Design of a data-supported care planning process

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PREFACE

This is a graduation project thesis for my Master study Design for Interaction at Delft university of technology. It documents my journey of this 7 months.

As a design student, I always want to apply my skills in this two years into a real-life project. This project is a good opportunity for my to practice these skills and find out what is still lacking. It requires intensive research and design in the filed of Dementia care with the use of location information.

There are too many thanks to say when the project is about to finish. I want to thank my supervisor team Gerd and Gubing for their guidance and patience. The context is new and quite complex for me at the beginning. They helped me a lot in the field study and inspire me how to find the value of location data.

My gratitude also goes to the care team in Zorgrope Elde. They spare valuable time in their busy work and share with me insight on their work and life. I will surely miss the time there a lot !

During the project, my friends in Delft are also my treasure. We encourage and inspire each other to face the challenges. In the Convi-19 context, their company are very precious. What we have gone through together would be my life-long memory. Without them, I can imagine how hard the 7 months would be.

Last but not least, I want to thank my family in China for their love and support!

Executive summary

BPSD (Behaviour and psychological symptoms of Dementia) is a progressive symptom infecting PwD's well-being and cause stress to care givers. It results from unmet needs in different aspects.

A personalized care plan is demanding to be made iteratively to meeting the individual needs of the each patient. It is made by the care team and guides the care givers to fulfill PwD's needs and manage BPSD.

Location data can reveal contextual information can improve communication. It has been applied in industries like public transportation and commercials. With the revealed information from location data, people can make actionable decisions. While in dementia care, location data bas not been widely applied.

This project investigates the value of location data in nursing home. It begins with literature review around location data and care planning communication. The care planning process is studied to build the structure of what care plan is and main factors affecting communication are identified as the guidance of field study

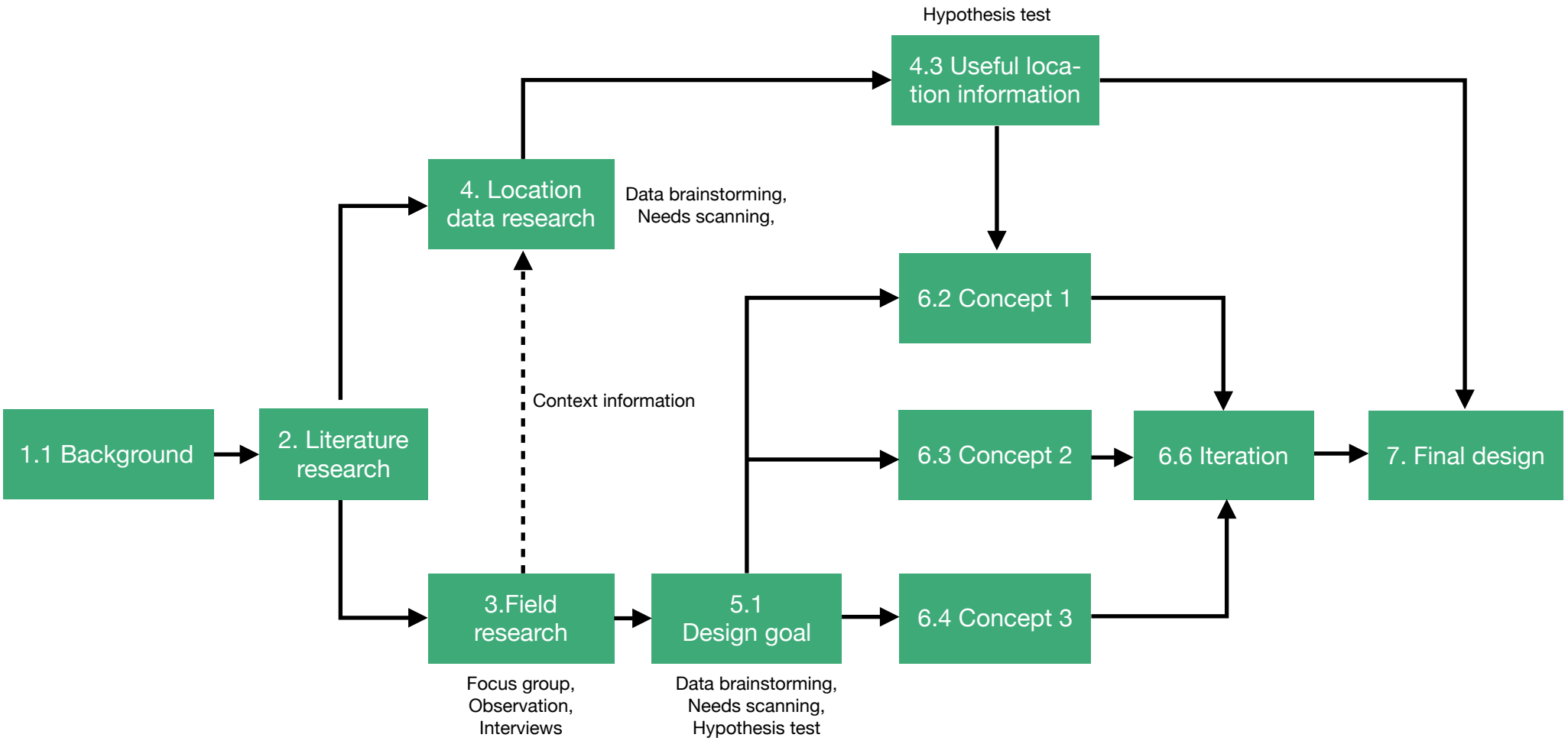
After literature research, two rounds of field research was conducted to understand how the care plan is made in the nursing home. A focus group was firstly held to map out the information systems in the process. Also the unmet needs of the care team communication during the process and opportunities to apply location data are identified. Then interview and observation on the main activities of care planning are done to see how the care team go through all the tasks. The insights are categorized based on influencing factors found from literature.

Parallel research on the insights of location data is also conducted. Three brainstorming sessions are held and small ideas on how the location insights can be used are also generated. More literature research on the the needs of PwD and management of BPSD is done.

Hypothesises are formulated to identify what location insights can actually help the BPSD management in care planning. The hypothesis test proves location information can be helpful in providing a more efficient communication experience in care planning. The needs location data can help address are sleep disorder, stress management, socialization and life safety.

A data analytics platform is design for supporting the caregivers to report and communicate with other care professionals.

Structure of the project



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Chapter 1- Introduction

1.1 Background
1.2 Research questions
1.3 Objective and approach

This chapter describes the project background, objective and approach, research questions and project flow.

1.1 Background

PwD (People with dementia) have several behavioral and mental problems. These include major depression, mania, agitation/ aggression, wandering and apathy. These symptoms are all called Behavior and Psychological Symptoms of Dementia. They are also sensitive to the environment they live in. The symptoms of dementia can also cause problems for the patients themselves as well as their caregivers; especially symptoms such as memory loss and changes in mood or behavior. It is suggested that as much as 65% of caregivers do experience depressive symptoms in the process of care, let alone the physical stress they are facing (Zhang et al., 2019).

A personalized care plan is needed to ensure the maximization of the mental and physical well-being of PwD all time because nursing home residents are heterogeneous in their functional status, underlying diagnoses and goals of car (Colón-Emeric et al., 2017) (Good, 2019). The care plan is the output of the care planning process that explains what care the person is having and contingency plans for the future (England.nhs.uk, 2019). It reflects the views points of different professionals in the care giving team.

Care planning itself is a continuous and planned process rather than a one-off event (England.nhs.uk, 2019). Reviews of the care plan is necessary to ensure the fulfillment of the evolving needs of PwD (England.nhs.uk, 2019). The inter-professional team must communicate clearly to makes sure that caregivers have all the necessary information such as care details, medications, and etc to make care decisions (England.nhs.uk, 2019).

IPS has the potential to assist the communication in caregiving team. It can track data like location and movement of PwD, monitoring whether personnel have been in contact with infectious patients or whether people have been close to infectious sources (Oude Weernink et al., 2018). These data can be used as the proof of a more objective communication in the care giving team and therefor improve their care decision.

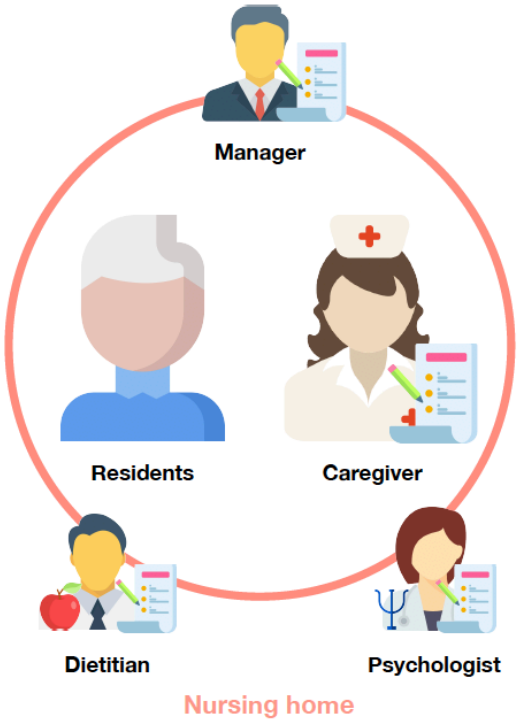
A universal IPS barely exist, the system should meet the specific requirement and user needs in the context (Oude Weernink et al., 2018). In which way the location information can be useful need to be revealed. Issues such as privacy and security also influence the acceptance of IPS (Oude Weernink et al., 2018).

The aim of this project is to explore the application of location data to improve the care planning process with an IPS platform.

The external partner
The project is in collaboration with the high-tech company pinXact and the nursing home Zorgroep Elde.

pinXact is the technology start-up that provides solutions in the areas of indoor positioning systems (IPS). It has developed the tag that can track the location information of the residents and care givers in the nursing home. They want to reveal the insights of the data in nursing home context and also help improve the care service in the nursing home Zorgroep elde. Zorgroep elde is a large-scale nursing home which hosts people with dementia at their moderated to late stages. One of the wards is used as the test field of the tags.

Initial stakeholders
As the initial brief of this project is to improve current care planning process in the nursing home. The assumed stakeholders include PwD who have BPSD, care givers, managers, doctor and psychologist.



1.2 Research questions

RQ 1: How to assist current process of care plan making with the use of the location data?

RQ 1.1: How do the care team make care plan in nursing home Zorggrope Elde?

RQ 1.2: What's the definition of a care plan?

RQ 1.3: How is current care plan making process like in nursing home Zorggrope Elde?

RQ 1.4: What are the reasons for care plan change, especially the factors related to movement and location of the residents?

RQ 1.5: How do the care team communicate to make the care plan?What do they communicate to meet the needs of PwD?

RQ 1.6: How do the team communicate with each other in current process?

RQ 1.7: What are their pain points of communication and how is the desired way of communication like?

RQ 2: What is the value of the location data in Nursing Home?

RQ 2.1: What are the reasons for BPSD?

RQ 2.2: What are the needs and main characteristics of PwDs?

RQ 2.3: What factors cause their emotion and behavior changes?

RQ 2.4: What are the location-related factors that influence their emotion and behavior/care plan change?

RQ 2.5: How do current IPS applications be used to manage PwD?

RQ 2.6: What features/functions do they have?What are the pros and cons of current IPS applications?

RQ 2.7: How to use the data insights to improve current care planning?

RQ 2.8: What kind of the data insights can actually help the care planning process?

RQ 2.9: In what ways the insights can be communicated within the care giving team so that it will improve the care planning?

1.3 Objective and approach

The objective of this project is to explore the value of location data in supporting a better care planning process. Specifically, the insights of the location data and how insights of the data can actually help communication in the care planning process need to be defined. After research, the scope is narrowed done to improve communication in safety management, stress management and sleep management with an IPS platform.

Approach

Double diamond model and participatory design approach are applied in this project.

Discover

The discover phase diverges into two direction: discovering the location data insights and its application to fulfill PwD's needs, and also explore the context and discover unmet need of the care giver. The method applied are focus group, observation and interview.

Define

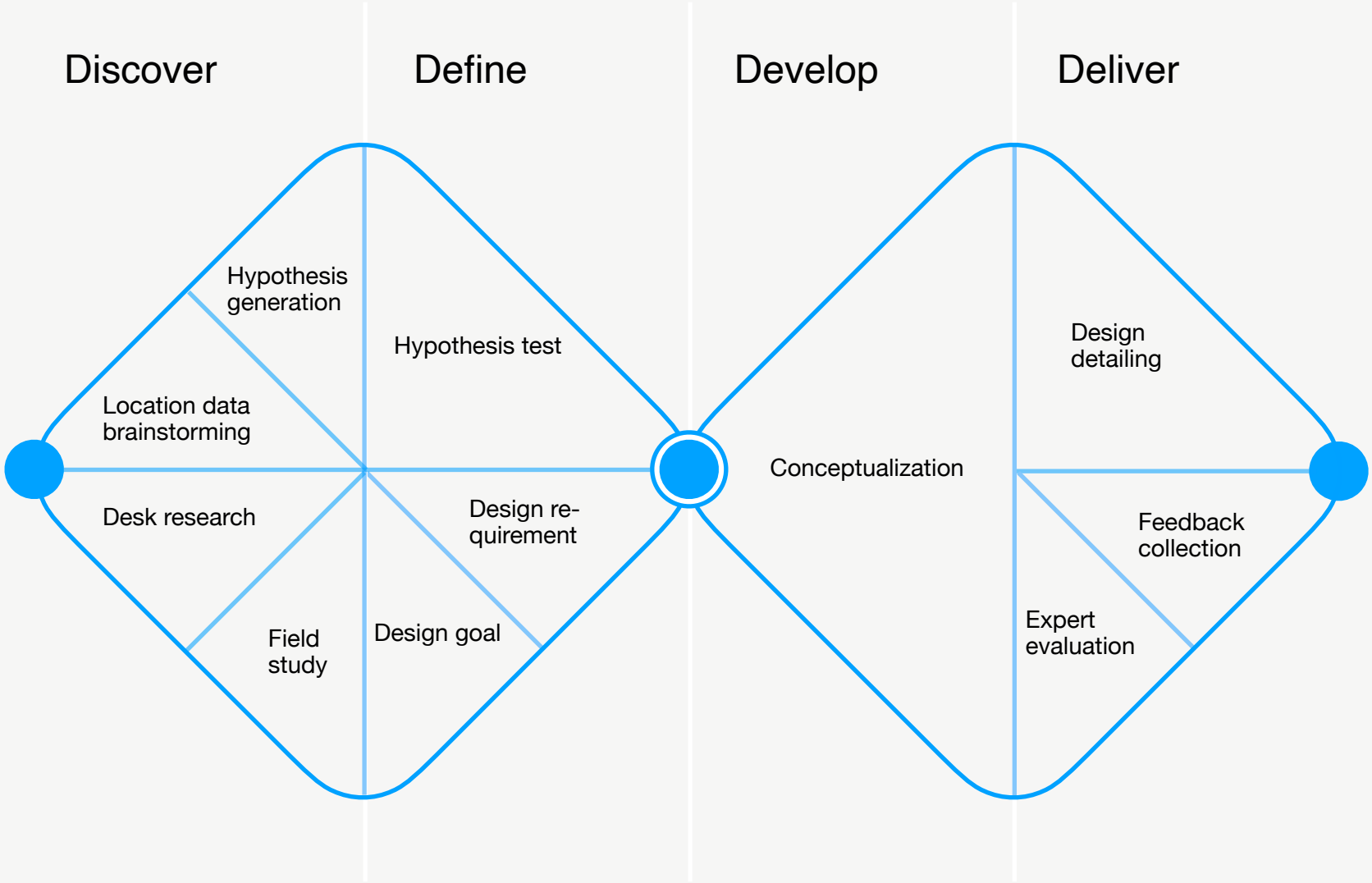
At this stage, it was aimed to converge by validating useful location data insights, narrow down context scope and formulate design goal and design requirements. Hypothesis testing and coding were applied in this phase.

Develop

Conceptualization and iteration are conducted at the phase. Three concepts are generated through brainstorming and feedback collection. They are tested with experts and care staffs in the nursing home.

Deliver

The final design is developed with implementation of location data. A Product-service system implemented with a data analysis platform is design. Also an example user scenario is delivered.


Discover
Define
Develop
Deliver
Hypothesis generation
Location data brainstorming
Desk research
Field study
Hypothesis test
Design re-quirement
Design goal
Conceptualization
Design detailing
Feedback collection
Expert evaluation

Chapter 2 - Desk research

2.1 PwD
2.2 BPSD management
2.3 Process of care planning
2.4 Communication problems in care planning
2.5 Summary of desk research

This chapter describes the basic information form literature that are helpful in further field study.

2.1 Mid and later stages of dementia

Dementia is an overall term that covers a wide range of specific medical conditions, including Alzheimer's disease. Disorder Dementia is the People in this stage have major memory deficiencies and need some assistance to complete their daily living activities (dressing, bathing, preparing meals, etc.). Memory loss is more prominent and may include major relevant aspects of current lives. For example, people may not remember their address or phone number and may not know the time or day or where they are.

Severity of dementia is classified in 5 stages based on clinical dementia rating(DementiaCareCentral.com, 2020).

In the **moderate stage of dementia,** people has trouble expressing their thoughts, has severe memory issues and can't perform daily tasks(DementiaCareCentral.com, 2020).

Communication for an individual is difficult. They might be unable to follow conversations, and may have trouble understanding what others are trying to communicate(DementiaCareCentral.com, 2020).

Behaviour and mood changes, difficult sleeping, repeating actions/words, hoarding, anger, wandering, frustration might be common(DementiaCareCentral.com, 2020).

PwD have significant issues with communication in **late stage of dementia,** words or expressions are often used. Eventually, verbally communication is not possible at all. Individuals may no longer be able to walk and and will require extensive assistance with daily living activities, such as personal hygiene and eating(DementiaCareCentral.com, 2020).

Insight:

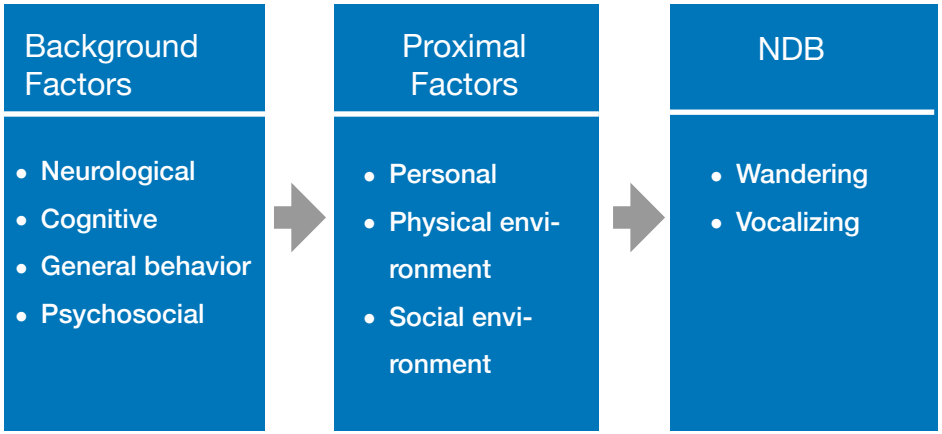
- Communication is the main problem PwD have at moderate and late stage.
- They need assistance to perform daily tasks.
- It difficult for care team to know what PwD needs in the way of communication with normal people.
- It is important to know how the care team get to know PwD's needs in current care planning process, so that design opportunities for care improvement can be found.

2.2 PwD's needs and BPSD

Among all the forms of dementia, BPSD (Behavioral and Psychological symptoms of Demtntia) is ubiquitous at every stage of dementia. BPSD includes agitation, wandering, aggression and etc. In terms of care, the symptoms are among the most stressful, complex and costly. Poor patient health outcomes are also resulted from them. (Gitlin, 2015)

According to Need-driven-Dementia-comprised Behavior (NDB) model (Algase et al., 1996), BPSD is a way of PwD expressing their undressed needs because oral communication is a primary problem to people with dementia at later stages. Background and proximal factors are the two types of factors that lead to BPSD. Background factors consist of cognitive, health status as well as psychosocial factors. While proximal factors are more about the social environment, immediate physical environment and the changing or dynamic states or needs.

Elements of background factors are relatively stable. It can offer the direction in identifying those at risk and suggesting the way of specifically modifying the environment for those exhibiting a particular behavior. When taking care of PwDs, BPSD can be a distractor to the real problem in many situations. Care givers might treat BPSD as a problem, rather than symptoms of the unmet needs (Christine R. Kovach, 2005). For example, it shows that caregivers have difficulty in determining the pain-related behavior. Anti-anxiety drug might be used to treat agitation when the real problem is arthritic pain, which requires an analgesic.
Therefore, the unmet need instead of the behavior is more significant to tackle.



Insight:
- PwD express their needs by BPSD
- BPSD is a symptom that PwD have unmet needs.
- Care giver needs treat real problems of PwD, but BSPD sometimes is treated as the problem.
- It seems there are lots of needs and factors leading to BPSD. In the design, it is necessary to define which needs and factors location data can address.

2.3 Process of care planning

Identify needs

When the diagnosis is communicated to the patient, the process starts, followed by future care planning. Every PwD and care-giver has specific needs that are based on the problems one has experienced and their individual preferences. **Besides, as the patients experience a progressive loss of functional and cognitive abilities over time, more assistance and supervision in daily living are needed (Wolfs, 2011).**

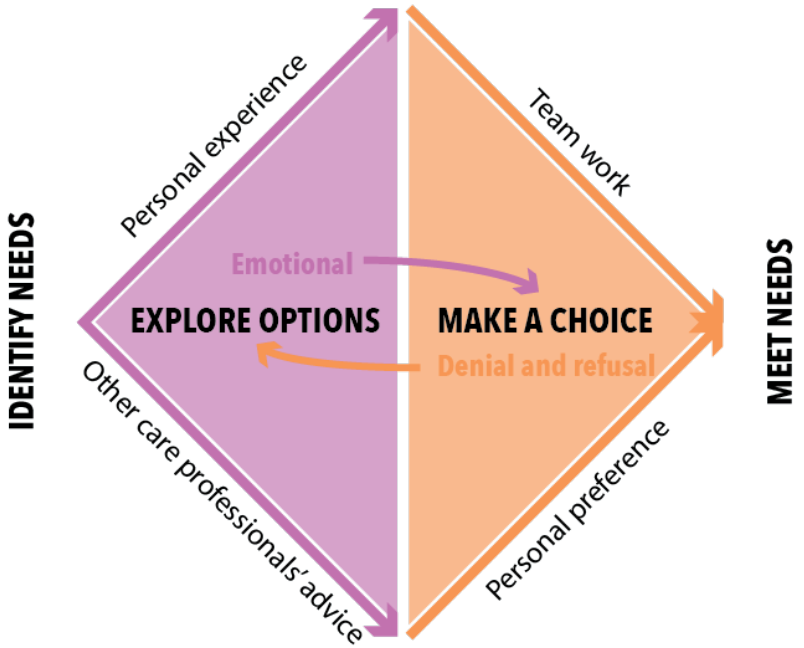
Explore options

After identifying individual needs, a solution in terms of appropriate care and treatment options must be made. Before the solution is available, the options need to be explored. It is time-consuming, complicated and a continuously changing process.

Different methods can be applied to explore these options. Health care professionals play an important role in exploring one's options. They can give advice, guide and inform the patient and their care givers on the possibilities. Apart from that, caregivers can obtain more information themselves. A significant part of the process of adjusting to the disease is regular revising and discussing these options. It is ongoing because of the progression of dementia. Denial and refusal would happen as a major interfering.

Decision making

A decision will be made whether it is necessary to make use of certain treatments or care. The choice is usually involving the patient, health care professionals, relatives is vital to ensure the fulfillments of relevant people's needs and preferences.



2.4 Communication in decision making

Care team need to communicate to make a care decision. The four important aspects are shown below.

Communication for Information sharing

It is significant to the healthcare teamwork that all team members can share relevant information they possess relating to the healthcare situation with all the members in the team. It is aimed for letting them all know what is going on and all on the same page about what is going on with the patient's care plan and feedback (Kreps, 2016).

Communication for Interpreting information

The provided health information is interpreted inevitably by the healthcare team member themselves. Each one is likely to decide on priorities for the best courses of actions and priorities for care. These decisions are normally based on their unique expertise, involvement in the case and unique experience. (Van, Mitchell, & Krass, 2011). To achieve mutual understanding of the care situation, it is important that they can explain their opinions in language and with understandable examples.

Communication for exploration

The healthcare team might face conflicting during communication. It is caused by district health care professional backgrounds and training (Kreps, 2016). Conflict encourages the expression of different ideas and courses of action for the team to consider, enabling exploration of different options and preventing premature decisions that don't take into consideration other important perspectives (groupthink) (Janis IL , 1972). Groupthink can also be avoided by encouraging different conflicting ideas to enable the care team to explore different approaches to cope with health issues.

Communication for decision making

Usable health care information is needed for important team decisions about addressing health issues. Timely, appropriate and accurate health information will enable team members to consider the different aspects of health issues carefully and make informed health decisions on responding to these issues(Kreps, 2016).

Insight:

- It is necessary to validate if the care team in nursing home also face communication issues in these four aspects and what issues they are face.

2.5 Current application of IPS in dementia care

In order to know how the trend of current application of location data and indoor positioning system in dementia care. Brief research on research&design about dementia care products is conducted.

ZigBee module
Functions:

- Help caregivers locate a wandering patient with Alzheimer's disease to ensure their safety.
- The application pinpoints the location of the patient on the built-in map.
- A software application that has the ability to display the real time position of all the patients.

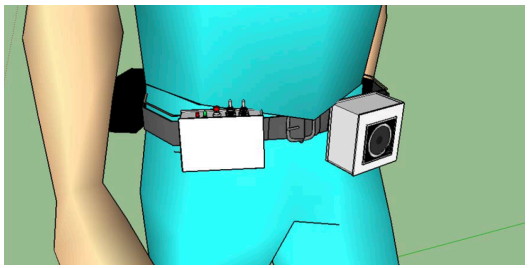


Figure 1-ZigBee module

Power tag
Functions

- Automatically and confidentially notifies staff of a potential elopement incident before a resident has left the building as well as a more critical notice that the resident is attempting to leave the building.
- Wireless staff management functions permit tighter staff management capabilities. Swift staff location allows for enhanced resident response to call bells and other critical patient care functions.

Figure 2-Power tag

Insight:

- Indoor positioning systems are mainly used for locating and tacking the patients.
- They mainly focus on protecting the patients from going to unsafe area such as leaving the nursing home.
- They can inform the caregiver in time to take actions.
- They can help improve service by visualize the staffs

Summary of desk research

In sum, BPSD is caused by unmet needs of people with dementia. Care givers need to identify their needs so that they can make a care plan. BPSD is the PwD's communication, so it is important to bridge location information with PwD's needs and BPSD. Namely, what needs location information can inform us. Knowing the bridging information, it is assumed the communication in the care planning process would be improved.

Information sharing, interpretation, exploration and decision making are four important aspects in care team communication. It's important to see what are the needs in these aspects in the context

In next chapter, it will show the context of the nursing home, the research questions are:

- What is a care plan in the context?
- How is the care planning process like?
- What are the unmet needs in terms of communication for the care team?
- What location information can be helpful in the care planning process?
- What is the scope of this project in the context?

