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: The Pumpkin Carver

Finalist's Name: Evan Gopinath

School and City: Nevin Platt Middle School, Boulder, CO

Sponsor's Name: Rebecca Fellows

Category: Engineering

Division: Junior (grades 6 - 8)

Abstract (250 words or less):

The Pumpkin Carver
By: Evan Gopinath
Nevin Platt Middle School

Many people spend countless hours carving pumpkins. With the pumpkin carver, all you have to do is upload your design, and your pumpkin will be carved for you. Instead of spending hours carving pumpkins, you can spend time addressing climate change and other societal problems.

Research Question: Can I learn the process and tools needed to make this contraption work?
Hypothesis: If I accurately put the carving design on the pumpkin mesh, I can use the robotic arm and Dremel to carve the pumpkin.
Engineering Goal: I want to try making a robotic arm to cut a pumpkin.
Expected Outcomes: Reduce the amount of time it takes to carve a pumpkin.
Materials: Pumpkin, carving arm, Dremel, computer, and motor controller.
Methods:

1) 3D scan a pumpkin to generate a pumpkin mesh (initially, we used a container as shown)
2) Pick a 2D picture to cut onto the surface of the pumpkin (triangle)
3) Project the triangle onto the pumpkin mesh and capture the normal vectors to the pumpkin surface. These will be used to position the cutter
4) Generate a model for my robotic arm (URDF format)
5) Position the pumpkin a known distance from the robotic arm
6) Use inverse kinematics to derive the arm angles for every point of the cut
7) Run the arm movements with the dremel on - watch it cut!

Potential risk/ Safety: Dremel, do not go near during operation
Data Analysis: I will test what I have along the way and collect data about what I have to modify.

Bibliography:

1) Collins, Addison Sears. "The Ultimate Guide to Inverse Kinematics for 6DOF Robot Arms." Edited by Addison Sears Collins. Automatic Addison, Addison Sears-Collins, 23 Oct. 2020, automaticaddison.com/the-ultimate-guide-to-inverse-kinematics-for-6dof-robot-arms. Accessed 6 Feb. 2025.

2) Islam, Zahidul. "InverseKinematics 6 DOF." Edited by Zahidul Islam. Ghitub.com, Md. Zahidul Islam, 19 Jan. 2023, github.com/zahid58/Inverse-Kinematics-6-DOF-Python-With-Visualizer. Accessed 6 Feb. 2025.

3) Unknown. "Model your robots in URDF and show them here!" Edited by Unknown, https://mymodelrobot.appspot.com/. Accessed 13 February, 2025

4) Courson, C. (2020, July 10). CCOURSON/Hiwonder-xArm1S: Hiwonder xarm1s 6-DOF servo controller libraries. GitHub. https://github.com/ccourson/Hiwonder-xArm1S

5) Pierre, Manceron, and Manceron Pierre. "IKPy." IKPy, Manceron Pierre, github.com/Phylliade/ikpy. Accessed 13 Feb. 2025.

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 you Finalist Verification/Permission Form. **A signed copy of this form must be included in your notebook.**