

HiveGuard



Smart protection. Safe minds. Confident play.

INNOVATION PLAN

Qianhao Han
The Bishop Strachan School
298 Lonsdale Road
Toronto, Ontario, M4V 1X2

April 8, 2026

TABLE OF CONTENTS

I. Overview

II. Problem

III. Customer Segments

IV. Unique Value Proposition

V. Solution

VI. Conclusion

VII. Bibliography



My Older Brother's Hockey Journey



Qiushi at 10 years old



Qiushi at 16 years old

A photograph of a hockey player lying on his back on the ice. He is wearing a black and white jersey with the number 26 on the back and a black helmet. A coach in a dark blue jacket and black pants is kneeling over him, looking down. The player's stick is on the ice. The background shows the yellow boards of the rink.

Qiushi had to quit hockey at 17 years old due to a severe concussion

He is not alone.

I. OVERVIEW

HIVEGUARD



**Smart Concussion
Prevention Helmet**

- Reduce concussion risk through innovative helmet design
- Warn players in real time by detecting neural abnormalities linked to concussion risk
- Providing **objective** decision support

CUSTOMERS

Youth ice hockey →
broader sports

BUSINESS

- Helmet sales
- DTC & B2B

IMPACT

Real-time visibility
into brain health in
real time

II. Problem

The Concussion Crisis

4.2 million

**Concussions in the U.S. and
Canada annually**

1 in 10

**Teens aged 10 - 19 experience
sports-related concussions**

1 in 2 concussions go unreported

The Concussion Diagnosis Gap

01

Concussions Are Missed in the Moment

- Symptoms can be delayed (24–48 hours)
- Athletes underreport symptoms due to pressure to continue playing

02

Sideline Decisions are Subjective

- Return-to-play decisions are subjective
 - ex: SCAT6
- No objective, real-time brain-health signal available in sports

03

No Brain Monitoring for Sports

- CT/MRI scans can't diagnose concussions
- EEG/medical monitors are clinic-oriented and expensive

III. Customer Segments

TAM:

Global Sports Helmet Market
\$40-\$60B/year

SAM:

North America Hockey
\$800M-\$1.2B/year

SOM:

\$10-30M
Over the next
3-5 years



Primary Market Youth Ice Hockey

- Leagues, clubs, & families
- Frequent helmet replacement
- Strong safety oversight and liability pressure



Secondary Market Impact & Fall Sports

- Collision sports: football, rugby
- Fall sports: snow sports (skiing, snowboarding), cycling

IV. UNIQUE VALUE PROPOSITION



HiveGuard is the first smart sports-ready helmet that both reduces impact forces and delivers immediate, objective brain-health insight in real time.

