

Atish Waghware | 18U130008
Guided by Prof. Swati Pal and Prof. Jayesh Pillai

Fingerspelling Mouse Design

Design Exploratory Seminar 2022

Approval

The Design Exploratory Seminar entitled “Fingerspelling Mouse Design” by Atish Waghware, Roll Number 18U130008 is approved, in fulfilment of the Bachelor’s in Design Degree at IDC School of Design, Indian Institute of Technology Bombay.

Internal:

External:

Guide: Prof. Swati Pal

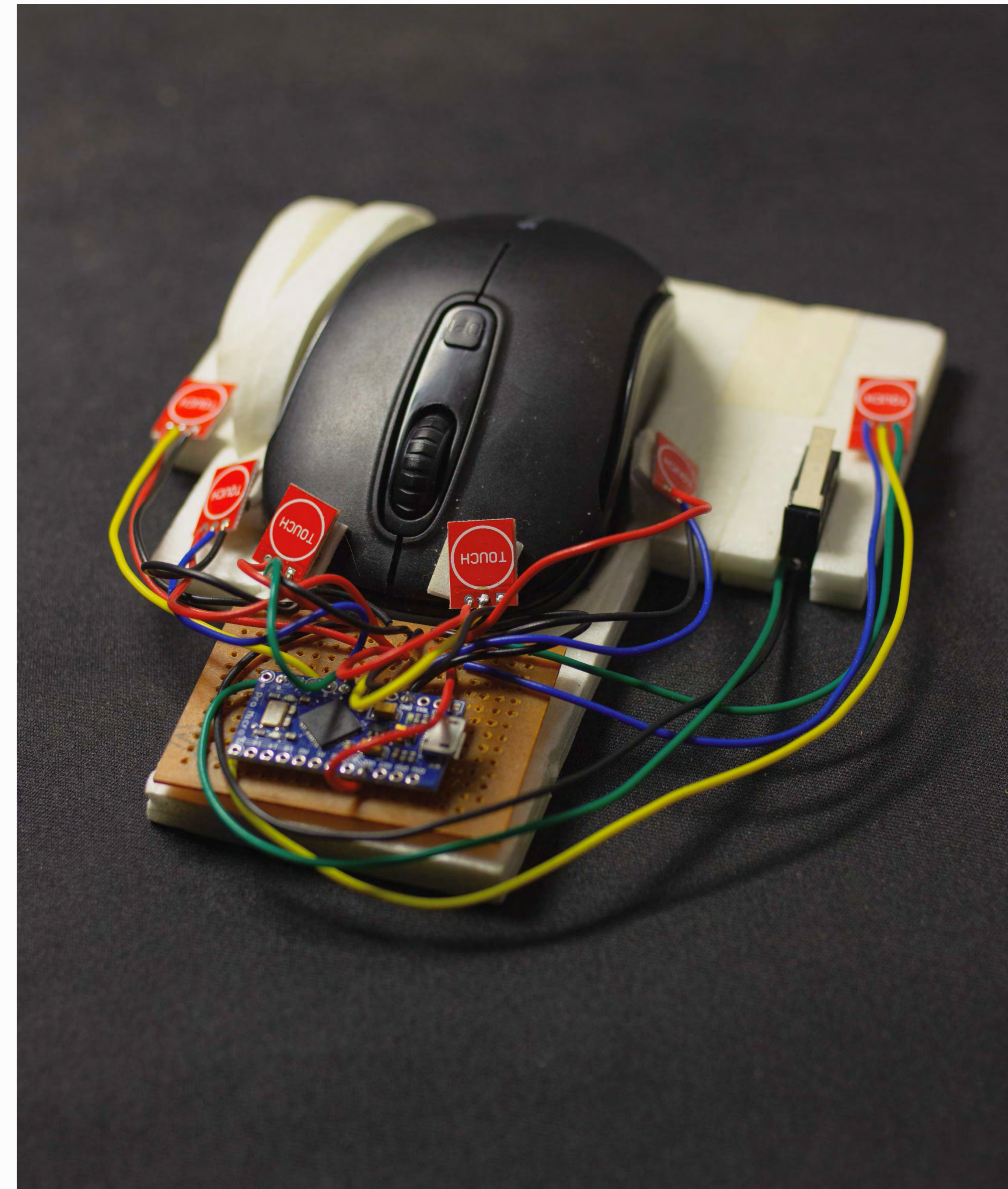
Digital Signature
Swati Pal (10001793)
22-Jul-23 12:02:21 AM

Co-guide: Prof. Jayesh Pillai

Digital Signature
Jayesh S. Pillai (i15316)
14-Jul-23 08:13:49 PM

Chairperson:

Introduction



Working prototype of the
fingerspelling mouse

Abstract

For my P1, I designed a novel interaction technique called Fingerspelling. It is a single handed numeric text entry method that involves lifting fingers resting on a mouse or a trackpad to input numeric data, without disrupting the normal functioning of a mouse. While I had a working prototype, I had completely neglected the ergonomics and user experience of the device.

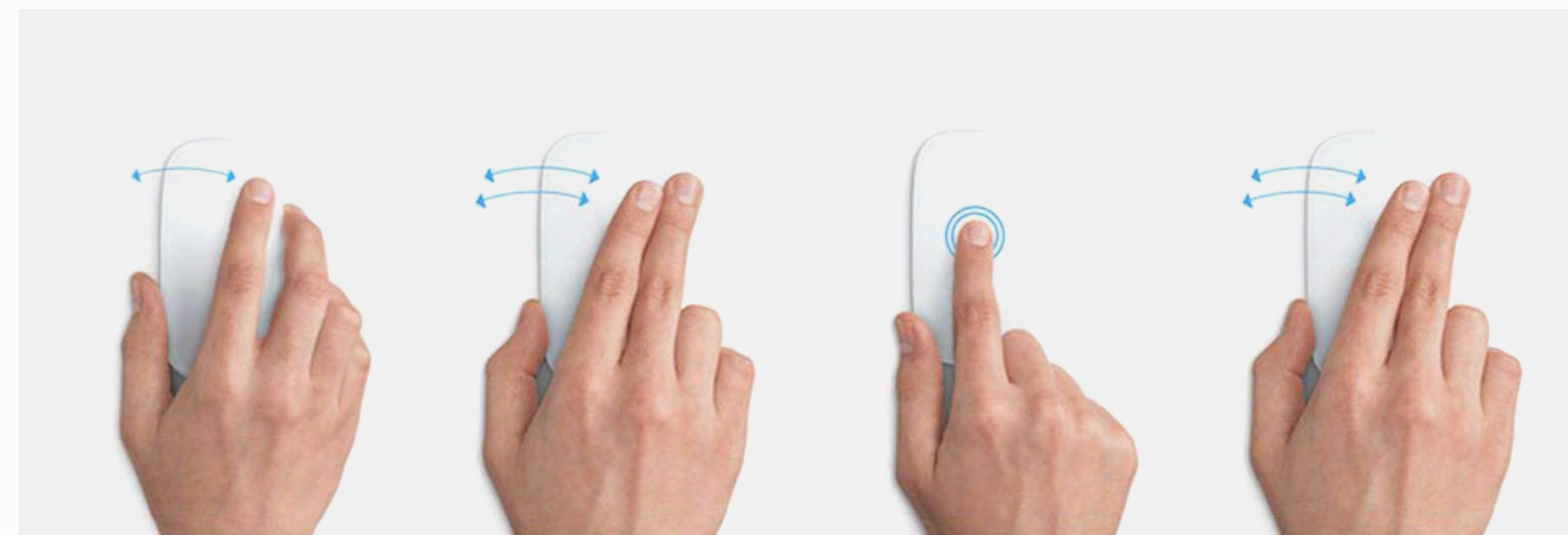
This project aims to explore those interactions and forms that arise when trying to incorporate fingerspelling gestures into consumer mice. I looked at existing mice designs, identified parameters that constitute the mouse user experience and develop concepts that incorporate fingerspelling into those mice.

Known Problems

- Three participants said it was difficult for them to locate the sensors after they lifted all the fingers without looking
- Three participants said having to bend their fingers to hold the mouse rig was uncomfortable and affected their performance
- Over 4 participants said even though the touchpad rig has a lack of palm support, their fingers feel more relaxed and they can see where they are placing their fingers
- Most participants had to look over and around the mouse to find the sensor for the little finger when placing their hand for the first time

Exploration Goals

- Explore multiple possibilities of forms and types of mice and how they can incorporate fingerspelling
- Explore different parameters that constitute the mouse experience
- Make each mouse form ambidexterous
- Consider the manufacturability of each form
- Explore interactions beyond just the industrial design and product styling



Existing Product Study

// Existing Product Study



Apple Magic Mouse

- Touch sensitive top with one physical click
- Support for multi touch gestures
- Only comfortable for upto three fingers
- Scrolling is done through touch gestures
- Meant for drag/swipe gestures

// Existing Product Study



Microsoft Arc Mouse

- Touch sensitive top with one physical click
- Intergidital pad support but no thumb or pinky finger support
- Scroll done through touch followed by haptic feedback
- Snaps flat for portability but might flatten if too much pressure is applied

// Existing Product Study



Logitech MX Master 3

- Ergonomically tilted top with thumb rest
- Physical main and side buttons with scroll wheel and LED indicator
- Ample palm and interdigital pad support
- Not meant for touch gestures
- Comfortable grip but not optimal for fingerspelling

// Existing Product Study



Logitech MX Vertical

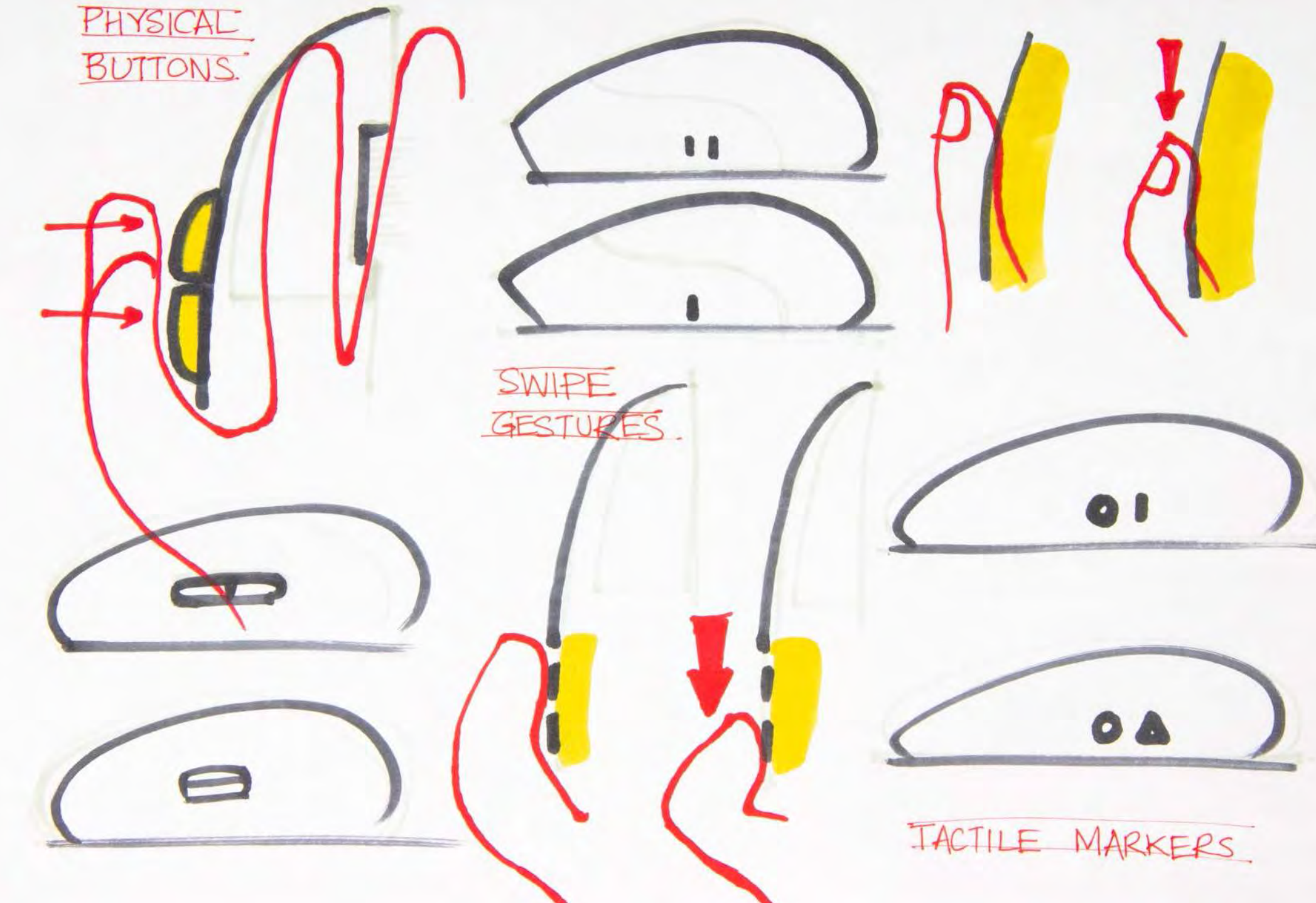
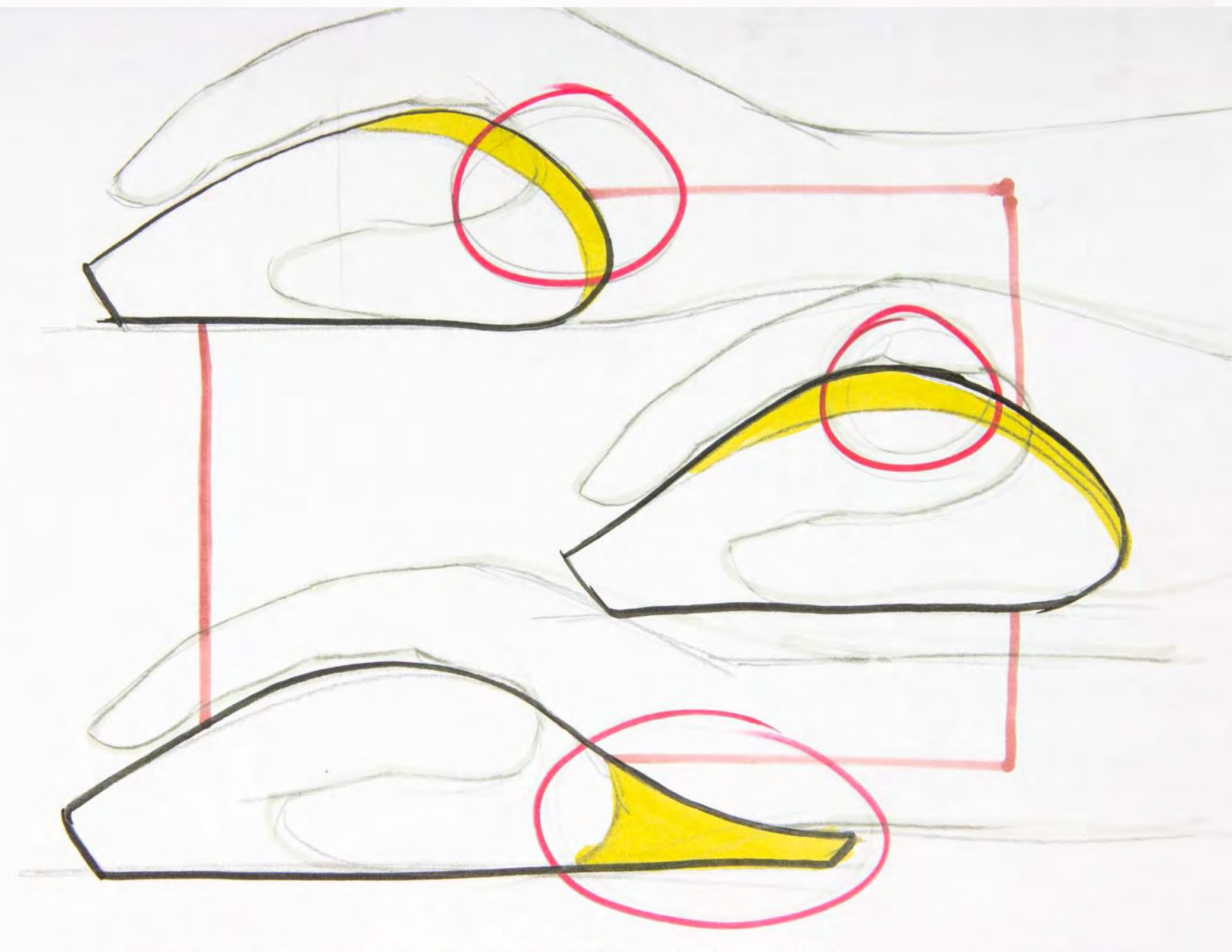
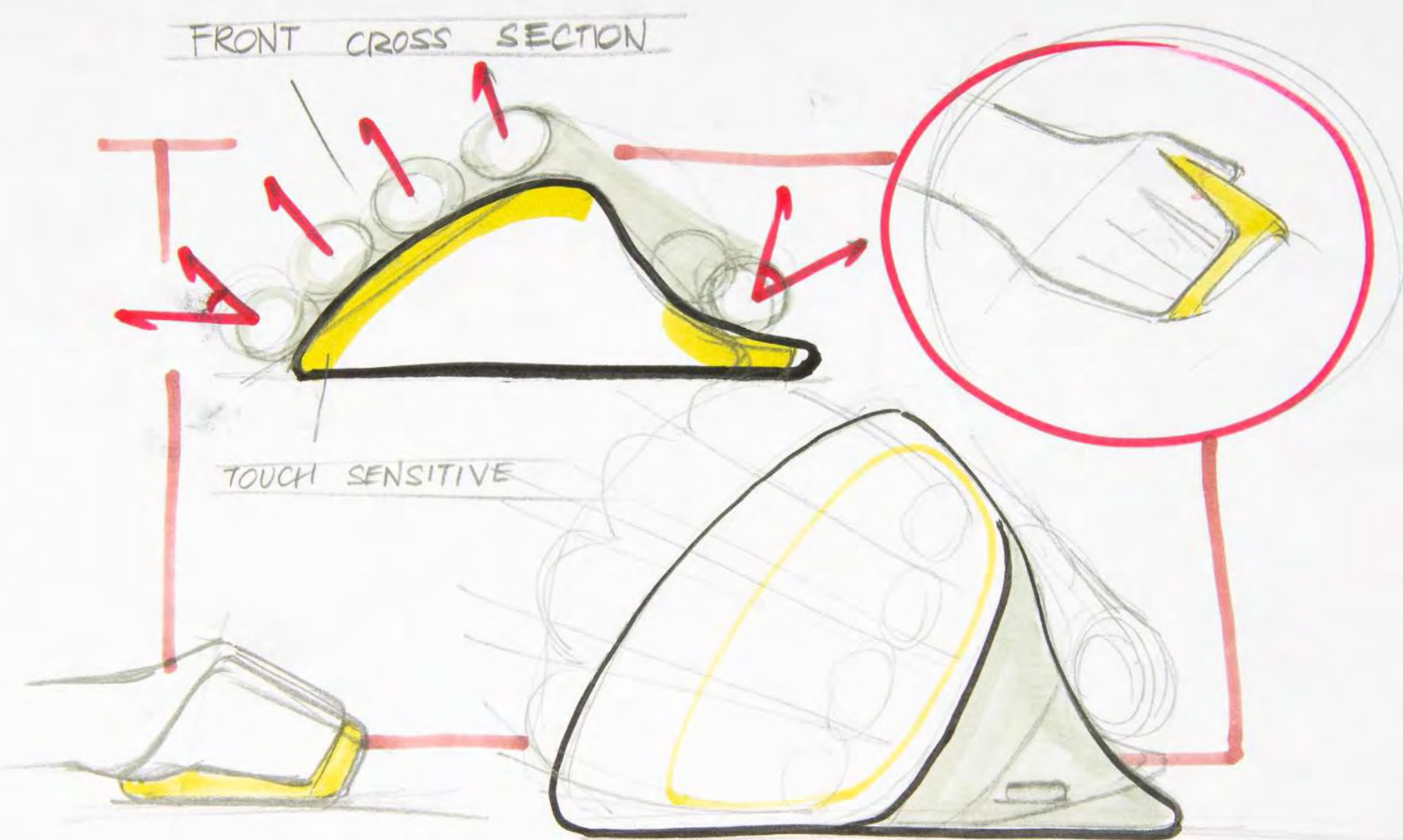
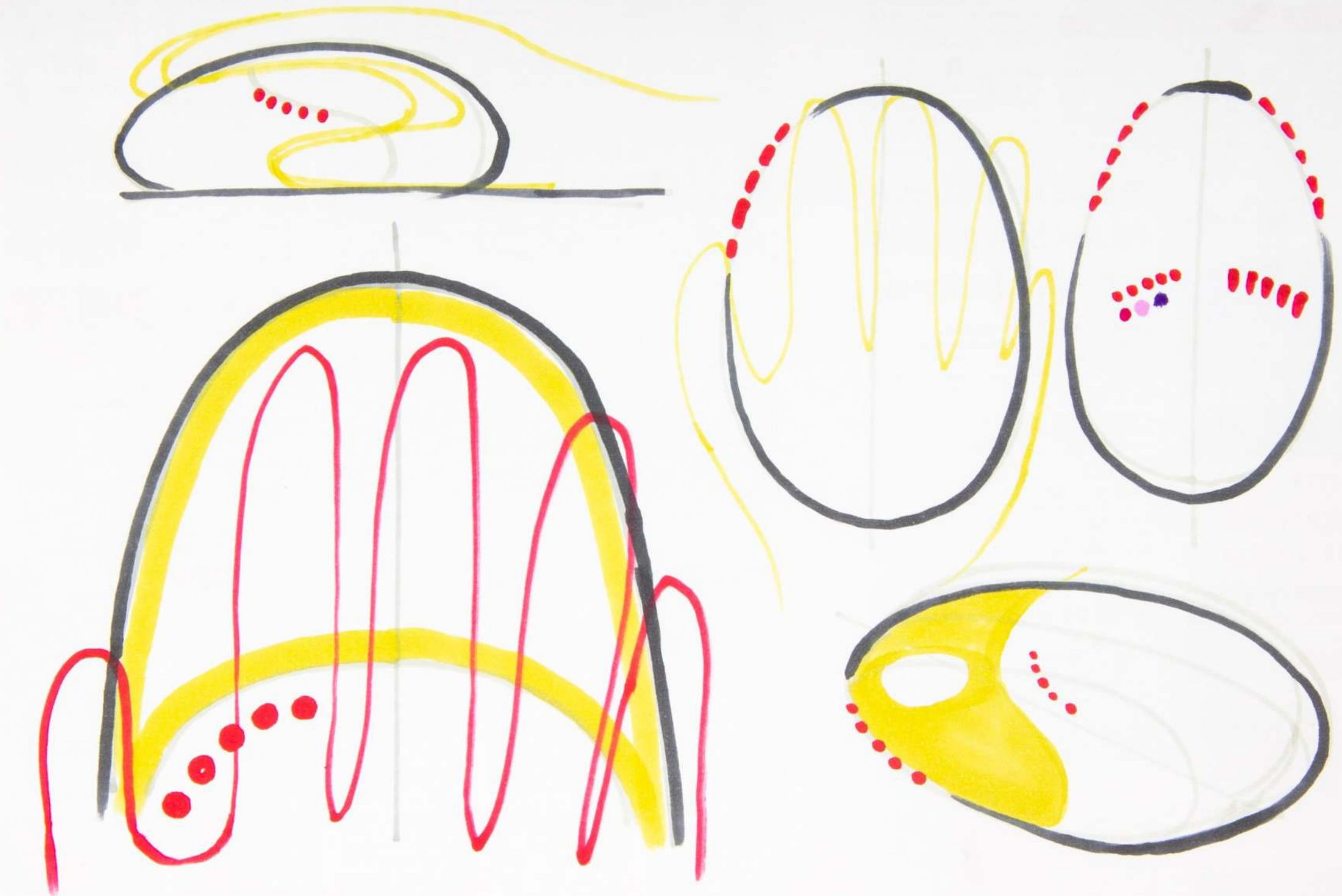
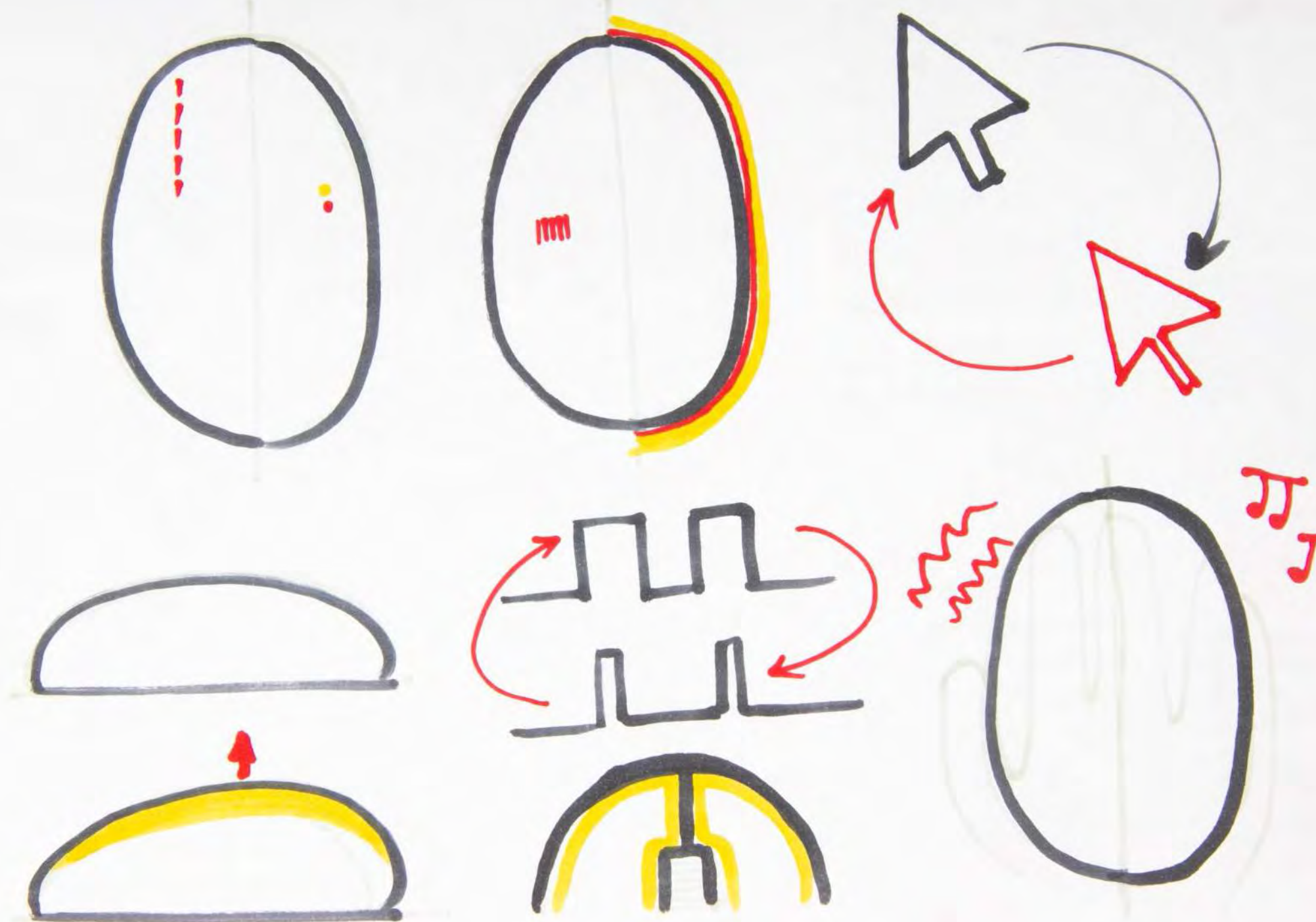
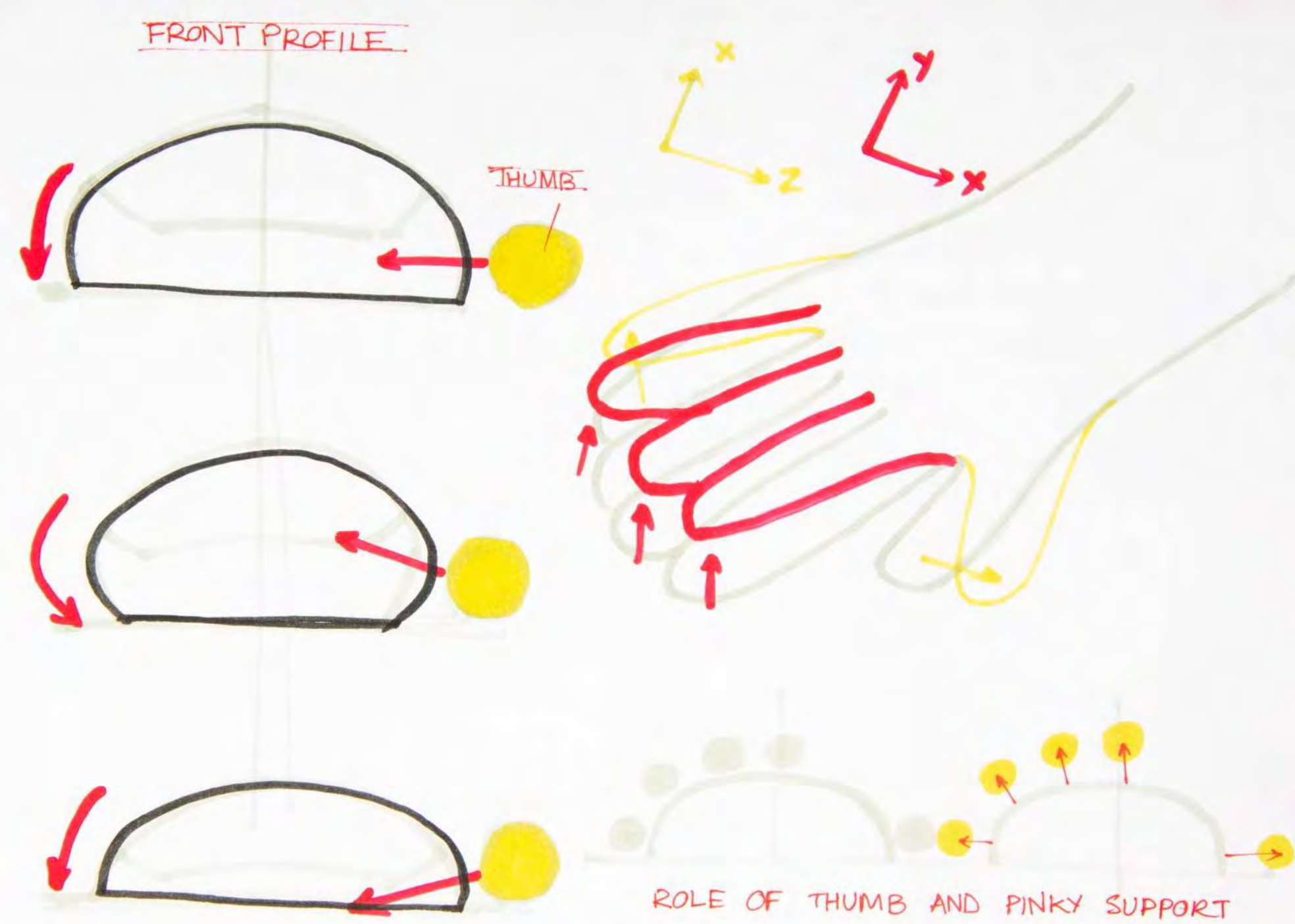
- Ergonomic and natural grip
- Sacrifices quickness for comfort
- Meant for physical clicking gestures only
- Not optimal for fingerspelling

