Sporty-UP: A Mobile Application for Real-Time Posture Assessment and Feedback in Indoor Sports

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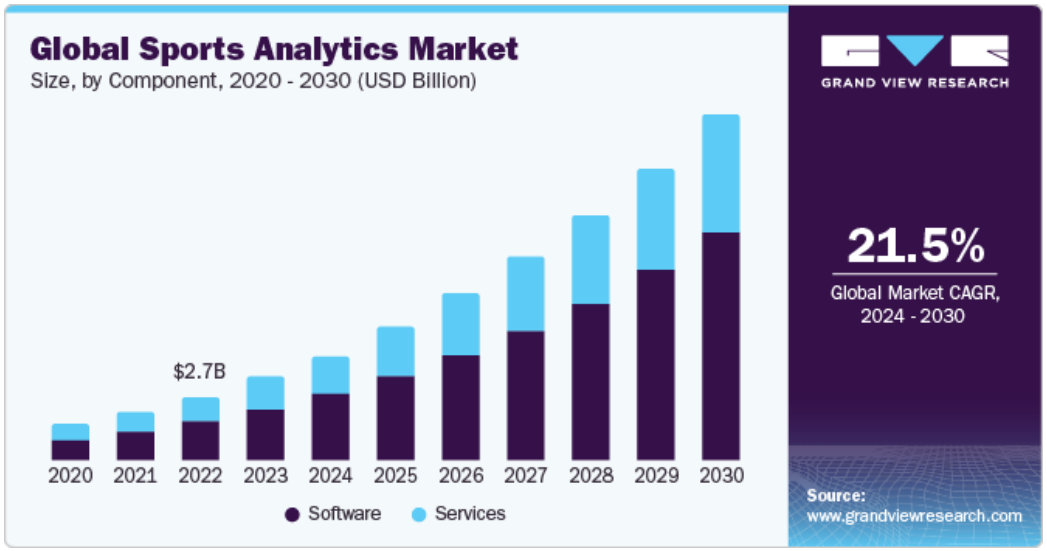
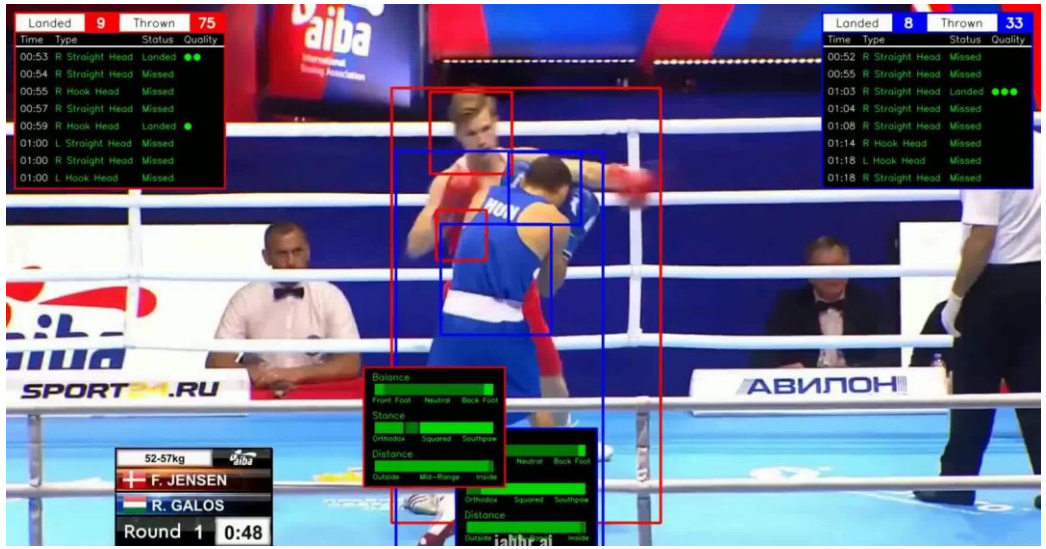
Growth of the Sports Industry and the Rise of Advanced Technologies

- The global **AI in sports** market is projected to grow from **USD 1.2 billion in 2024** to **USD 4.7 billion by 2034**, with a CAGR of **14.7%**.
- AI is increasingly being used for performance analysis, injury prevention, strategy optimization, and enhancing fan engagement.



