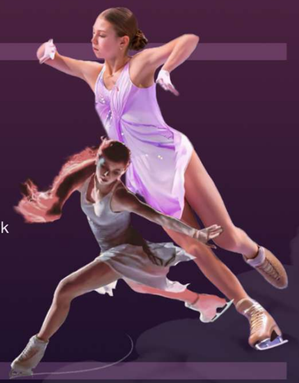
GLIDESYNC

Wearable Tech | App Design | Product Design

Inspired by entering the world of figure skating as an adult, this project stems from the challenge of remembering intricate movements during training. To transform these abstract skills into something more intuitive, I designed a compact device that attaches to ice skates, capturing curves, glide paths, and subtle shifts on the ice. Paired with an Apple Watch app, it visualizes each practice session, helping skaters rebuild their memory of movement through clearer, embodied feedback. By turning every glide into a traceable, learnable experience, the system supports a more confident and immersive journey of growth on the ice.

2 Months | Individual Project

INSPIRATION

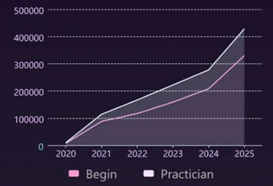


Beginning figure skating in adulthood made me aware of the sport's complexity and subtlety. The frustration of repeatedly forgetting movement details during training revealed that the learning challenge goes beyond technique—it lies in how the body and memory connect.

This experience inspired my interest in interactive learning assistance. By using technology to visualize abstract skills, I aim to create a more intuitive link between movement and memory, allowing each glide to become a more confident and immersive learning experience.

BACKGROUND RESEARCH

What Are The Current Trends Among World Skaters?



- **Population base is large**

The global figure skating community has been steadily expanding.

- **High proportion beginners**

Among them, over 90% of the newly added skaters are beginners and experiencer.

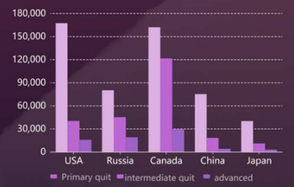
- **Dissemination area**

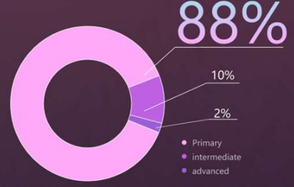
In more than forty countries and regions, the number of people experiencing is increasing.

Why Skating Attracts More And More People?

- **Accessibility**
  - Basic skills are easy to learn and the cost of trying them out is low.
  - Renting ice skates is much cheaper than buying them.
- **Entertainment**
  - Ice skating photography is beautiful and offers good experience.
  - Friends can go skating together and strengthen their social bonds.
- **Convenience**
  - Territory expansion: Many commercial ice rinks are in the shopping mall.
  - Ice rinks are mostly located in the city centers where the population density is high.
- **Universality**
  - The old man likes to use skating as a form of exercise.
  - Children's skating for entertainment and making friends

How Many Of The Participants Persisted In Skating?





- **Few Advanced Skaters**

In countries where ice skating is widely popular, the majority of people give up at the beginner and intermediate levels.

- **Initial Stage**

Over 88% of those who engage in continuous training abandon their practice at the beginner or intermediate levels.

- **Numerous Difficulties**

Beginner skaters encounter complex problems. The most important problems are setbacks and injuries.

What Caused The Skater to Give Up?

ECONOMICS

The cost of long-term training is high.

INJURE

Prone to falling or getting serious injured.

SITE

Professional ice rinks are located in the suburbs.

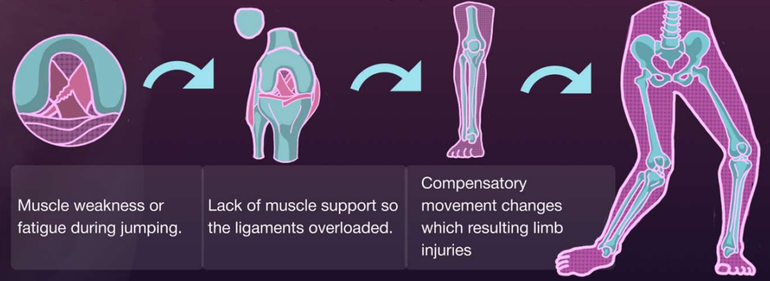
Frustration

It is difficult to advance to a higher level.

What Caused Frustration

How Figure Skating Movements Lead to INJURE

How Improper Movements Lead to Injury ? -Take ligament injury as an example



Muscle weakness or fatigue during jumping.	Lack of muscle support so the ligaments overloaded.	Compensatory movement changes which resulting limb injuries

Which Actions Are Prone to Causing Injury?