// Existing Product Study



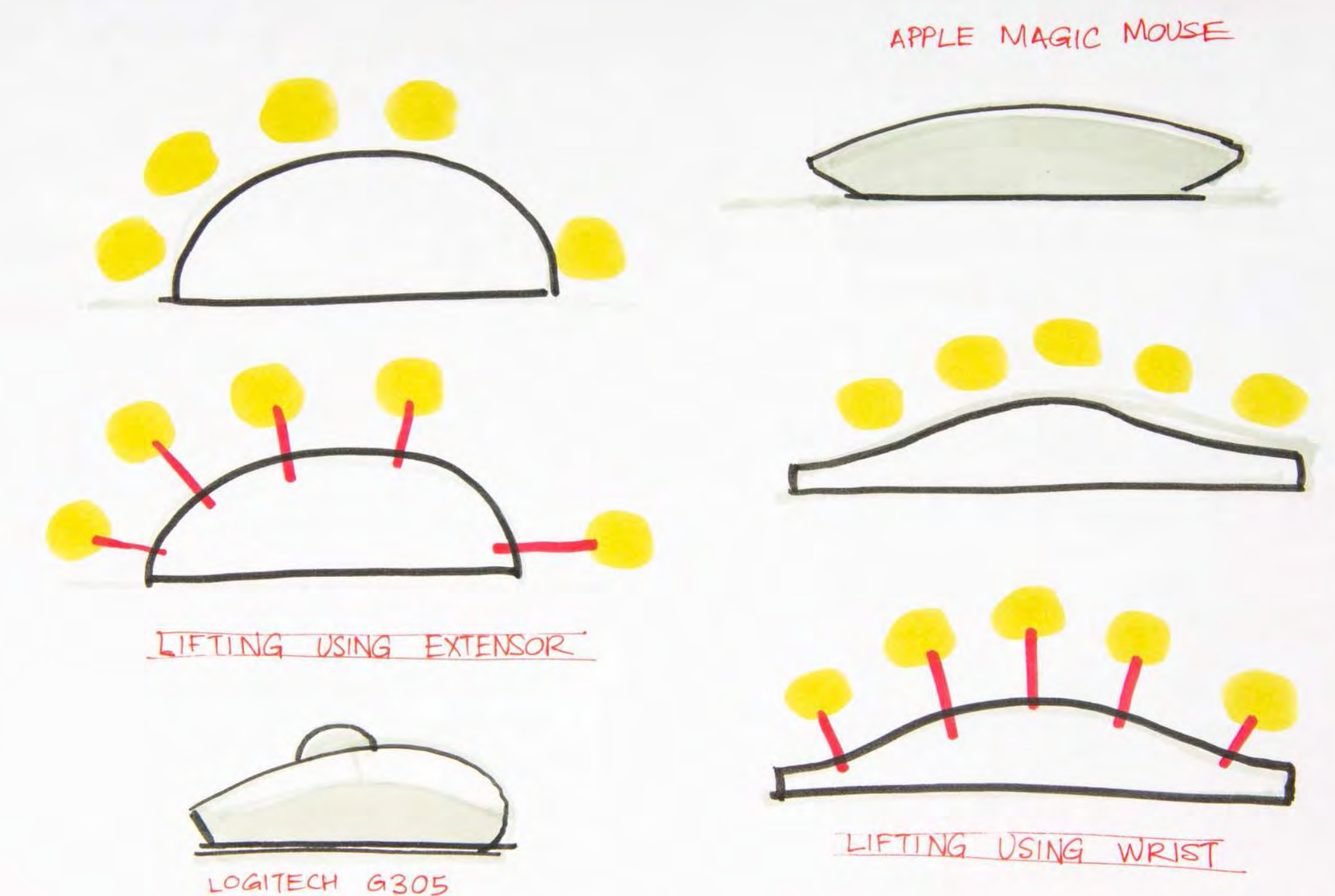
Apple Magic Ergo Concept

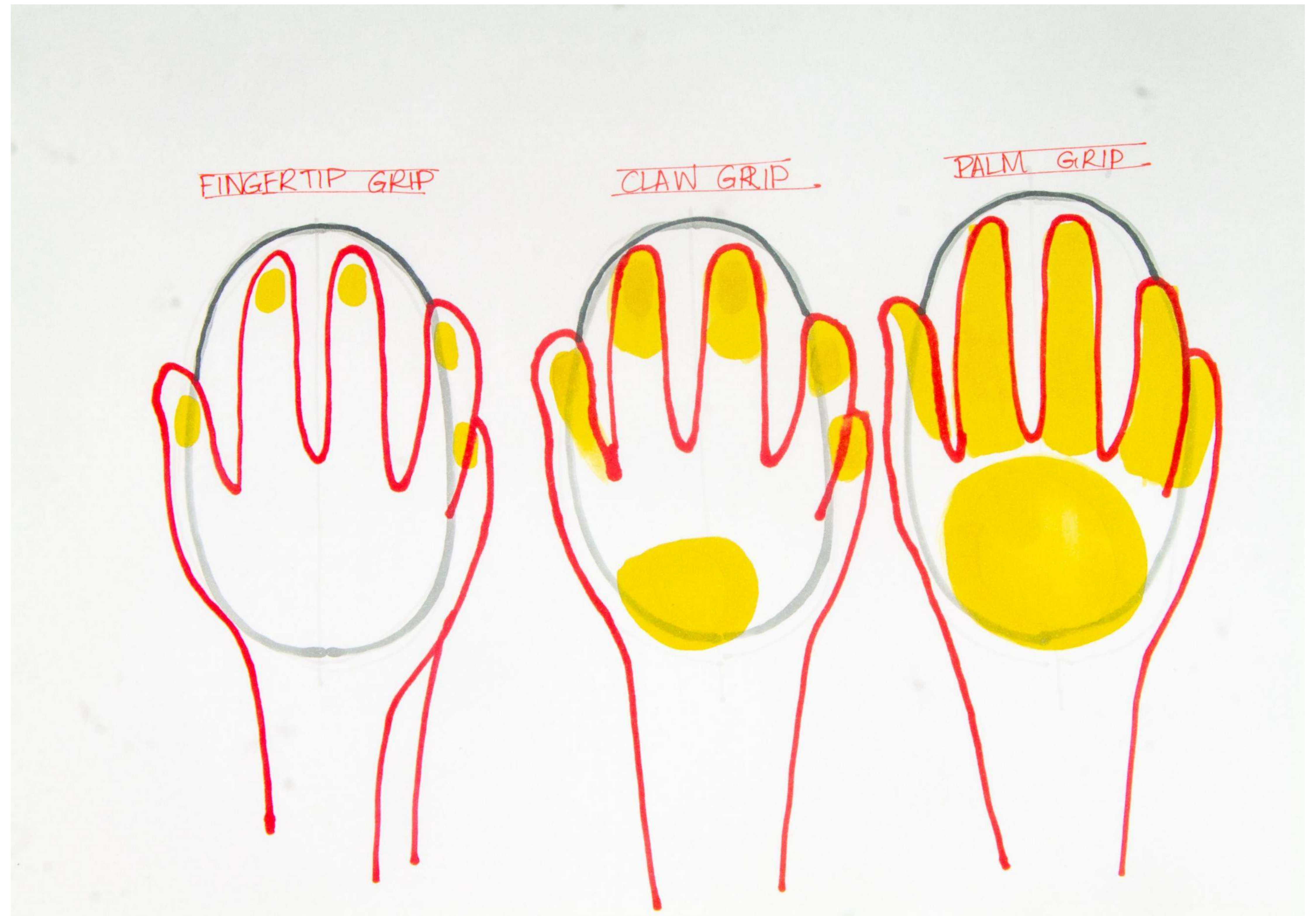
- Accommodates all five fingers
- Unconventional UFO-like design
- Touch sensor only supports up to three fingers
- Provides wrist / palm support
- Difficult to apply normal force using thumb



Parameters

Identifying parameters that would come into play while designing fingerspelling mice





Type of Grip

There are three kinds of grips based on the amount of contact one's hand has with the mouse -

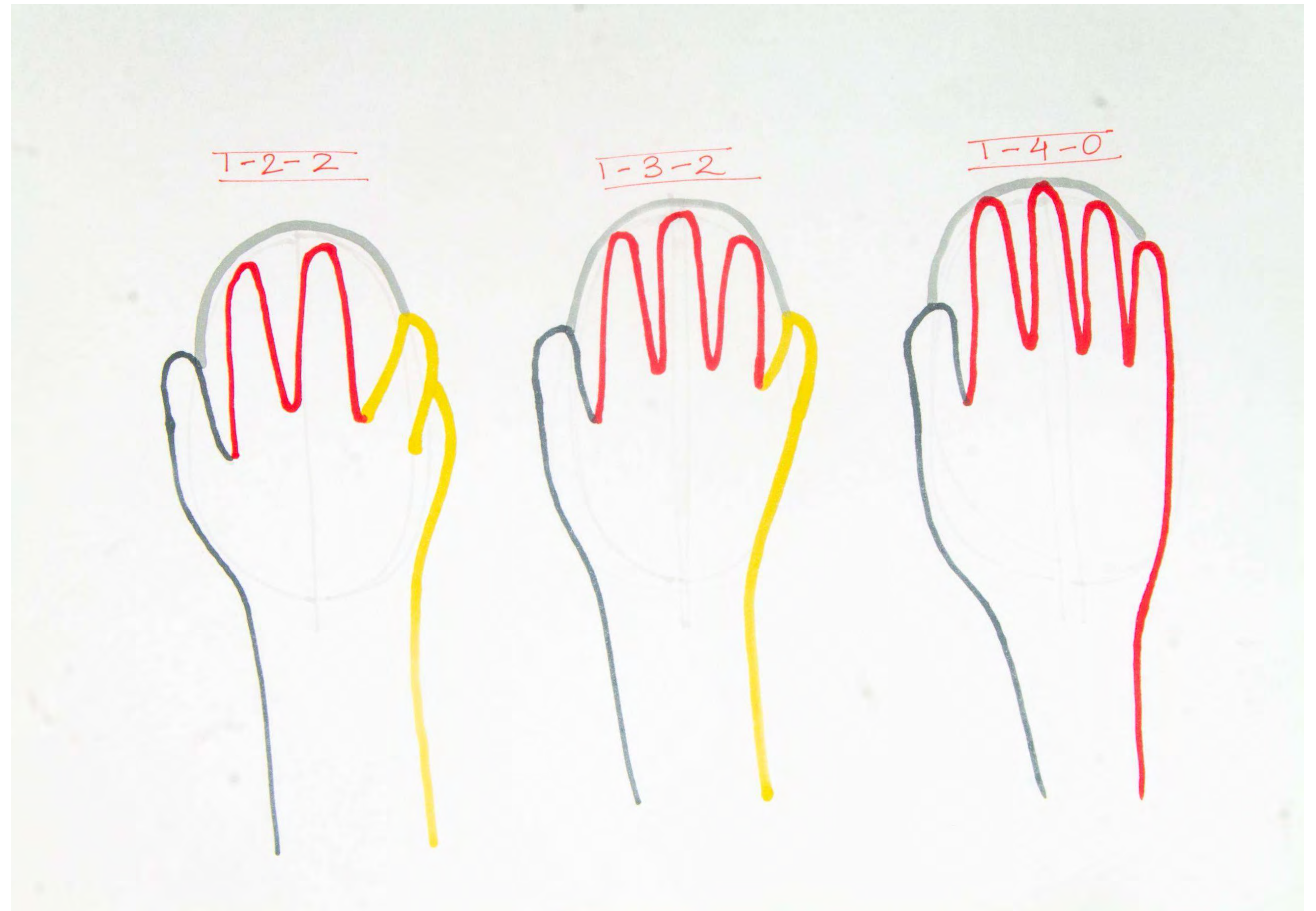
There are three kinds of grips based on the amount of contact one's hand has with the mouse - the Fingertip Grip is used to hold the mouse with only the tips of the fingers, the claw grip is used to hold the mouse with fingerips as well as the palm while the palm grip lays the entire palm and fingers flat on the mouse.

// Parameters

Style of Grip

There are also three popular ways to grip a mouse based on finger positions and is based on the number of fingers on the right, top and left of a right handed mouse or vice versa for a left handed mouse;

1-2-2 which means the thumb on one side, index and middle finger on top and the ring and pinky fingers on the side. Similarly there are 1-3-1 and 1-4-0 grips. These grip styles are determined by size of hand, shape of mouse and personal preference.

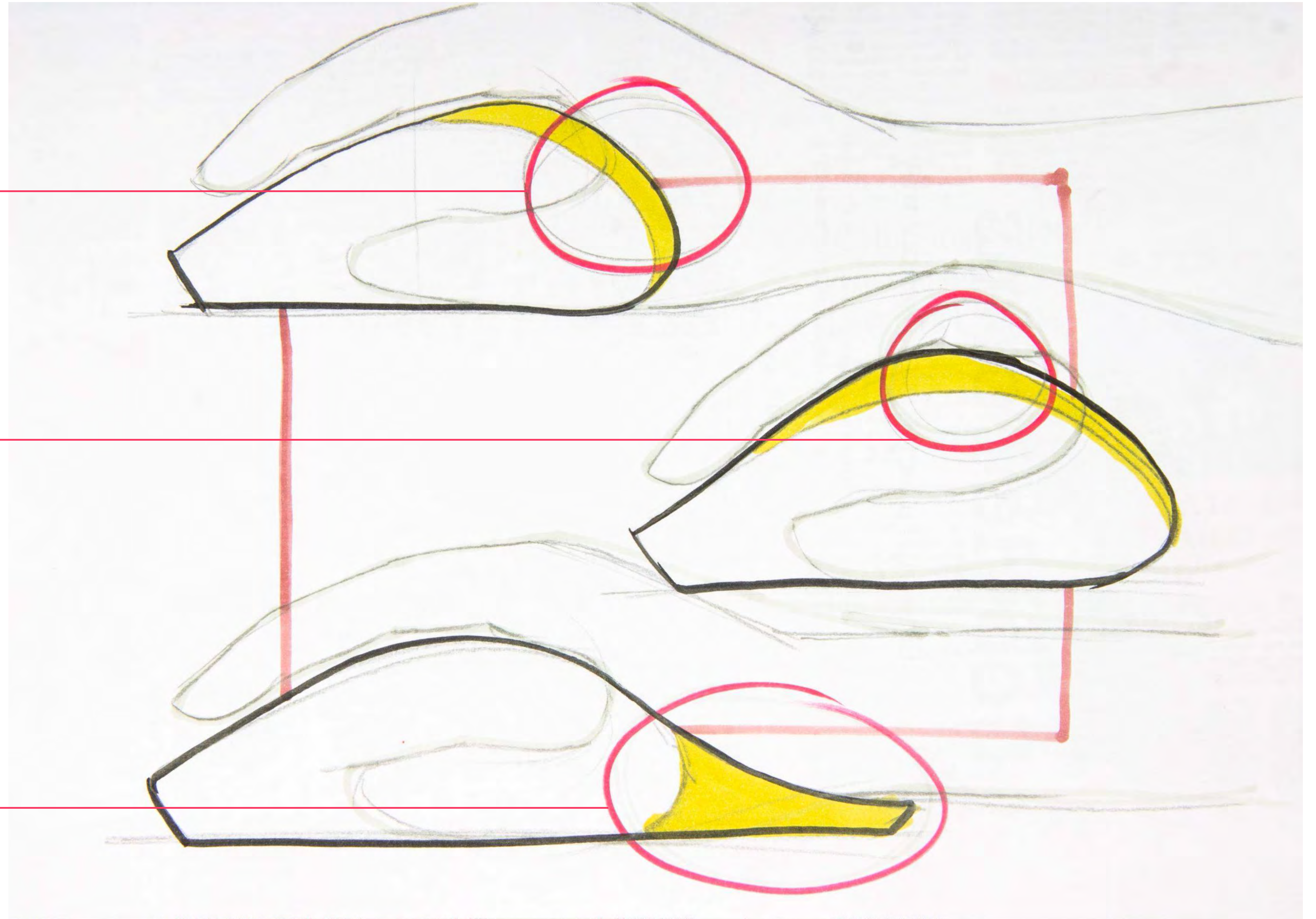


// Parameters

Palm Support

Interdigital Pad
Support

Wrist Support



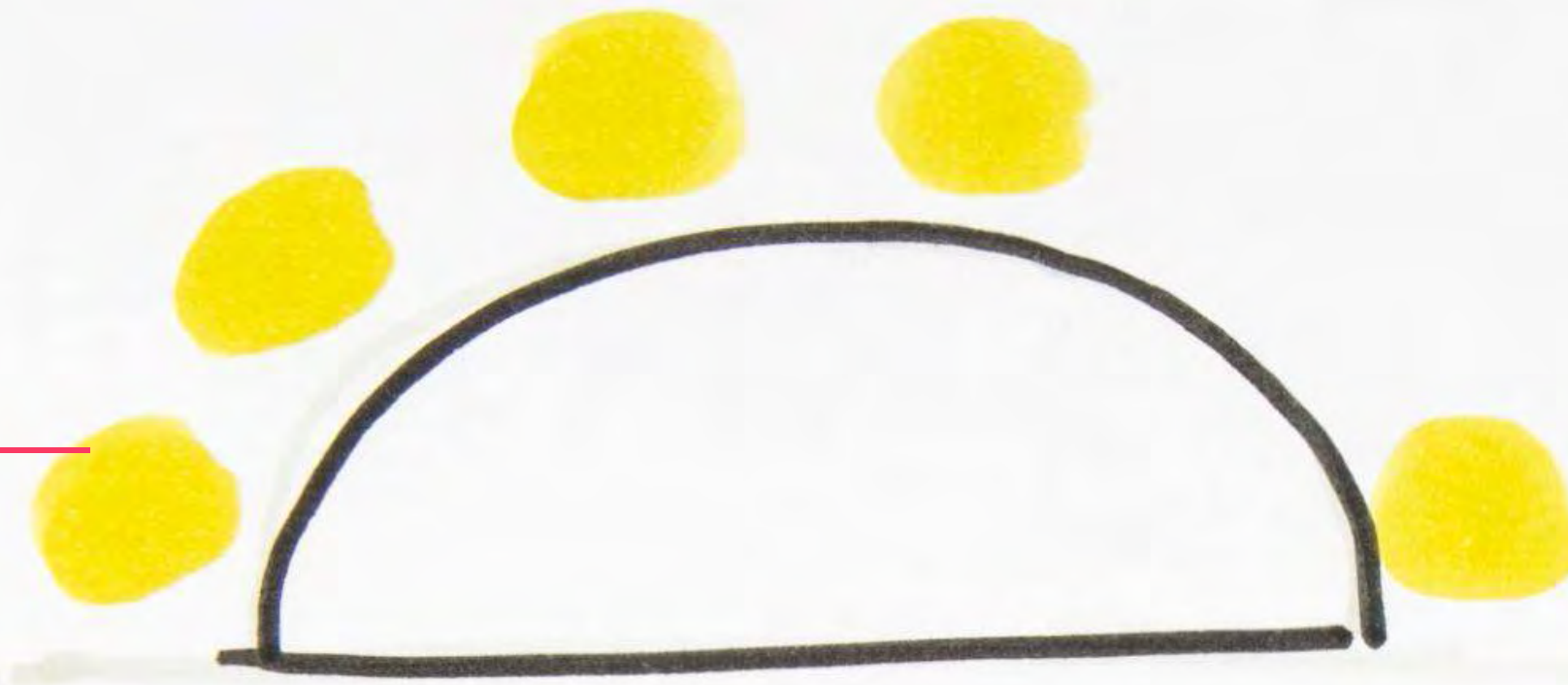
Type of Support

I identified three kinds of supports - Palm Support, Interdigital Pad Support and Wrist Support.

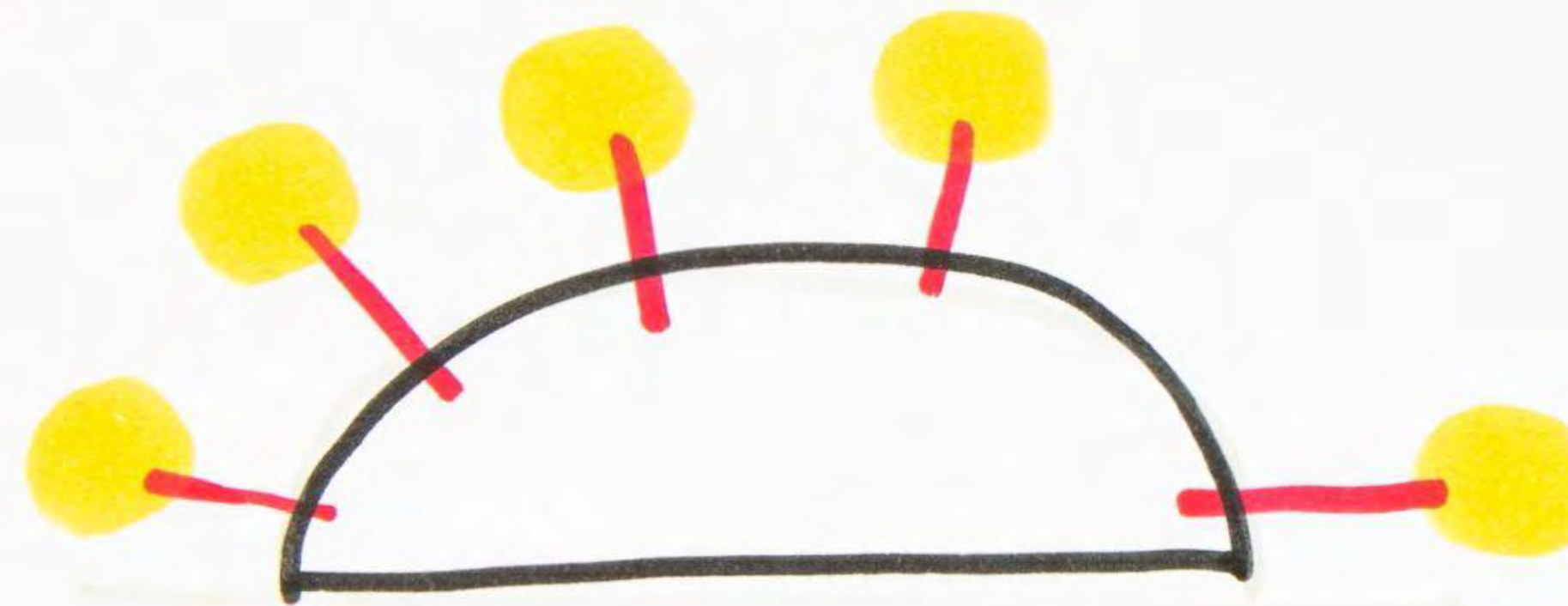
Most flat or small mice tend to force the wrist to be supported on resting surface even without having an actual wrist support.

