Advanced Hockey Shot Analysis Using Smart Puck Technology for Precision and Speed Measurement

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Introduction

Problem: There is currently no system available that analyses the full quality of hockey shots. Existing systems focus on individual metrics like accuracy or velocity, but not on a combination of factors such as accuracy, velocity, release time, stability, spin rate, and other factors. This leaves a significant gap in the hockey training field.

Goal: The objective of this project is to develop a system that analyses hockey shots holistically and provides real-time feedback, allowing players to gain actionable insights as they train.

Question

How can a comprehensive system be developed to measure hockey shot quality and provide real-time feedback, and which metrics are most relevant to that analysis?

Novelty

The system combines IR break-beam accuracy tracking with IMU movement data for a complete analysis of shot performance. Real-time feedback enables players to make immediate adjustments during training.

Methodology

In-Puck System

- Microcontroller
  - Controls data collection and transmission from the puck
- Inertial Measurement Unit
  - Captures movement data such as acceleration, velocity, and stability

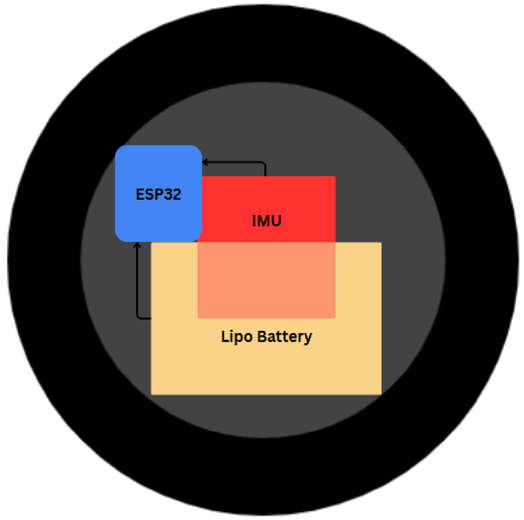
External System

- Microcontroller
  - Collects and transmits data from the Break-Beam Sensors
- IR Break-Beam Sensors
  - Positioned vertically across the target to detect shots of varying accuracy

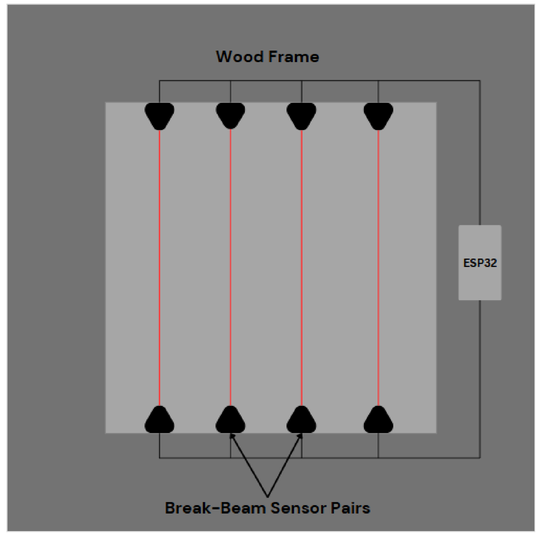
Analysis Algorithm

- Each of the 5 metrics will have a normalized score that will contribute to an overall score with the following weights:
  - Velocity (0.40)
  - Accuracy (0.30)
  - Release Time (0.15)
  - Stability (0.075)
  - Spin Rate (0.075)

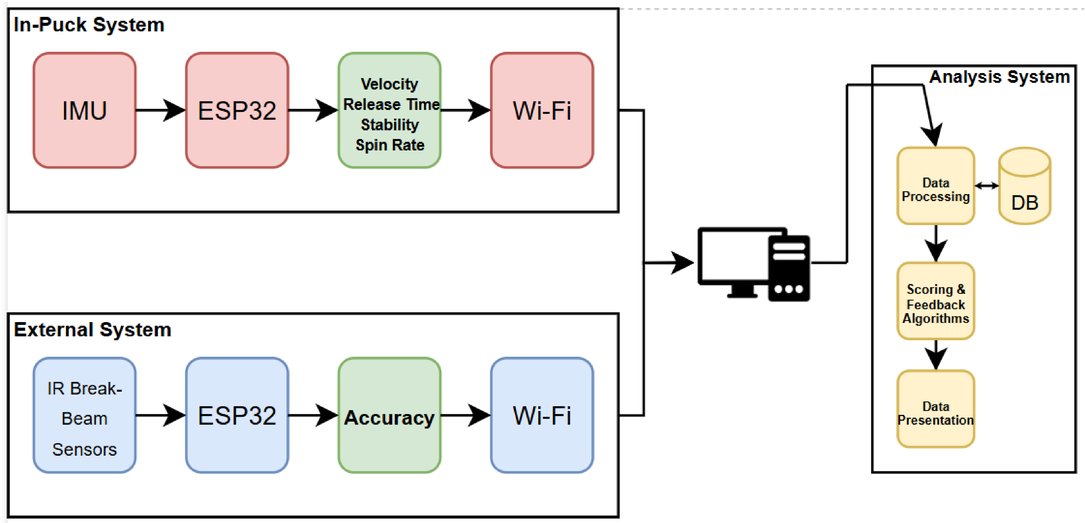
System Diagrams



In-Puck System



External Accuracy System



Data Flow Diagram

Future Work

- Collect data on a large scale with high-level or professional players to fine-tune contributions of each variable, thus increasing the accuracy of the system.
- Due to the modular nature of the design, it leaves open the possibility of adding or removing variables without significant effort.
- Integrate the system with wearable devices to expand upon analysis. This could be sensors on the arms of the shooter that measure arm movement throughout the shot, for example.

Results

Metric	Value
Velocity	9.21
Accuracy	10.00
Release Time	7.00
Stability	8.21
Spin Rate	10.00
Total	9.10

Great Shot

Metric	Value
Velocity	8.16
Accuracy	9.00
Release Time	7.70
Stability	0.00
Spin Rate	6.72
Total	7.62

Good Shot

Metric	Value
Velocity	5.21
Accuracy	6.00
Release Time	4.50
Stability	7.74
Spin Rate	4.65
Total	5.49

Average Shot

Metric	Value
Velocity	0.35
Accuracy	0.00
Release Time	3.50
Stability	9.21
Spin Rate	2.22
Total	1.52

Bad Shot

Conclusion

The SmartPuck system achieves real-time measurement of velocity, accuracy, release time, spin rate, and stability during hockey shots. It improves training methods by offering actionable insights for players and lays the groundwork for future enhancements, including expanded metrics and integration with additional systems.

Acknowledgements

MD Shaad Mahmud, Advisor

References

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