**Individual Project Proposal:**

**Automated CV Projection-Mapped Christmas Light Display**

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**Course**: AIPI 590

**Overview / Project Summary:**

This project aims to create an automated projection-mapped Christmas light display using a Raspberry Pi, computer vision, and GPIO-based hardware integration. The system captures an image of a house, detects architectural features (e.g., windows, rooflines, and house trimming), and overlays custom Christmas-light projections onto those contours. The goal is to offer an accessible, hassle-free alternative to physically hanging Christmas lights — which is not only labor-intensive and potentially dangerous, but can cost up to $1,000 when outsourced! This solution provides a festive, customizable display that’s easy to set up, scalable, and cool. ☺

**Technical Components:**

**Computer Vision:**

* Uses a Raspberry Pi Camera to capture an image of the user's house.
* A YOLOv8-based model identifies key features of the home (windows, doors, rooflines) using object detection.
* Optionally allows user input to refine or edit detected contours before projection.

**Projection Mapping:**

* Once contours are confirmed, the system generates a projection video (.mp4 file) that overlays virtual holiday lights or animations directly onto the mapped areas of the home.
* The video is played using VLC on the Raspberry Pi, outputting to a connected mini projector.

**GPIO-Based Hardware Output:**

* The Raspberry Pi controls a servo motor via GPIO to open a motorized “hatch” that covers the projector lens when not in use.
* This hatch protects the projector during the daytime (from bugs, debris, sun exposure, etc.) and automatically opens when the projection is ready to begin
* The hatch closes again after the projection ends.

**Hardware Used:**

* Raspberry Pi 4
* Raspberry Pi Camera Module
* Micro Servo
* Projector
* 3D-Printed Enclosure with Motorized Hatch
* Button to take picture
* LED display to let user know about events

**Software:**

* Python for main code
* OpenCV for pre-processing
* YOLOv8 for real-time object detection
* Roboflow for training/annotating detection model
* VLC for media playback
* Some sort of GUI for contour editing – TBD

**Expected Outcomes:**

* A functional, projection mapping system that displays mapped Christmas lights on a house.
* A servo-controlled hatch mechanism integrated with the CV logic and GPIO system.
* A scalable prototype that can be used for other seasonal/thematic projections?