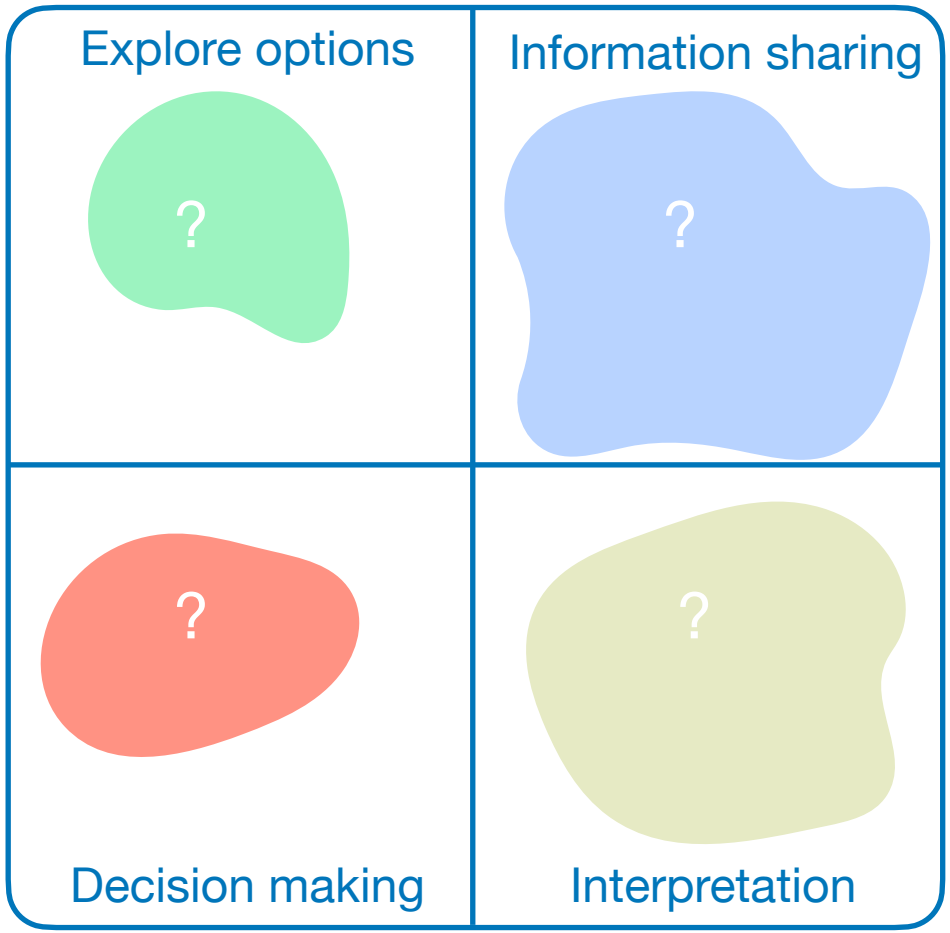


Figure 3-Factors influencing communication

Chapter 3 Field research

3.1 The context
3.2 Problem framing

This chapter introduce the context and reframe problem based on the context insights.


Danken
NESCAFÉ

3.1 The context

Focus group

Goal

1. To have an overview of how the care team making a care plan, their pain point and needs in the current communication during care planning.
2. To know the potential value (how location data might be helpful in communication) of location data.

Method

A focus group(DeVault, 2019) is used in user research to collect the opinions on current care planning process and the idea.

Procedure

The focus group started with introduction of each staffs' role and tasks in the care planning process.

Then each one needs to map out the information flow they have to take care of their clients.

The second assignment was used to trigger the participants to think about the possible system with the applying of location data.

Participants

The participants include the members of care team. Details are shown below.

Participants	Numbers
Care givers	2
Dietitian	1
Psychologist	1
Doctor	1
Manager	1

Data analysis

Thematic analysis applied for data analysis. Detailed code can be seen in Appendix 1. An information system diagram is also drawn. It shows the roles, information flows, communication tools and channels in the care planning process.

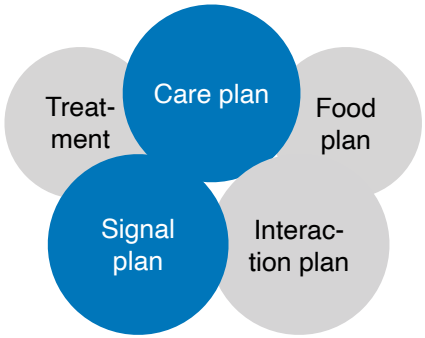
The care plan

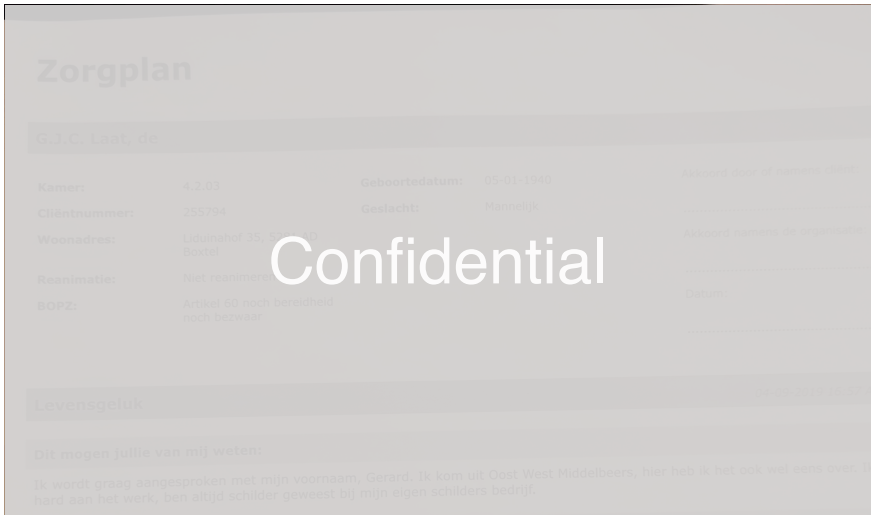
In the ward, care plan is the integration of all the other plans(Appendix 2). The other plans include signal plan, interaction plan, treatment plan and interaction plan. Since each client has different symptoms. Important things for the client will be put in the personal care plan.

Care plan is the long-term goal (six months) of the care service, and the goals are set in four main aspects: living and living conditions, participations, mental well-being and autonomy and physical well-being and health. Then it will be used as the guidance for caregivers' activity plan, which directs the care givers daily actions.

Signal plan is the guidance for the caregivers to assess people with dementia's stress level by their behavior, which has four phases, **green(Phase 0), yellow(Phase 1), orange(Phase 2) and red (Phase 3**). From green to red means that PwD is relaxed and happy to very stressful. It is used by the caregiver to determine the status of the client's daily emotions. Care givers needs to make a draft of it and consult psychologist for advice

Treatment plan will be used when the client need physical treatment. Similarly, food plan is made when there is food problems need to be addressed(For example, the client won't eat).





Insight:

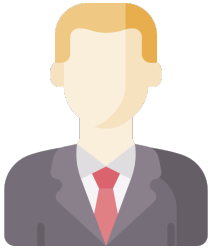
- Care plan covers different aspects of PwD's wellingbeing.
- By reading the care plan sample Appendix , the author found that care plan is tailored to the client. And the needs are the specific care they need in their daily life.
- Signal plan should be involved in design because it is related to how the caregiver identify and handle situations when PwD showing BPSD, it is also drafted by caregivers.

Stakeholders in the care team

Care givers

Roles:
- Take care of the client every day.
- Make and update the care plan for clients.

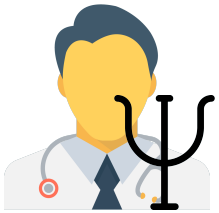
Manager



Roles:
- Make sure everyone is doing their job.
- Monitor the condition of the ward.

Doctor

Roles:
- Giving care givers advice on physical health care
- She usually work as a team with psychologist
- Doctor makes a treatment plan.



Roles:
- Giving care givers advice on metal health care
- They usually work as a team.
- Psychologist makes a signal plan and interaction plan.

Dietitian

Roles:
- Giving care givers advice on nutrition status.
- Making a food plan when it is needed.

Insight:
- The care giver is responsible for assist the client's daily life and making each client's care plan.
- Care giver is selected as the main target user of design because they are responsible for the care plan.
- If location data can be useful for the other stake-holders still need to be validated in the later stage.

Unmet needs of the care team

Unmet need 1:There is no objective data to take as an reference to support the daily report
As location data is objective, it can be used as the evidence to assess the client's behavior and emotion change. For example, the distance of walking will give a signal if the client is agitated or relaxed.

Unmet need 2: There is a need to detect factors that makes the client agitated.
Location data can also be applied to detect the potential environmental factors that leads to the clients' mood change. For instance, they want to know attending what kind of activities and whom the client interact with will cause the client's behavior change (walking a lot or not) and mood change (tension or relaxation). They also want to know when the changes start and stop.

Unmet need 3: There is no objective data to evaluate if the client really walk long or short.
By using location data, caregivers, doctors, psychologist and the dietitian can evaluate description on clients condition written in the report. They can asses if the client walking too long or not more accurately and improve the efficiency of care decision making.

Unmet need 4: The information in the care team need to be available more conveniently
In current system, there is too much information separated in different documents, different professionals. There is a need to get access to the right information at the right time.

Unmet need 5: There is too much information for caregivers during daily care for the clients.
Care givers have too many tasks to finish. It is difficult for them to memorize all the contents in the care plan and everything happened to the client. It is possible they can't find important guidance in the care plan immediately, such as what they should do when the client gets agitated or starts to wandering.

Unmet need 6: The information delivered by the care givers to other care professionals is incoherent.
Due to the fact the information of the clients' conditions is mainly obtained through observation and each care giver's experience, the report is sometimes quite subjective. The ways they describe the client's behavior sometimes are different. For example, when one care giver says the client walks a lot and quiet agitated, the other care giver may think the client doesn't walk a lot and quite relaxed. Besides, caregivers have their own way of writing the report, they might have different aspects to focus on or the level of detail differs. Therefore, other caregivers and professionals will be confused by this inconsistent information.

Insight:
- In the current care planing process, daily reports seem the most important part to be improved by location data.
- The description of the daily report can be more objective with the use of location data.
- The PSS would possibly help the care team exchange information and improve information availability.

Observations and Interview on writing a daily report/attending a weekly meeting and MDO

Goal

From the information system derived from the focus group. Daily review (writing a daily report), weekly meeting, and MDO are the three main activities to review the care plan.

The aim of this part of the research is to have an in-depth knowledge of the aim of the activities, what they do, and how they do that. Their communication experience and pain points at these activities.

Participants	Numbers
Care givers	2
Dietitian	1
Psychologist	1
Doctor	1
Manager	1

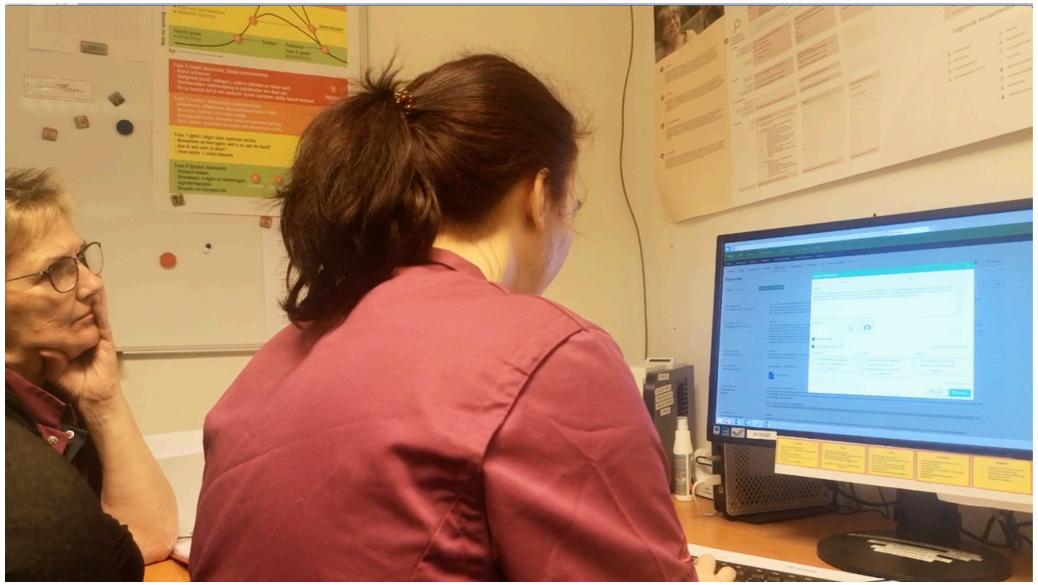


Figure 4-Care giver writing a daily report

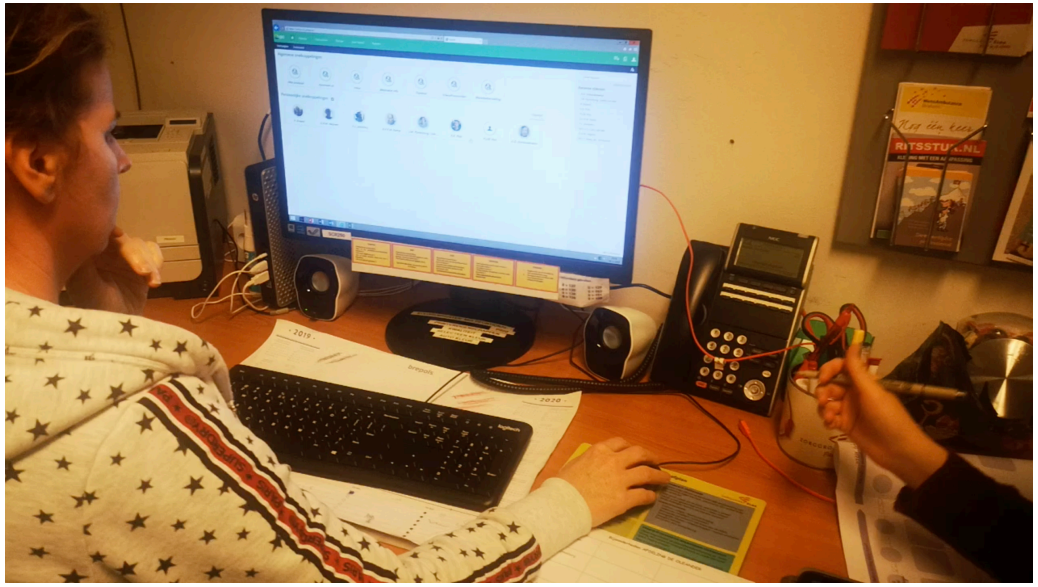


Figure 4-Care giver writing a daily report

The care planning process

A care plan is to be made when the client is about to move in the ward. Firstly, the EVV(first contact person) will read previous record of the client and then make a care plan.

Everyday, the care givers will write a daily report to reflect the clients' conditions and renew the care plan if necessary.

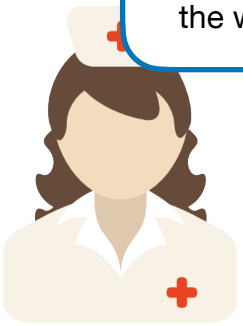
The care giver will meet the psychologists and doctor to have a weekly meeting. The meeting is to help make plans when there is a new client coming in and make changes to the care plan.

After six months, the care plan will be reviewed into a new version and updated based on the care givers' experience, observation and input from other care professionals. The care plan will also be adjusted when the client's conditions improve or get worse.

Unfixed meeting can be booked with other professionals so to get extra advice from those professionals.

Insight:

- There are three main activities in the care planning process: Daily review (when writing a daily report), weekly review(every 2 weeks), and MDO (every 6 months)
- When the caregivers do daily review, they will write a report based on their interaction and observation of the client.
- The daily report is the basic information resource of the whole process.



1. Daily review

What they report?

- Collect information during daily work
- Report based on goals in the care plan.
- Update certain goals in the care plan.
- Report behavior and emotions
- Consult other professionals about a certain problems by sending direct report.

How do they report?

- Collect information from other care givers.
- Read previous report
- Two caregivers report together, one support the other to recall the situations.

2. Attend a weekly meeting

What they consult?

- Consult the most urgent issues of certain clients.
- Get to know new clients's behaviours
- Adjust the care plan

How do they consult?

- Before the meeting, A lead care giver read previous report of the client, collect problems from other care givers.
- In the meeting, the lead caregiver propose the problems.
- Select the most urgent issues together.
- Reach agreements on on the issues, if not, discuss next time.

3. Attend an MDO meeting

What they report?

- Report the progress of the client's condition.
- Report new plan to the family.
- Answer questions from the family.

How do they report?

- Before the meeting, a lead care giver read previous report of the client. Update the care plan
- Report the progress of the client's conditions.
- Report new plan to the family.
- Answer questions from the family.

Pain points of care givers in the care planning process

Pain point 1: Care givers need to change the care plan by getting to know the client continuously.
"You don't know the client at the beginning, you need to make changes when there is something not right."

Pain point 2: Care givers need information support to make care decisions.
"And so not all the time I give the solutions. It's also often that the nurses know the solution, but they're afraid to do something sometimes".-Interview with psychologist

Pain point 3: Emotion affects how the caregivers describe client's conditions.
"They report on how they feel with their own emotions, not what they see." -Interview with caregiver on writing a report

Pain point 4: Information support is needed for the caregivers to write a daily report**.**
When writing a daily report, caregivers need discuss with other caregivers, which takes time. It cost time and they can't get all the information on their own.

Pain point 6: There is only limited time to discuss conditions about the clients at different meeting.
When writing a daily report, attending a weekly meeting or MDO, the schedule is always structured and constrained. Only issues at top priorities can be discussed.
"It's only that much time we have."

Pain point 7: Information might not be complete to reach conclusion to certain problems.
"Care givers need to observe and collect information for next rounds of meeting discussion to reach a conclusion when they don't have enough evidence to make a decision."

Pain point 8: Family are passive information receivers.
"At MDO, family are just information listening, it would be better if they can participate more into the care planning process."

Insight:
- Progression of the client's condition, getting to know the client are the two main reasons to update the care plan.
- Care giver need information support to make care decisions and finish their tasks (write daily reports, attend weekly meeting, make care decisions during daily care).
- Information might be incomplete and time limitation affect the efficiency of weekly meeting.
- Family are not considered in the project due to the unavailability.

Products for communication

Reporting system of caregivers

Currently, the main communication system they are using is called Qic. Care givers need to write a daily report of the client. They think it would be more effortless to search for information if there is an overview of the client's conditions(Gong & Haotian, 2019). The report will be uploaded and shared with the fellow care givers.

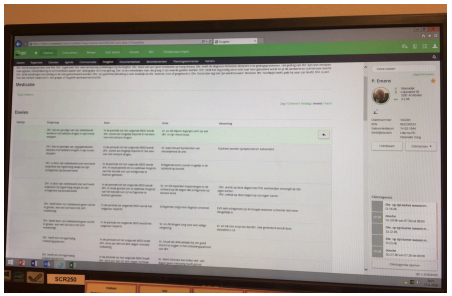


Figure 4-Qic.

Reporting system of the doctor and psychologist

Yasis is the system used by the doctor and psychologist. The system is similar to and connected with Qic(Gong & Haotian, 2019). Information in Qic will be shared with doctor and psychologist, doctor and psychologist can also read care givers' report and respond to it.

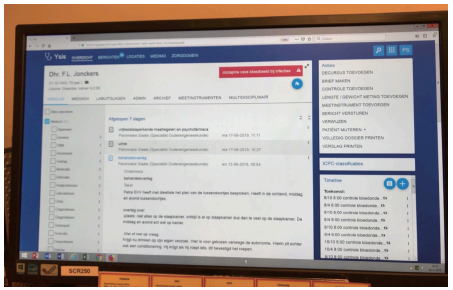


Figure 5-Yasis

Portable products

Portable products are used to allow the care givers to receive instant information and perform tasks when moving around. But sometimes it seems very annoying and increases the burden off receiving information. For example, care givers check the Bep notifications very frequently but they will normally mute it immediately. The severity of the indicator seems need to be classified so that the care givers will have a better control of the information.

Insight:

- The products used by different stakeholders are connected with each other.
- According pain points of using current products, design should provide an overview of the client's conditions.
- It would be nice if the design can be connected with the current system.
- Information should be in hierarchy to recuse distraction when care givers are working.
- Design should allow information sharing and help collaboration.

3.2 Problem framing

The field study helps understand current process of care planning. Also it helps explicit context scope. The unmet needs and pain points will be feed into the later hypothesises, which aims to identify what location data can be applied. And it will be applied to formulate design goal. to improve communication care planning of BPSD management.

Unmet needs and pain points are categorized into “Explore options”, “Information sharing”, “Decision making” and “Interpretation”. As the scope will be focused on writing a daily report, te

The design challenge of this project is to **improve the communication in care planning process by supporting the daily reporting with location data.**

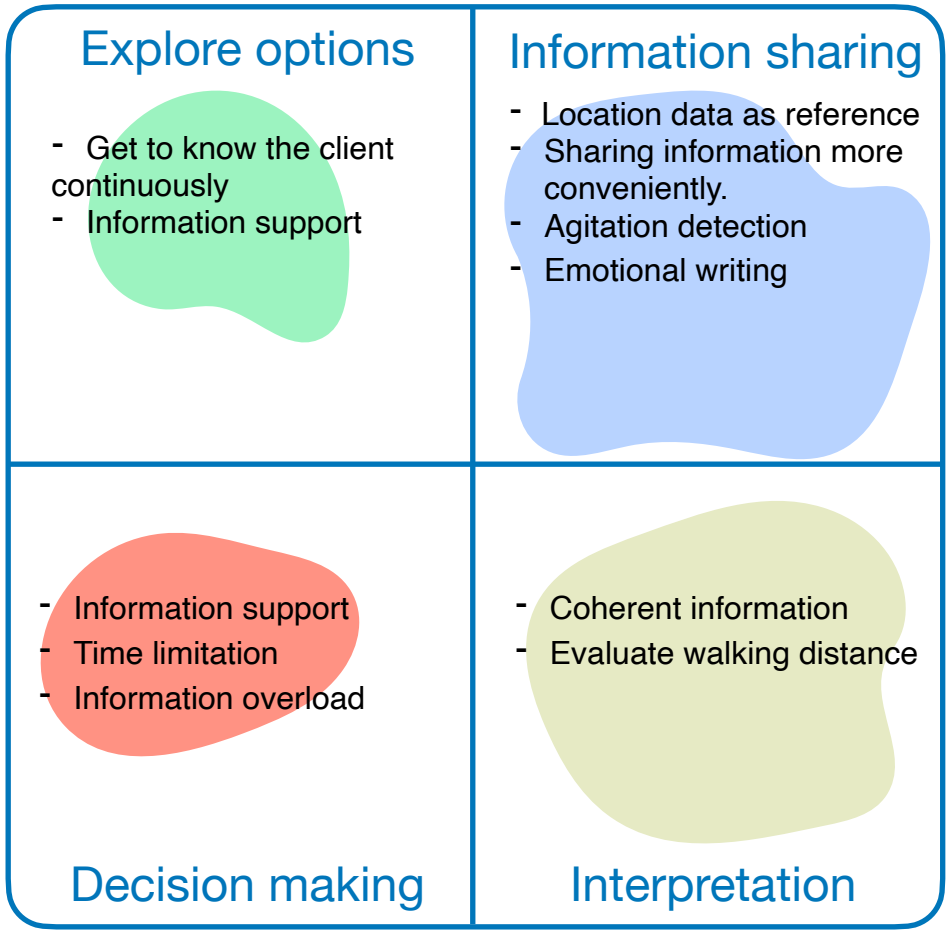


Figure 3-Aspects for improving communication

Key findings of this Chapter

- Daily report is the most important information resource for reviewing the care plan.

- There is an information overload for care givers during daily care. They need the right information at the right moment for the carving the client. Care giver can't remember everything in the plans.

- The care information delivered by each care giver may be incoherent. Information receivers can't get the same level of understanding of the situation.

- The description of the clients' condition may be more of the caregiver's emotion instead of the fact.

- Care givers need information support to make care decision when the client's condition changes.

- Engagement of communication in terms of providing necessary care information from each care givers for discussion is not ideal. When writing a daily report, care givers can only find person available at that moment to know about the situaiton, which is passive and not inaccurate. When it's about to have meeting, the lead care giver can't receive necessary information from colleagues.

- Location data could be used to detect agitation and evaluate walking distance.

CHAPTER 4 - Explore location data

4.1 Location data brainstorming
4.2 Hypothesis formulation
4.3 Hypothesis test and formulation

This chapter describes the procedures of generating location data insights and what insights would be beneficial to PwD.

4.1 Location data brainstorming

Goal
The goal is to explore what the insight of the extracted location data were and find out the possible usages.

Method
The brainstorming starts with context introduction about the nursing home, with basic knowledge, the participants are able to generate useful data information. The they read the data visualization(Appendix 4) and post-it enough ideas and questions from the visualization. Then how-to questions are formulated to brainstorm on ideas with use of these data insights(Appendix 3).

Theoretical model
The theoretical mode extracted from data analytic process is shown below(Schutt & ONeil, 2014). By applying data visualization, location information would will be revealed. As more rounds of brainstormings are conducted, more location information is possible to be found.

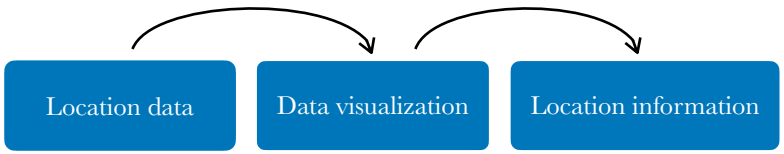


Figure 5-The theoretical model

Data collection:
The location data was collected from 7:00 am to 8 pm every day with a tag (Figure 4) attached to the client's body. The tag and corresponding dataset were numbered after room numbers (Appendix 4- raw data). Due to the limited-time of this project only five days' real data of client living in room 3 was used for a case study. And the data collected in the project are Data 1, Data4 and Data 5 in the Data requirement. The top view picture shown in below is the structure of the ward.

Figure 4-The tag

Data requirement:
According to data analytics process, the location data requirement are listed below. It is assumed that analysis of these location data are related to factors causing BPSD and would enable the care team obtain helpful information for making care decisions.

Data 1	duration of PwD staying in each room
Data 2	duration of PwD being physically closed to caregivers
Data 3	distance walked over the day by caregivers
Data 4	distance walked over the day by PwD
Data 5	total PwD staying time in each room
Data 6	total frequency PwD switching from each room

Table 1-Data requirement

Insights of location data

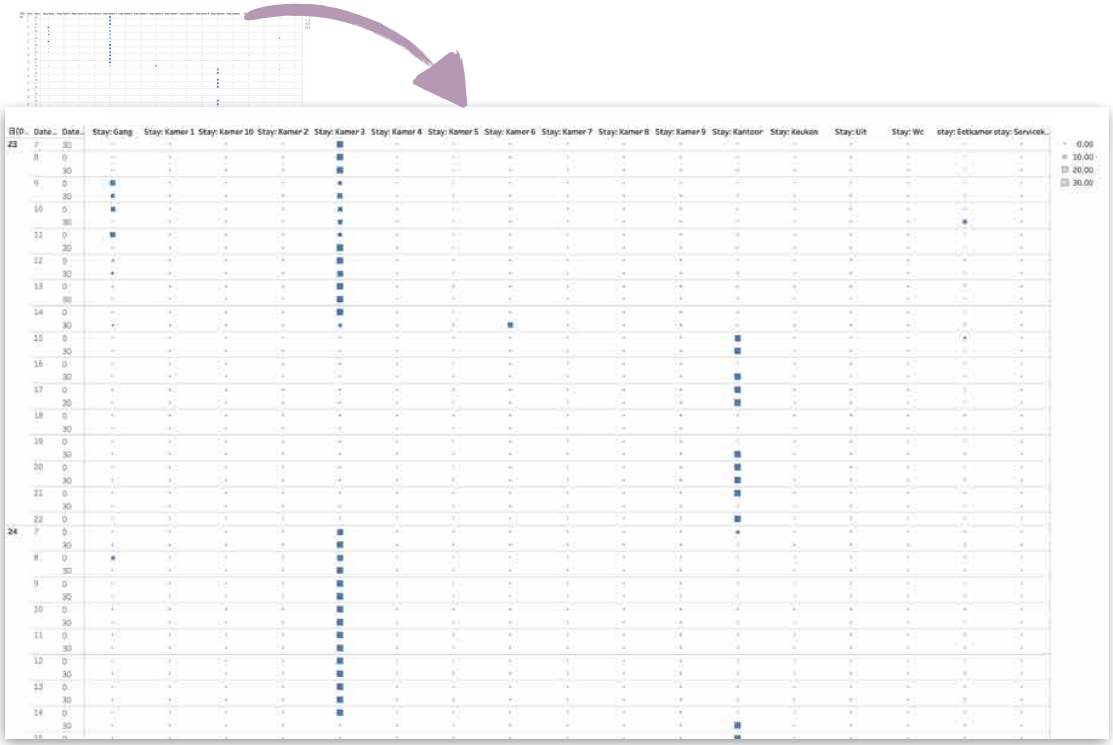


Figure 5-Duration of stay on a day

Category 1: Moving trajectory

Definition

Moving trajectory means how the client moves in the ward along a day. For instance, the client moves from Room 3 to the dinning room between 14.30 and 15.00 as “duration of stay” shows the client stayed in those two places consequently.