Global Market Insights – https://www.gminsights.com/industry-analysis/ai-in-sports-market



An AI-based statistical analysis program for combat sports, DeepStrike

Growing Demand for Indoor Sports

- The COVID-19 pandemic has led to a significant increase in interest in **indoor sports**.
- Expansion of Family-Oriented Entertainment Facilities

Indoor Sports Hub Tennis Courts

Richardson's Family Entertainment Centre

Sporty-up : A Mobile Application for Real-Time Posture Assessment and Feedback in Indoor Sports

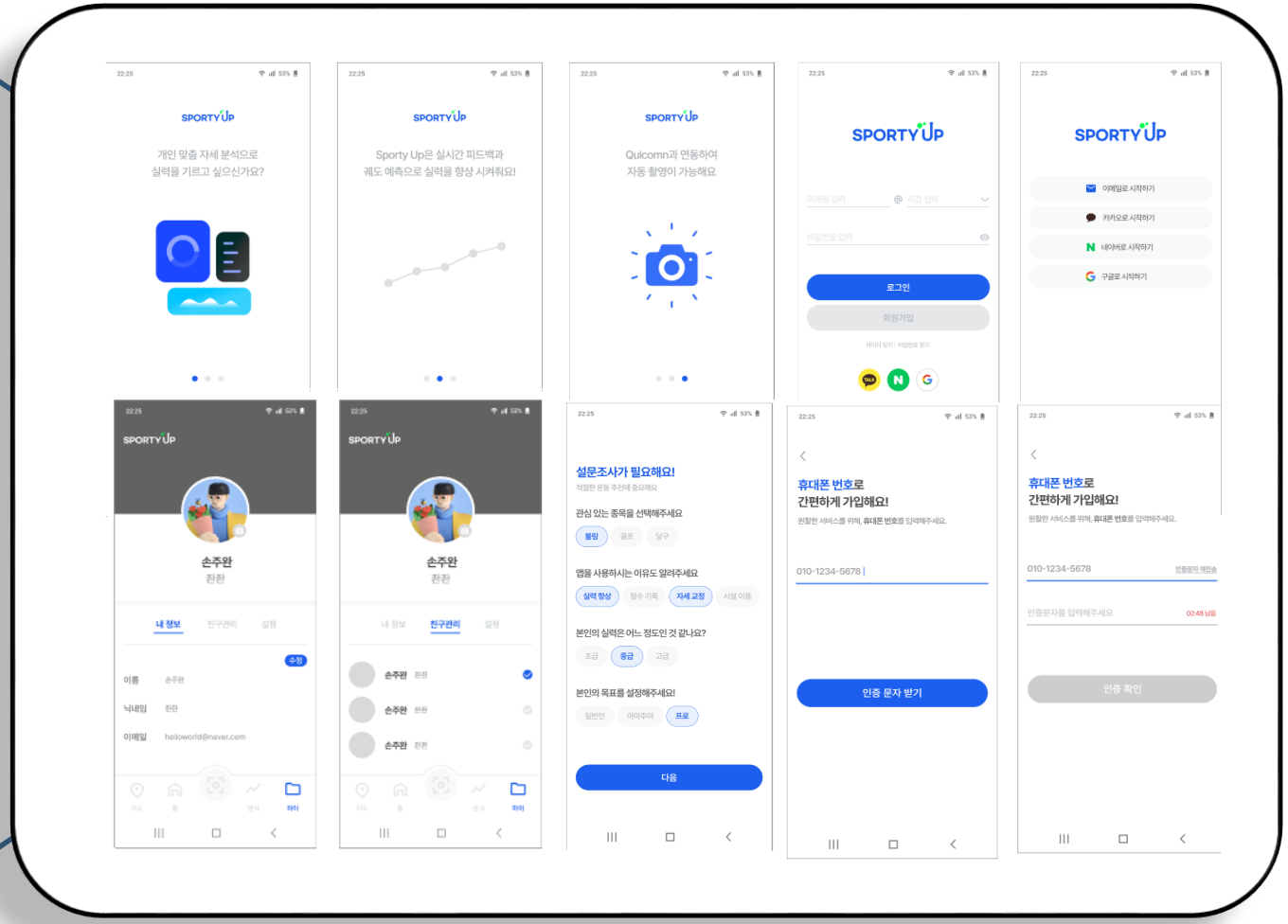
Real-time feedback system for non-experts

