

PACE YOURSELF

DESIGNING PAIN
MANAGEMENT FOR
PEOPLE EXPERIENCING
CHRONIC PAIN

HCI DESIGN
PROJECT
2024

Kanupriya Jamwal
Yilei Zhang
Chenwei Hsu
Aaryan Shrivastava

Partner -
Chronic Pain
Ireland

Supervisor -
Kevin Doherty



UCD School of Information and Communication
Studies
Scoil an Léinn Eolais agus Cumarsáide UCD

TABLE OF CONTENTS

I	INTRODUCTION	3
	RETROSPECTIVE #1	9
	DESIGN CHALLENGE	11
II	LITERATURE REVIEW	14
	• CHRONIC PAIN	15
	• TECHNOLOGY USE IN PAIN	18
	MANAGEMENT	
	• FEAR AVOIDANCE MODEL AND PACING	21
	DESIGN CHALLENGE REVIEWED	23
III	KEY THEMES	26
	• TECHNOLOGIES	27
	• CONCEPTS	28
IV	PROCESS	29
	RETROSPECTIVE #2	33
V	R/CHRONICPAIN	35
	• ANALYSIS	37
	• INSIGHTS	39
VI	FOCUS GROUP	44
	• INTERVIEW GUIDE	37
	• INSIGHTS	47
	• JOURNEY	49

TABLE OF CONTENTS

RETROSPECTIVE #3	51	
DESIGN CHALLENGE REVISITED	53	
• HOW MIGHT WE?	55	
• PERSONAS	59	
IDEATION	64	
• CRAZY 8	66	
• DARK SIDE	67	
RETROSPECTIVE #4	78	
DESIGN CHALLENGE REALISED	79	
VII	DESIGN	81
IX	EVALUATION	91
	• WORKSHOP AGENDA	92
	• FEASIBILITY-VALUE	93
RETROSPECTIVE #5	96	
X	PRODUCT	98
	• APP FEATURES	99
	• SYSTEM ARCHITECTURE	101
	• MOCKUPS	103
	• HI-FI PROTOTYPE	107
XI	THE END	111
XII	REFERENCES	116

INTRODUCTION



3

In the summer of 2024, four HCI masters students from UCD partnered with CPI to end pain support individuals who find themselves in a state of pain they feel they can't cope with.



Chronic
Pain
Ireland

HCI - Human Computer Interaction

UCD - University College Dublin

CPI - Chronic Pain Ireland

CHRONIC CARE CREW

We, dubbed the Chronic Care Crew, are a design team of masters students who worked on this project during the summer trimester (Jun-Aug, 2024) of our course.

4

Kanupriya Jamwal

Project Lead

A UX designer with an engineering degree. Experience in tech consulting, and product at early stage startup. Originally from India. Interested in emerging technology. Likes pop-culture, art and travel.



Yilei Zhang

Art Designer

An art management graduate originally from Shanghai with two years of experience in marketing. An extremely enthusiastic movie and game lover.



Chenwei Hsu

UX Researcher & Designer

An UX designer with solid research background. Experience in designing exploratory user research for local retail company with deployed design and academic research in human computer interaction. Originally from Taiwan. Interested in augment reality. Likes indie music, video games and badminton.



Aaryan Shrivastava

Interaction and Interface Designer

A computer engineering graduate and current HCI master's student originally from India, with a particular interest in game design.

Kevin Doherty

Project Guide

Our mentor who supported us with invaluable feedback and endless inspiration.



CHRONIC PAIN IRELAND

Chronic Pain Ireland (CPI) is a registered charity in Ireland dedicated to supporting individuals living with chronic pain. The majority of their work includes raising awareness and advocating for the needs of people living in chronic pain.

The CPI website helpfully explains chronic pain as:

Pain is your body's way of telling you that something is wrong and that it needs to be fixed. If you cut a finger or break a leg, your body's warning system is alerted and you will feel pain.

Acute pain is referred to as a useful pain and is defined as lasting less than 3 months. It is short-term and resolves with healing of the underlying injury.

Chronic pain is different – it persists, often disrupting normal living and sleep patterns. It serves no protective function.

Chronic pain is a complex, multifaceted, often life-altering condition. But it can be treated and sometimes resolved. Very early and accurate diagnosis is critical. A person with chronic pain may feel a range of emotions for the reduction or loss of many aspects in their quality of life. It also impacts family members, loved ones and society as a whole.

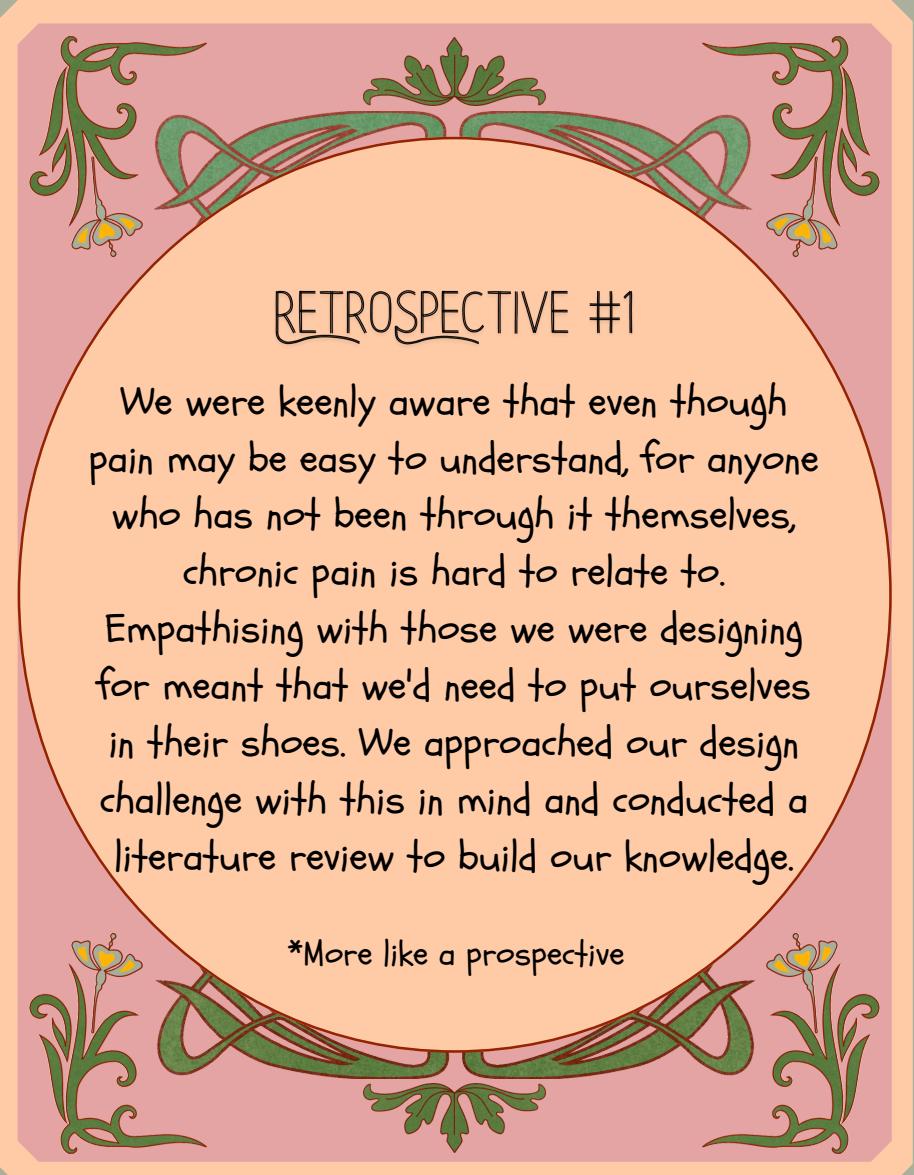
”



We connected with Christina Donnelly and Niamh Walsh, board members at CPI at the start of the summer and communicated expectations. In this initial meeting, we were recommended some avenues we could dive into.

- Helping people understand chronic pain
- Technology for a specific type of chronic pain
- Supporting people in coping with chronic pain
- Navigating people to seek help for chronic pain

Our partners at Chronic Pain Ireland supported us throughout the project. Thanks to them, we had access to the chronic pain community for interviews and workshops. We conducted regular meetings with Christina and Niamh to keep them posted on our progress.



RETROSPECTIVE #1

We were keenly aware that even though pain may be easy to understand, for anyone who has not been through it themselves, chronic pain is hard to relate to.

Empathising with those we were designing for meant that we'd need to put ourselves in their shoes. We approached our design challenge with this in mind and conducted a literature review to build our knowledge.

*More like a prospective



DESIGN CHALLENGE

11

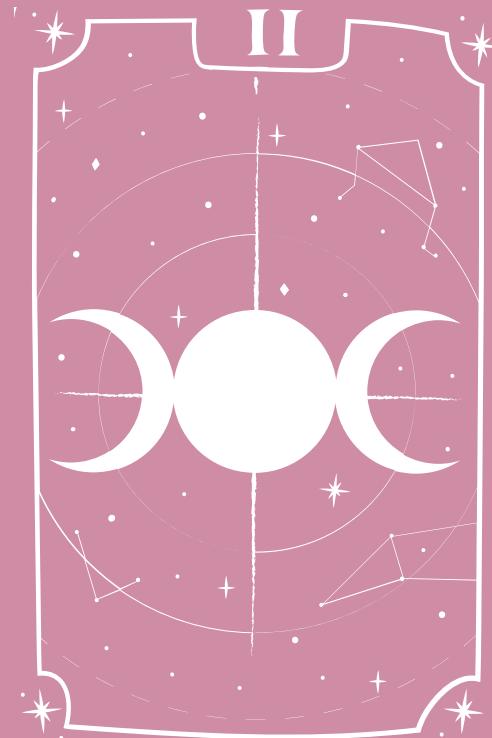


This question was the starting point for our design process.

|||||

12

LITERATURE REVIEW



For the literature review, the Chronic Care Crew probed across different contexts, themes, and technologies associated with chronic pain. We went on separate paths of research and briefed each other on what we had found.

CHRONIC PAIN

Chronic pain is characterised as persistent pain that extends beyond the typical healing period and lacks a clear biological purpose. Unlike acute pain, which serves as a warning signal for potential injury, chronic pain persists for months or even years, often without an identifiable cause. It is not merely a prolonged sensation of pain but is also associated with various psychological and social dimensions that affect the patient's quality of life



(Eccleston et al., 2013; Hylands-White et al., 2017; Sehgal et al., 2012).

Chronic pain often leads to a host of additional side effects beyond the pain itself. These can include psychological conditions such as depression, anxiety, and sleep disorders, as well as physical symptoms like fatigue and decreased mobility and even sociological issues such as relationship distress, social role loss, and isolation (Breivik et al., 2006; Hylands-White et al., 2017). The interplay between chronic pain and these comorbid conditions can exacerbate the overall burden on individuals, making management challenging (Lim et al., 2019). Patients frequently report a diminished ability engagement in daily activities and an overall decrease in life satisfaction due to the persistent and debilitating nature of chronic pain (Lim et al., 2019; Eccleston & Crombez, 2007; Andrews et al., 2012).

One of the primary challenges in managing chronic pain is its unpredictable nature, which is characterised by fluctuating intensities that lead to "good days" and "bad days" (Robinson-Papp et al., 2015). This variability complicates the assessment and treatment of pain, as patients often struggle with inconsistent symptom patterns. The episodic nature of pain flare-ups can make it difficult for healthcare providers to gauge the effectiveness of treatments and to adjust care plans accordingly (Eccleston et al., 2013). This variability complicates treatment and management strategies, as patients may respond differently to the same treatments over time. The unpredictable nature of flare-ups adds an additional layer of psychological stress and can make it challenging for individuals to plan and maintain a stable routine.



The experience of chronic pain is not solely determined by physical factors; the surrounding environment and psychological state significantly influence pain perception and management. For instance, a lack of understanding or support from healthcare providers and carers can lead to feelings of isolation and frustration in patients. The stigmatisation of chronic pain, especially in the context of opioid use, can further complicate the relationship between patients and healthcare providers, often leading to a sense of distrust or misunderstanding (Smith et al., 2018). Additionally, social and environmental stressors can exacerbate pain perception, thereby influencing the patient's overall experience of their condition (Andrews et al., 2012).

TECHNOLOGY USE IN PAIN MANAGEMENT

To support people with chronic pain in managing their pain and to help others understand chronic pain, several technological designs have been introduced. These innovations range from virtual reality (VR) and gamification to wearables and other novel technologies, each offering unique benefits in the realm of pain management.

VR and gamification have emerged as effective tools for managing chronic pain by providing distraction and education about pain. These technologies work by immersing patients in an alternative environment or engaging them in tasks that



require their attention, thereby reducing the perception of pain and understanding more about pain (Charette, 2024; Wang et al., 2022). For instance, VR can transport users to calming landscapes, while gamified applications can challenge them with tasks that shift focus from pain to the game (Wang et al., 2022; Gromala et al., 2015). Moreover, the immersive environments created by VR can help educate caregivers by simulating situations that individuals with chronic pain might encounter daily (Tong et al., 2017; Matsangidou et al., 2023). This approach is supported by research which suggests that immersive environments can significantly reduce pain intensity and improve mood, leading to better overall pain management outcomes.



Technologies such as wearables and other different devices, also play a crucial role in pain management. Singh et al. (2017) discuss the use of movement sensing and feedback technology to enhance body awareness and self-management in chronic pain patients. Their prototype, which provides real-time sound feedback based on body movement, helps patients become more aware of their physical capabilities and encourages more movement despite pain. This method not only aids in managing pain but also helps patients connect better with their bodies and, indirectly, with their families by enabling them to perform more activities. David et al. (2017) suggested another prototype to connect the elderly with chronic pain and their social network despite



unpredictable pain conditions. To align with pain conditions and elders' difficulty using technologies, a digital picture frame was introduced to facilitate asynchronous communication, in which they could send email by clicking the face of the photo and receive audio or video messages back at their convenience. This approach not only avoids synchronous interaction at a bad time, when they are unable to properly interact with others while feeling unbearable pain, but also enables users (patients and others) to interact at their own pace while maintaining social connections.

FEAR AVOIDANCE MODEL AND PACING

Chronic pain often leads to fear avoidance, where people with chronic pain avoid activities that they believe will exacerbate their pain. This behaviour can result in decreased physical activity, increased disability, and worsened pain (Andrews et al., 2012; Lethem et al., 1983; Vlaeyen & Linton, 2000). The fear avoidance model explains that fear of pain and injury significantly contributes to the functional limitations observed in people with chronic pain. Addressing these fears through education and cognitive-behavioural therapy (CBT) is crucial for improving patient outcomes. For instance, Turk (2004) emphasises the importance of



psychological factors in pain perception and the need for exposure-based treatments to reduce fear and encourage activity.

Pacing is another essential strategy for managing chronic pain and addressing fear of pain. It involves carefully planning the duration of activities to avoid pain flare-ups, helping people with chronic pain balance activity and rest to maintain daily function without overexertion (Andrews et al., 2012). Effective pacing requires them to recognise their limits, set realistic goals, and gradually increase their activity levels. This approach supports people

with chronic pain in maintaining a consistent level of activity, thereby reducing the overall impact of pain on their lives (Andrews et al., 2012). Implementing pacing involves several key steps: identifying activities that trigger pain flare-ups, setting a time baseline for these activities that do not provoke pain, alternating between activity and rest periods to prevent overexertion, and setting specific, achievable goals to provide motivation and a sense of accomplishment. By following these strategies, individuals with chronic pain can reduce flare-ups, gradually increase their activity levels, and ultimately enhance their quality of life (Lpcadmin, 2016b).



DESIGN CHALLENGE REVIEWED



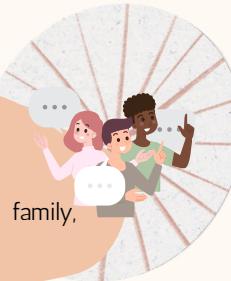
Our literature review helped us recognise nuances in our design challenge and break down our 'how might we' question.