Reduce

concussion risk

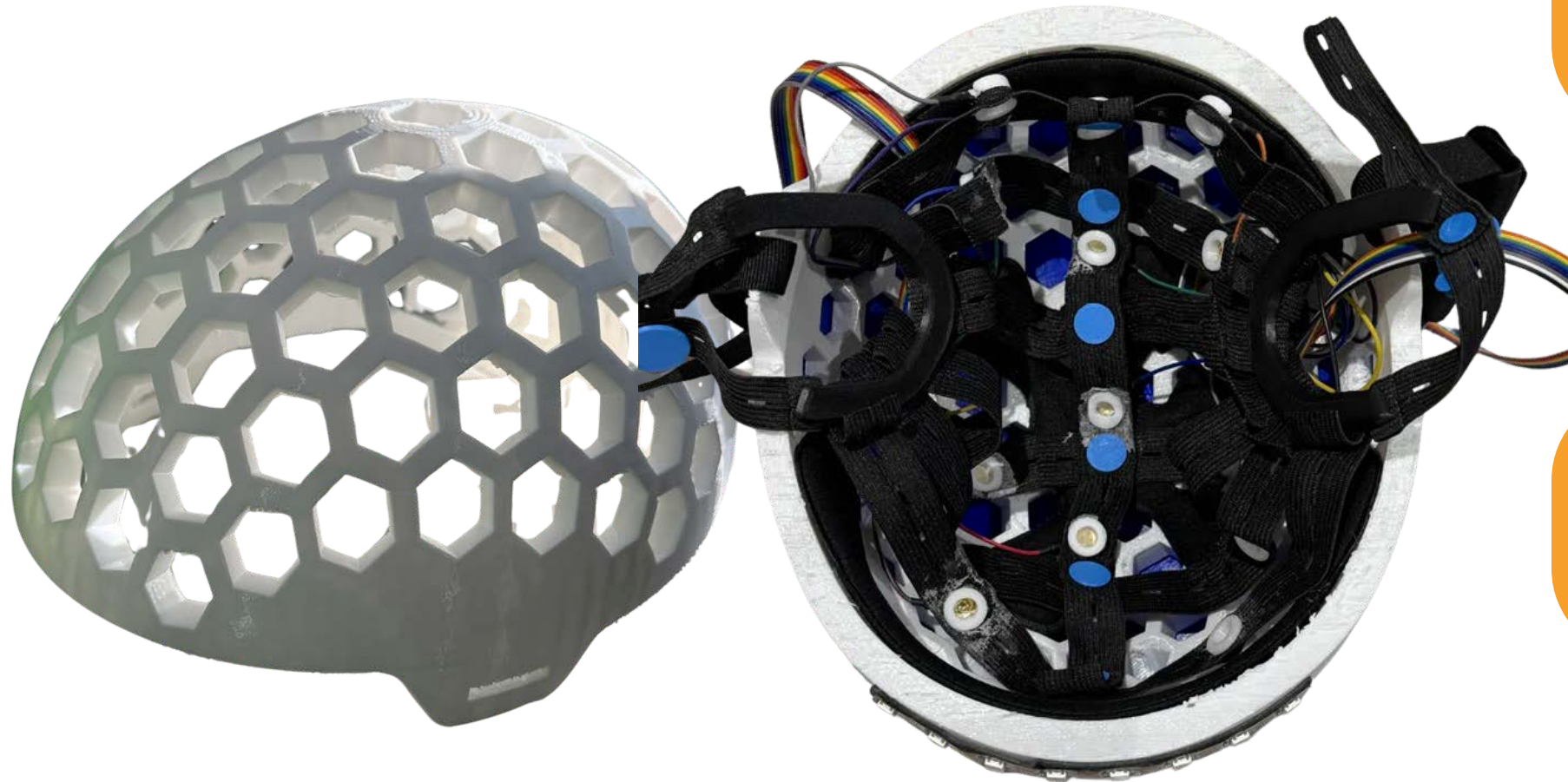
Warn

players in real time

V. SOLUTION



HiveGuard



01

Honeycomb pattern shock-absorbing structure to reduce impact

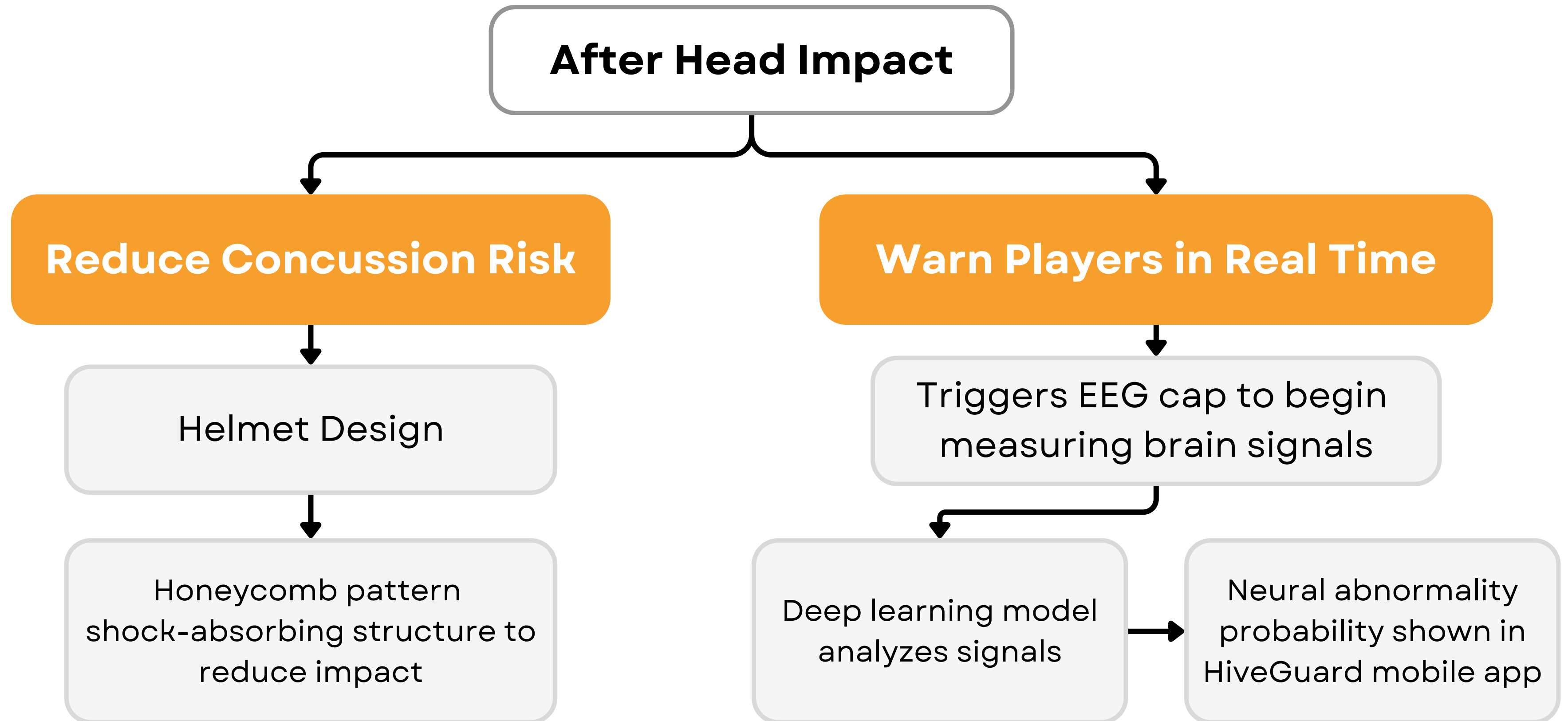
02

EEG (Electroencephalogram) system to measure brain signals after a hit

03

Deep learning model to detect deviations from an individual's cognitive baseline