Insight:

- The time the client leaves his room during the day.
- The time the client moves from one room to the next room.
- The client is not in the dinning room during lunch time.
- The time and location the client prefers to eats.
- His morning/afternoon moving trajectory.
- The client stays in his room most of the time.

List of questions

- Didn't he have lunch/breakfast?
- What is his eating time and duration?

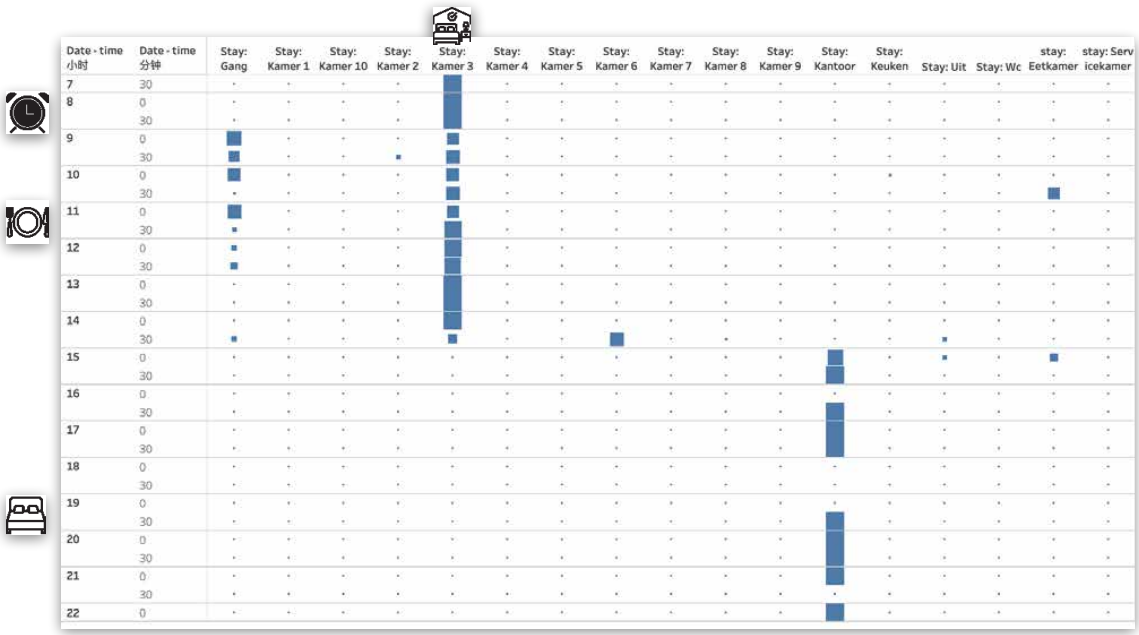


Figure 6-Duration of stay on a day

Category 2: Hot spot

Definition

From “duration of stay on a single day ”, we can see where the client stays longest in different period of the day. The detailed information is shown in the table below.

Insight:

- The place where the client stays
- longest during the day.
- The place he stays longest in the morning
- The place he stays longest in the after-noon.
- He stays so late in the office.

List of questions

- What are the influential factors of preferred places/people/setting?
- Why is he staying his room for such a long time?
- Why does he staying office so long?
- Why does stay in office so late?

Duration of stay on a day

Walking distance on a day

Category 3: Inactiveness

Definition

By comparing “duration of stay on a single day” and “walking distance on a single day” we found that the client stays still in the office in the afternoon, which means he was very inactive.

Insight:

- The place where the client stays
- longest during the day.
- The place he stays longest in the morning
- The place he stays longest in the afternoon.
- He stays so late in the office.

List of questions

- What are the influential factors of preferred places/people/setting?
- Why is he staying his room for such a long time?
- Why does he staying office so long?
- Why does he stay in office so late?

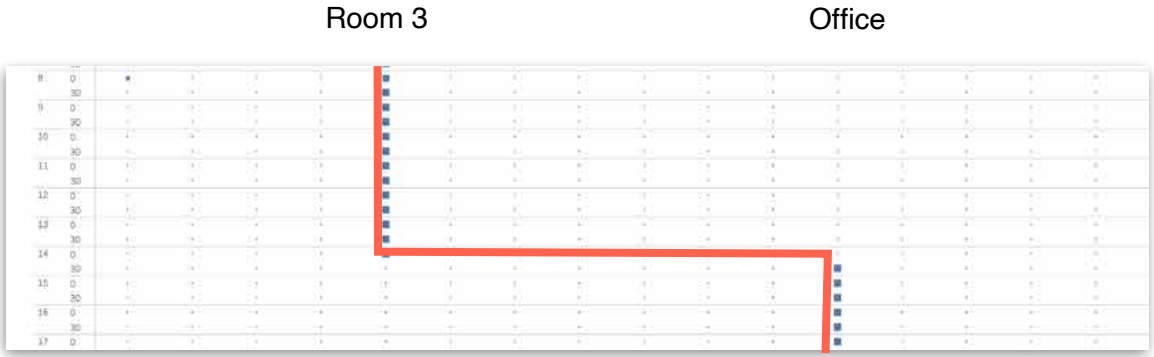


Figure 7-Duration of stay on a day

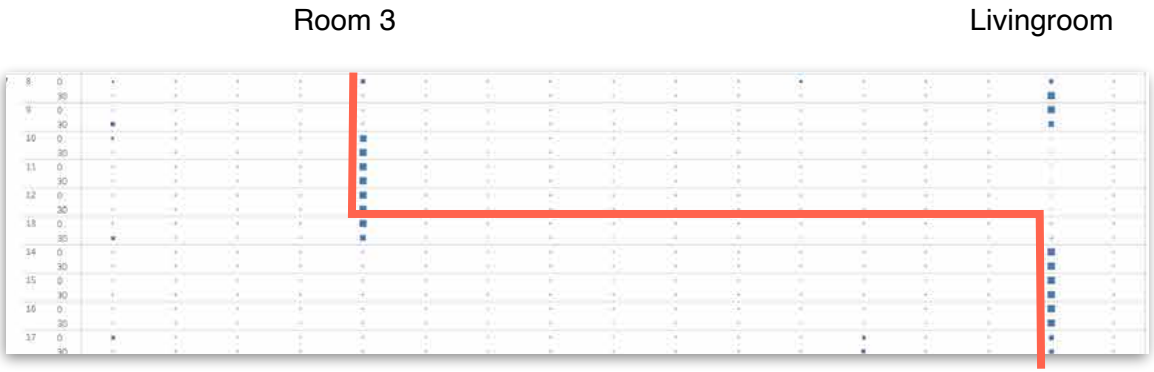


Figure 8-Duration of stay on a day

Category 4: Moving trajectory change

Definition

"Moving trajectory change" means how the client is moving differs from the pattern he usually has. From the overview of "duration of stay in a single day" on different days, we can see the routine moving trajectory change. The client stays in the living room in the afternoon instead of in the office.

Insight:

- On Friday, he stays in living room longer and in bedroom shorter than usual.
- On Friday, he seems more active because he spend more time outside his
- The client seems to have moved between different locations in a day.

List of questions

- Does he socialize at weekends?
- What is the trigger for the moving trajectory change?
- Does he prepare for weekends like us?
- When does the wandering behavior happen?
- What is the number of time that he entering different rooms?
- What does the trend from Tuesday to Thursday mean?

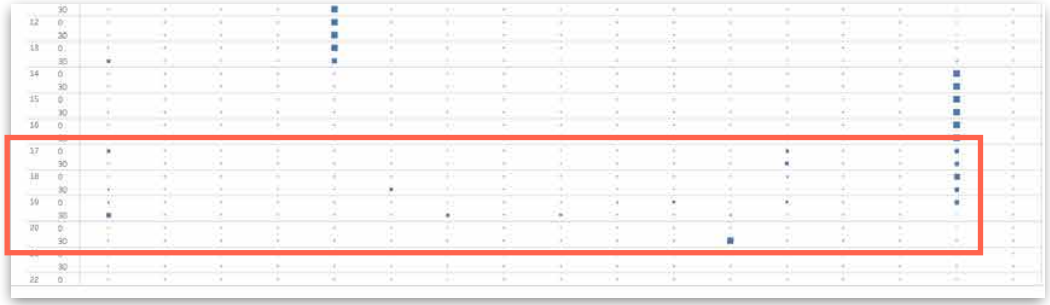


Figure 9-Duration of stay on a day

Category 5: Problematic locations

Definition

It means at a specific period of time, the client move around several places frequently. As from “duration of the stay in a signal”, we can see there is a period the client moving in different room, which is abnormal.

Duration of staying in dinning room

Category 6: Walking safety

Definition

Walking safety means that the client is not at the right place when he should be. For example, from 6 pm to 7pm, the client seems to disappear from the ward because he is not in any room.

Insight:

- There is a "peak hour" he entering different rooms.
- He is quite active during that time.

List of questions

- Can you spot running away?
- Is there a path that not known?
- Does he sleep walk?
- Is there a warning for when the sensor is not working?
- What is he doing in the office?

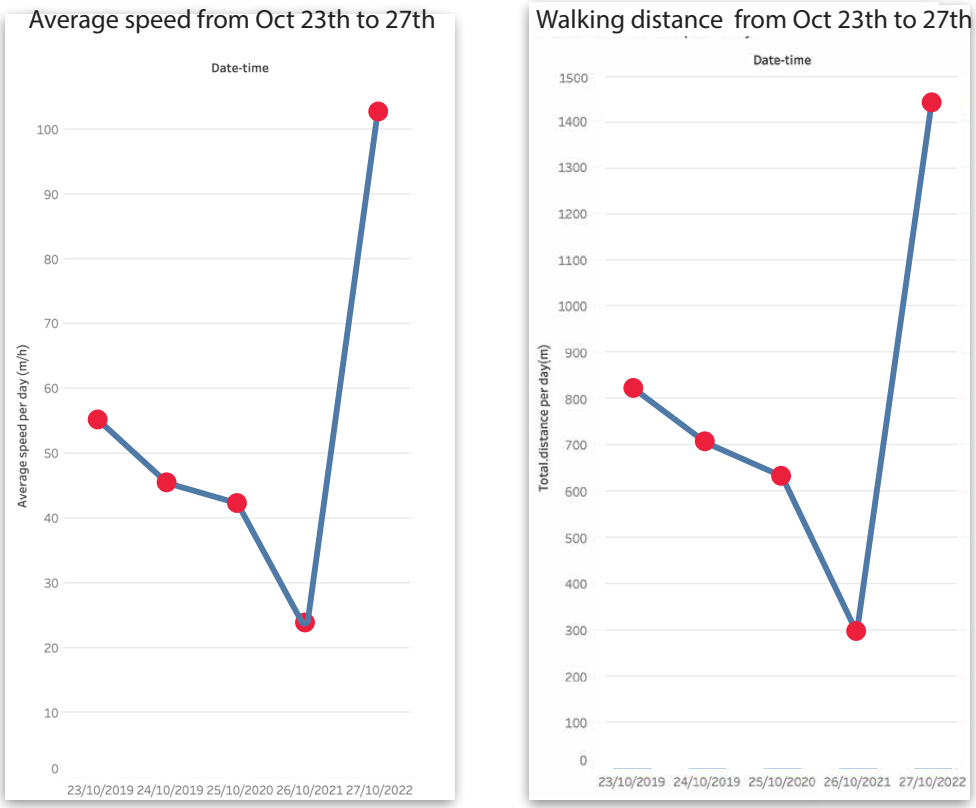


Figure 8-Average

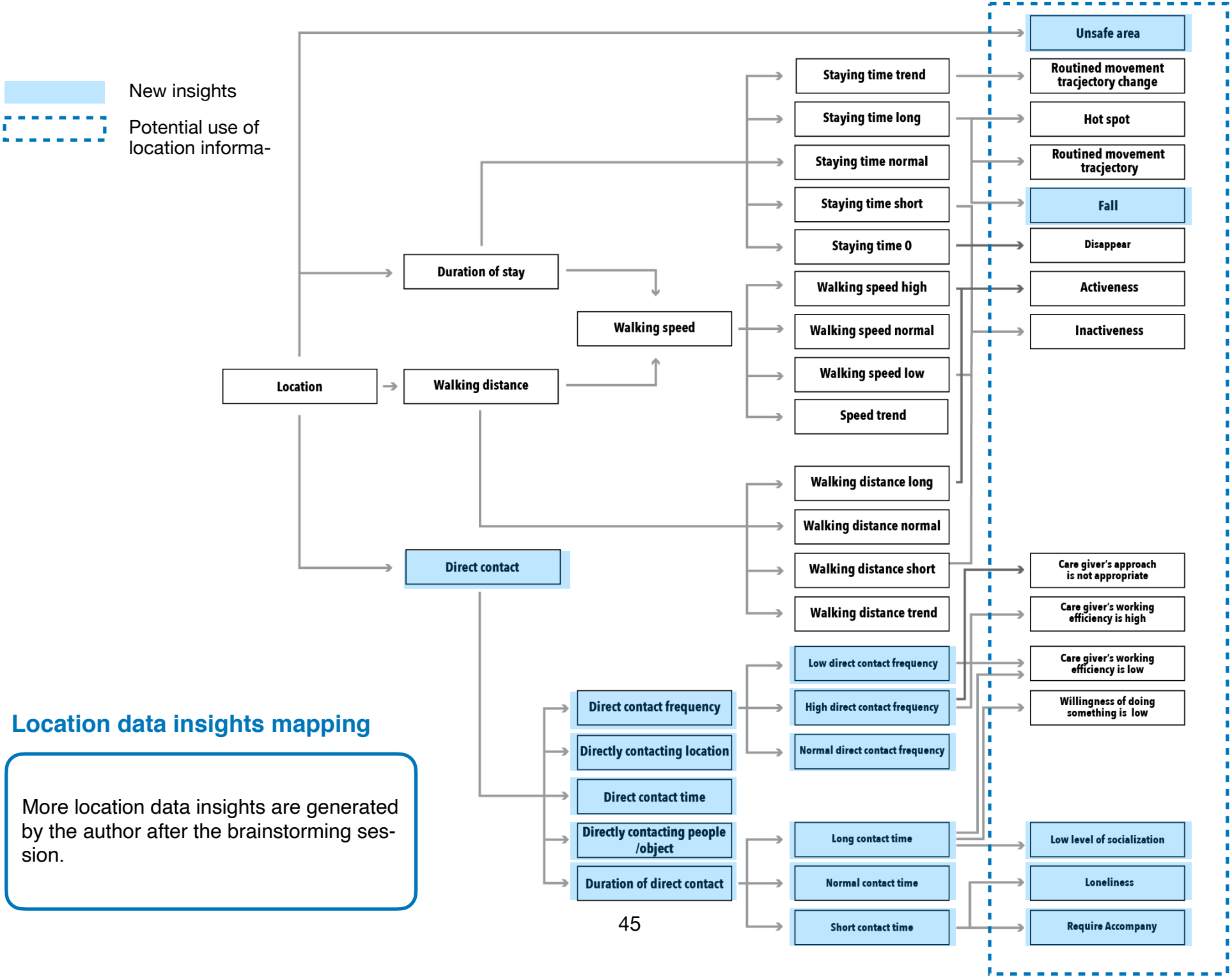
Category 7: Activeness

Definition

Activeness means the client is physically active since the client's average walking speed is pretty higher than that of the other day.From 23rd to 26th, the walking speed and walking speed decrease, while on 27th, they suddenly increase. The client seems gets active.

Insight:

- He seems quite active on Friday.
- He was getting inactive from Oct 23rd to 26th.



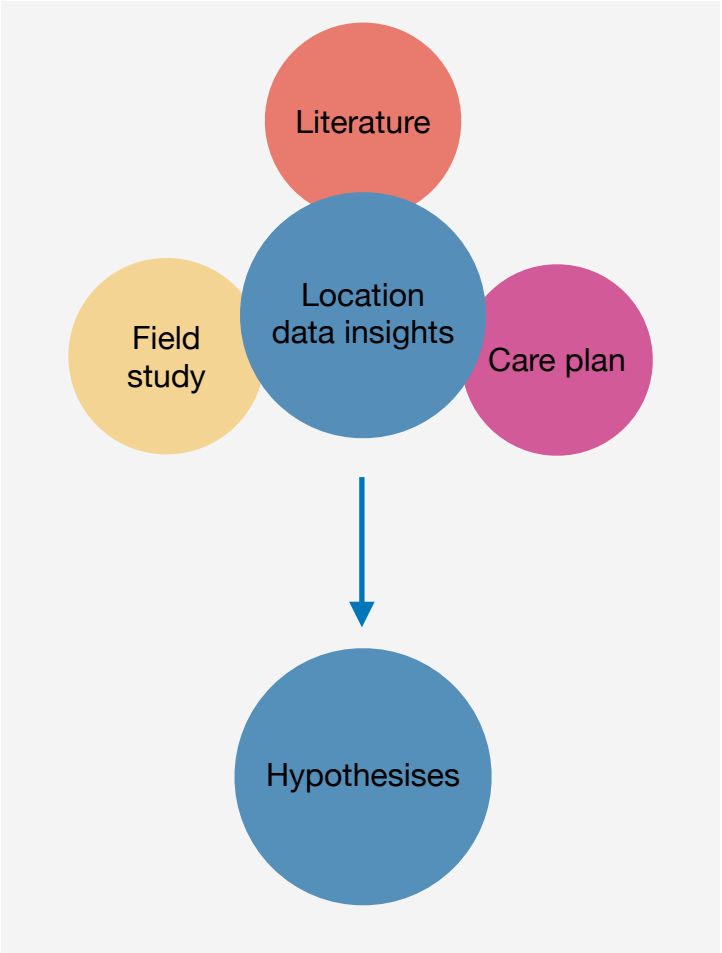
Location data insights mapping

More location data insights are generated by the author after the brainstorming session.

4.2 Hypothesis formulation

Goal
In order to validate what location insights can be helpful in the management of BPSD and fulfill needs of care giver and PwD, hypothesises are formulated and tested.

Method
To formulate hypothesis, needs of PwD are scanned from literature and care plan. Needs for the management of BPSD and communication are filtered out form previous field study as well. Combining the needs and location data insights, the author generated enough hypothesises by intuition for testing.



Needs scanned from the literature

The use of psychotropic drugs may have unpredictable effects and potential risks (Wergeland, Selbæk, Høgset, Söderhamn, & Kirkevold, 2013). Depression, anxiety, apathy and irritability are the most common neuropsychiatric symptoms of dementia, which can be caused by misuse of psychotropic drugs (Wergeland, Selbæk, Høgset, Söderhamn, & Kirkevold, 2013).

According to Maslow's hierarchy of needs, human needs air, water, and food are fundamental for human to survive, so do people with dementia. When these essential physical needs are unmet, PwD will show discomfort behavior (Cornawall council, 2020).

PwD are beneficial from regular exercise from regular exercise as other people(Department of Health & Human Services, 2014). These exercise include improved strength, endurance and cardiovascular fitness.

Pain is a common symptom that is experienced by PwD. But it is often poorly under-treated and recognise(Heerema, 2020). The main reason for this is that their ability to communicate their needs gets more difficult.

For people living with Alzheimer's disease and other dementias, wandering is a common behaviour(Cipriani, Lucetti, Nuti, & Danti, 2014). PwD might wander as a reaction to a loud noise an unfamiliar or overstimulating environment, a situation he or she doesn't understand.

People with dementia will also have sleep problems. They need a good rest at night otherwise they might be restless during day time. here is possibility that your the client may move throughout the home noiselessly(Kernisan, 2019). Caregivers need to check and help the client to fall asleep again. When they are waken up too early in the morning, they will be very agitated and refusal of care will happen(Gong & Haotian, 2019). They need to try several times to finish their tasks (dress the client up) (Gong & Haotian, 2019).

Direct care workers feel most incapable of meeting residents' social, psychological, and emotional needs. At the end of life, care for physical symptoms (including pain) and behavioral symptoms become the focus. For instance, a problematic behavior exhibited by a resident with dementia may be a means to express discomfort or a lack of social support(Cadieux, Garcia, & Patrick, 2013).

Specifically, unmet needs in social aspects are caused by the lack of stimulating daytime activities and social company. PwD need to be accepted as part of a wider group of people. They need social contact to feel they are loved and have stimulation with their life. Also, support to help cope with psychological distress is also needed.1 Reed and Tilly also suggest that the care fundamentals of PWD should include the opportunity to engage in meaningful activities (Cadieux, Garcia, & Patrick, 2013).

Besides, how PwD is treated and approached at daily activity is also an important aspect. PwD should be treated as a person, rather than an "object"(Powell, n.d.). Also care givers need be able to recognize the way PwD might be feeling in response to what is happening(Powell, n.d.).

Interpersonal interaction has an enormous effect on how PwD feels(Powell, n.d.). Last but not least, Identified needs included those for adequate strategies to cope with disabilities, the need to be respected and accepted as well as the need to come to terms with the condition.

According Powell, the environment plays an important part in how someone feels and have an impact on the fulfillment of physical and psychological needs. Several factors need to be taken into account: Poor layout of a room which doesn't allow for moving around; Some people may become distressed when in company or when left alone for long periods. Lack of 'Comfort cues' which are particular objects, pictures, pieces of furniture, photographs which help to past comfortable memories(Powell, n.d.).

Needs scanned from the care plan

By reading one example of the care plan, different kinds of needs are found (Appendix). The needs can be classified in two types. One is the needs of the client, the others are care team's needs.

Safety issues is an important aspect in the care plan. It seems that falling is a problems and attention need to be paid. Also the client might hurt themselves when going to the unsafe area. For example, the client might open hot tap and hurt himself. The client would hurt the care givers as well due to messing around in cupboard, where there is danger. Care givers need to guarantee personal safety of clients in the ward.

Behaviours and emotion aspects also need to be addressed. Specially, they need to be approached appropriately. If not, they will have verbal unrest , delusional and physically aggressive reaction. At management level, care givers need to make a signal plan and keep it up to date. To achieve that, care givers need to carefully observe and investigate where misunderstood behaviour can come from. The signals of the clients' disorder level getting high should be recognized and ensure care givers can anticipate on time an prevent escalation. Psychologist need to draw up an interaction plan and update it accordingly. Medication will be applied according to the signaling plan, when non-medication measures do not help.

Care givers also need to make sure the client's physical health. Medication need to be offered correctly, which requires collaboration between care givers and the doctor. The client should be in good nutrition level as well. Weight will be measured periodically. The client should have a good sleep at night, extra attention is needed if they are unrest at night.

Time and workload are also considered during care planning. Care givers measure the number of personnel and workload needed to perform each task listed in the care plan.

Needs scanned from field study

In terms of management of the BPSD, what the care team need is to know where, when, how and why the client have BPSD. If they know that, care givers will be able to communicate with other stakeholders more comprehensively, make a more rational care plan and signal plan, and offer care in good quality; doctor can diagnose physical needs more objectively; interaction plan could be improved as well. More needs are formulated based on the field study (Chapter3, Appendix1 and 2) .

Hypothesis

Literature review | Care plan | Field study

- PwD need to be safe of falling. → H1:"Client staying still" can indicate caregivers the client falls.
- PwD should not be hurt by the environment. → H2:Location information can indicate caregivers the client is walking to "unsafe" area.
- PwD might fall out of bed at night. → H3:"Client's walking distance" can indicate the client wakes up.
- PwD might fall out of bed at night. → H4:"Client's walking speed" can indicate the client wakes up.
- PwD need have a peaceful mind and good sleep. → H5:Overview of direct interaction at night may indicate the client's sleep quality.
- PwD need have a peaceful mind and good sleep. → H6:An overview of the walking distance can indicate the sleeping quality of the client.
- PwD need to have a good rest. → H7:Total walking distance indicates if the client needs rest.
- PwD might get unrest when they need to go to toilet. → H8:"Client's walking a long-distance" can indicate caregivers the client need to go to the toilet.
- PwD need to have a good nutrition level. → H9:Total walking distance can indicate whether the client needs a weight check.
- PwD need do exercise. → H10:An overview of walking speed indicates the client's level of activeness.
- PwD need do exercise. → H11:"Client staying still" can indicate caregivers the client needs more movement/activeness.
- PwD need do exercise. → H12:An overview of the walking distance can show the level of the client's activeness.
- PwD need to be relived from physical pain. → H13:An overview of the client's walking distance can indicate whether the client requires more treatment consultation.
- PwD's abilities should be recognized and the opportunities need to be given to allow them to do what they can do. → H14:"Direct interaction frequency at mealtime " can indicate caregivers the client is not willing to do something".
- PwD will be agitated when he is waken up too early. → H15: Overview of direct interaction can indicate the willingness to do something.
- PwD will be agitated when he is waken up too early. → H16:If caregivers interact with the client at the appropriate time, the chance of the client gets stressful will be reduced.
- PwD need social contact to feel they are loved and have stimulation with their life. → H17: Staying alone can indicate caregivers the client needs more company.
- PwD need social contact to feel they are loved and have stimulation with their life. → H18:Overview of direct interaction can indicate the socialization level of the client.
- PwD need social contact to feel they are loved and have stimulation with their life. → H19:"Direct interaction" can indicate caregivers the client needs accompany.
- PwD should feel safe of being danger. → H20:"Direct interaction" can alert caregivers the client is close to infectious personal/person.

Care givers, doctor and psychologist want to know what makes PwD stressful.	H21:"Client's walking speed high" and "Direct interaction" can indicate with whom the client interacted made the client stressful.
	H22:"Client's walking speed high" and "location information" can indicate the client gets stressful due to something he meets.
The client need a room with good layout allowing for moving around.	H23:"An overview of the duration of stay can indicate the likeness of the client to the living conditions.
Care givers, doctors and psychologist want to know when the clients's mood change happened.	H24:Overview of walking distance can indicate mood change of the client.
Care givers, doctors and psychologist want to know what cause the clients' mood change.	H25:Overview of direct interaction can indicate the trigger of client mood change.
Care givers, doctors and psychologist want to know when PwD are stressful.	H26:An overview of walking speed indicates that the client is stressful.
PwD might be unrested and wandering when they are stressful.	H27: "Movement trajectory" can indicate caregivers the client is stressful.
PwD might walk fast when they are stressful.	H28: "Client walking fast" can indicate caregivers the client is stressful.
PwD might walk a lot when they are stressful.	H29: "Client walking a long-distance" can indicate caregivers the client is stressful.

PwD need social contact to feel they are loved and have stimulation with their life.	H30: "Client staying still" can indicate caregivers the client is depressed.
Care planning needs to be more adaptive to PwD's condition change.	H31: Real-time location data can make care planning more adaptive.
Care givers need to be more aware of what happened to PwD to write a daily report.	H32: Real-time location data can let the caregivers be more aware of what happens to the client.
Care planning needs to be more efficient.	H33:Real-time location data can improve the efficiency of care planning.
Interacting with PwD at inappropriate time will cause refusal.	H 34:If caregivers know when each client is usually doing something and where they do that will improve caregivers' working efficiency.
Care giver will try several times to finish a task when PwD don't want to do it.	H 35:Overview of direct interaction can indicate the efficiency of the caregiver's' work.
Refusal of PwD to caregivers will cause stress to PwD and caregivers.	H 36:If caregivers interact with the client at the appropriate time, the chance of the caregiver gets stressful will be reduced.
Care giver will start serve the clients after they getting up.	H 37: Overview of getting up time can help caregivers plan the order of serving different clients.
PwD might not in the place for the specific activities, then caregivers need to find them.	H 38: An overview of the movement trajectory can help caregivers to plan their work schedule.
Care givers need to approach the client according to the signal plan.	H 39: Overview of direct interaction can indicate the how the caregiver approaches the client is not appropriate.

Care givers need to explain the client's condition to other care professional first to receive feedback.	→	H 40: Historical location data can help other / professionals understand what happened to the client.
Care givers need to write the daily report more objectively to update care plans.	→	H 41:Historical location data can help caregivers to write a daily report/and daily updating the care plan more objectively.
Care givers and other care professionals need to be more aware of what happened to the client.	→	H 42: Historical location data can help caregivers to share information with their colleagues about the client's condition.
Lack of "comfort cues" which are particular objects, pictures, pieces of furniture, photographs which help to past comfortable memories.	→	H 43:"An overview of the duration of stay can indicate the client's favorite place, so that the caregiver can plan activities based on that.

