

InHand


Empowering Arthritic Hands

InHand is an assistive technology concept which aims at motivating people with arthritic hands to improve dexterity through hand exercises and thus, empowering them to accomplish day-to-day tasks independently

RESPONSIBILITIES

Study design
Research analysis
Idea generation
Prototyping
User testing
Storyboarding
Branding
Concept video

CONTENT


PROCESS 

USER RESEARCH 

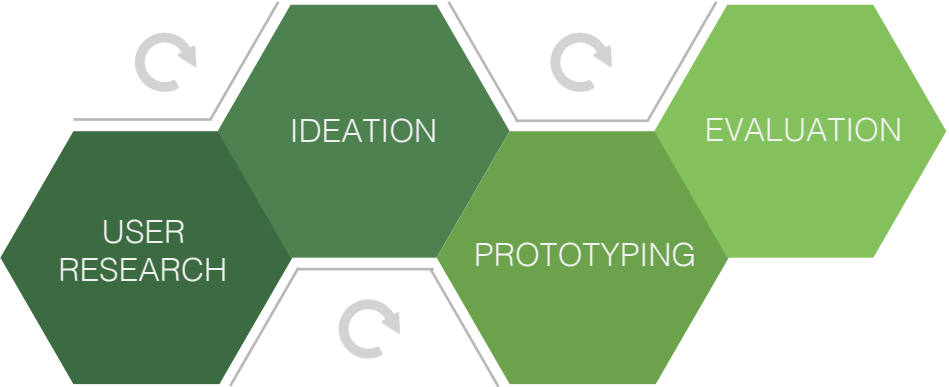
IDEATION 

PROTOTYPING 

EVALUATION 

DESIGN CONCEPT 

CHI ARTEFACTS **CHI**



ITERATION 1

- ▶ Semi-structured Interviews
- ▶ Bottom-up thematic analysis
- ▶ Affinity diagrams

- ▶ Idea generation
- ▶ Sketching

ITERATION 2

- ▶ Online questionnaire
- ▶ Top-down thematic analysis

- ▶ Brainstorming
- ▶ Idea generation
- ▶ Sketching
- ▶ Storyboarding

ITERATION 3

- ▶ Idea generation
- ▶ Sketching
- ▶ Storyboarding

- ▶ Low-fidelity mock-ups

- ▶ Body storming
- ▶ User evaluation

ITERATION 4

- ▶ Idea generation
- ▶ Sketching
- ▶ Storyboarding

- ▶ Low-fidelity mock-ups

- ▶ User evaluation



USER RESEARCH

MOTIVATION

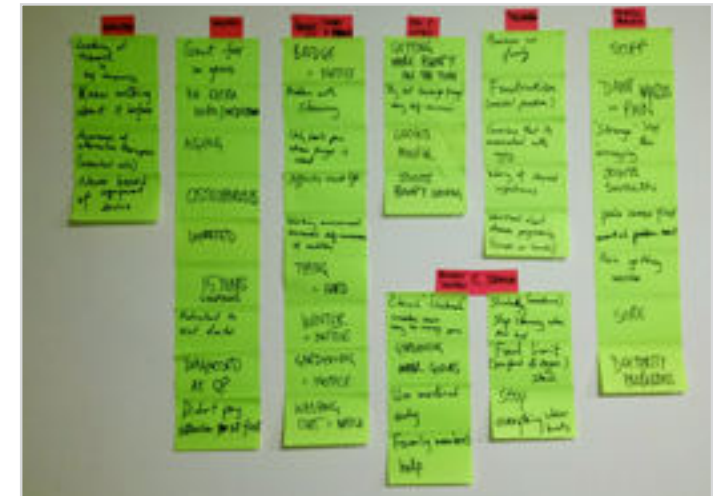
The focus was to develop an assistive technology for people with different abilities. Three members of the team had known sufferers of arthritis of hands in their friends and family. This was main source of inspiration to explore the design space in the area of ‘arthritic hands’

DATA GATHERING

Semi-structured interviews were conducted with three sufferers of arthritis of hands to get insight about the problems faced in everyday activities

ANALYSIS

The data collected was analysed using a bottom-up qualitative thematic coding technique to determine the impacted areas. An affinity diagram was created to organise the data into different categories based on areas of concern



TARGET POPULATION

In the UK, approximately 2 million people suffer from arthritis of the hands. The impact of arthritis of the hands can be profound. Many sufferers face an overall reduction in the use of the hands. The disease is generally observed among people above 40 years of age.

