INNOVICE

furniture scanning device

CONTEXT

What

The furniture industry is notorious for its wastefulness. Poor management of the waste has been causing substantial economic, environmental, and social problems.

One out of three individuals throw away household items that could have been donated, sold or reused.

"Only 17% of disposed furniture is recycled in the UK"

"22 million pieces of furniture are discarded each year in the UK"

Who

Target users are **big corporations**, where most furniture is being discarded.
The primary emphasis lies within **the repair and return sector**, as it is where furniture is either repaired or dumped into landfills.

Why

Inability to efficiently assess the damage and come up up with a fixing solution. The fully manual nature of the repair work in the industry leaves ample room for errors to occur.

Lack of **employees having experience in repair**, increases chances of potentially fixable furniture piece ending up in the landfill.

The survey of 50 people has been held to investigate the driving factors of

72% of surveyed users cannot or do not want a repair

55% desire a different style or size of the item

49% discard furniture due to limited space or different needs in the new residence

60% decide to throw their furniture away instead of donating it.

When and Where

The focus of this project are **workshops** of big corporations.

Opening hours vary from **9-10 AM to 8-9 PM** on Monday until Saturdays, on Sundays most furniture retail stores close at 5 PM.

How

How might we make furniture fixing process easy and accessible?

- create an AI platform allowing users to learn about furniture repair

How might we increase the efficiency of repairing furniture damage?

- create a new concept of a scanner that can be used in the industry and make fixing process efficient and fast

How might we make it safe for big corporations to interpret new technology?

- add a security step, such as Face ID.

INITIAL RESEARCH

To investigate how furniture waste emerges, it was necessary to collect **qualitative data**. For this process, the life cycle of furniture was divided into five different stages.

An AI scanner was selected as the most effective tool to offer a sustainable approach to **managing furniture waste**. This would facilitate damage repair and **encourage a circular economy system** in large furniture companies.

APPROACH:

Key stages

Interview of commercial manager of high quality **furniture manufacturing company**

Observation of user experience at IKEA and **user personas**

DESIGN

Interview with **owner of a luxury furniture company** investigating the prototyping and design phase

RETAIL

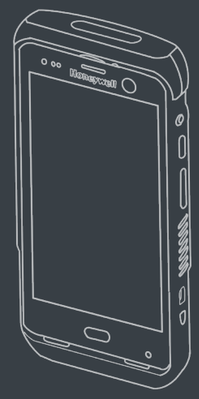
Interview of **returns and waste manager** at IKEA. Observation of the circular hub and the staff equipment.

LANDFILL

Interview with owner of a London **reclamation point**

INTERVIEW

The **waste manager of Ikea** was interviewed to obtain professional feedback on the AI damage scanner



The different equipment available to workshop workers and employees was observed.
Honeywell **hand-held computer** is the main device used by Ikea workers to accelerate many applications like in-store merchandising

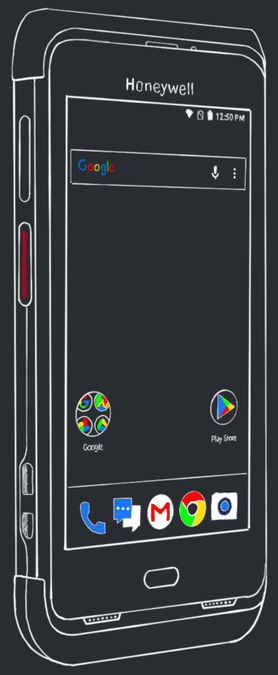
INSIGHTS

The damage scanner should be integrated into the handheld computers which should also be improved

Promoting a system like **Circular Hub** which gives damaged products a second chance by repairing and reselling them at a discounted price

Adapting the product to the conditions of the work environment

MARKET RESEARCH

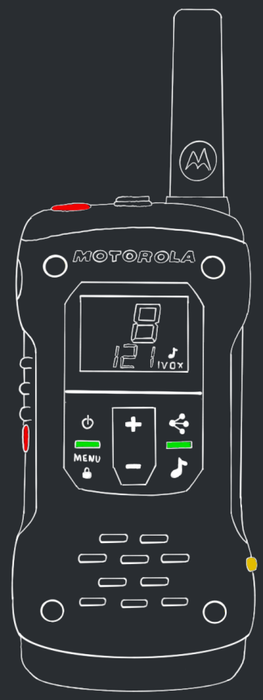


HONEYWELL

- **mobile computer** built on the Mobility Edge™ platform
- small and lightweight with industry targeted features
- **Android** powered
- accelerates many applications such as in-store merchandising

integrate AI powered features: damage scanner and style, colour suggestion

adapting the device to the **furniture industry** with an ergonomic design

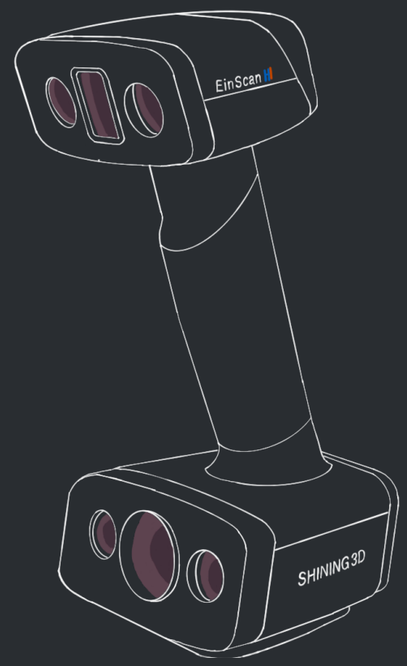


MOTOROLA

- professional **mobile radio with scanner**
- two programmable buttons allow quick and easy access to frequently used functions
- **affordable solution** for communication and simple data capture scanning