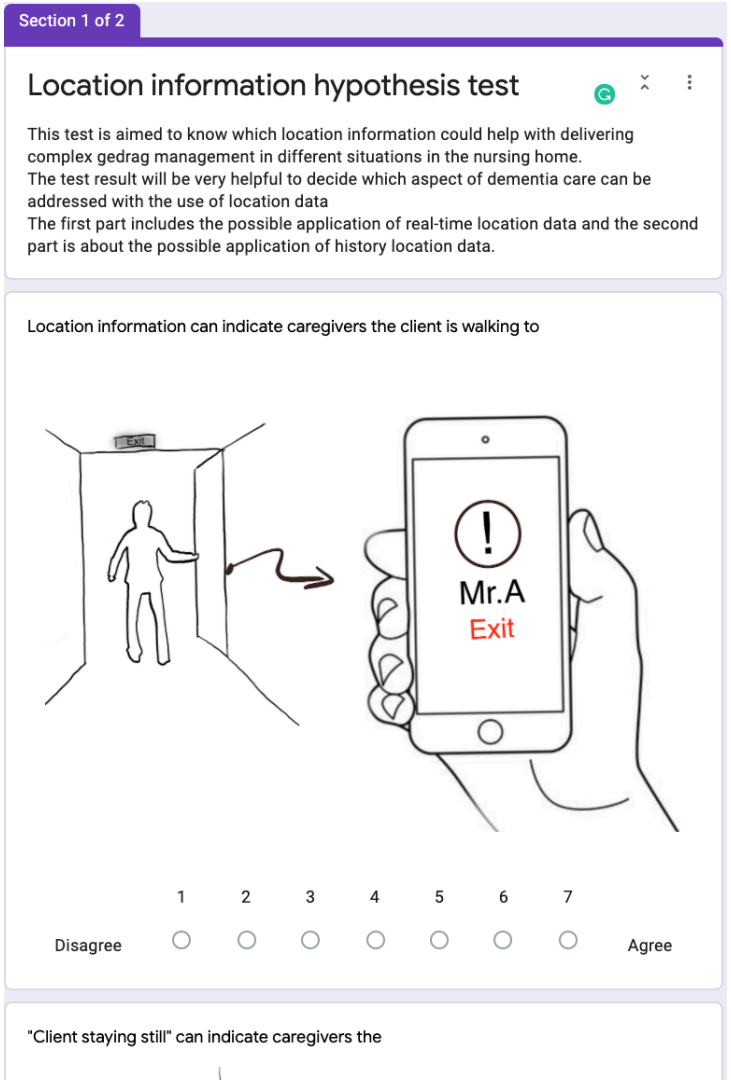
4.3 Hypothesis test

Method

The hypothesises are tested in the form of a questionnaire. Nine staffs in the care team responded to the test. They ranked in the likest-scale with a range of 7. “1” means “Disagree” and “7” “Agree”. The questionnaire can be seen in Appendix 3.

Data analysis

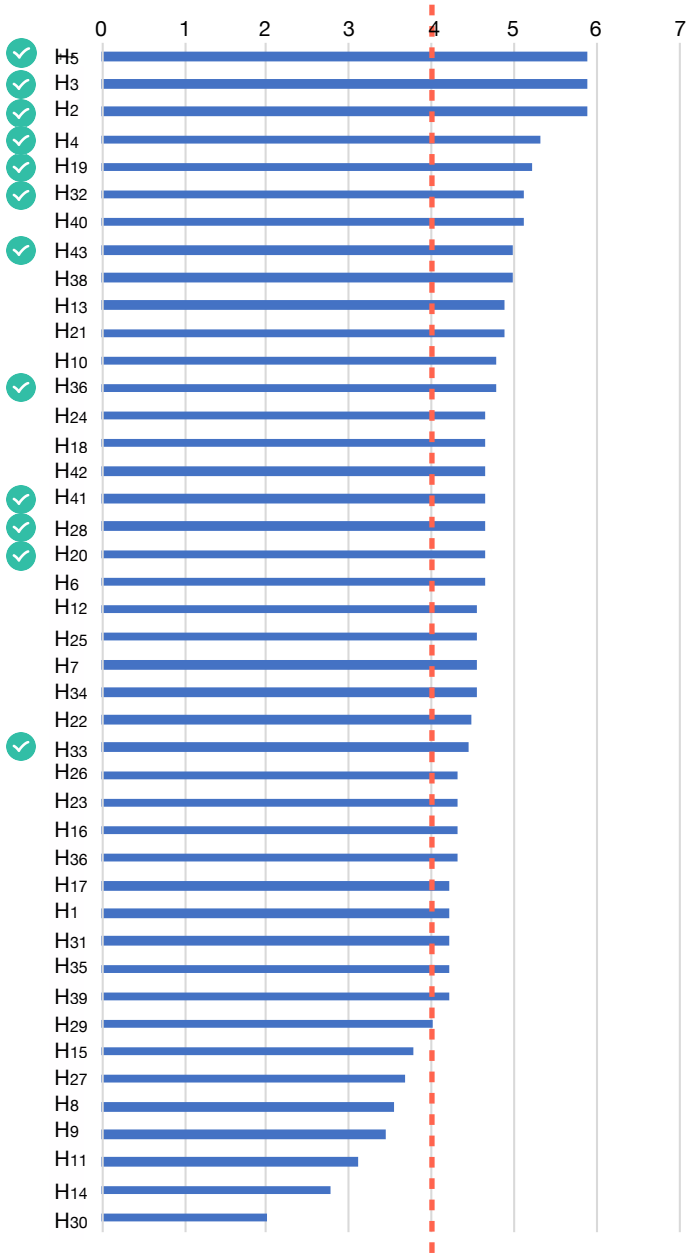
The validated hypothesises must follow the following rules:
Rule 1: the average rating is over 4.
Rule 2: five ratings are beyond 4 and the distribution of the rating is 5, 6, 7, and 1 is not selected.



Validated hypothesises

There are twelve hypothesises that can be used in the data analysis platform.

- H5: Overview of direct interaction at night may indicate the client's sleep quality.
- H3: ”Client’s walking distance" can indicate the client wakes up.
- H4: “Client’s waling speed can indicate the client wakes up
- H2: Location information can indicate caregivers the client is walking to "unsafe" area.
- H19: ”Direct interaction" can indicate caregivers the client needs accompany.
- H32: Real-time location data can let the caregivers be more aware of what happens to the client.
- H43: Historical location data can help caregivers to share information with their colleagues about the client’s condition.
- H36: If caregivers interact with the client at the appropriate time, the chance of the caregiver gets stressful will be reduced.
- H43: Historical location data can help other / professionals understand what happened to the client. (For example, consulting other professionals and caregivers during the weekly meeting and MDO).
- H28: ”Client walking fast" can indicate caregivers the client is stressful.
- H20: ”Direct interaction" can alert caregivers the client is close to infectious personal/person.
- H33: Real-time location data can improve the efficiency of care planning.



Discussion

H5, H3, H2, H19, H28 H20 are hypothesises that can fulfill the client's needs, and they are categorized in to four directions

Sleep disorder

"H5: Overview of direct interaction at night may indicate the client's sleep quality."
"H3: "Client's walking distance" can indicate the client wakes up."

Definition
It means the client having sleep disorder at night, especially situation where the client gets up. They will wander and be hard to sleep. Walking distance can show the clients walking, which means that she gets up. Every time she walks marks one getting up. The more she walks, the more serious the sleep disorder is.

Life safety

"H2: Location information can indicate caregivers the client is walking to "unsafe" area."

Definition
Life safety means the client's physical safety. The client need to be far away from the unsafe area. They might go to out side or to unsafe area in the nursing home. The position of the client can inform care givers that the client is at or close to the unsafe area.

Socialization

"H19: "Direct interaction" can indicate caregivers the client needs accompany."
Definition
It is defined as the client is in need of accompany so that he/she will actively contact people for accompany. If a client get close to people many times during a period, which will inform that the client needs company.

Stress

"H28: "Client walking fast" can indicate caregivers the client is stressful."
"H20: "Direct interaction" can alert caregivers the client is close to infectious personal/person."
Definition
It means the care stress caused by being close to infectious people or items. If the the client meet people will make him stressful, the she will suddenly walk fast and move away. And also interaction can be used to show the client is closed to the person.

The rest of the hypothesises are related to the care giver's work. They are proven that location data can be helpful in sharing information, improving efficiency, be more aware of what happens to situation. And according to the comments collected from the questionnaire, the most important thing to achieve these is to build a linking between location data and the care givers experience and observation. Or support their descriptions with location data.

CHAPTER 5 - Design brief

5.1 Design goal
5.2 Design requirements
5.3 Target users
5.4 Design strategy

This chapter shows the design brief, design requirement and target users.

5.1 Design goal

The 12 validated hypothesises are classified into 4 directions: stress management, sleep management, life safety and socialization management. According to feedback collected in the questionnaire. The most important thing is to build a link between the location data and the observable behavior, help the caregiver explain the condition.

Design goal

The main design goal is to improve the BPSD management in the care planning process by **providing a more efficient communication experience with the support of location information**.

BPSD management refers to knowing when, where, who has BPSD, helping inform the “why” of the BPSD, and making care decisions.

The aspects the platform focus on are sleeping, stress management, safety management and socializations.

Communication experience means that communication in daily working routine and meetings with the doctor and psychologist can be more efficient with more objective information from a daily report.

5.2 Design requirements

Based on the field study of care givers unmet needs and their use of current product , the design requirements are formulated.

Easy to use
The experience of using the product should be intuitive to learn and use. The interface, information and functions should be well-organized.

Timely efficient to use
Usage of the product should be timely -efficient to use along current work flow.

Provide information allowing collaboration/ sharing
Necessary information of the client's conditions should allow sharing conveniently.

Tailored information for different clients
Allowing specific information to be gathered tailoring personal care due to the factors they have different symptoms to focus on.

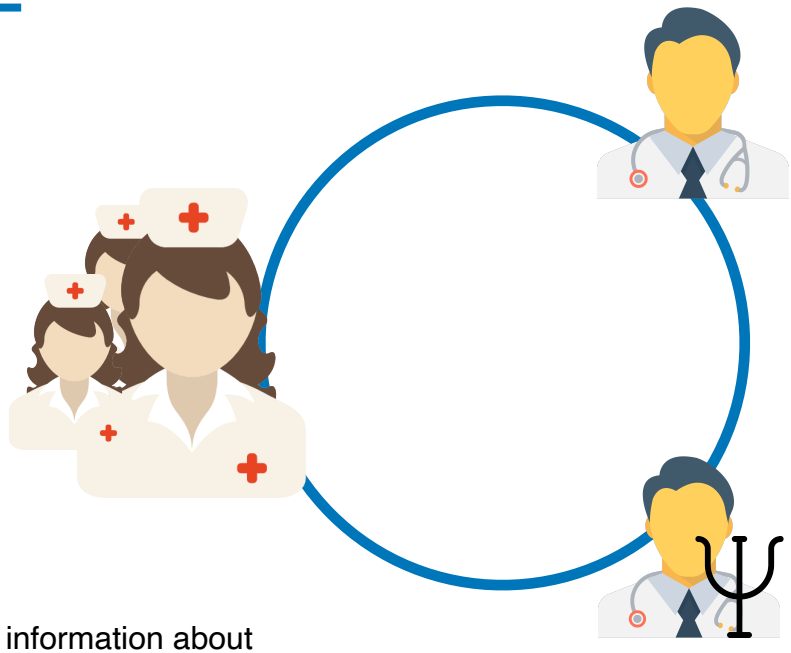
Be part of the current system
The product should be integrated with the current information system to support to reduce extra effort of learning.

Allowing exploration
As the interpretation of location data is subjective, the user should have the freedom to explore the location data.

Provide instant indicator
The product should be able show real time indicator of the care and conditions of the clients.

Feasible
The solution should be feasible for different users.

5.3 Target users



Motivation
- Receive a more objective daily report.
- Understand situations about the client.
- Get to know the client.
- Give care advice more efficiently.

Context of use
- Read care giver's report
- Weekly meeting

Motivation
- Collect situational information about client's behaviour and emotion
- Share information objectively and conveniently
- Get information support when making care decisions.

Context of use
- Taking care of the client then doing daily tasks
- Write a daily report.
- Prepare for weekly meeting (and other meeting).
- Updating care plan/drafting signal plan

Insight:
- Caregivers are the main users of the PSS.
- It would focus on helping caregivers collecting information, sharing information, interprating information and making care decisions with others.
- The optimal goal of the PSS design is to improve the efficiency of reach a care decision together between the three users .

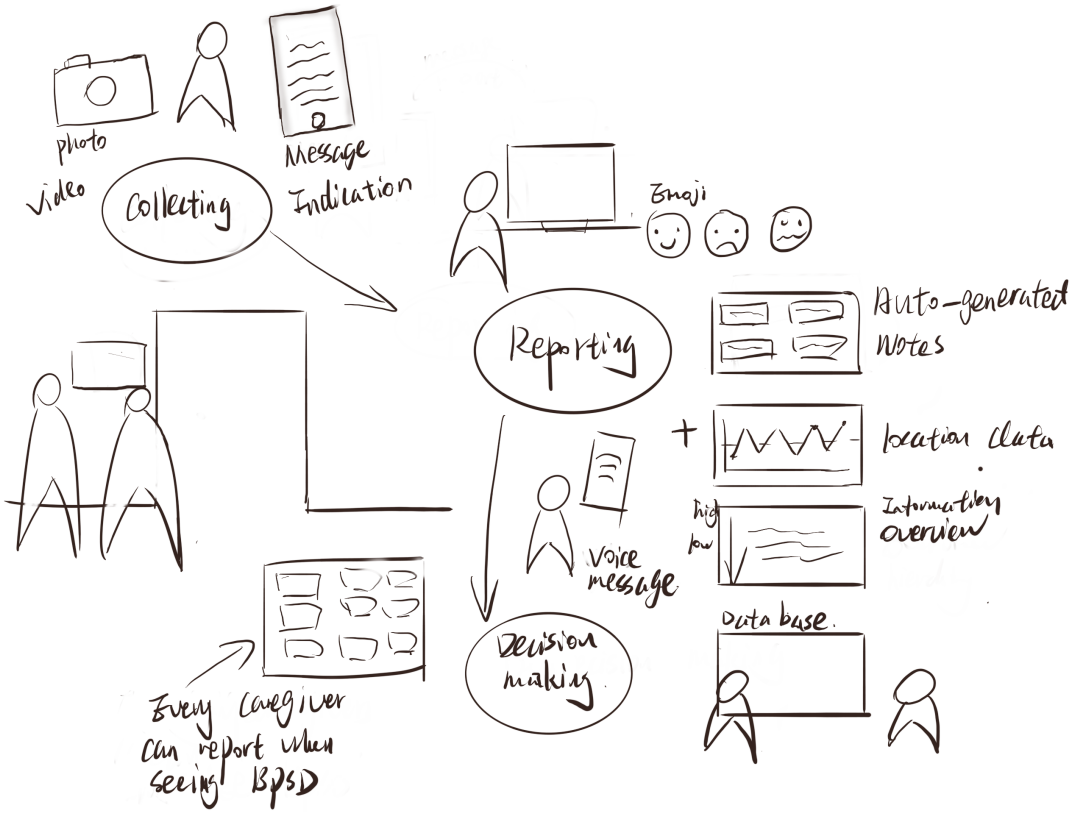
CHAPTER 6 - Conceptualization

This chapter shows three concepts generated by brainstorming method.

6.1 Ideation

Based on the filed research and the data brain-storming session, I did an elaborate brainstorming related to these insights(Appendix 3). The brain-storming questions are:

- How to collect the condition of client?
- How to write the daily report?
- How tp write the daily report more objectively?
- How to share the information with other care professionals?

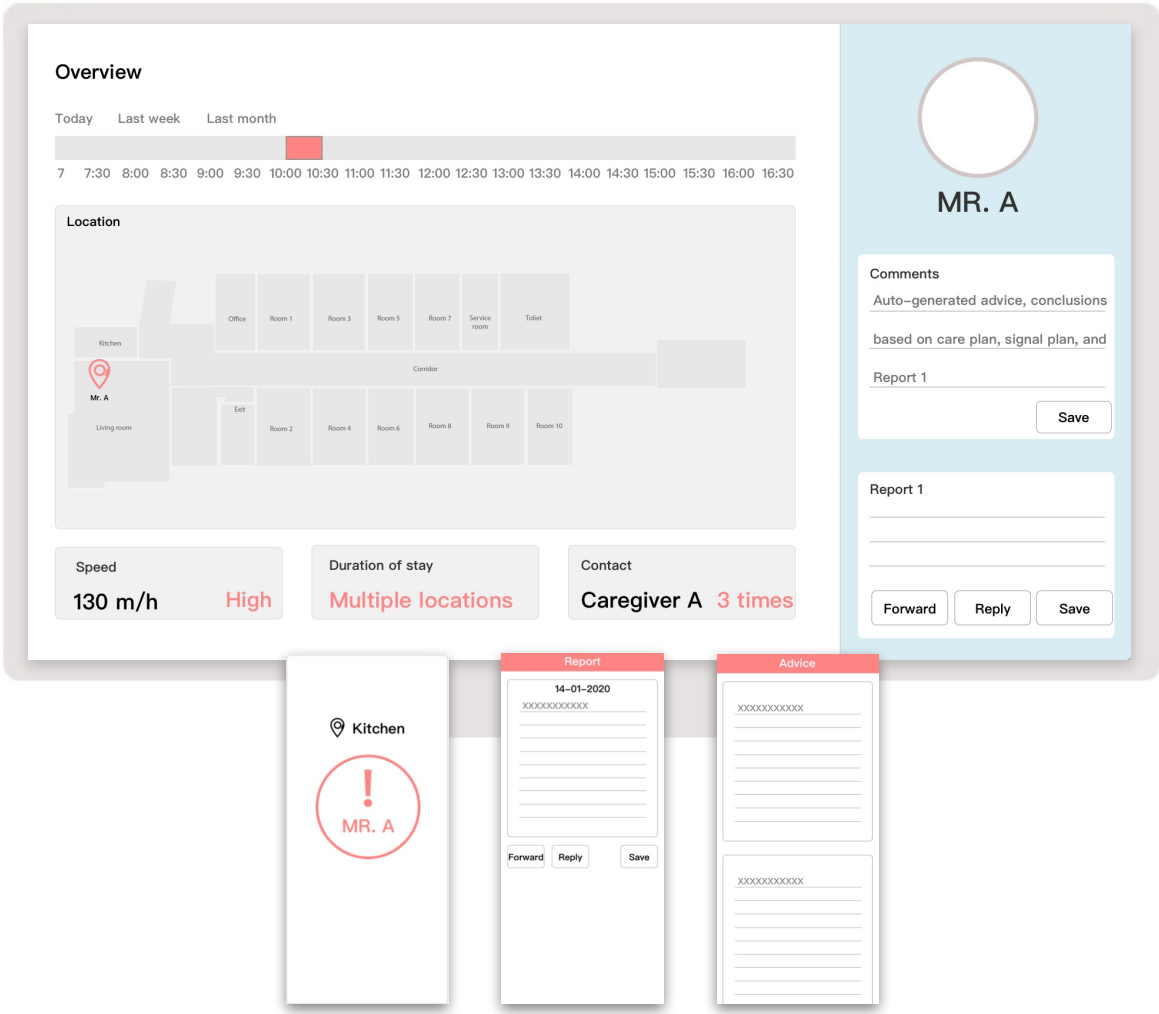


6.2 Concept 1-Monitor platform

The concept is a platform combining the location data and other qualitative data such as previous reports, the signal plan and care plan. It is aimed to help the care giver be more aware of the condition such as agitation and help them report and communicate with each other more efficiently.

So the text data can be filtered out as a reminder or guidance to tell if the client is stressful and find ways to help the client.
When the situation need to reported, the care giver can report remotely with the application or contact with other care professionals with if all the measures in the documents did not work.

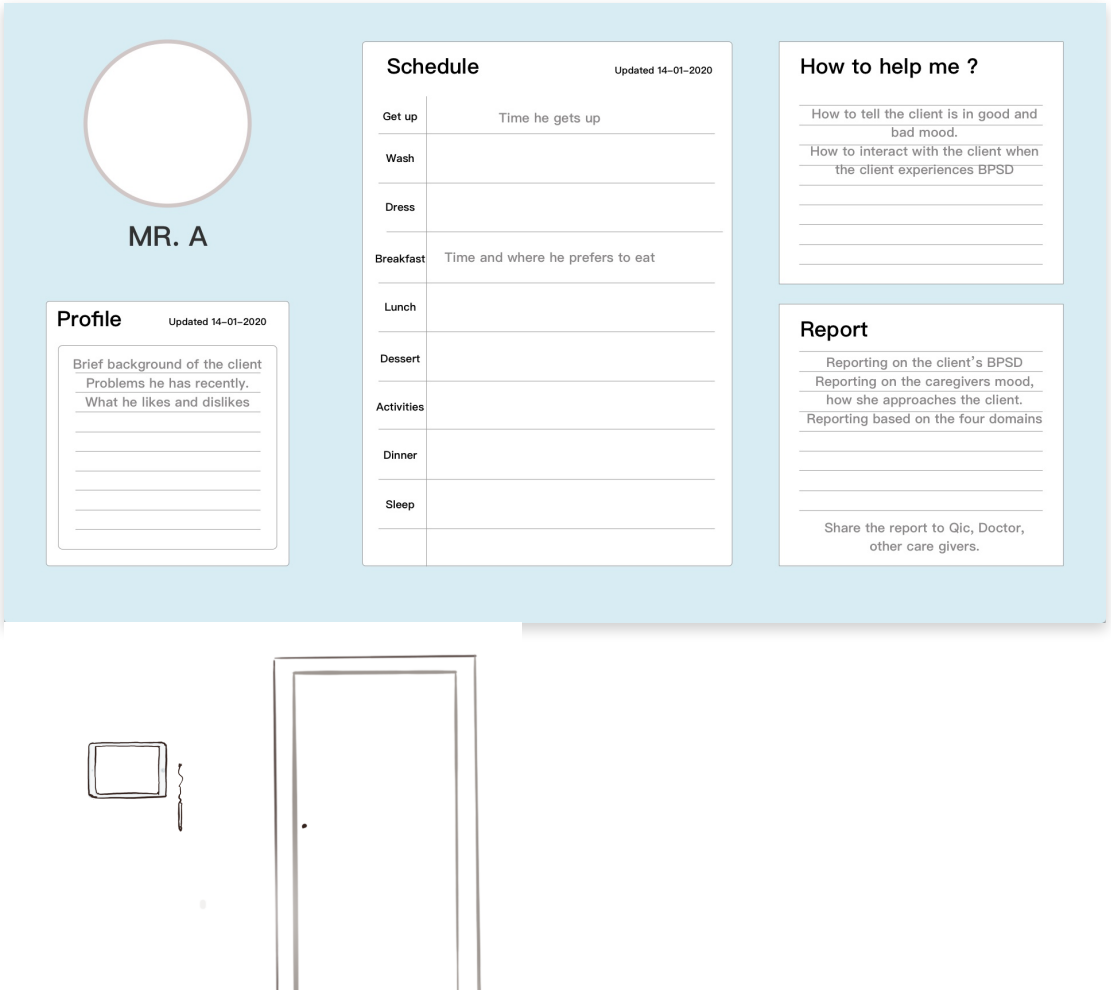
As the care givers writes report subjectively and sometimes it is incoherent, the auto-generated advice and conclusion is designed to help their writing to improve understanding of the condition.



6.3 Concept 2 - Information pad

This is an information pad that can be attached to the wall in the corridor. It allows every care giver to write a draft report when they see someone showing BPSD. In this way, the care givers will be able to help receive the client's condition information more collectively and therefor they can write the report more efficiently every evening.

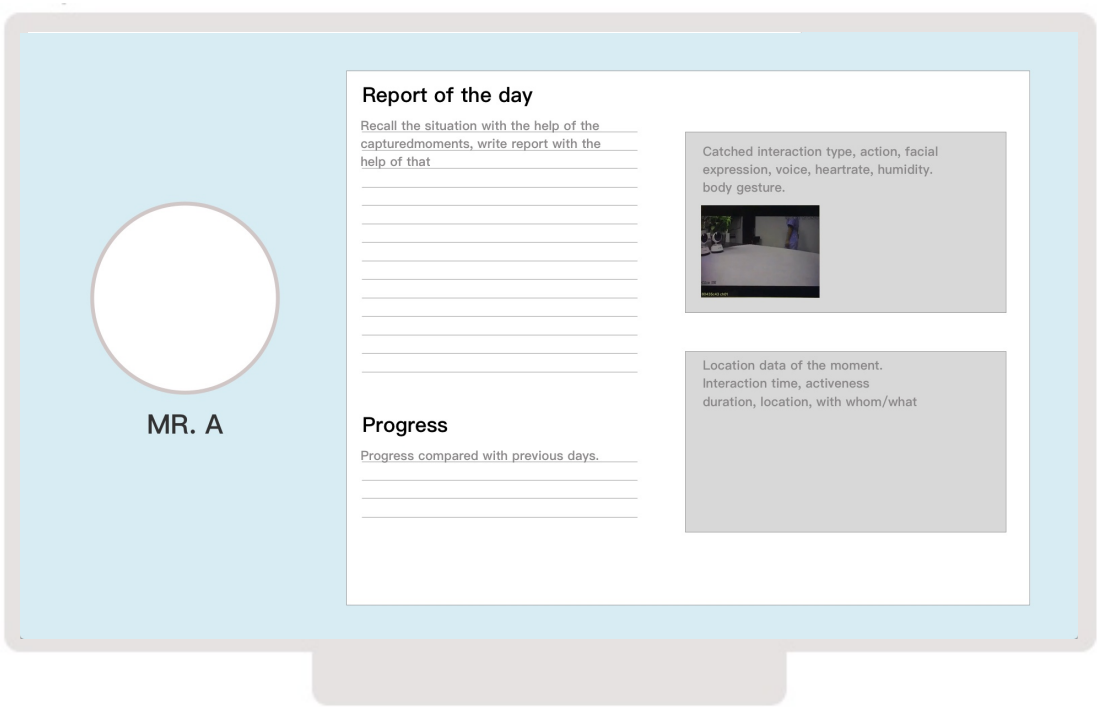
As not every care giver knows all the clients so well, the care giver need information support in terms of the clients' condition. Recent condition of the client is shown to let the care givers to know them quickly, the guidance will also be shown to the care giver to deal with the situation.



6.4 Concept 3- Camera recording

This concept is aimed to reduce workload of the caregiver recording the clients' conditions. Camera with facial recognition and motion detection is used to record the client's movement and behaviours.

The system is able to list all the information for writing the daily report, care givers would be be more aware of what happened to the client, and be able to share the information with other care professionals efficiently with the information.



6.5 Expert consultation

Feedback on the three concepts is collected.

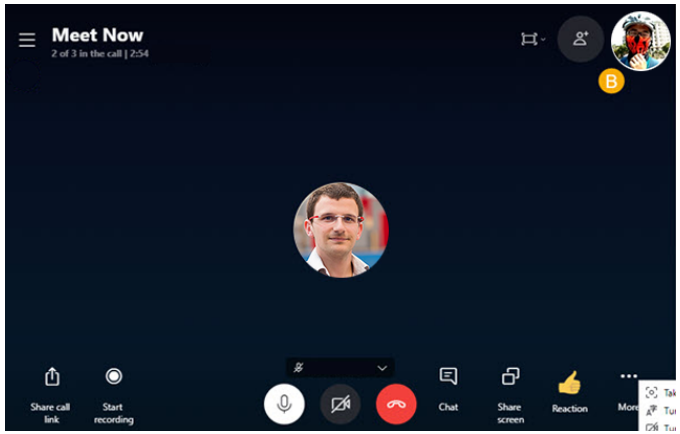


Figure 9-Skype meeting with Jacky

The first session is collected with Gubing Wang, a dementia expert in Tu Delft. She knows the the client and care givers well. The goal was to collect feed back on the viability, feasibility and desirability of different concepts.

The second interview is done with Jacky, who is a data expert from IO faculty of Tu Delft. The aim of this interview was to consult on the feasibility of technologies of process the qualitative and quantitive data.

Viability
The first concept is the most viable concept. The main reason is that it changes little of the current workflow while the second concept changes the workflow too much. Camera in the third concept is not preferred as the client's privacy is valued in the care team.

Desirability
The first concept is the most desirable concept as this concept support the current work flow. Different technologies are implemented in phases of the care givers' daily tasks. Word cloud in the second is interesting due to as it provide a eye-catching overview of the qualitative information.

