonate people's past experience or knowledge. The relatedness is of higher possibility to be evoked. Tracking other library members' discovering journey creates a playful way in the library. A comment board about a book or a bookshelf was mentioned in the session where library members can interact with each other.

Figure 43. Ideas of indirect interaction between library members

Expose the content of a book ahead of reading it

To make books more appealing, the content of the book can be displayed on a device such as a tablet or a bookmark. This idea creates the feeling of using a magnifier. Richer information such as a summary or a quote can be received by people when browsing throught the bookshelf.

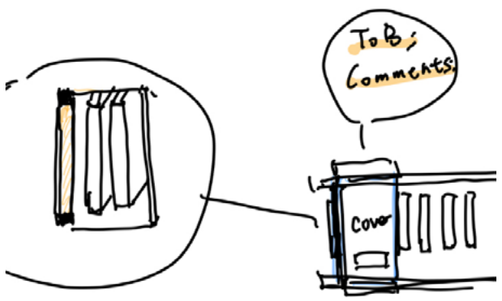


Figure 44. Idea of how to expose the content

Make books alive with sound, light, and motion.

Personification of books through making the book react to people's interaction. Sound description of the book is played or light in response to people's touching actions. Featured books on a bookshelf will shake when people are approaching. Using AR to scan the book and the author shows up telling the story of the book.

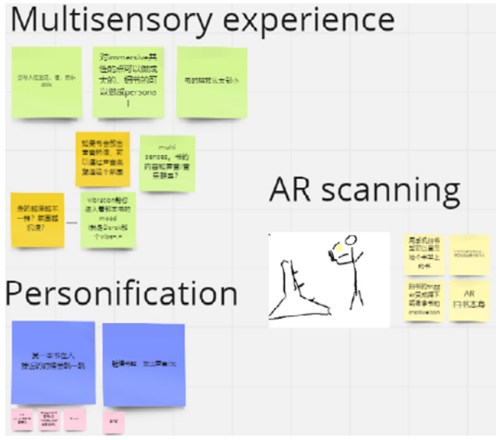


Figure 45. Ideas of how to make books alive

Filters in reality and use art animation to highlight

Use filters with AR to browse a bookshelf. Books filtered will be highlighted with animation e.g. light projects on books. This highlight can also be used to indicate books that haven't been borrowed for a long time. In this way, a playful discovering experience can be created and guidance is offered to people.

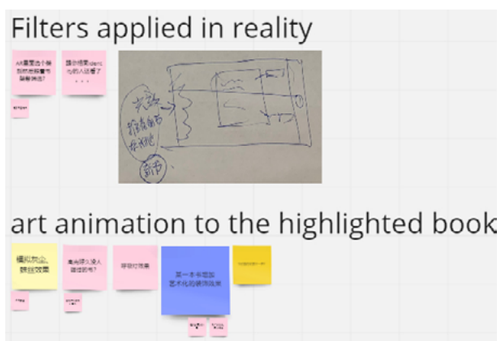


Figure 46. Ideas of AR application

Smart recommendation system

This cluster describes an interactive recommendation system that can recommend books based on people's books lending histories from the library database. Moreover, recommendations could be given through generative art, current emotion, personality test, and etc.

Theme related narrative journey

This cluster is an exploring route in the library based on a specific theme, e.g. different authors' work in the same era. The library space is seen as an exhibition place that allows library members to walk through. People can find books hidden everywhere in the library that related to this specific theme.

7.1.3 Discussion

"Smart recommendation system" was left aside. It requires the development of a smart system which would cost much for a library. Although how to make use of data in the context of this project can be considered carefully to avoid an information cocoon, this consideration is out of scope and not feasible time-wise. This direction could be interesting and valuable to do research on and design for as a recommendation of this project.

"Theme related narrative journey" was left aside because it's not sustainable enough for the library to develop and make use of in the long term. The theme needs to be upgraded from time to time and thus the cost can be high since a public library is a place where users would go not only once but frequently.

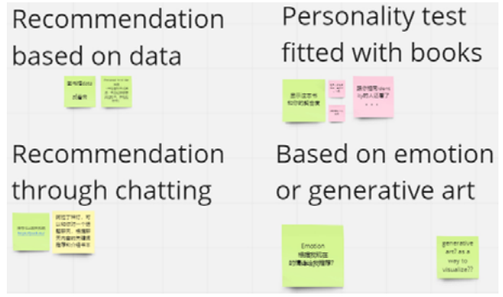


Figure 47. Ideas of the smart recommendation system

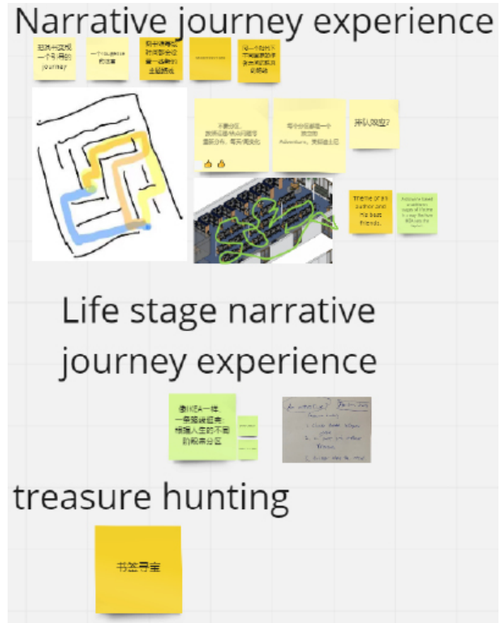


Figure 48. Ideas of the theme related narrative journey

7.2 Initial concepts and evaluation

Three initial concepts were generated based on the ideas from the creative session. To make a concept selection, the evaluation of three initial concepts was carried out to gather feedback based on the design goal. A detailed description of these concepts, the desired effect, and the gathered feedback can be found in initial concepts and evaluation results in Appendices.

7.2.1 Concepts generation

The overall design strategy is to let users **interact with digital information by physical interaction.** Through this way, the design helps them to make sense of books and facilitates them to explore further. The design concepts were considered mainly for personal experience based on the design requirements.

Information is considered to be displayed in a digital way due to its feasibility and less influence on the physical environment. To avoid distracting people too much from the interaction with physical books, the physical interaction plays an important role in these three concepts. The user's movement in the library and interaction with the books on the bookshelf are mainly made use of. These two physical interactions come originally from the current situation when users are discovering books in the library. By doing so, the interaction of the design concepts can be intuitive. I hope users can feel fascinating and inviting about the digital information and discovering process and can feel playful and inviting when they interact with the digital information.

7.2.2 Evaluation approach

3 users who participated in the user research, 2 employees from the Westfriese library, and 5 design students participated in the evaluation. The evaluation session was conducted individually via Zoom and Miro.

The focused context, problems to address, the design goal, and the interaction vision were briefly introduced to participants at first. The concepts were presented one by one to participants. Evaluation questions were asked by the author after the presentation. After three concepts were evaluated, participants were asked to give general feedback about three concepts and choose the most desired concept.

The evaluation questions were:

- Do you feel fascinated about the exploring experience? Why?
- Does the concept create an inviting feeling for you? Why?
- Do you think the concept is playful? Why?
- Do you want to explore other categories?
- Which concept do you feel most desired? Why?

Figure 49. Concept 1 exploring with phone-based AR application

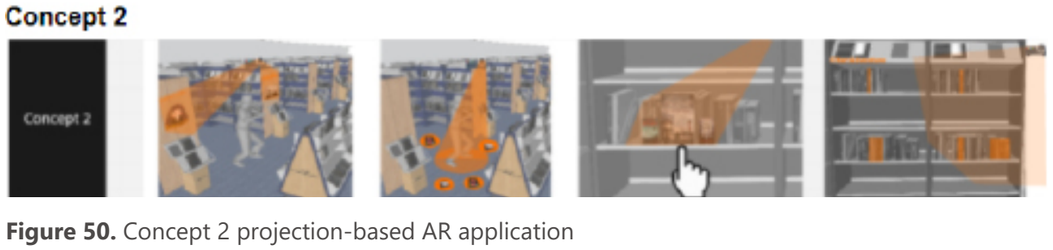


Figure 50. Concept 2 projection-based AR application

Figure 51. Concept 3 physical interaction with the bookshelf

7.2.3 Evaluation results

Overall, all three concepts can make participants feel fascinating, inviting, and playful. Participants all think these concepts can help to trigger them to explore other categories of books because of the randomness and recommendations of related books.

Concept integration

Concept 1 is better at creating an immersive feeling. It strengthens users' impression of a library where they stand within a huge amount of knowledge and can explore freely. The browsing part focuses more on offering information without too much distracting users from books. So, to less likely distract users from the browsing activity, the idea of a walking man on the bookshelf is left aside.

Concept 3 is better at helping users to focus on browsing through books on the bookshelf by displaying the information (cover image mainly) ahead of grabbing a book out. It can decrease the chance that a user misses a book of potential interest compared with the current situation.

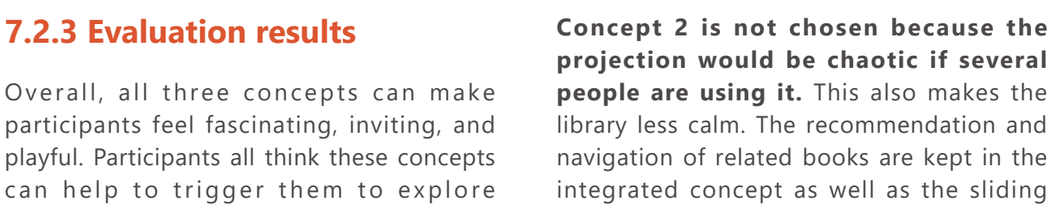


Figure 52. The exploring part from concept 1

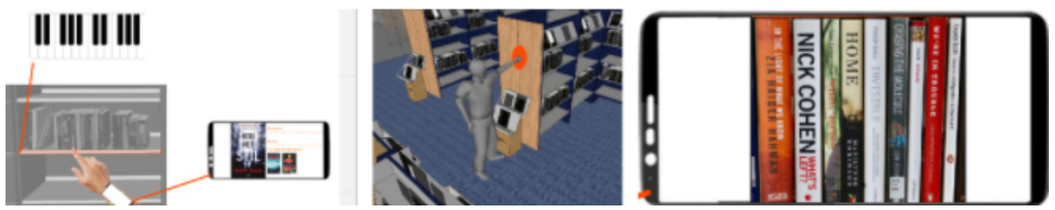


Figure 53. The browsing part from concept 3

Concept 2 is not chosen because the projection would be chaotic if several people are using it. This also makes the library less calm. The recommendation and navigation of related books are kept in the integrated concept as well as the sliding interaction.

The integrated concept is a **combination** of the **exploration part** when users are wandering in the library from concept 1 and the **browsing part** when users are standing in front of a bookshelf and browsing through books from concept 3. There is a tension between interaction with the concept and interaction with physical books. Consequently, the exploration part focuses more on playfulness and inviting feelings to trigger users to explore.

Concept development

Besides the evaluation of set criterias, other insights were learned from the session.

For the exploration part, users need to know more about a book before navigating it or exploring the related books. Thus in the integrated concept, a page showing detailed information about a book is needed along with the entrance of navigation mode and exploration of related books mode. What's more, **the efficiency of displaying books** from nearby bookshelves is doubted since the screen is relatively small to contain that many books. Not all books from the nearby bookshelves need to appear on the phone at the same time. Around 10 books are shown on screen at one time is an assumption to solve this problem. Users can choose to switch to another set of books to display on their phones as well.

The touchpoint of showing other member's book lists is moved to the stack of a bookshelf. In this way, a highlighting trigger can be created to add a surprising moment to the browsing activity. What's more, this booklist can be formulated from authors invited by the library, upcoming books, theme-related books by the library, etc.

Additionally, ideas such as supporting borrowing services, using double-tapping to work as "like" on Instagram, and adding books to the personal reading list were talked about by participants. Although these complements would make this concept more playful and functional, they are not going to be implemented due to the scope of this project. Yet it's valuable for the Westfriese library, in the future, to integrate this concept into the current library app and connect the physical and digital environment of the library.

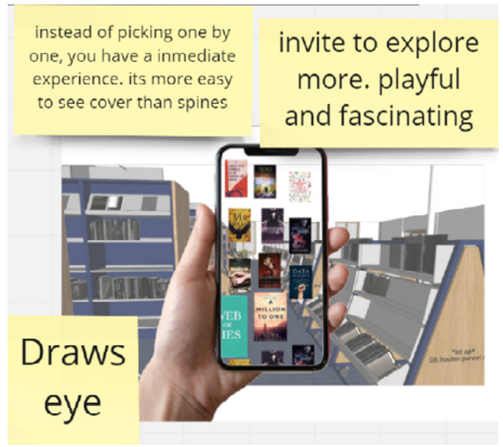


Figure 54. Feedback about the concept 1

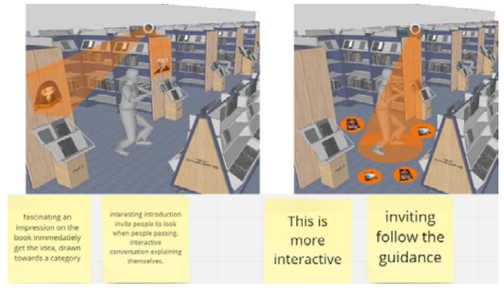


Figure 55. Feedback about the concept 2

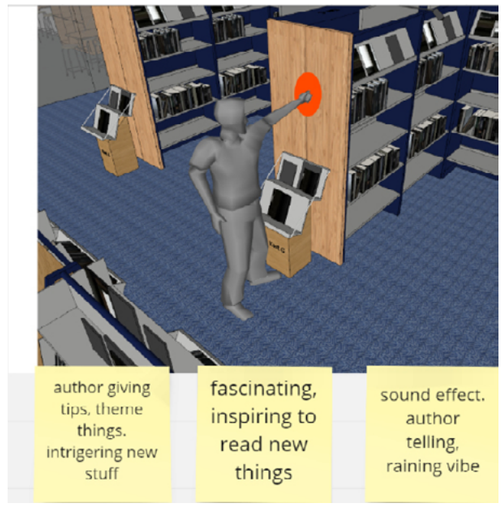


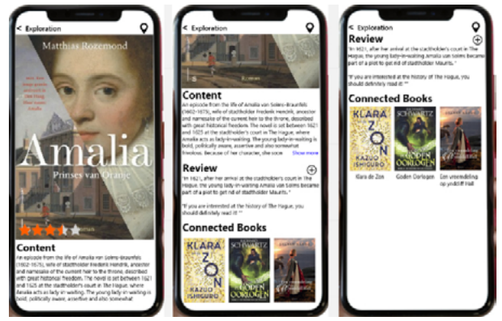
Figure 56. Feedback about the concept 3

7.3 Integrated concept

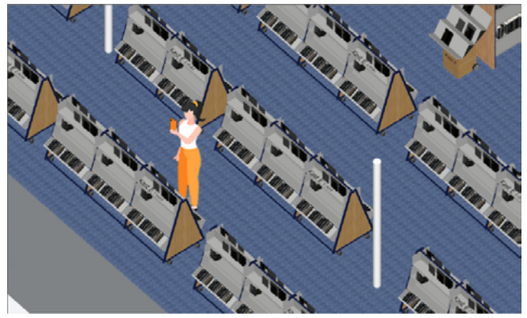
7.3.1 Storyboard of the concept

Anna walks into the library and uses the phone to explore books around her from the nearby bookshelves in a random layout. Anna moves around to get closer to a book and explore other books around her.

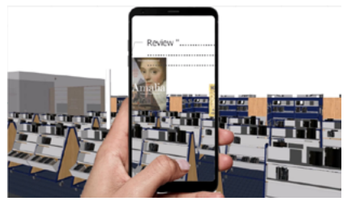
A video shows the interaction between the user's movement and books shown on the screen:
https://youtu.be/xr-hJ2mF58M



Anna chooses a specific book to know more on the screen by tapping the cover image. The content, review, and connected books would be shown on the screen. She goes back to exploration mode or navigate this book in the library or explore related books in this library.



Anna wants to navigate a book she's interested in. She sees a big cover image with location-based augmented reality as a guidance. She also sees the review of this book writtern by other members.



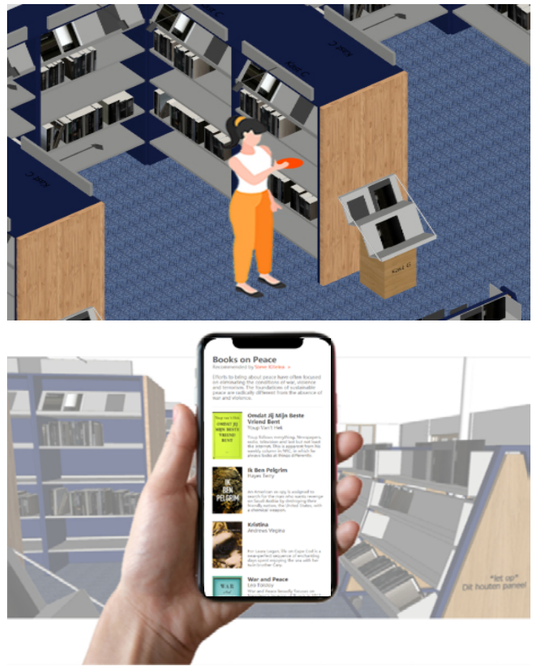
A video shows how navigation works on Anna's phone:
https://youtu.be/BezXOJFHXaI

Related books are shown on the screen with lines showing key words of the connection in a navigation mode.

A video shows how the function "related books" works on Anna's phone:
https://youtu.be/9T16NcNAZI4

Anna is interested in books on a specific bookshelf. She slides on the edge of the stack to point at a specific book and the information about the book. The information includes cover image, ratings, content summary, reviews, and connected books.