introduce a radio communication system on the work mobile computer

easy to hold and efficient design but with limited features and capacity



EINSCAN H

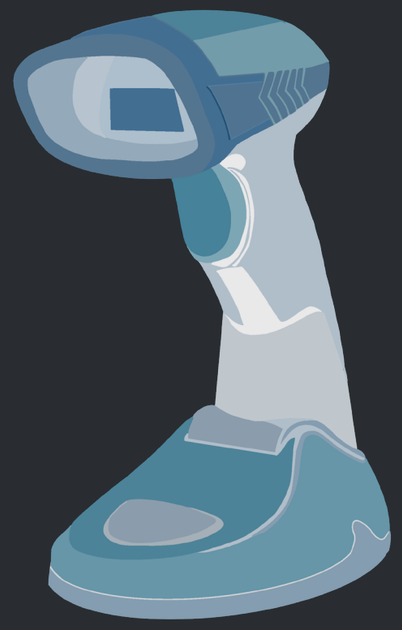
- handheld **3D scanner**
- portable, rapid full-colour scanning
- dual blue LED light and blue laser
- used for reverse engineering, CAD/CAM, 3D printing
- triangulation and **structured light projection** ensure high accuracy

explore the Solid Edge Shining software which allows **reverse engineering**

design from scan data with the ability to export to CAD programs as Solidworks

INITIAL IDEATION

An **AI-powered mobile computer** developed specifically **for the furniture retail industry**. A **wearable** technology equipped with a 3D scanner, camera and CAD softwares.

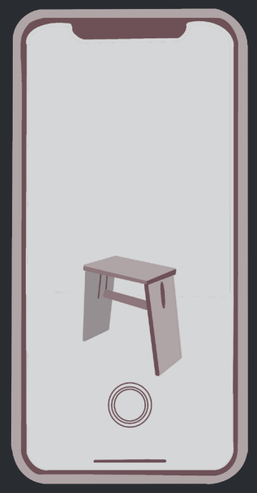


DAMAGE SCANNER

AI-powered scanner system which detects the damaged components.

Designed for waste managers, it scans the furniture that needs to be repaired.

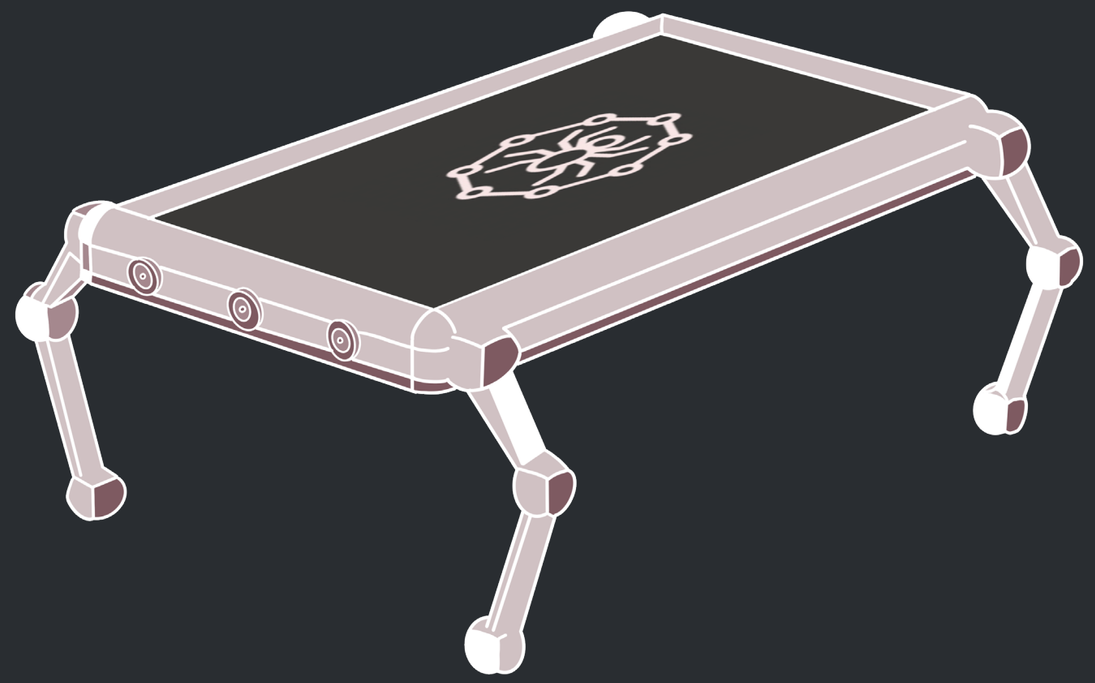
Main advantage is its ergonomic shape, however need a different screen to display the results which is a time consuming process.



Data from the scanner is displayed by a corresponding **app** which **generates new existing furniture that can be made with the available and intact pieces.**

The software will determine the solution based on different factors: total amount of waste, time/cost efficiency, client's requests, available pieces

Opportunity: **merge the manual scanner and the application** into a unique and efficient device with an ergonomic design and an AI-powered camera. **How? By developing a new generation of mobile computers**



Mobile computer wearable on the arm with an **integrated damage scanner, 3D camera, CAD softwares, and internet access.**

AI assistant for colour, style, pattern suggestions and comparison of prices, dimensions of different products for efficient customer service

FAQs

Why a mobile computer? *Most used and powerful device in the furniture workplace*

What kind of scanner? *A barcode, a 3D and AI repair scanner*

How does it reduce waste? *AI algorithm generates the most effective way of repairing a product and helps with product selection*

BRANDING

Origin

Furniture repair workers **lack a truly efficient tool** tailored to their specific needs, resulting in decreased efficiency during the fixing process.

Why Innovice?

Current products lack features targeted explicitly for the **furniture repairing** sector, Innovice provides a flexible solution to this.

Name

Innovice a short and catchy alteration for ‘innovative device’; reflecting our experimentations into how scanning devices could take shape and form.

Logo

Spider in the middle represents the multifunctionality of our device and potential shape design with 8 circle joint in the wrist-band.

