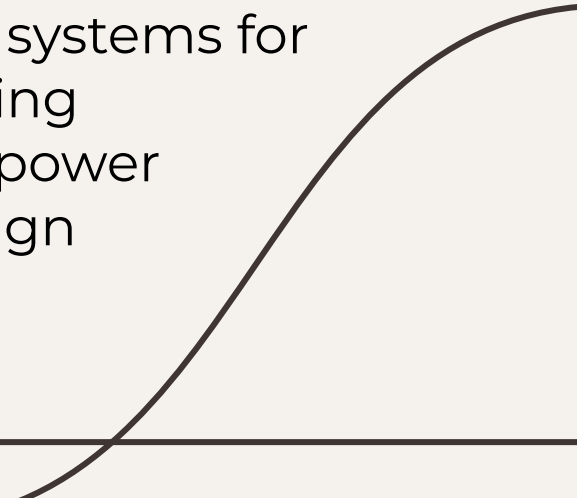


Product Scope

Competitiveness:

- Shared 3D viewing: better than monitors & VR
- Standalone: existing volumetric display products are only displays
- Interactivity: dynamic video, gestures

ECE Areas:

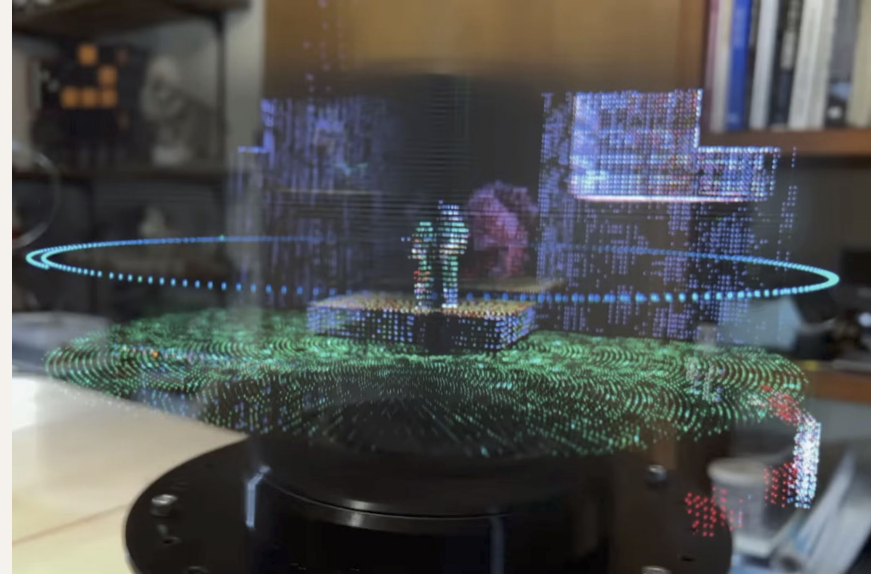
- Machine learning for gestures at application level
 - Embedded systems for display driving
 - Circuits for power system design
- 

Usage Overview

Our Hologram will function as a volumetric display of pixels with a set of applications using gesture control. Initially, we will implement a simple application where gestures can spin around a 3D model being displayed.

We imagine use cases such as:

- Entertainment (3D Pong)
- 3D model viewing
- Educational visualization
- Medical (MRI & CT scans)



Use-Case Requirements

- **Resolution:** 128 x 64 pixels to render readable text and clear logos
- **Frame Rate:** Minimum 30 FPS to maintain the Persistence of Vision (POV) illusion without flicker
- **Rotational Speed:** Target 900 RPM to ensure stable image formation
- **Latency:** From end to end, system should process gesture and update display in <200 ms (human reaction speed)

Technical Challenges

- **Resolution:** Achieving high pixel density to create the illusion of a smooth, continuous display while maintaining a light, movable frame
 - **Display Logic**
 - **Frame Rate:** Spinning two, 1 pound, 128x64 pixel panels at a rate of 900 RPM
 - **Vibrations**
 - **Warping**
 - **Spinning Wires**
 - **Power Consumption:** Maintaining a realistic power and current draw by the display while also ensuring a high enough brightness
 - **Gesture Controlled Logic:** Training a model to correctly identify gestures, and map those gestures to correctly interface with the display
 - **High RPM Stability:** Maintaining balance and structural integrity at high speeds in order to minimize vibrations and misalignment.
-