Anna thinks the book "Amalia" might be interesting to read, then she takes the book out of the bookshelf to read through pages.



During the browsing, Anna encounters a recommended book list about books on peace by Eva (another member).

7.3.2 Prototype - exploration part

The prototype of the exploration part is divided into two areas on the screen. As the figure shows, the upper part is the simulated view area which represents the user's view. The library environment is made from a 3d model of the library in Stede Broec. The AR application is based on a smart phone hold by the user. At the bottom part is the simulated body control areas. It includes the control of walking forward and back in the simulated environment, view direction, and shaking the phone. Users can interact with the prototype both at the screen area to interact with the AR application and also control the body movement by tapping the button at the

Users can experience different functions of the exploration part of the design under the controlled environment. The button "shake the phone" works as the function to refresh the current page and switch to see another set of books at the exploring page.

Since it's simulation of AR and the data base of books is made by me, users can only follow the preset route and see a limited amount of books and the information page about books as well. However, it's enough for users to know the design well and the prototype can serve the test purpose.

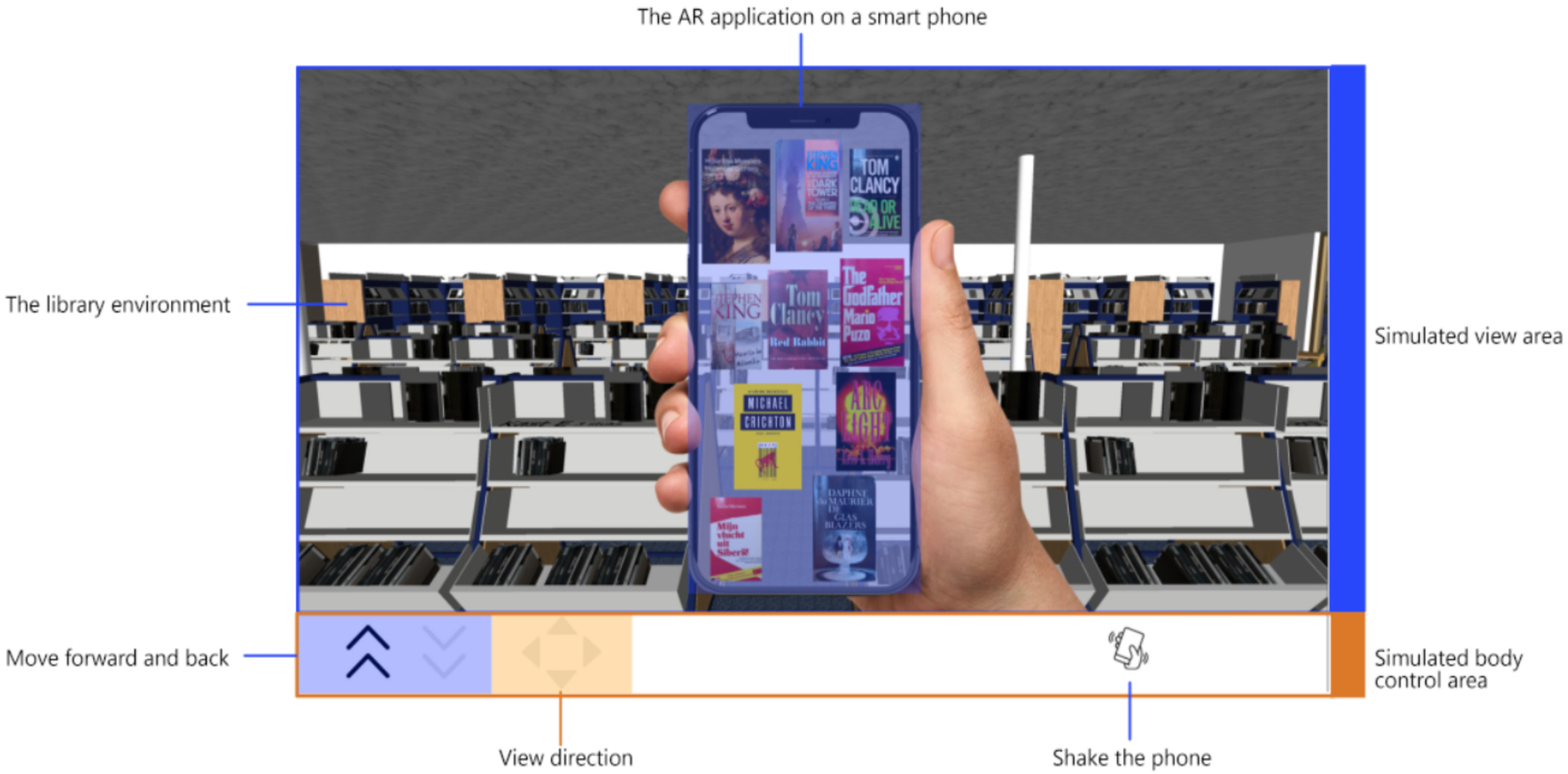


Figure 57. The prototype of the exploring part

Figure 58. A participant is trying the prototype of the exploring part on a laptop

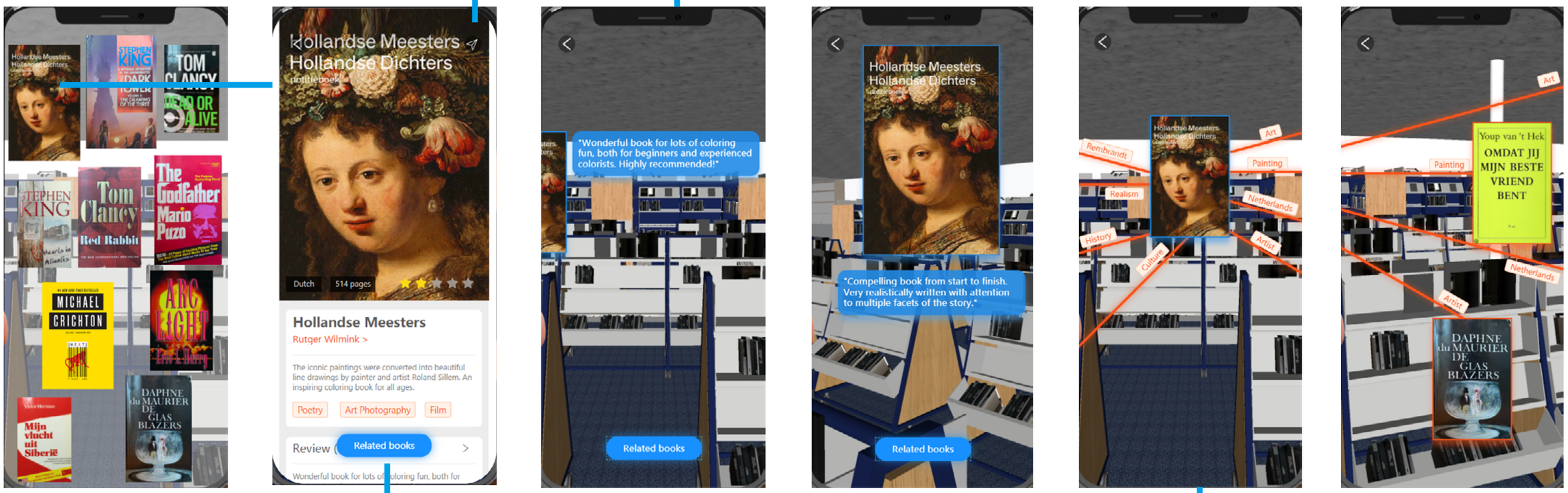


Figure 59. Overview of different pages of the prototype in exploring part

Exploration page
This page displays 10 books from the nearby bookshelves in a random way. Users can shake the phone to swtich to see another 10 books. With the user moves his/her body or changes his/her view to another direction, different books will pop up. The book cover on the screen can be tapped to know more about this book.

Book information page
At the book information page, book cover, ratings, title, author, summary, keywords, and other library members' reviews are displayed. Users can navigate the book in the library by tapping the navigation button on the top right and explore related books by tapping the related books button at the bottom.

Navigation page
At the navigation page, users can move the view direction to check where's the book in the library based on the location-AR. Along the way when the user approaches closer to the book, different reviews by other library members will show next to the book cover.

Related books page
At the related books page, first the book cover with keywords and lines will indicate where kind of other books related to those keywords are currently in the library. By mobing the view direction, user can see the related books' covers and the location.

7.3.3 Prototype - browsing part

The browsing part of the design concept was prototyped with Arduino for physical interaction and Protopie for interface displaying on the phone. Users can try the interaction under a controlled environment. The prototype can enable users to try the interaction with selected books by the author but it's unable to detect every book.

Since the technology ability limitation, applying the RFID and NFC technologies was not feasible for me in this project. I chose to simulate the RFID chips in books by making use of the analog read data of different resistors to detect the book pointed by the user. How this prototype works is explained at the next page.

During the test, users were informed that due to the limitation of the prototype, they had to pretend that they are pointing at the book instead of the circuit. The circuit was made to fit with the books on the bookshelves in order to give users the feeling that the circuit is aligned with the books.

Most of pages in this prototype with the exploration part including book information page, navigation page, and related books page. In the browsing part, there's a recommended book list page.

This recommended book list appears at a random moment when the user keeps browsing books. This page displays the recommended books by other library members. The user can choose to know more about these books by tapping the book covers and start a new book discovery journey.

Figure 60. A participant interacts with the prototype to connect the circuit

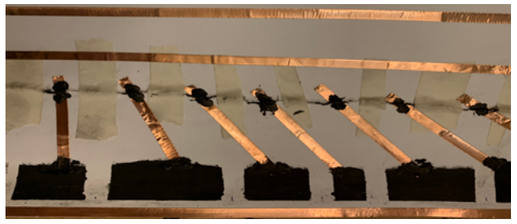


Figure 61. The circuit for the prototype of the browsing part

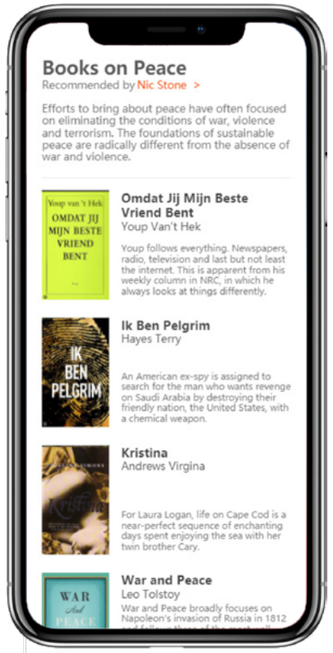


Figure 62. The recommended booklist page

The circuit works as the diagram shows that is bascially a DIY sliding rheostat. Users need to connect the circuit by connecting the black part (electric paint that is conductive) to the orange part (copper sheet) with tinfoil sticked to the fingertip. By doing so, the data can be read from the analog pin connected to the arduino. The smart phone is connected to the arduino board with a cable to communicate the data. The arduino can communicate this data to the protopie application at a smart phone and thus the protopie application can display different pages based on the preset data settings.

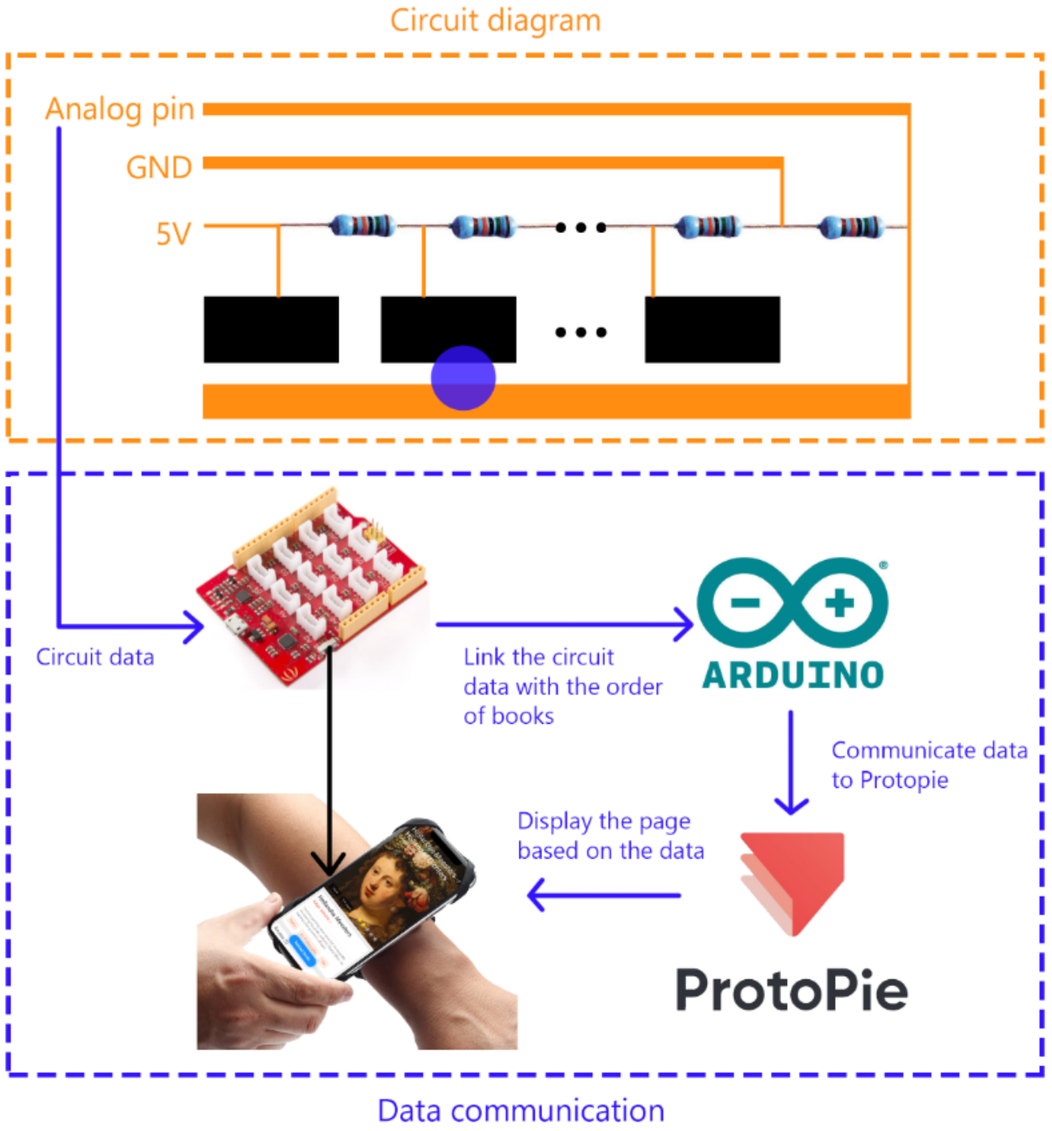


Figure 63. The diagram of how the prototype of the browsing part works

7.4 User test

7.4.1 Test objectives

The overall aim of the iteration test was to understand people's experience of the whole concept with a focus on the overall experience, content, and usability. The integrated concept was tested to gather the feedback to find out what are the potential improvements based on the feedback.

Questions to answer through the iteration test:

1. How do people think about the overall experience (function and interaction)?

2. How satisfying is the content related to books?

3. How usable is the concept perceived by participants?

7.4.2 Participants

6 participants who read books for pleasure, 20-25 years old were recruited to participate the test.

7.4.3 Test set-up

Test environment

The test was done at a reading corner inside a student housing in Delft. Part of the bookshelf was chosen to be tested at different eye level. Fiction and non-fiction books were selected ahead to ensure the aligment between the prototype and the physical environment.

Test procedure

Participants were first introduced about the project including the context and the activities they were going to experience. A consent form was agreed by each participant for audio recording.

Then participants were asked to first go through the exploration part of the concept on a laptop. After that, they were asked to wear the prototype of the browsing part to browse the selected books. There is no preset task for participants to find a specific book. During the process, the questions about usability were partly answered thourgh observation.

In the end, there's a semi-structed interview to gather users' feedback. This part was audio-recorded for analysis. The insights and quotes from each participant were summarized and categorised.

Figure 64. Test environment

Figure 65. Selected bookshelf to test

Figure 66. The iteration test with participants

7.4.4 Insights from the test

How do people think about the overall experience (function and interaction)?

1. Encountering the recommended book lists was a surprising moment during the discovery journey. On the other hand, it made participants feel they are forced to encounter it without any notification.

"I really like this recommendation page but do I have to encounter this recommendation? Is there a possibility that I can have a choice to skip it?" - P2

2. The feeling of being fascinated was not very strong because participants all thought although the design brings a new way to discover books in the library, the end result of what they can achieve when leaving the library doesn't change - books they want to borrow.

"It inspires you to look more, to try out stuff you haven't tried before and brings wonderment and curiosity to me. But in the end, the fact that library is interesting because of books doesn't change." - P1

Improvements

1. Before poping out the recommendation booklist, there should be a popup for users to choose if they are willing to check the booklist.

How satisfying is the content related to books?

1. The overlap that the title and author name show again on the screen is not really necessary since it's easier to get them by taking the physical book. However it's still needed to keep them since it helped participants to build a connection between the physical and digital world. Moreoever, the cover attracts participants to keep browsing through bookshelves.

2. Participants expected extra information that they can't get from the physical book. The reviews and ratings were appreciated but compared with the "overlapped" information, they were not visible enough especially the reviews.

"It's nice to explore books in those ways for the AR function but there is not very much added value to me since I can also get those information from the physical books in that part (browsing part)." - P3

3. 3 out of 6 participants thought that the historic information about a book is essential for them to judge if a book is good or not.

"Maybe like an availability percentage that you would see 95% of the time this book is out of the library, then I would know, okay, I need to be quick." - P5

Improvements

1. Increase the visibility of the reviews by other library members.

2. Decrease the space that the book cover, titile, and author name takes up.

3. Add the video information about the book to the book inforamtion page.

4. Add the historic information about a book.

How usable is the concept perceived by participants?