Community-driven experience sharing

High-quality feedback through mobile devices

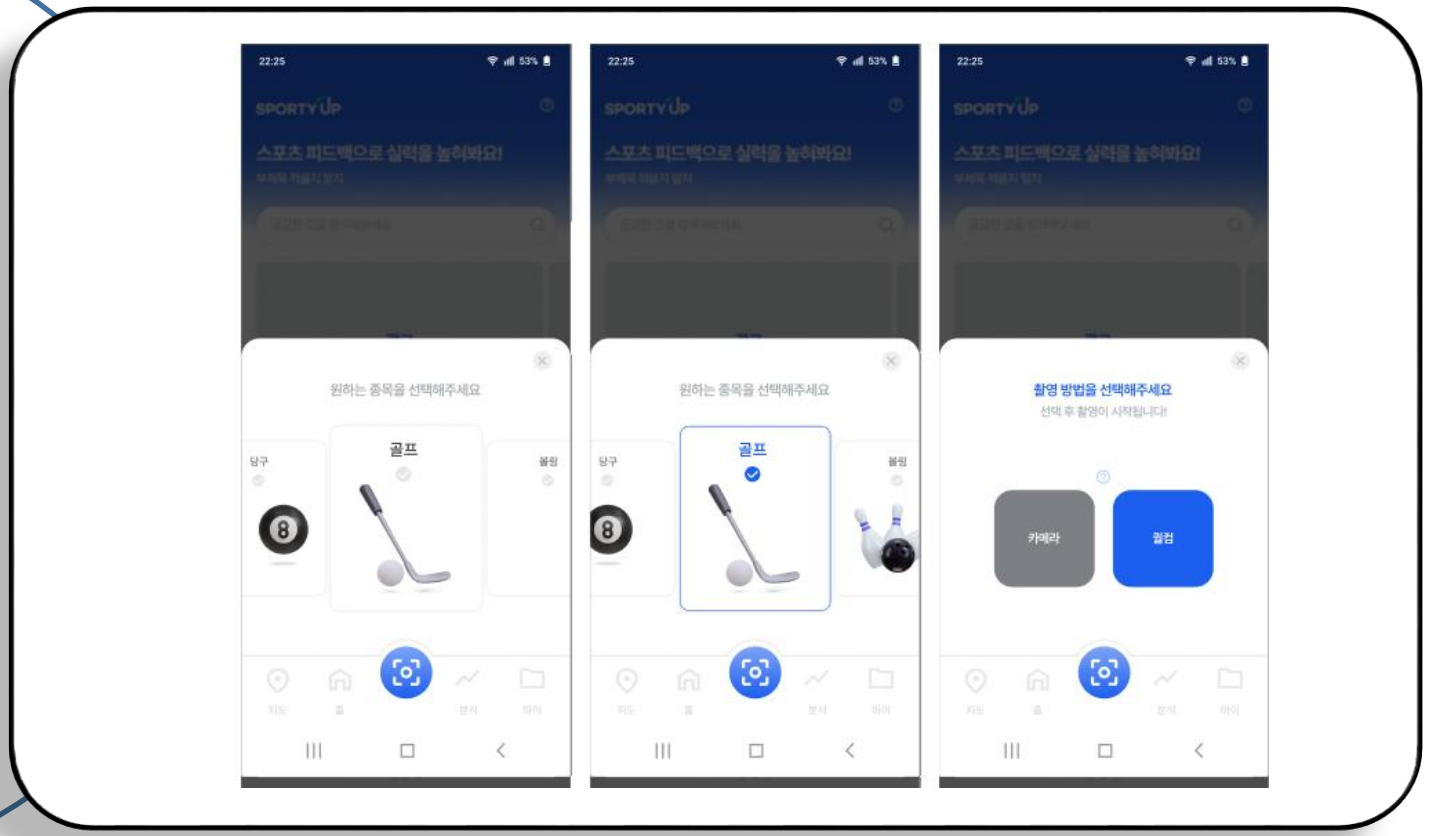
Personal data tracking and visualization