Hardware



Power

Dedicated 12V PSU



Mechanical Drive

Brushless Motor
Belt Drive

Rotation

Slip ring rated for
high RPM and
current

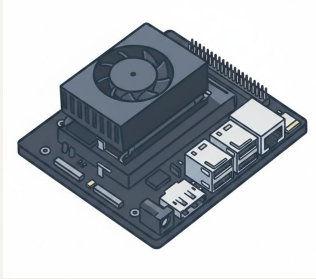


3D Printed Pulley

For custom fit on
belt drive



Hardware (Electrical)

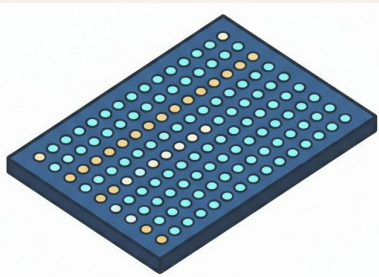


Compute

Jetson Orin Nano
with dedicated
GPU

Webcam

Used for hand pose
estimation

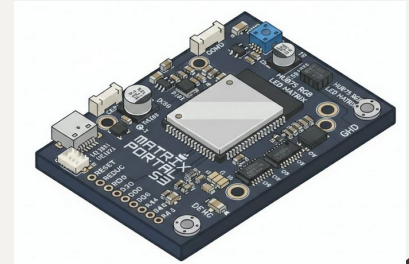


Display

P2.5 128x64 LED
Display

Display Driver

ESP32 for RTOS

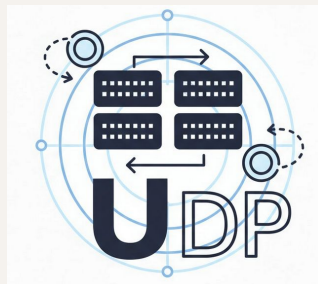


Software



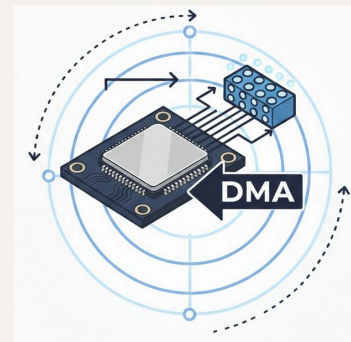
Computer Vision

Mediapipe for accurate hand landmark detection



Data Transfer

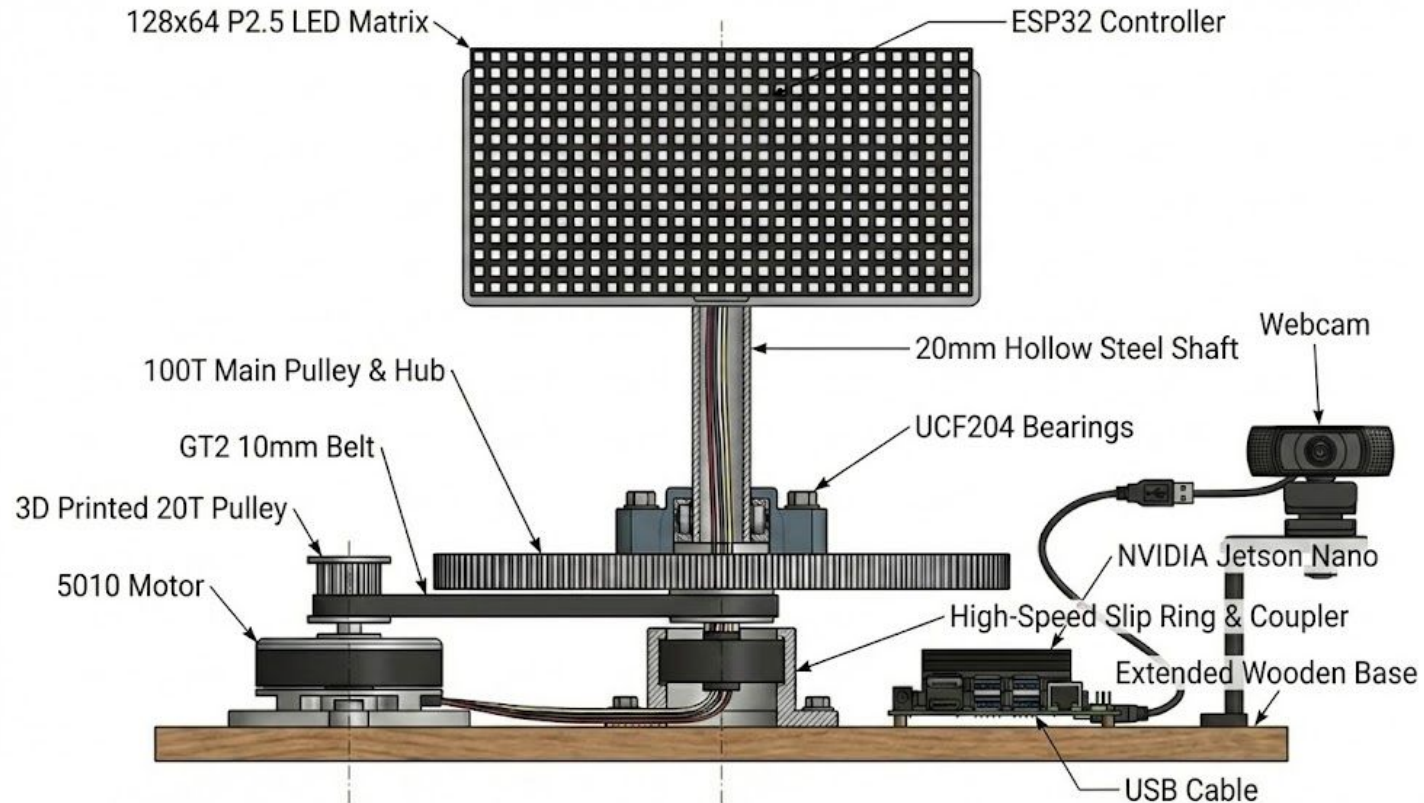
UDP for lowest latency