PERSONA



Jennifer
62-year-old
Retired accountant
Lives in London, UK

Interest:
Gardening, reading, spending time with family and friends

Goal:
To continue everyday work as normally as before

Difficulties:
Feels pain/stiffness in wearing gardening gloves, opening jars and using smart-phones

“I think its just sign of aging, there is nothing much that i can do”

AREAS OF CONCERN

- ▶ Knowledge of disease
- ▶ Visual appearance
- ▶ Impact on everyday tasks
- ▶ Physiological problems
- ▶ Psychological problems
- ▶ Reluctance for diagnosis
- ▶ Adopted disease management strategies



IDEATION

BRAINSTORMING

Based on identified areas of concern we brainstormed ideas to find potential solutions which could address particular issues. Total 40 ideas were generated.



SELECTED THEMES

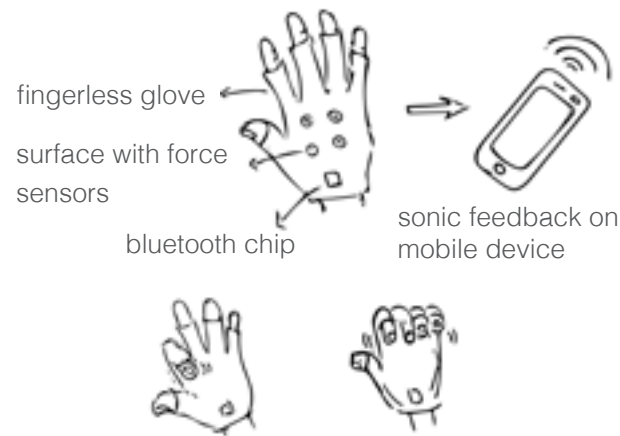
On the basis of uniqueness of ideas when compared with existing assistive technology for arthritic hands, and criticality of problems faced by sufferers, the design space was narrowed down to two major themes.

- ▶ Assistance for hand-held devices
- ▶ Improve dexterity through hand exercises

RAPID SKETCHING

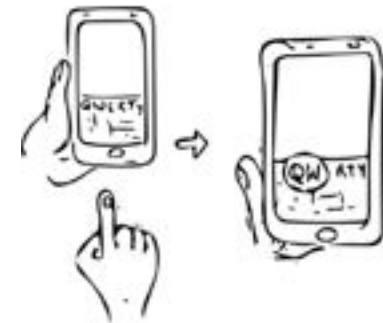
▶ FINGERLESS SONIC GLOVES

Sonic feedback on mobile device when applying pressure on glove surface.



▶ KEYBOARD MAGNIFIER

Approached area of keyboard by finger will be magnified to increase precision of selection of right key



▶ TOUCH-PAD PROJECTION

A case with hooks to support fingers and a projection application which could project the interface on thighs to provide a larger area for the usage. Once projection is synced, user doesn't have to hold the device.





IDEATION

FINALISING THEME

To finalise the theme of design space, an online survey was conducted to understand the problems related to hand-held touchscreen devices as well as awareness and attitude towards hand exercises. I worked on refinement of the questionnaire

82% of participants who had used hand exercises therapy before, found it useful

89% of participants who were not aware about hand exercises were willing to try

50 **50**

Half of the participants reported that they don't face any problem when touchscreen hand-held devices. It was interesting to know that many people have already adapted stylus for operating touch-screens

SECONDARY RESEARCH

Arthritis blogs and forums were explored to compliment our research. We also looked into previous research to identify most beneficial hand exercises for arthritis.

IDEA GENERATION

Based on outcomes of our primary and secondary research, to increase awareness and motivation as well as satisfy physiological and psychological needs, a holistic approach was adapted from this stage onwards, keeping four key factors into account.

- ▶ Knowledge
- ▶ Physical environment
- ▶ Motivation
- ▶ Social network

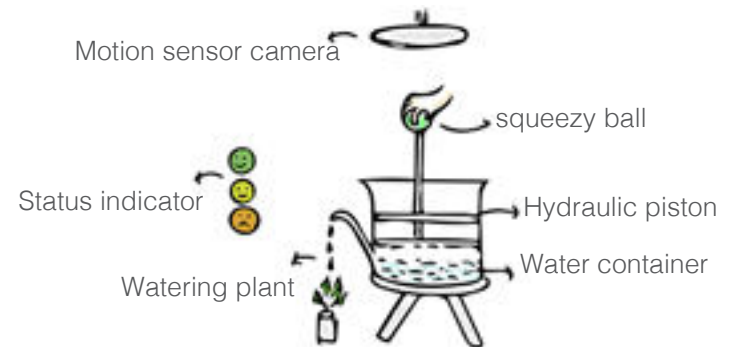
▶ LUMINOUS FIST BAND

LED lights underneath the pressure band would glow for area where force was applied. Larger the force more would be the intensity of light.



▶ SAVE THE PLANT

Squeezing the ball pushes the piston to pour water out into the plant. Smileys indicate the status of plant. Camera captures the hand movement.