// Parameters

Resting



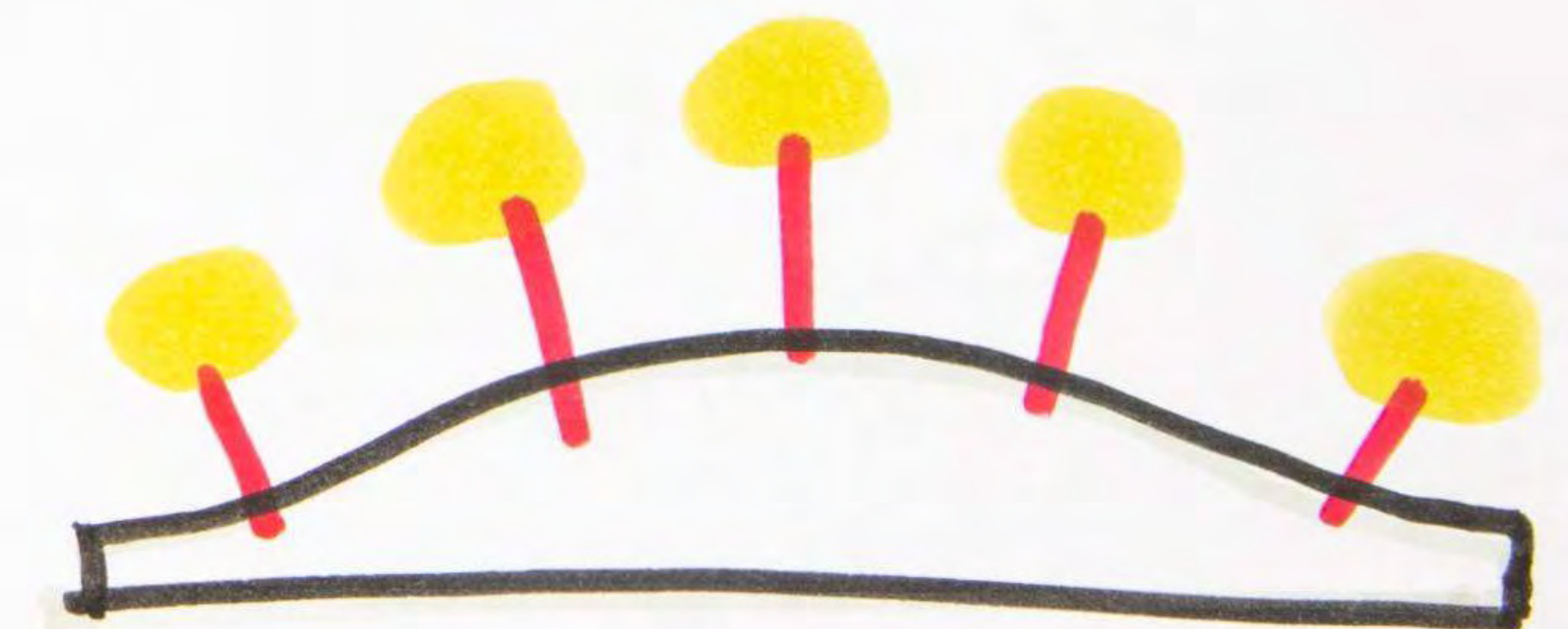
Lifting using
finger extensors



Lifting using
wrist extensors



APPLE MAGIC MOUSE



LIFTING USING EXTENSOR

LOGITECH G305

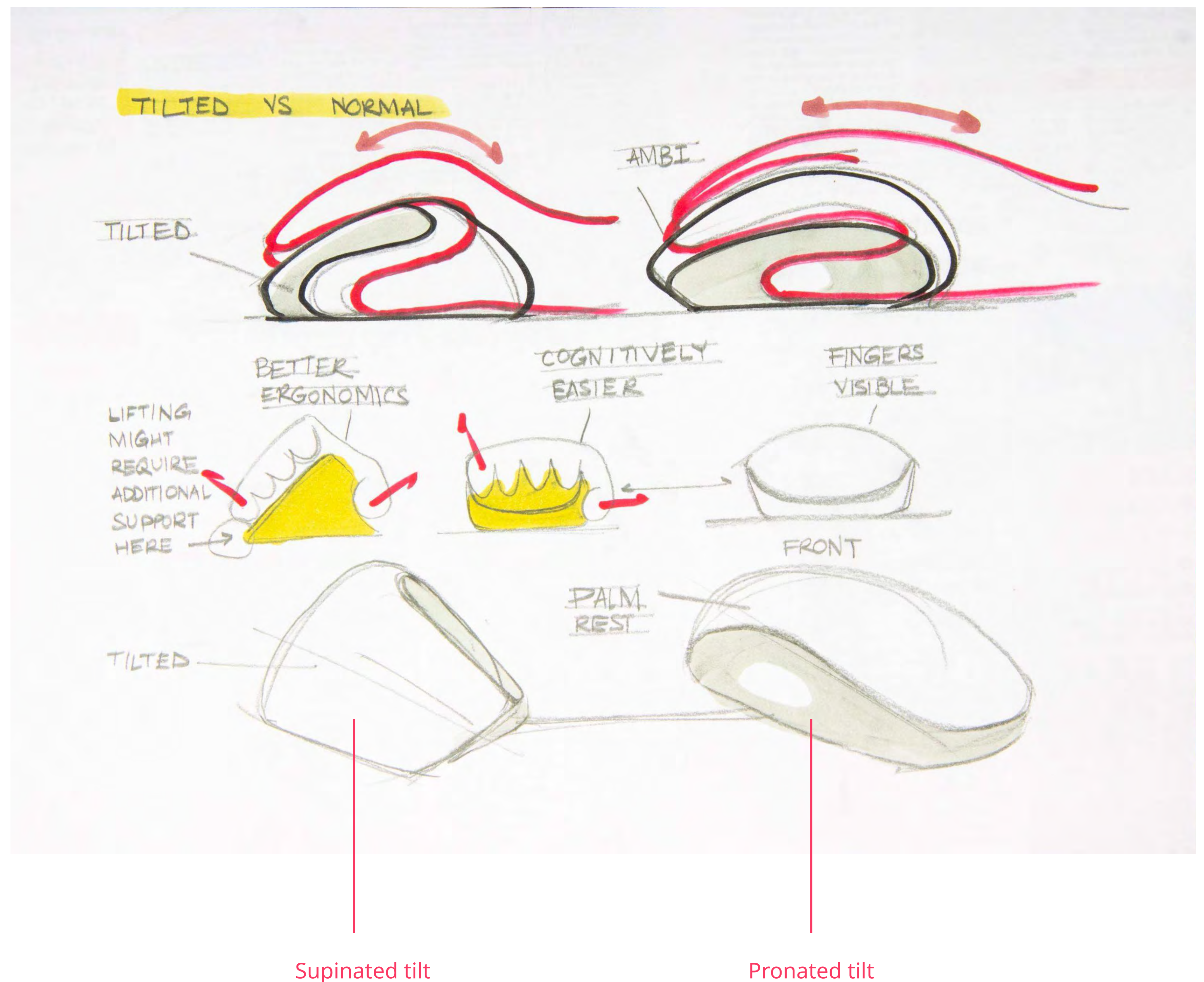
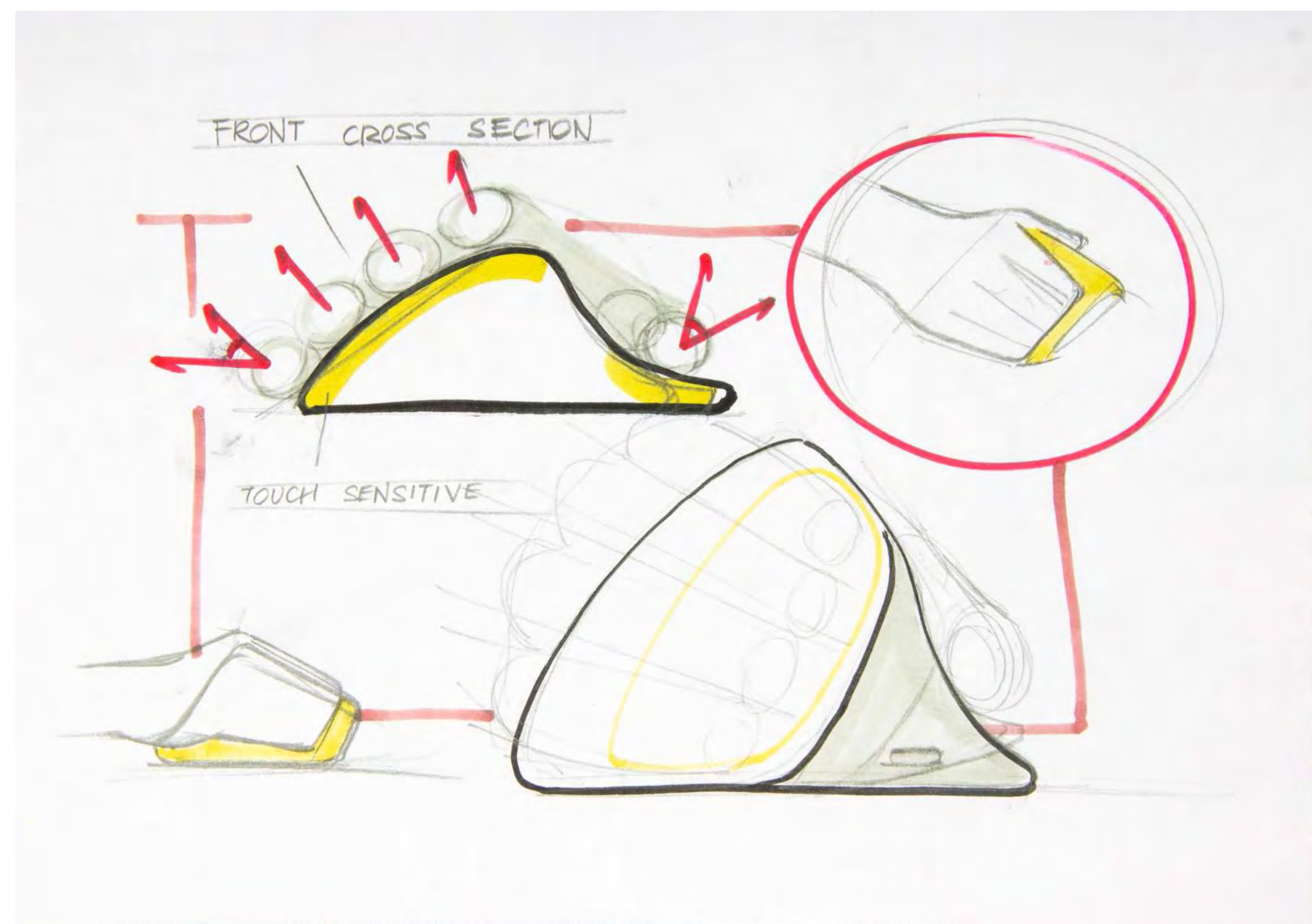
LIFTING USING WRIST

Wrist vs Finger Extension

I found that using a flatter mouse results in lifting fingers using wrist extensors while using a mouse with palm or interdigital

support results in keeping the interdigital pads planted and lifting using finger extensors.

// Parameters



Effect of Tilt

Mice that are tilted along the z-axis (supination) are ergonomically superior, but for fingerspelling gestures it is not so; lifting fingers on a tilted mouse results in the weight of the palm resting on the pinky which is the outermost finger,

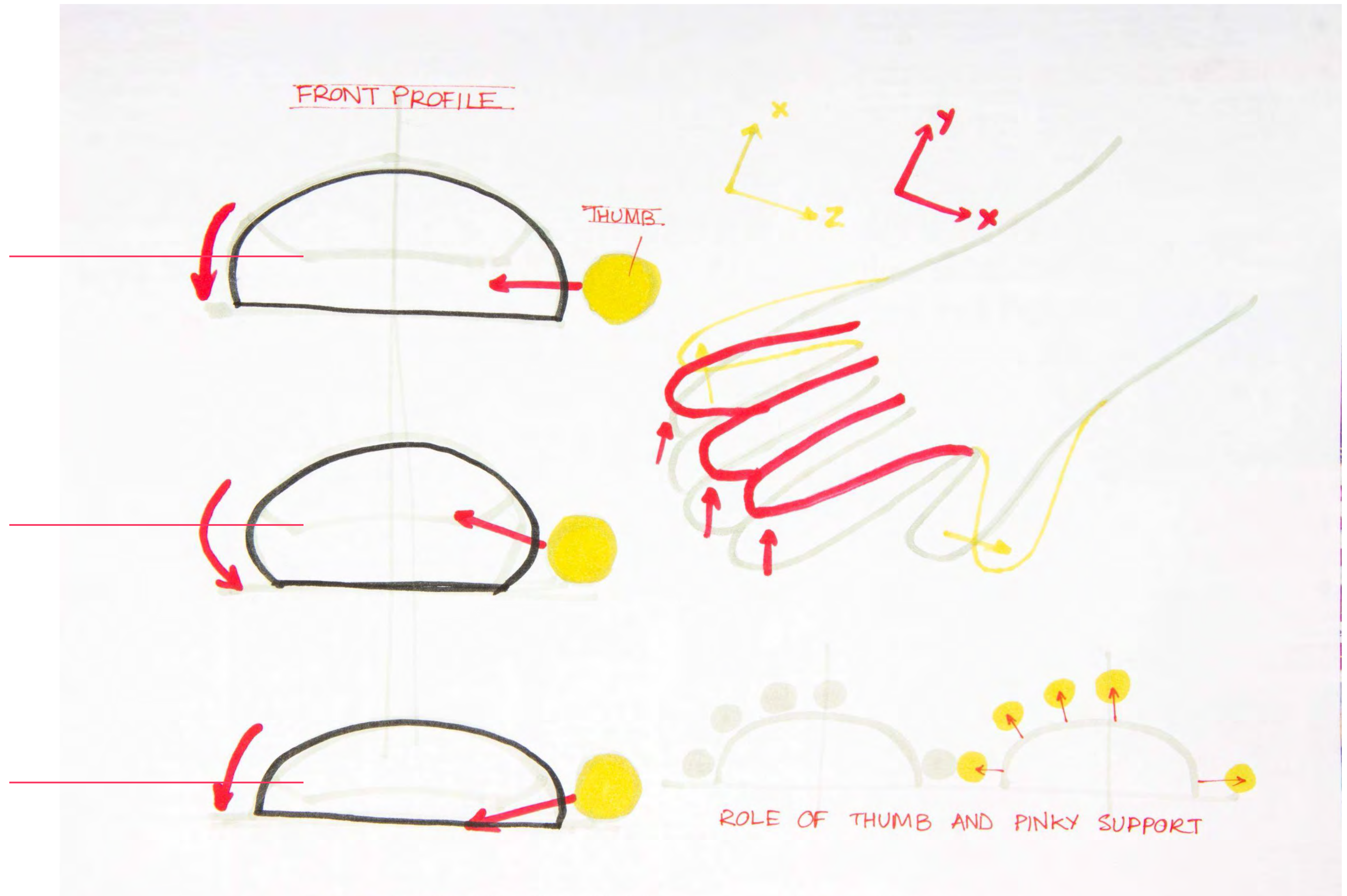
and lifting the pinky causes the hand to lose people's grip of the mouse. Hence a pronated grip is better and can also help design ambidextrous mice.

// Parameters

Vertical sides;
Relatively easier to apply
normal force using thumb

Obtuse sides;
Very easy to apply normal
force using thumb

Acute sides;
Difficult to apply normal
force using thumb

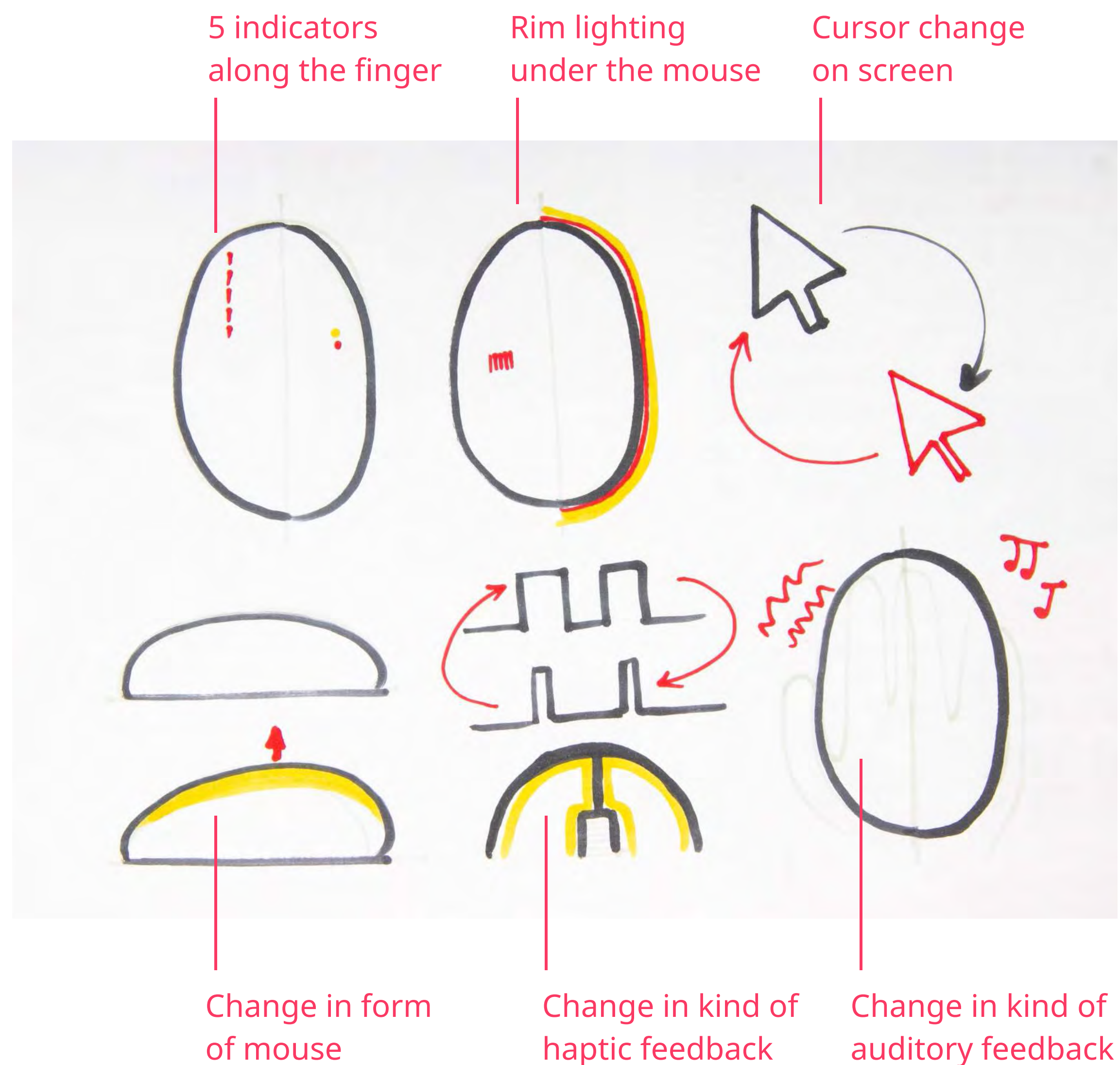


Normal Gripping Force

The flatter the mouse is the greater the lack of normal force using the thumb and pinky fingers. This leads to inability to grip properly or move the mouse from side to side.

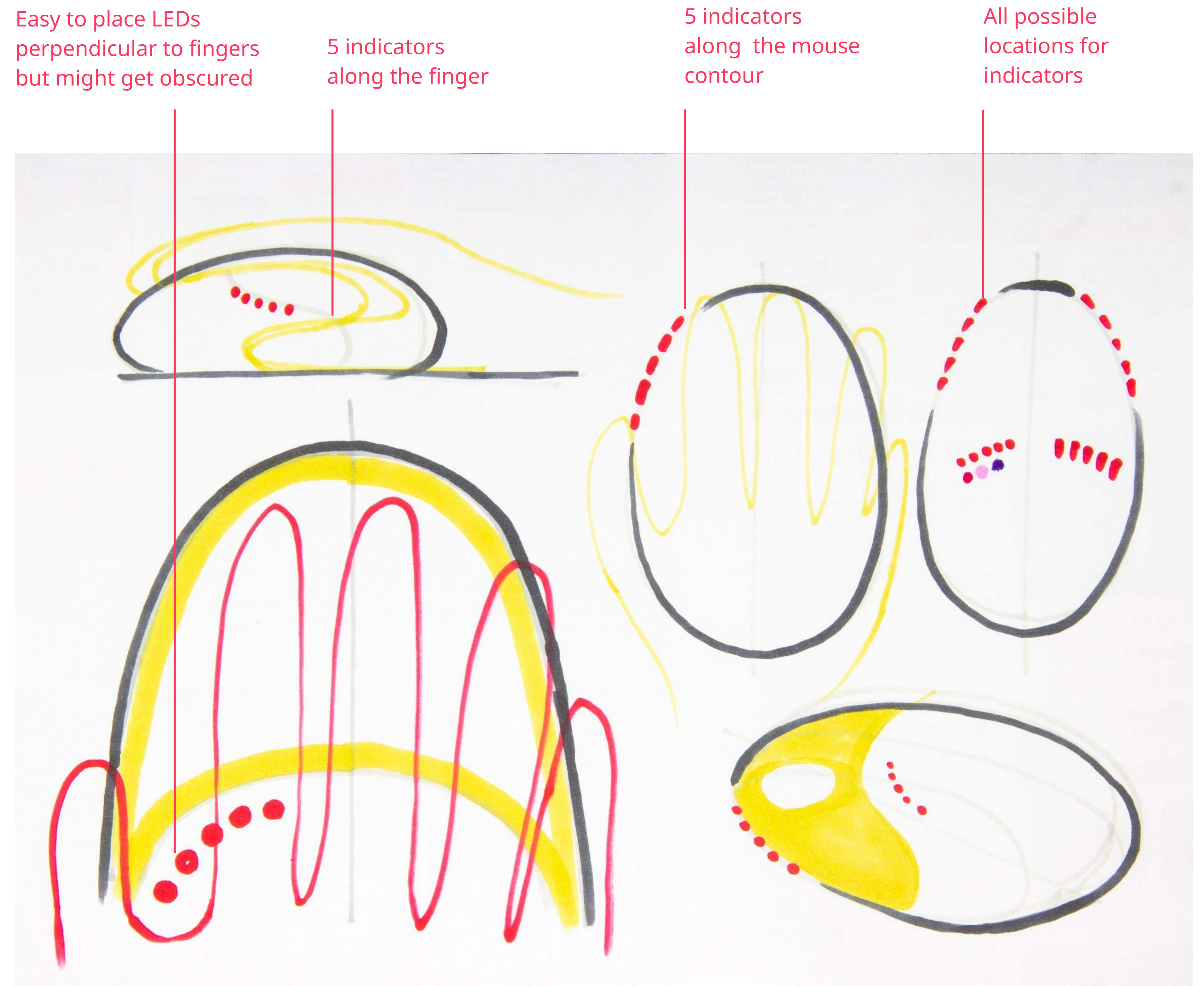
The sides of a mouse need to be at least a certain height vertically or convex to ensure proper grip.