- **Jump**

35% of the skaters have experienced sprained ankles during their learning process of the "Toe loop".

- **Spin**

Changing the blade angle during rotation is a necessary technical condition.40% of the skaters performed incorrect rotations and blade changes.

- **Sking Steps**

90% of the skaters have problems with blade changes during their skating steps.

CONCLUSION

If the equipment can reduce "the boredom of training", "the sense of loneliness during practice", or enhance "the visibility of personal progress", it may help to reduce the cases where people give up due to low motivation or strong frustration.

When designing assistive tools, incorporating mechanisms such as immediate positive feedback, progress visualization, and action decomposition - step-by-step, can alleviate the risk of "giving up because it's too difficult".

CASE STUDIES

PROFESSIONAL ATHLETE

• Technical pressure & bottleneck anxiety

Amber Glenn

Age: 26
Occupation: Athletes
Goal: Improve performance

Background

- The technical requirements are high, the difficulty of the movements is increasing.
- The training environment is highly stressful: intense competition.
- High risk of injury. Having strict requirements for physical condition

Influence

- High pressure due to skill limitations
- Repeated minor injuries disrupted training.

Painpoint

- Scientific growth curve records to help observe “actural progress.”
- Monitoring system for reducing injuries.

INSTRUCTOR

• Lack of efficient technical communication tools

Eteri Tutberidze

Age: 51
Occupation: Instructor
Goal: Improve teaching specificity

Background

- High standards are required for teaching methods and strategies.
- The ice rink environment is noisy, but continuous observation is necessary.
- The course schedule is irregular, so the trainer needs to prepare plans.

Influence

- There is a lot of repetitive work
- Progress records are disorganized.

Painpoint

- Visualization technology explanation tool
- Help to uniformly record the phased data

ADULT BEGINNERS

• Lack of long-term motivation & sense of achievement

Camille Annison

Age: 21
Occupation: Student
Goal: Leisure and entertainment, exercise for shaping the body

Background

- Most people started practicing for the sake of interest or fitness, but the learning time was affected by work.
- After reaching adulthood, one's physical conditions become weaker.
- Encounter a "period of setbacks before reaching the breakthrough point" during the learning process.

Influence

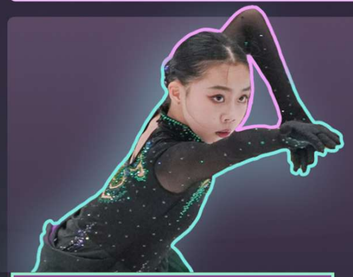
- Slow learning speed leads to self-doubt
- Lack of training planning, not knowing what to train

Painpoint

- Help establish the mechanism of "self-motivation / interest maintenance"

SKETING CHILDREN

• Mental stress & Technical anxiety



Amber Glenn

Age: 14
Occupation: Intending to become an athlete
Goal: Achieve professional standards

Background

- Parents decide whether to train, and the child's own interest is prone to fluctuate.
- Training and study time are prone to conflict.
- During the stage of physical development, the core, balance and strength are unstable.

Influence

- High level of novelty, but prone to boredom
- Limited execution ability

Painpoint

- Gamification methods enhance training interest.

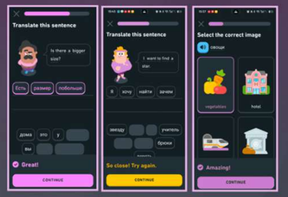
BENCHMARK

FEATURE 1 - Skill Recognition & Breakdown

Motion Data Capture: The participants run on the instrumented treadmill while multiple sources of data such as ground reaction force, motion trajectory.

Objective Action Evaluation: provides people with an objective standard for determining whether their movements are correct, rather than relying on "feeling".

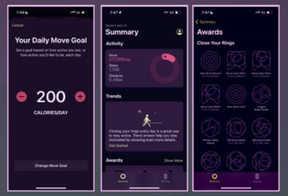
FEATURE 2 - Gamification



Incentive System: Employing gamified challenges to motivate users, thereby immersing them in the sense of accomplishment derived from progress.

Level Adaptation: As the users' abilities improve, new levels of content and difficulty are added.

FEATURE 3 - Personalized Training Path



Track Athletic Performance: Help individuals gain clear insight into their current condition to facilitate future progress.