Feasibility
From the dementia expert view point, the second and third concept are not feasible for care giver's working flow. Therefore the main questions I consult Jacky is what dat technologies are ideal for processing the qualitative and quantitive data. According to Jacky, the process of combination of qualitative and quantitive is a topic data scientist are working on. Processing these two types of data separately is more feasible in the the current concept. NLP(natural language processing) is recommended by him. However, I think in this project the requirement from care perspective is more important, so this feature need to be reconsidered.

Conclusion
Concept one is the concept to further develop in terms of evaluation in these three aspects.

6.6 Iteration

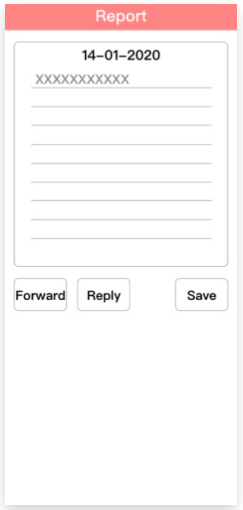
10:00 am

When the client experience agitation; the app shows alert and location of the client.

10:02 am

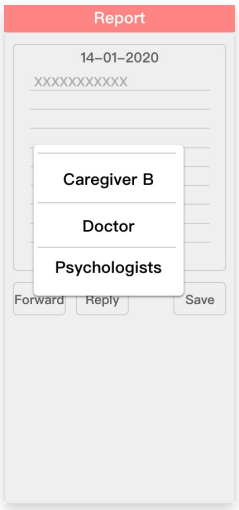
Care giver can check guidance on signal plan and it will also give advice based on care plan and daily report.

10:32 am

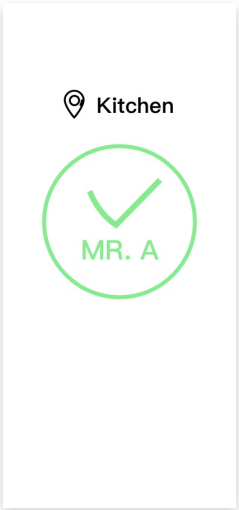


If the guidance or any other actions don't work, then care givers can write a report of this situation, share it with location data to other stakeholders:

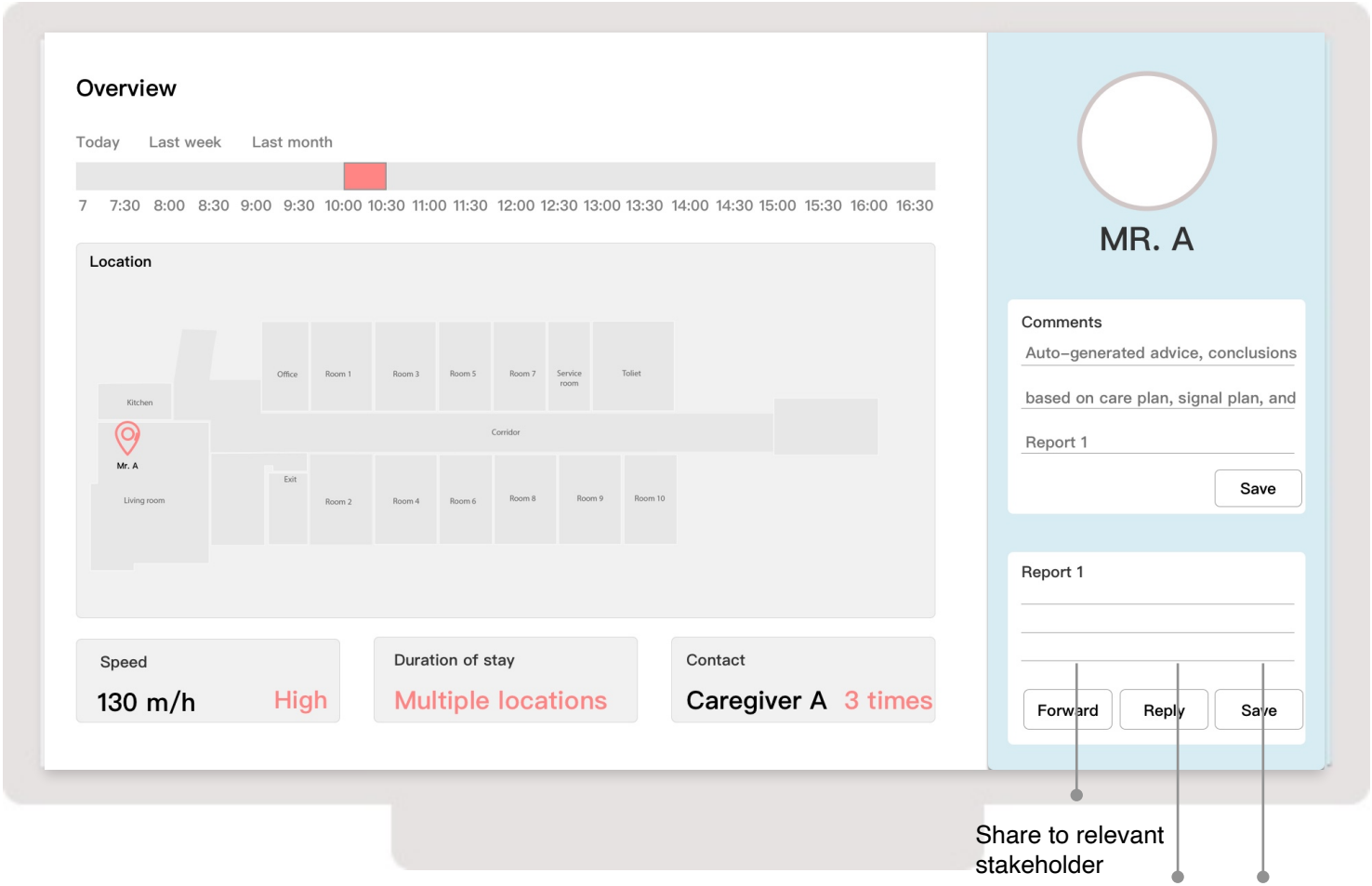
After taking action, the app shows client is getting relaxed.

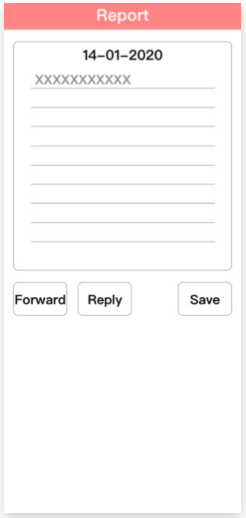


10:32 am



10:33 am





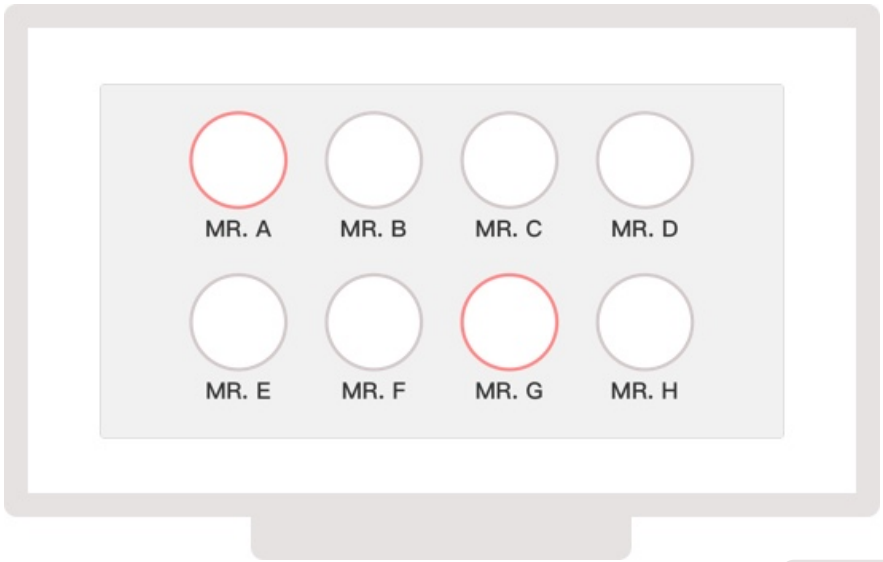
Relevant stakeholders receive a report on their phone or computer.

Share to relevant stakeholder

Save to Qic as a report

Reply to the caregiver.

5:00 pm

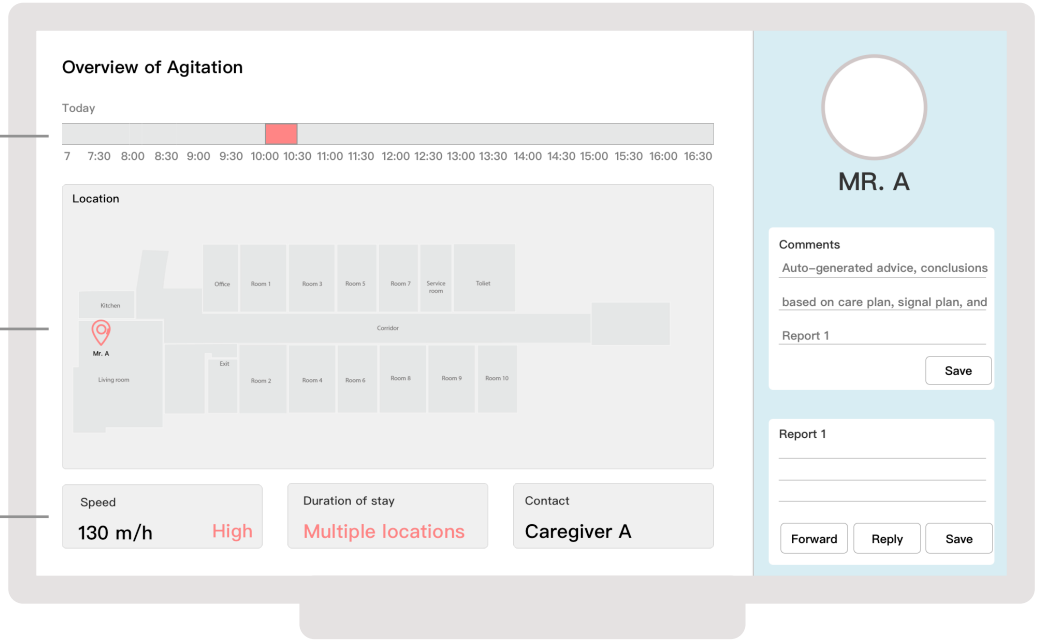


When writing a daily report, there will be an overview of to-day's client agitation conditions

Care giver can see at what time the client get agitated.

Caregivers can see where he got agitated and the person he contacted with.

From 10:00 to 10:30 am, the client's walking speed was really high; walked in different location and had Direct contact with care giver A.



6.7 Feedback collection

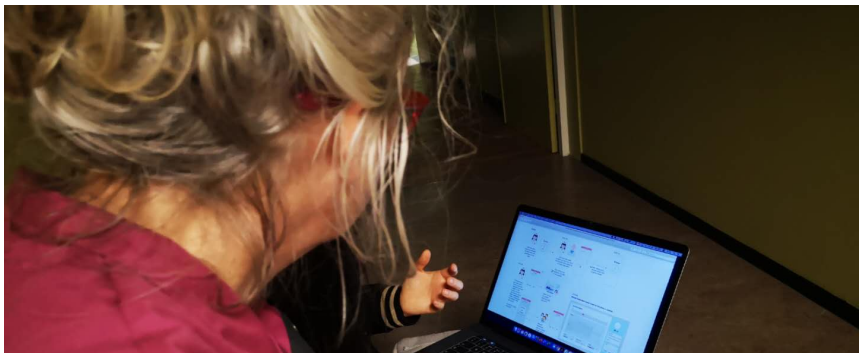


Figure 9-Feedback collection with caregiv-

Feedback on the concept is collected in the nursing home. Two caregivers and one doctor are interviewed.

Can location information be directly linked to agitation?
Agitation can not be diagnosed only by a single location indicator. Location information can only help them evaluate it.
"I don't always diagnose agitation by speed."-Care giver

Agitation behavior of different clients are defined differently. The behavior of one certain client be progressively developing along time. Shouting, sweating and etc are all possible.
"It's good, it shows he goes to multiple locations, but I can walk fast and I'm not agitated." - Care giver

Can it improve caregivers' report?
The location data can help doctors to evaluate care givers' writing, especially when they are emotional.
"When you are emotional about the patient, good or bad, you will make it bigger. It helps us to see if it really happens and give better support." -Doctor

Will it be helpful for exchanging information?
The platform implemented with location data enables the care givers to exchange information more conveniently.
"So they can adjust care plan quickly."-Doctor

Can it help you with care planning?
Alert/Progress indicator can help inform the client's condition change, and make actionable decisions.
"You can see the signal is going down, it gives you a good feeling".-Caregiver

Suggestions
Observable writing, no interpretive writing
Care givers tend to write interpretive description of the situations. What would be more helpful is the observative data.
"What I want is to keep their report clean. If they put emotion in it, she will say "she likes it", I want they say "I saw she likes it". I want it to be more observative, not interpretive." -Doctor

Care givers won't have time to read tips
They prefer to rely on their experience to approach the clients. The advice from care plan is helpful, but they don't have time to take out the phone and read it.

Privacy
There is a privacy issue to be considered. According to the doctor, it is not ethical to monitor the clients all the time. And it is also unnecessary to monitor all the clients as some of them doesn't have the same symptoms.
"Do you need to monitor everyone?"

CHAPTER 7 - Final design

This chapter shows the detailed design of the final product service system.

7.1 Defined use of location information

After iteration of the concept, it's time to implement the defined location information into the final design, according to the hypothesis test, the useful location information are"life safety", "sleep management" and "socialization management". Since in this project, the hypothesises are not all the possible use of location information, by doing explorative analysis, care givers would be able to find more insights about the client.

Life safety
Definition
Life safety means the client's physical safety. The client need to be far away from the unsafe area. So the information used will be location, distance to the location. Time and times getting close to the unsafe area.

Sleep management
Definition
It means the management of client's sleep disorder at night, especially situation where the client gets up. Besides, `care givers need to plan the times of night checking. client's checking times, check time are also useful. Direct interaction time and direction interaction frequency would also be helpful.

Stress management
Definition
It means managing stress caused by being close to infectious people or items.
Walking speed change is the main specifications used in stress management. Other location information selected is distance to the object and location.

Socialization management
Definition
It is defined as the client is in need of accompany so that he/she will actively contact people for accompany. Hence, the information used will be direct contact, direct contact times and direct contact contact time.

Exploration
Definition
Explorative location data visualizations can be applied for the care givers to find the potential reasons of problems in the four directions. Also, other useful insights might be found through explore location data. Care givers can share the finding with doctor and psychologist to ask for advice.

7.2 Main workflow

The main workflow covers caregivers using the platform to manage the four aspects and sharing the information with other care professional to let them explore the location data(find potentially new insights.

BPSD management aligns with the care givers daily workflow, It helps manage the known BPSD. Care givers can use the information as an alert from mobile phone application to be aware of what happened to the client. And they can report it to the care team or save as a note for reference of writing the report.

Exploration can be used when the care givers need help when current solutions are not working. It is aim for doing data analytics can do data analytics to get to know the progression of PwD and find more useful insights.

Historical location data trends can be used to check the client's condition progress and help care givers to explore options and see if their care works.

Location data, care plan and signal plan can be taken as reference for argument of care givers report, so that situation can be more understandable and objective.

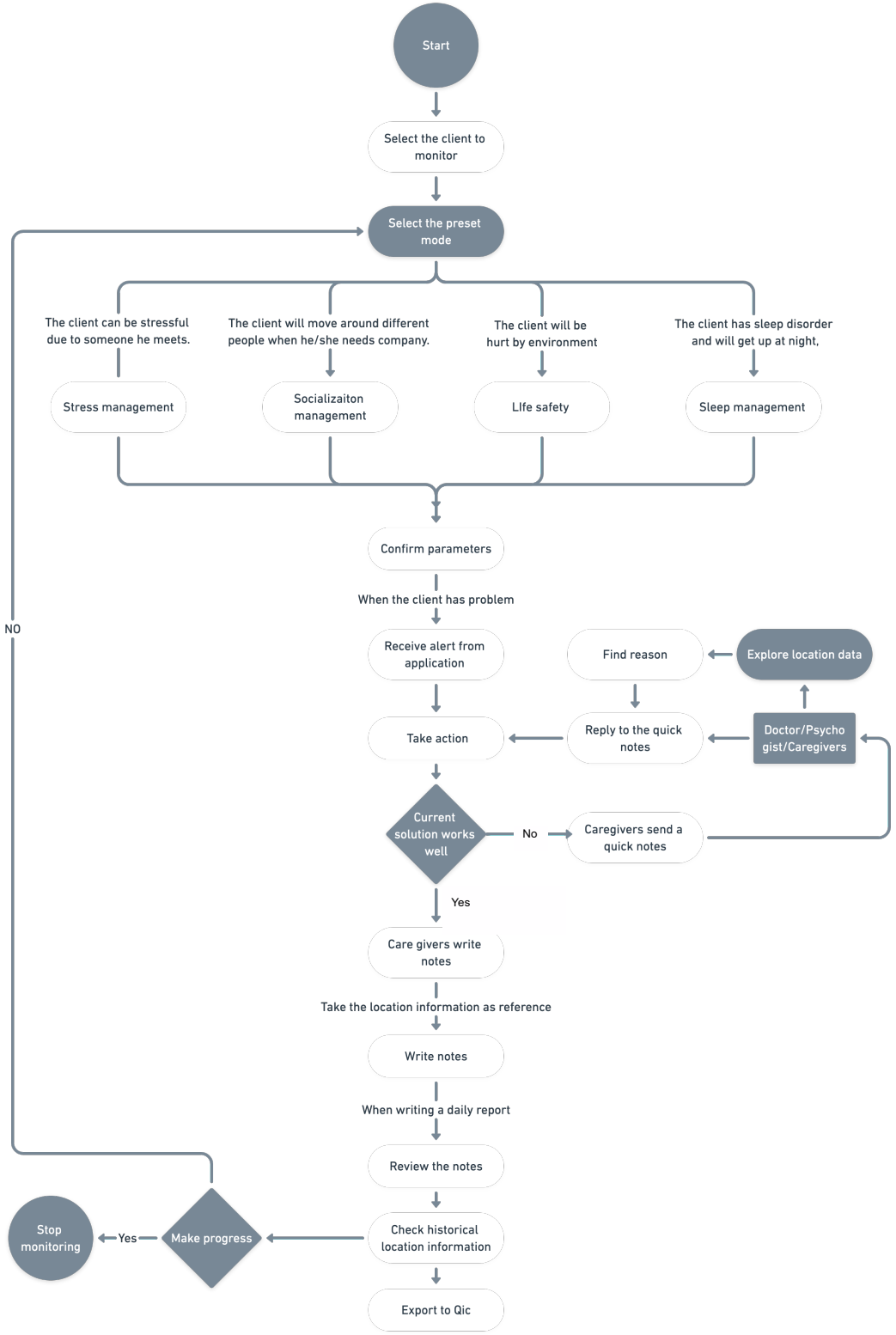


Figure 10-Feedback collection with caregiver

7.3 Main modules of PSS

The goal of the product-service system is to improve the efficiency of communication during the care planning process of BPSD management. It should be adapted into the current working routine, and the learning cost should be minimal. Hence, the platform and application integrated with IPS are put into current working system as a tool to collect information and support communication. The application is portable. It can display location information and important information for daily care. The platform is aimed for detailed analysis of location data, reporting and storing location data.

The communication between the tag and platform allows for the product to operate entirely on its own. The product itself would be able to attain its goal of tacking needed location data and display information. By using the interface on a mobile device, care givers can discreetly check, track and correct client's condition manually in the ward to have in-depth understanding of situations.

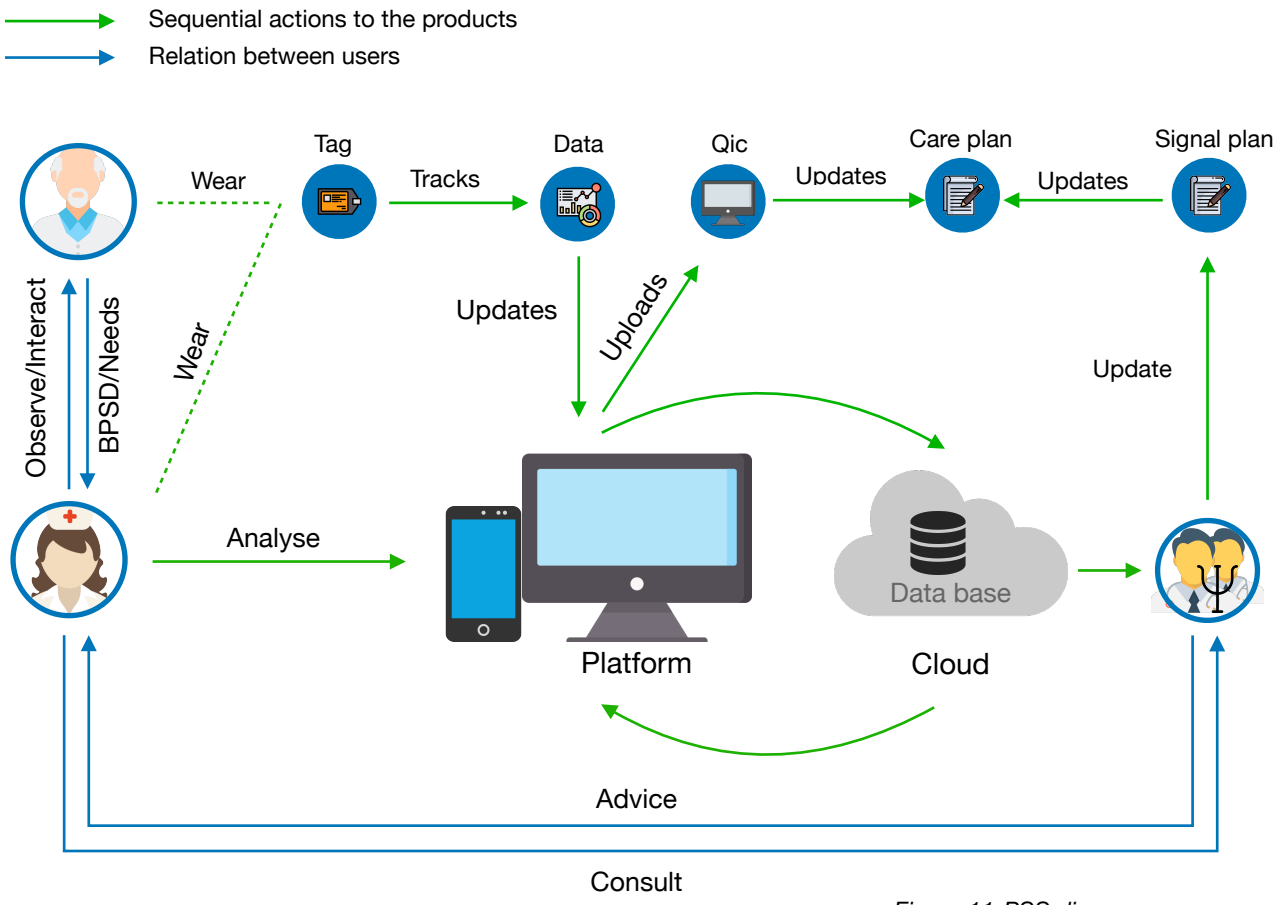
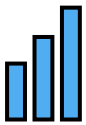


Figure 11-PSS diagram

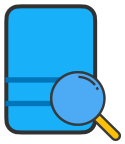
7.4 Main functions

Mobile application
The mobile application is used as an indication device. Also, it allows care givers to write notes anywhere and anytime. Care givers can send messages to other care professionals, which aims increase the availability and efficiency of the care planning.

Setting
The setting function allows users to select the aspects need to be monitored. Also, users can choose the location data they want to It gives users the freedom and a sense of control to the location data.



Management
Management module the pre-set module for sleep management, stress management, socialization management, life safety management. It shows daily location information and weekly location data change.



Exploration
This module shows all the real-time and all the historical data that allows the users to do data analytics and identify PwD needs and also the condition change. the possible reasons of the BPSD.

Notes
The aim of this platform is to support the daily report writing and it is part of the current system. This note enable care givers to write draft report immediate when the situation happens.

Message
Care givers, doctor and psychologist can send quick message to each other when there is an emergent situation.

7.5 Information architecture

Due to the fact that the PSS should be timely-efficient to use, “exploration” and “setting” are removed from the application. The wider visual range computer screen would be more suitable for data exploration. “Setting” is used less frequent compared with other function modules (it is often used when having a new monitoring taask.)