// Parameters



Confirmational Feedback

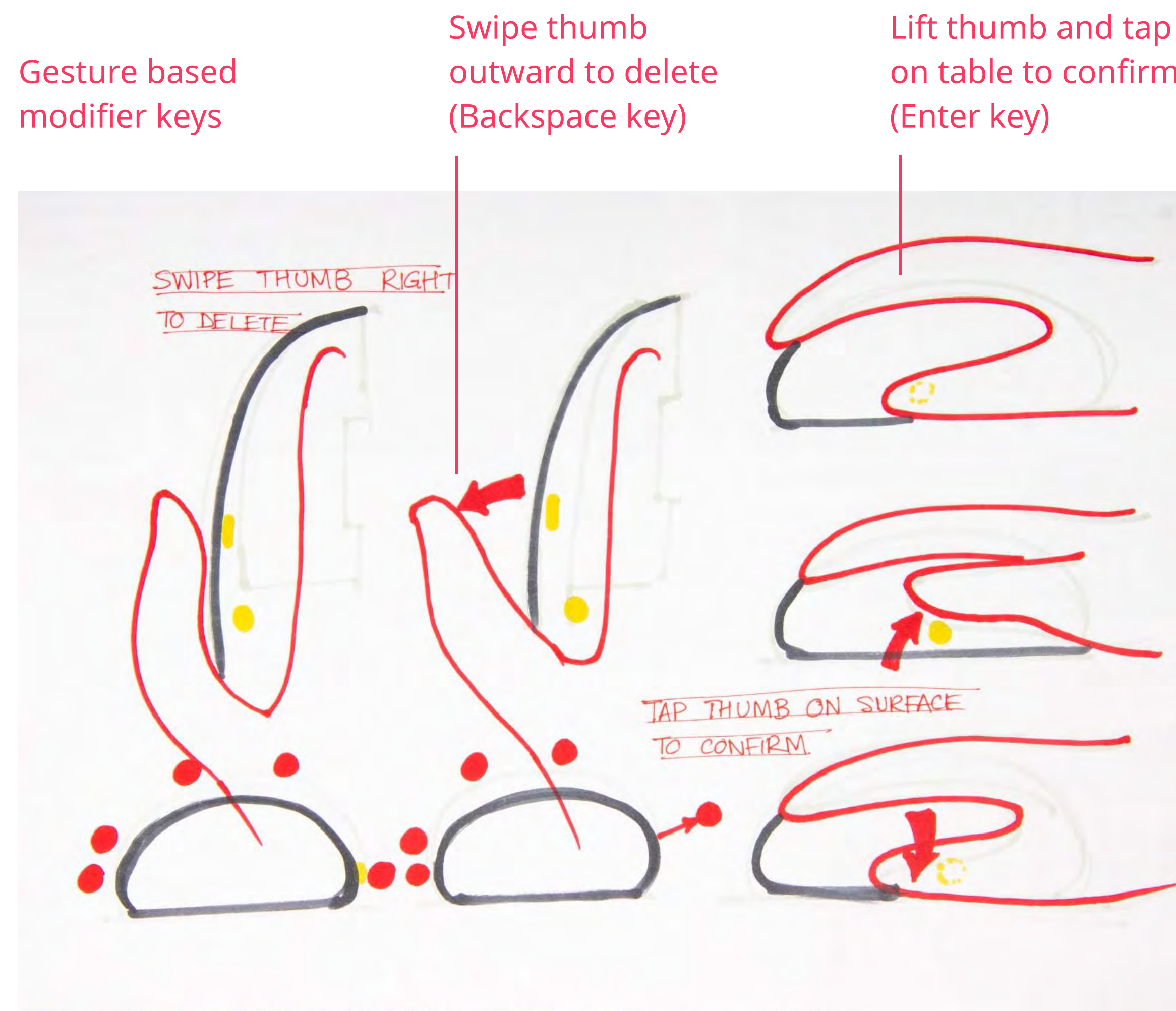
It is vital to give feedback to the user about the status of the mouse. I explored a few ways of letting the user know whether all 5 fingers are placed and detected by the mouse and whether fingerspelling mode is active. I explored visual and audio-haptic feedback methods.



The mouse may have LEDs that indicate the status of each individual finger or whether fingerspelling mode is active by lighting up the entire bottom of the mouse, so the user can know the status right from their peripheral vision

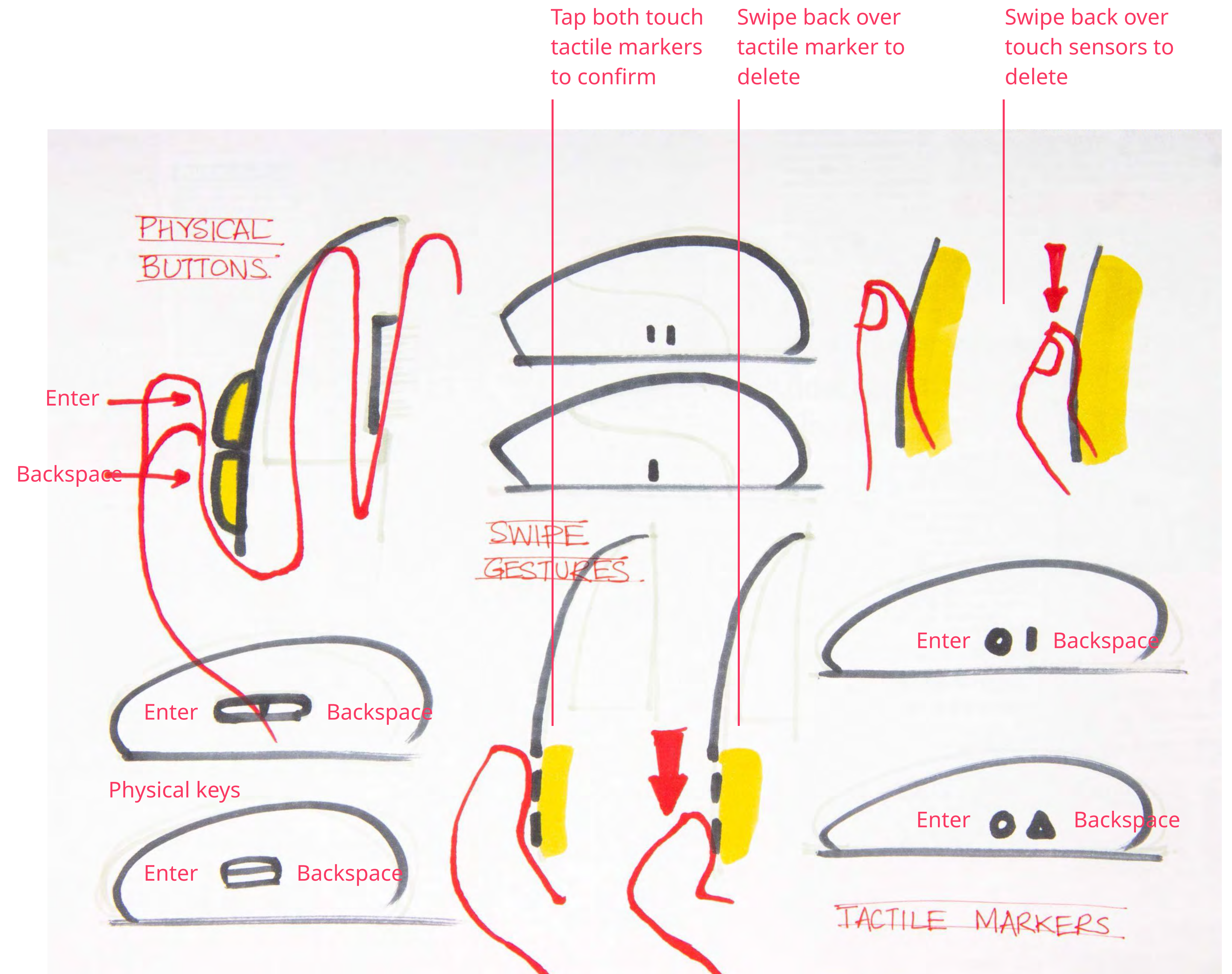
Other methods include varying the kind of haptic or audio feedback the mouse gives, such as shortening the duration of vibration feedback, or software level feedback such as changing the on-screen cursor

// Parameters



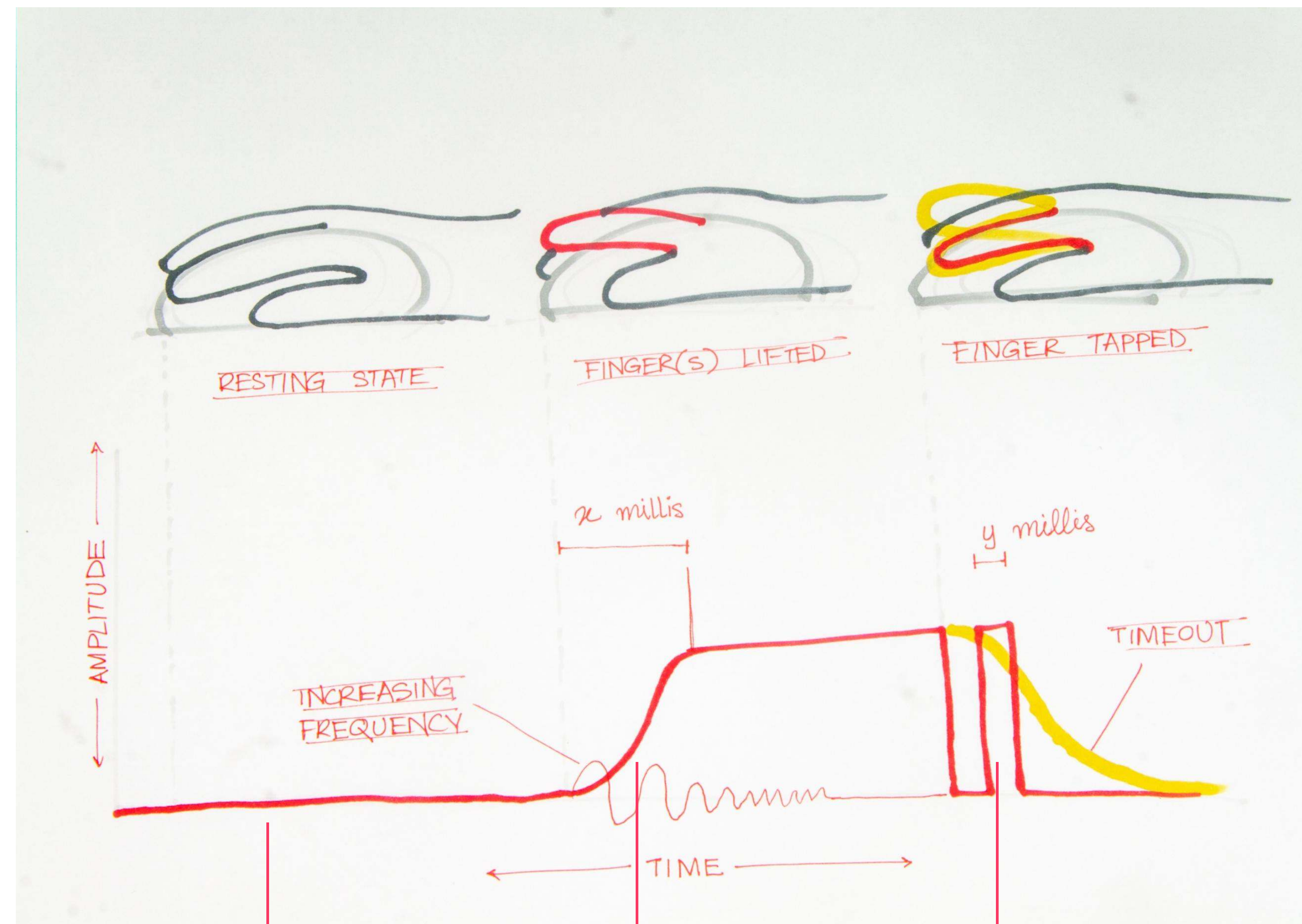
Modifier Keys

Modifier keys (Enter and Backspace) are required to complete the one-handed independence of the fingerspelling mouse. Many mice already have two side buttons which are a possible solution, but since our mice already have touch sensors, those can be utilized to minimize the need for additional buttons and integrate gestures into the pre-existing touch sensors.



I explored how mice can have tactile markers to replace physical buttons. These markers indicate where to touch to register a modifier key. There can be either two separate markers or just one.

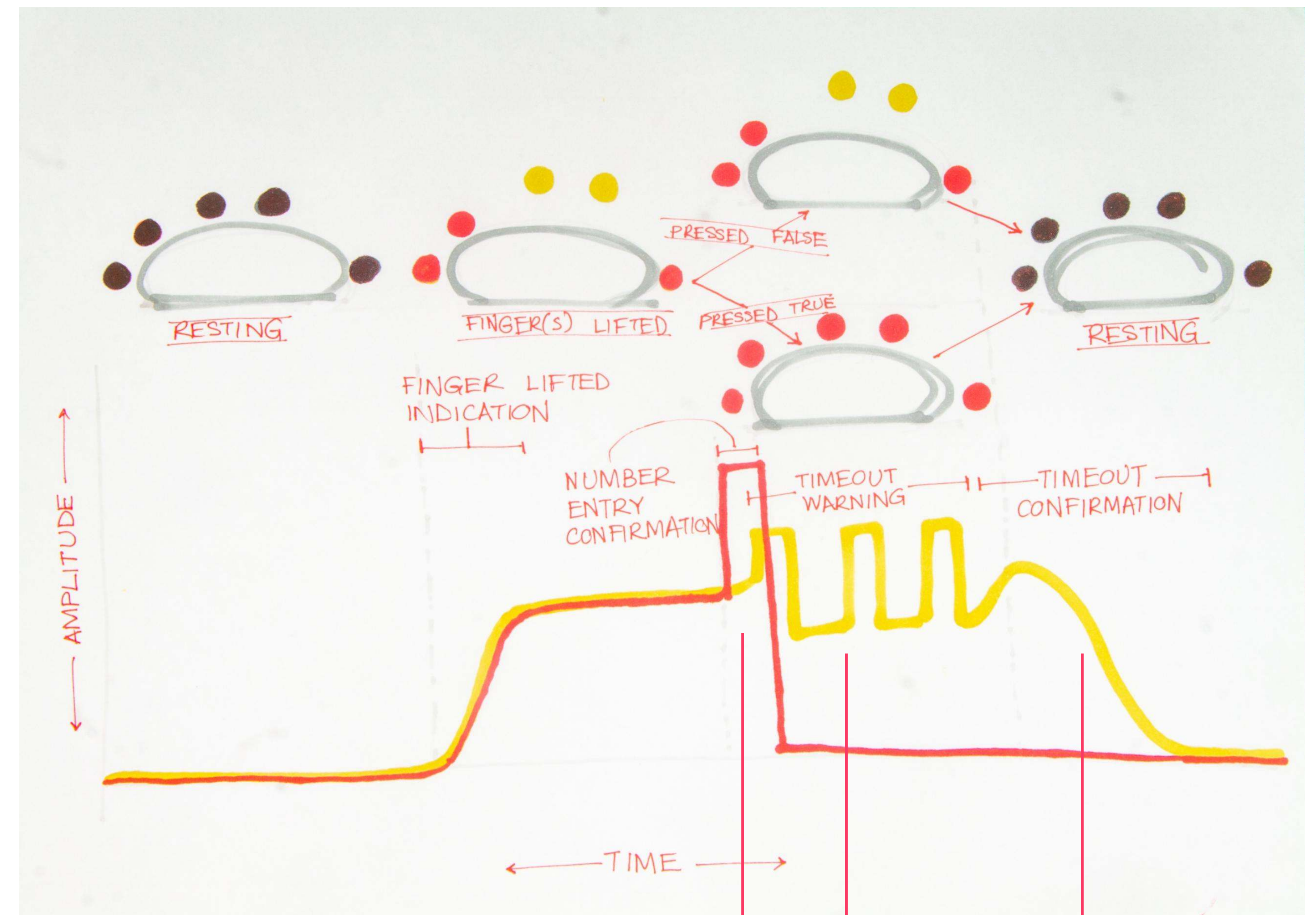
Alternatively, mice can use the pre-existing touch sensors and have thumb gestures to register modifier keys.



Feedback system dormant while hand is resting

Feedback goes from zero to a certain threshold

Vibrotactile / Audible click



Number Entry Confirmation

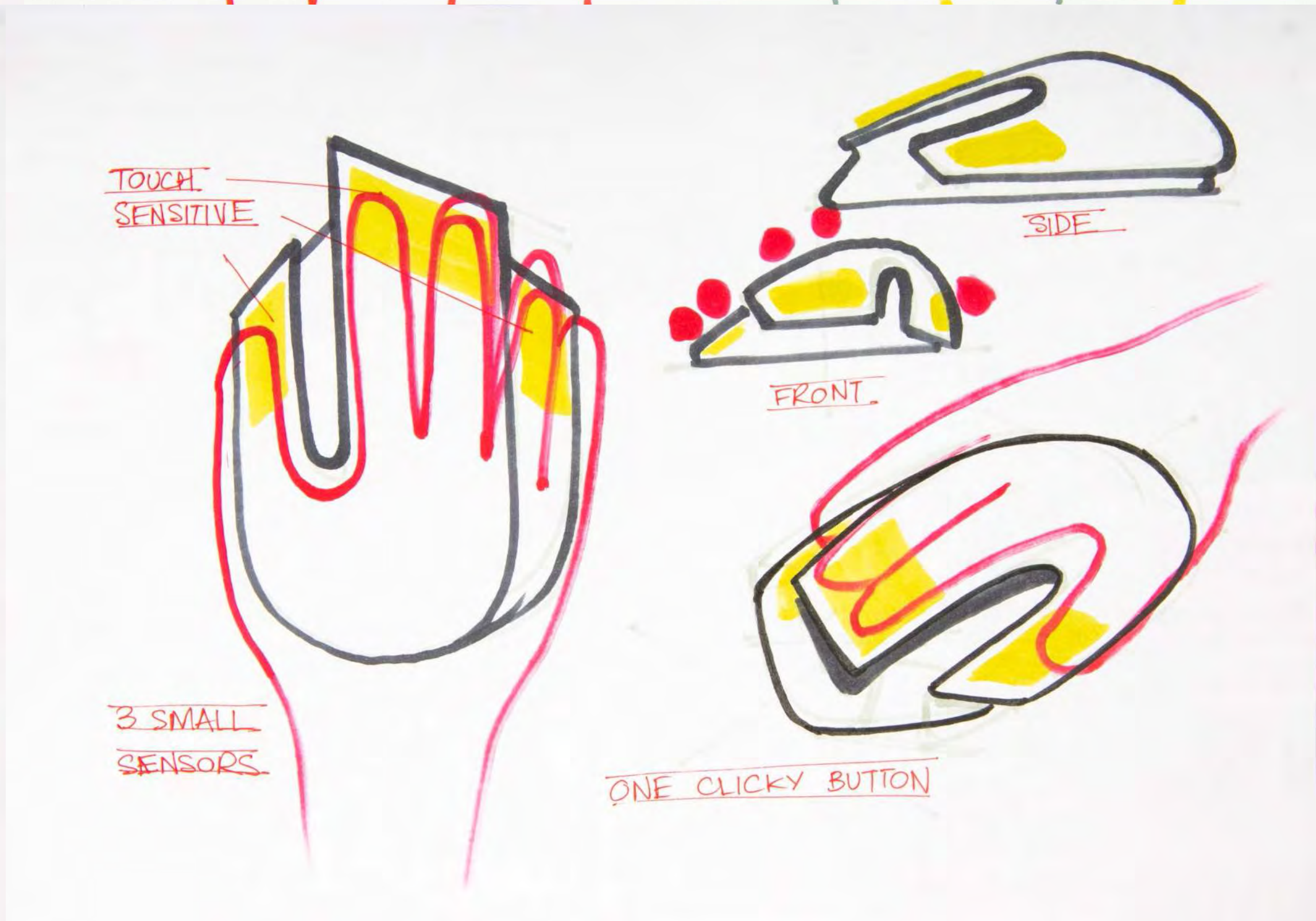
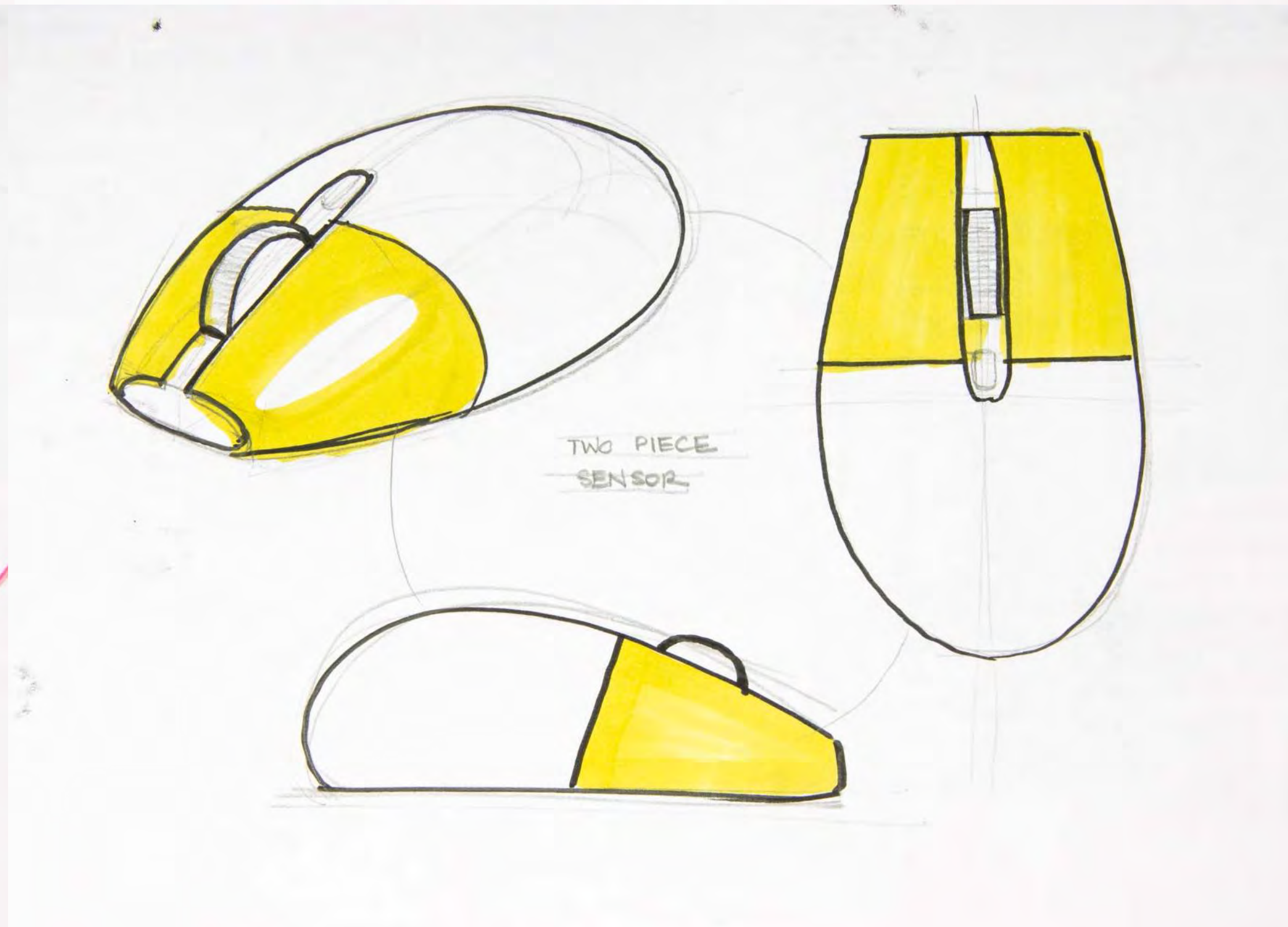
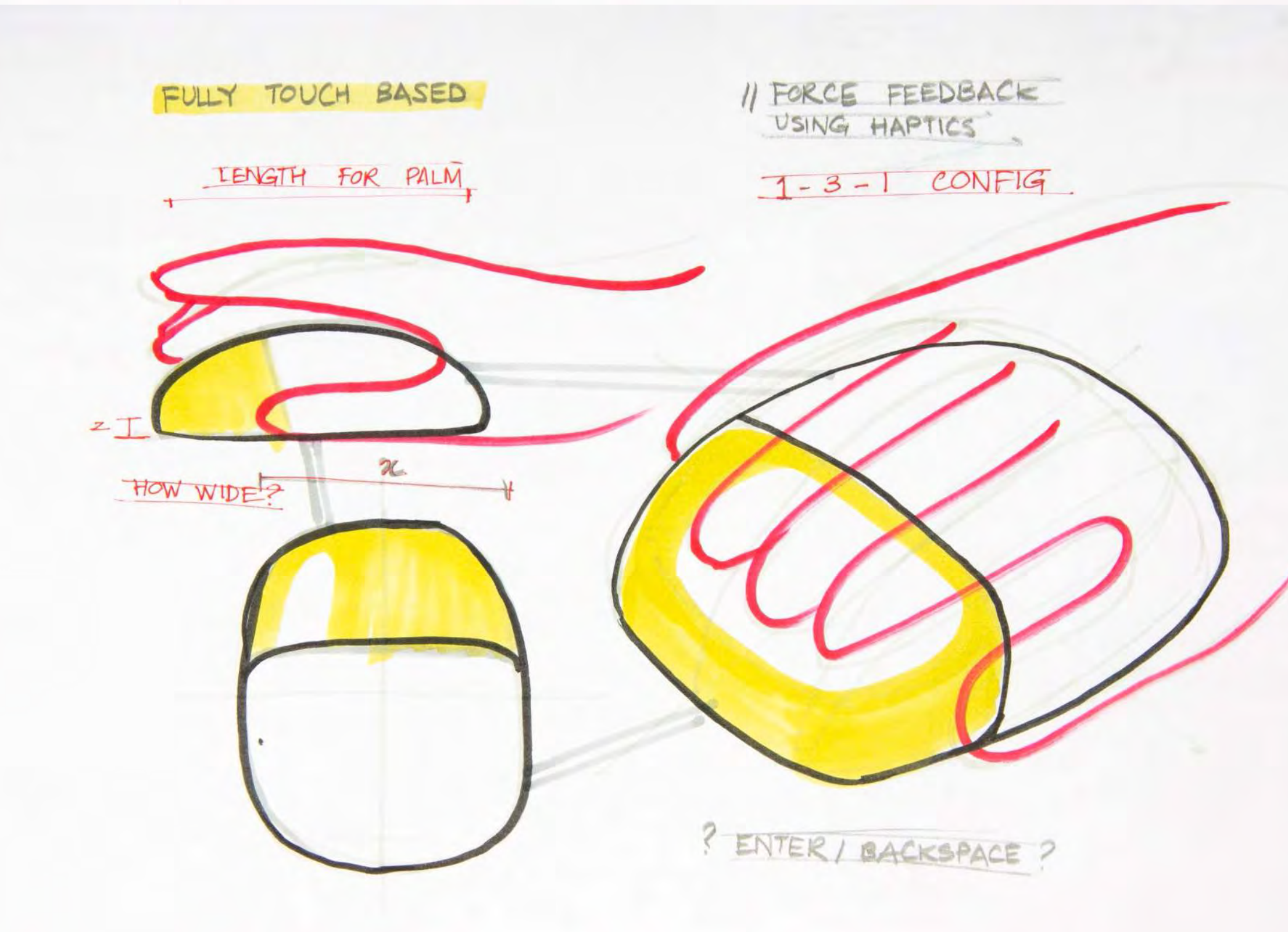
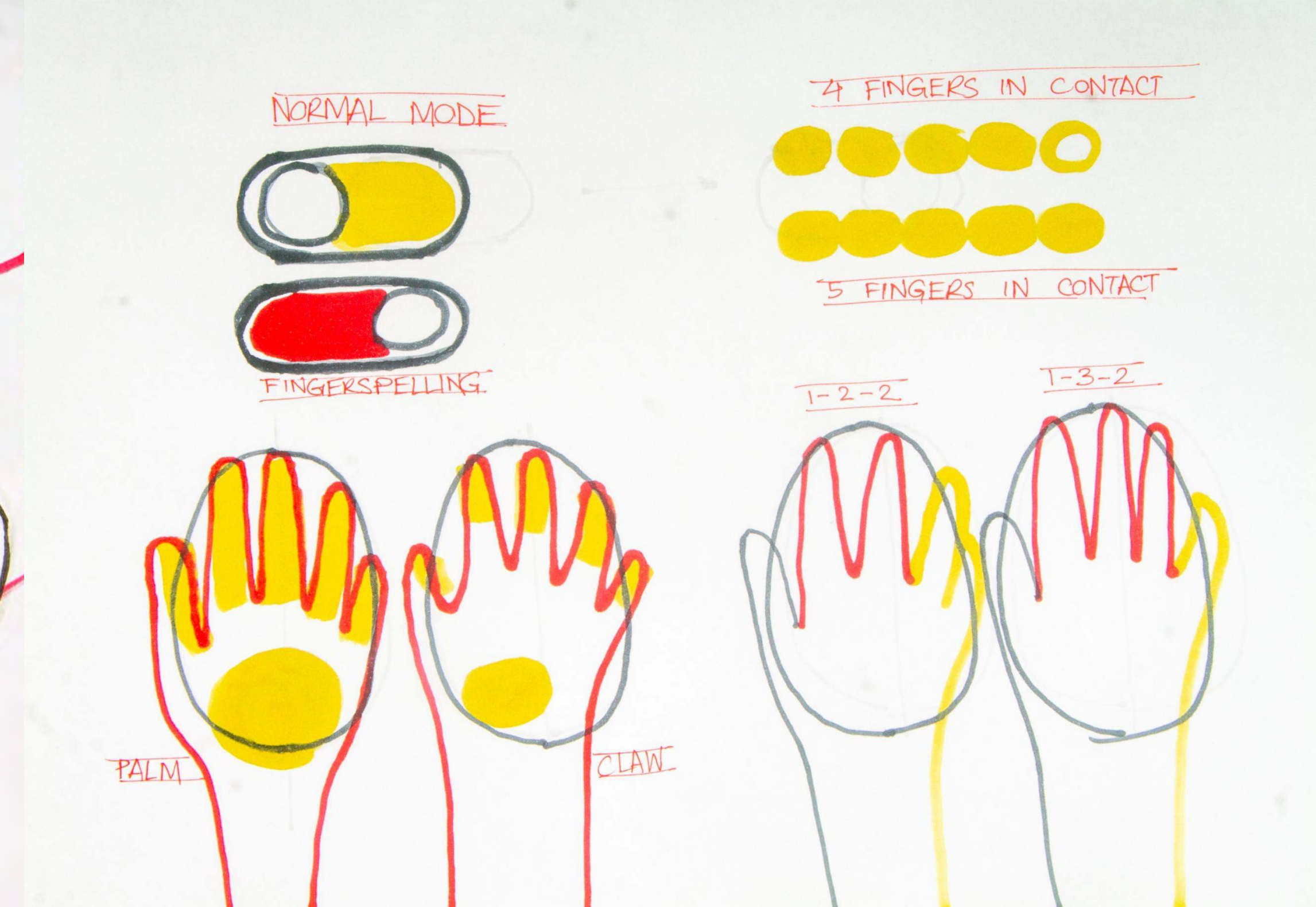
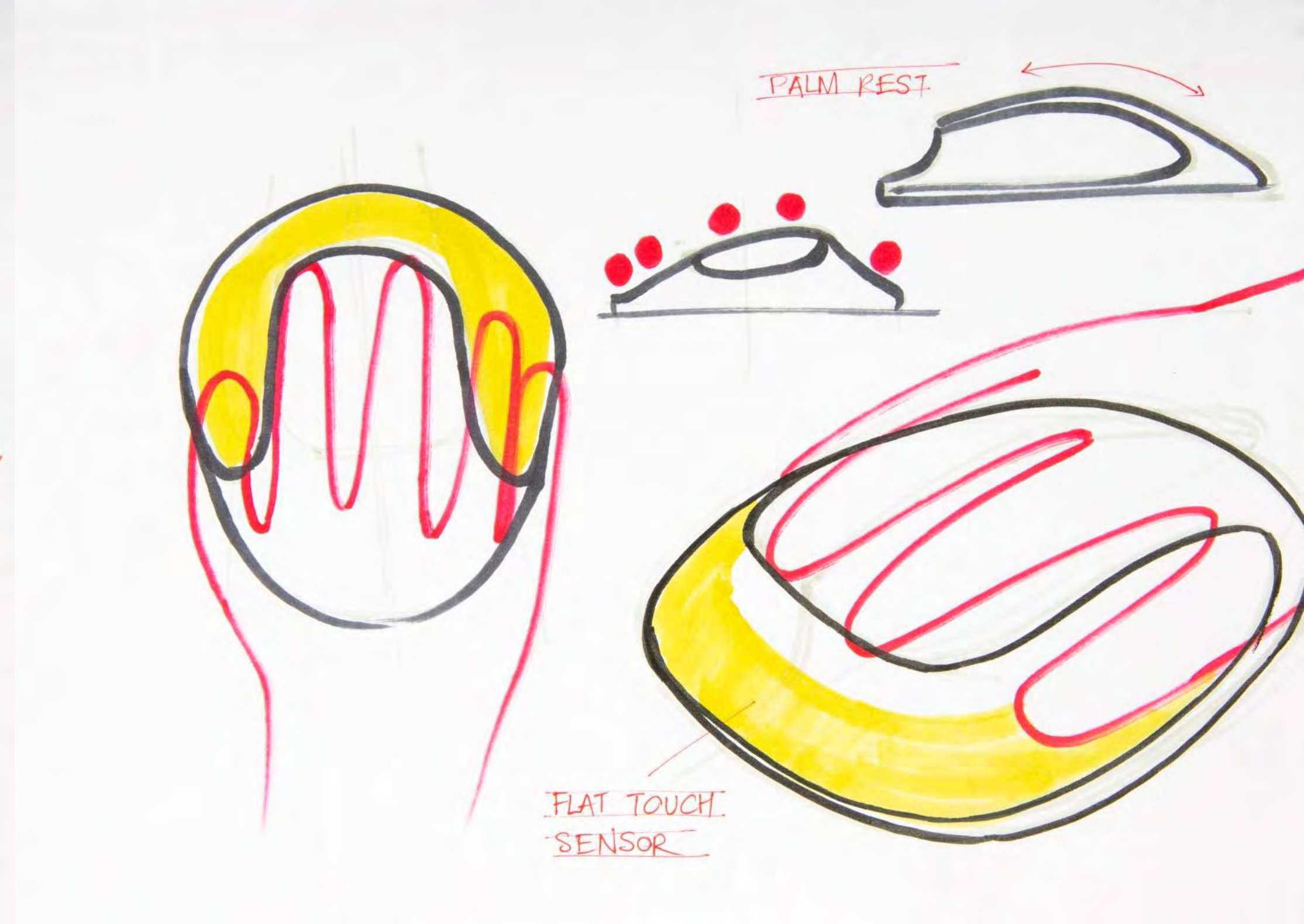
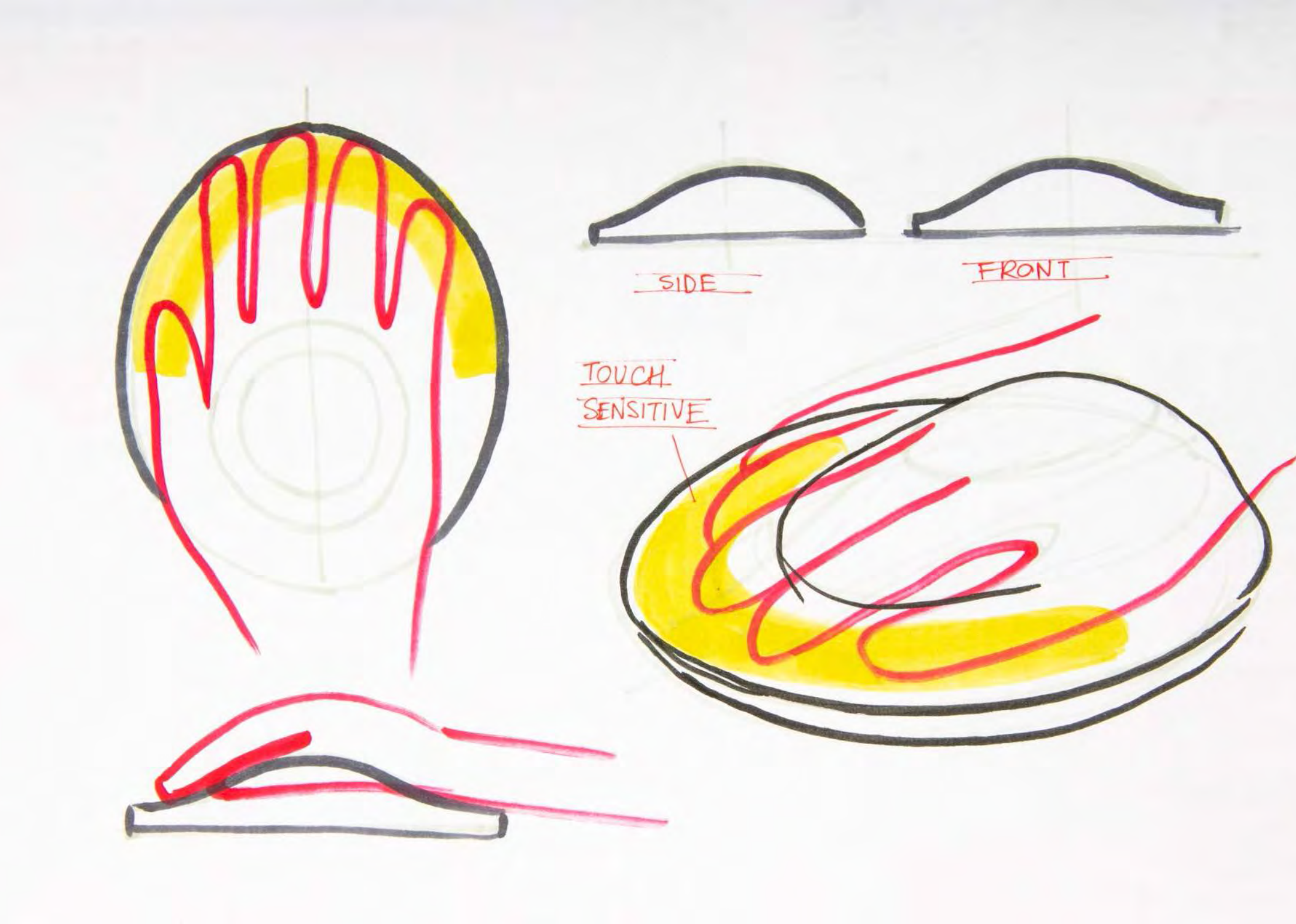
Timeout Warning