User

- Workshop employees
- Repair specialists
- Big corporation workers
- Consumers interested in furniture repair

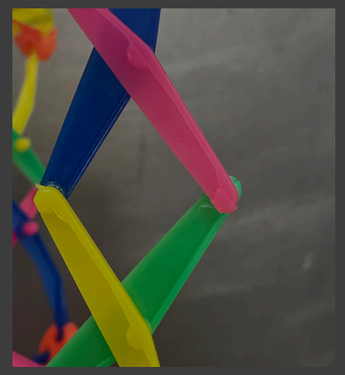
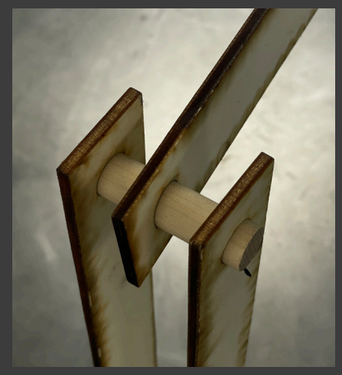
Style

Furniture repair is should be a **highly efficient, straightforward** experience. **Lightweight and practical** design is a focus in the workshop environment.

WORKS-LIKE PROTOTYPE

Joints Investigation

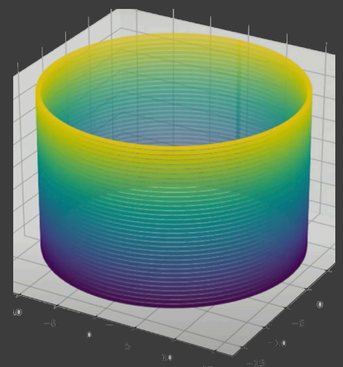
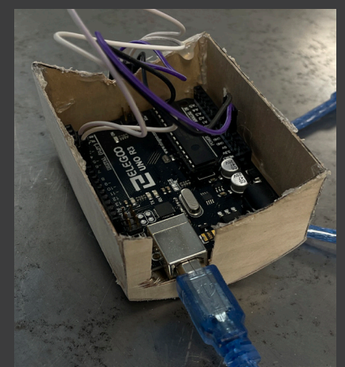
Inspiration was taken from a toy, that had **wide range of joint motion**.
Laser cutting was used to cut the joining system on a large scale. The last picture shows a working prototype that was developed using wood, screws and glue gun to create **soft edges for better user experience.**

Scanning system

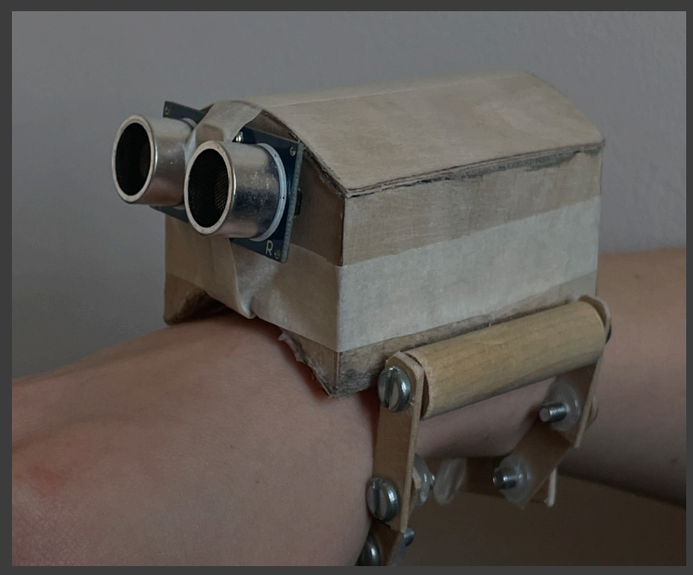
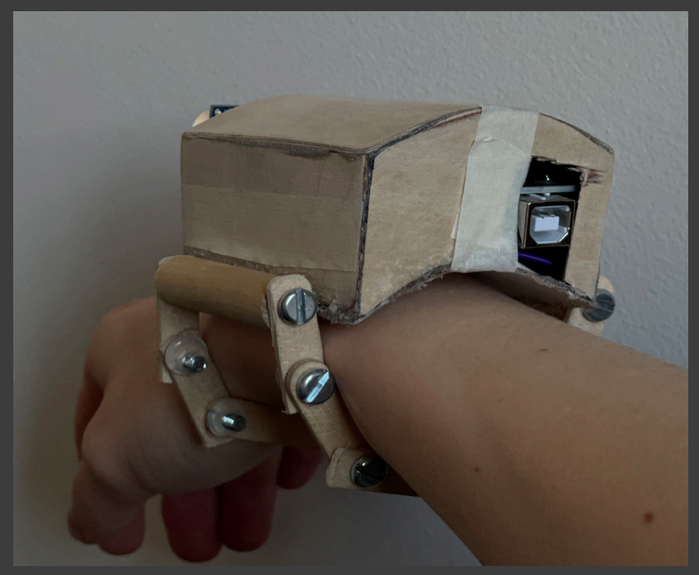
Ultrasonic sensor was used to create a 3D scanner. The sensor was connected to the Arduino board. The Arduino code allows to get the distance values from the object to the scanner in cm. Obtained results are then used to plot the **3D model** with Matplotlib on Python.

```
const int pingPin = 7; // Trigger Pin of Ultrasonic Sensor
const int echoPin = 6; // Echo Pin of Ultrasonic Sensor

void setup() {
   Serial.begin(9600); // Starting Serial Terminal
}

void loop() {
   long duration, cm;
   pinMode(pingPin, OUTPUT);
   digitalWrite(pingPin, LOW);
   delayMicroseconds(2);
   digitalWrite(pingPin, HIGH);
   delayMicroseconds(10);
   digitalWrite(pingPin, LOW);
   pinMode(echoPin, INPUT);
   duration = pulseIn(echoPin, HIGH);
   cm = microsecondsToCentimeters(duration);
   Serial.print(cm);
   Serial.print("cm");
   Serial.println();
   delay(500);
}

long microsecondsToCentimeters(long microseconds) {
   return microseconds / 29 / 2;
}
```

Final

The design of the belts allows them to **strap around the arm and to stand**, serving as a tripod for the scanner. The screen would be attached to the top cover.