Badge System: Motivating users to stay active and encourage them to keep exercising

FEATURE 4 - Rhythm-Synced Feedback System

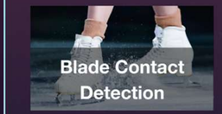
Rhythm: Enable users to familiarize themselves with the track in advance and integrate the music into their movements.

Musicality: Enable users to experience the emotions within the music and enhance the artistic expression.

DESIGN CONCEPT

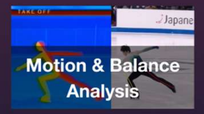
OVERVIEW

Wearable Vest



1. Real-time detection of the angle changes of the inner edge, outer edge.
2. Record the blade contact deviation and transmit it to the App.
3. Provide an assessment of movement stability.

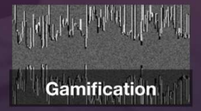
1. Give a warning signal for the preparatory imbalance.
2. In the action learning mode, synchronize "rhythm cues"
3. Support customizing the intensity of prompts.



1. Monitor jumping, rotating and walking movements.
2. Evaluate the stability of the ice floe and the drift of the rotation center.
3. The system automatically provides real-time recognition data

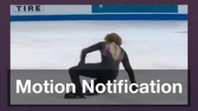
Applicaion

1. Visualize and display the changes in the cutting edge angle.
2. Generate training report: technical trends, error patterns, progress trajectory.
3. Provide technical suggestions based on blade contact data.



1. Each designated action is associated with a music segment. When the user successfully completes the action, the App will immediately play the corresponding musical element.
2. Action Missions：Set up multiple difficulty levels for action tasks.

1. The app provides rhythm guidance based on sensor data
2. Users can select songs and "perform the entire piece" by achieving the required level.
3. It can output actions with music matching diagrams as an auxiliary tool for choreography.



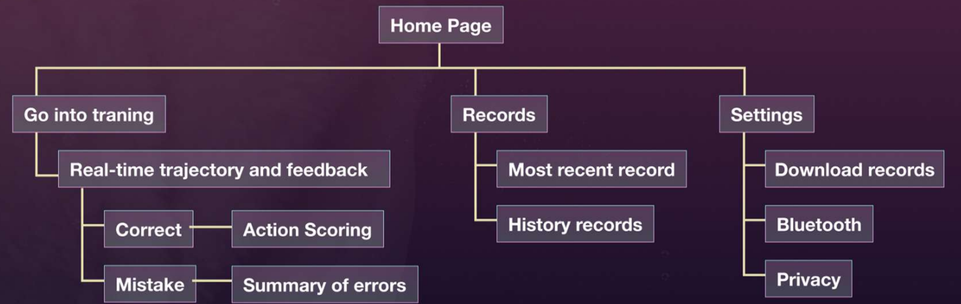
1. Monitor abnormal impacts, imbalances, sudden stops, and record incidents of falls.
2. Remind the user to pause the game mode and take a break when they are in a high fatigue state.
3. A vibration alert is triggered to enhance the safety.

STORTBOARD

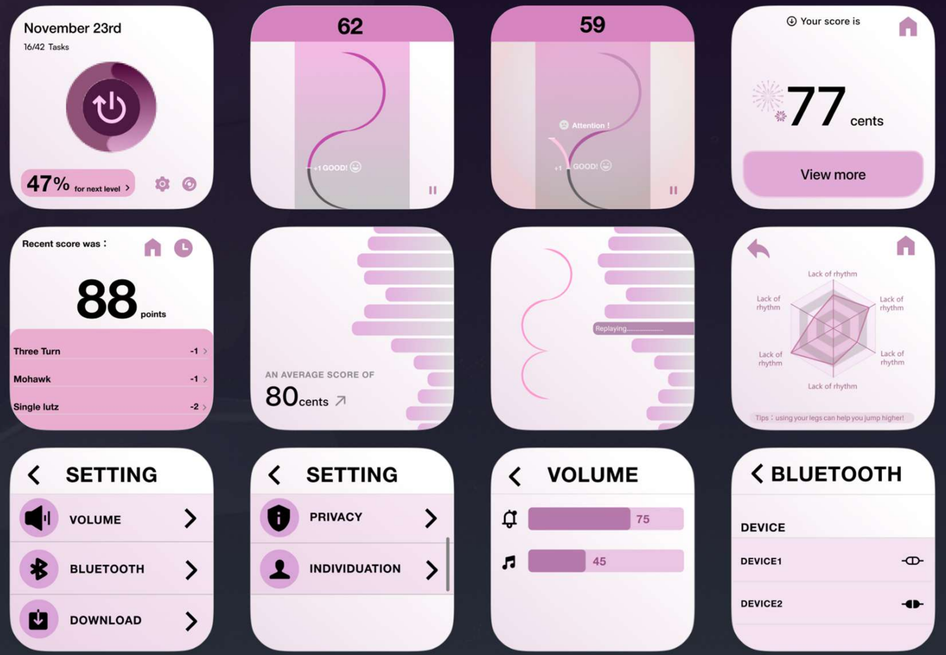
The user prepares to start their skating practice, opens the app, reviews their last session's record, and then taps to begin recording.