1. Due to the limitation of the simulation of argumented reality for exloring books, participants felt confused about the relation between controlling the physical movement and the interaction with the phone screen. The prototype didn't allow free physical movement that can help participants to explore. This caused it a bit difficult for participants to understand the functions of navigation and related books. However, after trying out the prototype, participants thought these two functions' argumented reality features make sense.

2. Showing 10 books on one screen each time made it hard for participants to browse easily in the exploration part.

3. 4 out of 6 participants thought that attaching phone to the wrist takes too much effort in the library and the benefit of this design doesn't worth this effort. Other 2 participants held the opinion that it's okay but should let it be an extra option and should not be a forceable one.

4. More guidance like indication of where's the book and what's happening currently was needed by participants.

5. The button of the navigation is too small to be noticed. Also an indication of what's the current page is needed to let participants aware of the current function.

"Make it more clear for how this design can help you to navigate books and in related books how to understand the location of the books." - P3

"Normally there are some arrows to show you the path towards the destination and those will definitely make it more clear for me to understand it's a navigation" - P2

Client's feedback

1. The smart phone has its own chip reader and that can be an alternative way to use instead of sticking the reader or tinfoil on the fingertip. Using the reader will increase the extra effort both for users and the library to implement. Also, it's hard to imagine how to offer the device that attachs the phone onto the wrist.

Improvements

1. The number of books displayed each time on the exploration page was changed from 10 to 8 to ensure it's easy to see on the phone screen.

2. In the navigation function, route arrows need to be added to indicate where's the book and how to get there in the library.

3. Page name indicating the current page was added to avoid the confusion.

4. The button of the navigation was made bigger and shared the same importance with the related books button at the bottom of the screen.

5. Making use of the chip reader inside the smart phone and the interaction with books in the browsing part was then changed to using the phone to tap the book spine.

7.5 Final design

The final design outcome of this project is an phone-based AR application intended for the public community library context. The application aims to create a fascinating, playful, and inviting book discovery experience for young adults in the library under the goal of facilitating serendipitous experience. There are two main parts of functions in this application: exploring part and browsing part.

The exploring part serves the moment when users want to explore books without a specific target category or theme and just want to walk around to find books of interest. The exploring part of the application shows books to users from the nearby bookshelves. Different sets of books vary in reaction to users' body movement such as moving around and turning perspectives around with the animation of poping in and out. Users can check fruitful information about books of interest which for some of the information they can not get from the physical books. With the function of navigation and exploring related books , users are able to explore books freely and encounter books of potential interest.

The browsing part serves the moment when users want to browse books through a bookshelf with a relatively clear goal of finding books. This part makes use of the NFC reader inside the smart phone to interact with the RFID chip attached to books and thus show the additional book information to the smart phone.

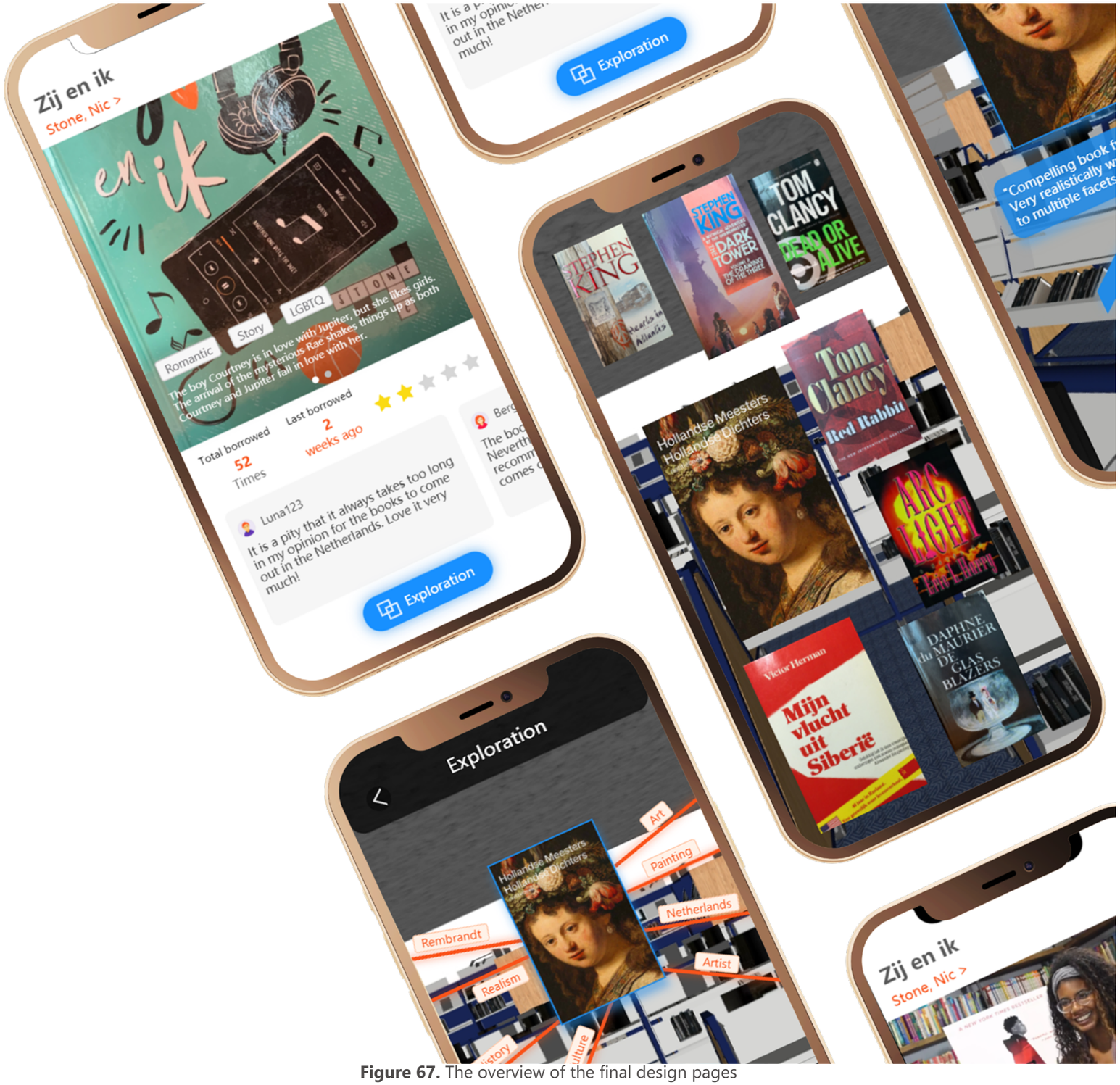


Figure 67. The overview of the final design pages

7.5.1 Exploring - exploration

The user walks into the library and uses the phone to explore books around him from nearby bookshelves. He moves around to explore different books. With the animation of books poping in and out, he gets fascinated about what books will show up at the next second.

He is interested at the book "Hollandse Meesters" and checks the book information page. He can know more about this book and then decide if he's interested or not. The layout of the book information page is to first let the user know the basic content and then shows the additional information for inspiration.

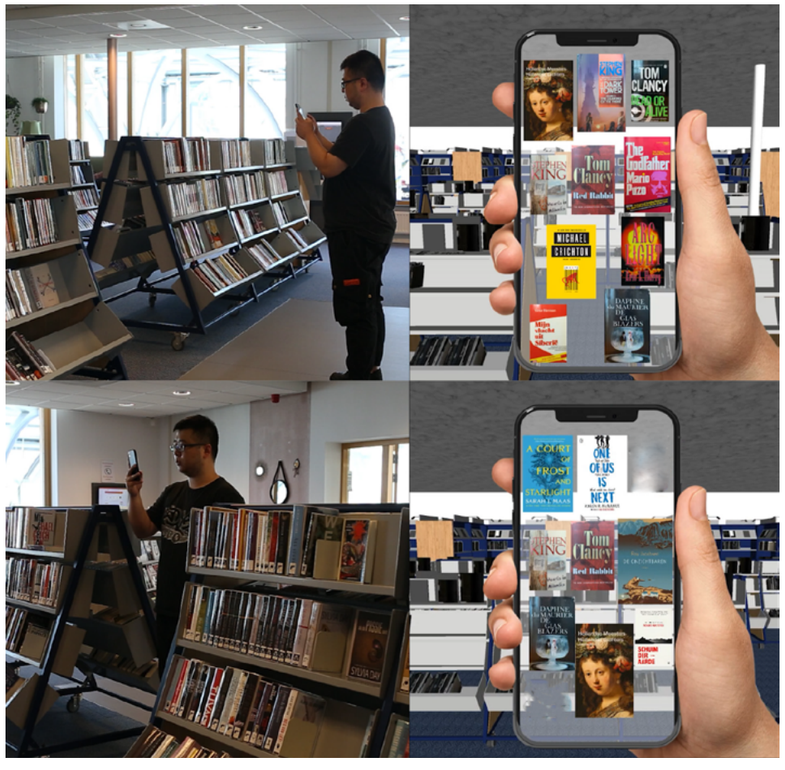


Figure 68. The storyboard (left) and interface (right) of the exploration

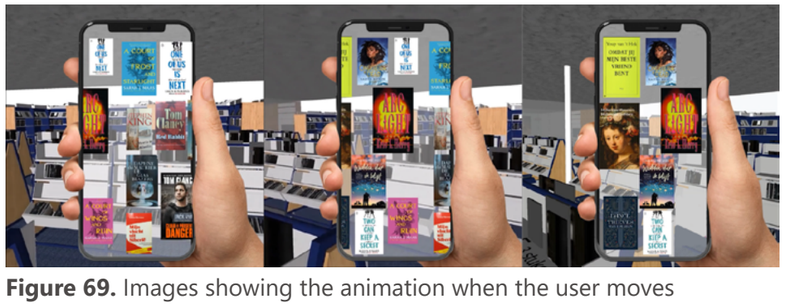


Figure 69. Images showing the animation when the user moves

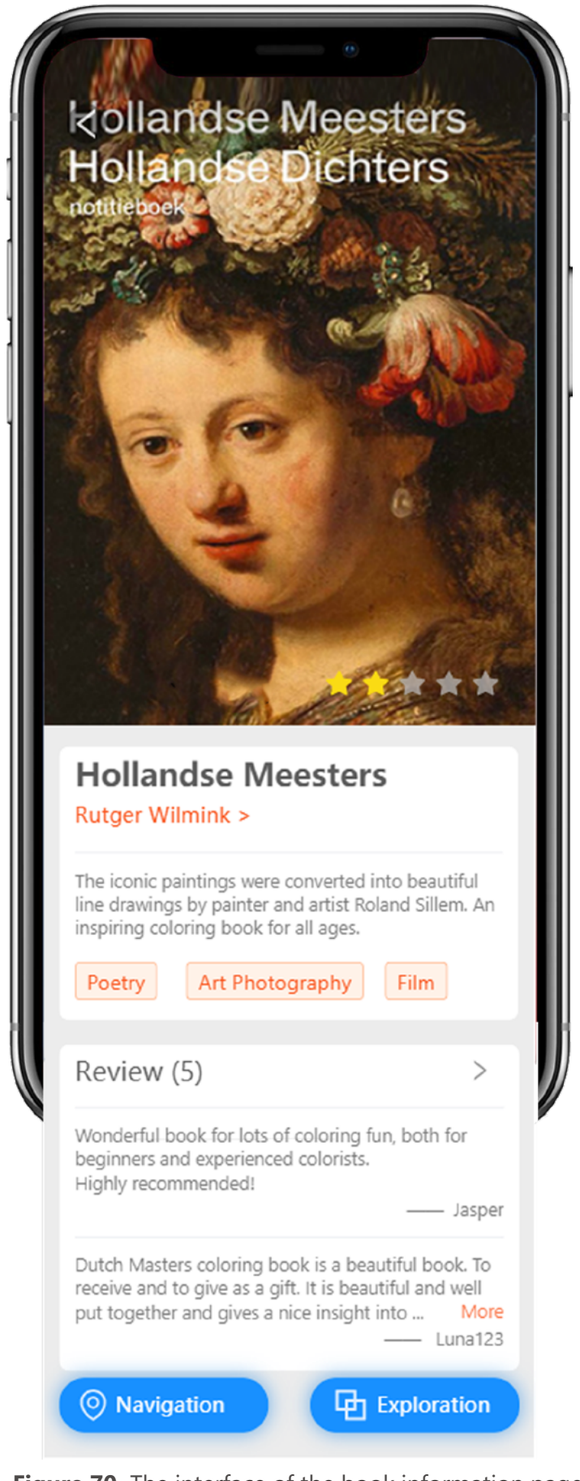


Figure 70. The interface of the book information page in the exploring part

7.4.2 Exploring - navigation

The user is interested at the book "Hollandse Meesters" from the exploration and wants to find it in the library. By following the navigation guidance, he walks along the route towards the book. The position of the cover image also moves with the user's location in the library to indicate the direction of where the book is. During this process, he can read the reviews about this book and feels invited to approach to this book. Along the route, the review changes too.

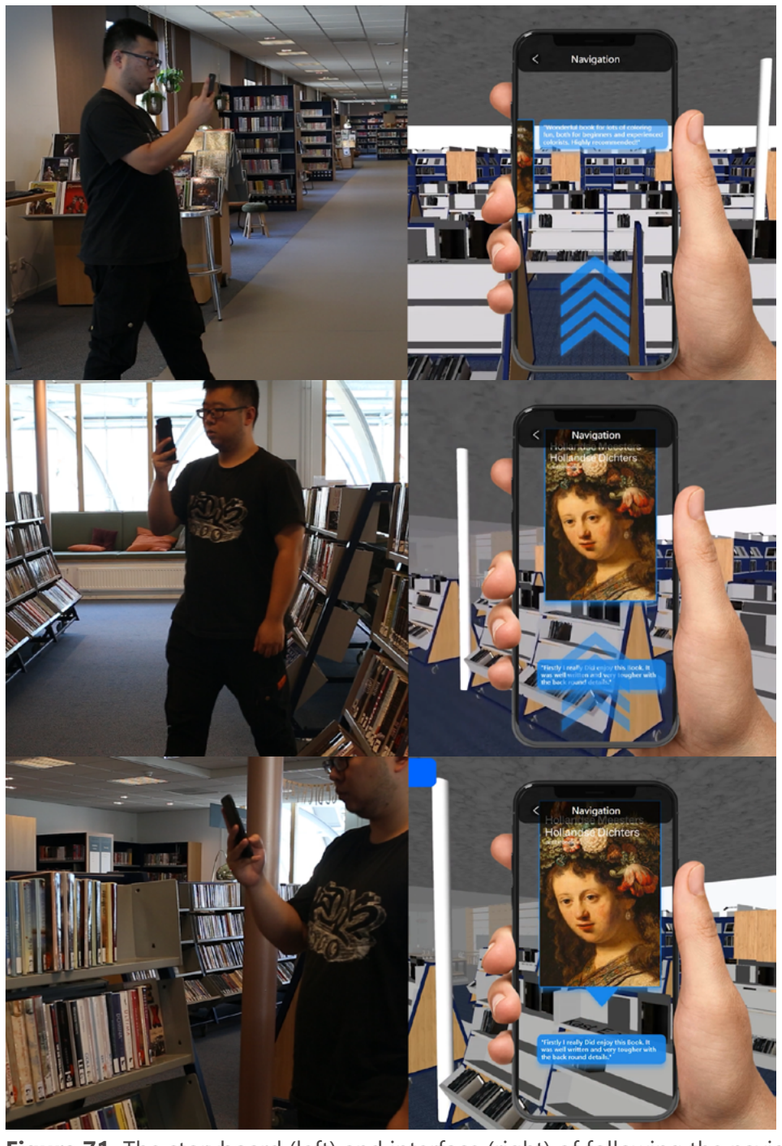
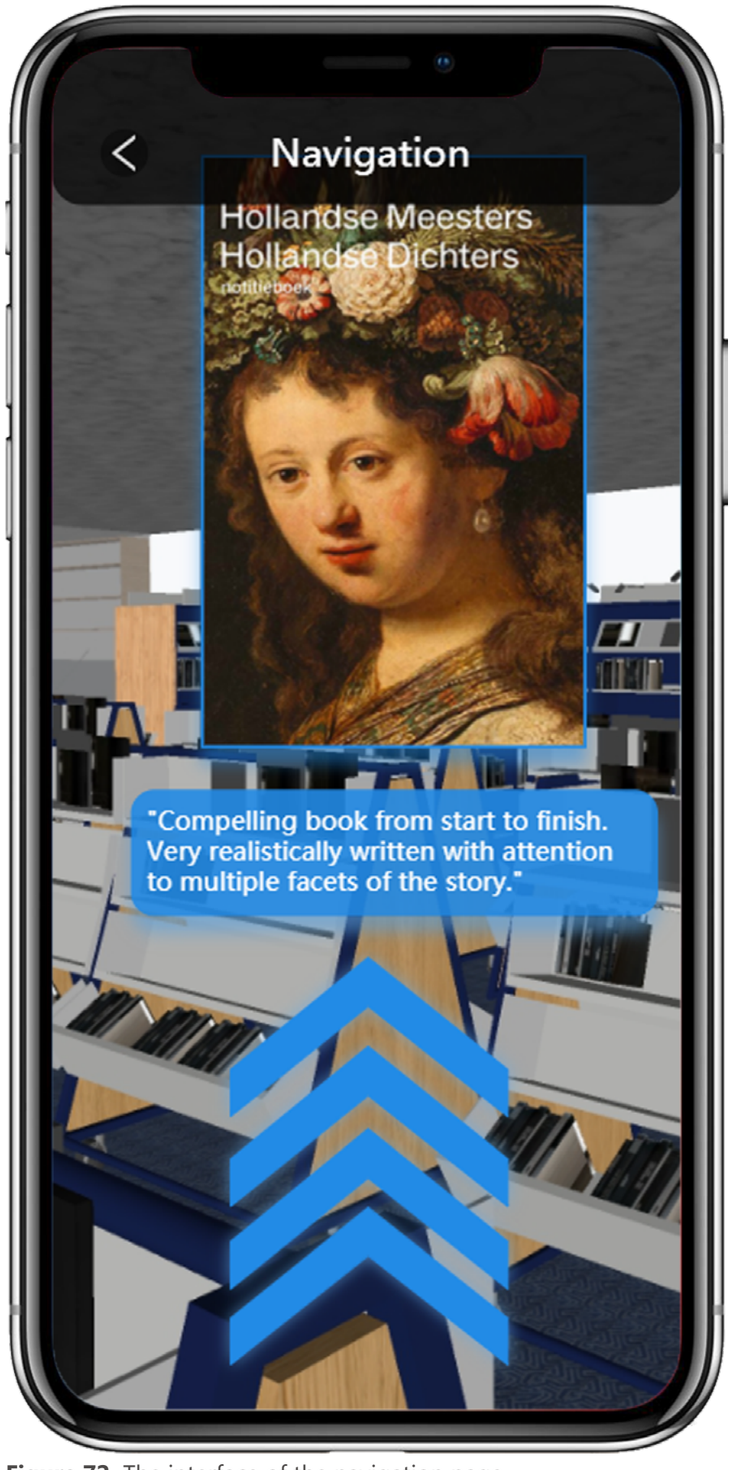


Figure 71. The storyboard (left) and interface (right) of following the navigation



Page title: To indicate users the current status to reduce the confusion problems caused by AR.