Community-driven experience sharing



Personal data tracking and visualization

Real-time feedback system
& High-quality feedback through mobile devices



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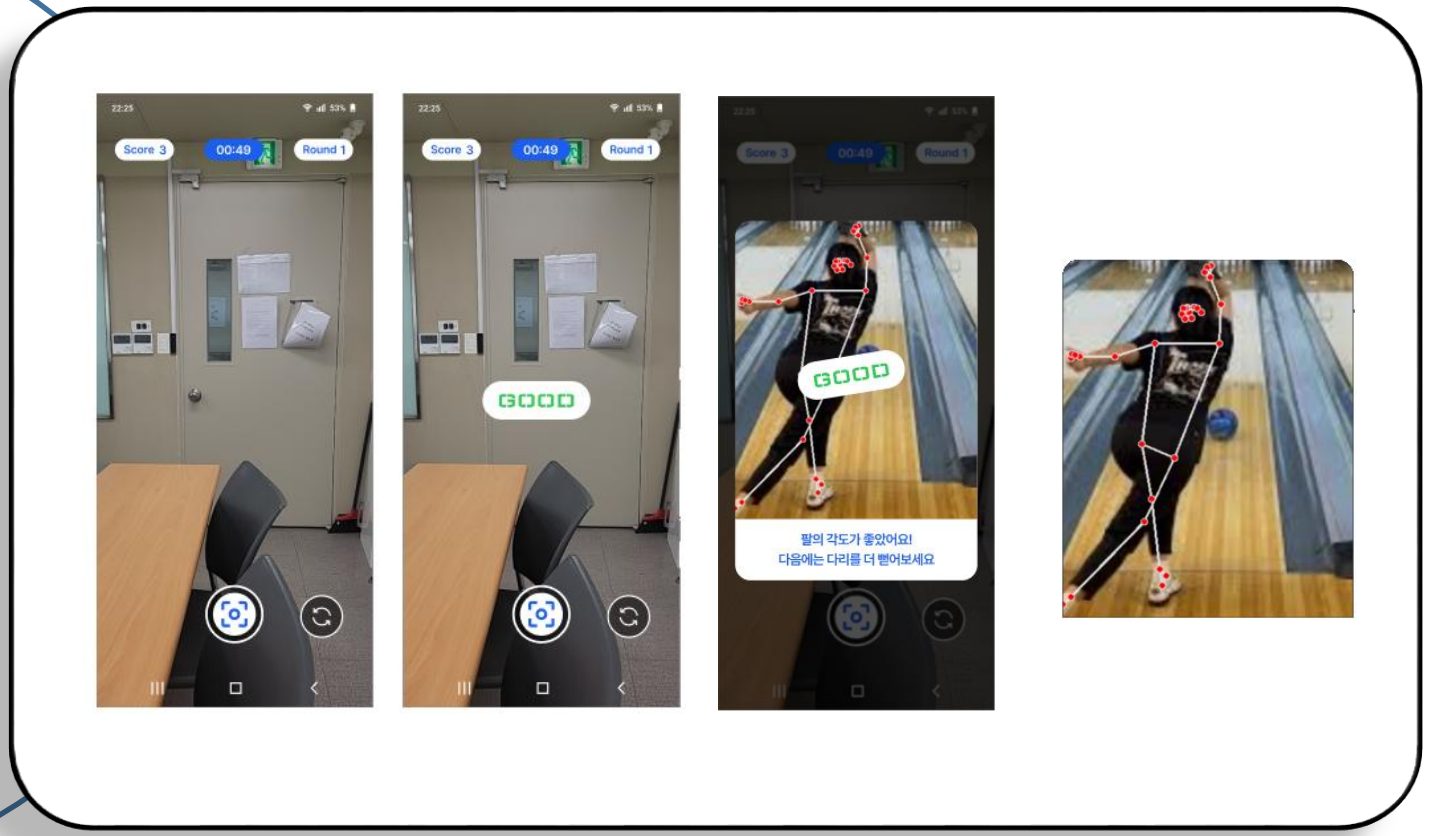