Timeout Confirmation

Audiohaptic Feedback

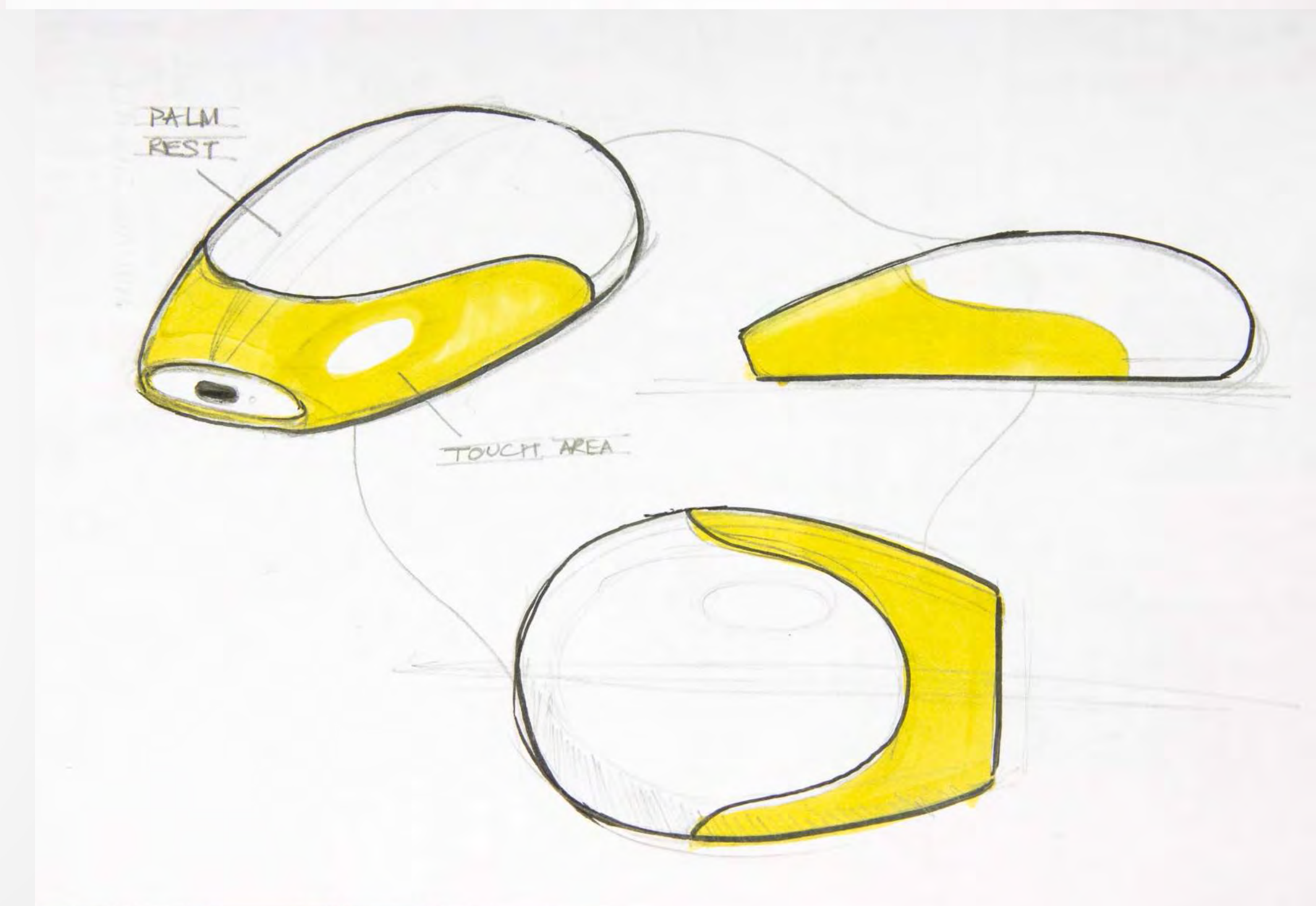
I tried to imagine the audio-haptic experience of a fingerspelling mouse so that the user doesn't have to take their eyes off the screen to know the status of the mouse. When a user lifts their finger(s), the vibration or audio intensity ramps up from zero (Finger Lifted Indication) to a certain threshold. If the user executes a gesture within the timeout limit,

there is a vibrotactile/audible click (Number Entry Confirmation) and the vibration/sound goes back to null. If there is no gesture within the timeout period, there may three gentle warning clicks (Timeout Warning) before the vibration/sound fades back to null (Timeout Confirmation).

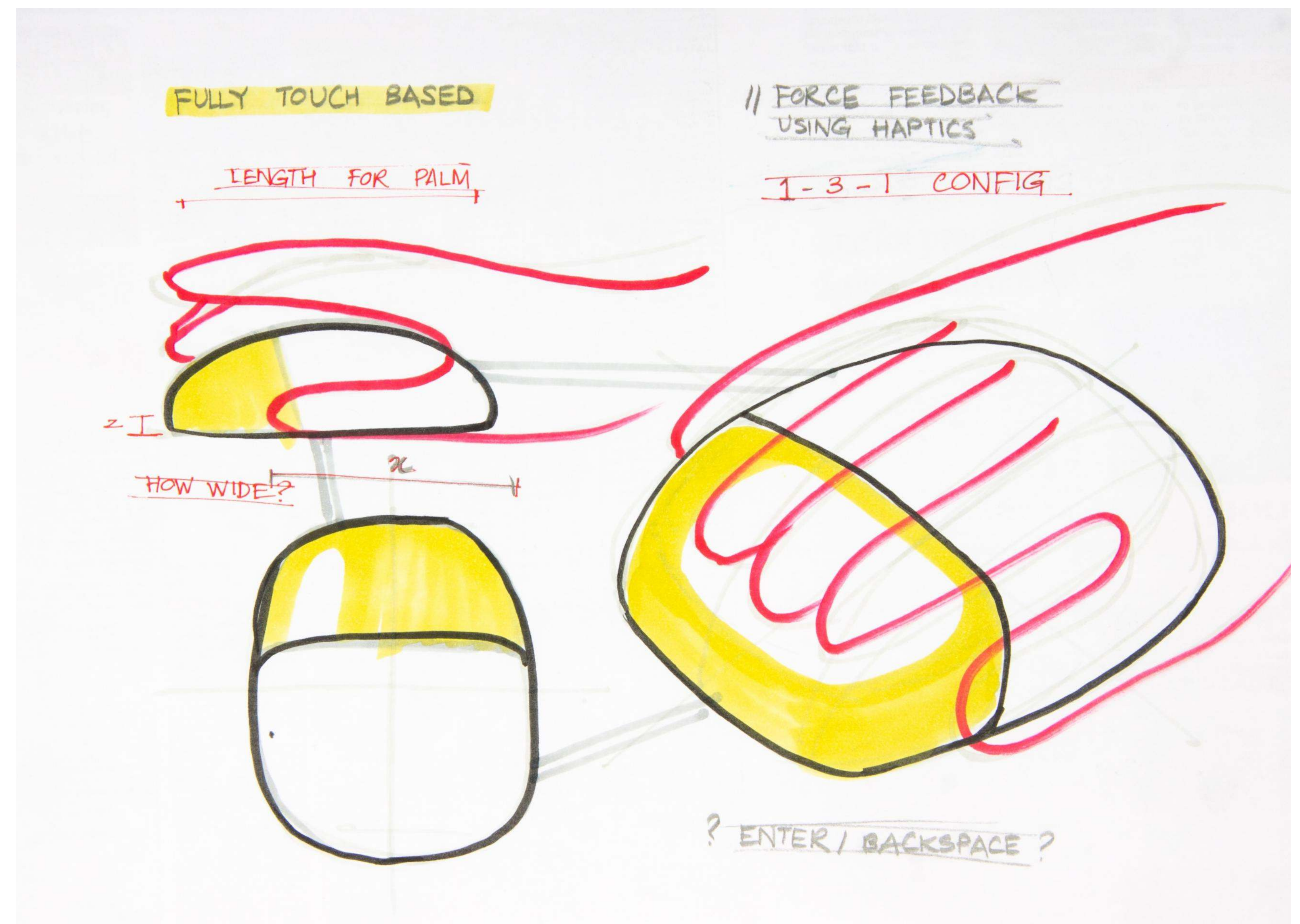
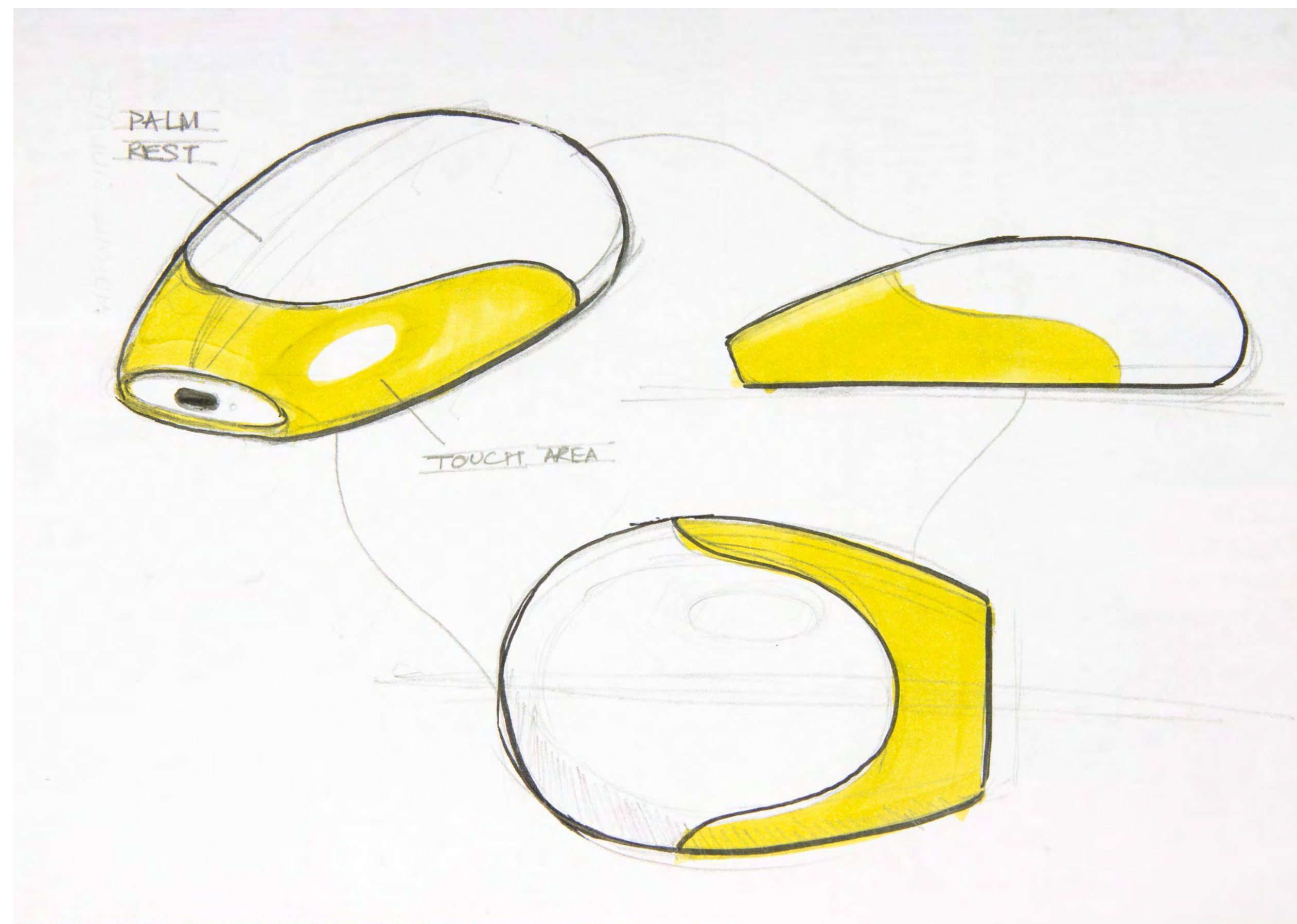


Ideation

Generating ideas for incorporating
fingerspelling into mice



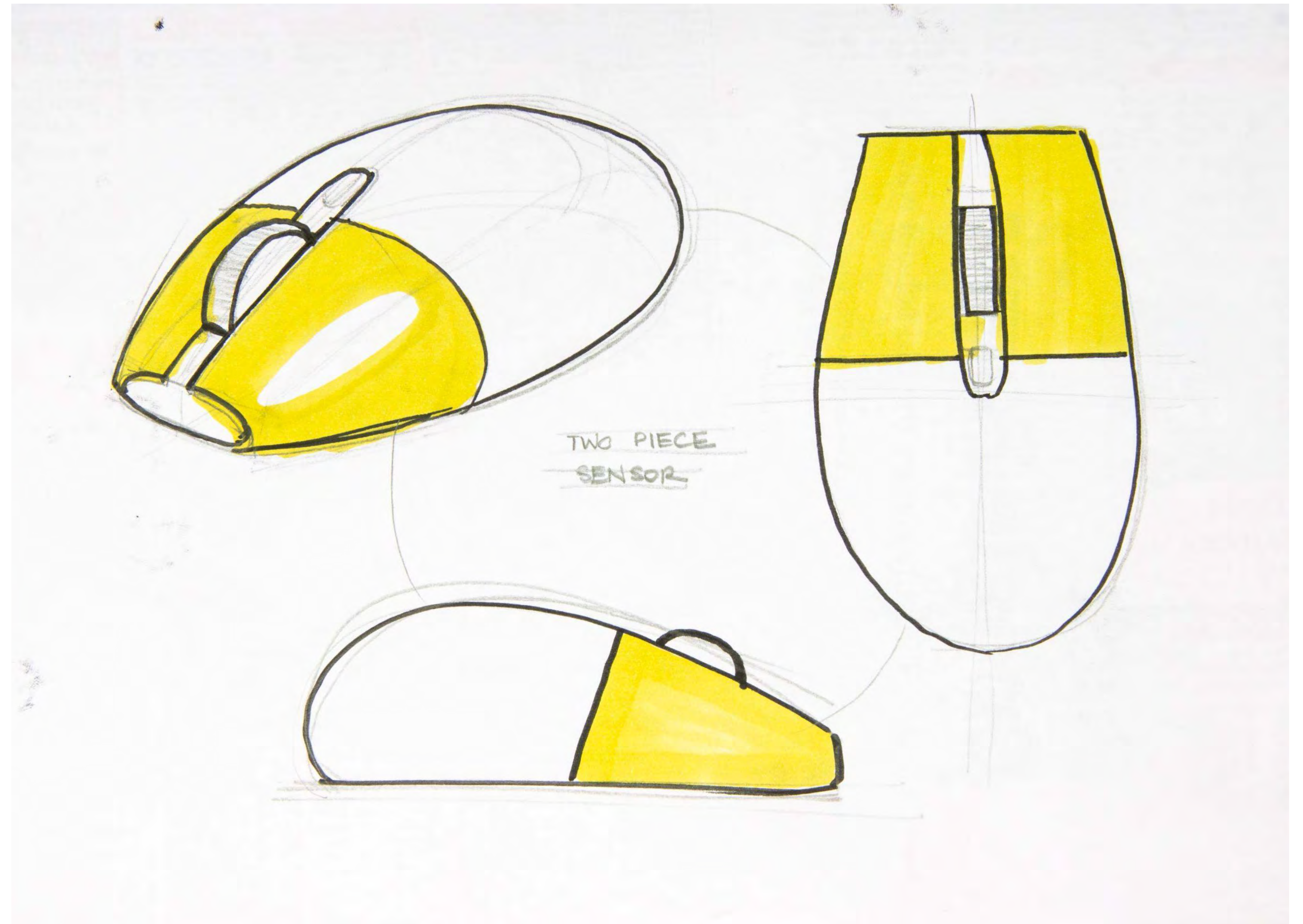
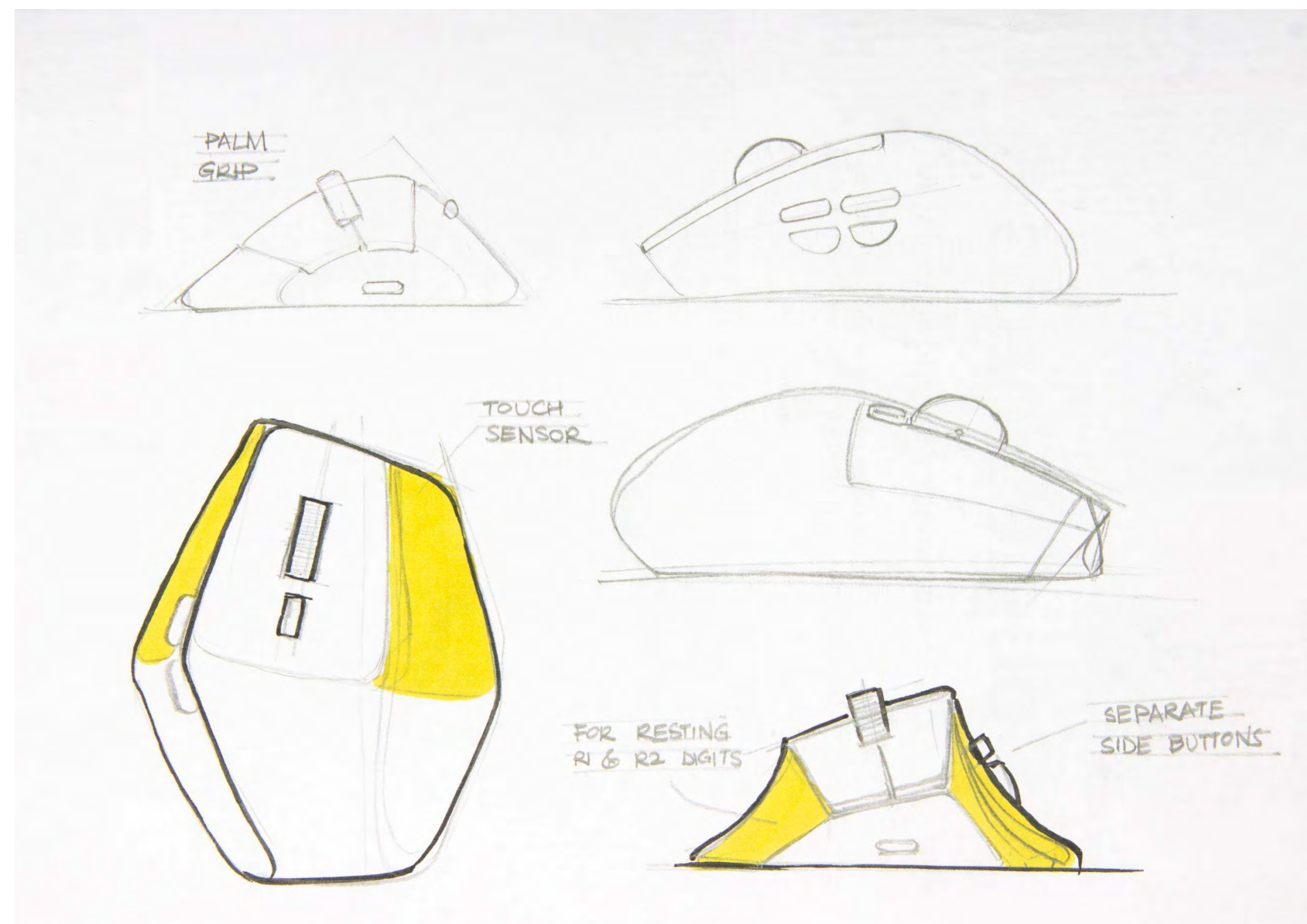
// Ideation



Generic Touch Based

A fully touch based mouse with no physical buttons. Feedback is given through audio or haptics and modifier keys (Enter and Backspace) are also either tactile markers or through swipe gestures. One large touch sensor wrapped across the body of the device such that all fingers rest on it when held. Since there are no external moving parts the mouse is durable and can be water resistant.