HIVEGUARD SYSTEM OVERVIEW



HELMET DESIGN

**Honeycomb-patterned shell
spreads impact forces
across a wider area**



**Drop tests to
evaluate impact
absorption**

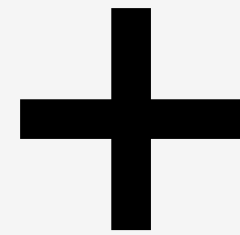
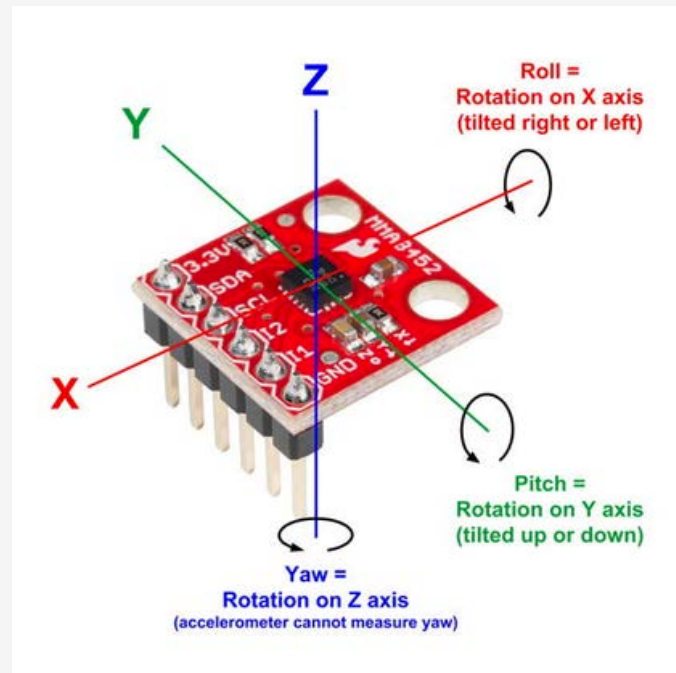
**15-20% lower
linear acceleration
+
10-20% lower rotational
acceleration**