The wearable vest records gliding trajectories and uploads them to the app, facilitating user learning.

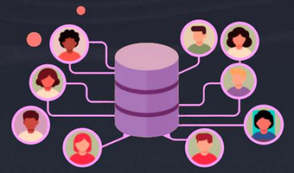
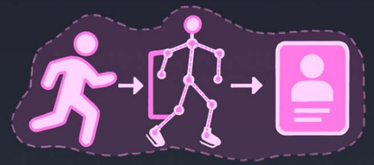
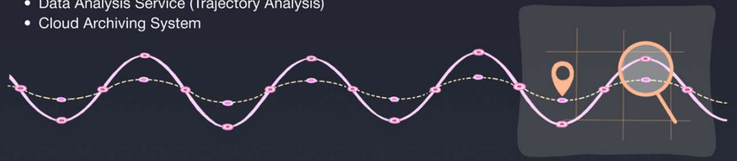
INFORMATION ARCHITECTURE



APP DESIGN



SERVICE BLUEPRINT

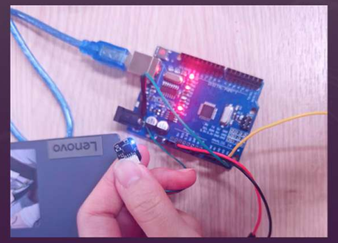
	Before skating			During skating			After skating	
Evidence	App main interface	Device pairing interface	Course selection, training mode configuration	• Put on the equipment and activate the sensor.			Training Completion Interface	Personal Ability Analysis Report
Customer Actions	• Open the app and view the training plan for today.	• Connect wearable devices	• Select the training mode and start	• Make movements according to the music • Correct the action according to the instructions			• View the training summary	• Check their problems
Line of interaction								
Front stage Actions	 • The app automatically detects the connection status of the device.	 • Display sensor calibration guidance	 • Display the level tasks and action goals	 • Start training / Start gamification tasks	 • Real-time display of posture data visualization: stability curve, rotation direction.	 • The game UI provides immediate feedback: vibration and music cues alert users to correct their posture.	 • Display the training duration, completion rate and score	 • View the playback of the dynamic trajectory	 • Generate an automatic summary report
Line of Visiblity								
Backstage Actions	• Equipment status monitoring • Download the action templates required for training	• Obtain users' historical data for personalized recommendations	• Load game level parameters (for example, determine if the level is cleared based on "blade inclination stability")	• The posture algorithm is running. • The game engine determine whether the actions meet the requirements.		• Real-time transmission & cleaning of IMU data • Package and upload the original IMU data to the cloud.	• Package the original data and upload it to the cloud. • The model automatically generates "performance analysis of actions"	• Update the user's long-term capability curve • Adjust the difficulty of the next task based on the performance of this training session.
Supporting Systems	• User database • Action model library (Edge Detection Models, Spin Models) • Device pairing system (Bluetooth / BLE connection) • Game Task Configuration System			• Action recognition algorithm (Edge Tracking Model + Stabilization Model) • Game logic engine • Data processing service (Posture filtering, Noise suppression) • Cloud archiving system			• Data Analysis Service (Trajectory Analysis) • Cloud Archiving System	

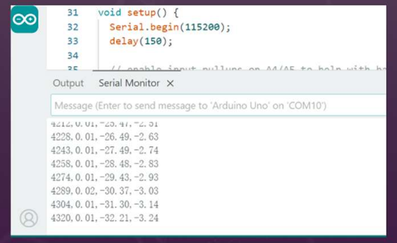
PRODUCT DESIGN

Sensor Testing

Angle sensor - MPU6050

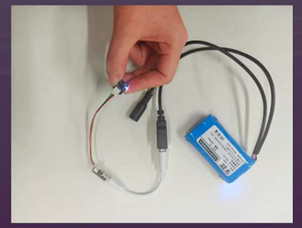
Rotate the MPU6050 module, and four numbers will appear on the window, namely Time, Pitch, Roll, and Yaw.