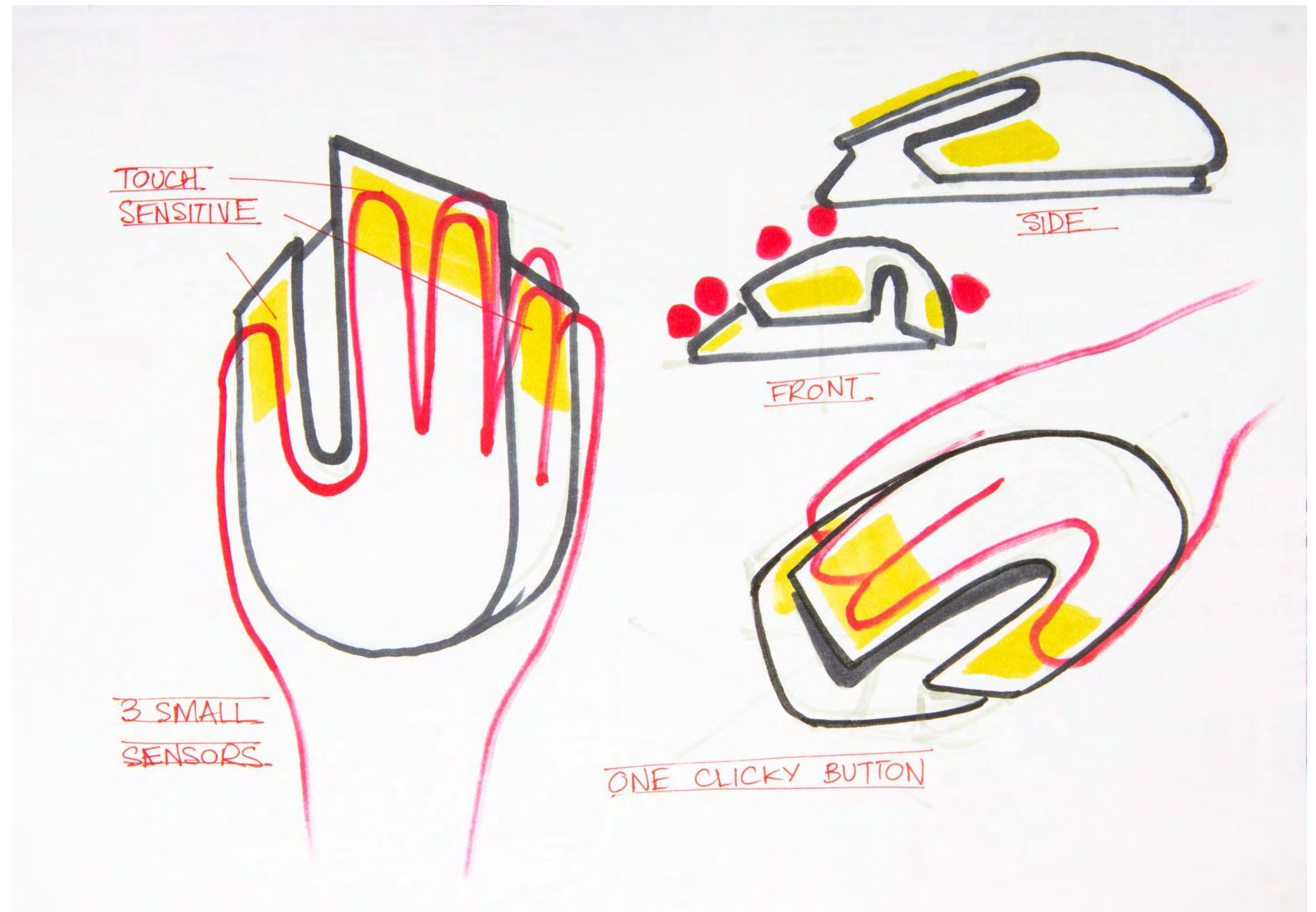
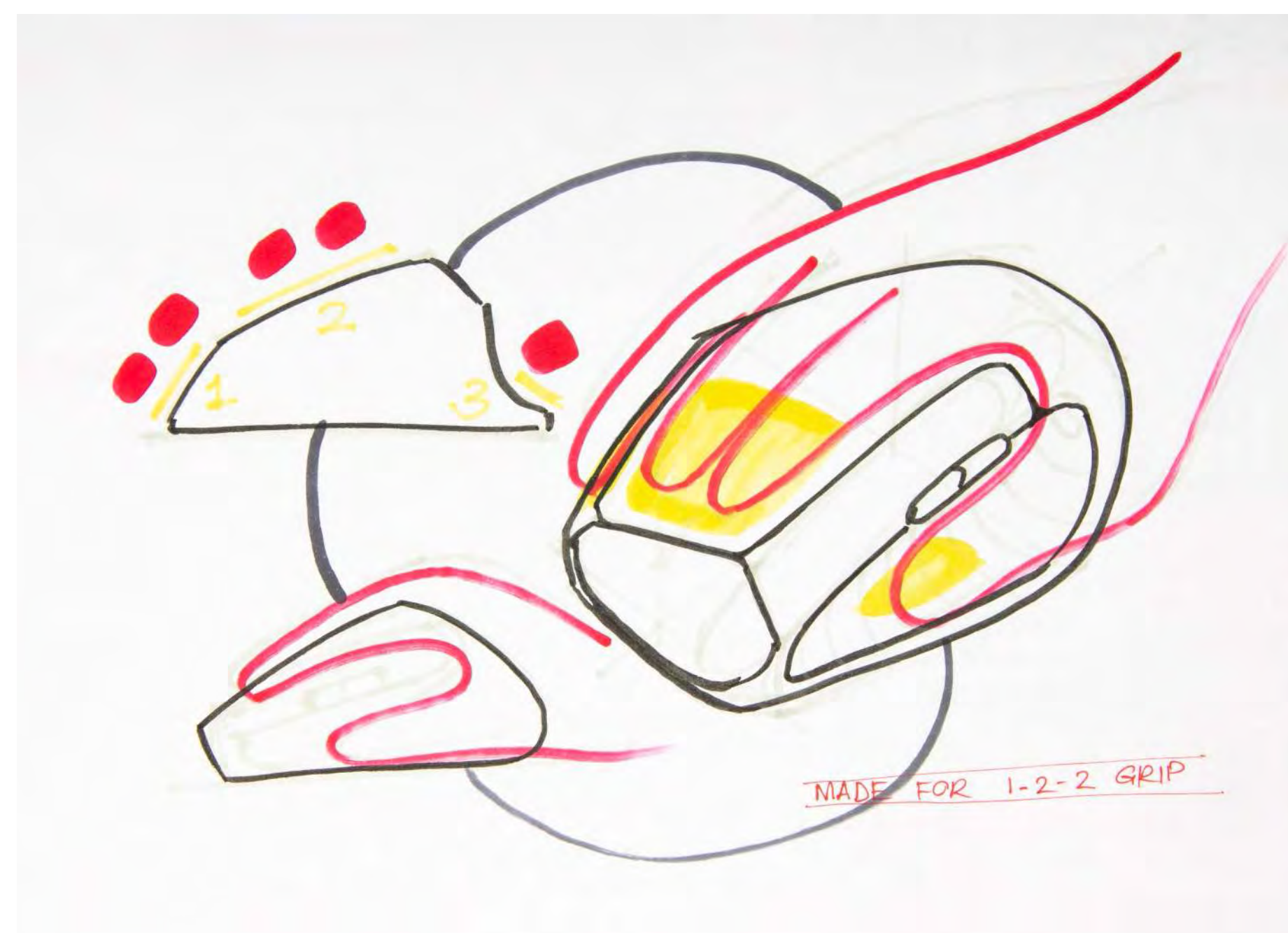
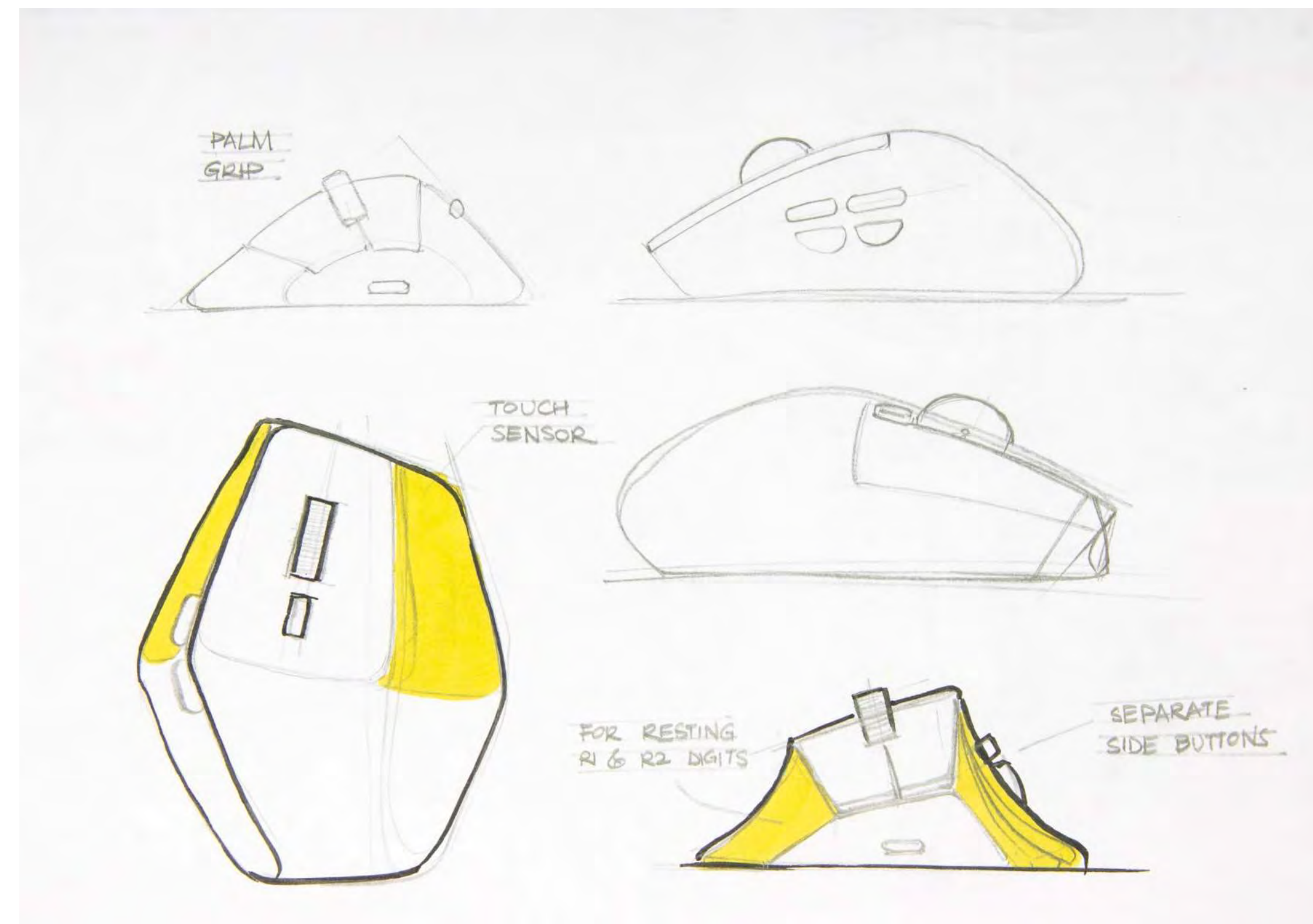
// Ideation



Touch and Click

Functions like a regular mouse but with additional touch sensors for fingerspelling. Has touch sensors built into the sides and the left and right click. The click actuation force is tweaked to avoid accidental presses while executing fingerspelling gestures. Can have tactile side buttons instead of haptic or gesture ones.

// Ideation



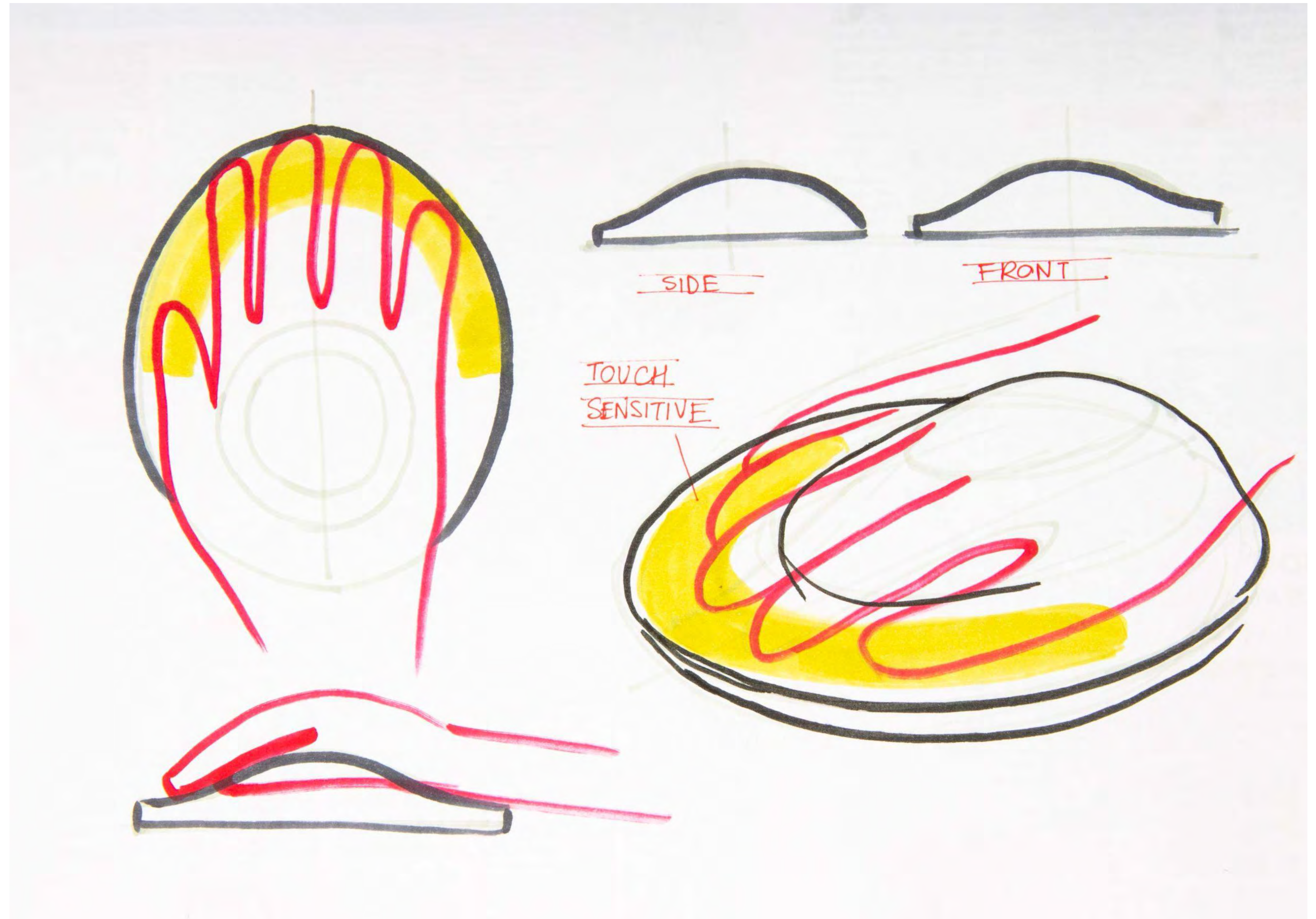
Triangular Grip

In order to make the mouse more manufacturable the touch sensor is split into three parts - one for the thumb, one for index and middle finger and one for the ring and pinky finger. The mouse has a triangular shape with an incline along the z-axis for better ergonomics. Can be fully touch based or have tactile clicks for both the main buttons as well as the side buttons.

Ergonomic Touch Based

Quite a few people preferred the freedom of the touchpad in my study. This mouse tries to provide that freedom while

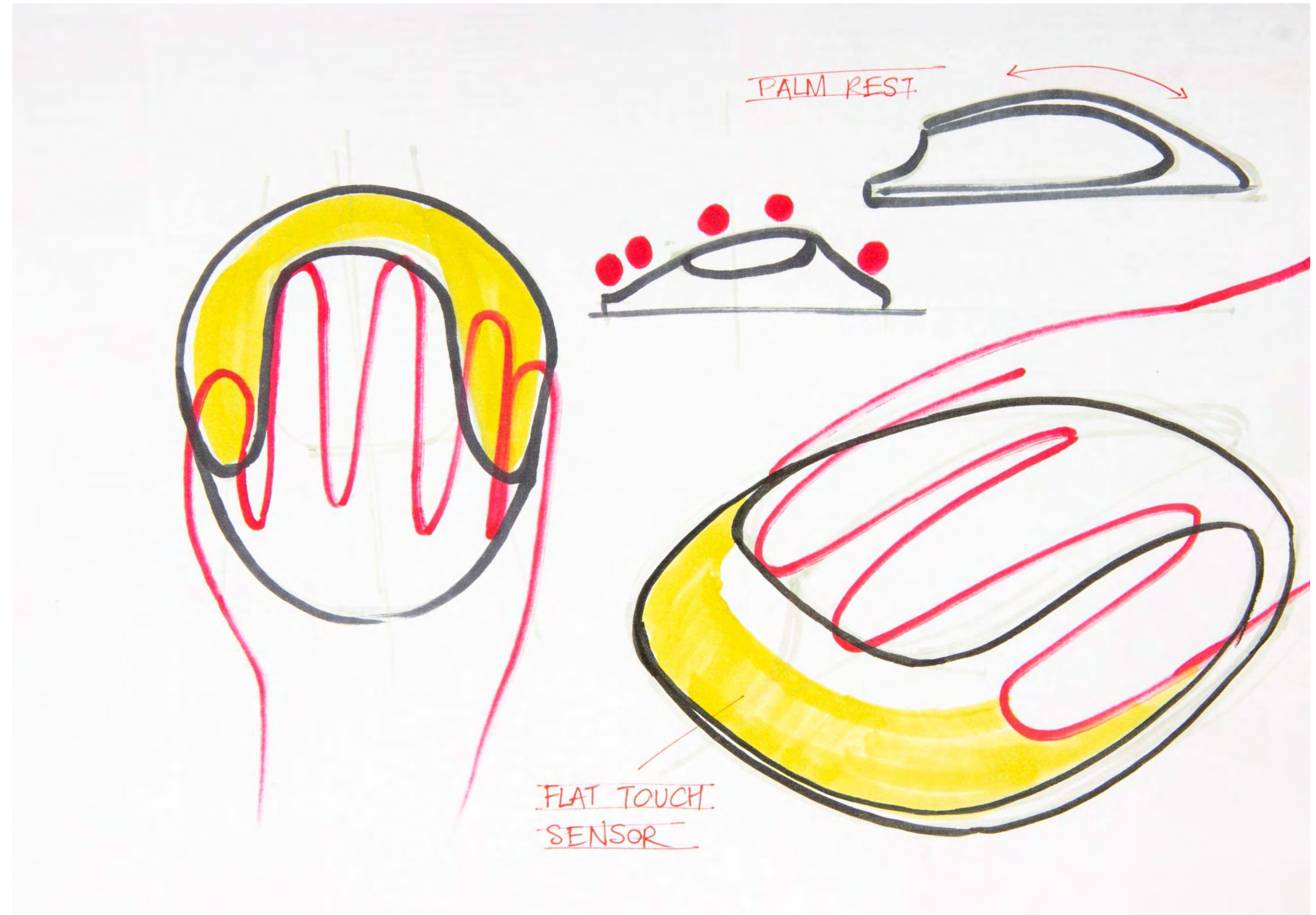
also giving some amount of palm and gripping support. There is one continuous U-shaped touch sensor for placing all 5 fingers at once.



Sculpted Hybrid Click

Because of the existence of either touch sensors or three different sensors in the other mouse designs, I wanted to have a

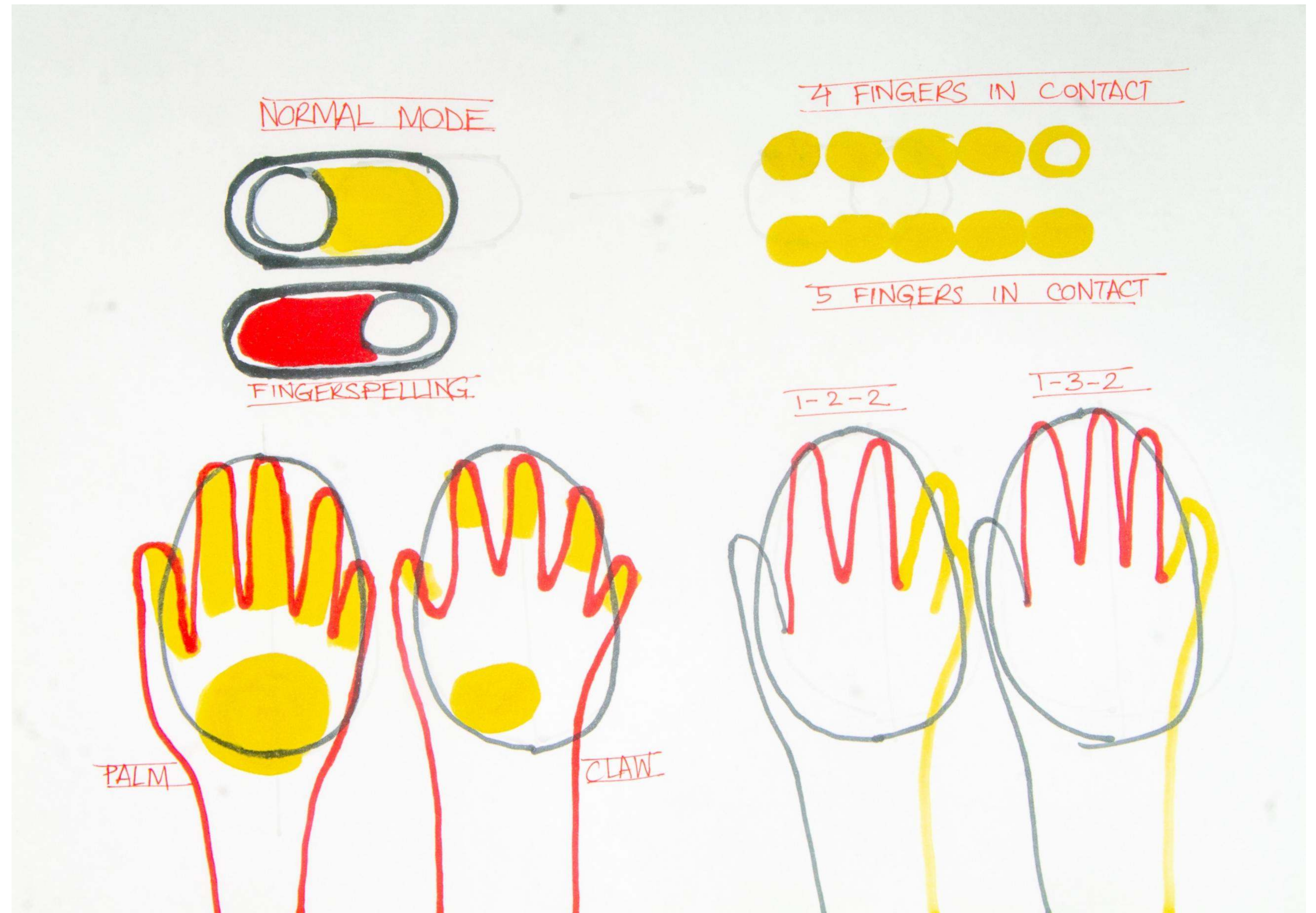
concept that had a single, flat U-shaped touch sensor that is presumably easier and cheaper to manufacture and include in the mouse design than the aforementioned options.