Book cover image

Reviews

Navigation guidance

Figure 72. The interface of the navigation page

7.5.3 Exploring - related books

The user is not satisfied with the book "Hollandse Meesters" after fliping through pages but he's interested at this category. He enters the exploration function and explores other books related to this book. All key words this book has are showed on user's phone and lines are attached to those keywords that indicate where those related books are in the current library. As the user turns aside the phone, he can see related books' covers and the location. Covers of related books can be tapped and let users know more about them in book information page.

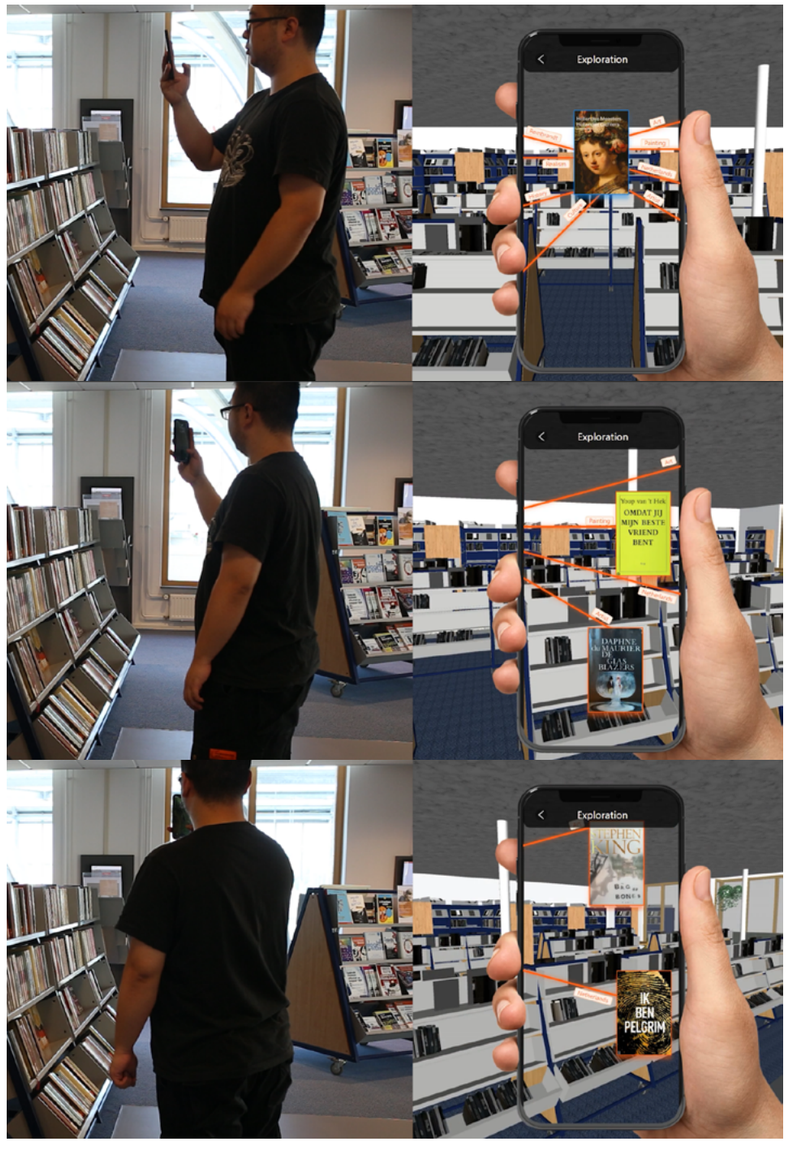


Figure 73. The storyboard (left) and interface (right) of the exploring related books

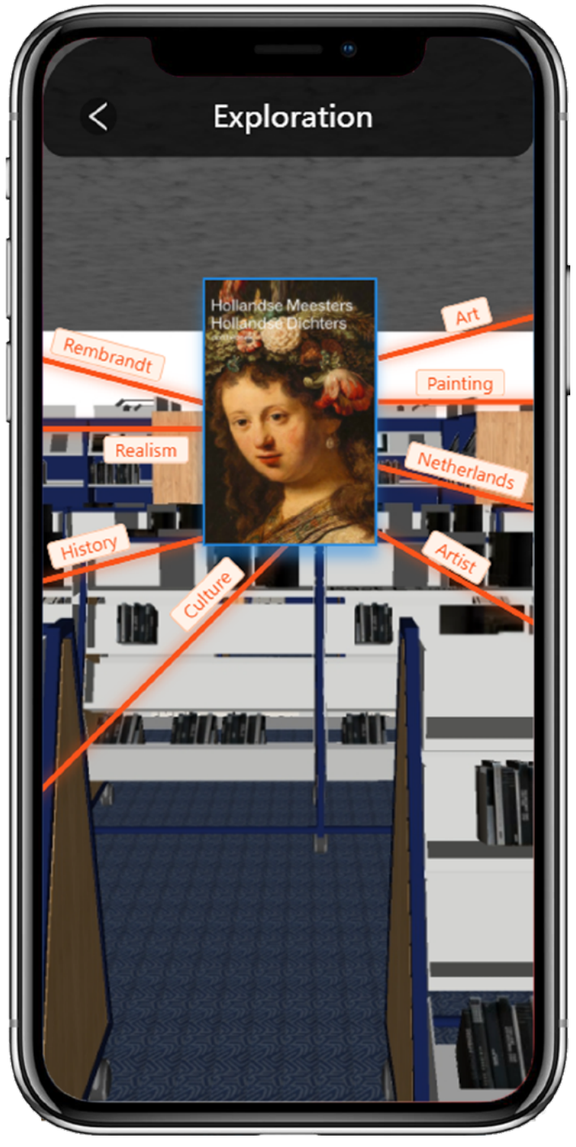


Figure 74. The interface of when the user just enter the related books page

Figure 75. The interface of when the user turns his perspective to right

7.5.4 Browsing

The user is interested at the young adult section and wants to find a book to borrow after exploring the related books. He uses his smart phone to tap the book spine to see the information about the book. The NFC reader inside the phone detects the book he points at and display the book information page about that book on his phone.

This information page is different from the one in the exploration. He sees the additional information such as when is this book last borrowed and reviews without scrolling down in a more visible way. By sliding left at the cover image, he can see the video interview with the author talking about the book.

The user keeps browsing with the application and at one moment he gets a popup notification of recommended book list about peace by an author Nic Stone. He checks the introduction of this book list and start exploring these books.

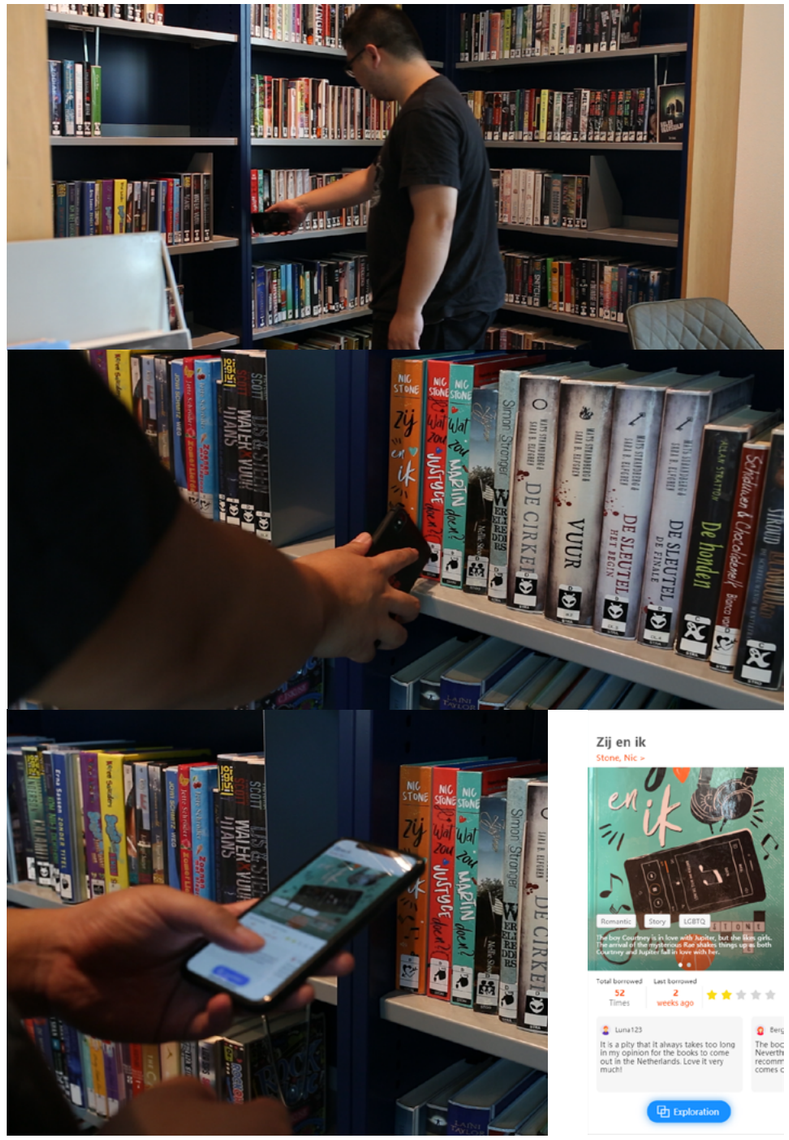


Figure 76. The storyboard and interface (bottom right) of the browsing part

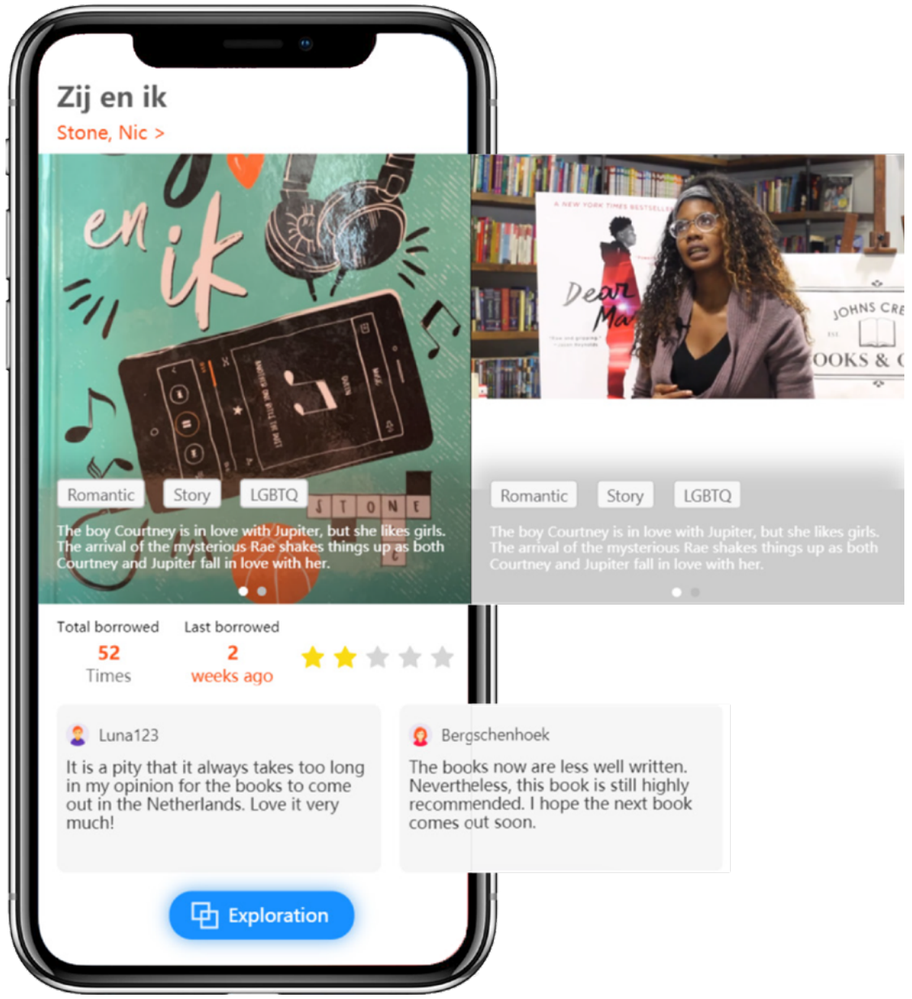


Figure 77. The interface of the book information page in the browsing part

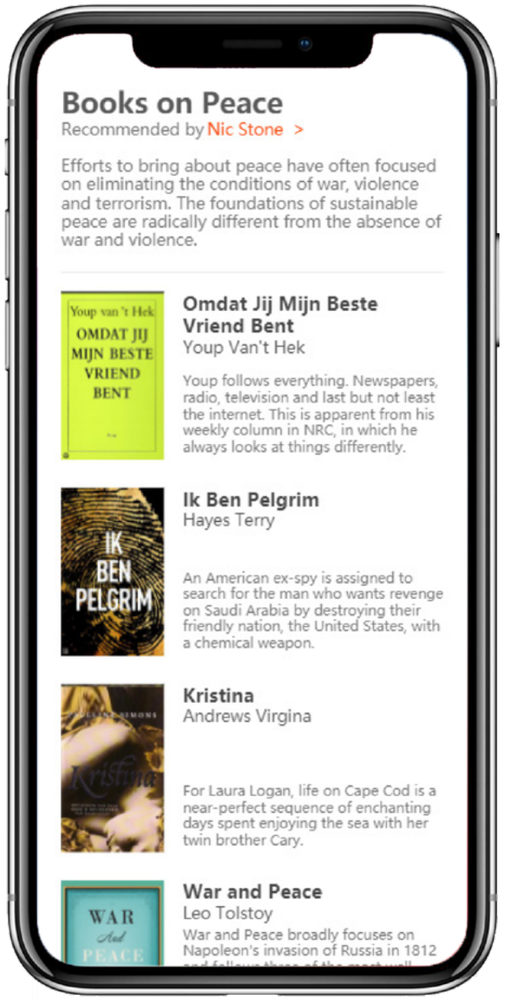


Figure 78. The interface of the recommended booklist page

Chapter 8
Evaluation and recommendation

In this chapter, the final concept evaluation and its results are presented and discussed. Evaluation tests were conducted to see if the final concept has met the design goal.

Chapter overview

8 Evaluation and recommendation

8.1 Evaluation objectives

The overall aim of the evaluation test was to evaluate how well the final concept could meet the design goal. Due to the limitation of the prototype that it can not offer a full data base that allows participants to experience based on their own reading preference, if the design can facilitate serendipity can not be evaluated. Instead, three design goal qualities that can facilitate serendipity based on research findings were focused to evaluate the design goal.

A list of research questions was formulated based on the design goal. After the test, these questions were answered.

a. Design goal

How fascinating, inviting, and playful do participants feel?

b. Usability

How usable is the concept perceived by participants?

c. Overall desirability

d.1 How desire do participants feel about the concept?

d.2 How likely will participants use the design concept for books discovery?

d. The displayed information

How satisfying is the content of the information related to books?

8.2 Approach

System usability scale (SUS) (Bangor et al., 2008) was applied to assess the usability of the concept. Participants were asked to scale from 1 to 5 representing "Strongly disagree" to "Strongly agree"for each usability test question (10 in total). It can distinguish if the final design is usable or not on small sample sizes.

AttrakDiff (Hassenzahl et al., 2003) was applied to measure the overall desirability (d.1). Participants were asked to scale from -3 to 3 for each assessment question (21 in total). The pragmatic quality part (usability) was removed to avoid overlap with SUS. The results from SUS was transformed to align with AttrakDiff and worked as the pragmatic quality to assess the overall desirability.

Qualities (fascinating, inviting, and playful) from the design goal were also included in the AttrakDiff yet focused more by asking participants to tell which factor of the concept cause the specific scale.

For the question c. and d.2, open questions were asked from a subjective perspective. During the assessment, participants were aksed to explain the reason for giving a specific scale and general feedback for suggestions as well.

Through asking 20-25 years old library members who visited the library, 6 participants were involved in the test.

8.3 Test set-up

Test environment

The evaluation test was done at the public library in Stede Broec. The young adult section was chosen as the test area since it's easier to set up the test environment where there's a table and chairs.

The prototype for the exploration part was done at the laptop by Protopie to simulate the AR situation. The prototype for the browsing part was done at three levels of the bookshelf in the young adult section.

