



Colorado Science and Engineering Fair

2025 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: Building a Safe Robotic Arm for Table-Top Interactions

Finalist's Name: Omar Manshad

School and City: Crescent View Academy, Aurora

Sponsor's Name: Moe Manshad

Category: Engineering

Division: Junior (grades 6 - 8)

Abstract (250 words or less):

I love playing chess, and last year I worked on an accessible chessboard for blind players. That project made me wonder if a robotic arm could play chess safely with blind and low-vision individuals. Then, I found a news article about a chess-playing robot that broke a child's finger, which made me ask: Are tabletop robotic arms really safe for humans?

For my project, I focused on learning how to improve an open-source robotic arm by making small changes and testing them through an iterative engineering process. I built a 6-degree-of-freedom (6DoF) robotic arm using open-source designs and gradually improved its accuracy and safety. I learned how servo motors work and wrote better code to control them. I also studied the field of view of different sensors, testing Ultrasonic, PIR, and Time-of-Flight (ToF) sensors to see which one worked best for detecting obstacles. Adding a PWM driver and an external power supply made the arm move more smoothly and with better precision. Through testing, I found that the ToF sensor was the most reliable for detecting objects, while the PIR sensor was not effective. My improved robotic arm became more accurate than the unmodified version (baseline), reducing placement errors from 3.54mm to 2.93mm. I completed 375 trials across two experiments and four tasks, analyzing accuracy, sensor reliability, and collision detection. I recently started Experiment 2, Task 3, which tests obstacle avoidance and collision detection. This experiment is still ongoing, and I will continue making improvements.

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:

Date:

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 of all of these forms to your Regional Fair Director with your Finalist Verification/Permission Form. **A signed copy of this form must be included in your notebook.**