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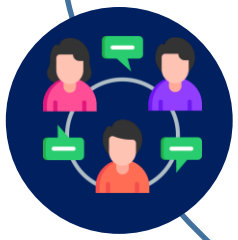
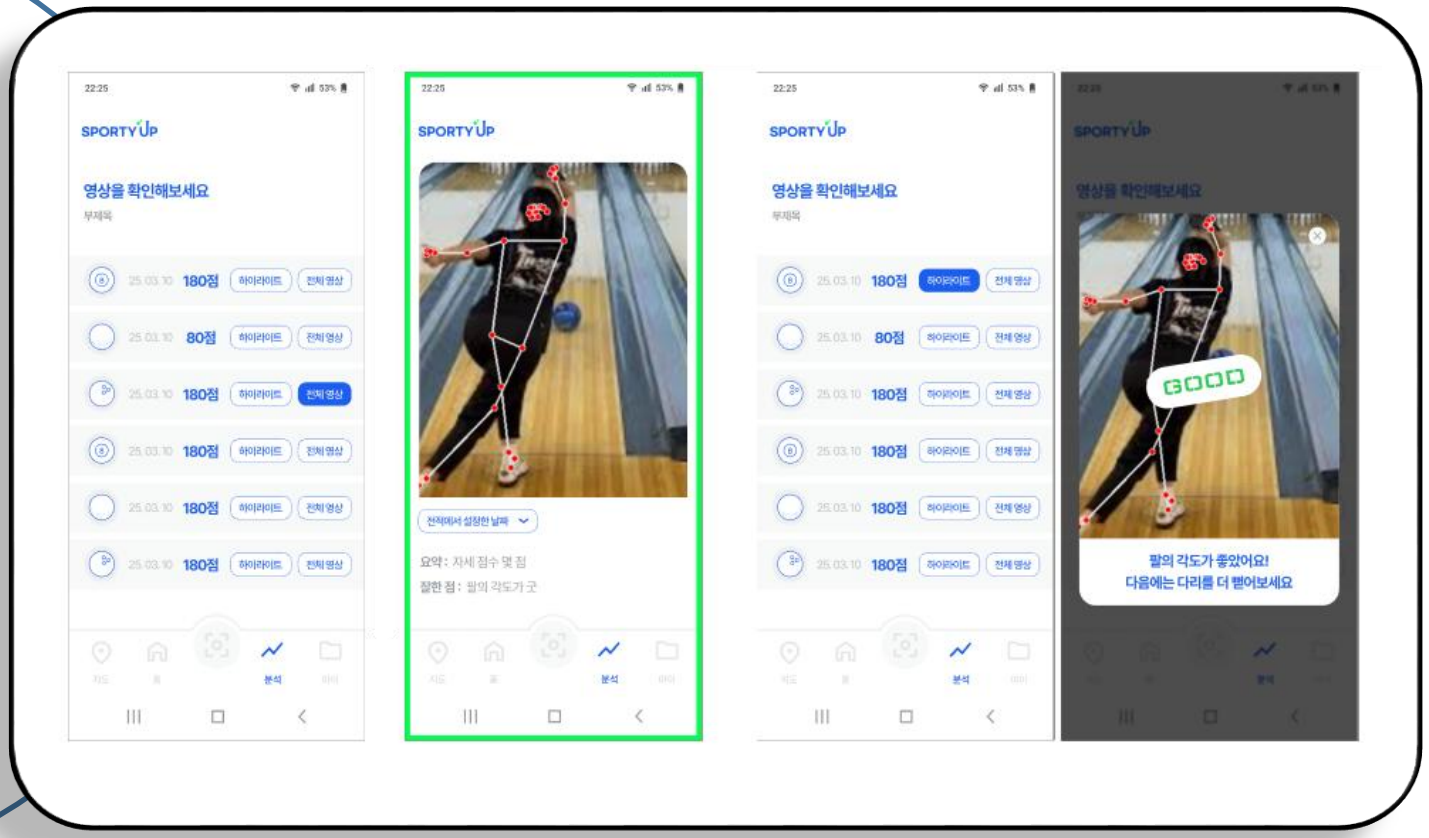




Technical Challenges in Mobile-Based Real-Time Posture Feedback

1

- **Limited computational resources and memory**
  - Mobile devices have limited processing power and memory, making it difficult to run complex AI models effectively.

2

- **Technical burden of real-time processing**
  - Real-time feedback requires both high speed and accuracy, placing significant demands on system performance.