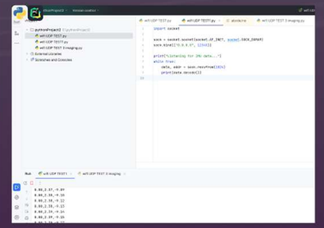




Remote Module - XLOT-Mini-C6

Disconnect the USB power supply, add UDP transmission in the code. The ESP-C6 board will transmit the angle data to the computer, which will be received by the UDP code in Python.





Testing Process

USB connection for the XLOT-miniC6 motherboard

Connect the same Wi-Fi environment

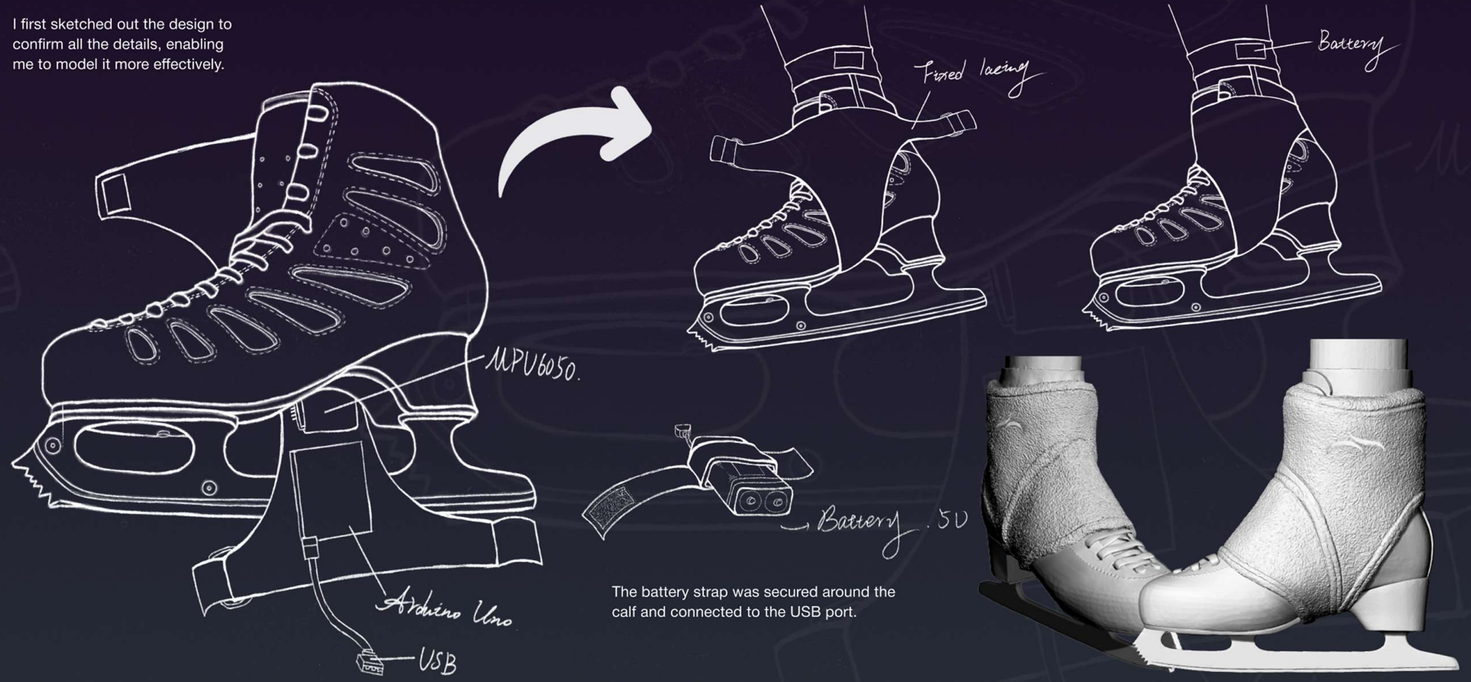
Accept UDP

Reference

We need to capture the movement of the feet, so the measurement module must remain relatively stationary relative to the feet. Therefore, the fixed method of using a rehabilitation ankle brace was adopted.