Test procedure

Participants were first introduced about the project including the context and the activities they were going to experience. A consent form was agreed by each participant for audio recording and assessment data from the test.

Then participants were asked to first go through the exploration part of the concept on the laptop. Four parts were emphasized: simulation of walking around to explore different books nearby, reading the information displayed on the phone, navigating the target book, and experiencing the related books function. Participants were guided if they miss some part. After that, they were asked to try prototype of the browsing part to browse the selected books with a given phone. They were first introduced how the prototype works and what kind of the technology it uses to let them understand the limitation of the prototype. There is no preset task for participants to find a specific book but explore and try the experience.

In the end, participants were aksed to fill in the assessment form (SUS and AttarkDiff) and answer the open questions. This part was audio-recorded for analysis. The insights and quotes from each participant were summarized and categorised.

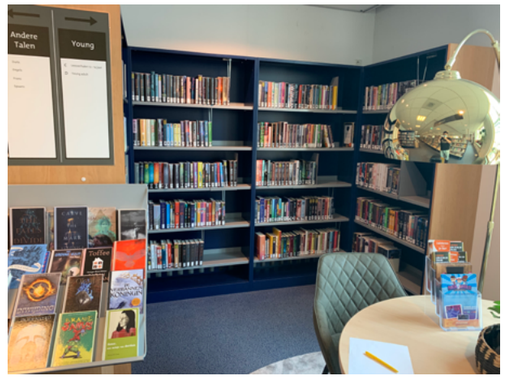


Figure 79. The evaluation test environment

Figure 80. The evaluation test of the exploring part

Figure 81. The evaluation test of the browsing part

8.4 Test Results

a. Design goal qualities

How fascinating, inviting, and playful do participants feel?

Fascinating

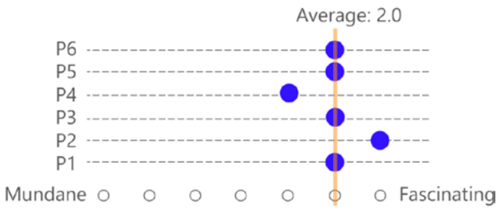


Figure 82. The score of how fascinating do participants feel

1. Participants felt fascinated while using the design to discover books mostly because the interaction between users and books let them want to know more about a book and explore related books.

2. The animation of books showing up and disappearing made people feel fascinated about books that will show next. The animation inspired participants to walk around, explore books at different areas, and thus encounter more books from the areas where they usually ignore.

3. The reviews were appreciated by participants and helped participants to know more about the books since the reviews offered an extra layer of information from other users' perspectives.

4. The function of related books helped to encourage participants to explore more books and find books of potential interest. Also, the lines and keywords connecting different books based adds to the feeling of exploring new books that makes participants feel fascinated about what kind of books would be connected.

5. It's a fascinating experience to see other library members' reviews while navigating to the target book in the navigation function. It offered a preview about the book. Yet the reviews could also come from other instituions such as podcast and other authors.

6. Encountering the recommended book lists was a surprising moment during the discovery journey. The recommended book list can be from different topics that doesn't necessarily be aligned with the current bookshelf. This recommended book list can also evoke participants' latent interest or need.

7. The interface didn't contain too much information which was good especially in the browsing part. The video information about the book are appreciated by participants.

"I feel it's warming me up for reading as I get closer to the book." - P5

"You could have a review that's usually like on the cover. There's something like, maybe New York Times said this and this, or another writer said this or this. So maybe a bit more credential." - P1

"I'm fascinated about the options. I think it's really cool that you can explore different topics, different writers and quite easily with just a click on a button." - P1

"I think fascinates me because the Information it provides like a second notice as fascinating me, because I usually it's time consuming" - P2

"I definitely think so. Sometimes I go on like the cover or just what do you see? Now it's a more random, because I like the APP just shows the random books that you might not see otherwise." - P6

Inviting

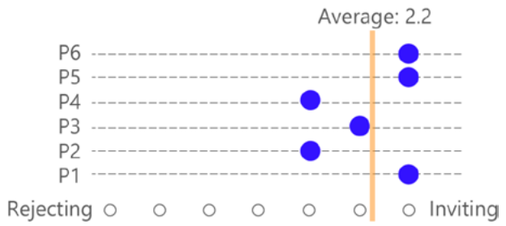


Figure 83. The score of how inviting do participants feel

1. In the browsing part, the keyword was appreciated by participants that it's clear and intuitive to get with a glance at. The keyword helped participants to know a book quickly.

2. Participants felt invited because the design encouraged them to look around, wander a bit , and look for books similar to each other. The freedom of interacting with the phone offered many possibilities for participants to indirectly interact with books around them.

3. The design made it easier and faster for participants to look for books with information offered. Lowering the effort also made participants feel invited to discover books.

4. Participants felt invited very much since the design invited the participant to explore places and touch things and look at those information that they might not necessarily consider before she goes to the library.

"When it becomes easier to like you're in the whole library of so many books that everything may be that becomes easier to like in a fast way" - P5

"If I think kind of in the sense that it invites me to explore to walk around really, instead of like saying it one place to see what's out there." - P4

Playful

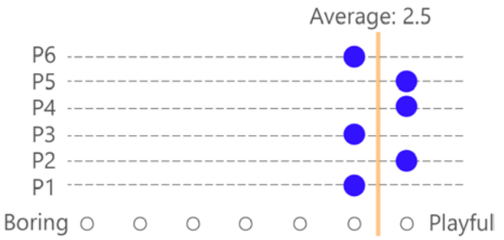


Figure 84. The score of how playful do participants feel

1. The way of using AR was fun and playful to participants since it's a new exerience that they hadn't experienced that in the current library although they had experience in AR in other context such as game applications and museums.

2. Participants felt playful because they can explore and browse books in a way of combination with physical and digital world.

3. The inteaction made the discovery more playful since it connected the browsing activity with the extra information. It brought about curiosity and encouraged the participant to explore more.

"I think the interaction makes it a bit more playful cause it has a sense of spontaneity, in a sense of that it brings about curiosity in me. And I think I'll connect that to play." - P5

"For the first section it's a really playful experience that you can see different books by walking around and shaking your phone" - P2

"It's like an APP and some guilty like a game and most of us like that." - P3

"So I think it's playful that it's interacting with your movement in the library, your position in the library. " - P1

b. Usability

How usable is the concept perceived by participants?

In the SUS, odd-numbered statements are positive and even-numbered ones are negative. The calculation of the overall SUS score for each participant can be summarised as below (T, 2020):

• A = Sum of the point s for all odd-numbered questions – 5
• B = 5 – Sum of the points for all even-numbered questions
• SUS Score = (A + B) x 2.5

The SUS score was 77.9 (n=6). Based on a research project with 5000 participants had participated and the grade and adjective rating for different scores were demonstrated as Figure. X shows. (Sauro, 2011)

The usability of the final design can thus be assessed as good.

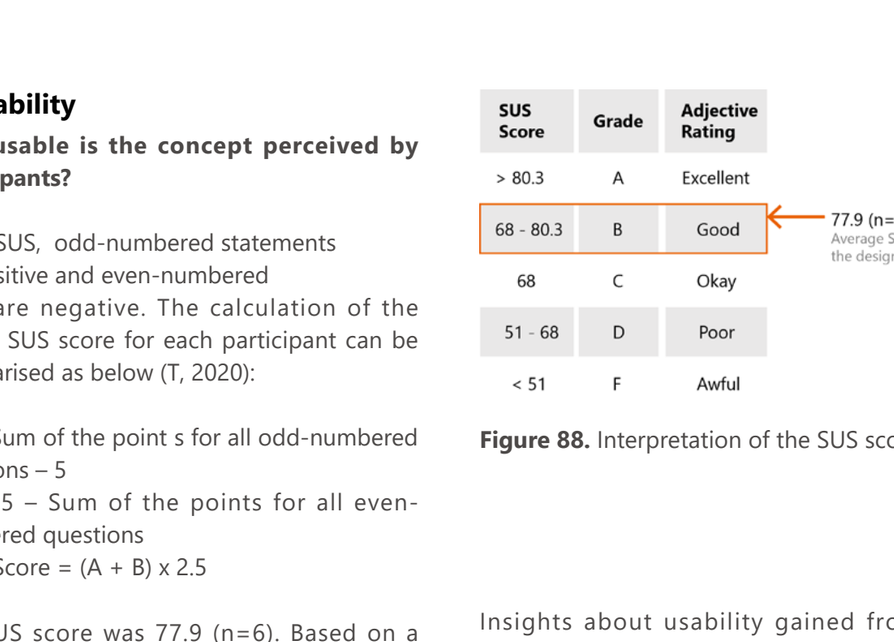


Figure 87. SUS score of the final design

SUS Score	Grade	Adjective Rating
> 80.3	A	Excellent
68 - 80.3	B	Good
68	C	Okay
51 - 68	D	Poor
< 51	F	Awful

77.9 (n=6)
Average SUS score of the design concept

Figure 88. Interpretation of the SUS scores

Insights about usability gained from the inteviews:
1. Bending down makes it less easier to interact with the bookshelf but overall it's a nice experience to browse books on the bookshelf with this design.

c. Overall desirability

c.1 How desired do participants feel about the concept?

The result of AttrakDiff showed that overall the final design is positioned at the "Desired" area of the analysis matrix. Overall participants were glad to have the final design in the current library and expected it can have more connection to the current library app and borrowing services.

c.2 How likely will participants use the design concept for books discovery?

It gives the current book discovery more options especially when the participant want inspiration on the topic of interest. On the other side, participants held the similiar opinions to each other that the final design is and should be an optional tool to use instead of replacing the current way of discovering books completely.

"But I don't think I would say you have to use this. I think it has a very specific use, because some people just want to grab a can just immediately like leave. But some people really like to go deep into it, which it happens to me." - P2

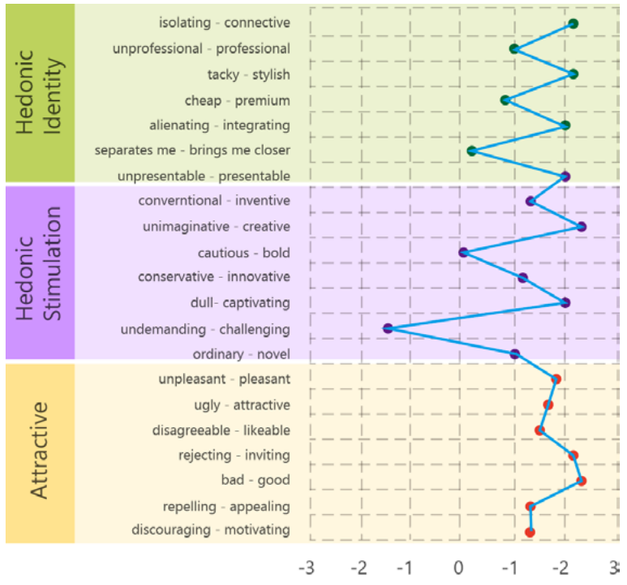


Figure 89. Results of the AttrakDiff of the final design - description of word-pairs (http://www.attrakdiff.de/)

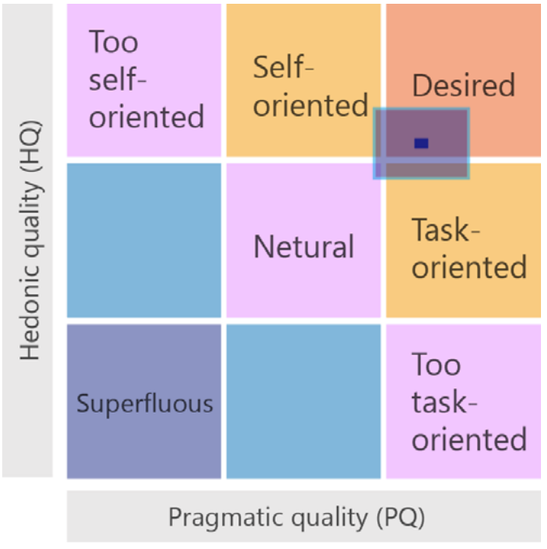


Figure 90. Results of the AttrakDiff of the final design - portfolio-presentation (http://www.attrakdiff.de/)

d. The displayed information

How satisfying is the content of the information related to books?

Overall, participants were satisfied with the content displayed in the application. The related books, video information, reviews and recommended book lists were appreciated most. Participants thought these content can inspire them to come up with new thoughts about a book and a connection between a book and their past experience was possible to be built.

During the interviews, 4 out of 6 participants asked questions about the exploration and recommended books if there is a specific algorithm working behind the screen. Participants expect books that they will encounter can be based on their reading history data. As a limitation in this project that I focused on designing a new interaction with books and less focused on the content, this direction is valuable to do research further.

"Maybe if you kept like a book with a certain topic, then you get like recommendations" - P4

Client's feedback

1. The technology that the final design applies is not hard for the library to implement. Also currently the content that the final design has offered can come from the data base of the library except the videos. These two factors can ensure the extra effort for the library to implement is low.

2. Making use of user's smart phone has the potential to let the final design integrated with the current application used in the library as the it's considered to make the application multifunctional in the near future.

Improvement feedback

1. The key word at the book information page can not only work as a category or theme indication but also a filtered entrance to exploring related book.

"Could you tap one key word and get like other books only about this key word?" - P3

2. The recommended book list function was appreciated by participants. It could be improved by letting participants explore the recommendation in an active way that they can choose which recommendation to get instead of encountering it randomly. However, this doesn't mean the feature that the application will pop up a book list when a user is browsing should be removed. The random appearing creates a surprising moment for users and can fascinate users as a highlight trigger.

"It's an option you can choose. And you come into the library and you think I want some recommendations." - P2

3. At the research phase, insight "recommendation of books should not cause social pressure" was gathered, however, in the evaluation test, 3 out of 6 participants suggested if how many people have rated can be added. One possibility of this incoherence might be the amount of participants in the research was not enough and the insight was biased.

"For the ratings can you also show how many people have rated?" - P1

8.5 Conclusion

In summary, the design goal with three design qualities has been reached with quite positive feedback to create a fascinating, inviting, and playful book discovery experience and thus facilitate serendipity in the public library.

a. Design goal

As the research findings have demonstrated, under the framework of serendipity theory and the context of the public library, a fascinating, inviting, and playful book discovery experience can help to facilitate serendipity in the public library.

Fascinating

The way of interacting with books and content displayed about books make users feel fascinated in the book discovery. The animation effect of AR stimulates users' curiosity to explore the digital world of books by physical actions in the real world. The randomness of books showing up and recommended book lists add to the richness and highlight of triggers. The connection between different books by related books and the relevance between books and users' past experience/knowledge by reviews contribute to triggering making a new connection and thus spark their latent need of books.

Inviting

Users feel invited mainly because they have many options to choose from and interactions to do because of the richness of the content and functions the design has offered. Also, the final design makes the book discovery easier and faster which users feel invited to explore more books.

Besides, the good usability of the final design lowers the cognitive effort and ensures it's a seamless experience to some extent which is a part of the contribution to the quality inviting.

Playful

The application of augmented reality in the library is not completely new in the world and people already know about this technology a bit for many years. However, it's new to use AR in the library in Stede Broec. Exploration of books from the nearby bookshelf and showing related books in AR is a playful and new experience to users there. The connection between browsing activity and additional information adds to the playfulness of the book discovery experience.

b. Usability

Based on the SUS assessment results of the usability, the SUS score of the final design can be defined as good. The reason that the usability performance can't reach excellent might be that the fidelity limitation of the prototype to some extent negatively influenced the usability score.

c. Overall desirability

The final design was appreciated by participants and they would like to see it implemented in the library. It's interesting to notice that the final design in the physical library should be an optional way of discovering books rather than a forceable one that users need to use phones all the time.

d. The displayed information

The content applied in the final design comes mostly from what the library currently has in the database. Besides the basic information to let users know what is a book about, the additional information like reviews and historic loan information worked quite well to satisfy users. Yet there's a potential to make use of users' book reading and browsing history data to assist users' book discovery journey by an algorithm.

Limitations

Fidelity of the prototype

Since it's not feasible to create the content for every book in the library and the test area was at the young adult sections only, the influence caused by the different preference of books can not be ignored. This is essential in this project because what can deeply spark users' interest and serendipitous experience in encountering books is the content of books. An ideal test situation can be like what Thudt et al.(2012) did that they developed a data base containing hundreds of books.

Both the exploration part and the browsing part were made in simulation of augmented reality. Participants were not able to try the interaction between the digital world and the real world freely. This limitation definitely effected how participants react to three design qualities especially for the exploring part of the final design.

Long-term test

The evaluation test was done in a short time, it's a fresh experience for participants to try at that moment. This feeling of trying something new may lead to relatively positive results especially when it comes to qualities fascinating and playful. Further researches are still needed to evaluate if the direction of final design can work to be an appreciated optional book discovery choice in the long term.

Participants

Due to covid situation, at the research phase of this project, the public library was closed for a long time. It's not easy to find participants who have the similiar experience in discovering books in a public community library in a small town in Netherlands. Before the evaluation test, both the user research and the iteration test were done with participants who have master degree or are doing master degrees from WO. At the evaluation test, participants had the educational background of MBO and HBO. The difference in educational background might influence their perception of the design concept.

Also the amount of participants was a bit too few especially for the quantitive evaluation that the evaluation results I have got might be biased. The evaluation results were quite positive yet during the iteration test phase, more critical feedback were gathered. It is valuable to test with more participants to be less biased.

Recommendation

Application of data

As mentioned in the evaluation results, in order to explore how to offer more fascinating content to library members, researches on users' data collection and usage are valuable to conduct. Based on users' reading preference, the design can pop up and recommend books that are more relevant to individuals. This can help to build connection between books and users' past experience and knowledge about reading, and thus facilitate serendipity to next step.