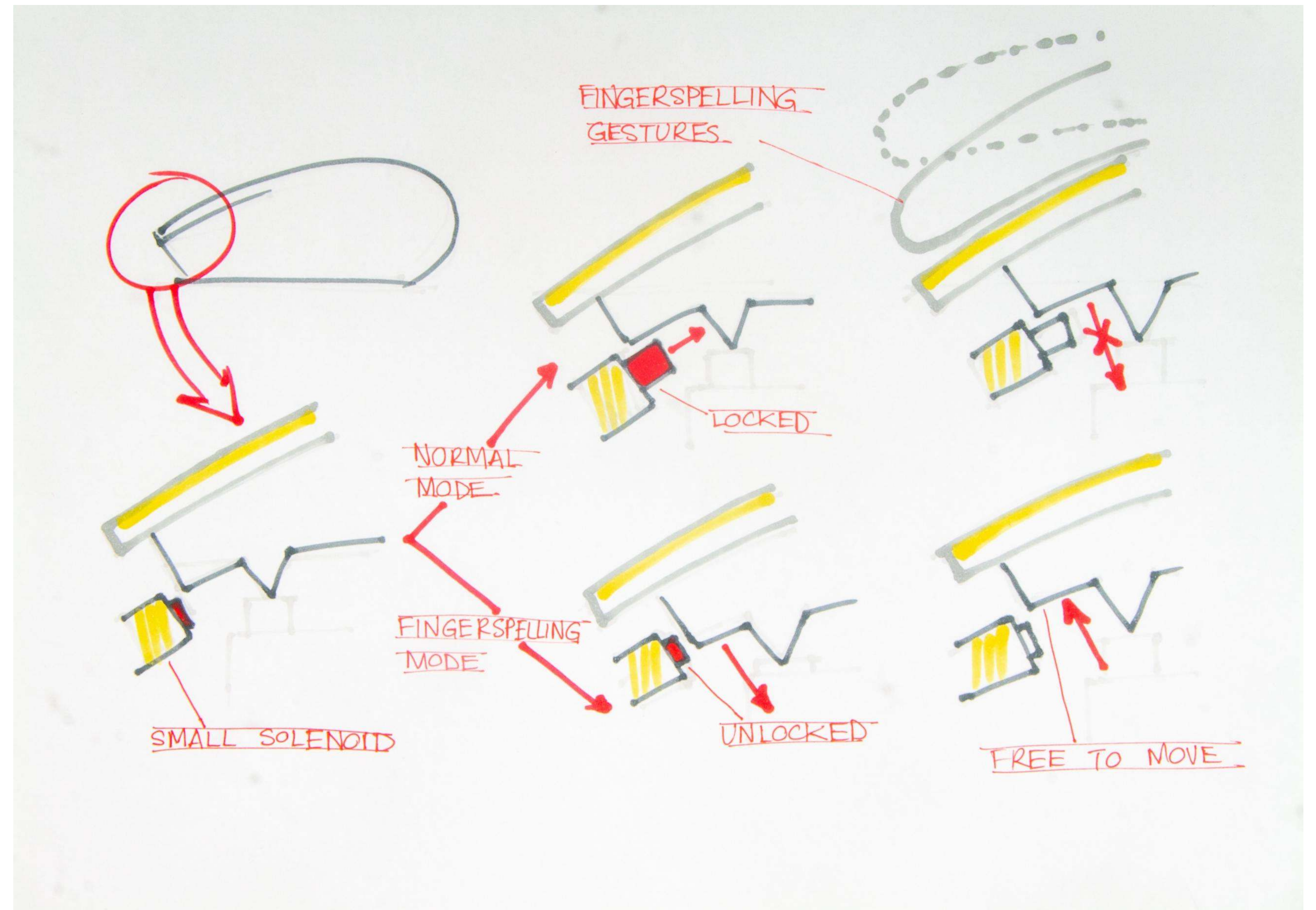


Fingerspelling Mode

There may be an explicit and dedicated 'Fingerspelling mode' which can be toggled by various kinds of interactions. It can be

turned on by changing the type of grip, the style of grip, have a physical toggle button or turn on only when certain conditions like having all five fingers in contact with the mouse are met

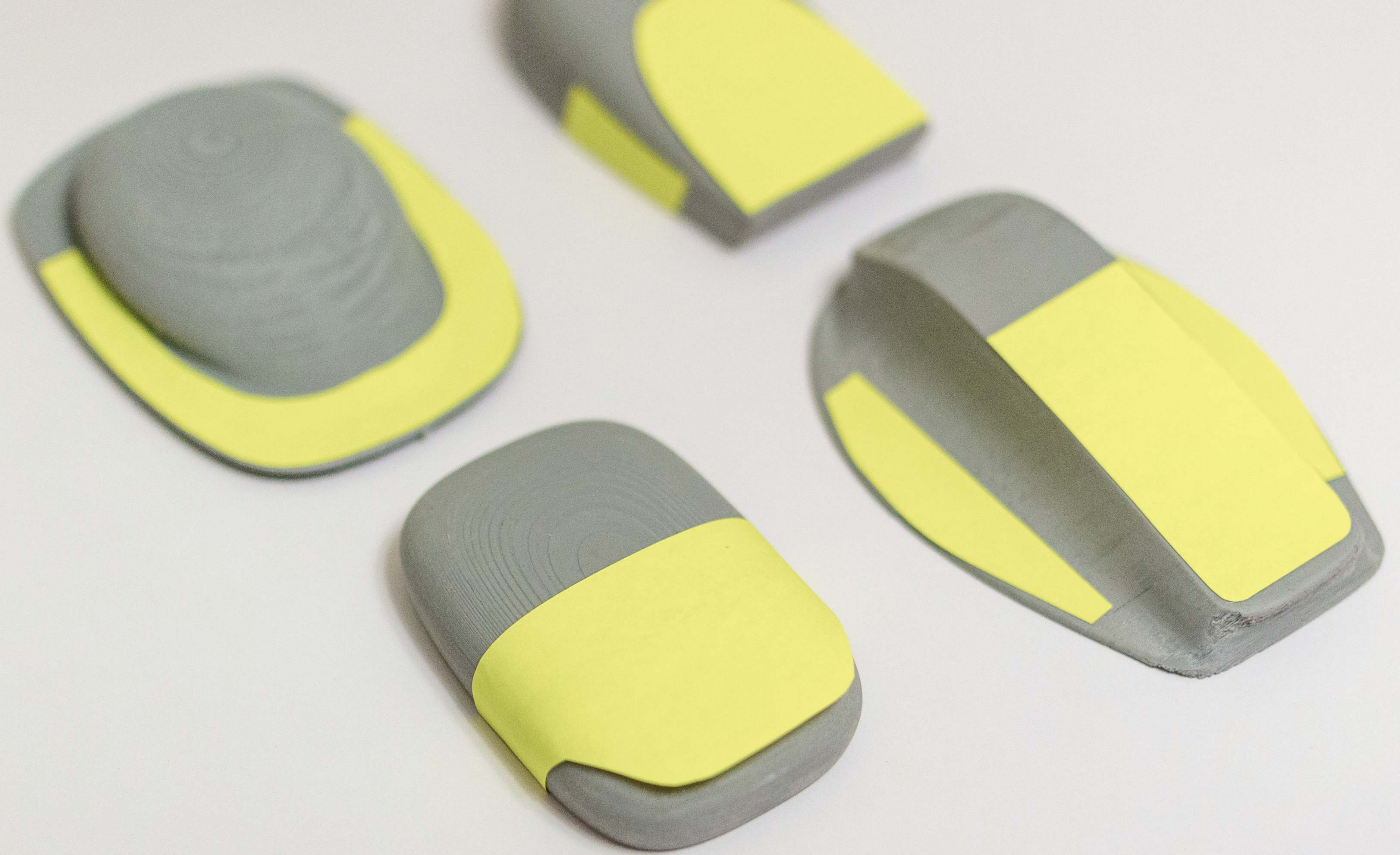




Actuation Lock

I thought of a mechanism to electronically lock the physical actuation of a mouse to avoid accidental physical clicks while doing fingerspelling gestures.

It uses a small solenoid to block the mouse button from travelling downwards when activated. This mechanism can be incorporated in mice that need to have tactile main buttons as well as touch sensors for fingerspelling.



Concepts

Envisioning how the identified parameters and ideas can be incorporated into four different types of mice

// Concepts

The Pebble

A small mouse that is meant for portability. These mice usually aren't meant to deliver a great tactile click and grip, and focus more on the convenience aspect. That is why, this mouse can be fully touch based so that it is seamless and portable. Because of the lack of external moving parts (the only moving part being the internal haptic motor), it can also be made water resistant which lends to the convenience aspect.



// Concepts



Single large touch
sensor wrapped
around body, difficult
to manufacture

// Concepts



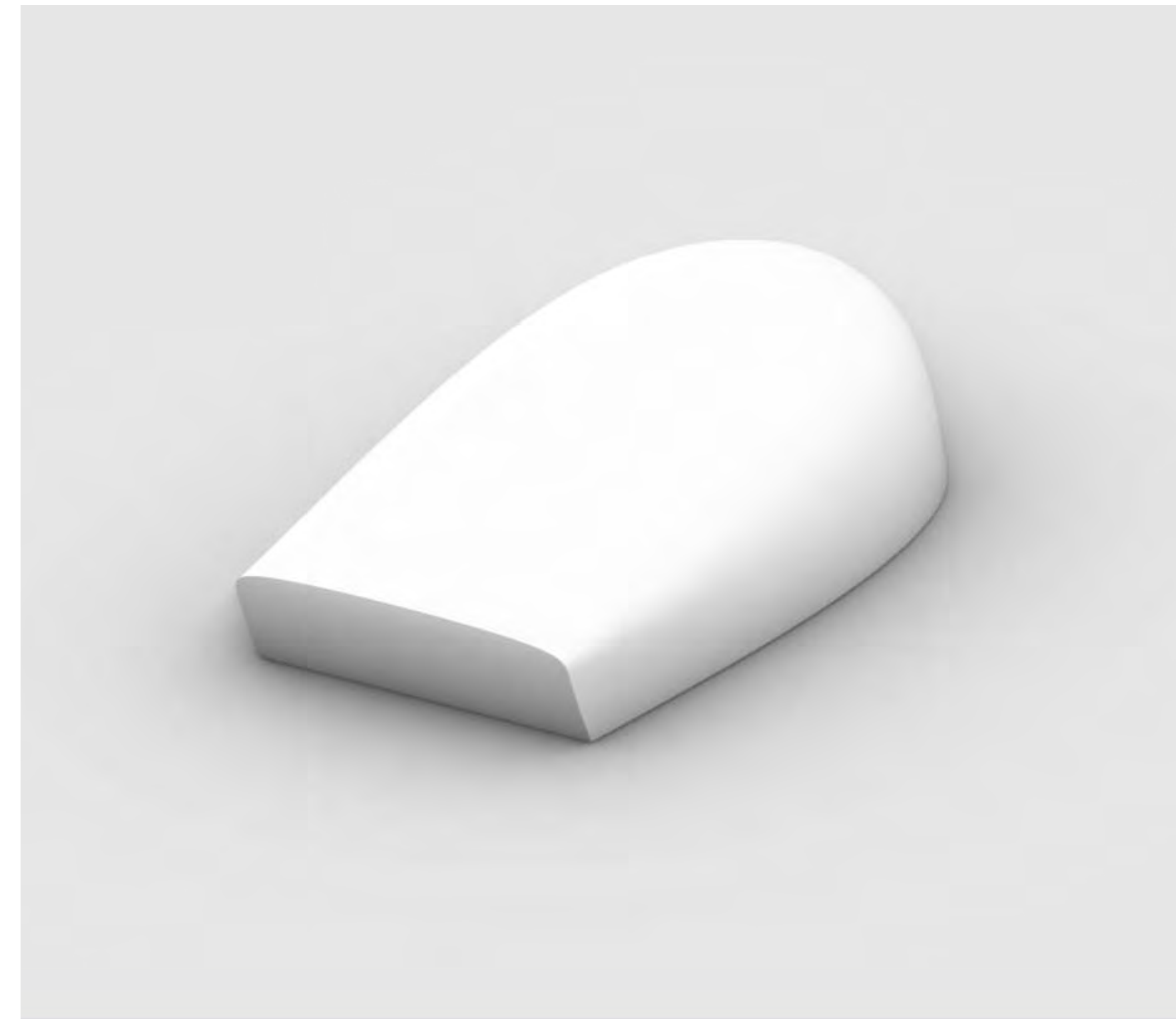
Details

- 1-3-1 or 1-2-2 or 1-4-0 grip
- Fully touch based
- Haptic main button
- Tactile markers for modifiers
- Extension using wrist because of lack of palm or interdigital pad support

// Concepts

The Generic

A tried and tested form factor, this is the most popular shape of a mouse. These mice are used in all scenarios, and are usually ambidexterous if side buttons are absent. They provide enough interdigital pad support and depending on the size, palm support as well. If the modifier keys are gesture based or tactile marker based, these can be made ambidexterous as fingerspelling mice.

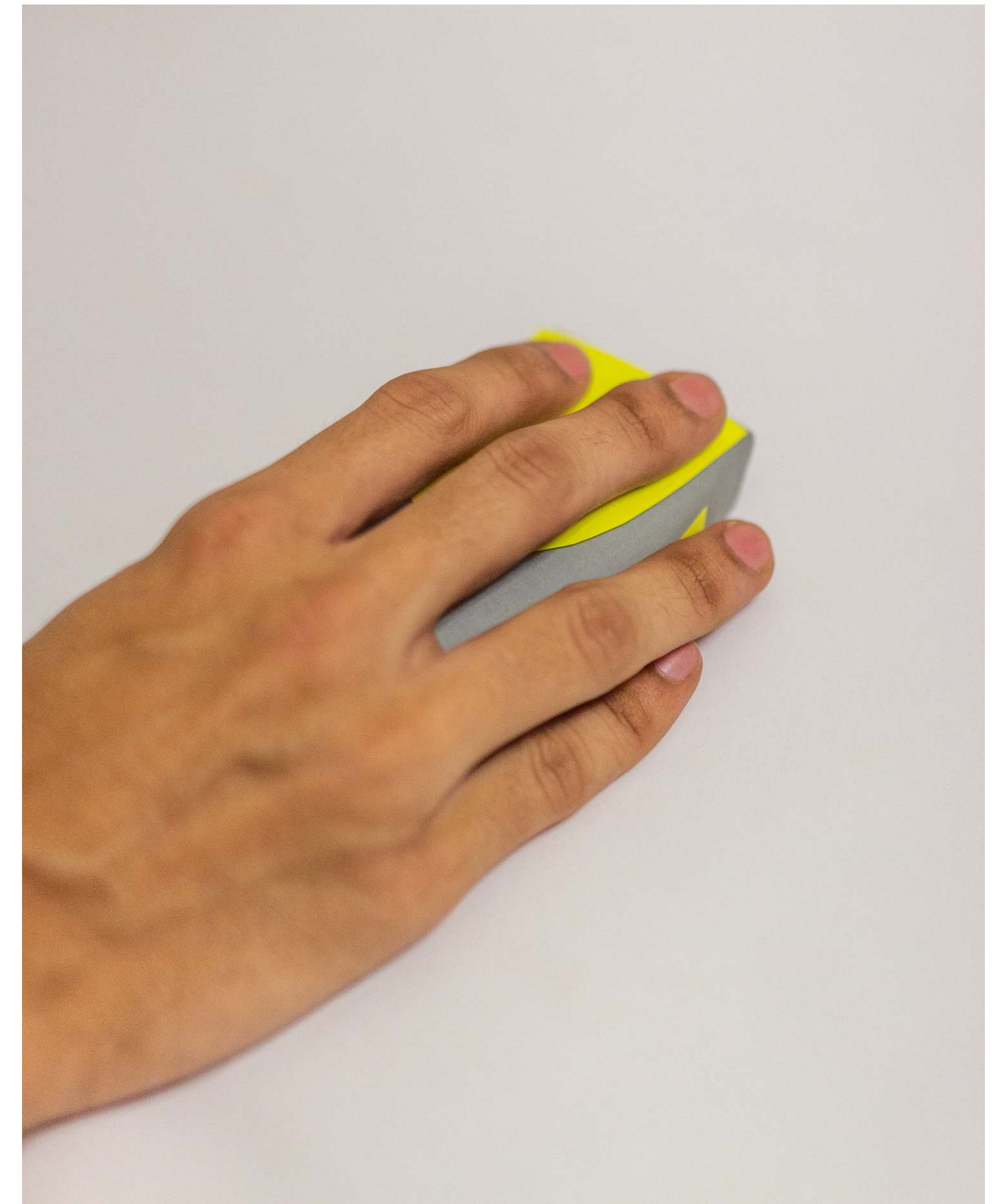
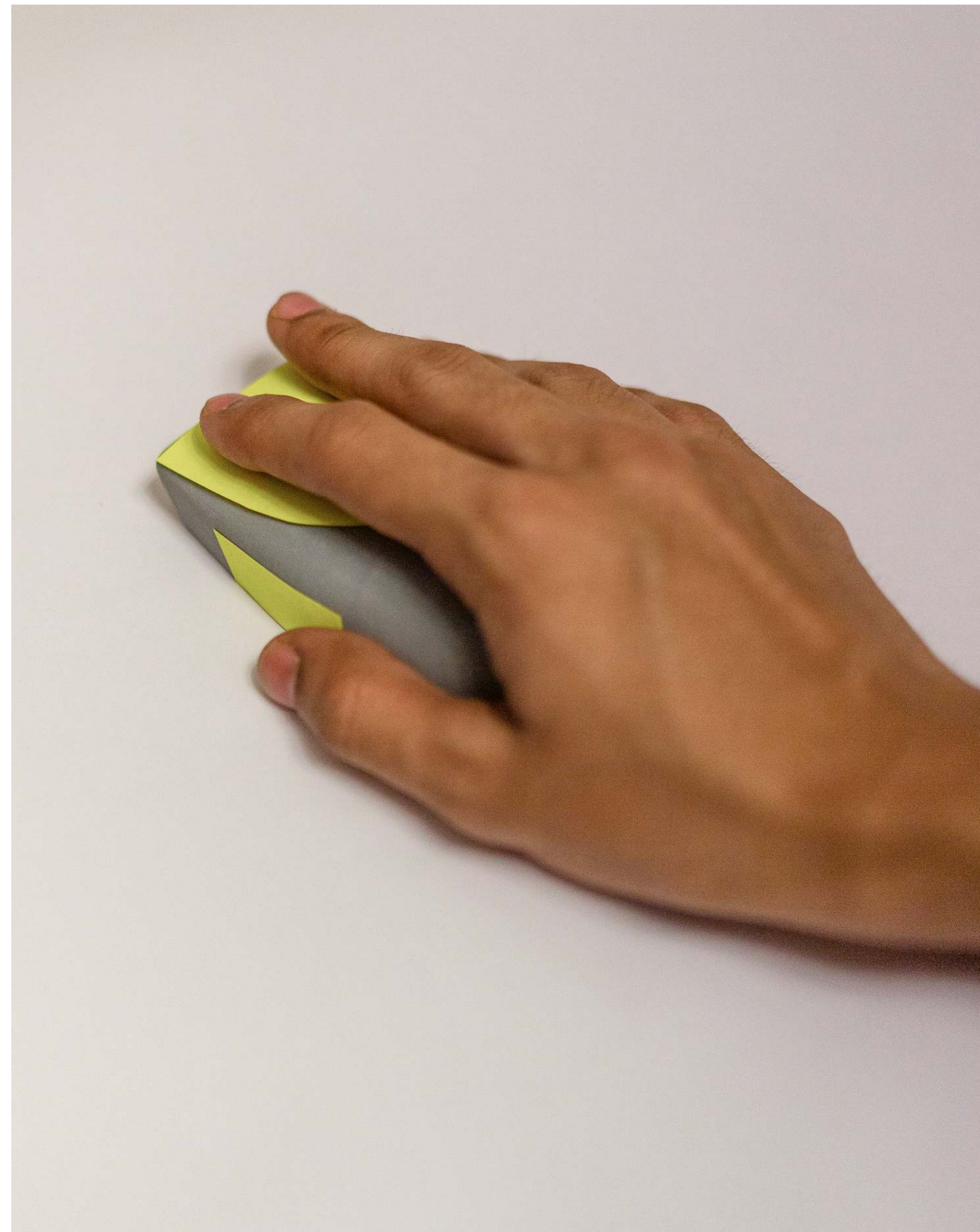


// Concepts



One main and two
side facing side touch
sensors

// Concepts

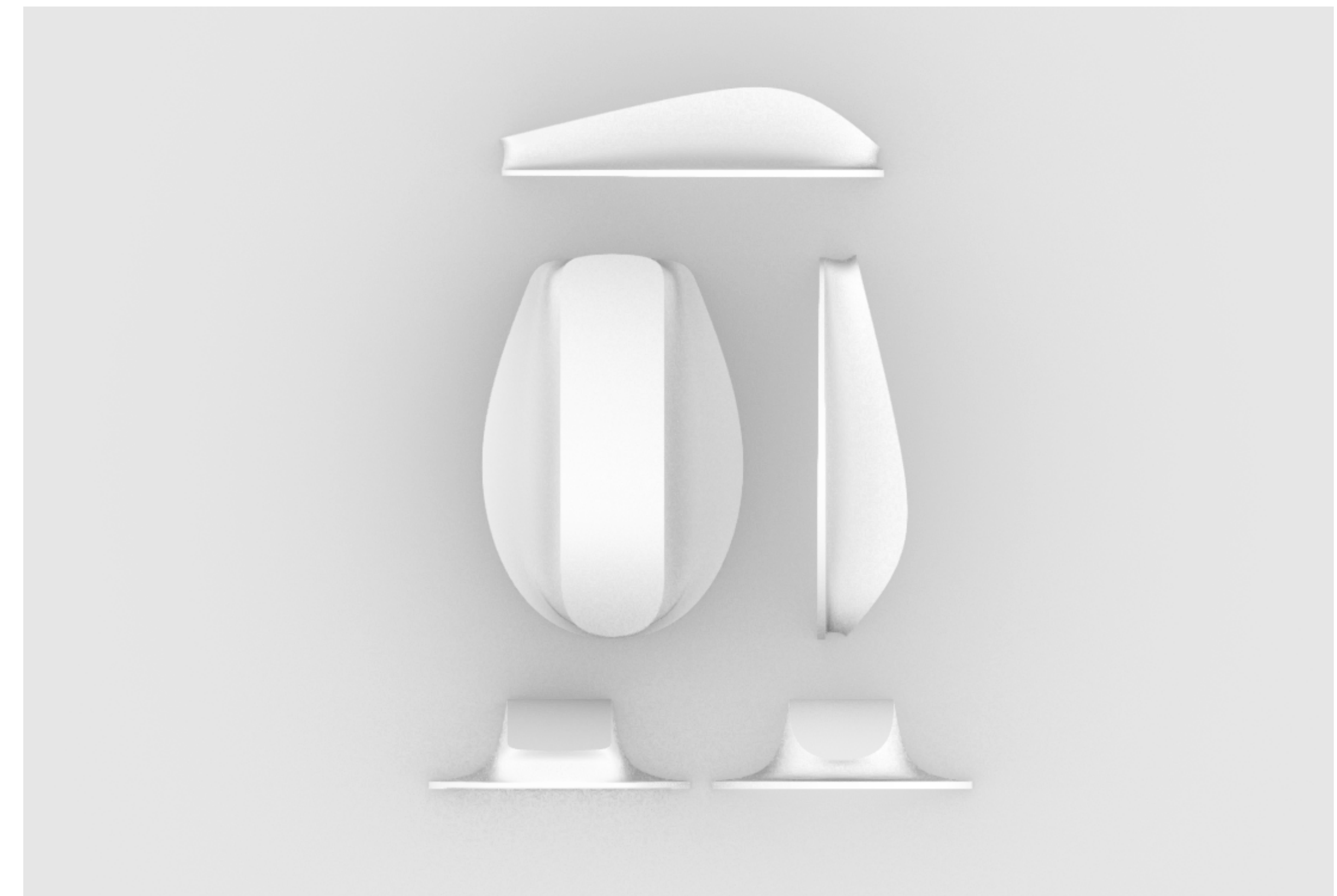


Details

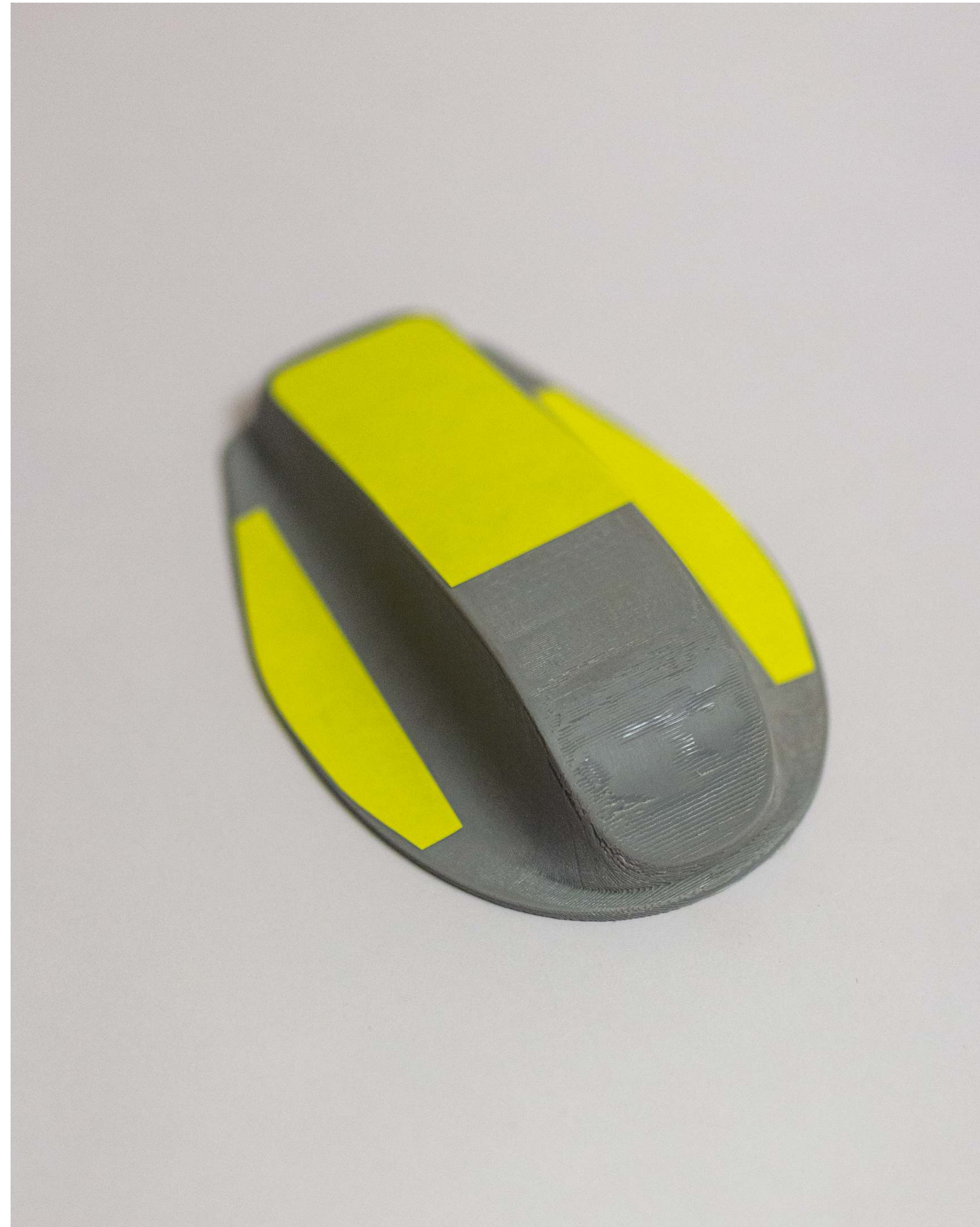
- 1-3-1 or 1-2-2 grip
- Partially / fully touch based
- Tactile main button / haptic main button
- Buttons / Tactile markers / gestures for modifiers
- Extension using fingers because side facing sensors

The Crocodile

A blend of a mice designs that provides ample thumb support, support for touch gestures with a touchpad on top which can also physically click, and an ambidexterous form. This mouse will have one tactile main button under the touchpad which can lock when in fingerspelling mode. There is place to rest the thumb, ring and pinky fingers with touch sensors on the resting place for fingerspelling.