We considered
how we might

Communicate

Effectively communicate pain to family, friends, and medical professionals



Understand

Understand pain, as well as how and why the brain generates it

Empathise

Create empathy and really get into the shoes of chronic pain patients



Deal with Fear

Identify pain's association with fear, manage and beat fear

Motivate

Find and maintain the motivation to seek pain relief and change body's pain system



KEY

THEMES

III



We organised the key takeaways from our literature review into technological and conceptual themes.

TECHNOLOGIES

“ VR technology may distract from persistent pain, provide reliable body movement tracking, and create immersive environments for pain relief. VR can also educate people about chronic pain, enhancing understanding and management strategies.”



“ AI applications such as personalised tracking and feedback may aid in pain management. AI-driven platforms can also generate therapeutic content such as music and soundscapes tailored to the user's pain and psychological state.”

“ Wearables may monitor movement and provide real-time feedback using biometric data to recognize pain and fear. This could help people adjust their pain management strategies. Wearable technology can also offer customized alerts, aiding safe task performance.”



“ Effective health tracking must be holistic, considering user capabilities, environments, and social interactions. Holistic health tracking systems could enable effective health monitoring and daily task performance.”

CONCEPTS

“ Effective communication enables social support”

Application: Community features such as forums, support groups, and peer mentoring programs where users can share experiences and provide mutual support.



“ Enhancing motivation provides individuals with the confidence to manage their pain”

Application: Interactive features such as goal setting, progress tracking, as well as virtual environments to practice mindfulness.

“ Awareness of the nature of pain can enable individuals to improve coping strategies.”

Application: Educational and multimodal resources about pain mechanisms, treatments, and self-management.

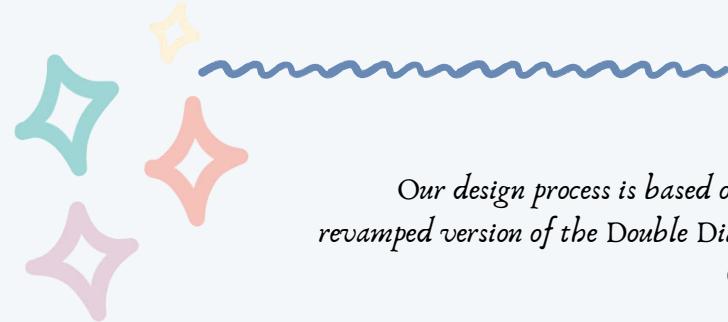


PROCESS

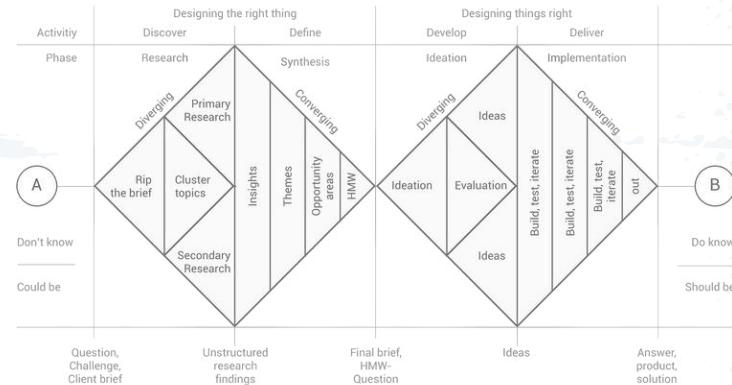
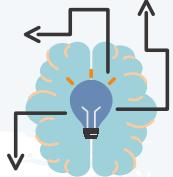


29

After getting initial insights from the literature, we decided to focus our work by adopting a design approach.

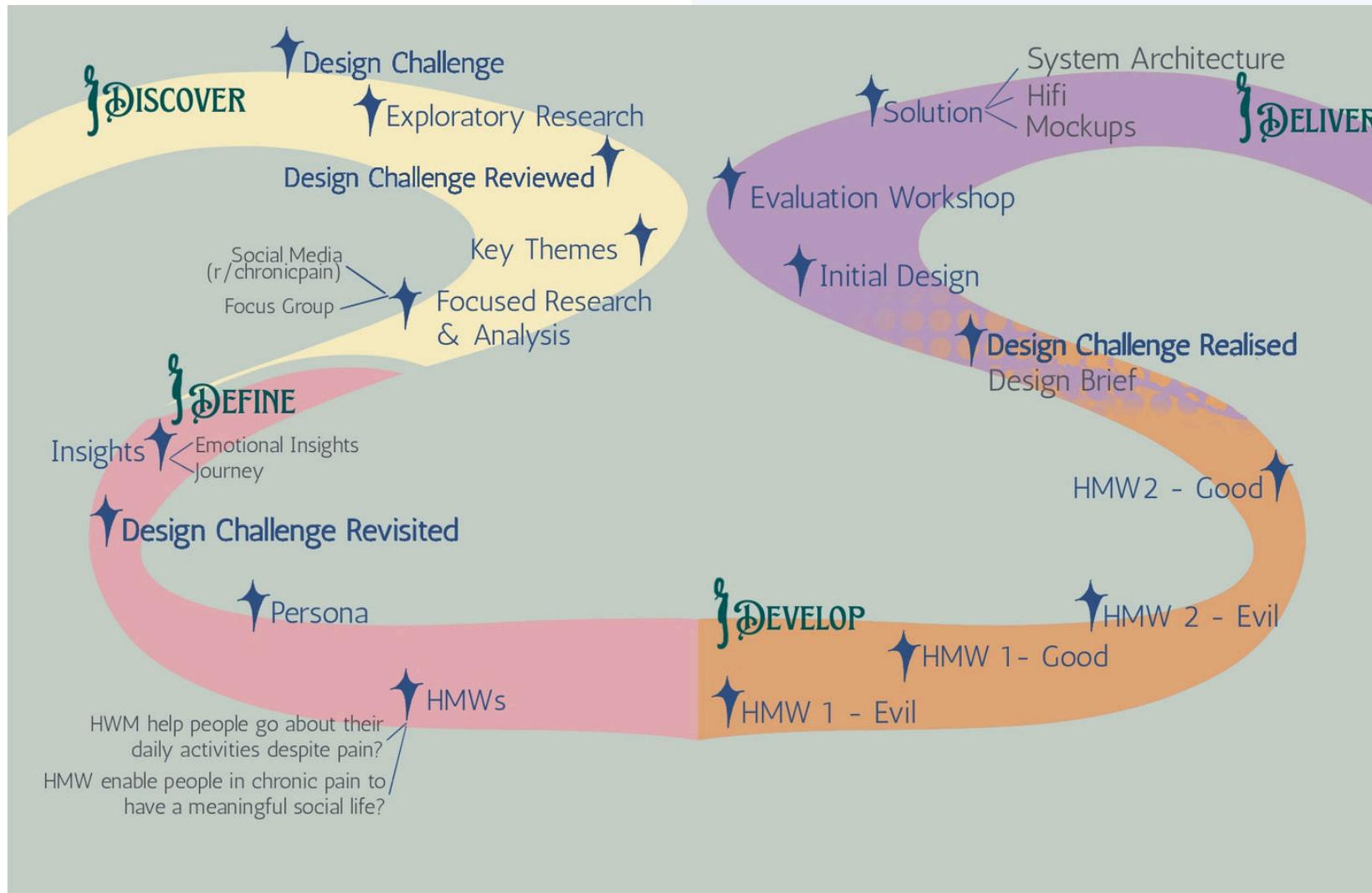


*Our design process is based on Dan Nessler's revamped version of the Double Diamond diagram
(Nessler, 2024)*



30

As our journey progressed, our design process evolved



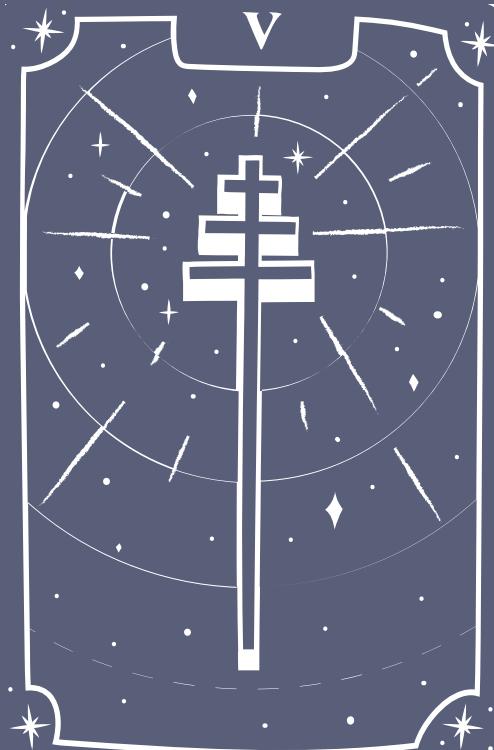
RETROSPECTIVE #2

The literature review got us familiar with chronic pain in an academic sense. There was unconventional technology to explore and we knew what chronic pain was all about. But we were still missing actual experiences from people who were dealing with chronic pain. We decided to understand these experiences by analysing the subreddit, r/ChronicPain and conducting a focus group.

Our idea of chronic Pain



R/CHRONIC PAIN

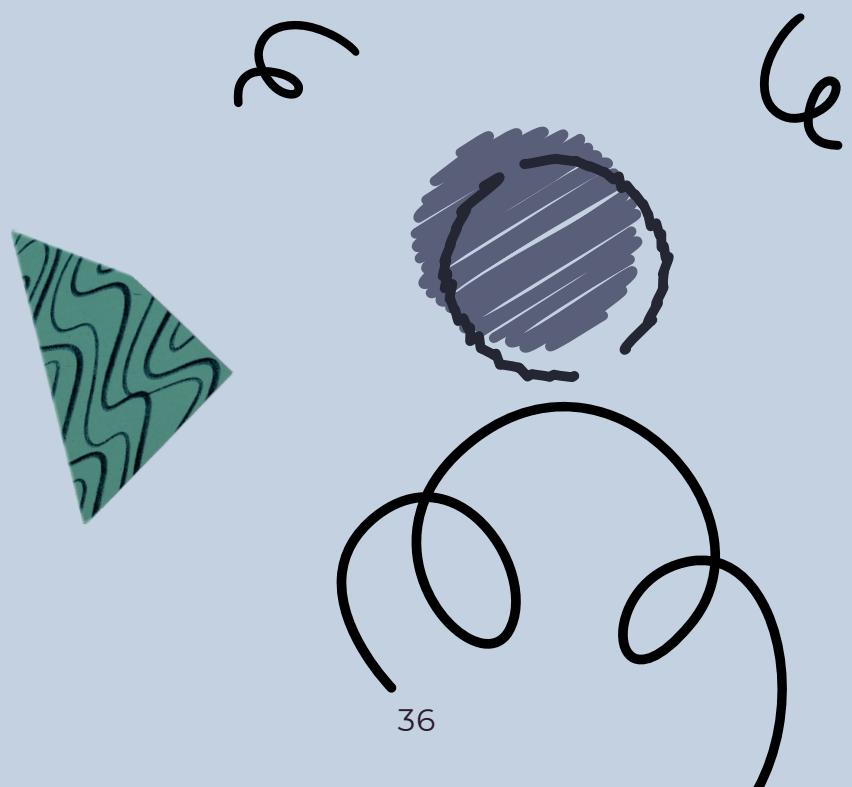


35

We extracted text from random 100 r/ChronicPain subreddit posts of all time and their comments using the 'PRAW' Python package (Subreddit - PRAW 7.7.1 Documentation, n.d.-b). We went through 100 posts and their comments to identify patterns in the data. We found that a lot of online users talked about other people in their lives with unrestrained emotions.

We decided to track people's Relationships and Emotions. We also found our research question for our Reddit analysis -

"How does the presence of pain emotionally affect people's relationships?"



36

ANALYSIS

To answer our research question, we needed to understand the emotions expressed by people with chronic pain while interacting with a social connection. We conducted relational analysis, which enabled us to qualitatively analyse the words in large scale of content and see the association of emotions and relationships when people discuss chronic pain online (Politz, 2024; Hsieh & Shannon, 2005).

We coded words with any mention of other people into different relationships, and we coded words with any mention of emotion into positive, neutral, and negative.

Relationship:

- Family/friend
 - 'parent', 'spouse', 'pet'
- Medical
 - 'doctor', 'therapist', 'surgeon'
- General
 - 'people', 'society'
- Colleague
 - 'coworker', 'company'
- Institution
 - 'government', 'FDA', 'school'

Emotion:

- Positive
 - 'satisfied', 'better', 'support'
- Negative
 - 'exhausting', 'depressed', 'painful'
- Neutral
 - 'wish', 'feel', 'relatable'



Next, we ran a co-occurrence analysis on the data. We wanted to identify sentences with two explicit categories (a relationship and an emotion) within the text extracted from the subreddit. This was done using the qualitative data analysis tool, ATLAS.ti 24.1.1 for Mac.

Consider the sentence, 'I am not happy'. Sometimes, a sentence tagged with a positive emotion may actually be negative in context. So, we manually cleaned the data by removing irrelevant sentences and reclassifying emotions in falsely tagged sentences.

After we had all the relevant sentences, we identified the presence of pain in each sentence. The role of pain and their impact on relationships was then coded. A lot of the codes overlapped, so we clubbed them together until we had a small number of distinct codes. Finally, we analysed emotional insights from these common codes.

Data



Codes



Co-occurrence analysis



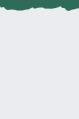
Data cleaning



Refining Codes

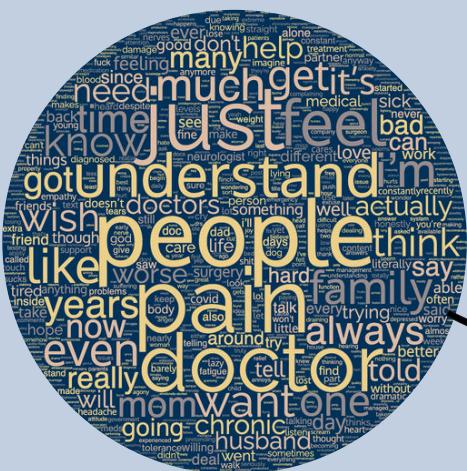


Insights



INSIGHTS

Insights from the analysis have been depicted in the form of tarot cards. We felt that tarot cards convey the complexity of experiences that cannot be expressed simply by words. Tarot cards became part of our portfolio design aesthetic from here on.



R/Chronic pain Subreddit

Insights from relational analysis



The following quotes have been modified to protect online Reddit users' anonymity.

BIAS

INSIGHT: Perceived bias negatively influences emotional state.

QUOTE: "Before surgery, I saw this neurologist who said that my nerves and bone alignment was fine and that I must just want attention."



SADNESS

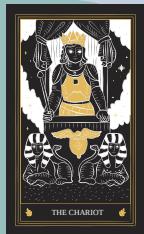
INSIGHT: Feelings of guilt, sadness and isolation may arise because of pain.

QUOTE: "But there are days I can barely even function so my dog has to go without [a walk] and that makes me feel even worse ... I feel like a bad dog owner."

CONFFLICT

INSIGHT: Others' perspectives may lead to contemplation or conflict.

QUOTE: "... then you have to listen to constant annoying questions from friends and family: well why can't you do this now? you did it last week"



HUMOUR

INSIGHT: People sometimes use humour to cope with pain or being misunderstood.

QUOTE: "It's funny when I tell people why I lost 30 pounds in less than two months and they're jealous.."

CARE

INSIGHT: The emotional impact of care/treatment/diagnosis of pain symptoms depends on individual circumstances.

QUOTE: "It was liberating to hear that my dr (doctor) recognizes this as an ongoing issue and she wants me to get an additional opinion, from a third neurologist who is willing to spend more time to listen to what I'm going through."



SHARING

INSIGHT: Sharing and validating similar experiences of pain with others can have a positive emotional impact.

QUOTE: "So I get teary because finding people who know how I feel and knowing I'm not the only one is such a relief."



SUPPORT

INSIGHT: Support, understanding and successful communication of pain often has a positive emotional impact.