Relation between space and interaction

The interior space in this project was mainly involved as a design ingredient to serve. Researches and designs about the influence on the interior space that the AR application in this project can have can be done. Following the direction of this project, new forms of technology and medium can be integrated to the physcial library. Since the architecture or interior space is designed to serve the human activities, it's crucial for the space to deal with the new interactions such as the layout of bookshelves.

Further test

As mentioned in the limitations, more tests with more participants with different educational background to figure out if there's different needs between these groups of people in terms of a serendipitous book discovery experience. Also the fidelity of the prototype can be improved with augmented reality. I would assume the evaluation results of fascinating and playful can become more positive and new insights about applying AR to the physical public library can be gathered as well.

Reflection

The graudation project was a long-running and individual work. It's more complex than I had thought before. I can still remember the day when I went to the library in Stede Broec and had the talk with Ruud and Sandra for the first time. When I look back to the journey of this project, I find that I have learned a lot both about the topic of the project and how to be a designer.

During the discover phase of this project, due to the covid situation, I was not able to do field research to learn about the current book discovery behavior. This limitation led me to ask literature for help. At first the research progress was chaotic that I didn't know where's the direction and what's my research question. After exploring a bit, it became more and more clear and I found the theoratical base of book discovery is information seeking. When I reflect on this phase, I find it's not that complicated to define my research questions and thus find a way out. I have learnt that I should notice if I am stuck or not and take a step back to look at the goal of the project, the target of the deliverable, and the context. Hurrying to do stuff can only consume one's energy and passion with making little progress.

When I had no clue how to deal with the user research results, applying the framework of serendipity theory into the analysis of the user research findings was another knowledge that I have learnt during the discover phase.

Talking about the design outcome, although it does have some influence on the current interior space and how people interact with it, the research and design about the space itself is far from what I expected in the project brief. I only made use of the current space qualities to serve my design and failed to learn something the other way around. This is partly because the limitation of a graduation project that one can't be too ambitious and also because of my abilities limitation. Yet I am still glad that the client Ruud, Sebastian, Sandra, and Paula from Westfriese Bibliotheken are satisfied with the final design outcome. It's both glad for me to know the design outcome is possible to implement regarding technology abilities and to integrate with the current mobile app of the library.

This project also let me know my weakness and it's a great lesson for me to learn. I have found that my project management skill is not good enough to ensure making continuous progress. This had also led to several periods of stuck in depression especially when I was doing an independent project under the covid situation. The communication with either supervisors or clients was not enough. What I have learnt is that there's always someone you can ask for help, the key is to understand what kind of problems I have and face up to difficulties, seek solutions to solve them.

Finally, I hope that the research findings and design outcome can help Westfriese Bibliotheken to create a new and serendipitous book discovery experience for young adults and even other age groups.

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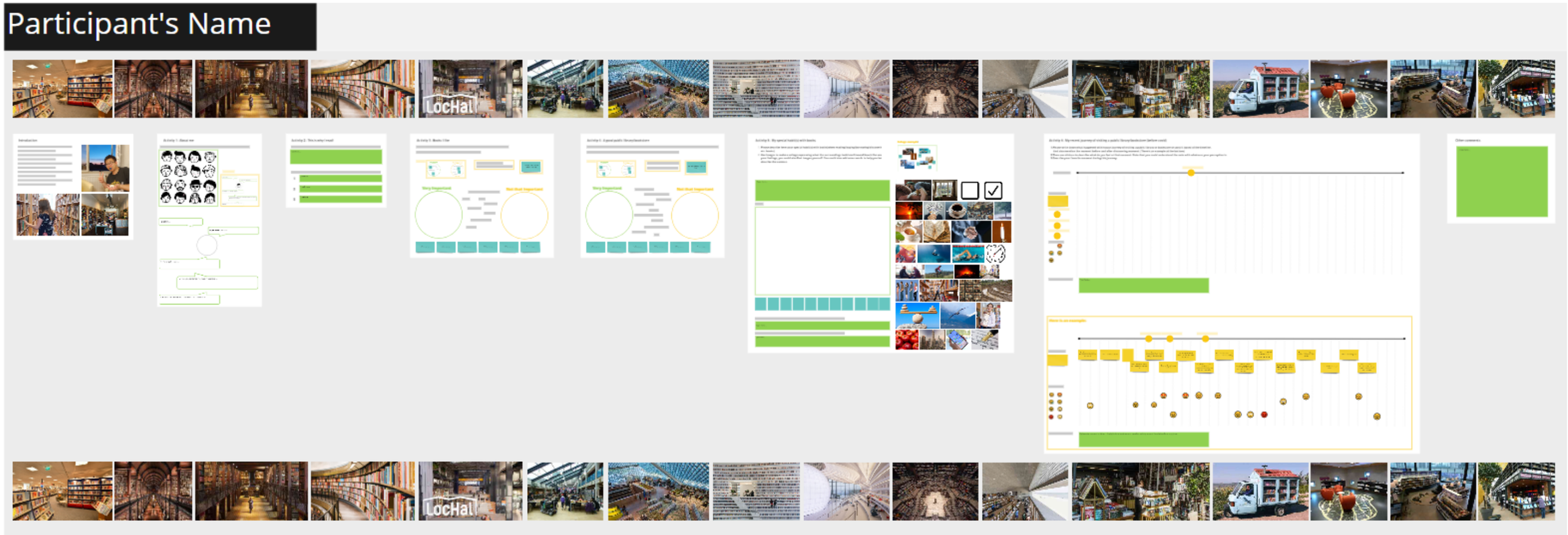
Appendices

Overview of the online booklet for contextmapping



The online booklet for contextmapping

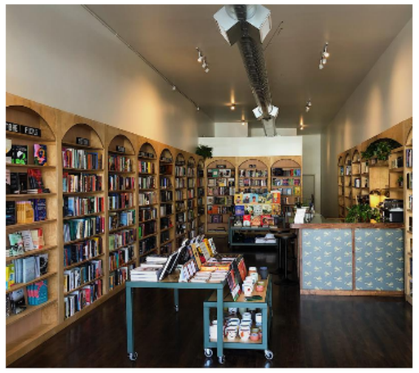
Introduction

Hallo! I'm Junyao, a second year Design for interaction student from the faculty of industrial design engineering in TU Delft. This research is for my graduation project which is to explore a new way to discover books in public libraries in Stede Broec. This study is to get you involved in the vibe of this topic and ready for the coming contextmapping session(an user research method). In the session we will talk about your personal experience with discovering books.

There are 6 activities in total and note that there is no wrong answer at all and all your insights would be valuable to this project since you are the expert of your own experience. There are stickers/images included that may help you do the activity. The information gathered in this research would be used in the graduation project "Explore a new way to experience books" for inspiration and fundation of the design phase.

If there is any questions, do not hesitate and contact me through email.
leejunyao518@gmail.com

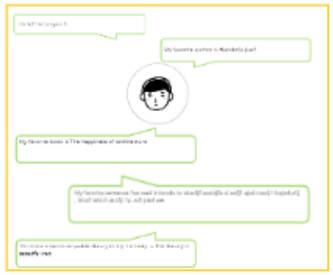
Best,
Junyao



Activity 1 : About me

Please introduce your book world! You could pick an avatar you like and put it into the circle.

Example:



Hallo! I'm ...

My favorite author is ...

My favorite book is ...

My favorite sentence I've read in books is: ...

The most impressive public library in my memory is: ...

The online booklet for contextmapping

Activity 2 : This is why I read!

Do you think it's important to read in your life? why?

Type here...

What are your 3 best moments when you spend time on books? And which book was that?

1 Type here...

2 Type here...

3 Type here...

Activity 3 : Books I like

What do you think is very important and not that important for a book?

1. **Drag the attribute word to the circle which you think belongs to.**
2. **Try to indicate the book title related to the word. (attribute word: book title)**
3. **You could Use post-its to write more.**

Example:

Relaxing value: Harry potter
Author: The essays on the sidom of life

Ratings: One Hundred Years of Solitude

Very Important

Not that important

Place of the book within its genre

Theme **Author**

Cultural value

Relaxing value

Appearance

Quality of the content

Easy to get

Write more... Write more... Write more... Write more... Write more... Write more...

The online booklet for contextmapping

Activity 4 : A good public library/bookstore

What do you think is very important and not that important for a public library/bookstore?

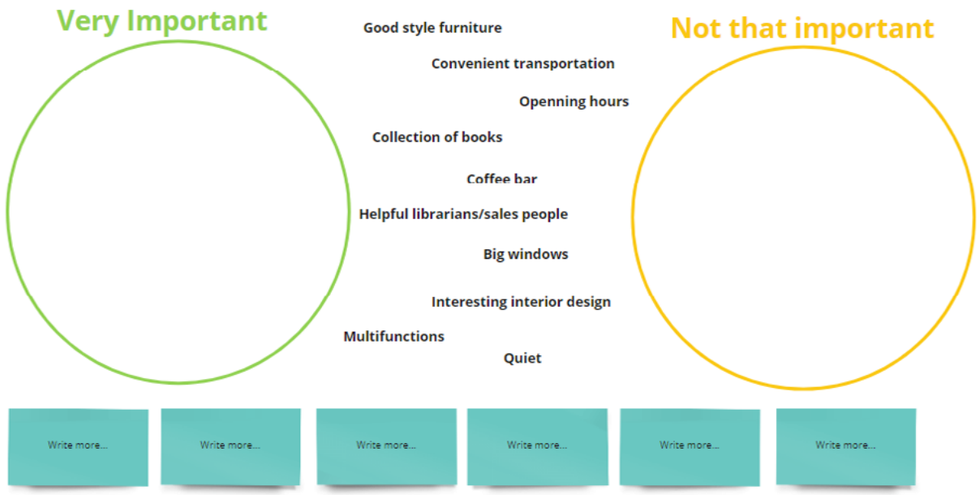
1. **Drag the attribute word to the circle which you think belongs to.**
2. **Try to indicate the name of the library or bookstore related to the word. (attribute word: the name of the library/bookstore)**
3. **You could Use post-its to write more.**

Example:

Interesting interior design: Lochal

Multifunctions: Dok

Easy to find books: Tianjing library



Activity 5 : My special habit(s) with books

1. **Please describe here your special habit(s) with books(when reading/buying/borrowing/discovering etc. books).**
2. **Use images to make a collage expressing what the surroundings look/smell/sound/touch like and your feelings, you could also find images yourself. You could also add some words to help you better describe the context.**

Collage example

Type here...

Collage

For how long do you have this habit(s)?

Type here...

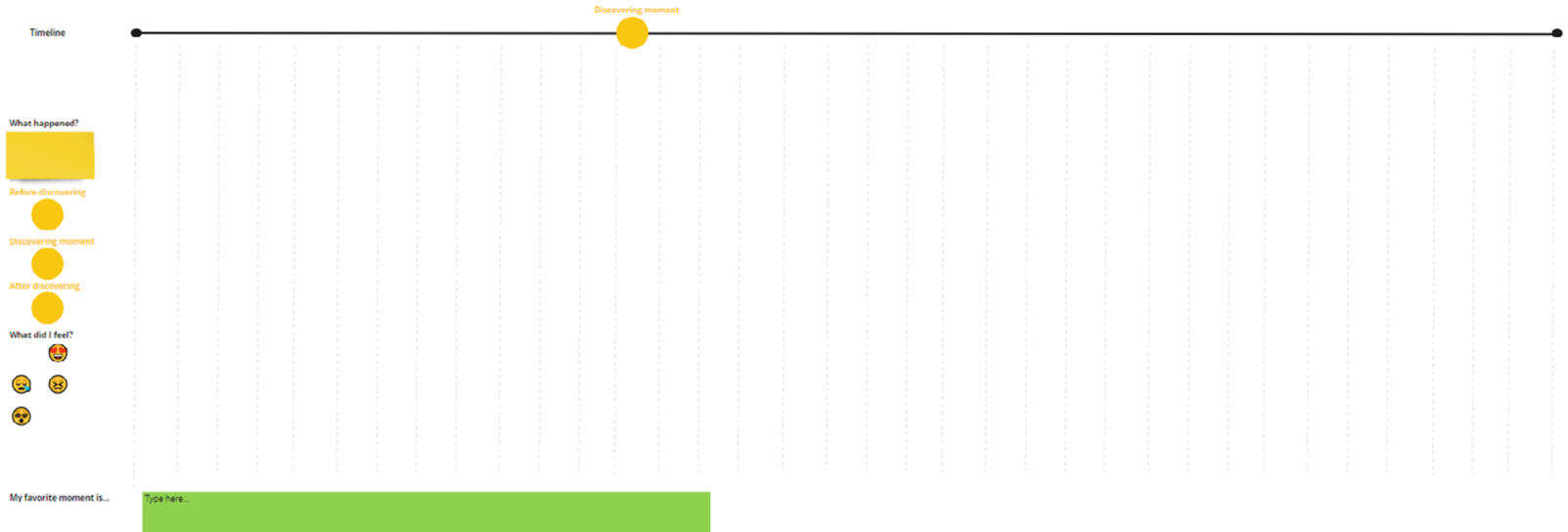
When was the last time something changed? What has changed?

Type here...

The online booklet for contextmapping

Activity 6 : My recent journey of visiting a public library/bookstore (before covid)

1.Please write down what happened within your journey of visiting a public library or bookstore on post-it based of the timeline.
And also mention the moment before and after discovering moment.(There's an example at the bottom)
2.Then use stickers to describe what do you feel at that moment. Note that you could understand the note with whatever your perception is.
3.Describe your favorite moment during this journey.



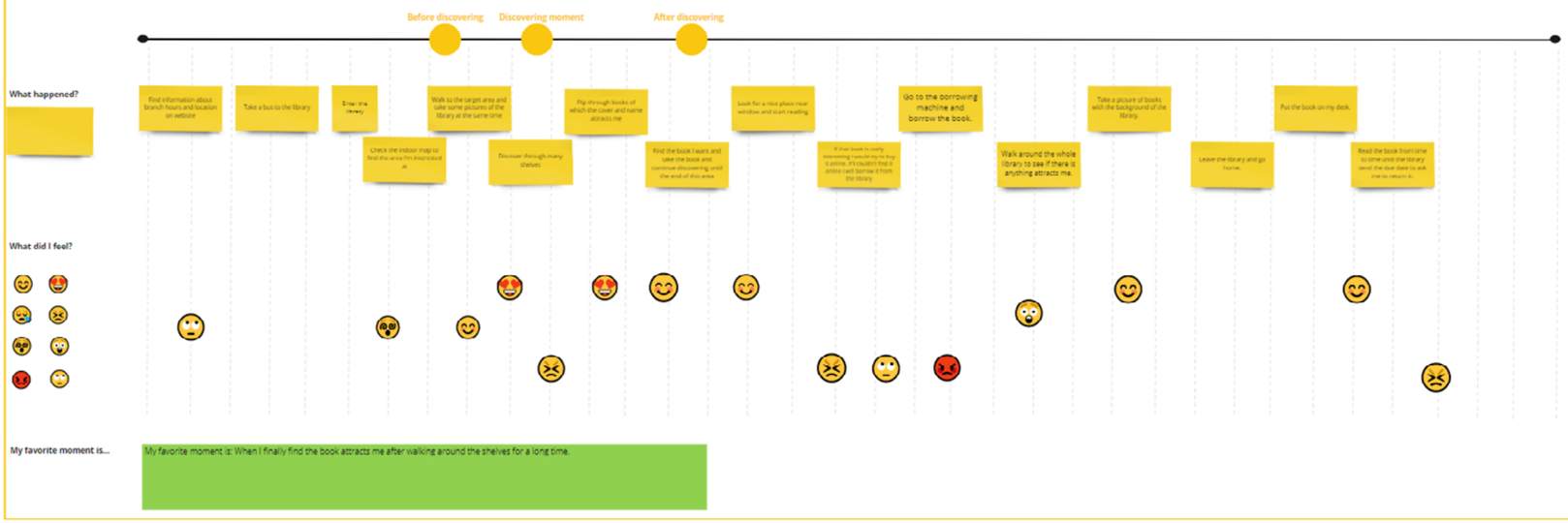
My favorite moment is...

Type here...

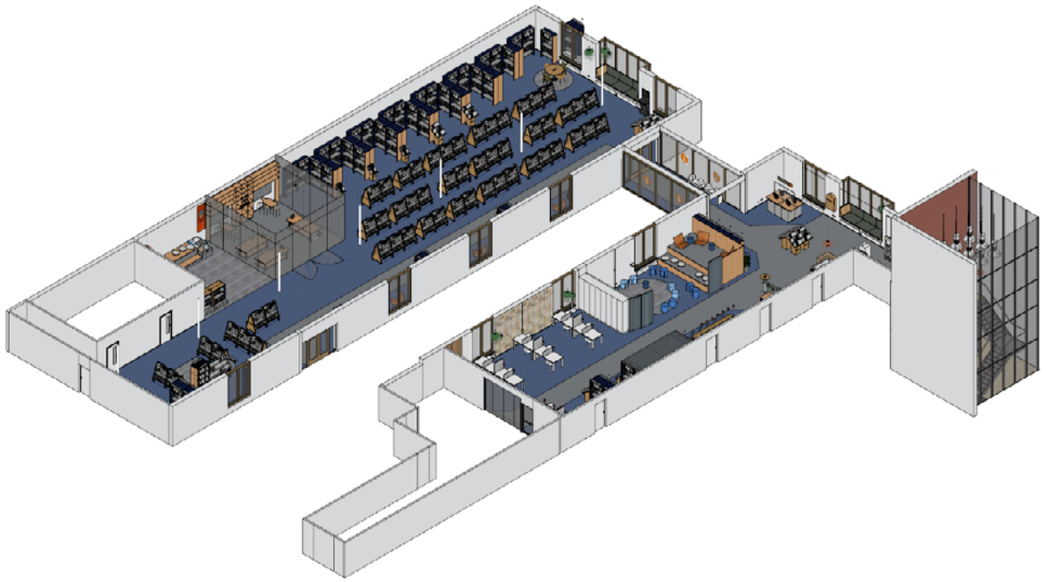
Other comments

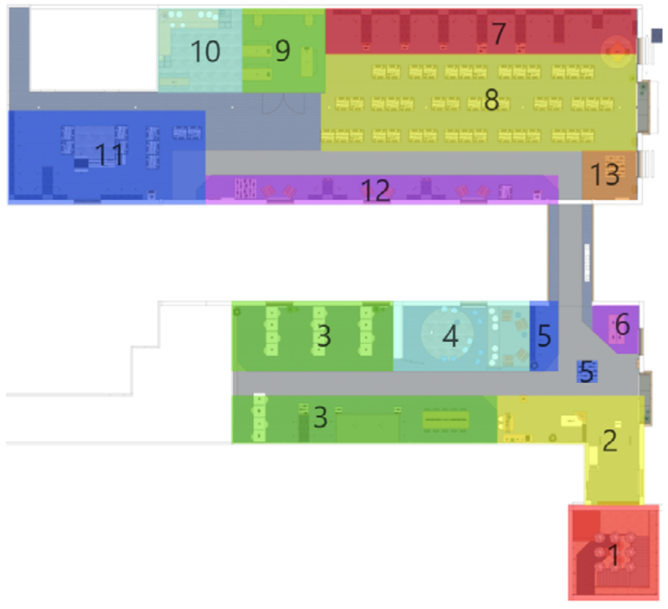
Type here...