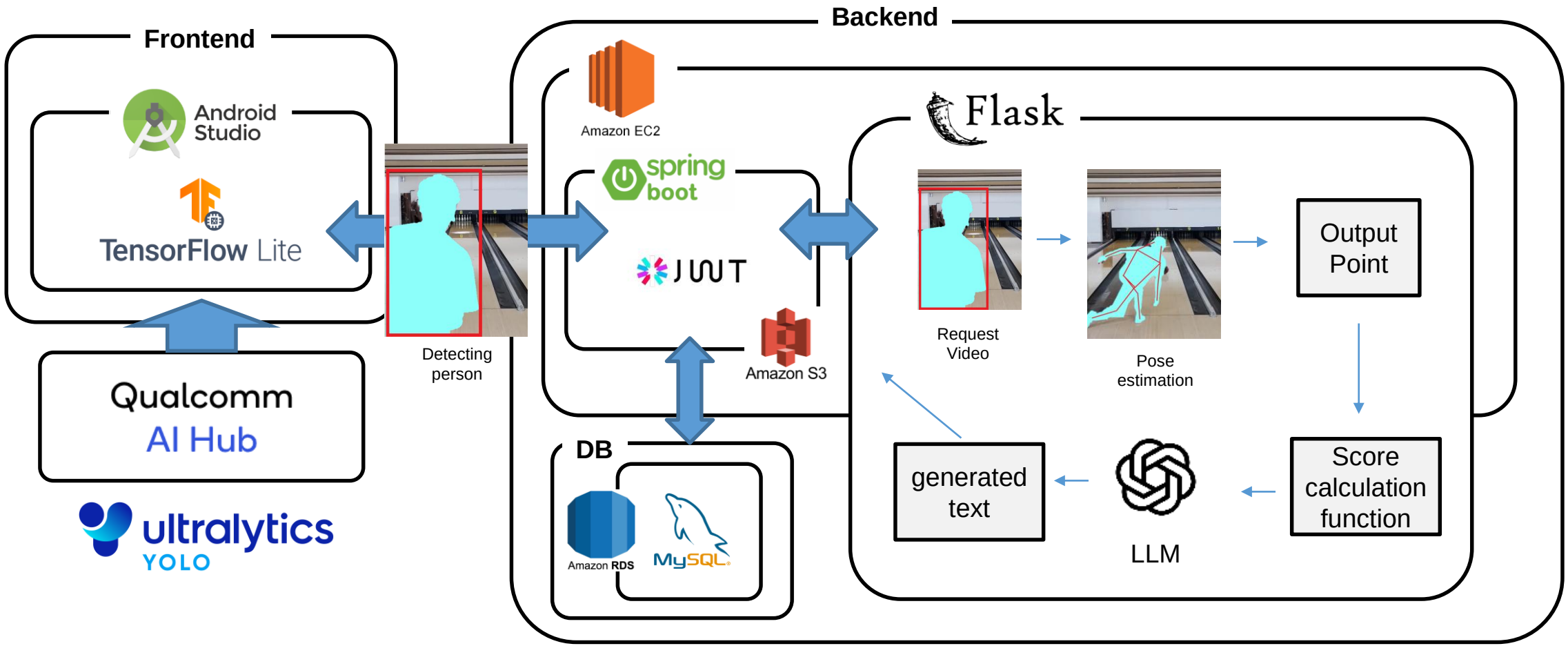
3

- **Inability to handle complex analysis**
  - On-device processing alone has limitations when it comes to performing advanced or high-level posture analysis.

System Design Strategy ① – On-Device AI with Server Integration

- **On-device AI utilization (Qualcomm AI Hub-based)**
  - Automatic determination of real-time capture timing
  - Avoidance of unnecessary computation → performance optimization
- **Server-based API integration**
  - High-precision analysis performed on the server.
  - Ensuring high accuracy in a mobile environment
- **Hybrid structure of on-device AI and server AI**
  - Achieves a balance between fast responsiveness and high-precision analysis