QUOTE: "I'm one of a very fortunate loving family who fought for me when I couldn't sit/stand/speak at the worst times."



FOCUS GROUP



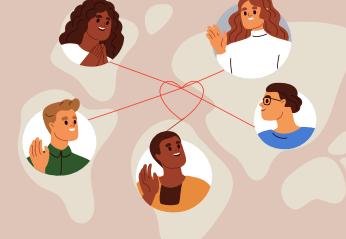
After reading literature and going through people's experiences online, we wanted to talk to chronic pain patients ourselves. We sat down with members of the Chronic Pain Ireland community to answer our burning questions. We conducted 2 focus groups with total 13 participants. All participants were experiencing chronic pain. The participants were mixed gendered, ranging in age from 18 to over 64. The focus group interview sessions were held online and lasted 1.5 hours each. We prepared an interview guide based on what we wanted to know.



The 3 focal points for our inquiry were -



Community



Experience



Support

INTERVIEW GUIDE

Could you describe your pain?

What has your journey with pain been like?

- Could you walk us through how it started and how you got here?
- Have you experienced any turning points in your journey?

Can you talk about the distinction between 'discomfort' and 'pain'?

- Are they different things or interrelated in your experience?

How does your condition impact your daily life?

- How do different situations impact your pain and why do you think that is?

Do you have any techniques to manage your pain?

Can you talk about a support system that you may have?

How do you engage with the CPI pain community?

- How did being part of a community change things for you?

How aware do you think the general population is of chronic pain?

- Is there anything you would like the general public to be aware of?



INSIGHTS



We used thematic analysis from Braun & Clarke's (2006) influential research paper and fit the method to our context. We went through the 2 focus group transcripts multiple times and highlighted common experiences into recognisable patterns or codes. We compared and merged codes from the two transcripts to gain insights. We could identify people's experiences to fit into different stages of the chronic pain journey.

1. Initial Diagnosis and Early Stages:

- A number of participants experienced periods of delay in diagnosis, if any at all.
- During this period, people with chronic pain may undergo numerous tests and consultations with different healthcare providers.
- The lack of a definitive diagnosis leads to feelings of frustration and anxiety.
- Participants often feel misunderstood or dismissed by doctors and society in general.

2. Daily Life Impact:

- Chronic pain significantly affects daily activities. Participants mentioned difficulties in performing basic tasks such as walking, sitting for extended

periods, and even sleeping.

- The pain often leads to a reduction in social activities, contributing to feelings of isolation and loneliness.
- Work and career impacts are prominent, with many participants needing to reduce working hours, change jobs, or leave the workforce entirely due to pain-related limitations.

3. Emotional and Mental Health:

- Chronic pain has a profound impact on mental health. Many participants reported experiencing depression, anxiety, and a sense of hopelessness.
- There is a recurring theme of feeling misunderstood by friends, family, and even healthcare providers, which exacerbates emotional distress.

4. Coping Mechanisms and Support Systems:

- Participants employ various coping mechanisms, including physical therapy, medication, alternative therapies (like acupuncture and massage), and lifestyle adjustments (diet, exercise).
- Support from family and friends is crucial, but there is a noted need for better emotional support and understanding from these networks.
- Support groups and communities, both in-person and online, play a significant role in providing emotional support and practical advice.

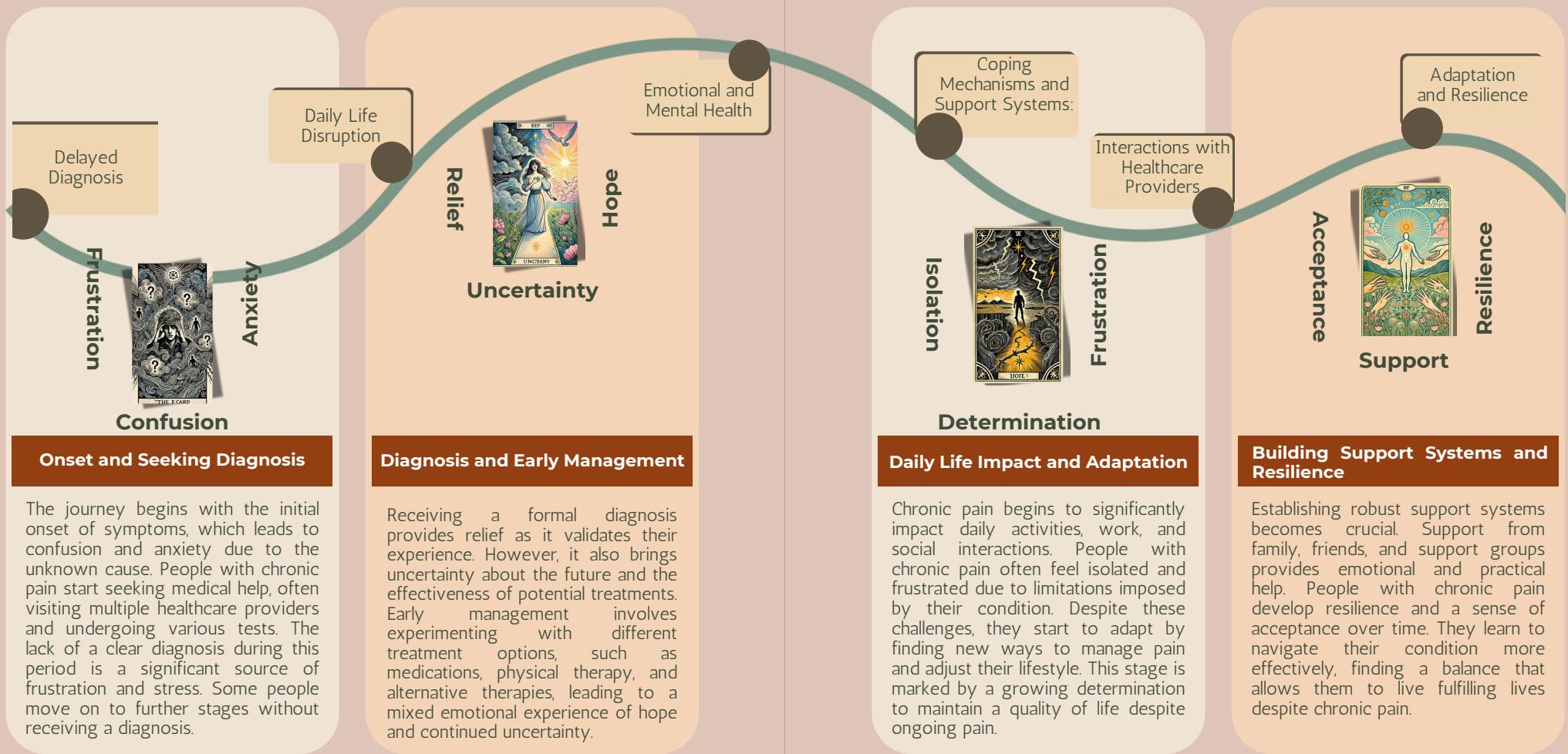
5. Interactions with Healthcare Providers:

- There is a mixed perception of healthcare providers. Positive experiences often involve providers who are empathetic, listen actively, and provide holistic treatment plans.
- Negative experiences typically involve providers who are dismissive, focus solely on medication without addressing other aspects of pain management, or lack knowledge about chronic pain conditions.

6. Adaptation and Resilience:

- Over time, many participants develop a level of acceptance and resilience. They learn to adapt their lifestyles to manage pain better and maintain a reasonable quality of life.
- Despite ongoing challenges, there is a sense of perseverance and determination to find effective ways to manage pain.

JOURNEY



RETROSPECTIVE #3

It was only when we analysed and talked to people from the chronic pain community that we started to deeply empathise with the people we were designing for. We'd found ourselves getting emotional over the struggles faced by people with chronic pain during the literature review. But it was nothing like our focus group interviews. As speculated, we hadn't properly understood chronic pain patients by reading about them. We were shocked, moved, and sad. As researchers, it was confronting to feel this way about someone's daily struggles. We had so much more clarity about people's problems. Our work could help people in chronic pain, and we would do anything to make that happen.

RETROSPECTIVE #3

From this point on, we found ourselves changing our language when referring to our 'user group'. 'Chronic pain patients' were changed to 'people / individuals with chronic pain'. We wanted to find a balance in our language so we could refer to our 'user group' as people with distinct needs but avoid using words like 'patients' so we don't treat people as someone inherently different from us. In the design, we would employ the term, 'users' because we were designing with a digital user in mind.



DESIGN CHALLENGE REVISITED



It was time to turn our insights into ideas. Our design challenge at the start of the project was quite broad. To focus our ideation, we needed a more specific design brief.



HOW MIGHT WE...?

We wanted our new design brief to also be a 'How Might We' or 'HMW'. To ensure we were ideating for the right problems, we set some rules from the Nielsen Norman Group (Rosala, 2024).



Begin by focusing on the insights

Often, teams create "How Might We" (HMW) questions that are too broad and not tied to their actual findings. After completing our discovery research, it's important to agree on the key insights. Base HMW questions on these insights to ensure we are targeted and effective.

Don't incorporate a specific solution

Embedding solutions in questions can limit creativity and result in fewer generated ideas.

Keep HMWs broad

When formulating HMW questions, consider whether they can be broadened. A wider scope in our questions can lead to the generation of more ideas. However, it's important to ensure that these questions remain focused enough not to stray from the problem we aim to solve.

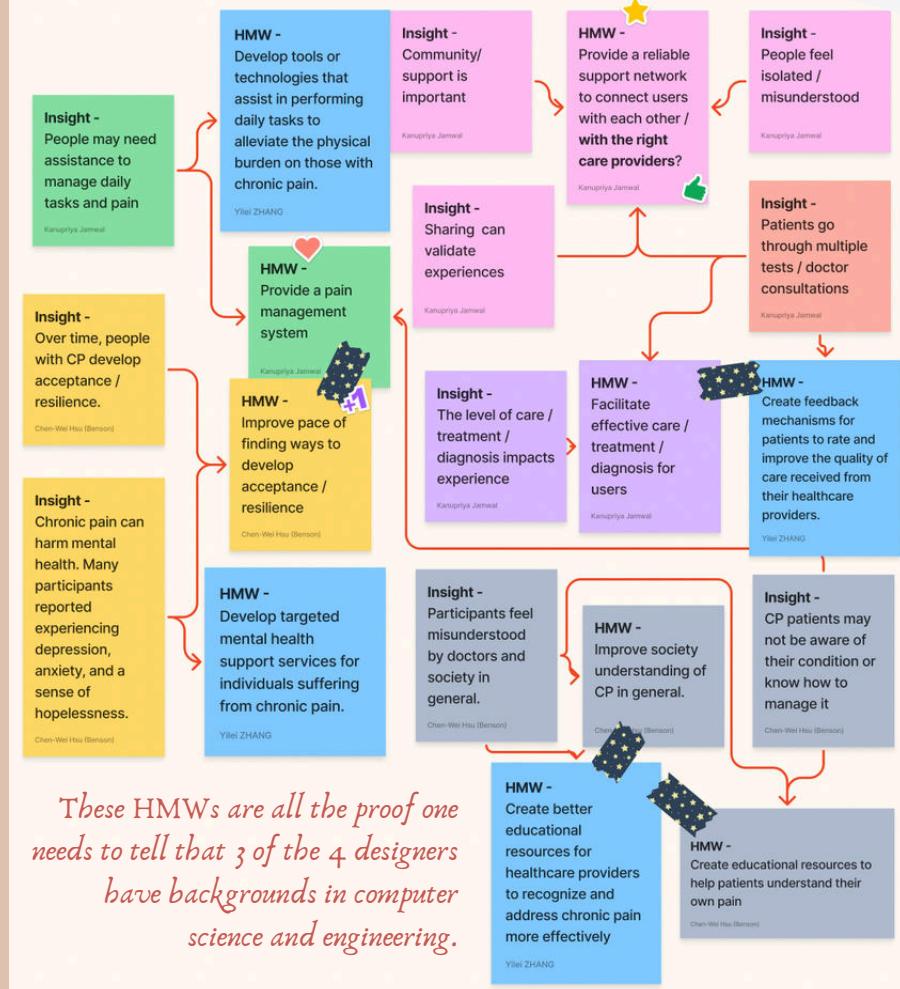
Target desired outcomes

To ensure we're addressing core issues rather than just symptoms, our HMW questions should target the desired outcomes. By centering on the desired outcome we avoid superficial solutions, and foster more creative and effective resolutions.

Frame HMW questions positively

Frame HMW questions in a positive manner to foster greater idea generation and creativity. This positive framing can lead to a more constructive and expansive brainstorming process.

We came up with 10 HMWs, some of them felt related and all of them were too **technocentric**



'HMW provide a pain management system?'
or
'HMW provide feedback mechanisms to ...'.

It felt like our HMWs were created with a technical solution in mind.

We had to come up with HMWs that solved our users' problems, not our problems. We came up with four personas that were grounded on our focus group participants. These personas would help us consider people's pain points (pun) while formulating an HMW, along with insights.





**Stage in Journey:
Undiagnosed**

Tess used to have an active lifestyle where she would start her day with a bit of exercise, tend to her garden, and drop her child off at school before going to work. After a car accident, Tess found herself in intense, constant pain all over her body. Even after consulting multiple doctors, no one was able to diagnose her pain. As a result, she was forced to lead a more dormant lifestyle. Since her condition is undiagnosed, Tess finds it hard to avail disability benefits and convey her pain to others. Her condition also causes her considerable anxiety. Some doctors prescribed her pain medication, but after alleviating the pain for a short time, the medication was ineffective, and the pain came back even harder.

Tess McQUEEN

Age	36
Sex	Female
Job	Sr. Exec
Loc	Ireland

Frustrations

- Undiagnosed
- No resources
- No Reliable doctors
- Money spent on consultations
- Misunderstood

Goals

- Get back to an active lifestyle
- Follow her hobbies
- Work and take care of her child without restriction from pain

“It's exhausting to wake up each day and fight a battle with an invisible enemy. I've spent countless hours and money searching for answers, but I still feel misunderstood and trapped in this cycle of pain”

Brant Armani

Age	42
Sex	Male
Job	Unemployed
Loc	Ireland

Frustrations

- Pain medication does not provide relief
- Uncertainty about future
- Isolation and guilt
- Money spent on consultations
- Multiple treatments ineffective

Goals

- Find the right treatment plan
- Engage in physiotherapy to ease pain
- Talk to people going through a similar experience

“Finding the right treatment feels endless. I just want to feel better and connect with others who understand. It's frustrating to spend so much on treatments that don't work.”



Stage in Journey: Daily life Impact

Richard struggles with the impact of arthritis on his daily life. His condition frequently disrupts his ability to maintain a stable work schedule and engage in social activities. Richard enjoys walking for exercise, but severe pain often prevents him from doing so. He has had to leave family events early to manage his pain, leading to feelings of guilt and misunderstanding among his loved ones. Despite these challenges,

Richard is determined to find a way to live with his pain, balancing it with his daily responsibilities and social life. He yearns for a more inclusive environment where his condition is understood and accommodated.

RICHARD SANCHEZ

Age	40
Sex	Male
Job	Office Admin
Loc	Ireland

Frustrations

- Issue with conducting daily activities
- Unable to be stable on the work time
- Hard to participate social activities
- Difficulty developing and adapting to new life style

Goals

- Having understandable environment for his pain conditions
- Can manage pain as well as daily and social activities
- Create life style align with his condition

KATE MELANIE

Age	46
Sex	Male
Job	Manager
Loc	Ireland

Stage in Journey: Adapting to pain

Kate has dealt with pain from a very early part of her life, as early as she can remember. It took her a while to recognise her condition as chronic lower back pain. After recognising her condition, she consulted all sorts of medical professionals, including doctors, therapists, and pain specialists. Kate educated herself on her condition and went through years of trial and error to find the right combination of care. Kate actively searched for and built a network of individuals suffering from chronic pain. Kate now regulates her activities to fit her lifestyle, is in therapy, connects with other people in chronic pain regularly, and has less pain than earlier. Her carefully planned lifestyle allows her to live a good life, despite her condition.