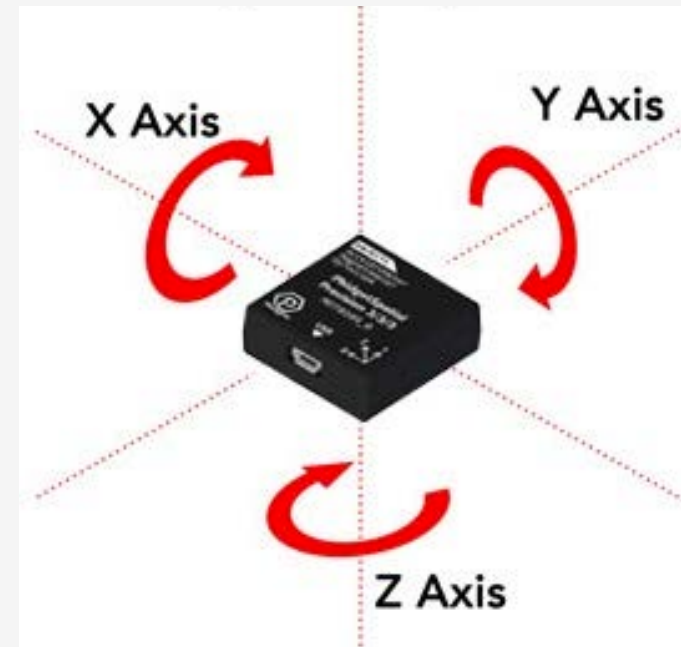
**40% improved
impact absorption**

EEG SYSTEM

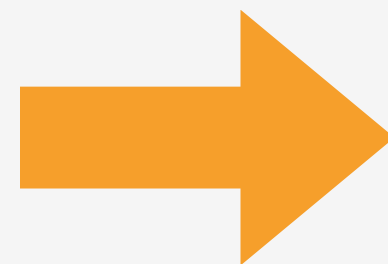
Accelerometer



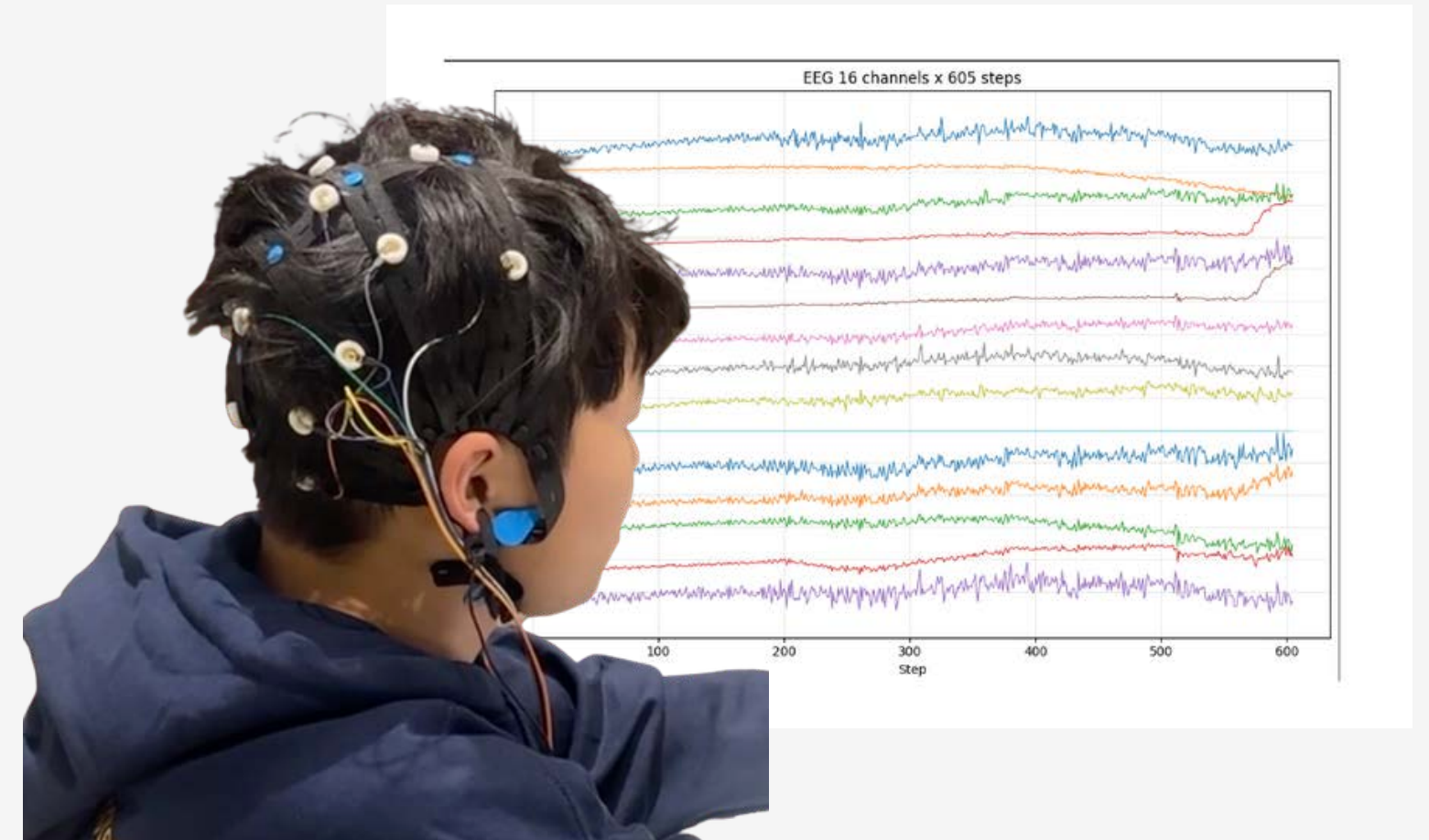
Gyroscope



A collision/impact is detected based on the accelerometer (acceleration) and gyroscope (rate of rotation)



Triggers 16-channel EEG system to collect brain signals immediately after the hit