Feedback

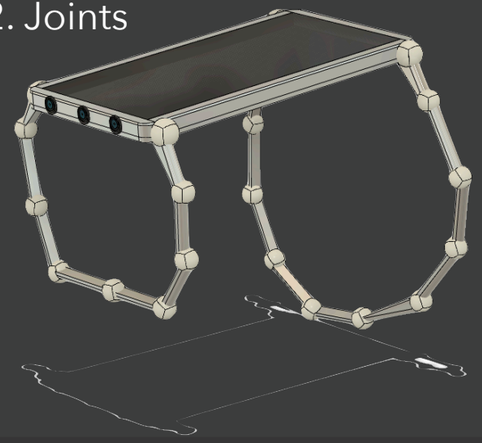
- The box looks **too chunky** on the wrist: would be inconvenient in use
- The scanning system only works if the sensor is being **held at specific positions at specific times**, leaving room for error.

LOOKS-LIKE PROTOTYPE

Which wrist-band is most convenient to users?

1. Solid belts

2. Joints



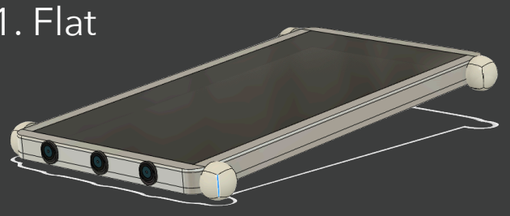
Feedback:

- The first design looks uncomfortable. It doesn't seem to be easy to take it off.
- I would not be able to put the first option in the pocket since it is solid. The second option looks like i can change its shape.

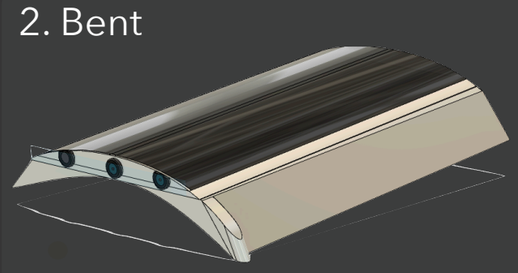
Second option was chosen 70% of the time due to the range of joints motion.

Most convenient screen shape?

1. Flat



2. Bent



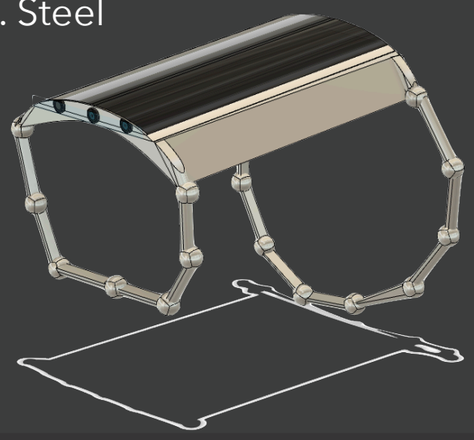
Feedback:

- The first shape looks like a phone attached to the wrist, doesn't seem very comfortable.
- In the workshop environment it's better to avoid edges (about 1st) . Second one looks safer.

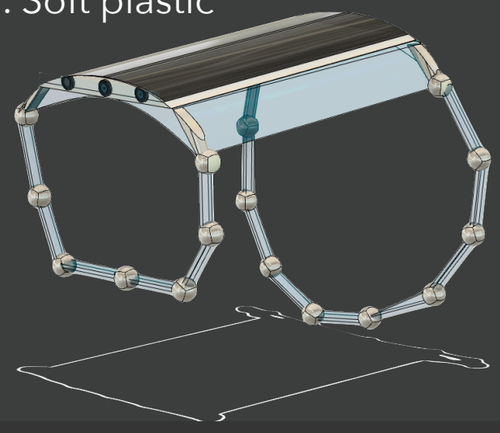
93% voted for the 2nd option due to its comfortable look.

Which material would be most comfortable?

1. Steel



2. Soft plastic

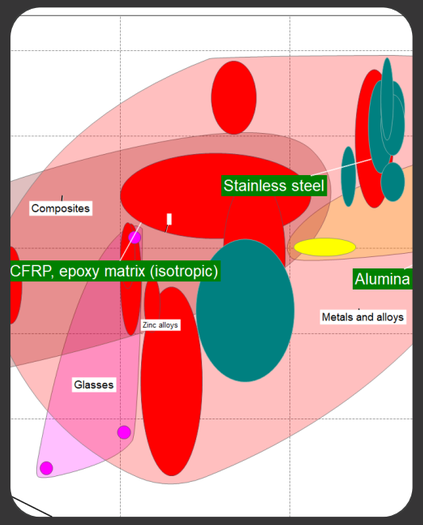


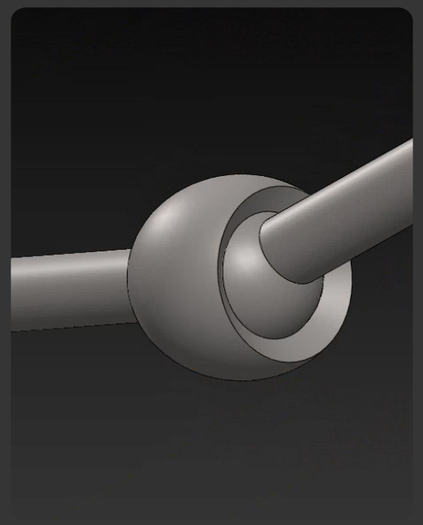
Feedback:

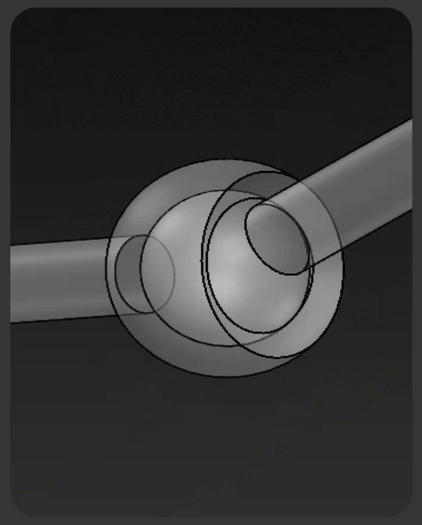
- Steel version looks heavy. I don't want my arms to get tired in the middle of a workday. I prefer the second one.
- Steel looks chic, however as a person who works in the work shop all the time, practicality and comfort is more important.

Plastic was preferred by the user as a lightweight material.

LOOKS-LIKE PROTOTYPE

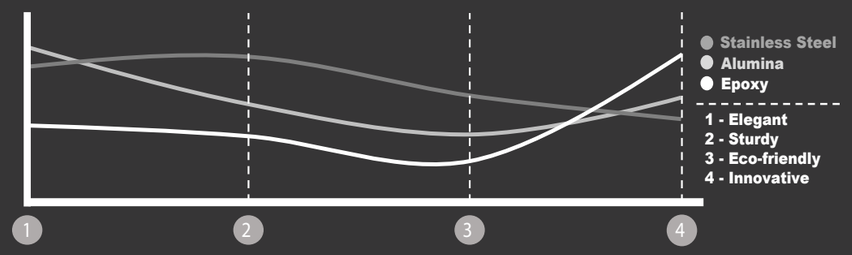




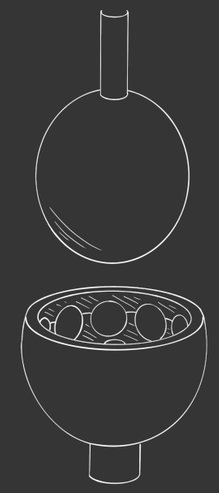


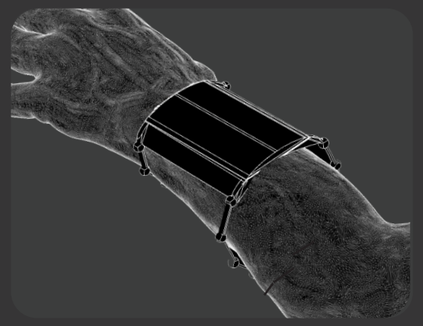
Joints study

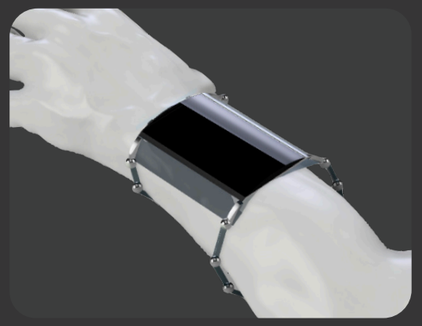
The materials are Stainless steel, CFRP Epoxy matrix, and Alumina. These three materials were rated from 1-10 based on the 4 factors:



Stainless steel was chosen for the joints.





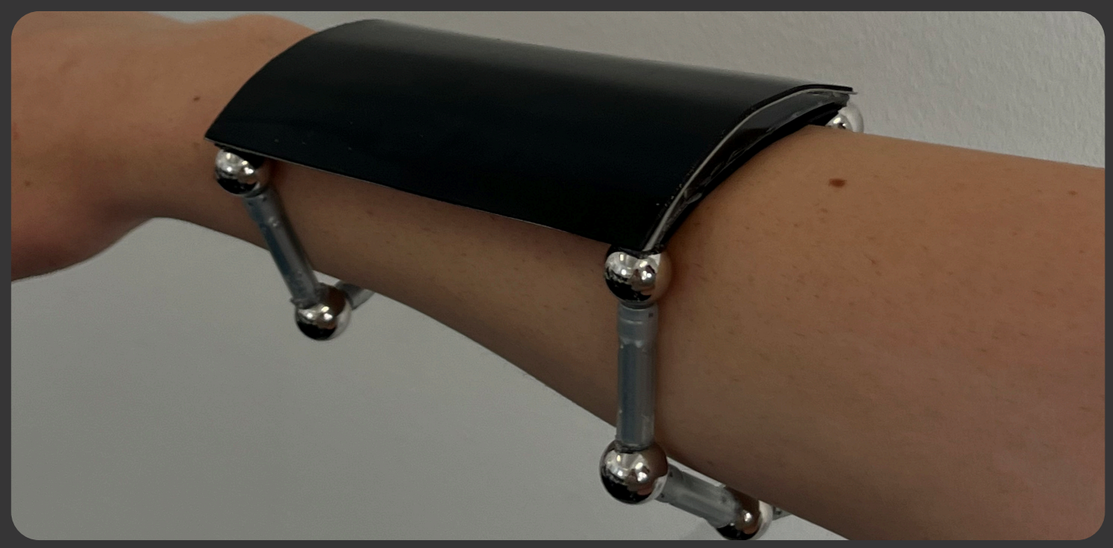


Shape study

From the received feedback users preferred bent screen with joints wrist-band. Arm study was held to find the ideal screen shape that would fit perfectly. To determine the exact proportion, clay was used.

Final

To build legs magnetic sticks were cut and connected with **steel joints**. Soft **acrylic** material was used for the screen and inner cover. The base is **bent metal.**



CONCEPT VALIDATION

Comfortable and lightweight design for waste managers in workshops.

The screen follows the shape of my forearm, which feels safe to work with. It feels light and stable at the same time.