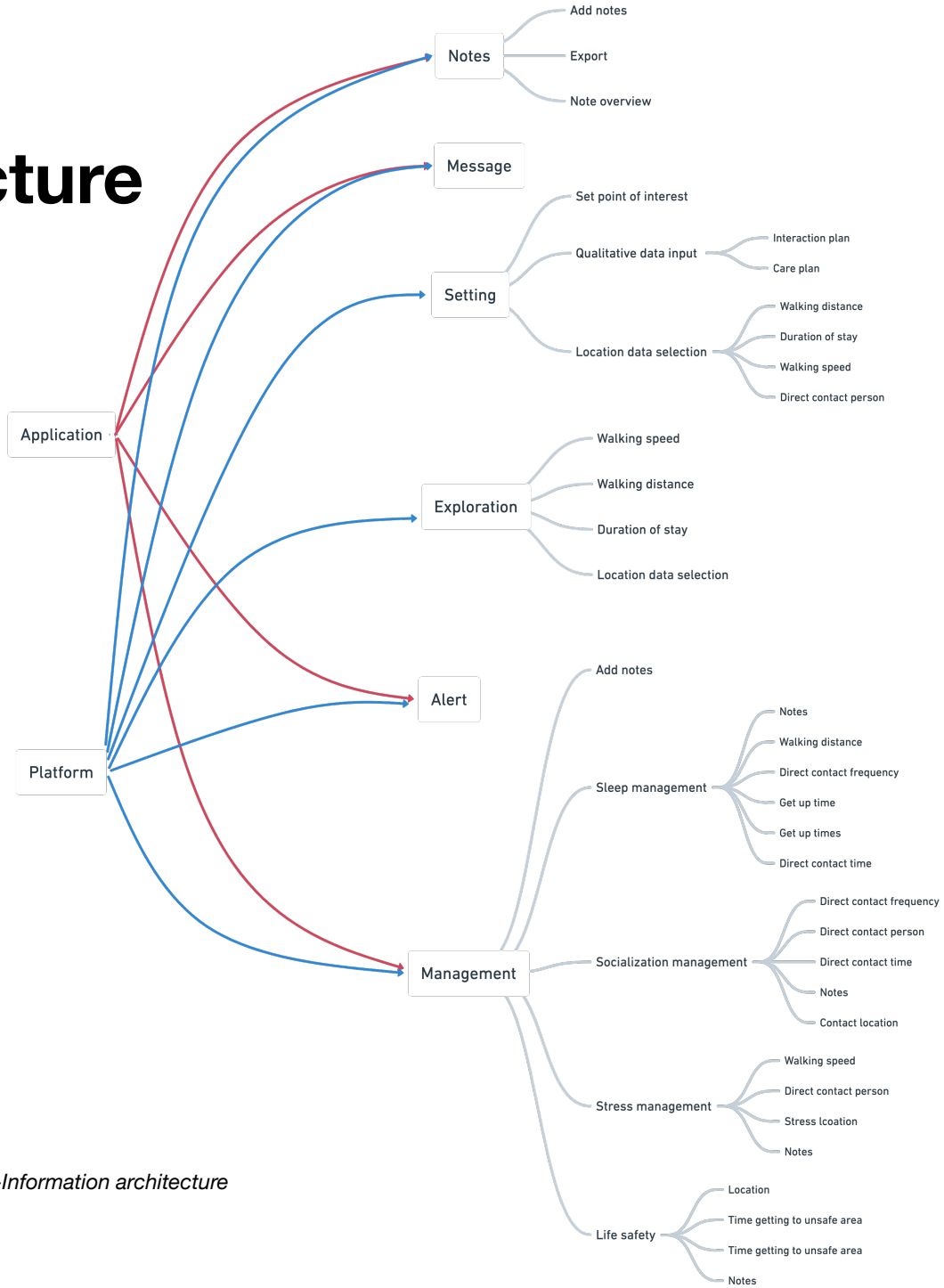
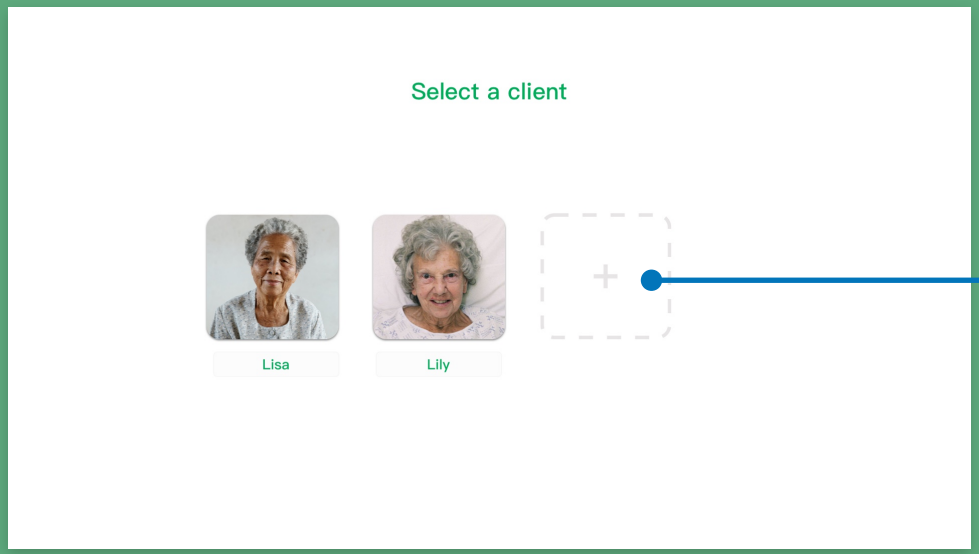
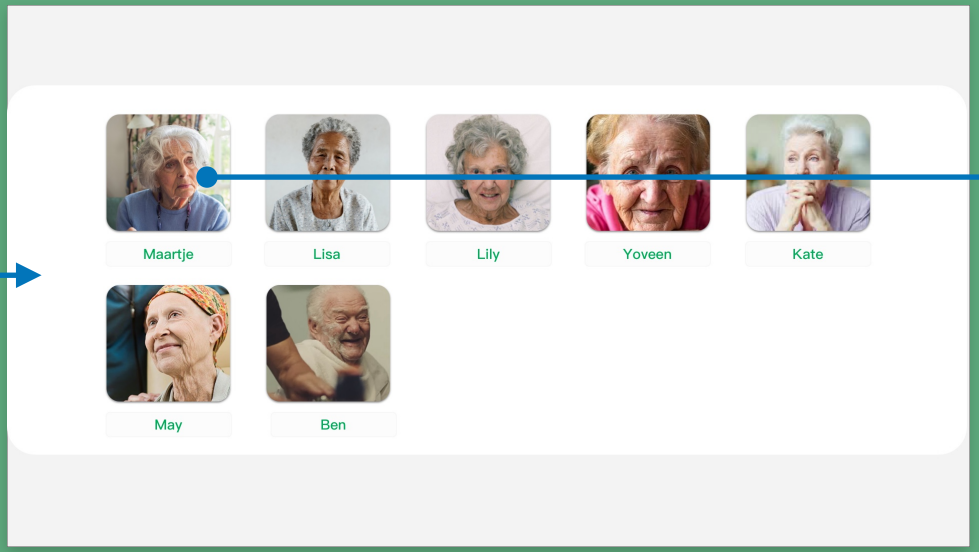


Figure 12-Information architecture

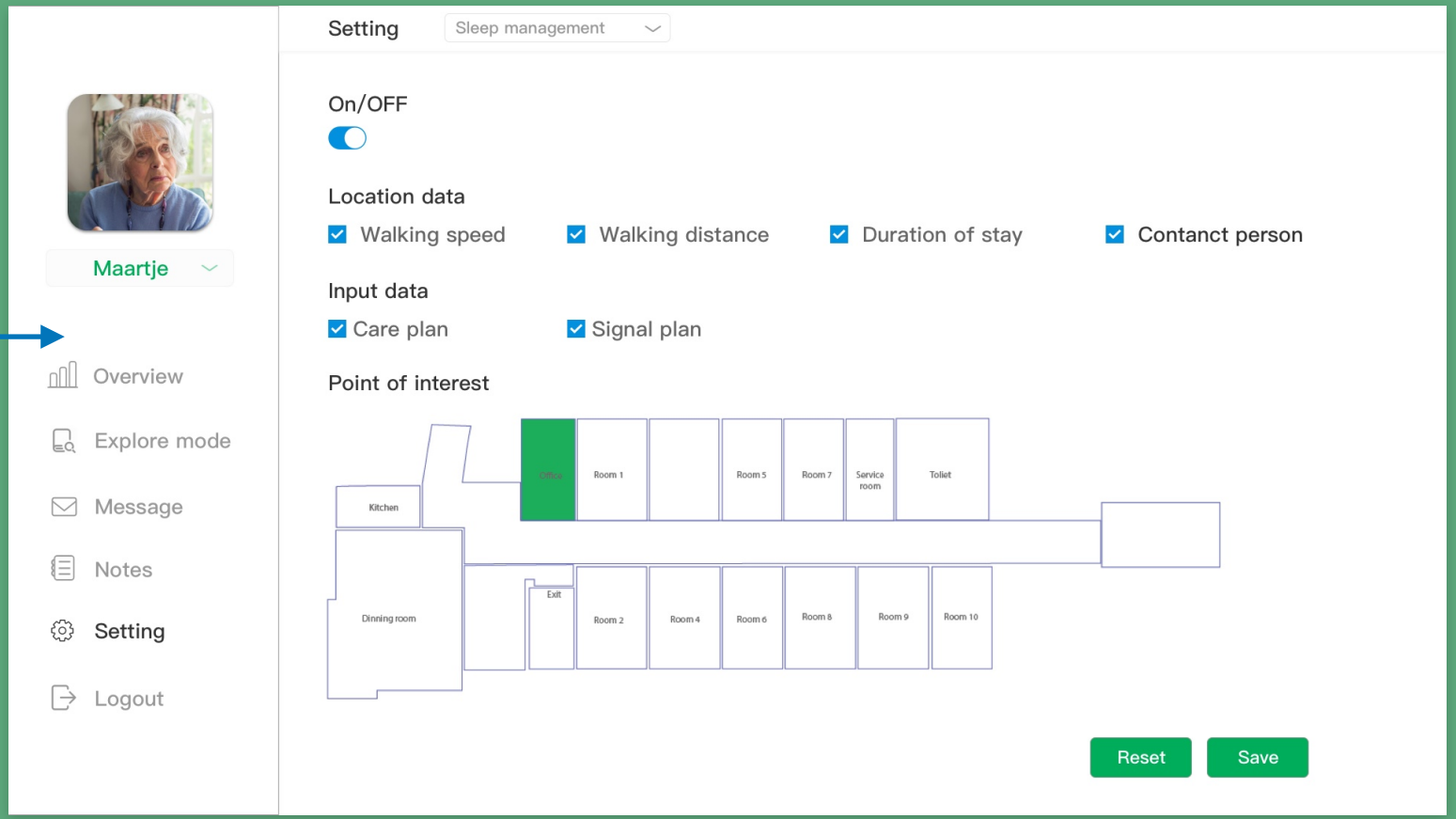
7.6 Main interfaces

Setting-select a client





Setting-setup management aspects



Drop-down list
It allows users to switch between different management functions to set up the parameters by clicking.

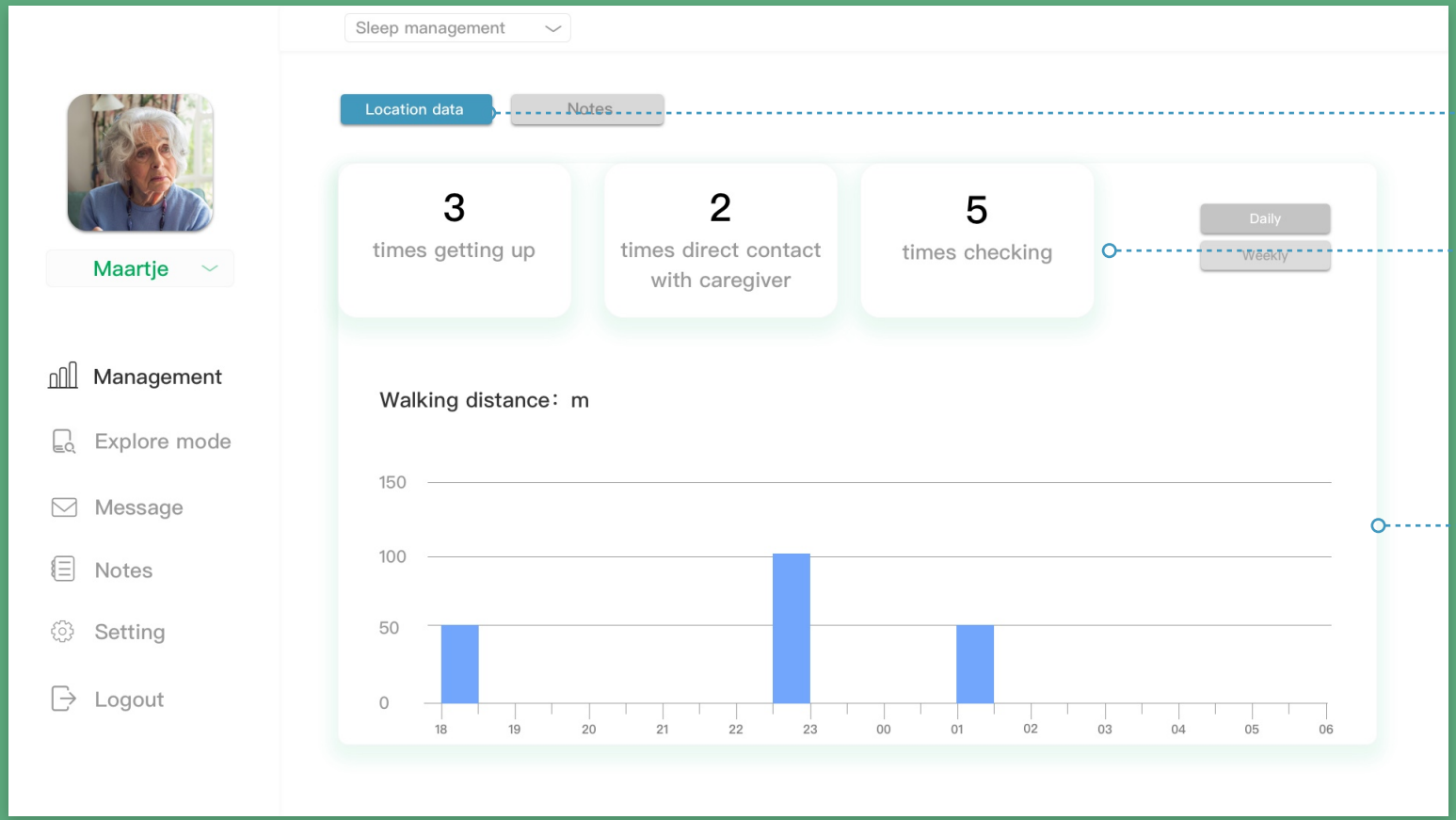
On/off
Users can turn on/off the management module by switching on/off.

Location data setting
The pre-set location parameters give users freedom to turn off the ones they don't need by unticking the box.

Input data
Care plan and signal plan can be selected as input for reference of report.

Point of interest
Users can select areas as point of interest by multiple clicking.

Management-Sleep



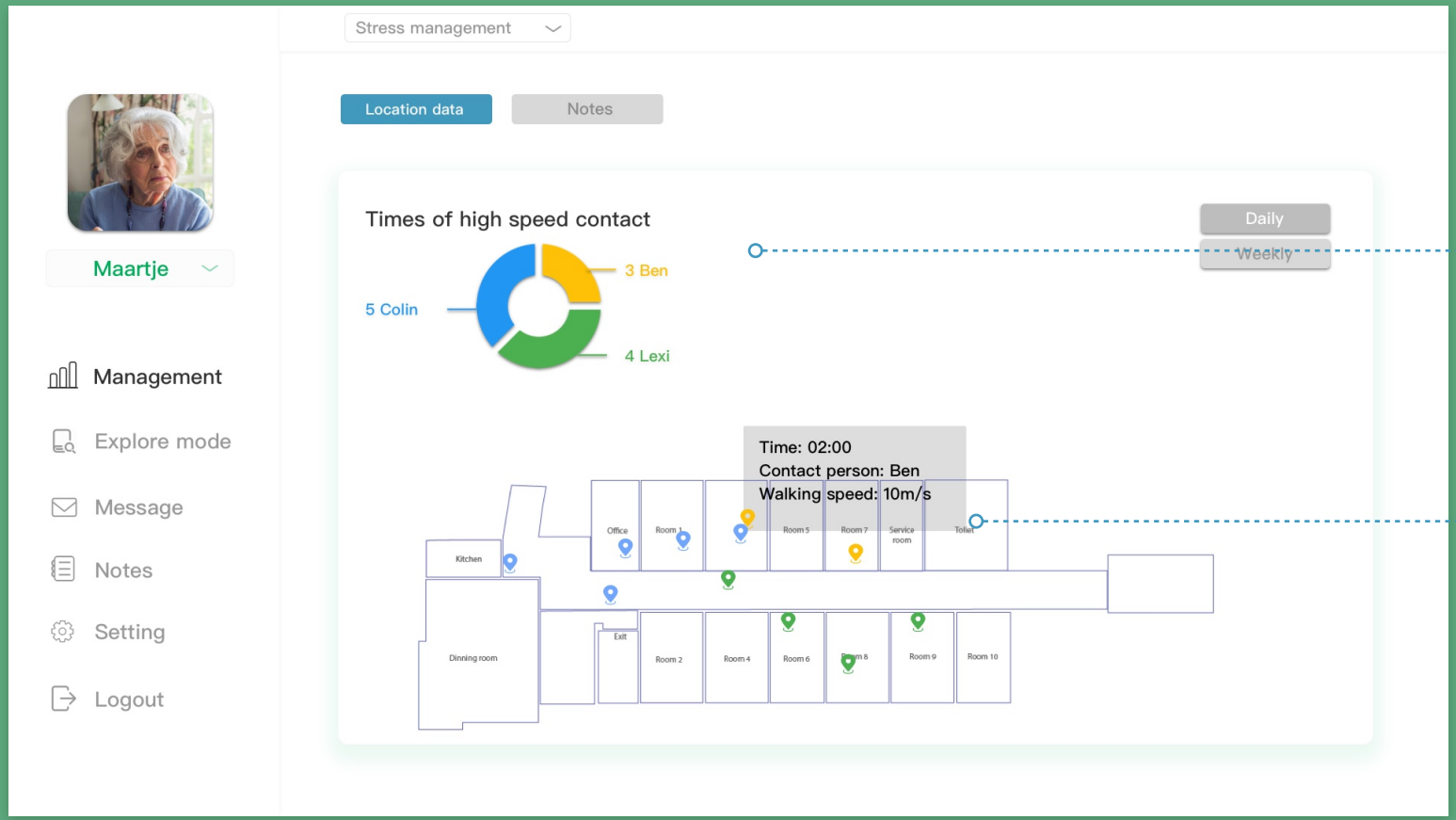
Location data page
It shows daily location information and weekly information.

Daily location information overview
It shows how many times the client gets up at night, how many times the client contact directly with the caregiver and caregiver's checking time at night.

Daily Walking distance diagram
Walking distance diagram shows when and how many times the

Weekly location data diagram
It shows the changes and trends of each location information. Users can tell if client's sleep quality improves or not by those information during a week.

Management stress



Daily location information overview
It shows with whom the client has contacted during the day and how many times the client has contacted with each person.

Daily contact floor plan
It shows historical data of this day. By hovering onto each anchor, users can see whom the client contacted with, when the client contact with the person, and the client's walking speed at that moment.

Weekly location information summary

It shows historical data of this week. Users can see time the client contact with different people.Also it shows how many times the client walks very quickly during each day.

Management- life safety

Daily location information overview
It shows how many times the client entering unsafe zone and how long the client stay

Unsafe zone floor plan
By hovering onto each anchor, users can see when the client enters the zone, how many times the client enters the zone, the client's walking speed at that moment and when the client entered the zone.

Times entering unsafe zone

Users can see times the client entering different unsafe zones, trends and changes during this week.

Management-socialization

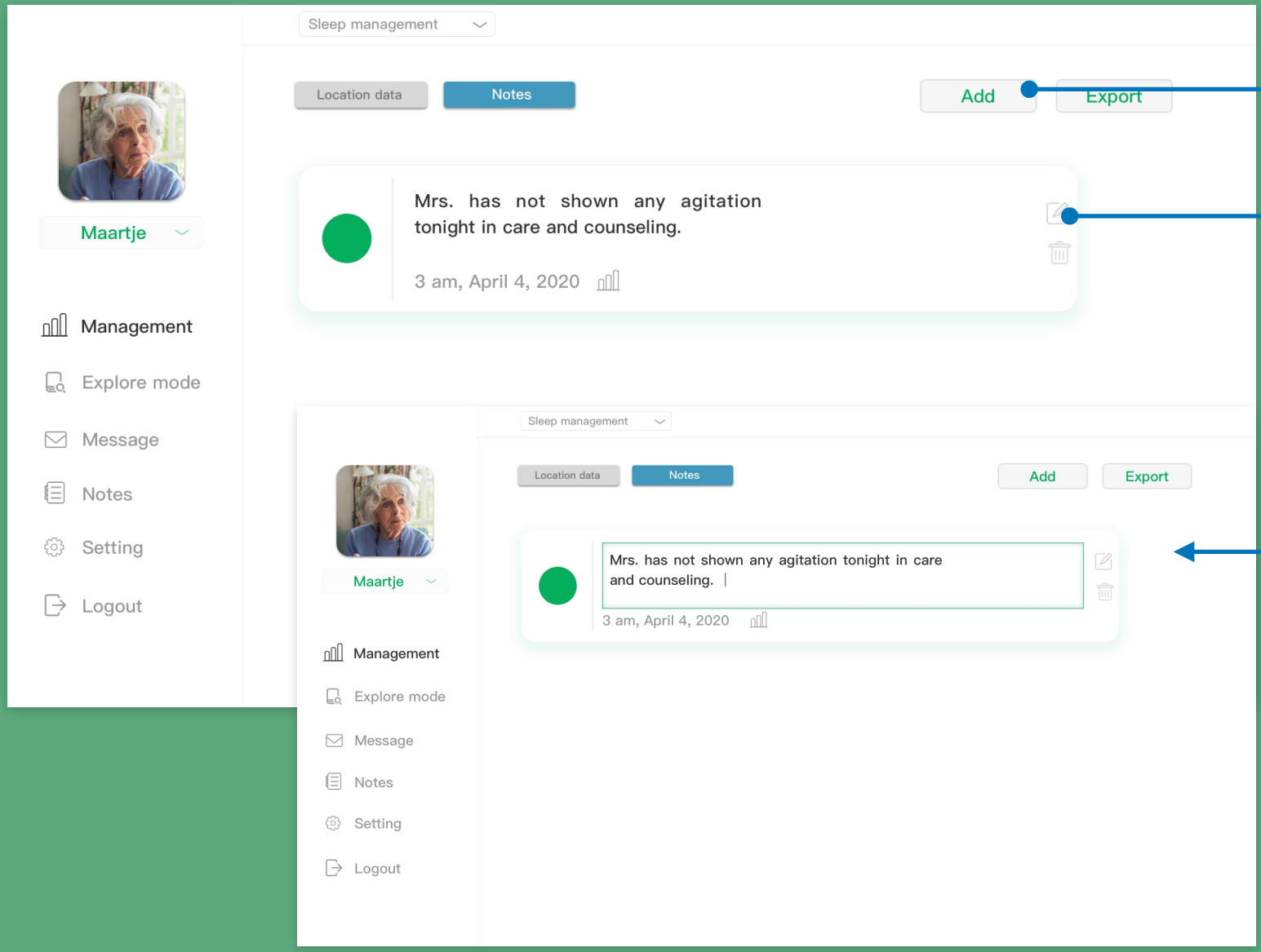
Daily location information overview
It shows when, how many times the client contacting with different people and how long they contact with those people during a day.

Direct contact floor plan
By hovering onto each anchor, users can see when the client contact with that person, how many times they contact with each other, where they contact and walking speed of the client.

Times entering unsafe zone

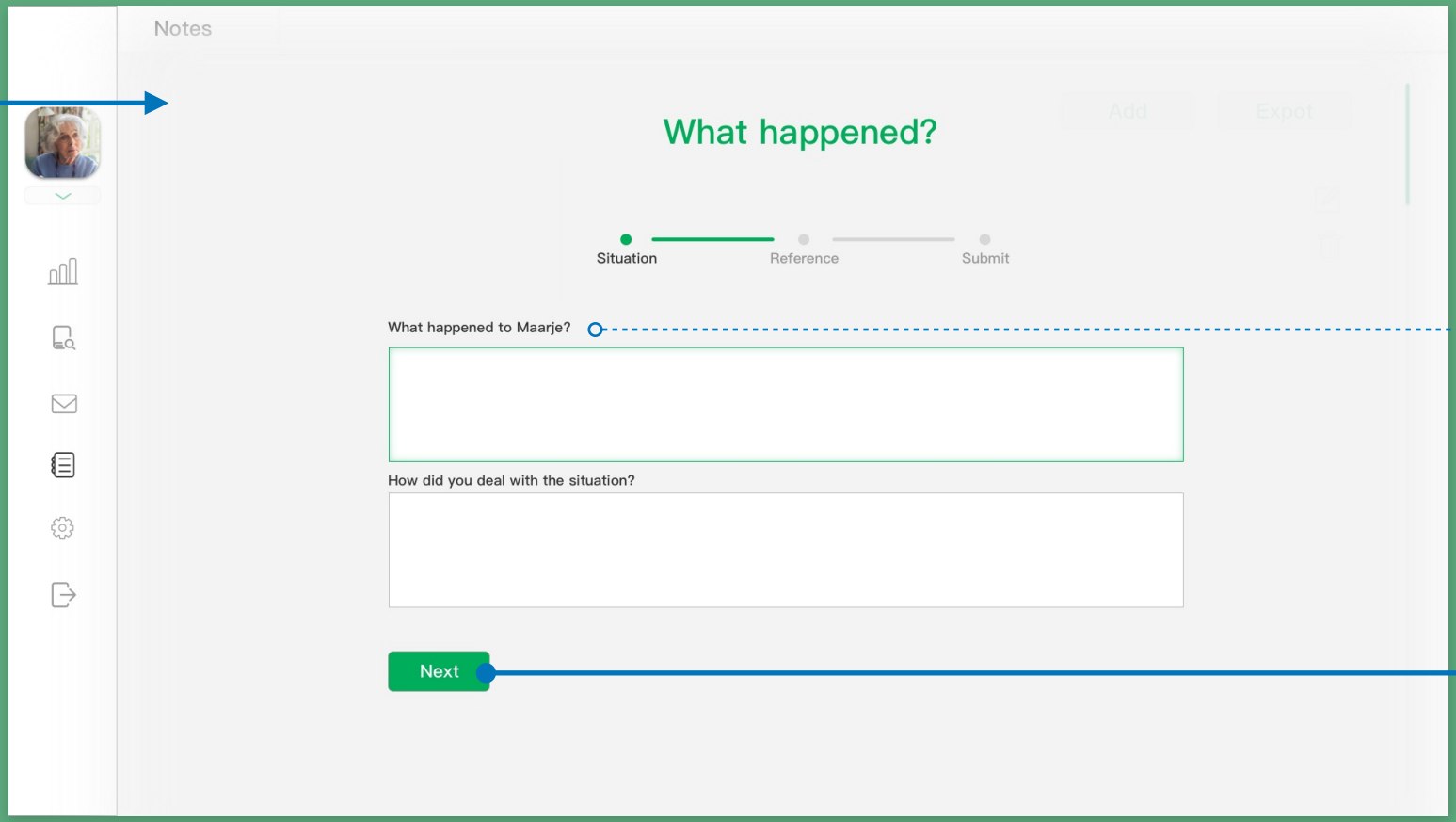
Users can see times the client contacting different people during, trends and changes during this week.