Frustrations

- Issues with 'pacing', i.e., balancing engaging in daily activities and rest periods.
- Deals with semi-regular flare-ups, i.e., unpredictable periods of intense pain
- Unable to plan daily and social activities

Goals

- make people more aware about chronic pain
- Create and improve a pain self-management routine



“Living with arthritis means constantly adjusting my life around the pain. It's frustrating when I can't work or enjoy a simple walk. I wish people understood how hard it is to balance everything and create a lifestyle that fits me.”

“Finding the right treatment feels endless. I just want to feel better and connect with others who understand. It's frustrating to spend so much on treatments that don't work.”



*This time we came up with
2 HMWs
that were interesting and feasible*

HMW—Improve pace
of finding ways to
develop acceptance /
resilience

How might we provide
a pain management
system?

1 HMW help people go about their daily activities despite pain?

2 HMW enable people in chronic pain to have a meaningful social life?

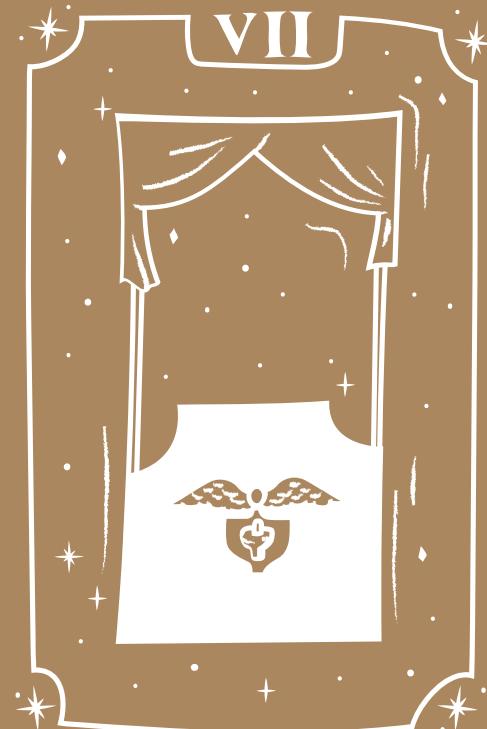
How develop tools or technologies that assist in performing daily tasks to alleviate the physical burden on those with chronic pain.

HMW—Create feedback mechanisms for patients to rate and improve the quality of care received from their healthcare providers.

How might we help people with chronic pain get better medical treatment without wasting too much money?

How might we assist people with chronic pain in enhancing their mental and emotional health to effectively cope with the emotional challenges associated with pain?

IDEATION



Once we had identified our HMW questions, we decided to brainstorm using 2 ideation techniques

CRAZY 8

In the realm of design, Crazy Eights goes beyond a simple card game; it's a rapid brainstorming technique used to quickly generate multiple ideas. Known as a 'design sprint,' the goal is to create and sketch eight distinct solutions to a problem within eight minutes. This demanding exercise results in eight different rough sketches, each representing a potential solution. When used in team environments, this method proves even more beneficial, as it produces a variety of unique ideas that can be explored and expanded upon in subsequent brainstorming sessions (Verma, 2022).



- Each team member should split their paper or canvas into eight separate sections.
- Set the timer for eight minutes.
- Each team member should individually draw one idea in each of the eight rectangles, working diligently until all sections are completed.
- Stop when the time is up and share their thoughts.

DARK SIDE

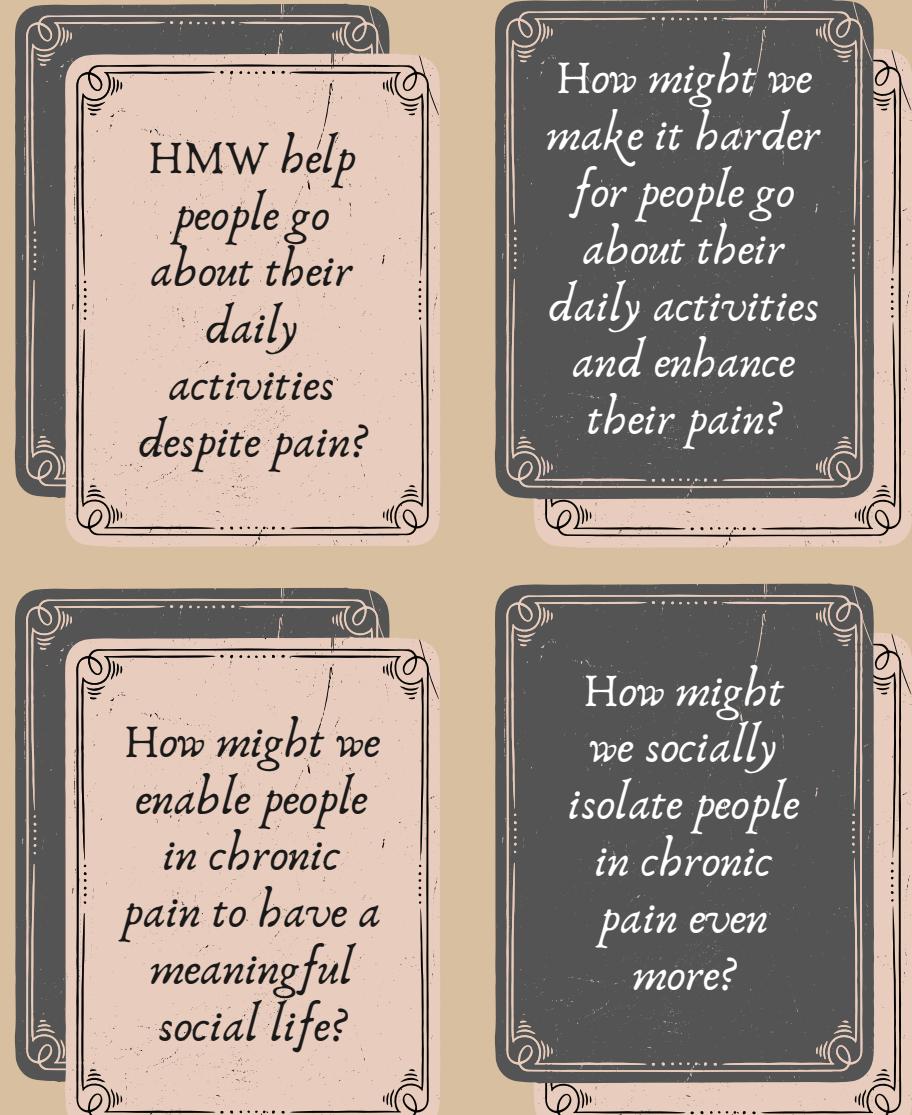
We came up with two more HMWs that directly contradicted our original HMWs. If the original goal was to help people, the goal of the dark side was to ruin lives. This method allowed us to detach from the emotional weight of our research findings and view the HMWs from a fresh perspective (*Dark Side*, n.d.).

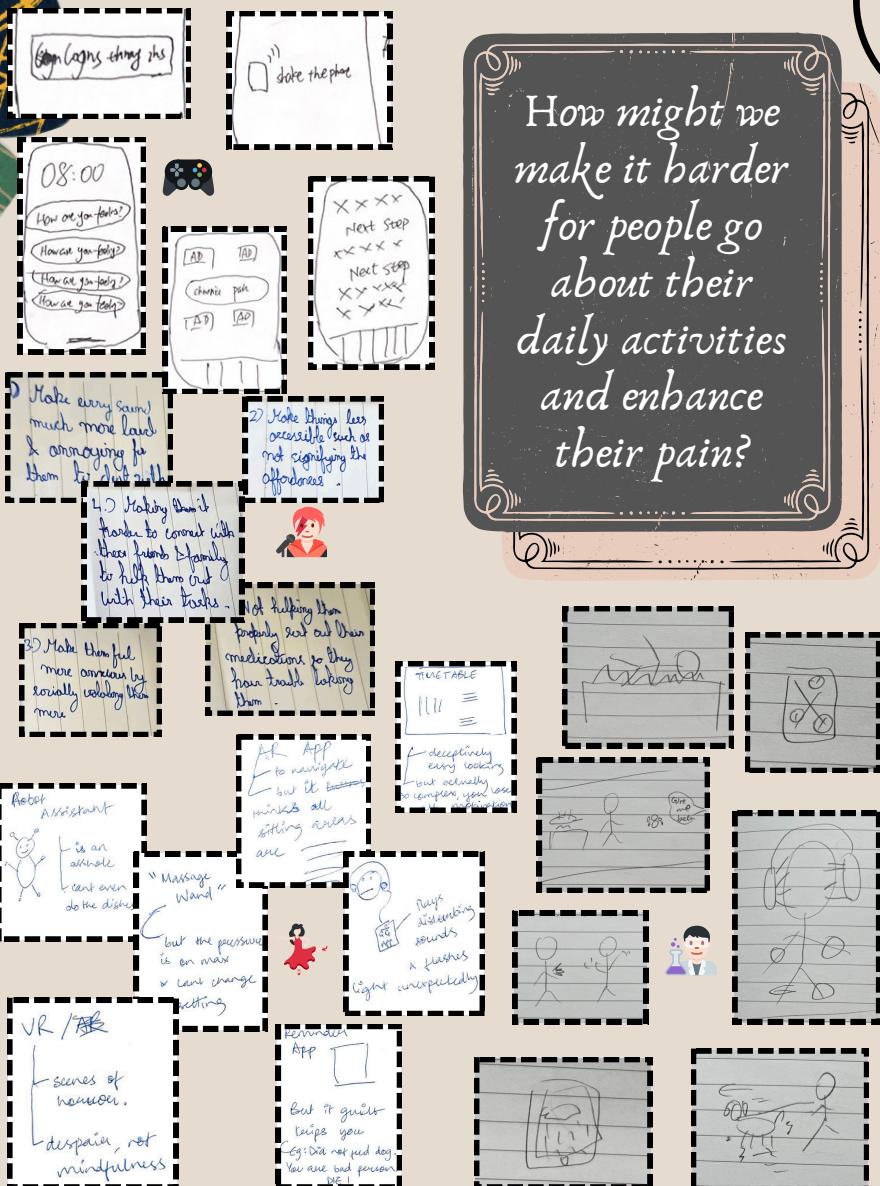
Conducting this exercise proved invaluable, as it helped our team break free from our tendency to look for an immediate 'fix', enabling us to explore a broader range of ideas. The dark side also helped us consider the deeper implications of certain technical and design decisions.

- Write down our design challenge and reframe it in the most negative way possible.
- List down as many solutions as possible that solve our new design challenge.
- Add another idea that transforms or inspired from the first solution into a positive one.
- Discuss all ideas with everyone.



For these four questions, the four members of our group had four rounds of Crazy8 brainstorming.





*How might we
make it harder
for people go
about their
daily activities
and enhance
their pain?*

- 

Kanupriya Jamwal

 - An application induces pain through harsh lights and sounds.
 - Timetables make them consume more time and complex when using.
 - Induce their pain through harsh pressure.
 - Maximize notifications without being sensitive.
 - Useless robot.
 - VR for Bad.
 - AR navigation for misleading them

Yilei Zhang

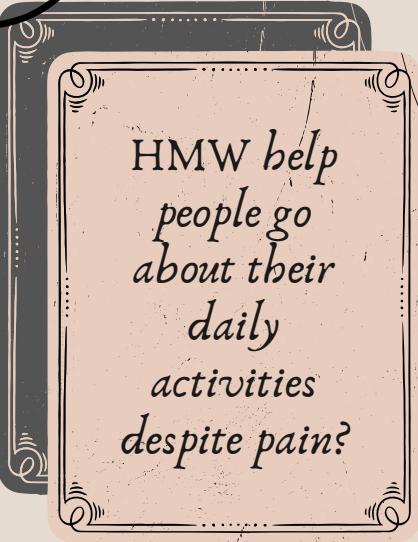
- Complex interface.
 - An app forced them to have social interaction.
 - An app with excessive notifications.
 - An app having mandatory physical interactions.
 - An app with irrelevant content overload.

Chenwei Hsu

- Noisy music with carrying weight when exercising.
 - Hardest bed to sleep in the world.
 - A device that forces you to run faster than your capability.
 - A device hides your painkiller.
 - Fake weather forecaster.
 - Devices that force you to keep moving and electric shock you when you stop.
 - An environment that annoyings them a lot

Aaryan Shrivastava

- Every sound, like an alarm or doorbell, is loud, squeaky, and annoying.
 - Add a pull bar to a push door without telling them which regulator is for which.
 - Don't let them connect to friends and family.
 - Make it harder for them to properly sort out their medications or put useless reminders for events past already.



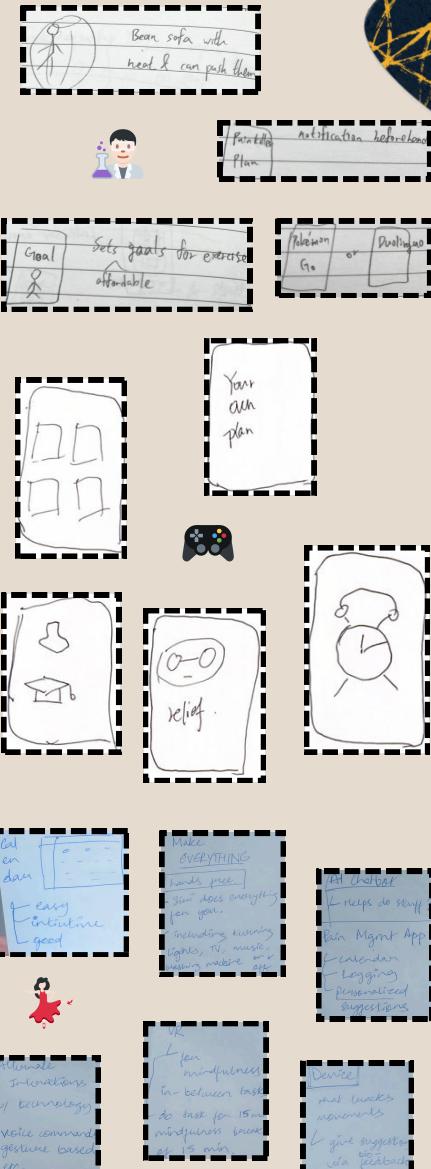
1) Have everything made with clear pointers & easy to use? Introducing shall we connect with a low learning curve.

2) Have more of alarm double & cliff present to fair depending on the location. 3 more alarms. Personal lesson?

3) Layout home tailoring so that the house looks easily to done via voice commands.

4) Design a gym or something like a call off of such that will be the right to have know that they require help on doing work.

5) Making sure that their routine & medicine are maintained at regular intervals.



Kanupriya Jamwal

- Intuitive calendar.
- Reward System.
- Pain management app: all-in-one dashboard, personalized, logging activities.
- VR: task for 15 minutes; mindfulness, break for 15 minutes.
- IoT functions: lights, music, windows, washing machine.
- Alternative Interactions.
- Bio feedback.