Multi-functional: allows to scan the damage, generate and display an efficient fixing procedure

The app design appears easy to navigate, very clear. It is useful to be able to save the 3d scan and import it into CAD: saves a lot of time

The total amount of **waste is reduced** and a circular economy is established

It helps having an algorithm calculate how to deal with a damage and from where to take the replacement.

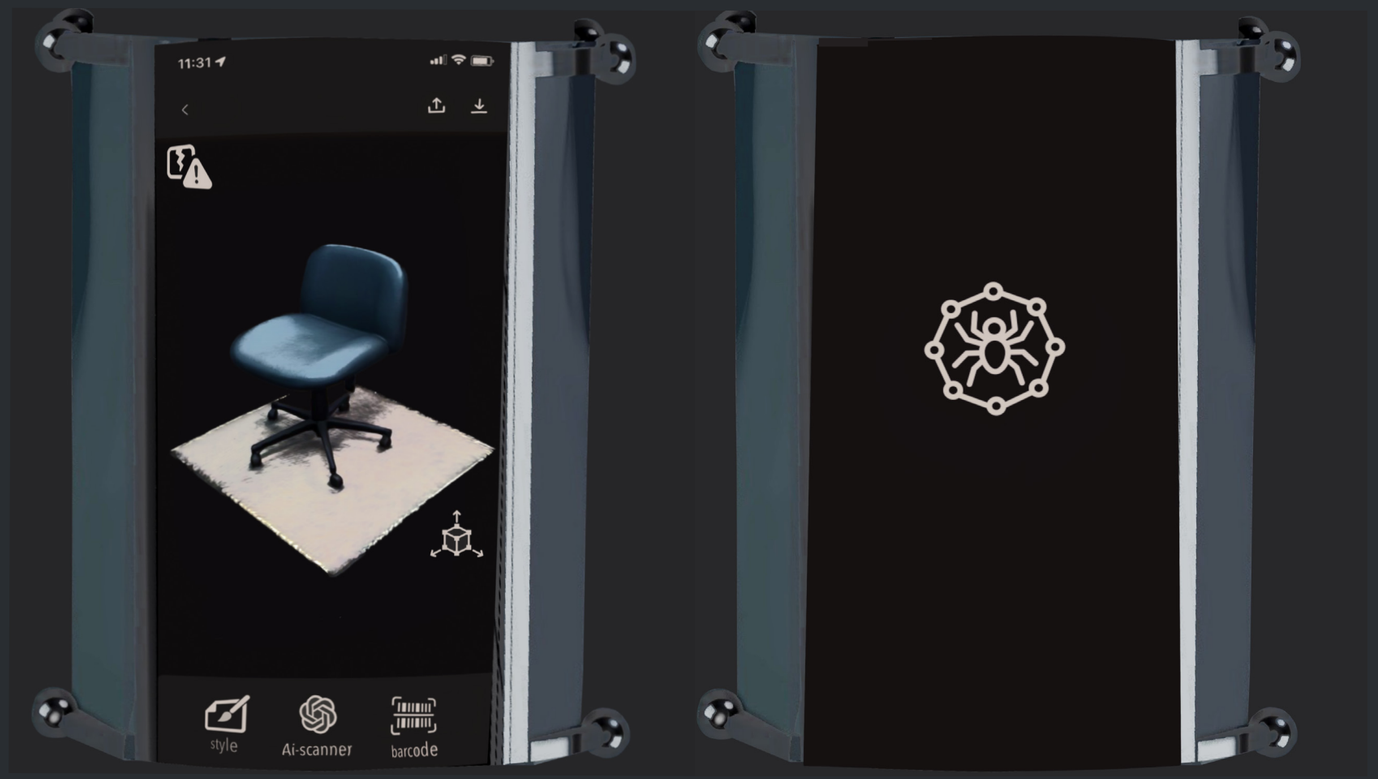
- validated by Ikea workshop staff member