Here is an example:



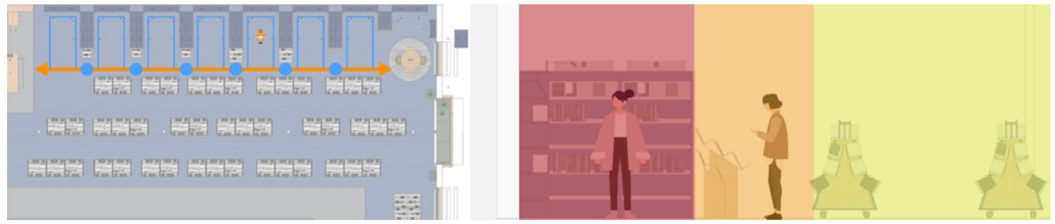
Interior space analysis of the library in Stede Broec

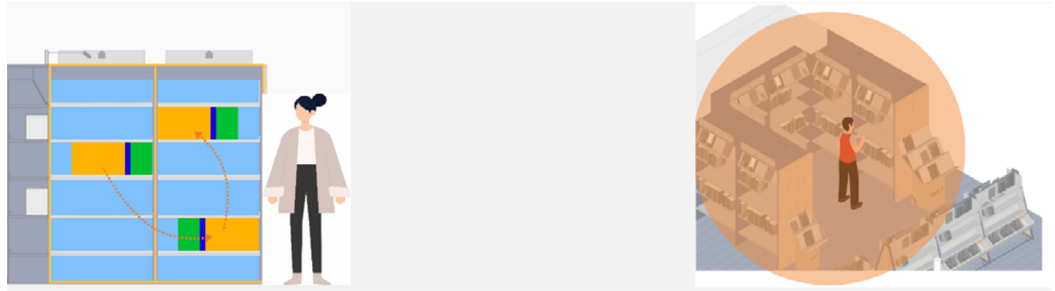




7 Knowledge & information books
8 Thrillers, literature, and romance books
9 Digital lab
10 Kid's wonderland
11 Children's books
12 CD, sheet music, books for low eyesight people
13 Comics

1 Entrance
2 Reception
3 Study and work place, magazinges and newspapers
4 Public activity place
5 Reservation shelf
6 Self-service





The consent form for user research

Consent Form for [*Explore a new way to discover physical collections in the library*]

Introduction

This interview is for the research of current ways how young people make use of the library for the Design for interaction master's graduation project "explore a new way to discover physical collections in the library" from the faculty of industrial design and engineering in TU delft. There would be no risks at all during the interview.

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [10/05/2021], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves [an audio-recorded interview, a generative session, pictures of the session with my face blurred, the collage materials]	○	○
I understand that information I provide will be used for [the graduation project report in the form of transcript in appendix and quotes in the research phase]	○	○
I agree that my information can be quoted in research outputs	○	○
Future use and reuse of the information by others		
I give permission for the [*audio-recorded interview, anonymised transcripts and quotes, pictures of the session with my face blurred, the collage materials*] that I provide to be archived in [*Explore a new way to discover physical collections in the library*] so it can be used for future research and learning.	○	○

Signatures

Name of participant [printed]	_____ Signature	_____ Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Junyao Li	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: [*Junyao Li, +31 0645206210, leejunyao518@gmail.com*]

The consent form for iteration test

Consent Form for [*Explore a new way to discover physical collections in the library*]

Introduction

This interview is for the research of current ways how young people make use of the library for the Design for interaction master's graduation project "explore a new way to discover physical collections in the library" from the faculty of industrial design and engineering in TU delft. There would be no risks at all during the interview.

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [10/05/2021], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves [an audio-recorded interview, a generative session, pictures of the session with my face blurred, the collage materials]	○	○
I understand that information I provide will be used for [the graduation project report in the form of transcript in appendix and quotes in the research phase]	○	○
I agree that my information can be quoted in research outputs	○	○
Future use and reuse of the information by others		
I give permission for the [*audio-recorded interview, anonymised transcripts and quotes, pictures of the session with my face blurred, the collage materials*] that I provide to be archived in [*Explore a new way to discover physical collections in the library*] so it can be used for future research and learning.	○	○

Signatures

Name of participant [printed]	_____ Signature	_____ Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Junyao Li	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information: [*Junyao Li, +31 0645206210, leejunyao518@gmail.com*]

The consent form for evaluation test

Consent Form for [*Explore a new way to discover physical collections in the library*]

Introduction

This test is for the research of current ways how young people make use of the library for the Design for interaction master's graduation project "explore a new way to discover physical collections in the library" from the faculty of industrial design and engineering in TU delft. There would be no risks at all during the interview.

Please tick the appropriate boxes	Yes	No
Taking part in the study		
I have read and understood the study information dated [22/07/2021], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves [an audio-recorded interview, pictures of the test with my face blurred]	○	○
I understand that information I provide will be used for [the graduation project report in the form of transcript in appendix and quotes in the research phase]	○	○
I agree that my information can be quoted in research outputs	○	○
Future use and reuse of the information by others		
I give permission for the [an audio-recorded interview, pictures of the test with my face blurred] that I provide to be archived in [*Explore a new way to discover physical collections in the library*] so it can be used for future research and learning.	○	○

Signatures

Name of participant [printed] _____ Signature _____ Date

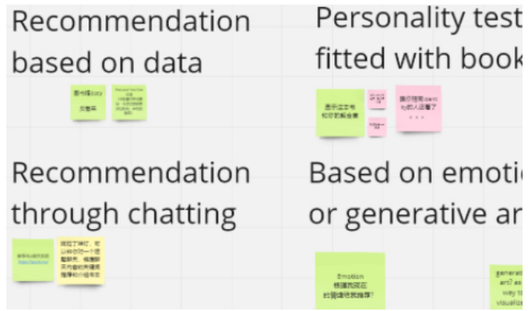
I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Junyao Li

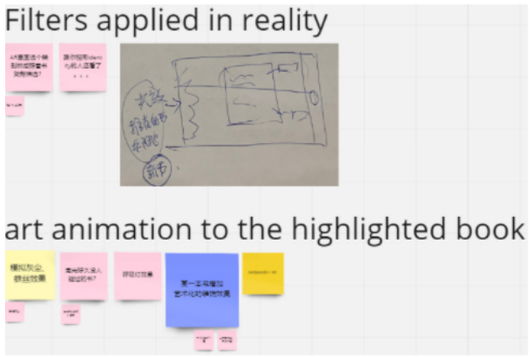
Researcher name [printed] _____ Signature _____ Date

Study contact details for further information: [*Junyao Li, +31 0645206210, leejunyao518@gmail.com*]

Idea clusters



Smart and playful recommendation system



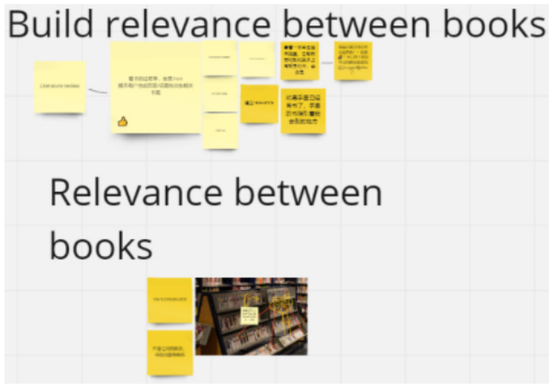
Filters in reality and highlight books with art animation

Indirect and non-instant interaction between strangers

Haptic vibration searching experience

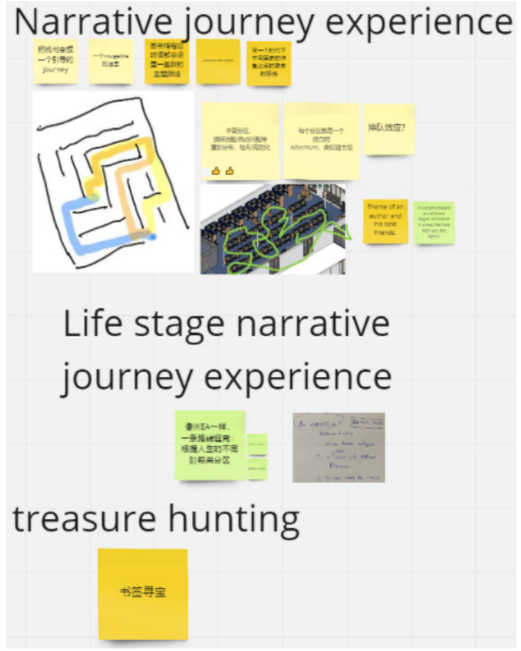
Motivate people to look down via interaction between motion and art animation

Visualization of the book content ahead of reading it

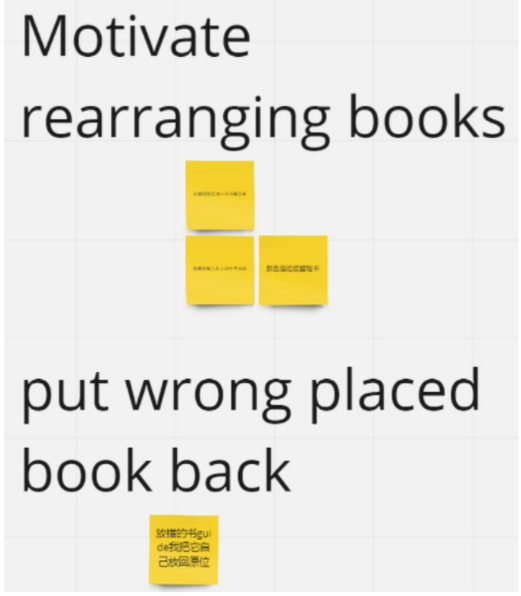


Display relevance between books not only in content but also a visual clue

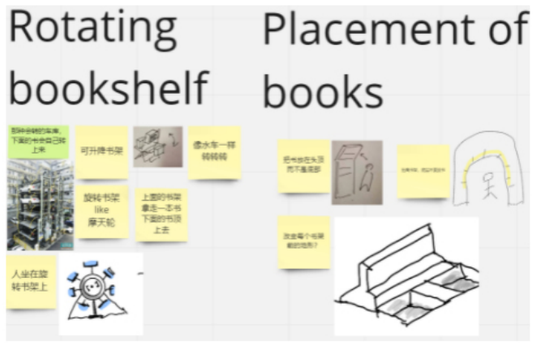
Multisensory experience



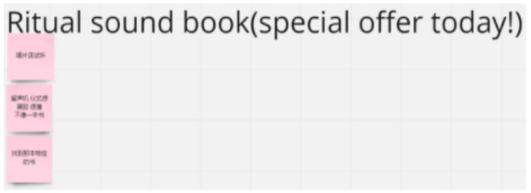
Theme-related narrative journey experience



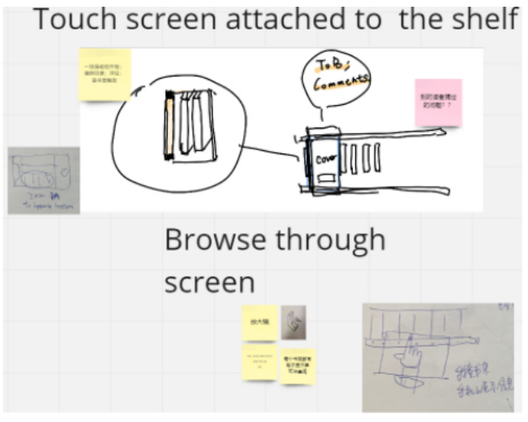
Place the book into the right category game experience



Move books to eye-level



Interactive try-out installation



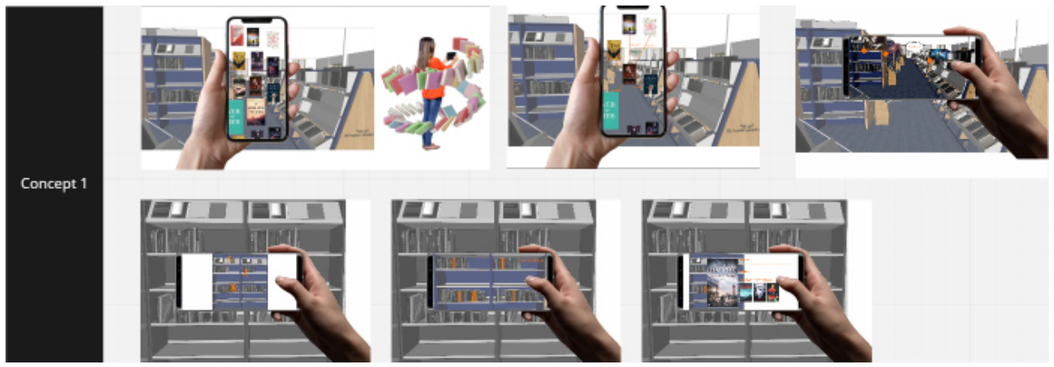
Touch screen attached to the bookshelf, working like a magnifying glass

AR scan the book and someone shows up and talk about the book

Initial concepts and evaluation results

Concept 1 description
Concept 1 is an app on the phone which could create an immersive world of books for users by applying the technology of marker-based and location-based augmented reality. Users can check books from bookshelves nearby with a feeling of standing inside a storm of books. Users could choose one specific book by touch it virtually and the app would show detailed information about this book and other books related to it based on the keywords. In navigation mode, users could follow the guidance by this app to explore books inside the library and seeing visual representatives or reviews by other customers. When the user is standing in front of a bookshelf, he could use the app as a tool to browse books on the bookshelf to know more detailed information or filter the books. The animation would show on the screen to guide people's attention towards the lower part of the bookshelf to add more fun and make those books get more attention from users.

Desired effects on the user
I would like the users to enjoy this interesting interaction in which real books and virtual books are mingled together and play with the books. I want them to feel fascinated by the connection between books and the journey of exploring books. Also, I hope the navigation mode could offer them a feeling of being invited to explore different books and others' reviews shown on the screen could inspire them to explore.



Evaluation results

Pros:
+ It's a new way to explore books by working together with the physical space which could make the library space more vivid instead of picking books one by one.

+ Walking around and spinning around to see more books can invite people to explore further.
+ The connection lines, interesting interaction, and voice conversation give people the feeling of inviting.
+ Other customers' review is a high motivational trigger to facilitate exploration.
+ Animation when people touch the book makes it more interactive and lets people feel more playful.

Cons:
- The way of interaction is inviting but not the content.
- There are still some books that would be ignored because of the same eye-level problem.
- The efficiency of showing information is doubted since the screen is relatively small to contain many books.
- A starting point is missing here to motivate people to use this concept.
- How does the animation on the bookshelf work is still vague. A connection between the animation and the content should be built such as showing the connection between different books.
- Maybe it could distract you from real books since it really draws your eyes.

Suggestions:
Show how the recommendations are made to let users know this app knows me.

The animation of the little man on the shelf could work as a guide or IP of the library. The emotional connection would help to build trust to guide users to find something new.

In order to make the animation less likely to be bored, it could be made with theme months, festivals, or people could choose their own character.

The connection with phones could have huge potential to develop an entire service such as borrowing books.

Concept 2 description
Concept 2 is a projection-based augmented reality in which users could explore books being free of holding a device in hand. The information about books on the bookshelf would be projected on the ground or side of the bookshelf, for instance, one character from Harry potter saying a quote. In this way, the projection could seduce people's attention and make books more alive. When the user is browsing through the bookshelf, he could point at a specific book and the image of the cover would be projected on the book spines which work as a canvas. Also, highlight on the books could be done to offer more guidance for users when they are browsing. When the user puts a book back on the shelf, a projection showing related books would follow the user on the ground as navigation to facilitate further exploration.