PROTOTYPING

■ FILTERING IDEAS

Ideas were filtered on the basis of innovation and feasibility using a 2X2 evaluation matrix

	INNOVATIVE	
TOUCH-PAD PROJECTION	EXERCISE SYSTEM WITH A SQUEEZY OBJECT	
KEYBOARD MAGNIFIER	SAVE THE PLANT	
	LUMINOUS FIST BAND	
LESS FEASIBLE		FEASIBLE
	FINGERLESS SONIC GLOVES	
	LESS INNOVATIVE	

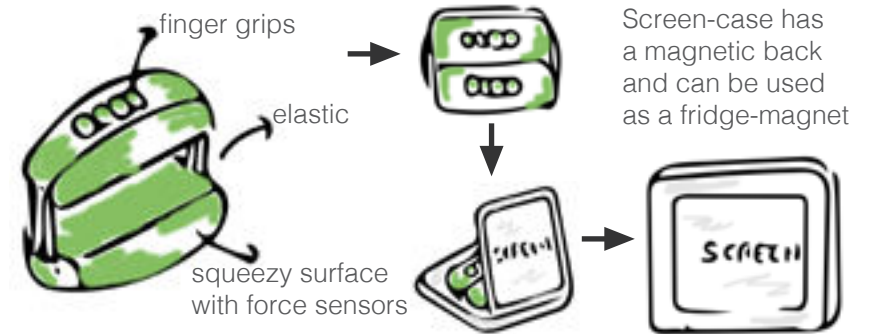
■ LOW-FI MOCK-UP

Low-fidelity mock-ups were created for finalised ideas. Picture on the right shows mock-ups created for the selected idea. (image courtesy: team member)



► HOTDOG-SCREEN

An integrated system of a hotdog shaped squeezy object for exercise and a screen for feedback and information.



Gross grip



MCP flexion



Radial walking



Eccentric wrist extension

Range of exercises with Hotdog-Screen

SELECTED IDEA

- Exercise ball
- Mini-printer which prints a random image of a jigsaw puzzle
- Screen for feedback and information

Concept was to engage users through fun activity and motivate them to perform exercises consistently. Also, focus was to place design in their home environment.

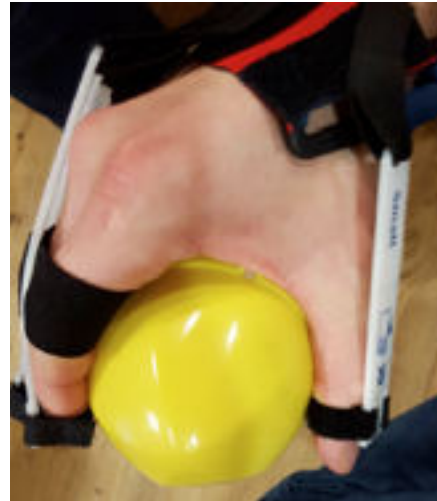




EVALUATION

■ BODY STORMING

We decided to use an empathy modeling technique called body storming on two of the team members to understand the feel of the device to an arthritic hand. An arthritic hand emulator was used to determine the feel of the ball. We found that exercise ball was manageable to squeeze and had a good grip. (Image courtesy: team member)



USER FEEDBACK

We explained our design idea to potential users and it was found that they were least interested in arranging jigsaw-type puzzles. Moreover, potential users struggled to pick and move the printed papers.

The feedback about ball was generally positive. Although, one user mentioned that just squeezing a ball can become boring, and adding the light element makes it exciting.



DESIGN CONCEPT

INHAND

Considering the outcome of our questionnaire that arthritic people favour tablet devices and on the basis of our evaluation and user feed back, we cross-pollinated our previous ideas to come up with InHand system. We replaced printer with an interactive screen, and made both screen and ball to be used as fridge-magnet.

This design concept satisfies all of the user requirements we established. However, due to time constraint we couldn't conduct a rigorous evaluation. Although, it was well received by two potential users and they showed willingness to try the prototype.



(Image courtesy: team member)

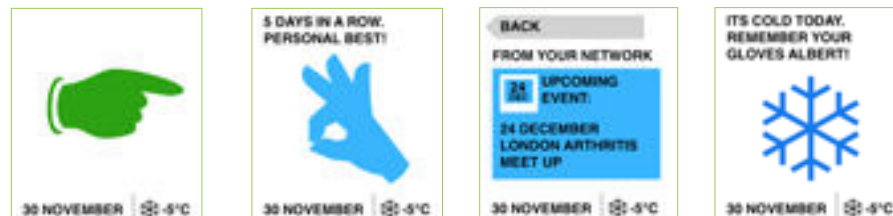
EXERCISE BALL

It would have a soft surface with heating pads to warm the hands and loosen the stiff joints. Pressure applied by each finger would be measured using force-sensors. LEDs would provide instant feedback on applying pressure. Harder the squeeze, brighter the lights.



