**Colorado Science and Engineering Fair**

# 2024 Individual Project Abstract Form

**Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.**

Title of Project: Feel The Ball: Convert Ball Motion to Touch for Vision/Hearing - Impaired Sport Audiences

Finalist's Name: Amy Zhang

School and City: Lakewood High School, Lakewood

Sponsor's Name: Casey Walter

Category: Mathematics & Computer Sciences (MACS)

Division: Senior (9th - 12th grades)

Abstract (250 words or less):

My research aims to develop an innovative system that makes sporting events more accessible and engaging to sports enthusiasts with vision or hearing impairments. Unlike existing captioning-based (i.e., see the real-time commentary) or audio-based (i.e., hear the ball) assistance methods, my system enables users to feel the spatial, dynamic ball movements. The architecture of this system includes extracting real-time ball motion information from broadcast sports videos using computer vision and artificial intelligence technologies and transforming it into dynamic touch feeling through a force feedback device (so-called haptics techniques). Specifically, a novel Swin Transformer combined with DeconvNet and Long Short-Term Memory techniques are developed to achieve reliable, real-time tracking of small, blurred, fast-moving balls from broadcast videos. Then a novel psychology-guided haptic technique is developed to enable the user to feel the extracted spatiotemporal ball motion through a force-feedback joystick. This system helps visual or hearing-impaired spectators have a more immersive accessibility to live sports and thus experience the excitement accompanying a sports match. Additionally, this system will heighten people' sense of reality and spatial awareness and potentially change the way people interact with the real world, advancing future immersive technologies in various fields requiring sensory augmentation. Besides personal use, the fundamental technology innovation in reliable tracking of small and fast-moving objects and intuitive haptics of real- world object motion has broader impact on other applications such as video surveillance and airport safety.

*I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.*

Finalist's Signature: Amy Zhang Date: 2/28/2024

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES o all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.