Yilei Zhang

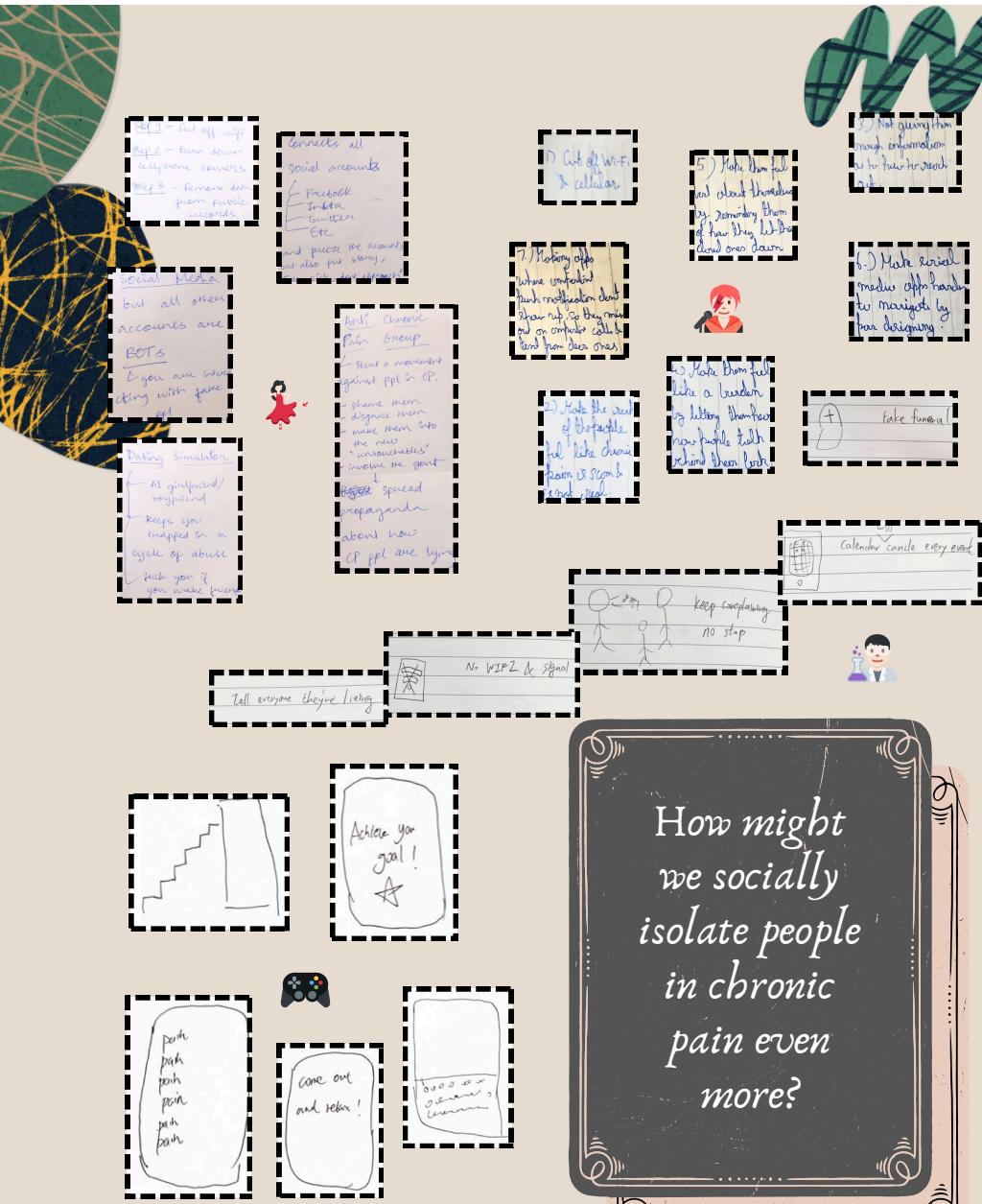
- An app with a clutter-free interface design.
- Resource hub for pain management: provides verified information, tutorials, and expert advice on managing chronic pain.
- Adaptive activity suggestions: The app would learn from the user's feedback to continuously improve its recommendations.
- Virtual pain relief coach: features virtual coaching sessions for pain relief.
- Customizable notification system: with a highly customizable notification system. Allow users to set preferences for reminders.

Chenwei Hsu

- Bean bag that automatically heats up.
- Affordable exercise goals.
- Painkiller notification.
- Gamification.

Aaryan Shrivastava

- Make things easy to use with clear signifiers and a low learning curve.
- Personalization of sounds.
- Basically let other people in the house know that this person is experiencing pain. If we can quantify pain in some way, their partner or someone else in the house can get a notification in their smart device automatically that the person is under immense pain today.



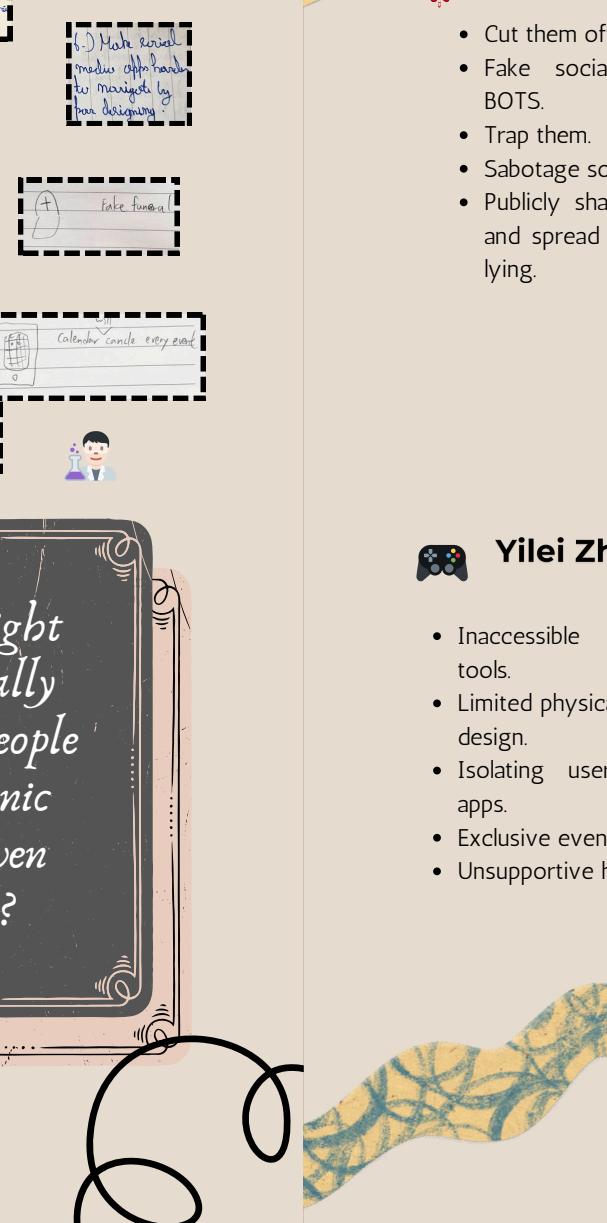
Kanupriya Jamwal

- Cut them off.
- Force people to keep complaining about their pain at social events.
- Stop their WiFi and signal.
- Make a fake funeral and hide them.
- Tell the public they are lying about the pain.
- Calendar that secretly cancels every event.



Chenwei Hsu

- Force people to keep complaining about their pain at social events.
- Stop their WiFi and signal.
- Make a fake funeral and hide them.
- Tell the public they are lying about the pain.
- Calendar that secretly cancels every event.



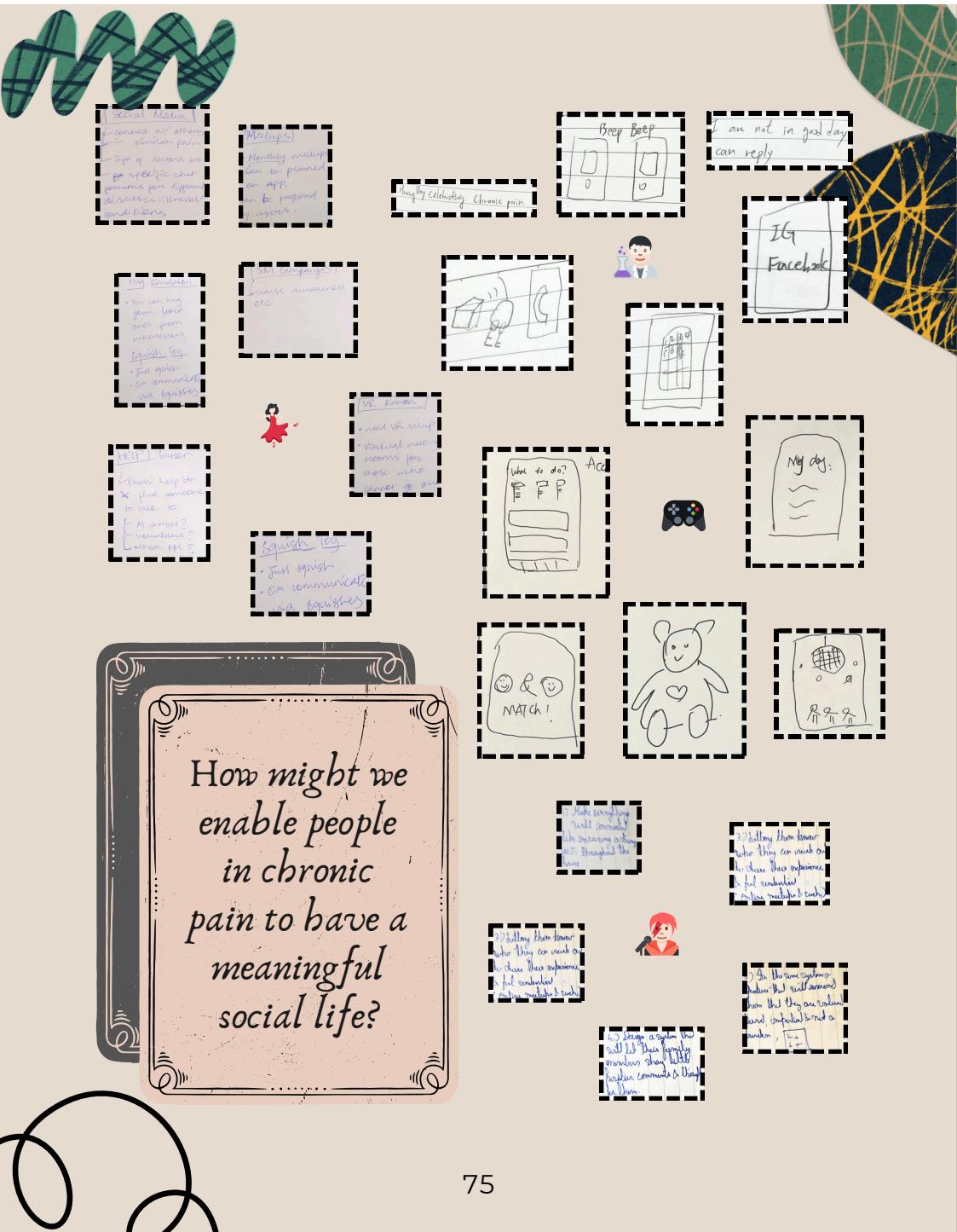
Yilei Zhang

- Inaccessible communication tools.
- Limited physical access in public design.
- Isolating user experience in apps.
- Exclusive event platforms.
- Unsupportive health tracking



Aaryan Shrivastava

- Spread propaganda.
- Isolate them by not telling them about the resources they have and the people they can talk to and feel understood by.
- Make an app that gives negative reminders and what people talk about them behind their back.
- Make them miss important text messages and calls by not showing them important notifications.



Kanupriya Jamwal

- Social Media.
- Monthly meetups: set a plan; users may plan.
- Campaign to raise awareness.
- Virtual rooms for virtual interaction.
- Talk to someone's statistic.



Chenwei Hsu

- Keychain can call you when squeezing it.
- Calendar predicting good days.
- Audio notification when having the same pain conditions.
- Special social media status for bad day.
- National holiday for chronic pain.
- Canned message reply.

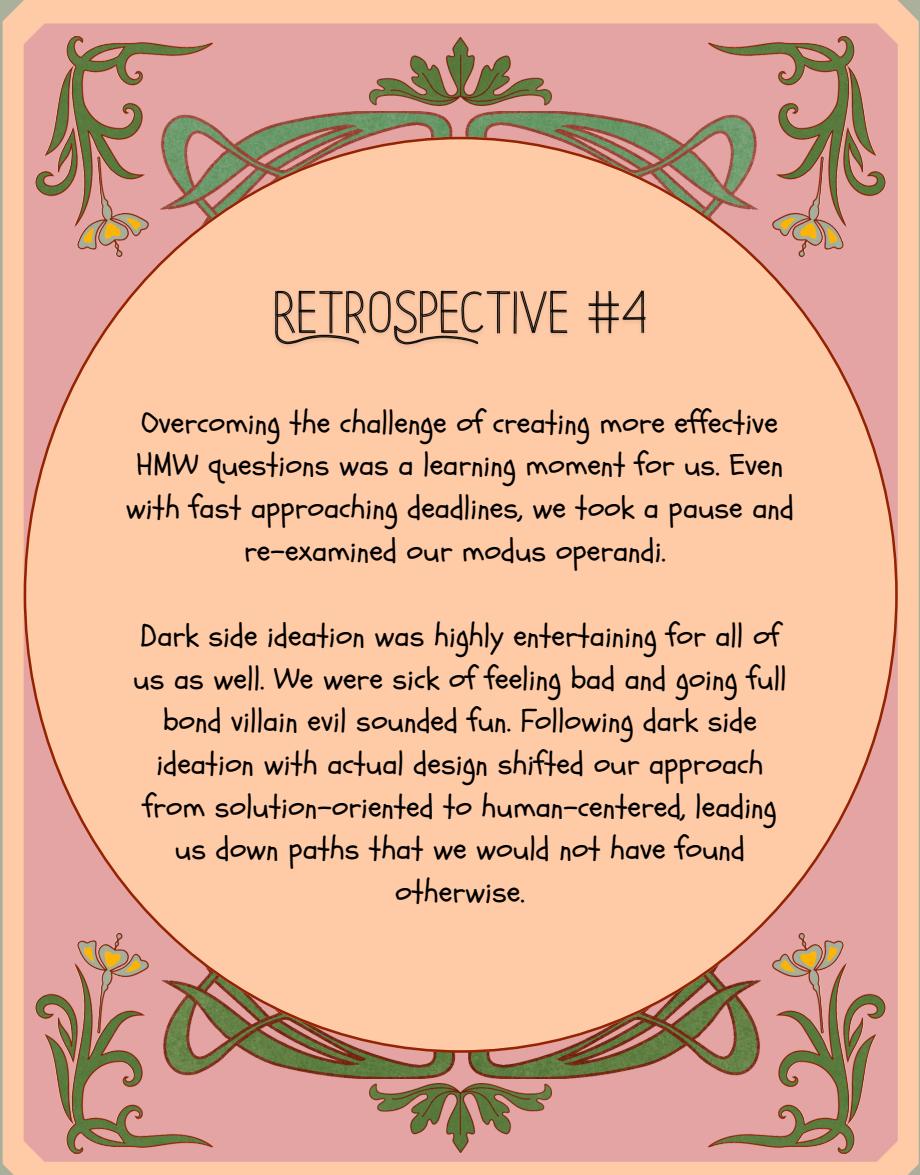
Yilei Zhang

- Accessible event discovery app: helps users find local events with accessibility information clearly displayed.
- Peer support matching app: facilitate forming support groups or one-on-one connections, providing a space for shared experiences and empathy.
- Virtual meetup platform.
- Care Bear: a plush bear with a built-in chatbot. The level of strength with which the bear is hugged can be used to help the chatbot understand the user's current pain level.



Aaryan Shrivastava

- Basically an app that, at regular intervals, reminds them that they are not a burden by automatically making a collage of all the positive things their close ones have said about them and maybe with photos also.



RETROSPECTIVE #4

Overcoming the challenge of creating more effective HMW questions was a learning moment for us. Even with fast approaching deadlines, we took a pause and re-examined our modus operandi.

Dark side ideation was highly entertaining for all of us as well. We were sick of feeling bad and going full bond villain evil sounded fun. Following dark side ideation with actual design shifted our approach from solution-oriented to human-centered, leading us down paths that we would not have found otherwise.



DESIGN CHALLENGE REALISED



We now had a plethora of ideas and several directions to choose from. Based on our ideas and preferences, we settled on a single HMW.

This is the last one, we promise.



DESIGN



An exhaustive discussion and much deliberation later, we decided to make a mobile app for pacing.

Pacing

Pacing, a pain management strategy, involves carefully planning the duration of activities to avoid pain flare-ups, helping people with chronic pain balance activity and rest to maintain daily function without overexertion (Andrews et al., 2012).