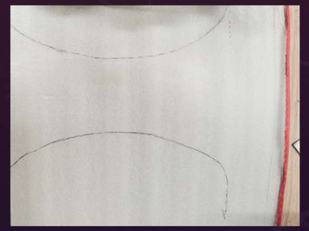
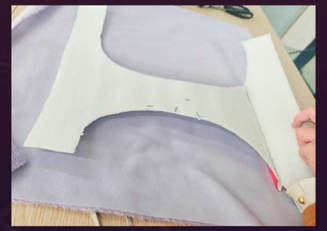
Sketch & Model

I first sketched out the design to confirm all the details, enabling me to model it more effectively.



The battery strap was secured around the calf and connected to the USB port.

FABRICATION


I placed the stitched fabric over the skating shoes boots to test it, ensuring a perfect fit that wouldn't interfere with practice or gliding on the ice.



Based on the measurements taken from the paper template, I cut the fabric and sewed the edges.

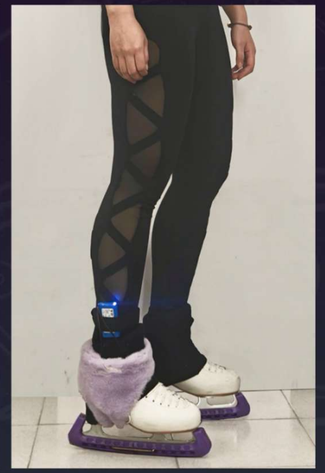


I added hook-and-loop fasteners to the sewn prototype to ensure it could be easily put on and taken off during practice, and the elasticity allowed the product to remain flexible without restricting movement

FUNCTIONAL PROTOTYPE

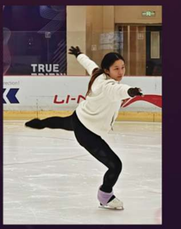






When wearing gloves, I can very easily secure the equipment onto my ice skates, and then I went onto the ice and performed some basic movements.




During on-ice testing, I ensured that the weight of the prototype did not affect technical movements, and it was barely noticeable when worn.

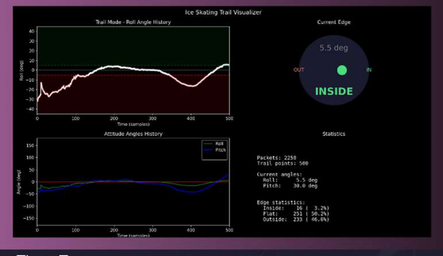
FINAL OUTCOME

Wearable Devices

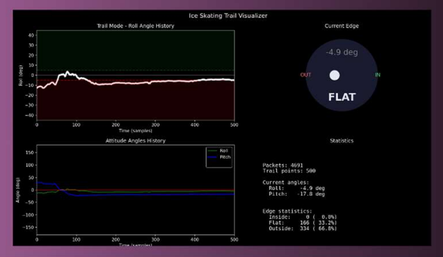
Ice Skating Trail Visualizer

- Below are the angles and inside/outside edge variation curves of some typical basic movements.
- From these angle sequences, the skate blade direction can be inferred, enabling assessment of movement.

- Forward Outside Edge Spiral



- Three Turn



- Lutz jump

USER FEEDBACK

Jia Yuanhang

Basic information

- Adult skater
- Skill level: single jumps, basic turns and steps.

Observation

- During falls, the user instinctively lifted the leg wearing the device to avoid damaging the battery.

Insight

- The presence of the device altered natural falling behavior, increasing cognitive load and safety anxiety.

Shao Wei

Basic information

- Coach, former athlete
- Skill level: triple-jump, advanced turns and steps.

Observation

- During movements, the lower-body technique is corrected but the student subconsciously looks down.

Insight

- While the device helps correct lower-body movements, it lacks detection on upper-body alignment.

Coral

Basic information

- Competitive figure skater
- Skill level: triple jumps, advanced turns and steps.

Observation

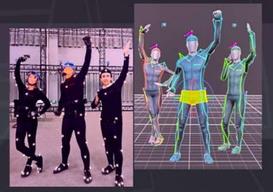
- While using the device, Coral became aware of the exact moments when edge errors occurred.

Insight

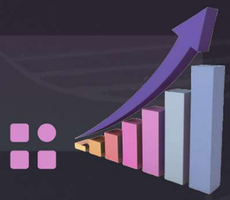
- Precise, moment-based edge feedback helps advanced skaters enhance movement awareness.

FUTURE DEVELOPMENT

1. Reduce safety anxiety by making durability both physical and perceptible.



2. Full-Body Posture & Gaze Awareness System



3. Skill-Level Adaptive Feedback System for different skaters.