APP INTERFACE

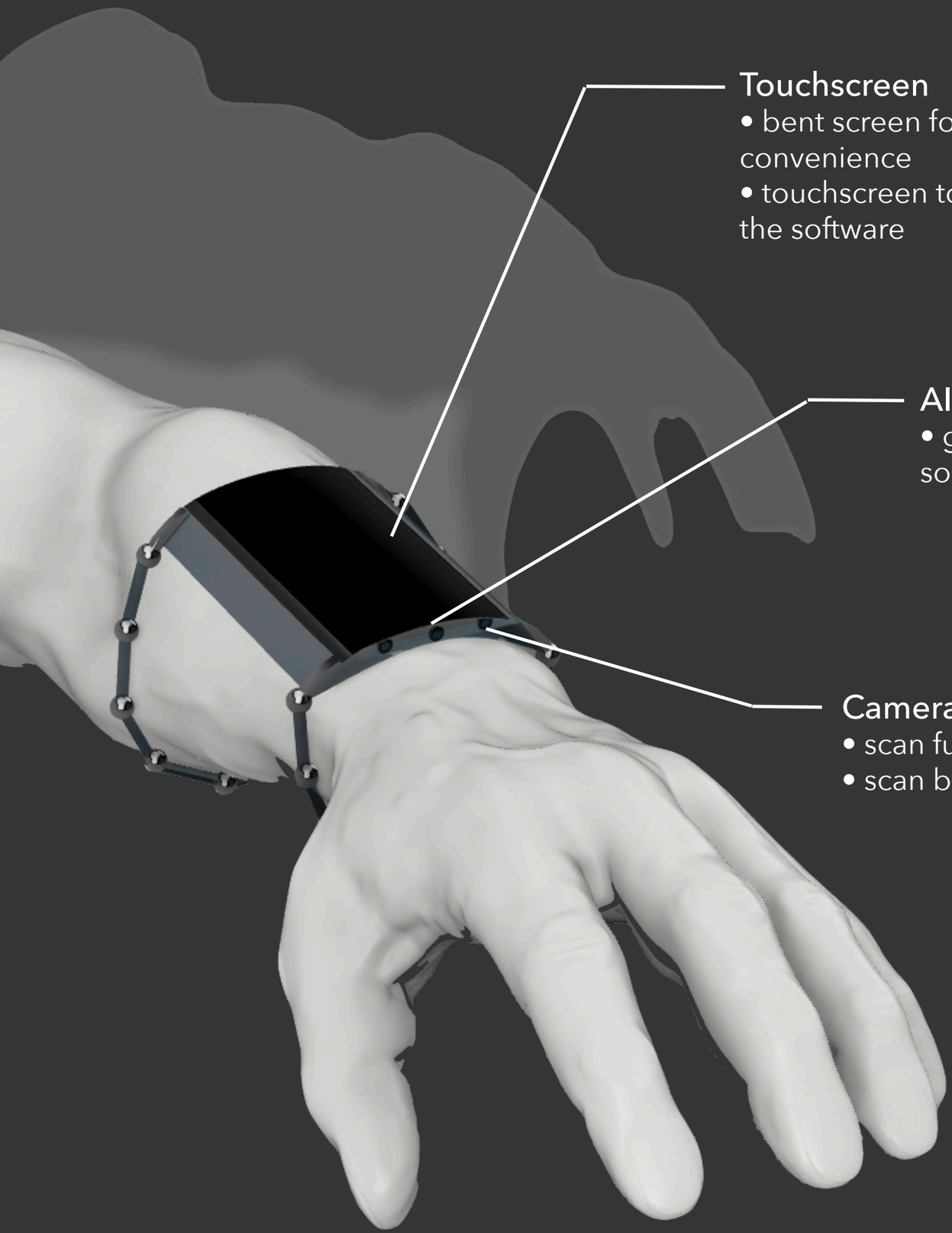
- **AI damage scanner**: main icon on the screen
- **AI style and colour suggestion**: uses machine learning to find perfect colour/style based on client's requests
- **CAD**: open the scan on Solidworks or Autocad

Suggestions from users (furniture retail staff):

- *Settings should be always easily accessed*
- *Include a quick* **measurement** *and* **zoom** *icon next to the scanned object*
- *Can copy the object by pressing on it for a few seconds*