Flare-up

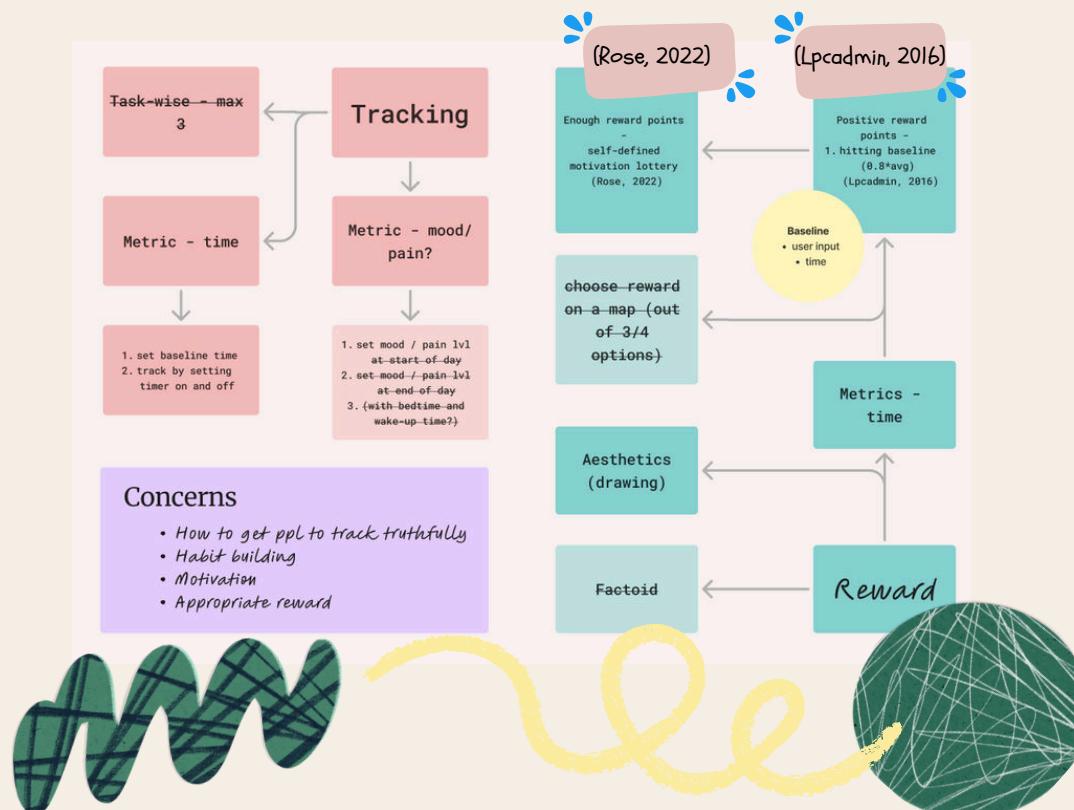
A flare-up refers to a period of intense pain which is felt more severely than your day-to-day chronic pain. Flare-ups may last hours, days or weeks and often there is no set pattern to them. They often come on quickly and without much warning (NHS inform, 2023).

Baseline

Since the key of pacing is to work out how long you can do a task without a pain flare. Baseline is the average time you can do activity without pain and reduce this number by 20% (or multiple by 0.8) for a buffer (Pacing and Goal Setting - Pain Management - PainHEALTH, n.d.-c).

PACING APP

Our app would have 2 basic functionalities - task tracking and reward

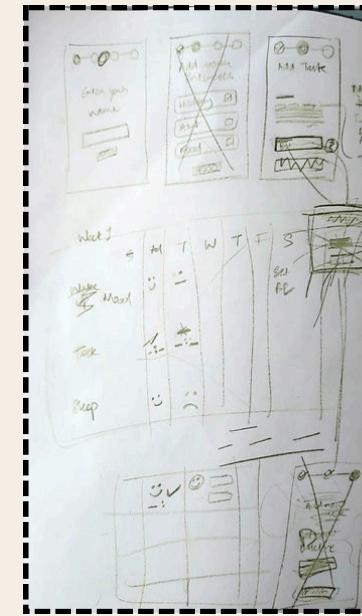
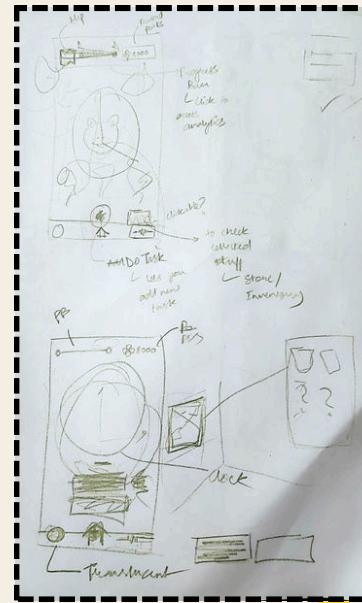
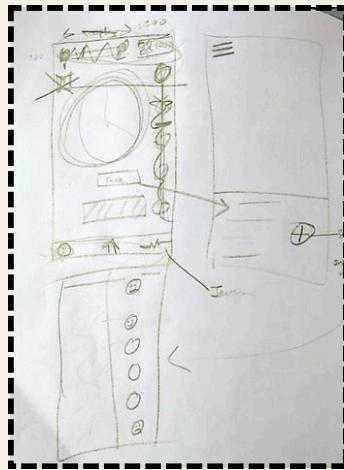


We considered how many screens we would create and what we would track

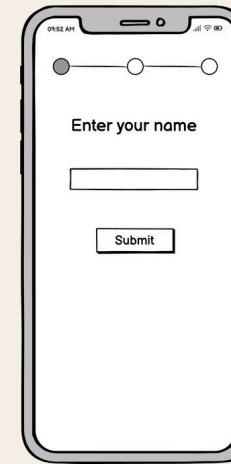


Our wireframes include the very basic features. Sure, we had cool ideas like providing social media features or providing a sentiment analysis from people's daily comments, but we had to figure out the basic functionalities first. Our wireframes were also left open-ended so we could make changes without affecting the entire design.

PAPER WIREFRAMES



Onboarding



Considering that some users don't know enough about the pacing process and baseline time, we provided an info button for guidance.

Those who have experience with pacing could set the baseline time directly. Others could set the baseline time suggested by our app after recording tasks for a while.

In the last step, we would give a basic introduction to the features of the app.

WIREFRAMES

Users will first enter some personal information; we didn't want the process to be too complicated, so we just asked for a name.

The user then sets their own task; we wanted this to be completely personalised, and the baseline time for each task to be determined by the user.

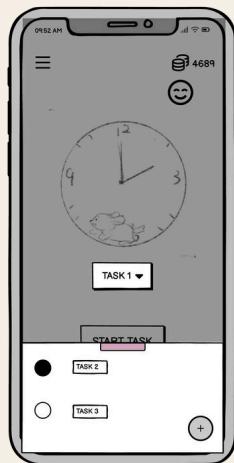
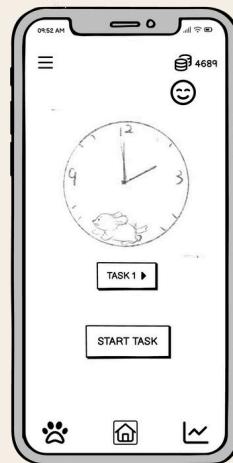
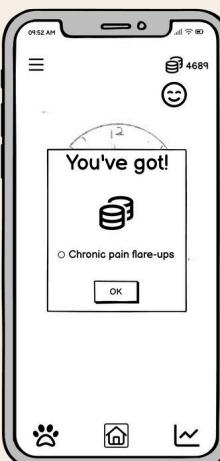
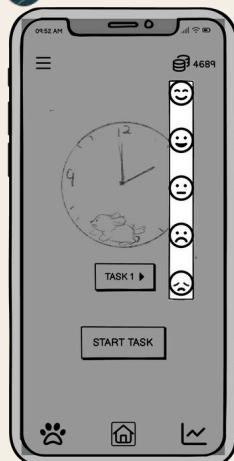


WIREFRAMES

Home

The homepage has been designed to be as simple as possible for ease of use. The clock in the middle is to keep track of time, and a puppy runs around in it when the task starts. To avoid stressing the user, we don't use a countdown; instead, we display how long the task has been going on for. The user may stop it at any time.

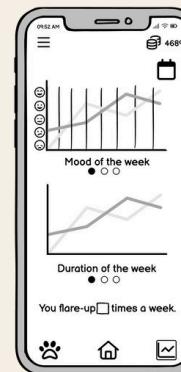
The user may also set different tasks to ensure the integrity of the pacing process.



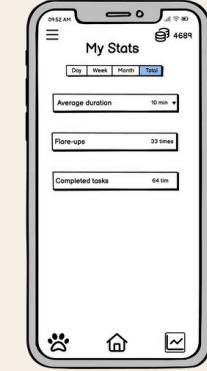
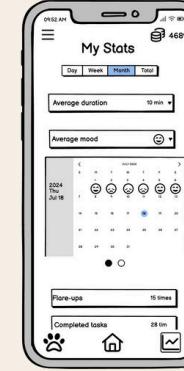
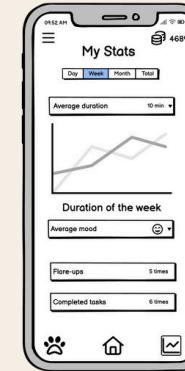
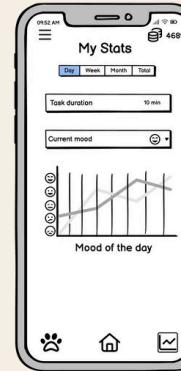
The emoticon icon on the homepage is used to record the user's mood of the day for later analysis. There are five different icons in total, so users can choose according to their personal situation.

Users will be rewarded with coins after each task is completed, and at the same time, users will be asked whether they experienced chronic pain flare-ups or not, which is conducive to better control of their pacing.

Analysis



Version 2

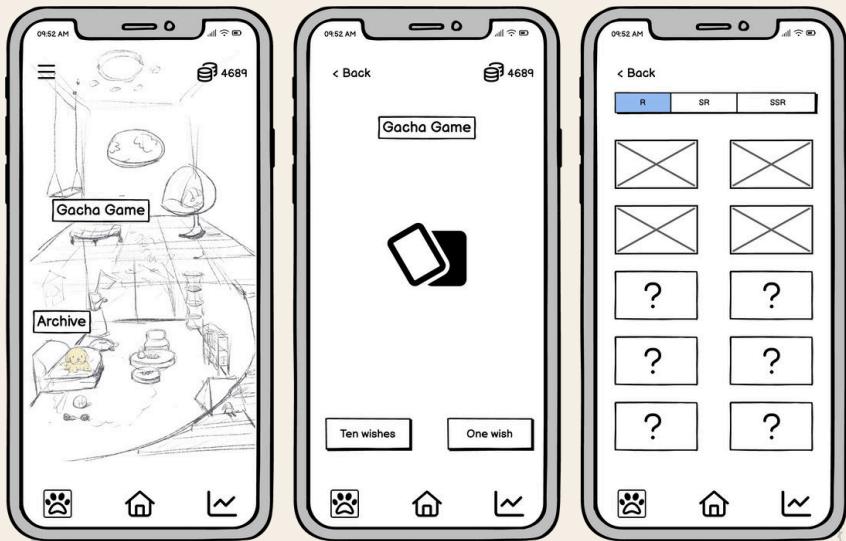


In the analysis section, we carried out two versions of design, and after a group discussion, we decided to go with the second one.

Our app records the time a user spends completing each task along with daily mood and pain flare-ups. While the calendar will show the user's daily mood to help them understand their pain at a glance, users can also gain deeper insight into their pacing process. Users' task durations, moods, and pain will be systematically represented in the form of line graphs, with the different dimensions of days, weeks, months, and total.

WIREFRAMES

Rewards



Regarding the reward part, we will design a cosy page to represent the puppy's home. In our exploration of people with chronic pain, we found that some people's pet dogs were an integral part of their lives and gave them a lot of mental comfort. So cute postcards featuring our puppy will serve as a motivation for users to use the app. This puppy will be designed to be interactive. For example, if you click on it, it will talk to you.

Users will get gold coins as a reward every time they finish a task. These coins can be used to play a lottery (Gacha Game). We will design many beautiful postcards as prizes, and users will get different cards in each wish, and these cards have different rarities.

On this page, users can view the postcard illustrations they have obtained. Users can have fun collecting.

EVALUATION



91

Before finalising our design, we wanted to ensure that our ideas would work for those we were designing for. To validate our design, we held an hour-long online design workshop with 3 participants - 2 people with chronic pain and 1 researcher who is familiar with chronic pain in their work. The participants were mixed gendered, with an age range from 18 to more than 64.

WORKSHOP AGENDA

- An overview of the **key insights** we got from our focus group interview
- Context and decision for our 'How Might We' question or the **design brief**
- An explanation of our **design features** with the help of wireframes
- Validation of design features through a **feasibility-value** matrix
- A Q&A session followed by feedback from our participants

92

1. Baseline
a. User adds baseline when onboarding
b. User is suggested after 1 week of task tracking

2. Rewards
a. lottery w/ reward points
b. pet interaction - feedback - once a day
c. freq - after every task / pet
d. freq - once a day

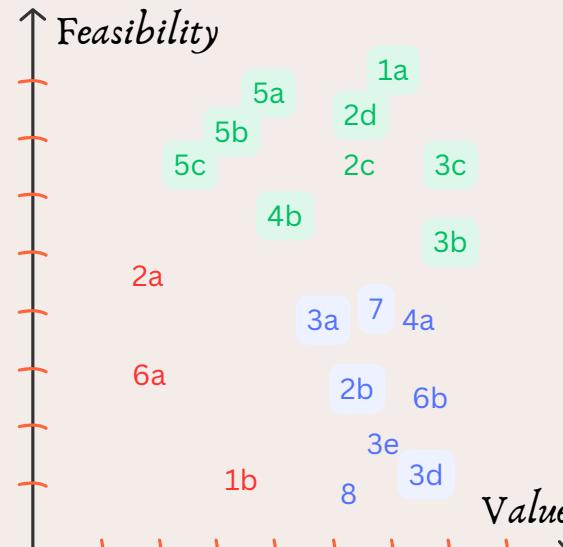
3. Task tracker
a. tracking more than one task
b. timer
c. Start / stop button
d. Pause
e. task completed?

4. Analysis
a. line chart
b. calendar

5. Mood / pain tracker
a. emoji - mood
b. slider - pain
c. colour - pain

6. Flare-up tracker
a. track once a day
b. track severity?

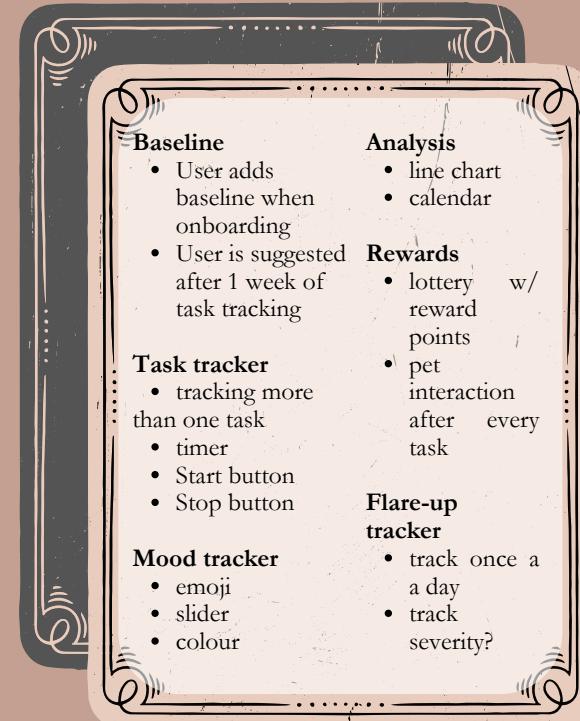
New features -
7. journal per day / comment
8. monthly progress report



Every part of the workshop led to insightful discussions that got us further clarity on our users' motivations and changed the direction of how we approached some of the design.