Manage-Daily notes

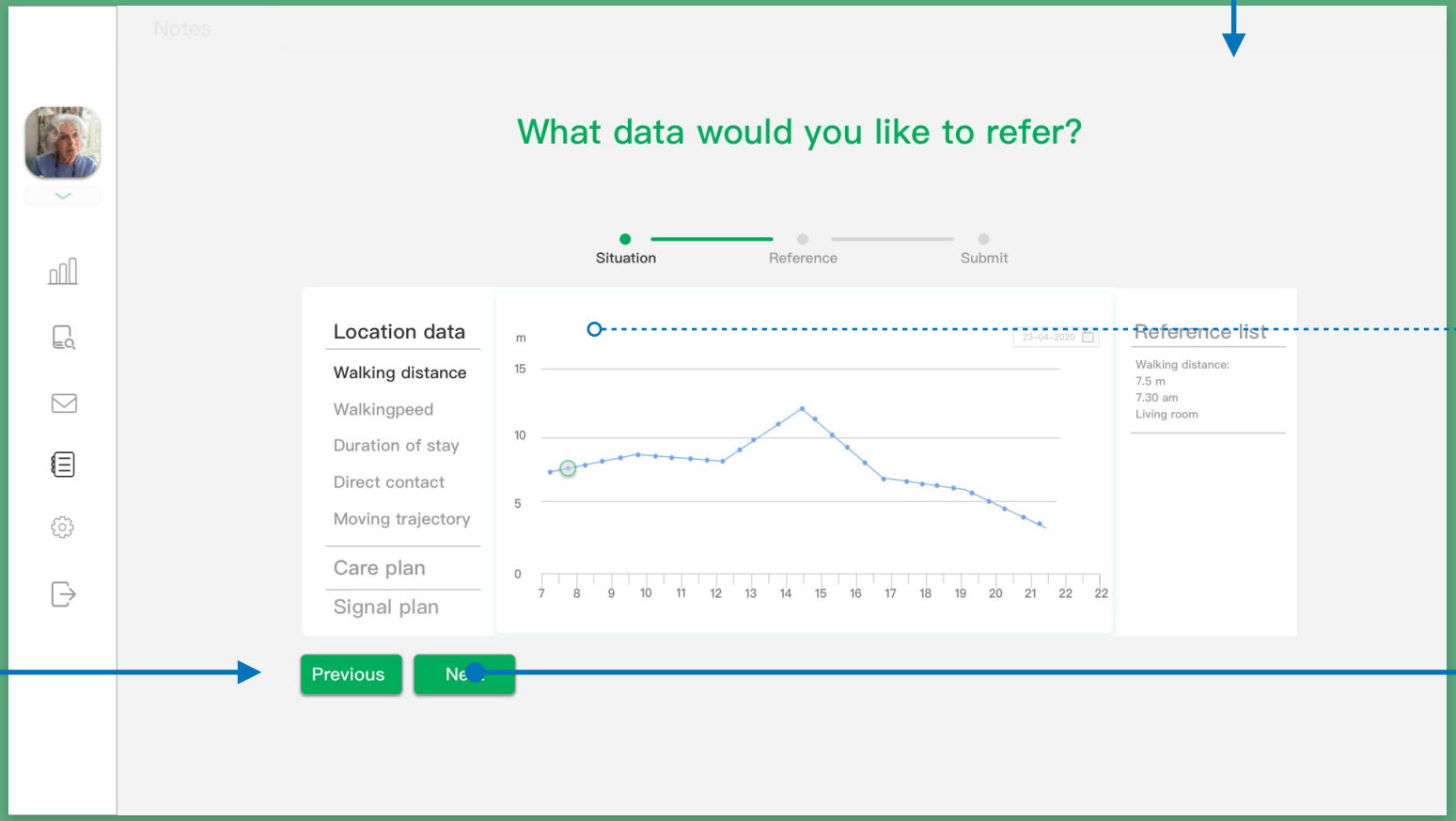


Add note
Users care add today's notes for reporting

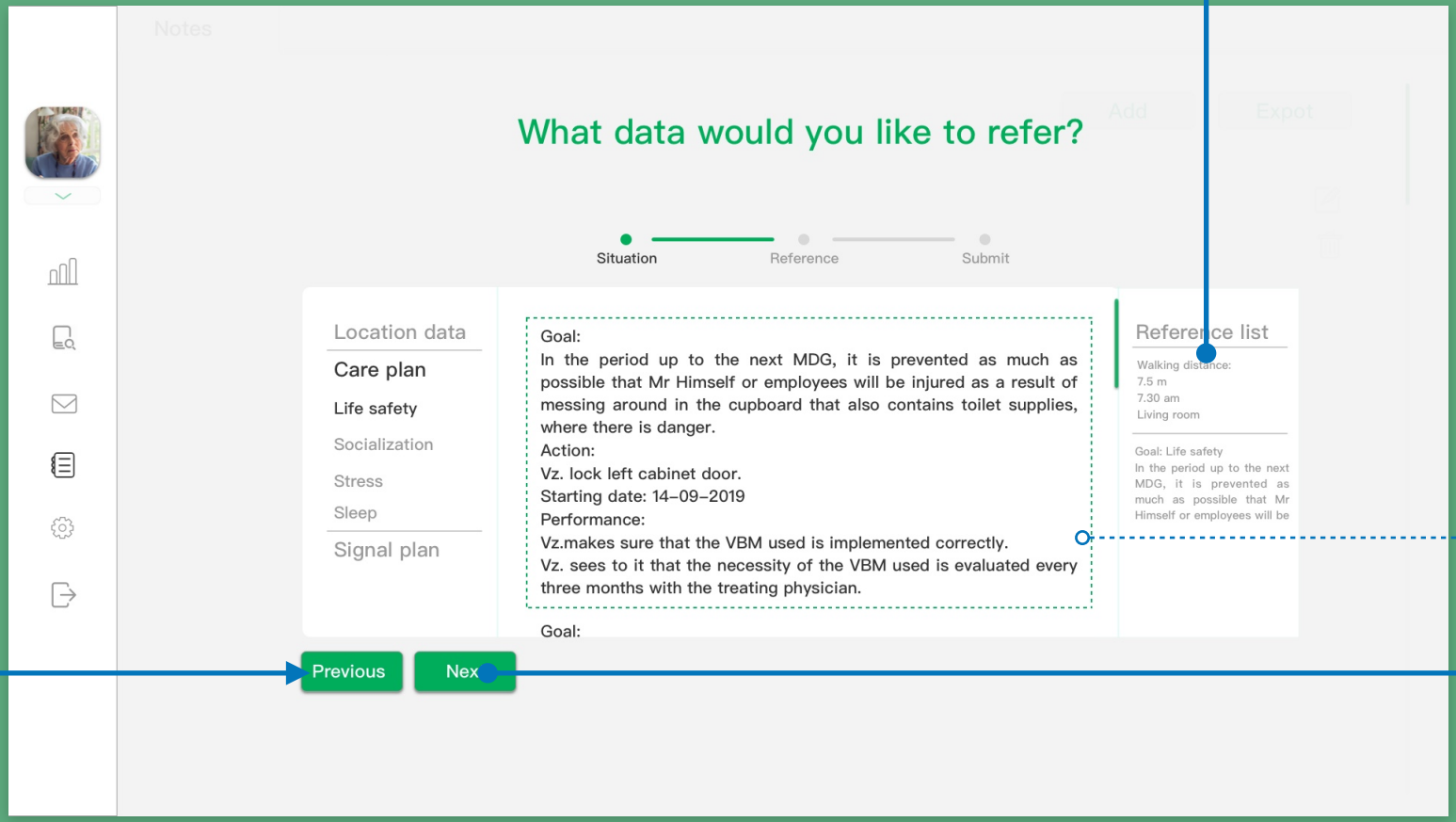
Edit note
Users can edit notes



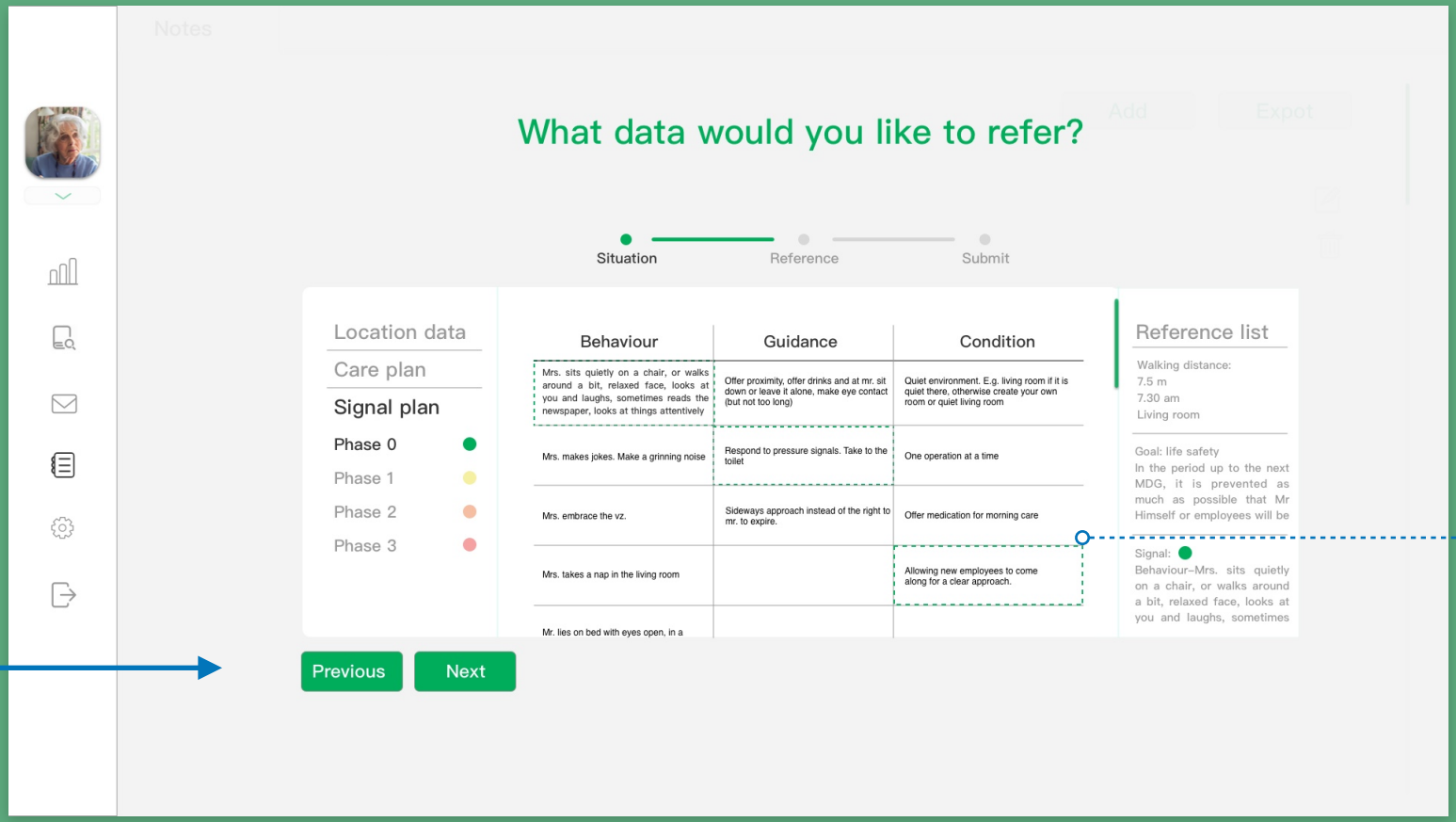
Structure of reporting
The structure guides the users to write the notes step by step, in order to write the notes more coherently.



Location data reference
Users can take location data as a reference to support their descriptive notes.



Care plan reference
Care plans (stored in cloud by NLP) related to the notes can be referred to help quickly reviewing and update care plan when write a report.



Signal reference
Signal plan can be taken as the reference to help the reader understand the situation and

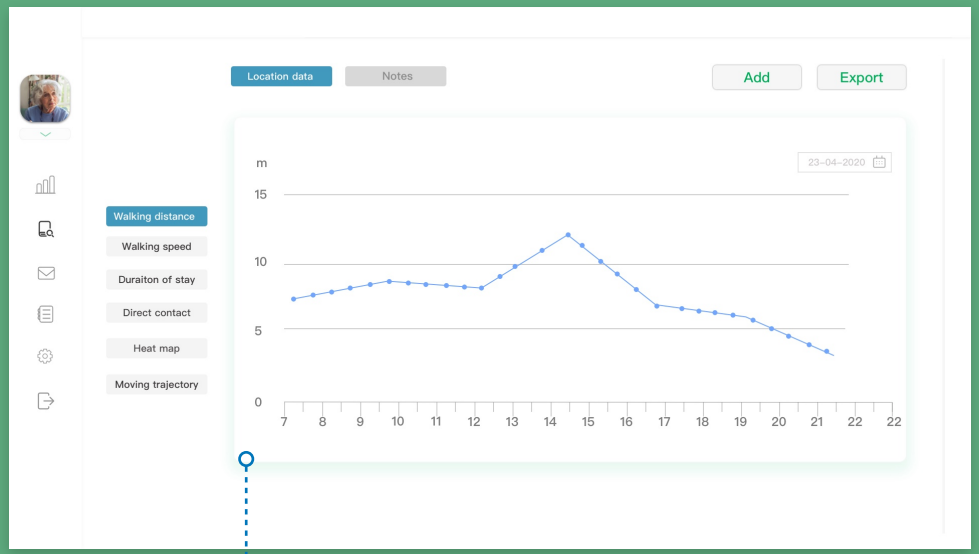
Notes overview

Export notes
Users can export notes to Qic as a daily report

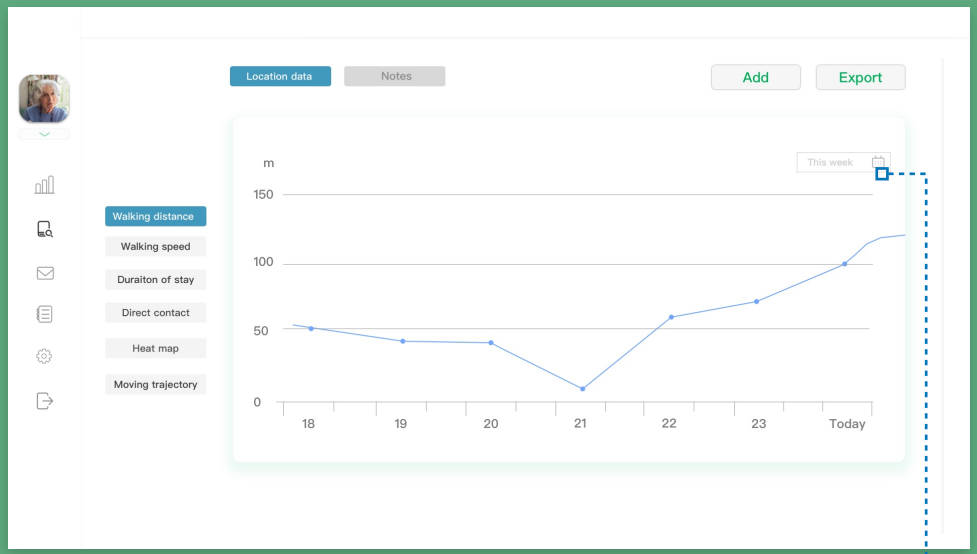
Stress level
Users can have an idea about the overall severity of client's stress level indicated by different notes with the eye-catching color code. The color code is corresponding to the signal plan.

Filter
Users can quickly select notes according date, categories and stress level.

Exploration-Walking distance

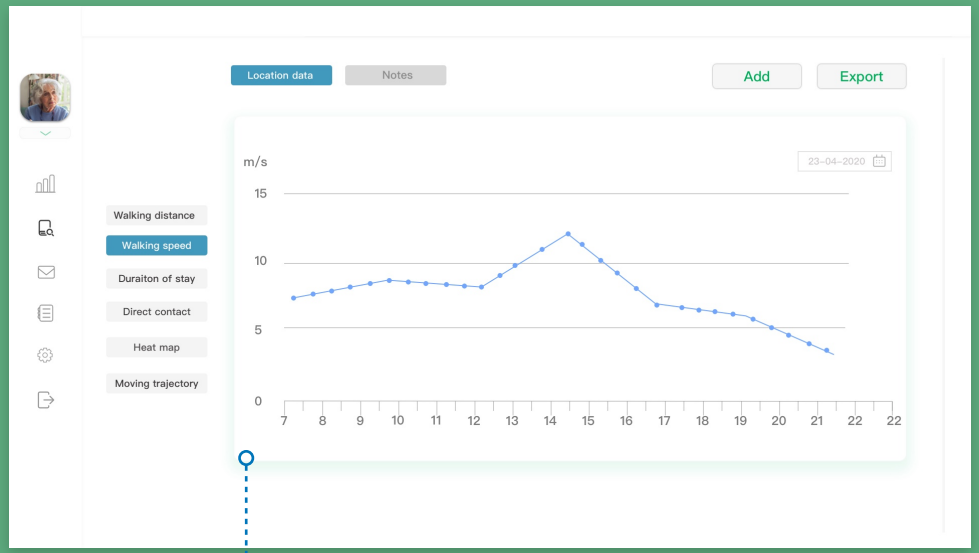


Real time walking distance
It shows real-time walking distance per 30 minutes during a day.



Date selection
Users can select the date to check the historical walking distance on different date.

Exploration-Walking Speed



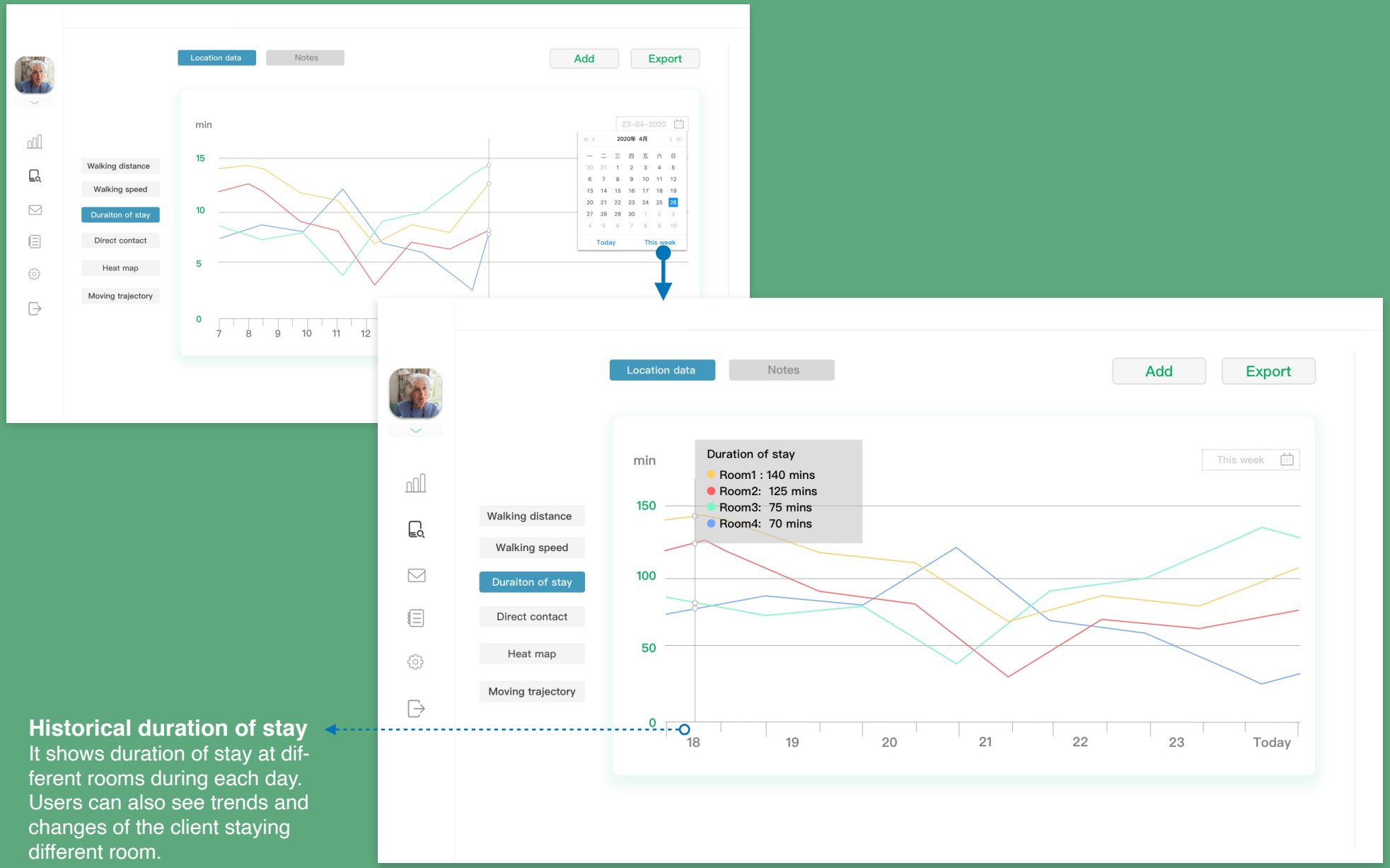
Real time walking speed
It shows real-time walking speed per 30 minutes during a day.

Historical walking speed during during each days
It shows real-time walking speed during each days

Exploration-Duration of stay

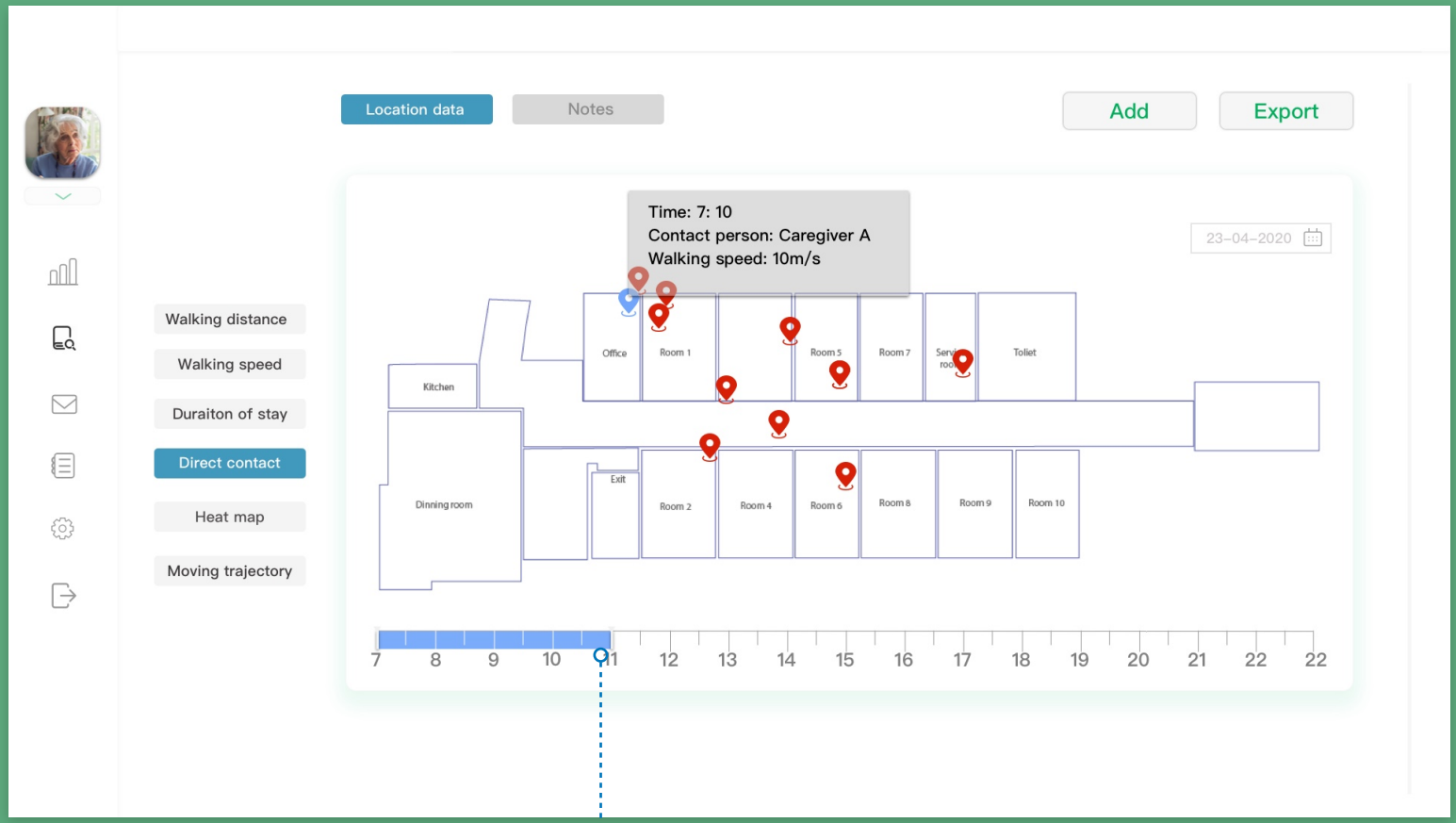
Add notes on findings
Users can add notes on the insights they find out from the location data.

Real time duration of stay
By hovering on one of the point on the vertical line, users can see real-time duration of stay at different areas per 30 minutes.



Historical duration of stay
It shows duration of stay at different rooms during each day. Users can also see trends and changes of the client staying different room.

Direct contact



Real time direct contact
User can slide and select the time range on the time scale to see when, where and with whom the client contacted with other people.

Historical contact times
Users can see with whom the client contacted and times of contacting during each days

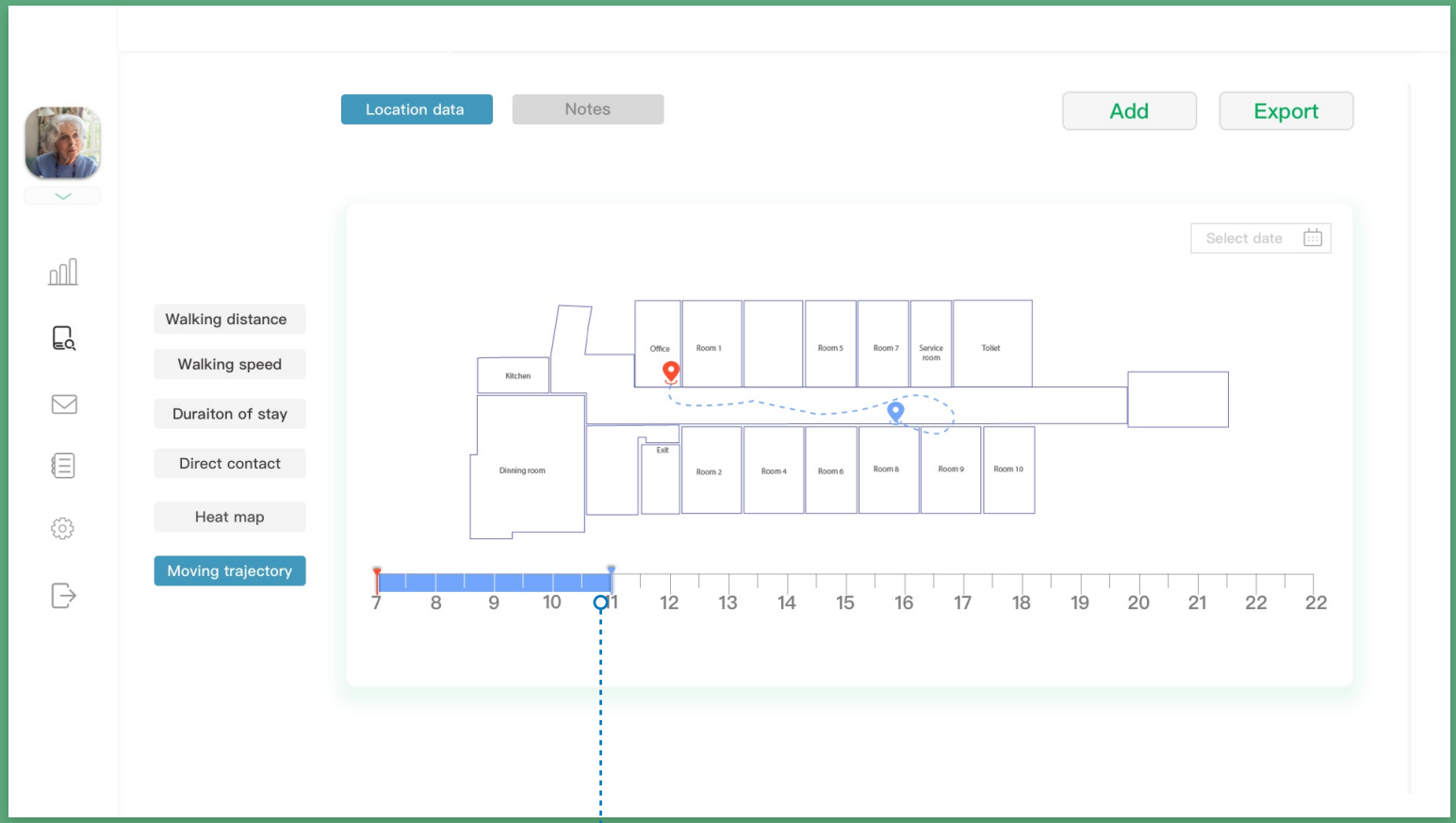
Heat map

Real time heat map
Users can explore where the client prefer to stay during a day by selecting different time ranges.

Heat map

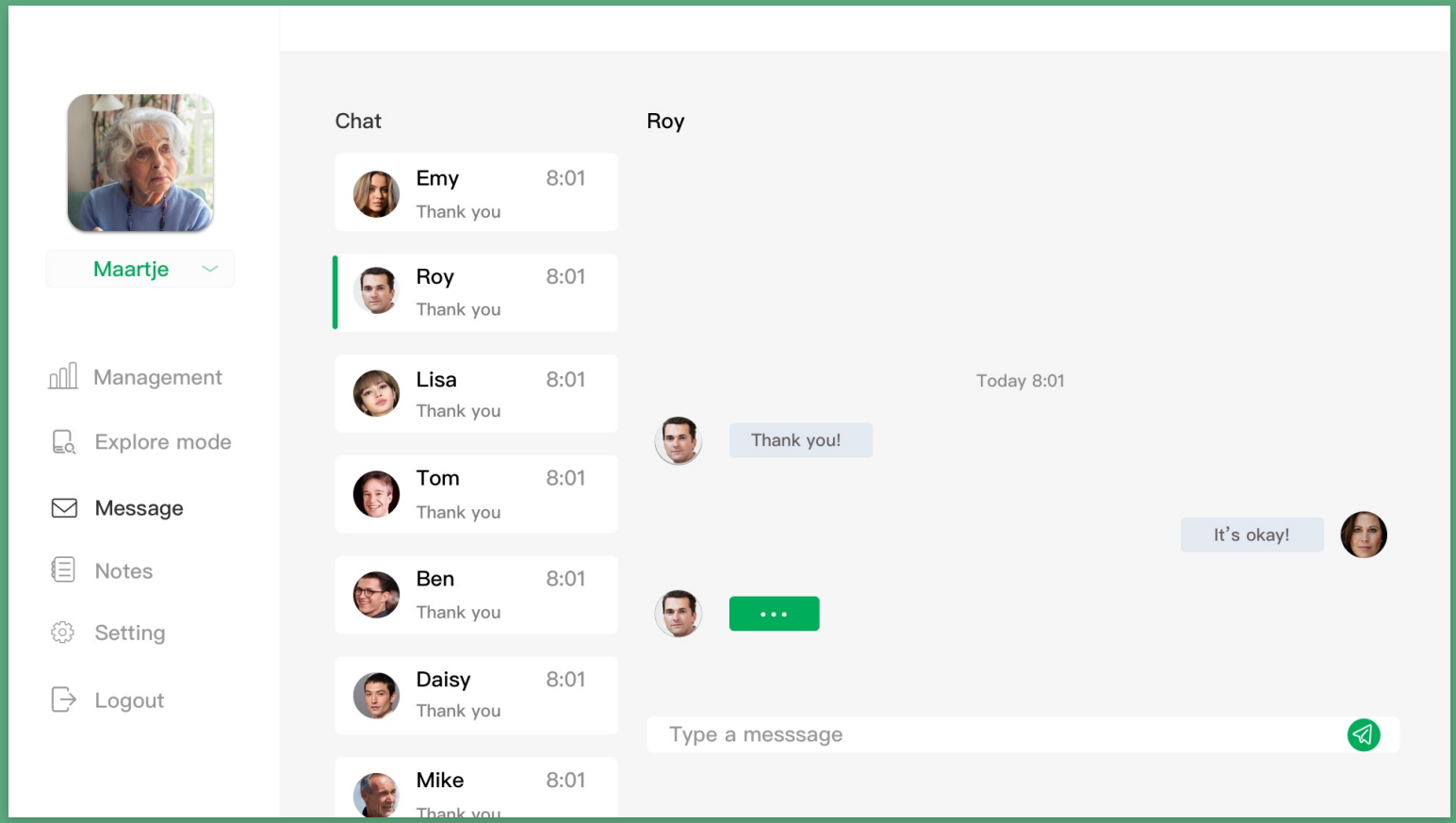
Historical heat map
Users can explore historical heat map of different days. It shows the changes of hot spots on a daily basis.