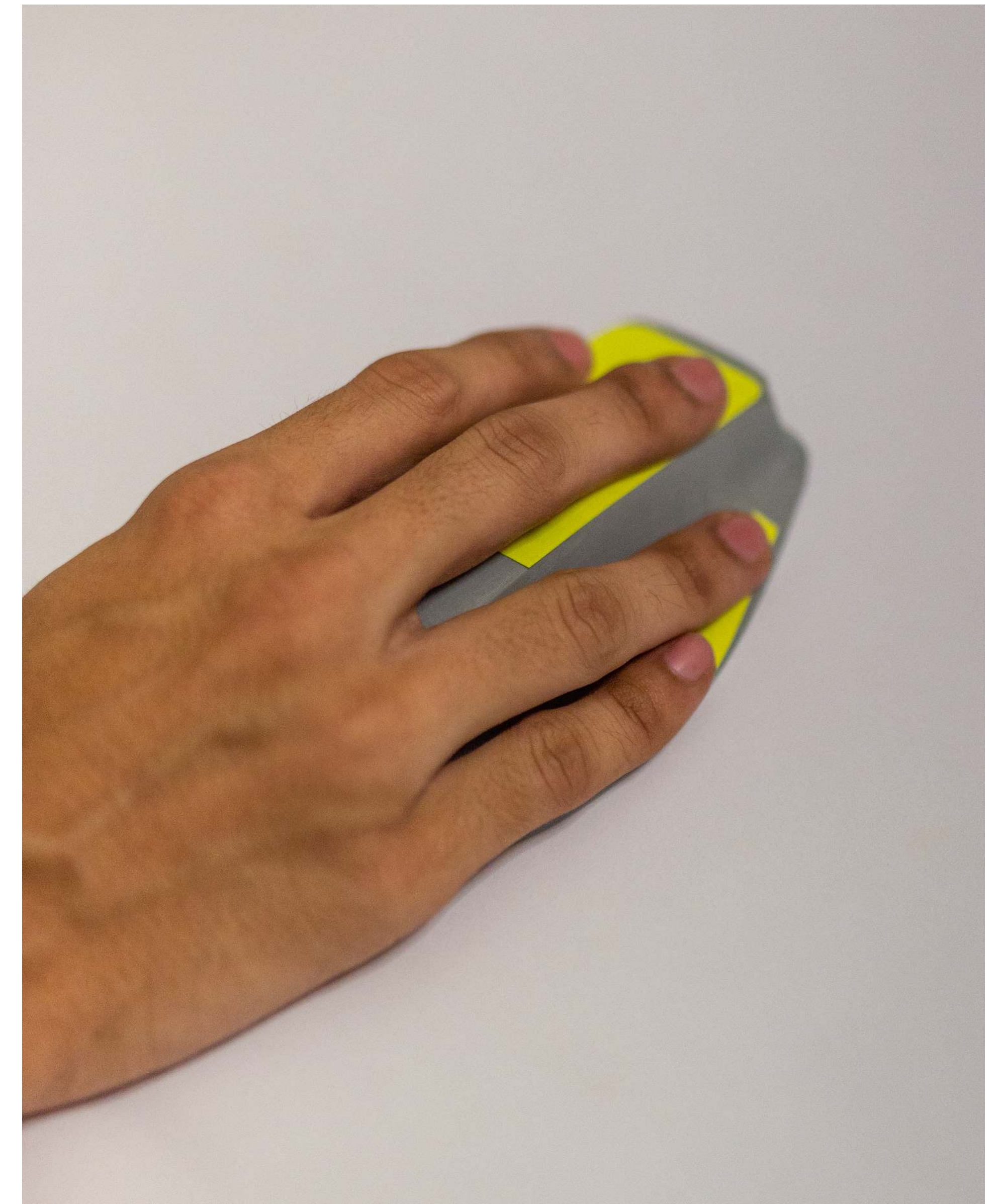
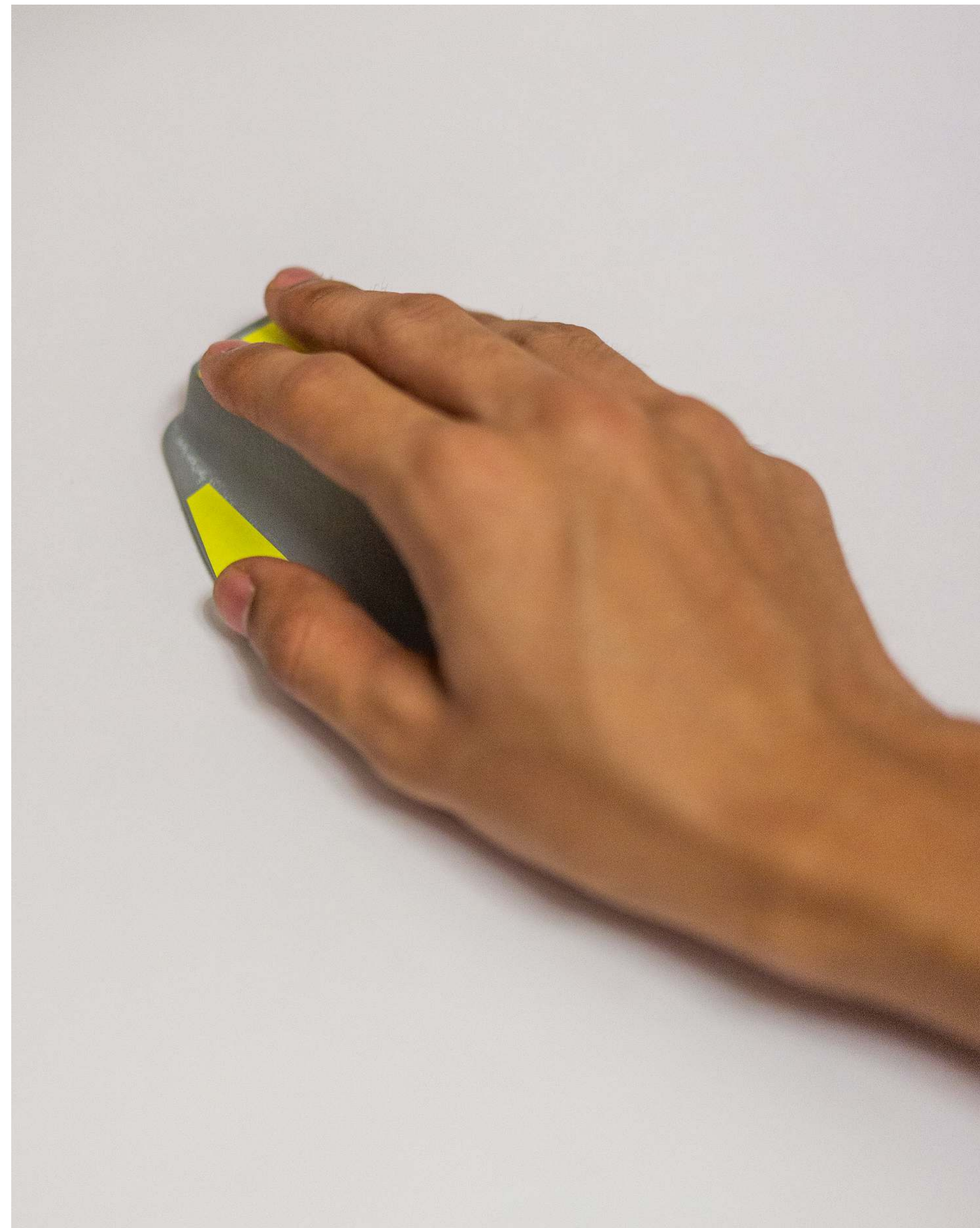
// Concepts



One main and two
upward facing touch
sensors

Central touch sensor
for touch gestures
and side touch
sensors for
fingerspelling

// Concepts



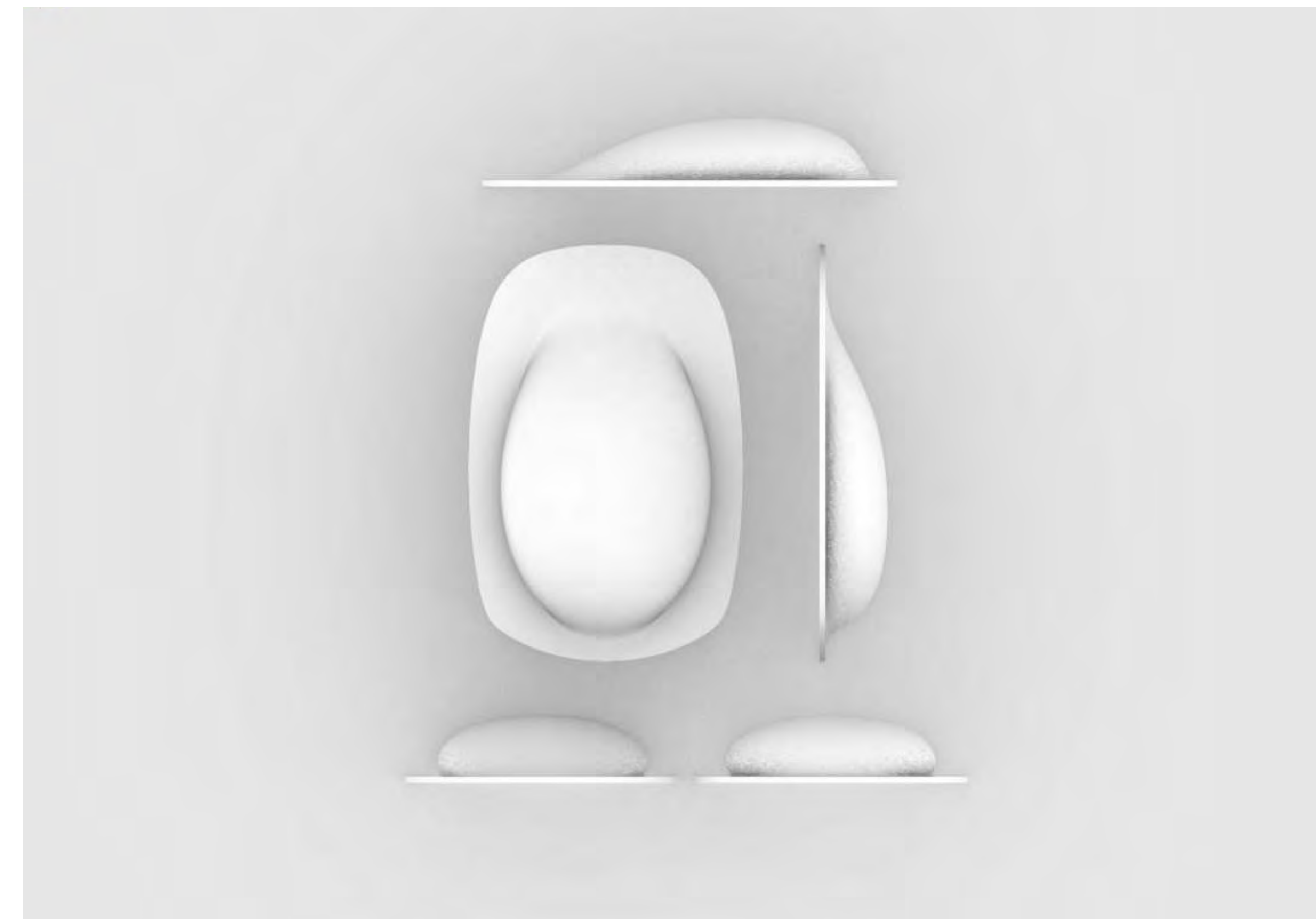
Details

- 1-3-1 or 1-2-2 grip
- Partially touch based
- Tactile actuation for main button with haptic feedback
- Tactile side buttons or haptic markers / gestures
- Extension using wrist because upward facing sensors

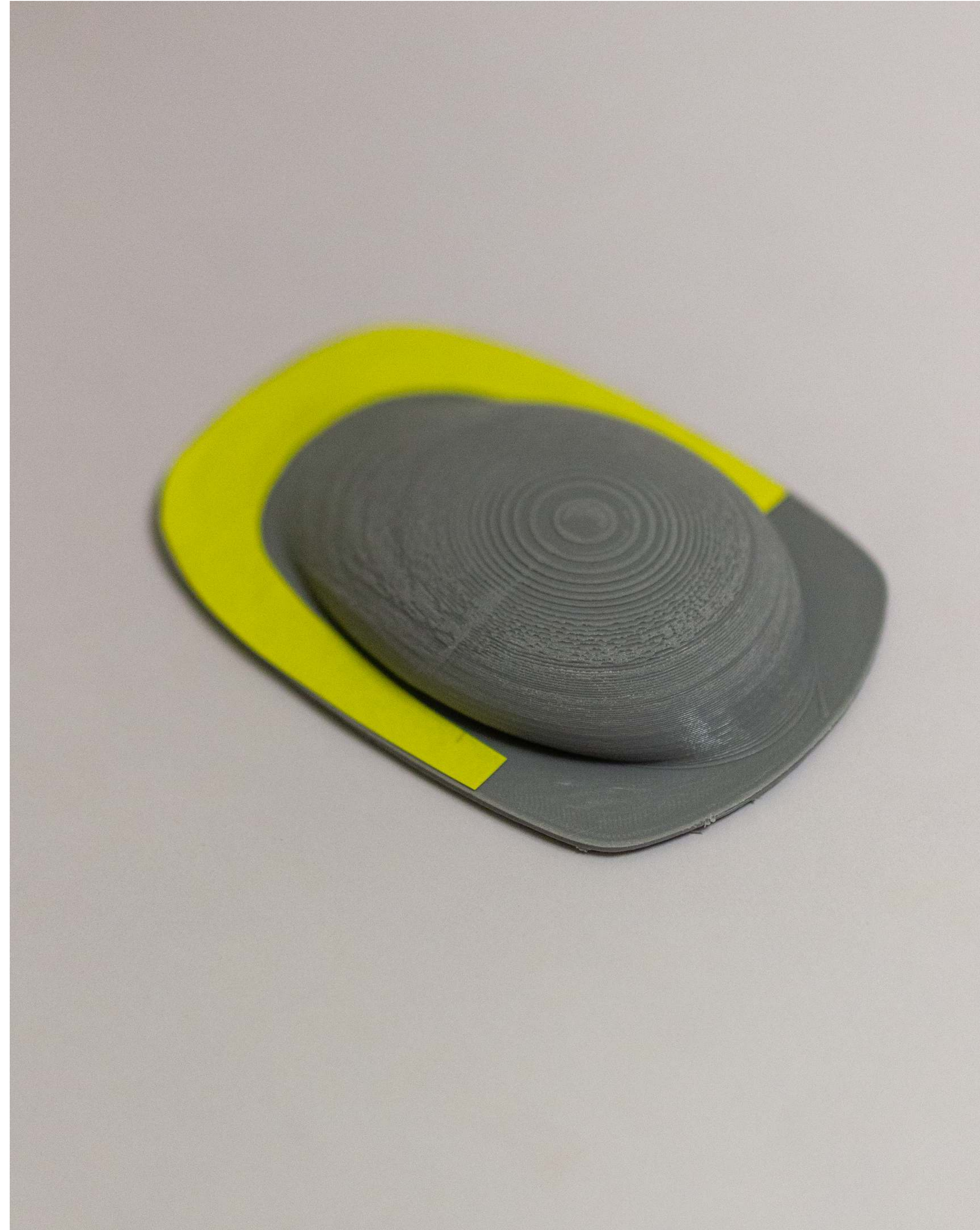
// Concepts

The Mushroom

A mouse that is more like a movable trackpad. A single U shaped touch sensor that goes from the thumb to the pinky fingers. The user can force touch to press main buttons and receive haptic feedback or do tapping fingerspelling gestures like a touchpad. There is ample interdigital pad support and based on the size, palm support as well. Cheap to manufacture because of less moving parts and a simple touch sensor.

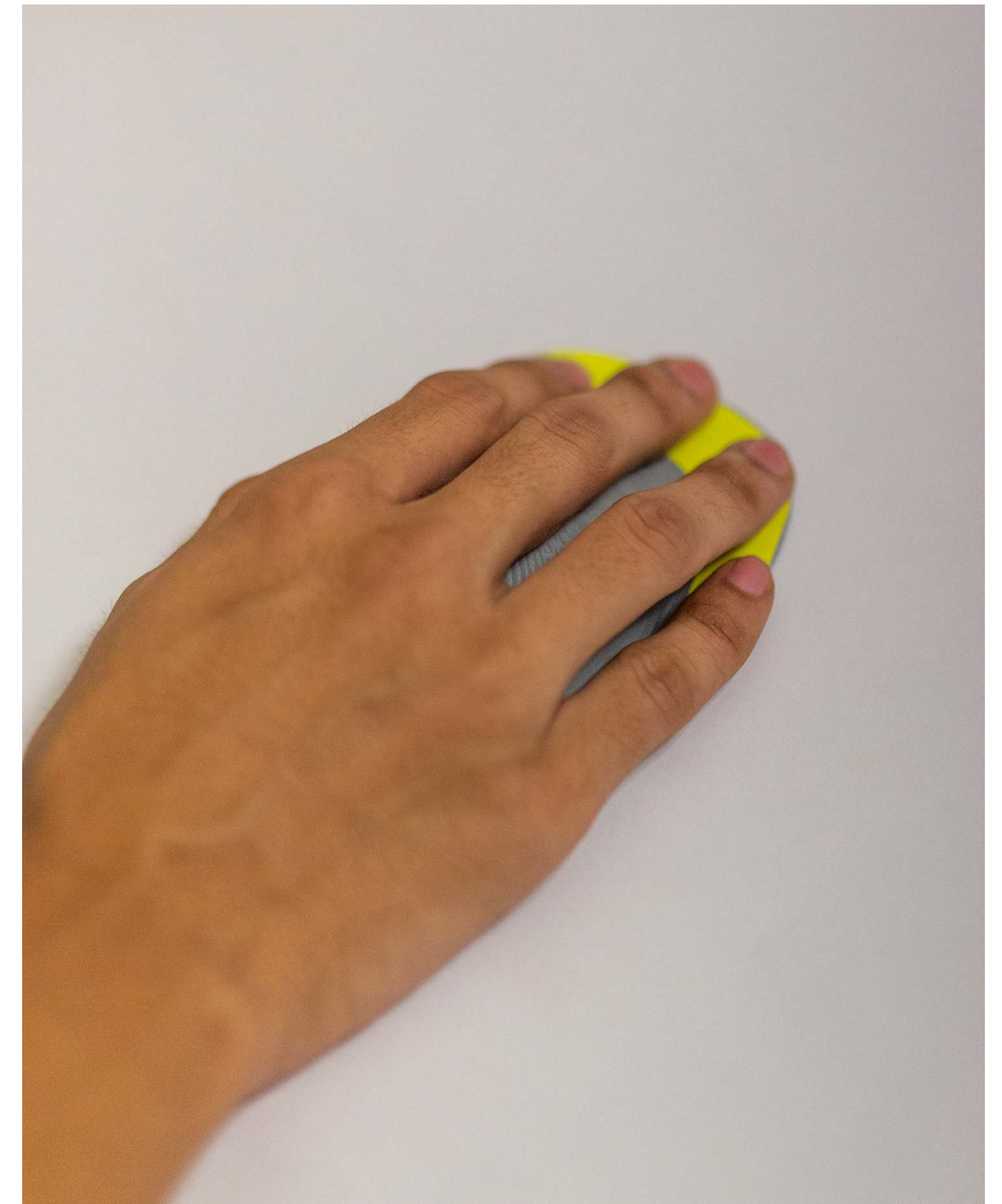
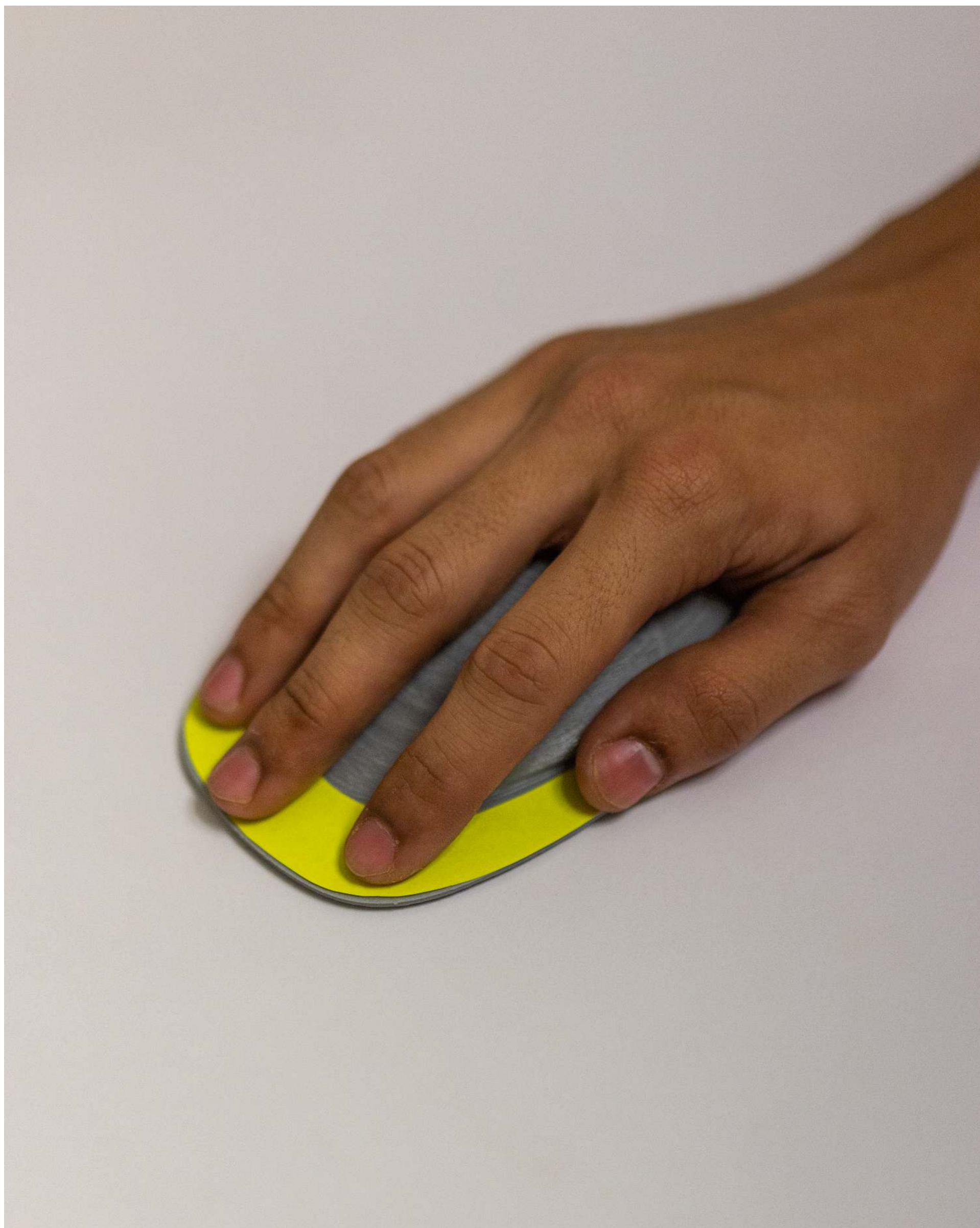


// Concepts



Single U-shaped
upward facing touch
sensor

// Concepts



Details

- 1-3-1 grip
- Fully touch based
- No main button, touchpad with haptic feedback
- No side buttons, modifier keys using gestures
- Extension using fingers because of palm support

Scope

This project can further lead into full industrial design of either of the concepts in this exploration. Due to time limitations, this exploration leaves the design detailing and usage of anthropometric measurements for the four concepts for the possible future.

All product images belong to their respective owners.