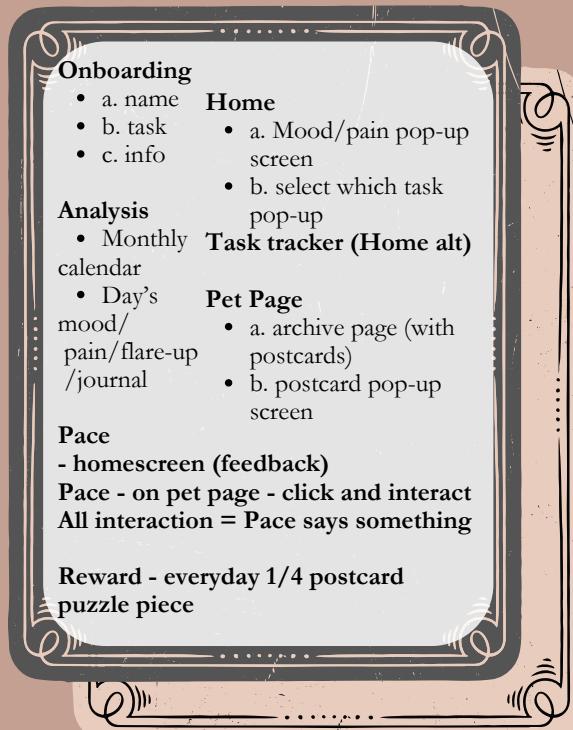
While we were happy to find that most of the features we designed would provide value to our users, visually laying them out on a prioritisation model (Gibbons, 2018) helped us focus our work on their core needs..

And so our design went from



this

to this

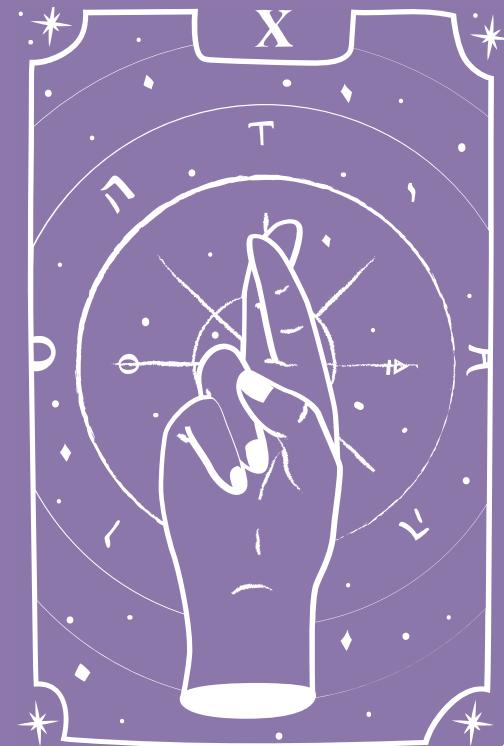


RETROSPECTIVE #5

The discussion and Q&A session led to some helpful discoveries

- Our app's task tracking system works as a method of pacing
- Our participants reported that they knew of no existing apps for pacing
- Time, pain and mood tracking on a calendar is an appropriate data representation for users to track their progress
- Tracking flare-ups is vital for pain management.
- We could name our pet, 'Pace'

PRODUCT



97

98



APP FEATURES

Onboarding



When users first start using the application, they will encounter the onboarding screen. Here, they are prompted to enter their name, task name, task description, and baseline duration. We encourage users to set their own baseline rather than measuring it for them. An explanation of the baseline concept will be provided to ensure users understand it fully.

Homescreen



On the home screen, users can choose and set multiple tasks according to their preferences. They have the ability to pause or complete tasks while starting pacing. As a reward for completing tasks, users receive one fourth of a postcard featuring their pet with landscape in Ireland. In addition to a mood tracker, the home screen includes trackers for mood, pain and flare-ups, allowing users to monitor their overall condition throughout the day. Users can also leave comments about their day.

Statistics



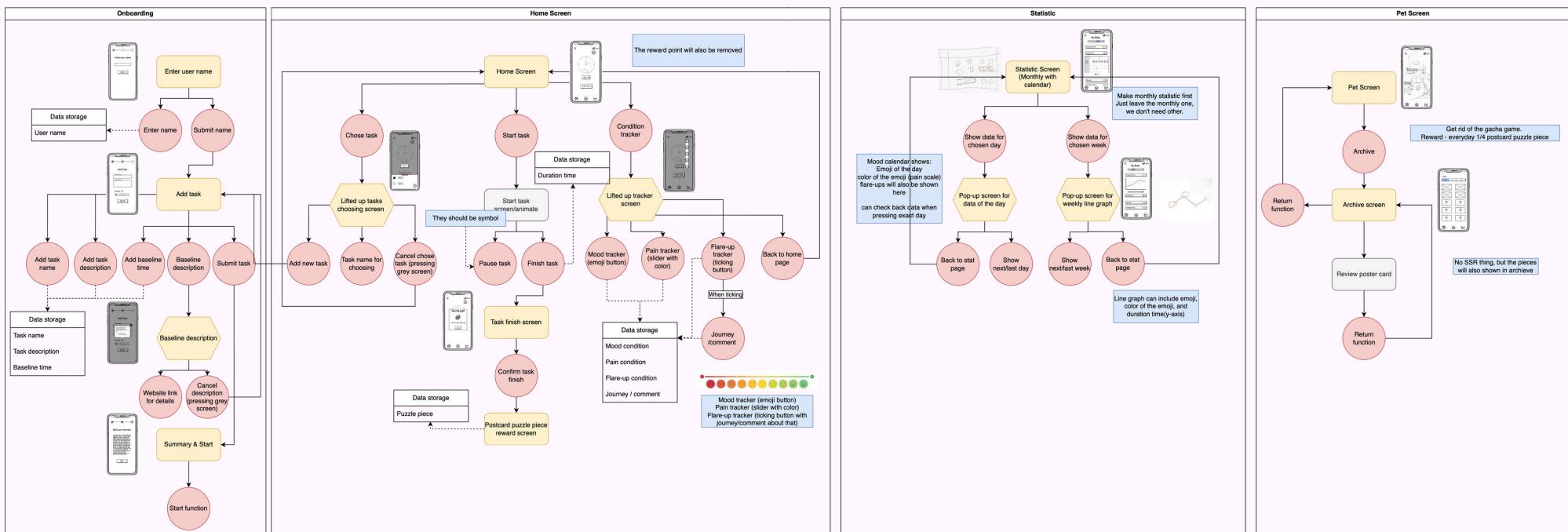
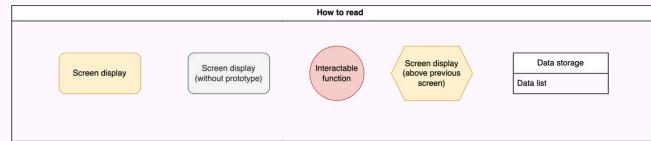
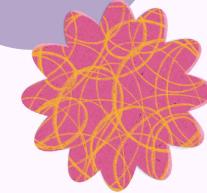
The statistics screen enables users to review their conditions using a monthly calendar. The calendar displays their mood (with emojis), pain levels (with colors), and flare-up conditions. By selecting a specific day, users can see detailed information about that day's condition and their comment of the day.

Pet screen



On the pet screen, users can interact with their pet by tapping on it. They can also view their collection of reward postcards by clicking on the photo frame within the screen.

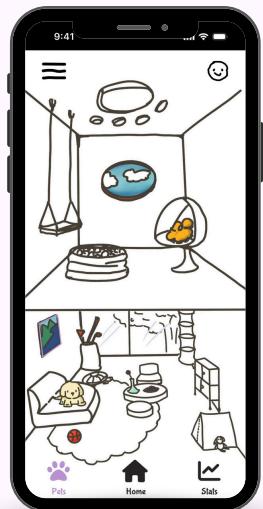
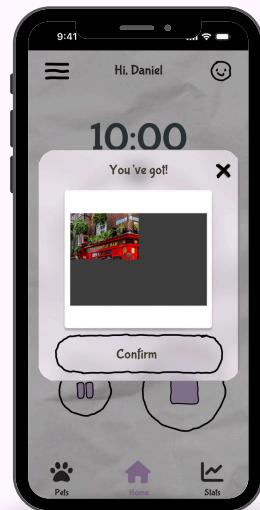
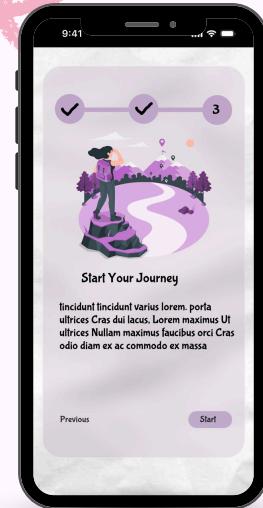
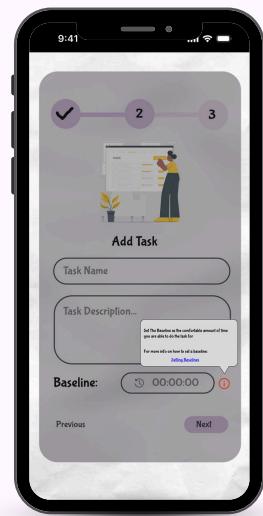
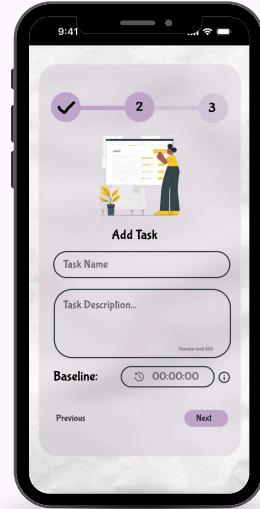
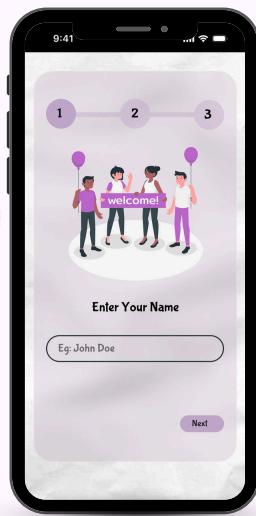
SYSTEM ARCHITECTURE



MOCKUPS

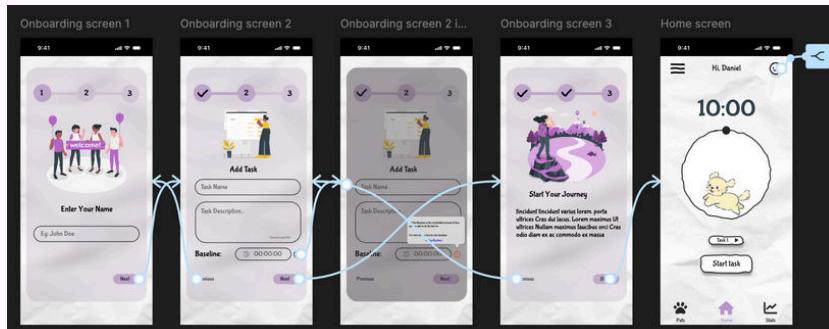
playful, simple, easy



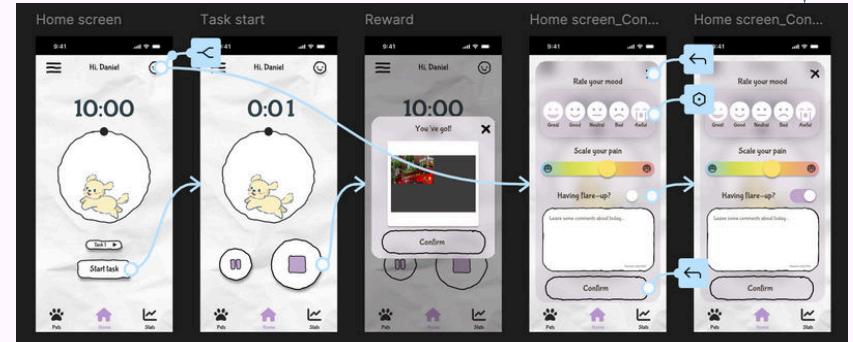


(Raudi, 2014;
Niederwimmer, 2020;
Haupt, 2020; Janik, 2020)

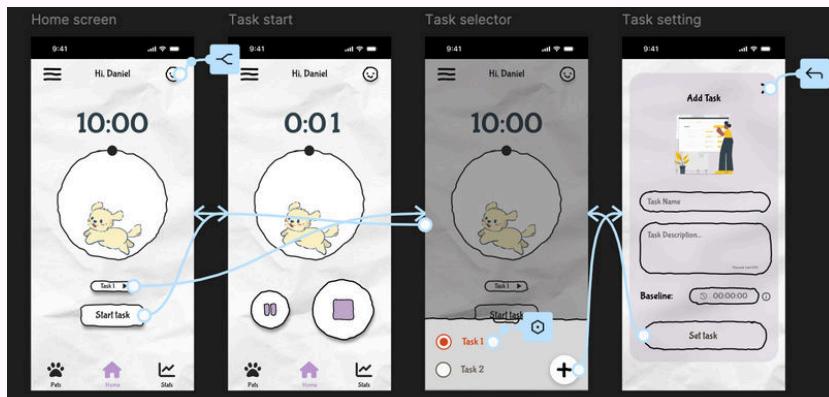
HI-FI PROTOTYPE



During the onboarding process, the user will input their name, add task information, and set a baseline for the task. After onboarding, the user will be taken to the home screen, where our app's mascot 'Pace' will greet them.



On completing a task, the user will receive part of a postcard featuring Pace as a reward. We wanted to provide parts of postcard after every task to keep the user motivated and come back the next day. The user may also record their mood, pain, flare-ups and journal about their day.

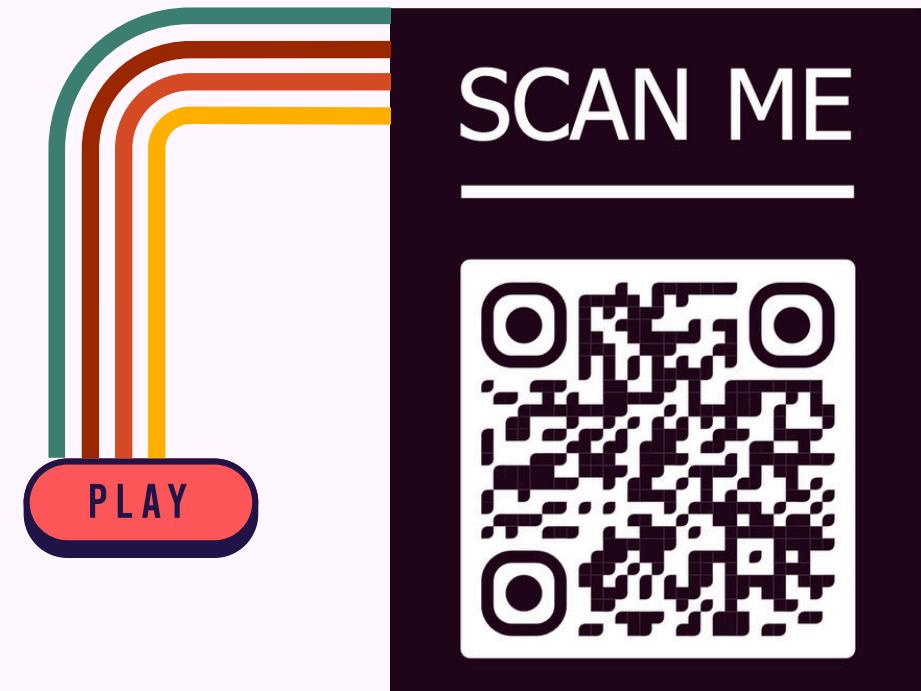


On tapping start on the home screen, the task timer will start and the user will see Pace running. The timer starts from zero to the baseline set by the user. This choice was made so that the user would not get stressed about how much time is left. Pace running was added as an interaction to make the user feel less alone while doing their task as well as resist the temptation to close the app before completing their task. The user has options to both pause and stop the task. The user can change the task on the home screen as well as add new tasks.