System Design Strategy ① – On-Device AI with Server Integration



System Design Strategy ② - Optimization through Qualcomm AI Hub

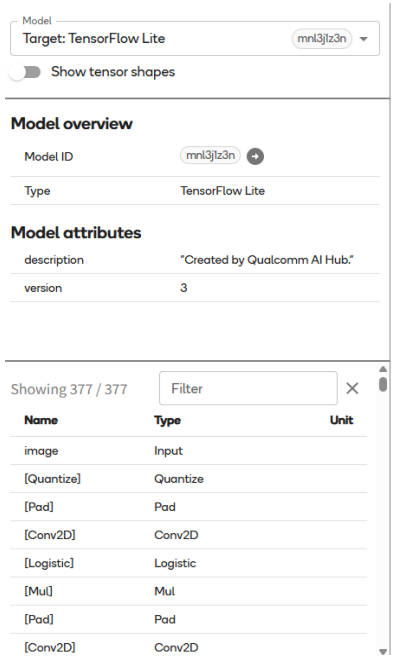
```
Optimizing model yolov11_det to run on-device
Waiting for quantize job (j5qe01J45) completion. Type Ctrl+C to stop waiting at any time.
  ✅ SUCCESS
Scheduled compile job (jp3vn7ylg) successfully. To see the status and results:
    https://app.aihub.qualcomm.com/jobs/jp3vn7ylg/

Profiling model yolov11_det on a hosted device.
Waiting for compile job (jp3vn7ylg) completion. Type Ctrl+C to stop waiting at any time.
  ✅ SUCCESS
Scheduled profile job (jgokzwjxp) successfully. To see the status and results:
    https://app.aihub.qualcomm.com/jobs/jgokzwjxp/

Running inference for yolov11_det on a hosted device with example inputs.
Downloading data at https://qaihub-public-assets.s3.us-west-2.amazonaws.com/qai-hub-models/models/yolov7/v1/yolov7_demo_640.jpg to C:₩Users₩EliteBook₩.qaihm₩models₩yolov7₩v1₩yolov7_demo_
640.jpg
100%|██████████████████████████████████████████████████████████████████████████████| 410k/410k [00:00<00:00, 731kB/s]
Done
Uploading dataset: 1.21MB [00:00, 1.48MB/s]
Scheduled inference job (jpv0qmjj5) successfully. To see the status and results:
    https://app.aihub.qualcomm.com/jobs/jpv0qmjj5/

yolov11_det.tflite: 100%|████████████████████████████████████████████████████████| 2.83M/2.83M [00:00<00:00, 5.53MB/s]
Downloaded model to C:₩Users₩EliteBook₩yolo11_tflite₩yolov11_det.tflite
Waiting for profile job (jgokzwjxp) completion. Type Ctrl+C to stop waiting at any time.
  ✅ SUCCESS
```

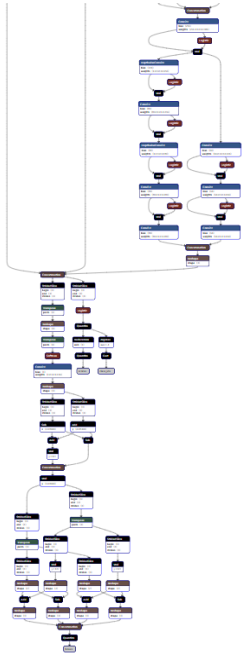
- Quantization and Optimization (W8A8 + NPU Target)
  - Significantly reduced memory usage and computation compared to the original full-precision model.
  - W8A8 quantization reduces model size and computation while maintaining near-original accuracy.

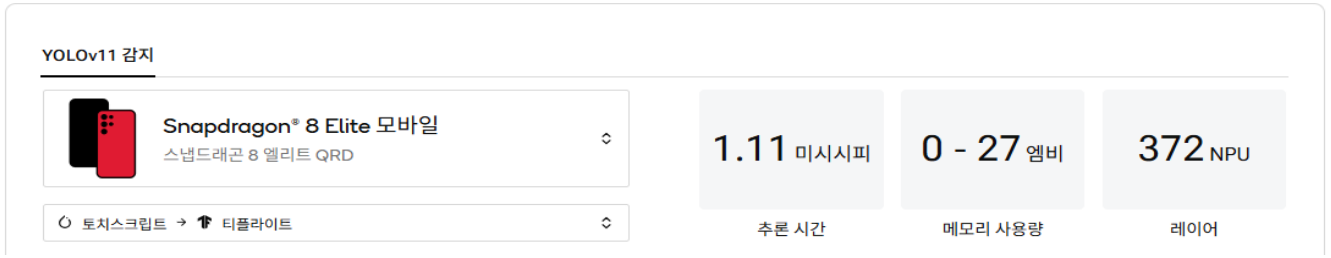
- **Model Quantization**
  - Reduced model size → improved computation speed
  - Minimized power consumption and heat generation

- **Device Fit Optimization**
  - Performance adjustment tailored to the target device
  - Real-time execution on the device