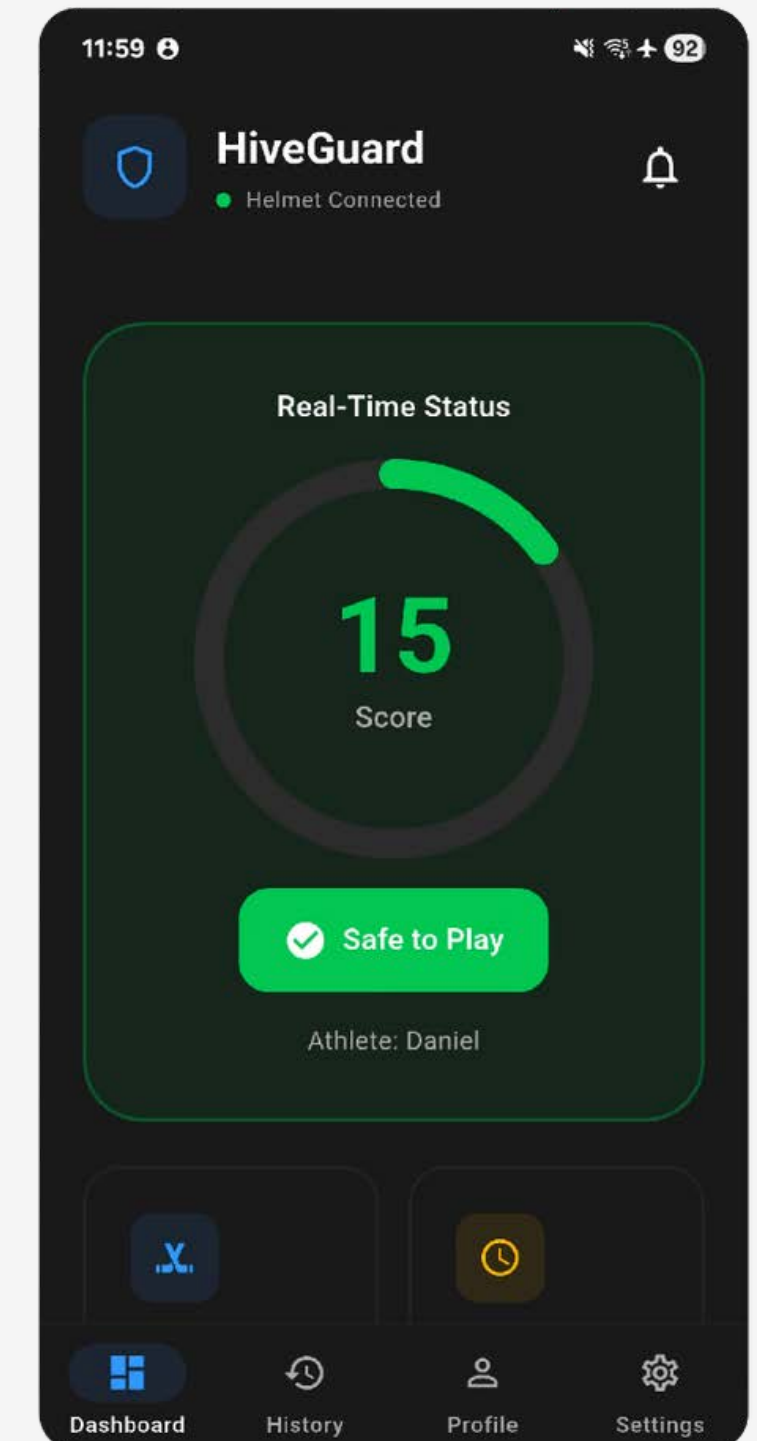
DEEP LEARNING MODEL

**Deep Learning model
(EEGConvTrans) outputs the
probability of altered neural
condition on HiveGuard Mobile App**



**Combined score
derived from four EEG
signal categories
known to be affected
by concussions:**

- 1. Language**
- 2. Motor control**
- 3. Cognition**
- 4. Physiological regulation**