INTERACTIVE SCREEN

It would provide daily reminders, show progress, provide information for disease management and feeds from the community.



(Image courtesy: team member)

INHAND APP

It would complements interactive screen by providing a platform to get connected with community and to access the information even when away from home.

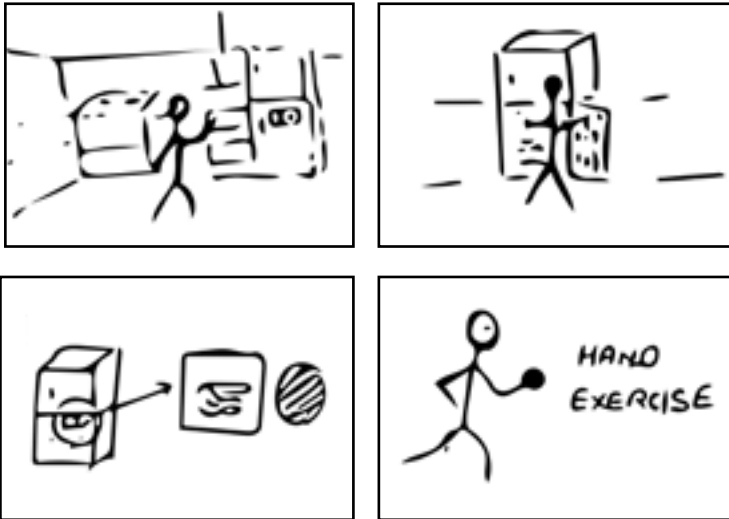
Inhand system in a household



CONCEPT VIDEO

I was responsible for conceptualization, storyboarding, shooting and editing of video

Excerpts from storyboard



Video link



<https://www.youtube.com/watch?v=xum26aIPVeo>

POSTER

I with a team member designed the poster for CHI student design competition. We both were also responsible for overall branding.

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Process

- Data Collection:** Identifying activities deemed to be essential activities based on participants' self-reported activity logs and observations from an occupational therapist.
- Analysis:** Identifying useful tasks and user requirements for a device to support the needs of our users without creating any unnecessary complexity in the exercise design.
- Iteration:** Ideas were prioritized by importance and user feedback in the form of usability, usability, and interviews with users.
- Prototyping:** Low-fidelity prototypes were created in cardboard, foam, and 3D printed. The prototypes were used to test user requirements and to refine the design.
- Testing:** Identifying performance and usability issues and their solutions based on user feedback and usability testing.

Design

The InHand exercise design management system follows a holistic design approach focusing on the empowerment and agency of people with arthritic hands through its integration into their daily life. It consists of five components:

- 1. Exercise ball:** The app tracks and logs the exercise.
- 2. Interactive touchscreen:** It acts as an information point for the users to manage their disease through self-care.
- 3. Smart App:** The app adds social element to the system by helping users to connect with the relevant community.
- 4. Interactive touchscreen:** The exercise touchscreen provides all aspects of disease management through its simple and easy to use interface.
- 5. Smart App:** The app adds social element to the system by helping users to connect with the relevant community.

Research Findings

- The impact of arthritis on the hands can be profound. Many sufferers face an impact on their quality of life.
- Following diagnosis, many people would the disease or a part of it, if not the full of its symptoms.
- Self-management of arthritis within a supportive network can be transformative.
- Several studies have demonstrated the effectiveness of hand exercise therapy.
- Many of the people that we worked with would like to have an exercise device if they could access it.

Exercise ball

- Heating pads:** Heating pads warm the ball's surface to soothe arthritic joints before gross-grip exercise sessions.
- Touchscreen:** A soft and tactile surface provides a tactile affordance.
- Touchscreen Feedback:** LEDs provide immediate feedback during and after the exercise sessions.

InHand App

- Contact community:** A support system comprised of other people who have the application provides electronic support and advice.
- Contact Physiotherapist:** Interested professionals can give advice and guidance to the community.

Interactive touchscreen

- Touchscreen Feedback:** Touchscreen displays progression, short-term and long-term feedback on exercise performance.
- Navigation:** A helpful hand controls the user that it is used for the daily exercise.
- Disease Management:** The interactive touchscreen provides all aspects of disease management through its simple and easy to use interface.
- News:** Messages of support and disease related information from friends in the network community are displayed throughout the day.
- Help:** Important knowledge such as weather warnings and diet tips are integrated into the interaction.

Key benefits

- Fun, motivating and including exercise experience.
- Timely feedback to keep the users well-informed.
- Support of the disease given users the control of its development.
- Social network to receive and give emotional support.
- A system integrated within the home environment.

Future work

- We would like to know how long-term use of system changes disease progression and is diverse for users through a fully-featured app.
- We envisage to develop devices to accommodate a range of hand sizes, other than gross-grip.

UCL