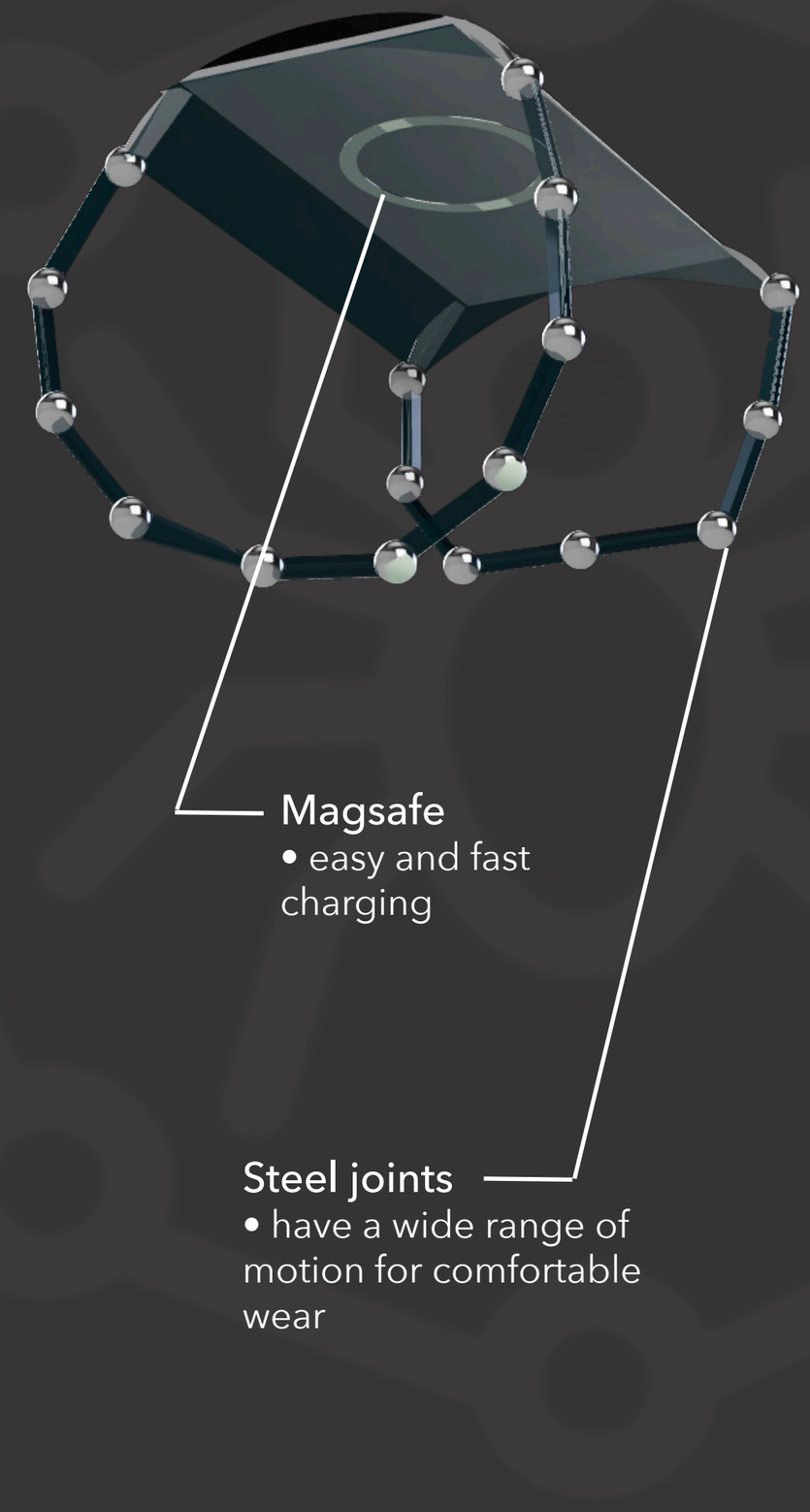
FINAL PRODUCT



Touchscreen
- bent screen for convenience
- touchscreen to navigate the software

AI software
- generates fixing solutions

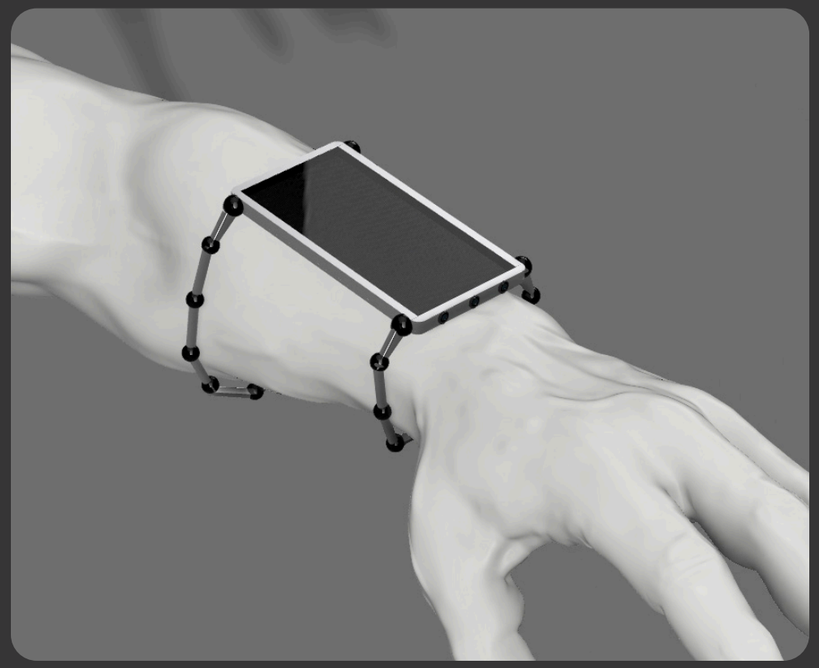
Cameras
- scan furniture in 3D
- scan barcodes

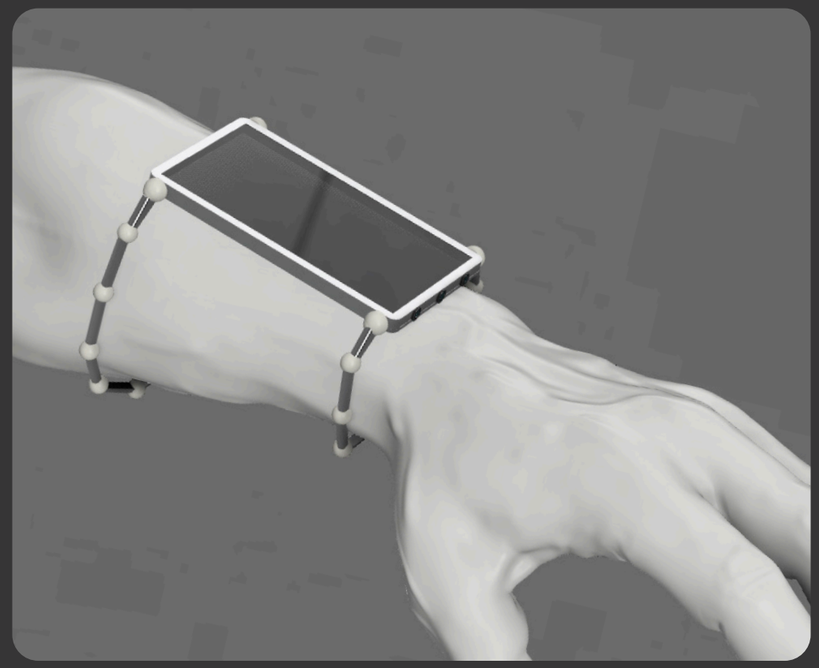


Magsafe
- easy and fast charging

Steel joints
- have a wide range of motion for comfortable wear

APPENDIX





More design options with different colored joints.

```python
import matplotlib.pyplot as plt
from mpl_toolkits import mplot3d
from mpl_toolkits.mplot3d import Axes3D
import serial

ser = serial.Serial("COM3", baudrate=9600,timeout=1)
fig = plt.figure()

ax = plt.axes(projection ='3d')
ax.scatter(x, y, z, c=z, cmap='viridis', linewidth=0.5)
ax.set_title('3D Plot Of The Scan')
plt.show()
```

Python code for plotting the 3D model in Matplotlib.

Prototyping process

Cutting the magnet sticks

Works-like prototype option with cardboard casing

1. RightGreen – Furniture Waste | The UK's Furniture Waste Problem [Internet]. rightgreen.co.uk. 2021. Available from: https://rightgreen.co.uk/furniture-waste/
2. NLWA Annual Report 2019-20 | NLWA [Internet]. Nlwa.gov.uk. 2019 [cited 2023 Feb 18]. Available from: https://www.nlwa.gov.uk/ourauthority/nlwa-annual-report-2019-20
3. A third of UK adults throw away furniture which could be recycled or reused [Internet]. www.bhf.org.uk. Available from: https://www.bhf.org.uk/what-we-do/news-from-the-bhf/news-archive/2019/october/uk-adults-wasting-furniture
4. Study into the re-use potential of household bulky items | WRAP [Internet]. wrap.org.uk. Available from: https://wrap.org.uk/resources/report/study-re-use-potential-household-bulky-items
mosaic. Furniture waste – The forgotten waste stream [Internet]. Recycle Track Systems. 2020. Available from: https://www.rts.com/blog/furniture-waste-a-growing-issue/