Desired effects on the user
I would like the users to feel engaged and immersed in the discovery experience where they could be inspired by the additional information offered by this concept while keeping the original physical interaction as much as possible without other devices interrupting. By doing so, I hope users could also have the chance to notice books passing by

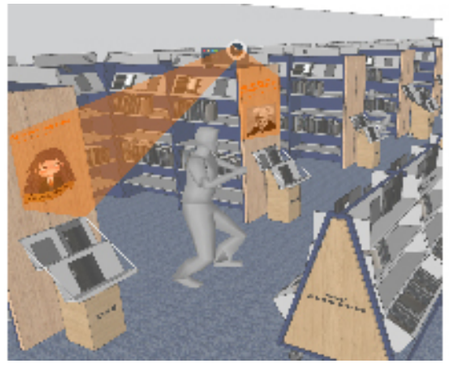
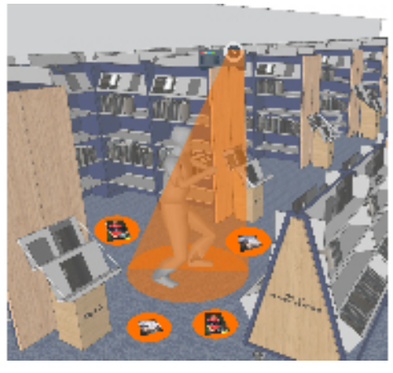
Evaluation results
Pros:
+ The projection on the side of the bookshelf is vivid, self-explaining, and would spark people's curiosity to be invited to explore.
+ The way of sliding through book spines is playful and could motivate people to explore more.
+ This concept could get rid of using a phone as a good point compared to the other two concepts.
+ Asking questions by the projection could give users a feeling of involvement.
+ Participants feel inviting by following the guidance.
- The projection would be chaotic if there are several people next to each other.
- A connection between the projection and next-step guidance is missing.
- The projection of a book cover is not enough to motivate people to explore.

Cons:
- A control is needed to activate the projection about related books to avoid overwhelming.
- The projection should not highlight users who make them feel uncomfortable in the library.
- A starting point like projection showing the cover and moving around is needed to indicate this interaction and create the feeling of inviting.

- The projection should not highlight users who make them feel uncomfortable in the library.
- A starting point like projection showing the cover and moving around is needed to indicate this interaction and create the feeling of inviting.
- The projection would be chaotic if there are several people next to each other.
- A connection between the projection and next-step guidance is missing.
- The projection of a book cover is not enough to motivate people to explore.

Suggestions:
The logic of highlighting books could be more creative and interactive such as highlighting books that are read least or most and the projection would react when people put the book back to the shelf or take the book out.

More interaction could happen here such as tapping the book twice and the related books would be highlighted.

Concept 3 description
Concept 3 is a tool and the main feature of this concept is when the user is pointing at a certain book, the information such as book cover, others' review, videos, etc. would show on the phone on the users' wrist. By doing so, users could absorb more information rather than just the title and author name during the browsing process in a quick and intuitive way. It would also help users to browse the books at the lower part of the bookshelf by switching the bar on the bookshelf for the books down at the shelf. Also, a sound about one of the books down at the shelf would be played when the user switch to browse the lower part.

Desired effects on the user
I would like the users to have fun with this playful and intuitive interaction while could be able to receive the information about books in good quality. I hope this concept would be a long-term used tool rather than just a short-term interest.

Evaluation results

Pros:
+ The way of interaction is very intuitive and could help users to browse books.
+ The storytelling is fascinating.
+ The community recommendation makes sense to users.
+ Fascinating and inspiring to read new books.

Cons:
- The layout of information would have a slight conflict with the orientation with the pointing hand.
- The connection between sound and interaction is vague although it is playful indeed.
- No inviting feeling is emphasized in this concept.
- How to browse books at the bottom part of the bookshelf is still a problem.

Suggestions:
Apply the interaction we are used to in a digital environment such as double-tapping on the screen means like on Instagram.

The guidance could have a relation with the content of the book.

It could be combined with the concept of AR.

The reading list could also be given by authors, new coming books, etc. Sound could be implemented e.g. raining sound for books to read during rainy days.

Arduino code for the prototype of browsing part

```
int sensorValuea = A0;
int sensorValueb = A1;
int sensorValuec = A2;
int x1 = 0;
int y1 = 0;
int x2 = 0;
int y2 = 0;
int x3 = 0;
int y3 = 0;

void setup()
{
  Serial.begin(9600);
   pinMode(sensorValuea,
INPUT);
   pinMode(sensorValueb,
INPUT);
   pinMode(sensorValuec,
INPUT);
}

void loop(){
      int a =
analogRead(sensorValuea);
      int b =
analogRead(sensorValueb);
      int c =
analogRead(sensorValuec);

    if (a > 10) {

   if (a > 900) {
      x1 = 1;
    if (y1 != x1) {
      Serial.println("<a1>");
    }
   }

   if (a < 700 && a > 400) {
    x1 = 2;
    if (y1 != x1) {
      Serial.println("<a2>");
    }
   }

   if (a < 400 && a > 300) {
    x1 = 3;
    if (y1 != x1) {
      Serial.println("<a3>");
    }
   }

   if (a < 300 && a > 200) {
    x1 = 4;
    if (y1 != x1) {
      Serial.println("<a4>");
    }
   }

   if (a < 200 && a > 160) {
    x1 = 5;
    if (y1 != x1) {
      Serial.println("<a5>");
    }
   }

   if (a < 160 && a > 130) {
    x1 = 6;

    if (y1 != x1) {
      Serial.println("<a6>");
    }
   }

   y1 = x1;


  if (b > 10) {

   if (b > 900) {
      x2 = 1;
    if (y2 != x2) {
      Serial.println("<b1>");
    }
   }

   if (b < 700 && b > 400) {
    x2 = 2;
    if (y2 != x2) {
      Serial.println("<b2>");
    }
   }

   if (b < 400 && b > 300) {
    x2 = 3;
    if (y2 != x2) {
      Serial.println("<b3>");
    }
   }

   if (b < 300 && b > 200) {
    x2 = 4;
    if (y2 != x2) {
      Serial.println("<b4>");
    }
   }

   if (b < 200 && b > 160) {
    x2 = 5;
    if (y2 != x2) {
      Serial.println("<b5>");
    }
   }

   if (b < 160 && b > 130) {
    x2 = 6;

    if (y2 != x2) {
      Serial.println("<b6>");
    }
   }

}

y2 = x2;

  if (c > 10) {

if (c > 900) {
     x3 = 1;
  if (y3 != x3) {
    Serial.println("<c1>");
  }
}

if (c < 700 && c > 400) {
  x3 = 2;
  if (y3 != x3) {
    Serial.println("<c2>");
  }
}

if (c < 400 && c > 260) {
  x3 = 3;
  if (y3 != x3) {
    Serial.println("<c3>");
  }
}

if (c < 300 && c > 200) {
  x3 = 4;
  if (y3 != x3) {
    Serial.println("<c4>");
  }
}

if (c < 200 && c > 150) {
  x3 = 5;
  if (y3 != x3) {
    Serial.println("<c5>");
  }
}

if (c < 150 && c > 120) {
  x3 = 6;
    if (y3 != x3) {
      Serial.println("<c6>");
    }
   }
  }
    y3 = x3;

delay(50);
}
```

SUS form for evaluation test

System Usability Scale (SUS)

This is a standard questionnaire that measures the overall usability of a system. Please select the answer that best expresses how you feel about each statement after using the website today.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1. I think I would like to use this design frequently.	☐	☐	☐	☐	☐
2. I found the design unnecessarily complex.	☐	☐	☐	☐	☐
3. I thought the design was easy to use.	☐	☐	☐	☐	☐
4. I think that I would need the support of a technical person to be able to use this design.	☐	☐	☐	☐	☐
5. I found the various functions in this design were well integrated.	☐	☐	☐	☐	☐
6. I thought there was too much inconsistency in this design.	☐	☐	☐	☐	☐
7. I would imagine that most people would learn to use this design very quickly.	☐	☐	☐	☐	☐
8. I found the design very cumbersome to use.	☐	☐	☐	☐	☐
9. I felt very confident using the design.	☐	☐	☐	☐	☐
10. I needed to learn a lot of things before I could get going with this design.	☐	☐	☐	☐	☐

How likely are you to recommend this design to others? (please circle your answer)

Not at all likely 0 1 2 3 4 5 6 7 8 9 10 Extremely likely

AttrakDiff form for evaluation test

human*	○	○	○	○	○	○	○	technical
isolating*	○	○	○	○	○	○	○	connective
pleasant*	○	○	○	○	○	○	○	unpleasant
inventive*	○	○	○	○	○	○	○	conventional
simple*	○	○	○	○	○	○	○	complicated
professional*	○	○	○	○	○	○	○	unprofessional
ugly*	○	○	○	○	○	○	○	attractive
practical*	○	○	○	○	○	○	○	impractical
likeable*	○	○	○	○	○	○	○	disagreeable
cumbersome*	○	○	○	○	○	○	○	straightforward
confusing*	○	○	○	○	○	○	○	clearly structured
repelling*	○	○	○	○	○	○	○	appealing
bold*	○	○	○	○	○	○	○	cautious
innovative*	○	○	○	○	○	○	○	conservative
dull*	○	○	○	○	○	○	○	captivating
undemanding*	○	○	○	○	○	○	○	challenging
motivating*	○	○	○	○	○	○	○	discouraging
novel*	○	○	○	○	○	○	○	ordinary
unruly*	○	○	○	○	○	○	○	manageable
stylish*	○	○	○	○	○	○	○	tacky
predictable*	○	○	○	○	○	○	○	unpredictable
cheap*	○	○	○	○	○	○	○	premium
alienating*	○	○	○	○	○	○	○	integrating
brings me closer to people*	○	○	○	○	○	○	○	separates me from people
unpresentable*	○	○	○	○	○	○	○	presentable
rejecting*	○	○	○	○	○	○	○	inviting
unimaginative*	○	○	○	○	○	○	○	creative
good*	○	○	○	○	○	○	○	bad

DESIGN FOR our future

4780

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME
Save this form according the format "IDE Master Graduation Projec: Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name	Li		
initials	J.L	given name	Junyao
student number	4815130		
street & no.	.		
zipcode & city	.		
country	.		
phone	.		
email	.		

Your master programme (only select the options that apply to you):

IDE master(s): ( ) IPD ( ) ★ DfI ( ) SPD

2nd non-IDE master:

individual programme: - - (give date of approval)

honours programme: ( ) Honours Programme Master

specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **
Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair	Prof.dr.ir. A. Bozzon	dept. / section:	SDE/IoT
** mentor	Prof. dr. Stappers, P.J.	dept. / section:	HCD/DCC
2nd mentor	Ruud Wierenga		
	organisation: westfriesebibliotheken		
	city: Bovenkarspel	country:	Netherlands

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Prof.dr.ir. A. Bozzon date 02 - 03 - 2021 signature

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 32 EC
Of which, taking the conditional requirements into account, can be part of the exam programme 32 EC
List of electives obtained before the third semester without approval of the BoE

(X) YES all 1st year master courses passed
( ) NO missing 1st year master courses are:

name J. J. de Bruin date 04-03-2021 signature JdB

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: (V) APPROVED ( ) NOT APPROVED
Procedure: (V) APPROVED ( ) NOT APPROVED
comments

name Monique von Morgen date 16/3/2021 signature MvM

Personal Project Brief - IDE Master Graduation

Explore a new way to experience books — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 19 - 02 - 2021 21 - 07 - 2021 end date

INTRODUCTION **
Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Context:
Libraries play a fundamental role to serve knowledge, culture, and education in society for people to learn and also help ensure an authentic record of knowledge created and accumulated by past generations. Not only a place to store books, magazines, or newspapers, libraries are also changing from a storage place to a social hub in local society offering courses, meetings, exhibitions, etc. which become more and more attractive. However, in recent years, public libraries seem to be less attractive. The library in Stede Broec is involved in this project which sees itself a community library that currently offers a coffee bar, programming knowledge, reading, study place, and space for public activities such as presentations and workshops. They are facing a problem that fewer people come to libraries especially young adults(18-25). Libraries want more people to come and stay there (currently most of the members are people under 18 and over 40). To solve that problem, Westfriese Bibliotheken would like to take Bibliotheek Stede Broec as an example to explore a new way to experience books which could make a change to attract young adults.

Stakeholders:
- Westfriese Bibliotheken: They serve as the client in this graduation project and would like to improve the reading experience to attract young adults to come to the library. The employees such as librarians, youth program managers would be seen as stakeholders too.
- Young adults(18-25 years old people) who read but seldom go to the library: The survey outcomes indicated that among participants who never visit the library, the most prevalent reason for not doing so as they got their books elsewhere. Approximately 28 percent of respondents had another place where they get books, while 21 percent did not read or enjoy reading(Amy Watson,2020). Thus in this project, the young adults who read would be the target group to design for. As the Internet develops, it becomes easier for people to get access to what they want to know and this group of people's approach to creating and accessing information is substantially different from those who came before them. Lack of time could be another reason and thus the library is less attractive than before. The project outcome is expected to attract these people back to the library with a new experience.

Opportunities:
With the help of new media and technology developed nowadays, the experience in the library could be brought to an interesting stage. Last but not least, Westfriese Bibliotheken has a very open mind and is future-oriented as long as the outcome could help.

Limitations:
There would be a challenge which under the current virus situation it would be a bit more difficult to do on-site research/user test and talk to people. Also, libraries are closed from time to time due to the regulations announced by the government to control the virus situation.

Reference:
Statista, 2021 Reasons not to use the library in the Netherlands 2020. Retrieved from https://www.statista.com/statistics/883999/reasons-not-to-use-the-library-in-the-netherlands/

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: 3D model of the library

image / figure 2: Library Stede Broec

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

In order to attract young people who read back to libraries, the main problem would be how to add value to the current library to support young people in their reading experience. In this project, I will focus on exploring how to help young people to explore books when they look for books to read and get access to those books. The reason influencing people's reading choices and motivations why people make that choice would be analyzed to find the opportunity areas.

Besides, after the intervention coming to the relationship between young people and the library, any influences on the space in a library would be discussed, e.g. more space saved for other activities when bookshelves are not needed anymore.

The research questions would be:

1. What's the current situation when people look for and get access to books?
2. What's the current solution offered by libraries?
3. What's the opportunity area that libraries could help?
4. What kind of affinities of young people could be applied in this project?
5. What influence would have on the interior space of libraries and what kind of benefits could be used?

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Design a tool that helps libraries to support young readers to explore books they want to read.

This project aims to create a new exploring books experience for young readers. I would apply human-centered design methods to achieve that goal.

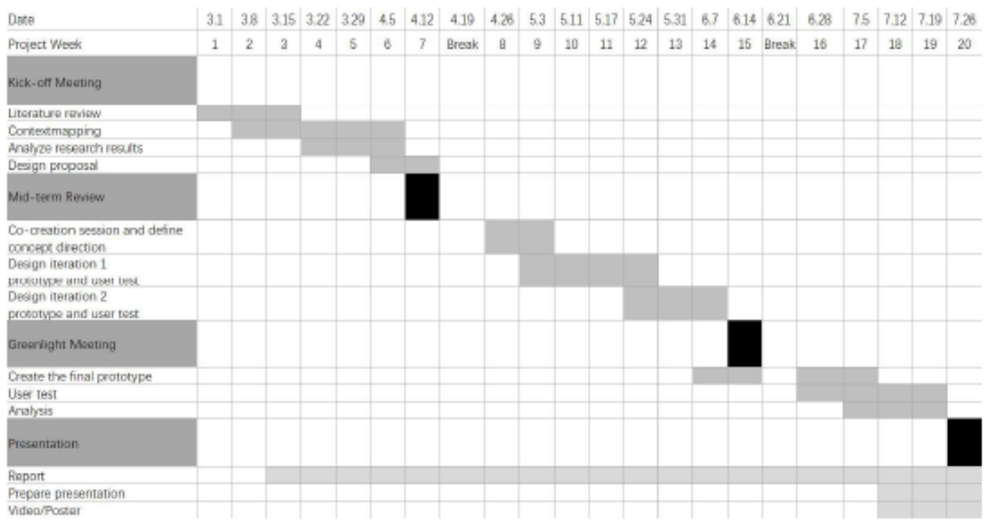
The research would consist of two parts which the first one is a literature review and the second one is generative user research. Literature would be reviewed from several perspectives: how young people access books/information/knowledge, influence on people's decision making. The generative user research would be conducted with interviews on employees working in public libraries, young readers who would go to libraries usually, and young readers who don't. The knowledge of the current and past interaction and experience would be gained through this means.

The design outcome would be a tool to improve the interaction between young readers and books when they explore books. The library would be involved in this interaction to offer support and thus attract young readers back to libraries. Meanwhile, a space design guideline would be structured as a reference as to how could libraries adapt to the influence this intervention would cause to better support young readers.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 19 - 2 - 2021 21 - 7 - 2021 end date



This project would follow the double diamond model with three phases. The first research phase would be focused on understanding the context and users. The next two phases would be generating design concepts, iterating design concepts, and evaluation.

Research: Literature review and company research would be done first. Next for the field research with users, method Contextmapping would play an important role to help the project process as a knowledge gaining guidance, method of analysis, and way of generating a design concept. At the end of this research phase, a more specific design brief with a clear design goal and interaction vision would be generated to guide the next design and evaluation phase.

Design: First an ideation session would be done through co-create to get the first several ideas. Based on those ideas, prototypes would be made to go through user tests and used for iterating design concepts. At the end of this phase, a concrete design concept would be defined for further evaluation.

Evaluation: 6-8 participants will be invited to go through the final evaluation and will experience the new way designed to explore books. Evaluation forms and interviews will be conducted to evaluate the design objectively and subjectively.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

Motivation:
Having a background in architecture design, I am always interested in how would it be influenced by human activities, and thus I have learned DFI to know more about the interaction between people and other stuff. In this project, I would like to explore the possibility if a new interaction would influence the original space or not.

Competence:
The research and design skills I have learned through one and half years DFI could become the basis of what I would encounter in future design challenges. To be more specific, contextmapping(besides C&C I took the elective contextmapping skills to expand this knowledge and practice) and usability/user experience test and evaluation will become an important role in this project.

Learning Ambitions:
- To improve my communication abilities including conveying my design/research ideas especially in the form of a report.
- How to generate suitable design tools or methods to help me in a new and different design challenge.
- To understand the new role of the library in people's life nowadays as digital life is taking more and more space.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.