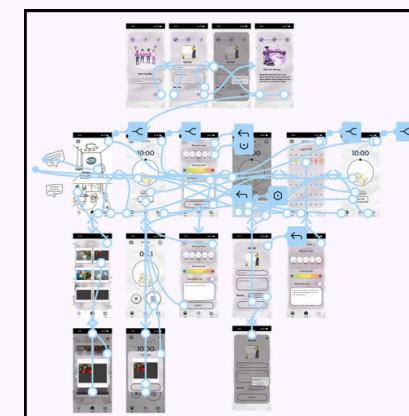


The user can see Pace sitting in his room. The user can click on a painting on the wall to see their archive of postcards. The user may also interact with Pace by clicking on him. Both the paintings on Pace's wall and Pace have been highlighted to draw the user's attention.

The user can access a calendar to view their monthly records. The calendar provides a bird's-eye view of the user's mood, pain, and flare-ups. On clicking a date on the calendar, the user can access the details of their entry on that day.



<https://shorturl.at/LsUCH>



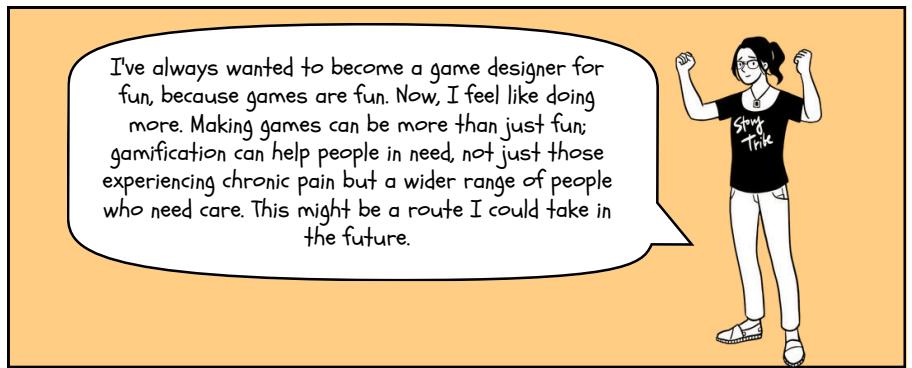
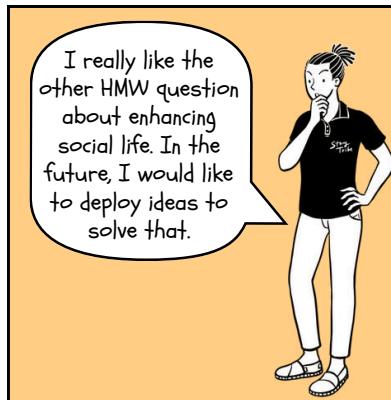
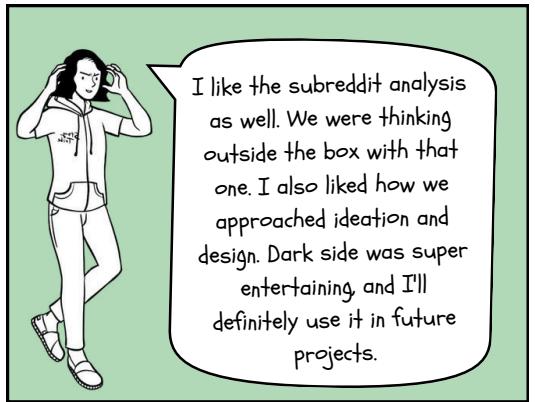
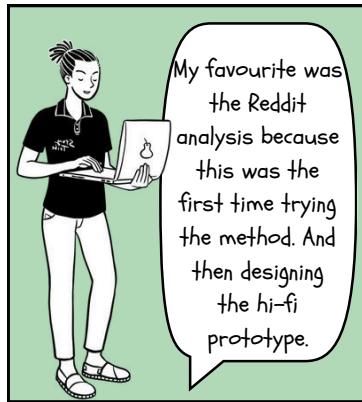
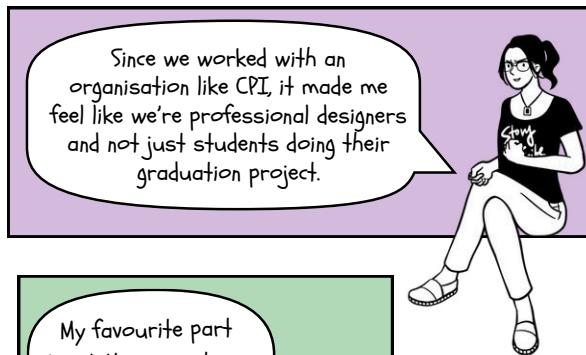
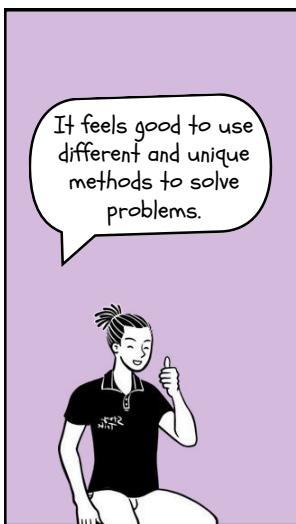
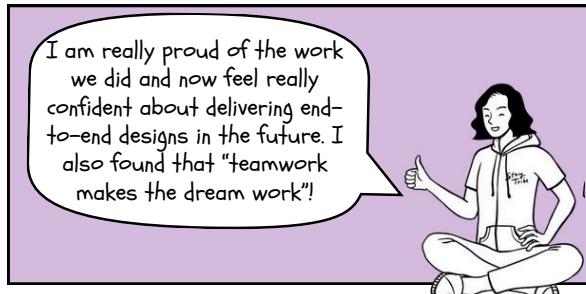
THE END

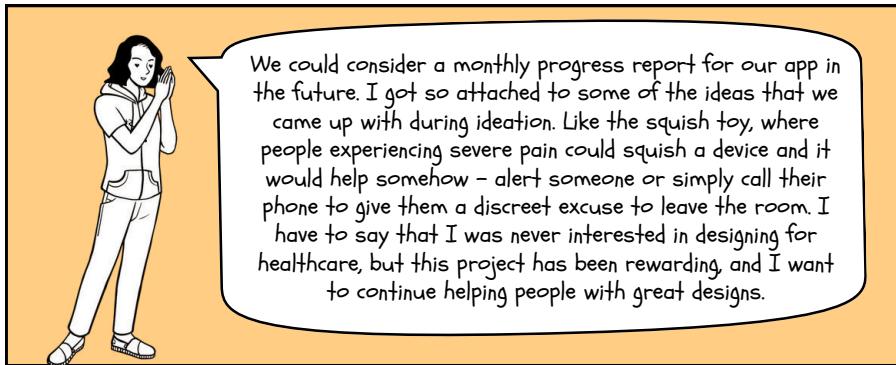


111



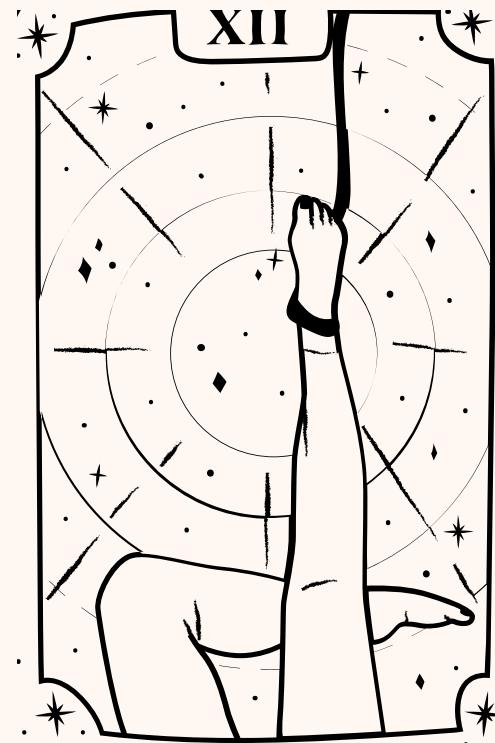
112





115

REFERENCES



116

REFERENCE

Andrews, N. E., Strong, J., & Meredith, P. J. (2012). Activity pacing, avoidance, endurance, and associations with patient functioning in chronic pain: a systematic review and meta-analysis. *Archives of physical medicine and rehabilitation*, 93(11), 2109–2121.

ATLAS.ti Scientific Software Development GmbH. (2024). ATLAS.ti Mac (version 24.1.1) [Qualitative data analysis software]. <https://atlasti.com>

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77–101.

Breivik, H., Collett, B., Ventafridda, V., Cohen, R., & Gallacher, D. (2006). Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. *European journal of pain*, 10(4), 287–333.

Charette, M. (2024). "There is Nothing Fun About Pain": A Critical Phenomenology of Games for Chronic Pain. *Philosophy & Technology*, 37(1), 2.

Dark side. (n.d.). <https://toolkits.dss.cloud/design/method-card/dark-side/>

David, J. M., Benjamin, A., Baecker, R. M., Gromala, D., & Birnholtz, J. (2011). Living with pain, staying in touch: exploring the communication needs of older adults with chronic pain. In *CHI'11 Extended Abstracts on Human Factors in Computing Systems* (pp. 1219–1224).

Eccleston, C., & Crombez, G. (2007). Worry and chronic pain: a misdirected problem solving model. *Pain*, 132(3), 233–236.

Eccleston, C., Morley, S. J., & Williams, A. D. C. (2013). Psychological approaches to chronic pain management: evidence and challenges. *British journal of anaesthesia*, 111(1), 59–63.

Gibbons, S. (2018, May 27). *Using Prioritization Matrices to Inform UX Decisions*. Nielsen Norman Group. <https://www.nngroup.com/articles/prioritization-matrices/>

Gibbons, S. (2024a, January 12). *Journey Mapping 101*. Nielsen Norman Group. <https://www.nngroup.com/articles/journey-mapping-101/>

REFERENCE

Gromala, D., Tong, X., Choo, A., Karamnejad, M., & Shaw, C. D. (2015, April). The virtual meditative walk: virtual reality therapy for chronic pain management. In *Proceedings of the 33rd Annual ACM conference on human factors in computing systems* (pp. 521–524).

Haupt, M. (2020). *gray rocky mountain beside blue sea under blue sky during daytime*. [Photograph]. Unsplash. <https://unsplash.com/photos/gray-rocky-mountain-beside-blue-sea-under-blue-sky-during-daytime-fXmG986sqnk>

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research*, 15(9), 1277–1288.

Hylands-White, N., Duarte, R. V., & Raphael, J. H. (2017). An overview of treatment approaches for chronic pain management. *Rheumatology international*, 37, 29–42.

Jackman, A. (2024, July 21). What is chronic pain. *Chronic Pain Ireland*. <https://chronicpain.ie/what-is-chronic-pain/>

Janick, K. (2020). *Puffin Bird Nature*. [Photograph]. Pixabay. <https://pixabay.com/zh/photos/puffin-bird-nature-birds-animals-5404178/>

Lethem, J., Slade, P. D., Troup, J. D. G., & Bentley, G. (1983). Outline of a fear-avoidance model of exaggerated pain perception—I. *Behaviour research and therapy*, 21(4), 401–408.

Li, Y., Li, F. M., & Carrington, P. (2023, April). Breaking the "Inescapable" Cycle of Pain: Supporting Wheelchair Users' Upper Extremity Health Awareness and Management with Tracking Technologies. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (pp. 1–17).

Lim, C. Y., Berry, A. B., Hartzler, A. L., Hirsch, T., Carrell, D. S., Bermet, Z. A., & Ralston, J. D. (2019, May). Facilitating self-reflection about values and self-care among individuals with chronic conditions. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1–12).

Lpcadmin. (2016, May 16). *Pacing and chronic pain - London Pain Clinic*. London Pain Clinic. <https://www.londonpainclinic.com/resources/pacing-and-chronic-pain/>

REFERENCE

Matsangidou, M., Solomou, T., Høegh Langvad, C., Xynari, K., Papayianni, E., & Pattichis, C. S. (2023, June). Virtual Reality Health Education to Prevent Musculoskeletal Disorders and Chronic Low Back Pain in Formal and Informal Caregivers. In *Adjunct Proceedings of the 31st ACM Conference on User Modeling, Adaptation and Personalization* (pp. 343–351).

Morlion, B., Finco, G., Aldington, D., Überall, M., & Karra, R. (2021). Severe chronic low back pain: patient journey from onset of symptoms to strong opioid treatments in Europe. *Pain Management*, 11(5), 595–602.

Niederwimmer, L. (2020). ireland dublin temple bar pub beer. [Photograph]. Pixabay. <https://pixabay.com/zh/photos/ireland-dublin-temple-bar-pub-beer-4945565/>

Nessler, D. (2024, January 27). How to apply a design thinking, HCD, UX or any creative process from scratch. *Medium*. <https://medium.com/digital-experience-design/how-to-apply-a-design-thinking-hcd-ux-or-any-creative-process-from-scratch-b8786efbf812>

NHS inform. (2023, October 18). *Coping with a flare up of chronic pain* / NHS inform. NHS Inform. <https://www.nhsinform.scot/illnesses-and-conditions/brain-nervs-and-spinal-cord/chronic-pain/coping-with-a-flare-up-of-chronic-pain/>

Pacing and goal setting - Pain management - PainHEALTH. (n.d.). painHEALTH. <https://painhealth.csse.uwa.edu.au/pain-module/pacing-and-goal-setting/>

Politz, D. (2024, June 17). What is relational content analysis in qualitative research? – Delve. Delve. <https://delvetool.com/blog/relational-content-analysis>

Rajagopal, R. (2023, November 16). Interview Transcript analysis methods. MOS Transcription Company. <https://www.legaltranscriptionservice.com/blog/different-approaches-interview-transcript-analysis/>

Raudi, E. (2014). Sheep Ireland Wool. [Photograph]. Unsplash. <https://pixabay.com/zh/photos/sheep-ireland-wool-animal-369173/>

Robinson-Papp, J., George, M. C., Dorfman, D., & Simpson, D. M. (2015). Barriers to chronic pain measurement: a qualitative study of patient perspectives. *Pain Medicine*, 16(7), 1256–1264.

REFERENCE

Rosala, M. (2024, January 31). Using "How might we" questions to ideate on the right problems. Nielsen Norman Group. <https://www.nngroup.com/articles/how-might-we-questions/>

Sehgal, N., Manchikanti, L., & Smith, H. S. (2012). Prescription opioid abuse in chronic pain: a review of opioid abuse predictors and strategies to curb opioid abuse. *Pain physician*, 15(3S), ES67.

Singh, A., Bianchi-Berthouze, N., & Williams, A. C. (2017, May). Supporting everyday function in chronic pain using wearable technology. In *Proceedings of the 2017 CHI Conference on human factors in computing systems* (pp. 3903–3915).

Smith, C. L., Severtsen, B., Vandermause, R., Barbosa-Leiker, C., Wilson, M., & Roll, J. (2018). Seeking chronic pain relief: A hermeneutic exploration. *Pain Management Nursing*, 19(6), 652–662.

Reddit - PRAW 7.7.1 documentation. (n.d.-b) . https://praw.readthedocs.io/en/stable/code_overview/models/reddit.html

Tong, X., Ulas, S., Jin, W., Gromala, D., & Shaw, C. (2017, May). The design and evaluation of a body-sensing video game to foster empathy towards chronic pain patients. In *Proceedings of the 11th EAI International Conference on Pervasive Computing Technologies for Healthcare* (pp. 244–250).

Turk, D. C. (2004). Understanding pain sufferers: the role of cognitive processes. *The spine journal*, 4(1), 1–7.

Verma, S. (2022, January 6). Rapid Brainstorming with Crazy Eights - Scia Verma - Medium. *Medium*. <https://scieverma7.medium.com/rapid-brainstorming-with-crazy-eights-2d0d992e91ae>

Vlaeyen, J. W., & Linton, S. J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain*, 85(3), 317–332.

Wang, J., Anslow, C., McCallum, S. J. R., Robinson, B., Medeiros, D., & Jorge, J. (2022, November). VR Games for Chronic Pain Management. In *Proceedings of the 28th ACM Symposium on Virtual Reality Software and Technology* (pp. 1–11).