System Design Strategy ③ - Active Utilization of Qualcomm AI Hub







- **Pre-performance verification through profiling**
  - Prediction of performance (speed, memory usage, etc.) on the target device

Stage	Time	Memory
Compilation	0.0 ms	0.0 MB
First App Load	697.6 ms	56 - 63 MB
Subsequent App Load	694.2 ms	8 - 51 MB
Inference	(min) 4.3 ms (median) 4.5 ms	0 - 31 MB

- **Utilization of model visualization tools**
  - Intuitive understanding of the model architecture

- **Ensuring stability through pre-deployment testing**
  - Final verification tailored to the device environment
  - Improved processing performance and predictability

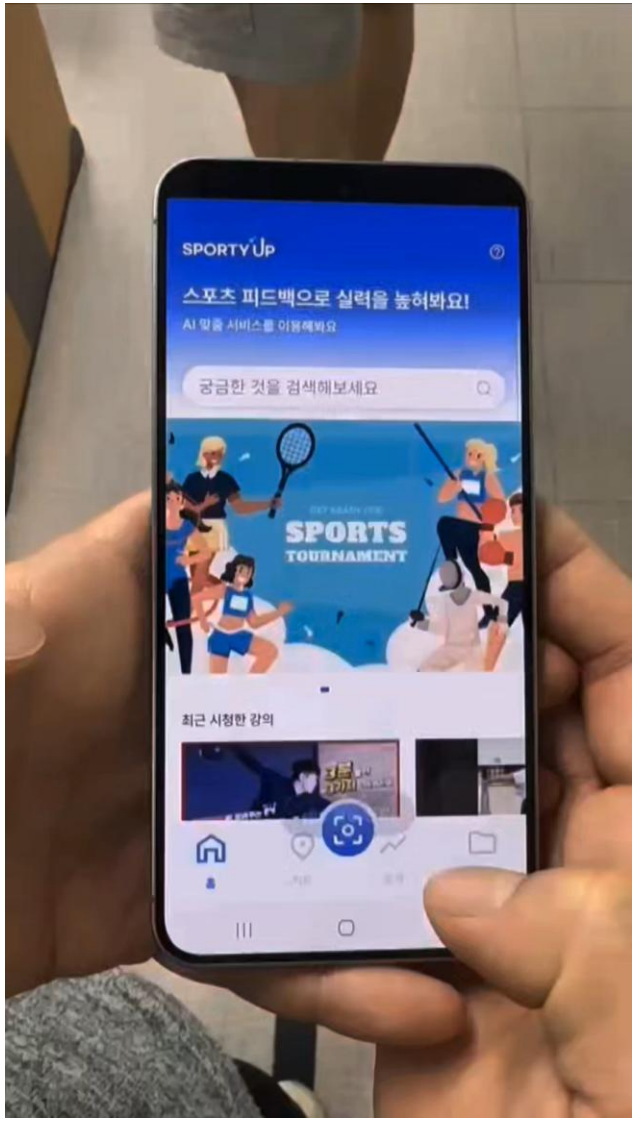
Conclusion

- **Performance Comparison: Before and After Optimization**

Platform: Snapdragon 8 Gen 1 Elite QRD
Runtime: TensorFlow Lite (TFLite)
Quantization: W8A8 (Weight & Activation 8-bit)

Metric	Full Precision (Before)	Optimized (W8A8 + TFLite + NPU)	Improvement
Min Inference Time	4.3 ms	1.1 ms	74% faster
Median Inference Time	4.5 ms	1.1 ms	4x speed up
Peak Memory Usage	31 MB	26 MB	16% less memory
Compute Operations	359 ops	373 ops (optimized)	Better NPU utilization
First App Load Time	697.6 ms (56~63MB)	396.4 ms (27~35MB)	Faster & lighter
Subsequent Load Time	694.2 ms (8~51MB)	394.8 ms (0~36MB)	Optimized loading
Accuracy (PSNR)	N/A	Boxes: 37.02 dB / Scores: 37.7 dB	Accuracy preserv

Demo


SPORTY UP
스포츠 피드백으로 실력을 높혀봐요!
AI 맞춤 서비스를 이용해봐요
궁금한 것을 검색해보세요
SPORTS
TOURNAMENT
최근 시청한 강의

Thank you!