COMPETITIVE ANALYSIS

Features	Traditional Helmets ex: Bauer, Riddell	Medical EEG Devices ex: BrainScope, NeuroCatch	 HiveGuard 
			
	Mechanical Protection		
	EEG based data		
Integrated into sports			

BUSINESS MODEL

Sales Channels

1. **Direct-to-customer** (web): \$449 MSRP
(Manufacturer's Suggested Retail Price)
2. **B2B deployment** in clubs, schools,
leagues: \$349/helmet
3. **Retail wholesale:** \$329 to professional
hockey/sports retailers

Unit Costs

Main costs:

- Materials
- Assembly
- Packaging + shipping
- Customer support
- App + cloud operations

Cost of goods sold per helmet: ~\$238

VI. CONCLUSION

KEY POINTS & FEASIBILITY

Differentiated Integrated System:

Prevention:

honeycomb-patterned
impact structure

Warning:

impact-triggered EEG + AI for
immediate status

Clear unmet need: real-time post-hit decisions are still subjective and inconsistent

Validated feasibility

- Lab testing
- Integrated Proof of Concept completed
- Alpha testing underway

Market Pull

- 70+ survey responses and interviews show demand
- LOIs + Toronto hockey club pilot secured

Defensibility

- Canadian Utility Patent in progress
- Published Demo Poster and Research Paper at top conferences

www.hiveguard.ca



Smart Protection
Safe Minds
Confident Play

Kevin He
NHL Winnipeg Jets Prospect



VII. BIBLIOGRAPHY

1. Conley, A. C., Cooper, P. S., Karayanidis, F., et al. (2018). Resting-state electroencephalography and sports-related concussion: A systematic review. *Journal of Neurotrauma*, 36(1), 1–13.
2. Harmon, K. G., Drezner, J. A., Gammons, M., Guskiewicz, K. M., Halstead, M., Herring, S. A., Kutcher, J. S., Pana, A., Putukian, M., & Roberts, W. O. (2013). American Medical Society for Sports Medicine position statement: Concussion in sport. *British Journal of Sports Medicine*, 47, 15–26.
3. Han, Q. (2025). Honeycomb-structured helmet with embedded EEG system. In *Proceedings of the Tenth ACM/IEEE Symposium on Edge Computing* (pp. 1–3).
4. Han, Q. (2025). Honeycomb-inspired concussion protection helmet with intelligent EEG feedback system. Preprints.
5. Kholoosi, F., & Galehdari, S. A. (2019). Design, optimisation and analysis of a helmet made with graded honeycomb structure under impact load. *International Journal of Crashworthiness*, 24(6), 645–655.
6. Kadri, A., & Apriani, N. (2022). Electroencephalography findings in traumatic brain injury. *The Open Neurology Journal*.
7. Rowson, S., Duma, S. M., Greenwald, R. M., et al. (2014). Can helmet design reduce the risk of concussion in football? *Journal of Neurosurgery*, 120(4), 919–922.
8. Munia, T. T. K., Haider, A., Schneider, C., et al. (2017). A novel EEG-based spectral analysis of persistent brain function alteration in athletes with concussion history. *Scientific Reports*, 7, 17221.
9. Hallock, H., Mantwill, M., Vajkoczy, P., Wolfarth, B., Reinsberger, C., Lampit, A., & Finke, C. (2023). Sport-related concussion: A cognitive perspective. *Neurology: Clinical Practice*, 13(2).
10. Tang, A., David, L., Williams, K., Yengo-Kahn, A., Zuckerman, S., & Terry, D. (2024). The cost of a single sport-related concussion in adolescent athletes. *British Journal of Sports Medicine*, 58, A156.
11. Mayo Clinic Staff. (2024). Concussion: Symptoms and causes. Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/concussion/symptoms-causes/syc-20355594>
12. National Institute of Neurological Disorders and Stroke. (2024). Traumatic brain injury (TBI). National Institutes of Health. [Conley, A. C., Cooper, P. S., Karayanidis, F., et al. \(2018\). Resting-state electroencephalography and sports-related concussion: A systematic review. *Journal of Neurotrauma*, 36\(1\), 1–13.](#)