Moving trajectory

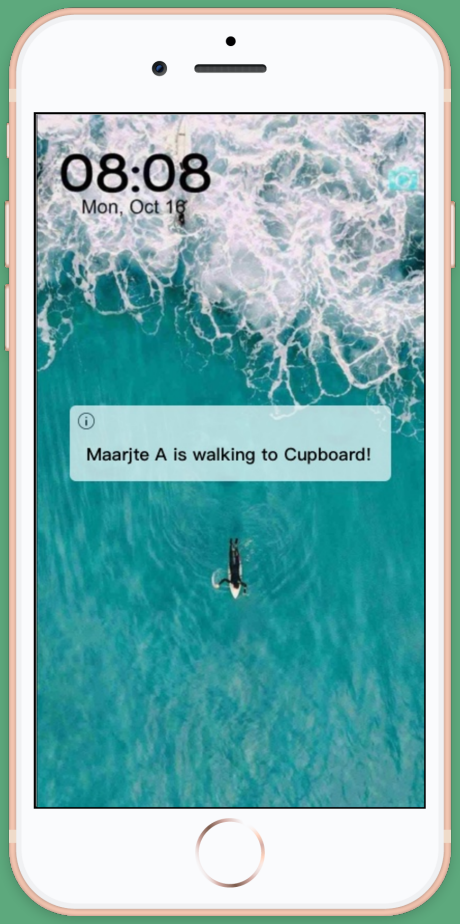


Moving trajectory during a day
By sliding the two vertical bars, users can see the moving trajectory of the client during that time period.

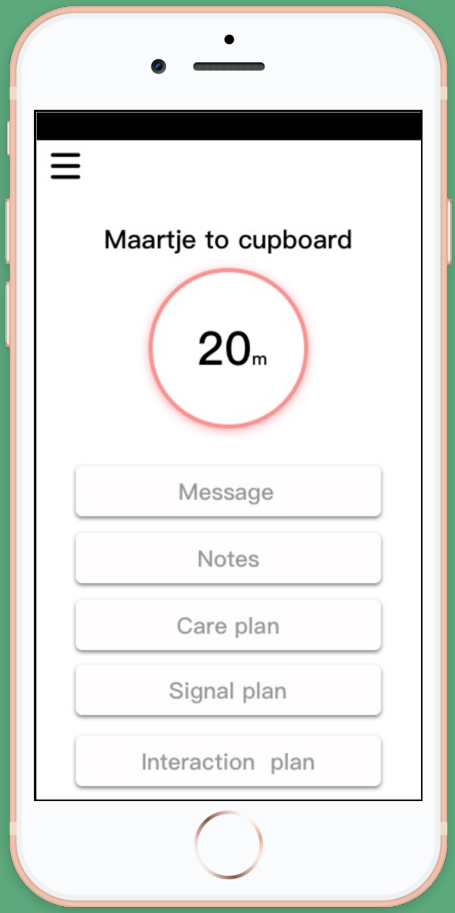
Messages


Maartje
Management
Explore mode
Message
Notes
Setting
Logout
Chat
Emy 8:01 Thank you
Roy 8:01 Thank you
Lisa 8:01 Thank you
Tom 8:01 Thank you
Ben 8:01 Thank you
Daisy 8:01 Thank you
Mike 8:01
Roy
Today 8:01
Thank you!
It's okay!
Type a messsage

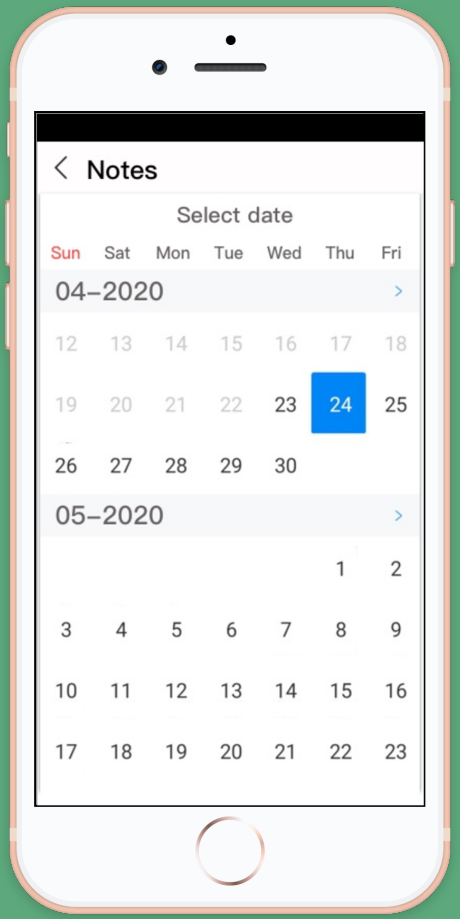
Main application interfaces



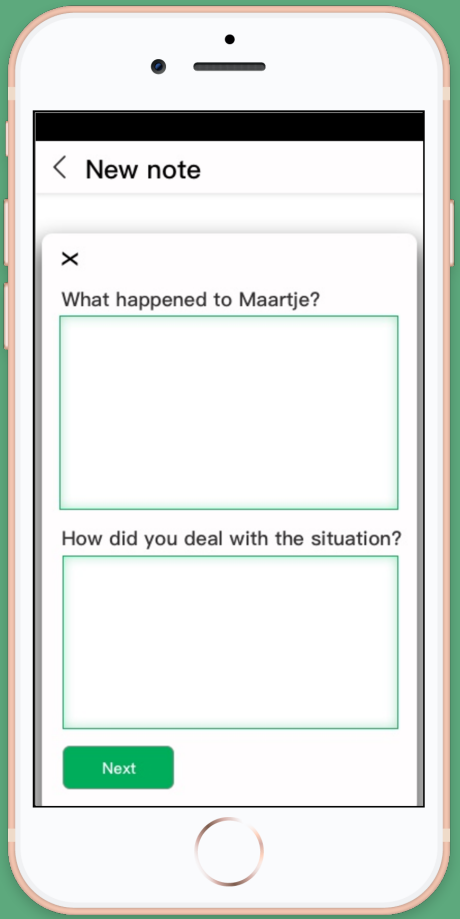
Indication



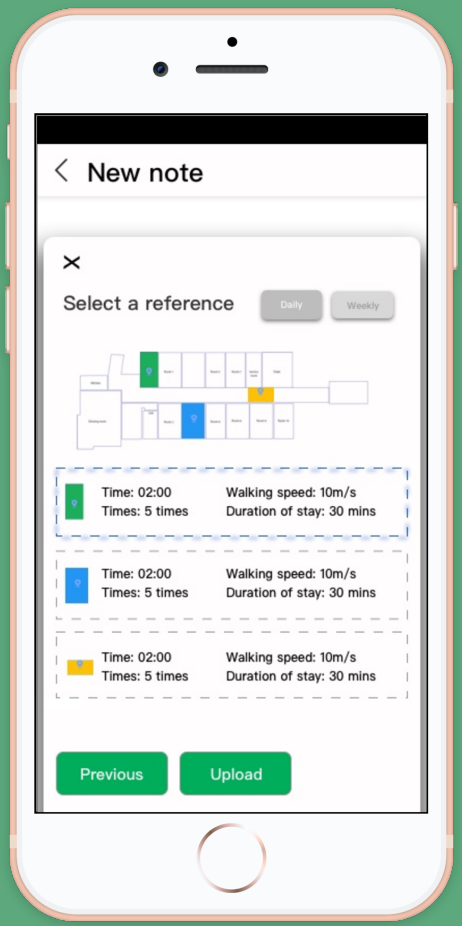
Detailed indication



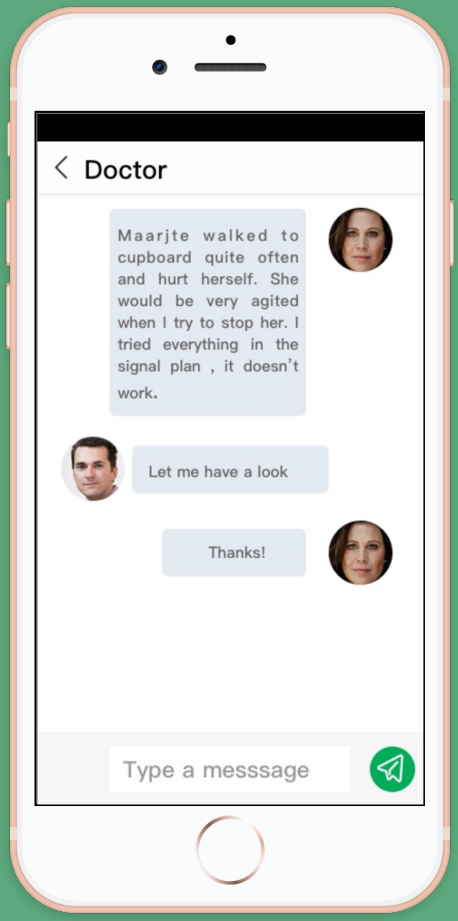
Note-select a date



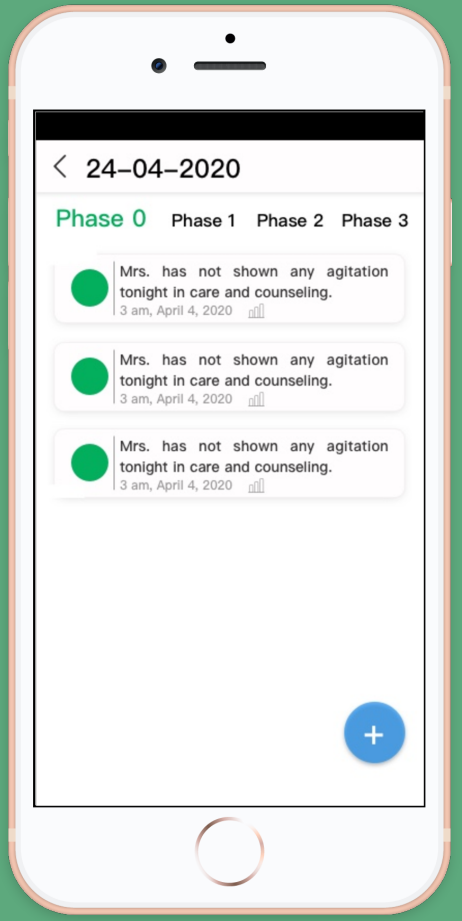
Note-write a note



Note-select a reference



Message

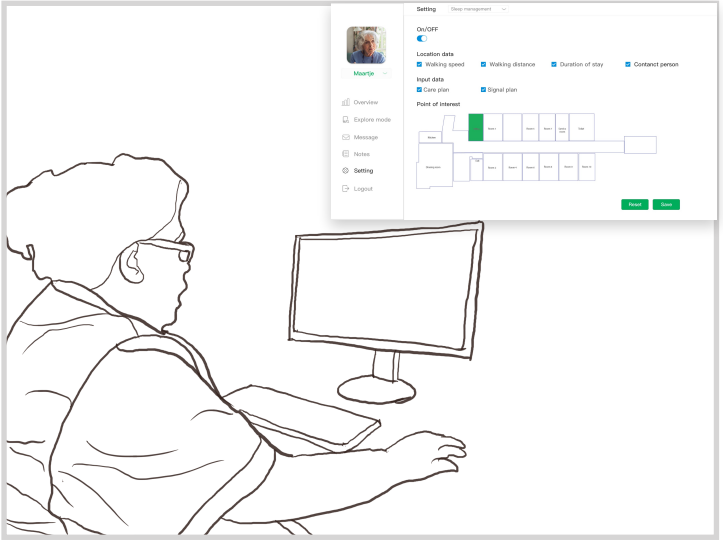


Note overview

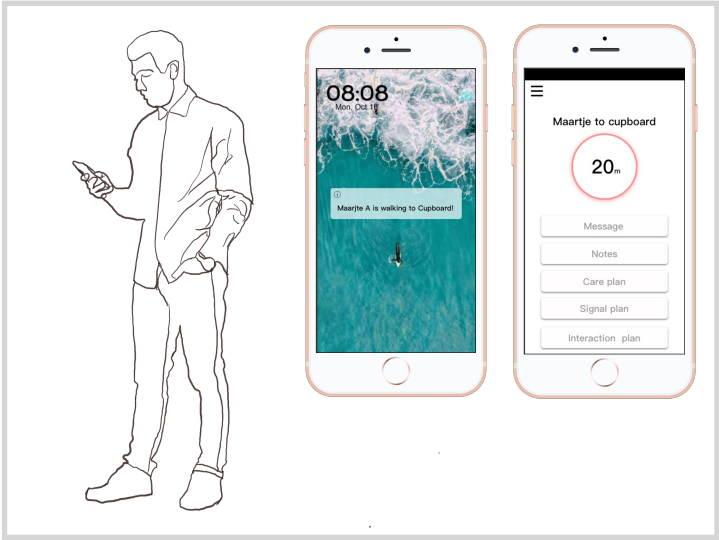
Scenario

Maartje likes to mess around near cupboard. She hurts herself and other people when she does that.

In order to prevent Maartje's safety, what the care giver do now is locking Maartje in her room. They need to find the reason for Maartje's behaviours and a better approach to solve the problem.

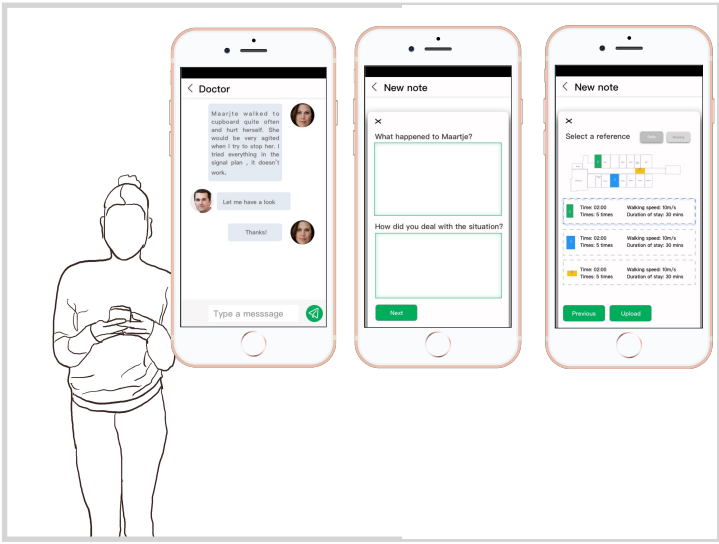


Care giver set cupboard as point of interest to inform her when Maartje is going there.

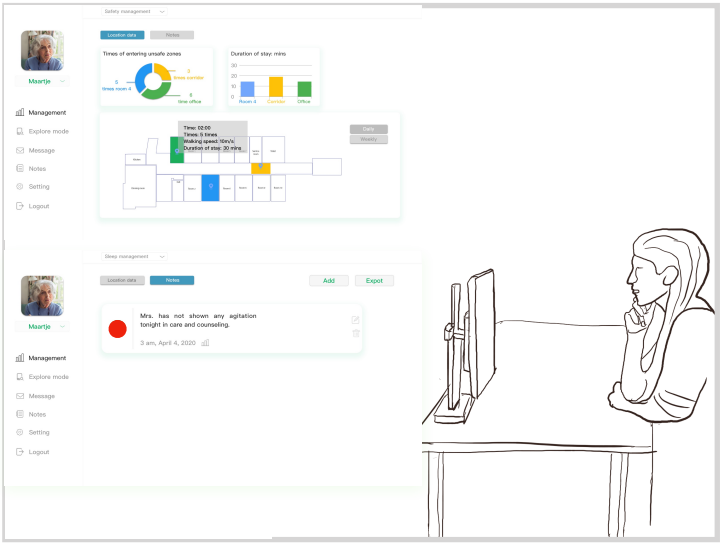


During day shift, the care giver receives a indication saying that Maartje is close to cupboard.

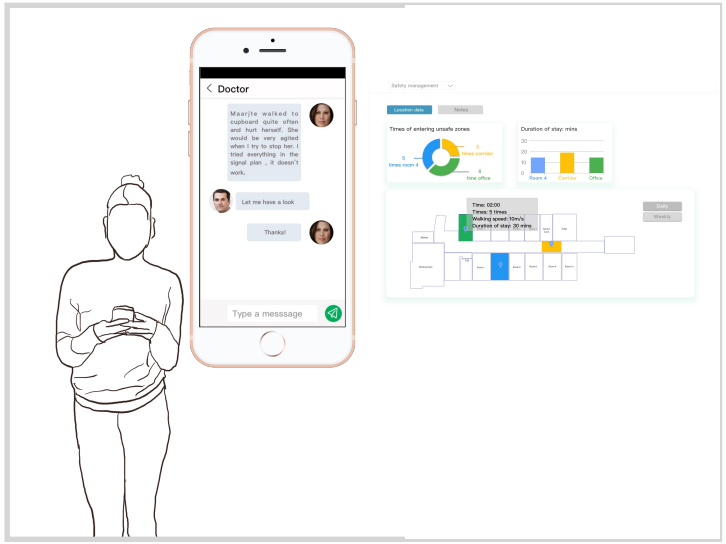
She goes there in time and sees what is happening. Maartje is trying to open the cupboard, so the care giver stops Maartje and lcoks Maartje into the room.
This time the Maartje is very agitated and all the methods in signal plan don't work.



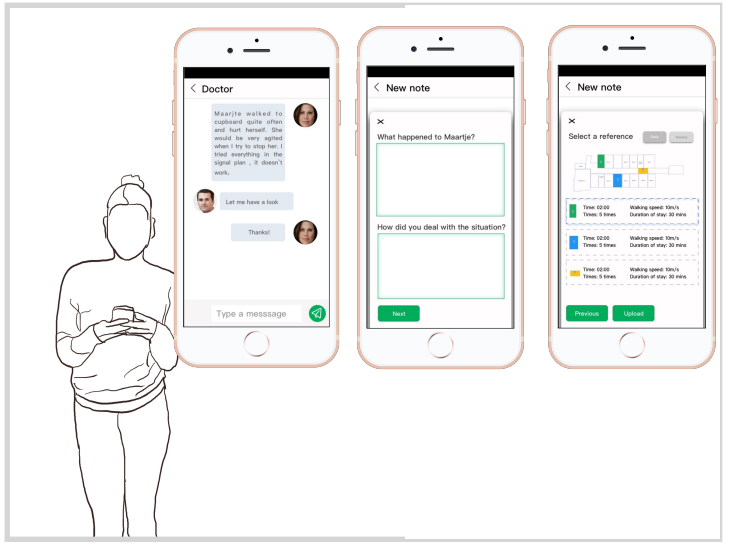
She messages doctor and psychologist for help as it seems they need a better solution quickly. She also write a note to inform the afternoon shift to keep and eye on it.



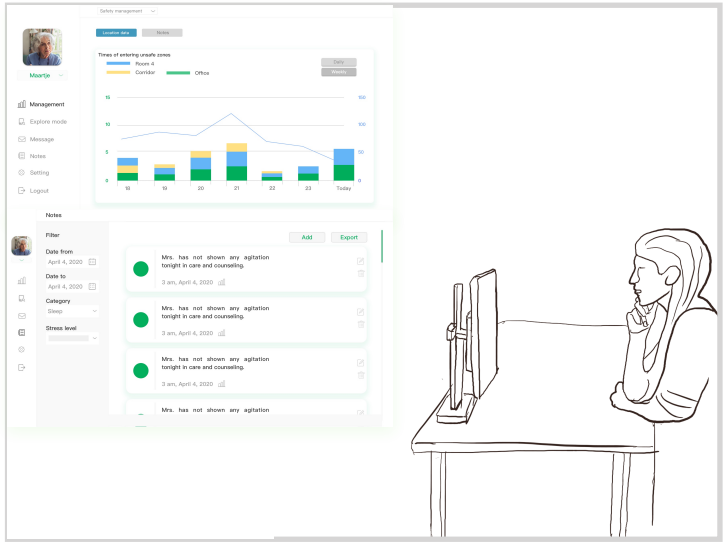
When writing a daily report, the afternoon shift caregiver review Maartje's notes about safety. The phase 3 note catches her eye and she saw Maartje did go to the cupboard a lot. She exported it to Qic.



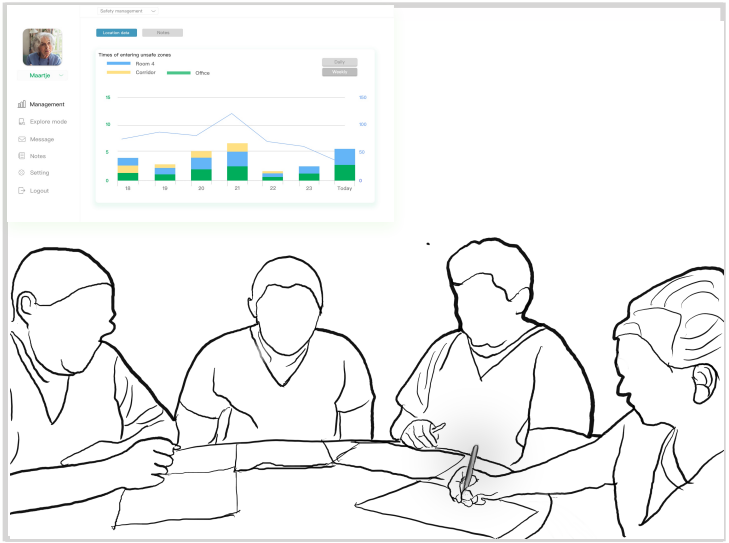
After two days, psychologist sends the caregiver message saying that she can give Maartje a cup she likes (which is based on previous medical record the psychologist have), or give her some snacks she likes because psychologist found Maartje goes to cupboard the most during dessert time.



The caregiver tries these two options, and found giving a cup to Maartje works. She told it to psychologist and write a notes.



The times Maatje going to cupboard reduced and the notes on that is getting positive.



Before weekly meeting or other meeting with doctor and psychologist, they already have conclusion about the reason and also approach to deal with the situation.The meeting is more like a review instead of a discussion now.

CHAPTER 8 - Conclusion&recommendation

8.1 Answers to research questions
8.2 Conclusion
8.3 Recommendation
8.4 Personal reflection

This chapter shows a comprehensive conclusion of the graduation project , recommendation and personal reflection.

8.1 Answers to research questions

RQ 1: How to assist current process of care plan making with the use of the location data?
RQ 1.1: How do the care team make care plan in nursing home Zorggrope Elde?
Answer: P28-29

RQ 1.2: What's the definition of a care plan?
Answer: P24

RQ 1.3: How is current care plan making process like in nursing home Zorggrope Elde?
Answer: Chapter 3.1

RQ 1.4: What are the reasons for care plan change, especially the factors related to movement and location of the residents?
Answer: Care plan change happens normally when the PwD make progress. Namely, when they have new behaviour and current approach doesn't work.

RQ 1.5: How do the care team communicate to make the care plan?What do they communicate to meet the needs of PwD?
Answer: P28-29

RQ 1.6: How do the team communicate with each other in current process?
Answer: P28, 29, 31

RQ 1.7: What are their pain points of communication and how is the desired way of communication like?
Answer: P26,29

RQ 2: What is the value of the location data in Nursing Home?

RQ 2.1: What are the reasons for BPSD?
Answer: P16

RQ 2.2: What are the needs and main characteristics of PwDs?
Answer: P24

RQ 2.3: What factors cause their emotion and behavior changes?
Answer: P45, 46

RQ 2.4: How do current IPS applications be used to manage PwD?
Answer: P19

RQ 2.5: How to use the data insights to improve current care planning?
Answer: Chapter 7

RQ 2.6: What kind of the data insights can actually help the care planning process?
Answer: Chapter 7

RQ 2.9: In what ways the insights can be communicated within the care giving team so that it will improve the care planning?
Answer: P24

8.2 Conclusion

In this project, what the author did was to explore the application of location data in nursing home. The conclusion reviews the process of research.

Firstly, literature review was did to get basic idea of the care planning process and problems in their communication. Then through field study, the care planning process was mapped out and care giver writing a daily report is set as the main scope of the context. The care plan and signal plan are the main plans the design will help improve. The problem is reframed at the end of field study with the identified unmet needs and paint points of care givers.

At the same time, location data insights was generated and research on the needs of the people with dementia is done. 43 hypothesises are generated on that in order to validated what location data can be helpful to take care of PwD. 11 hypothesises are validated and the ones beneficial for PwD are categories into four directions.

The design goal is framed based on the field study, which is more human side. Elaborate brainstorming based on the “How2” ideas is conducted to generate 3 concepts help with caregivers writing reports. The 3 concepts were evaluated by two experts for dementia side and data side, Concept 1 was selected for iteration. The iterated concept was evaluated by two care givers and one doctor in the nursing home.

Nursing home staff value privacy and mentioned that it is not necessary to monitor every one. The reason is that different PwD have different symptoms and they are progressive.

In the final design, validated location information are integrated. The product service system consists of a mobile application and desktop platform , which helps the care givers to manage the needs in four aspects. With use of location data, they can find the progression of Pwd and make adjustment to their plans. The application allows the caregivers to know situations happening and take notes with data as reference. It is aimed for more objective reporting.

The core value of location data in the care planning process is to give care givers a more efficient communication experience with other care professions by improve the reporting process.

8.3 Recommendations

Be prepared before the project
Nursing home context is diverse and complex, it would be beneficial for following students to do a research course to be well-prepared for graduation project.

More hypothesises
As there are so many aspects in a health care organizations, more hypothesises can be formulated to explore the possible benefits of using location data.

More real data
Due to limited time of the project, one 5 day's location data is used. More location insights could be found if the there is more location data from PwD with different symptoms.

Evaluating user acceptance and impact of the final design
User acceptance is important for IPS application nursing home because their lots of rules, departments, culture differences. Whether the final design can really have a positive impact on care team if the design requirements are fulfilled need validating with real users. Due to the factor that it is not accessible to the nursing home in Covid-19 context, it would be beneficial to do that after the quarantine.

High-tech design options
Although it is not the top priority for this project, it would be nice to apply trending data techniques in the future design. The author believes that techniques like data mining, NLP, and etc would Increase the care planning to a more efficient level.

8.4 Personal reflections

Reflection on user research

The field research started with focus group, which was beneficial to have an overview of the whole picture of the information system during care planning. Quick selection of the scope in the context should have been done while it took quite a while to do that. It was challenging to get a clue what show be taken into next stage in the fuzzy front end.Besides, the research could have been more consecrated if the location data brainstorming was done first. That is to say, if I knew what location data can be useful in the context, then the scope could be narrowed down early, the deep dive into that direction and more valuable design would be generated.

Language barrier and unfamiliarity with the muring home was another challenge for the author. All the terminologies, names of documents are in Dutch. It took time to empathize the users at the beginning.

Reflection on the approach

The approach is gradually clear for the author with knowing more and more about the project. In human side, focus group was firstly done to map out the care planning process and the unmet needs of the care team. On the location data side, data visualization is used to get potential useful information from collected data. Their combination was very good to converge to scope and have a clear design goal with useful location information. In the design phase, the two round evaluation are done with collecting feedback. They were not structured tests but still helpful to get insights to push forward the design.

Reflection on planning

The plan was changed into more practical one after the project really started. That is to say, the author misunderstood the project challenge a bit before the kick-off meeting. More in-take meeting could have been done with both of my supervisor team. They are my clients as well so reaching a common interest on the project goal would be really helpful. It was lucky with their help the plan was adjusted in time and moved onto the right track. In the later stage of the project, due to the Covid-19, I experienced a period of hard time to get used to the quarantine. All the plans got a bit loose, I was depressed and not that productive. My chair and mentor encouraged me at the last meeting so that I can come back to do my job appropriated.

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