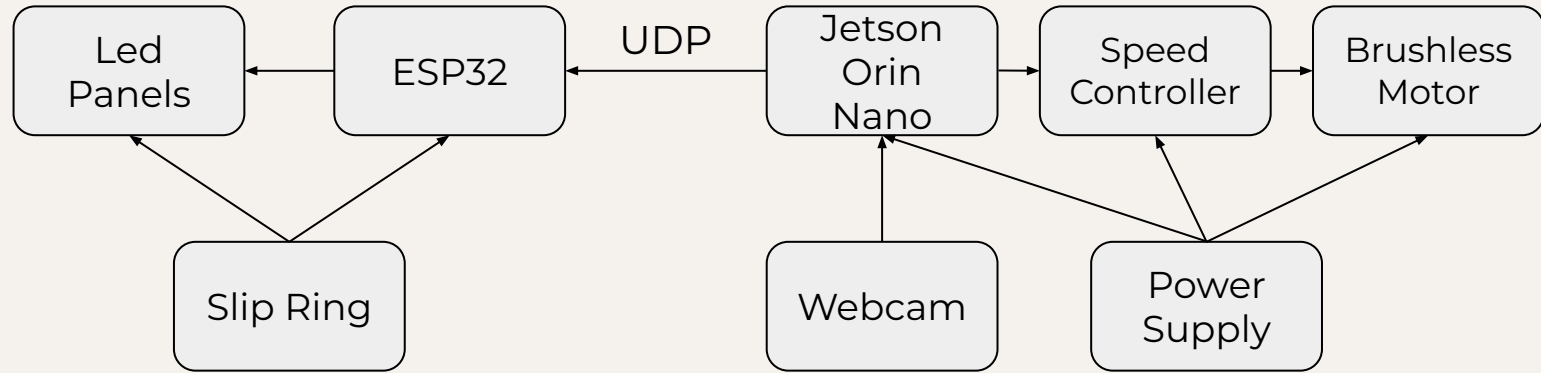
Display Driver

Direct Memory Access (DMA) to drive LEDs without blocking CPU

System Diagram



Block Diagram



Testing, Verification, and Metrics

Requirement	Method	Target
Frame Rate	Log frame timestamps on ESP32	≥ 30 FPS
Latency	Timestamp Jetson frame send and ESP32 frame display	≤ 200 ms
Visual Stability	Display a constant straight line and observe any angular deviations	≤ 2 degrees
Power Draw	Measure current and voltage draw with multimeter	≤ 300 Watts

Task	Description	Teammate
CAD Hardware	Design and fabrication of the system's mechanical framework	Kendric
LED Display	Write code for displaying on screens and test	Steven
Software	Implement gesture detection, udp communication, and application logic	Andrew
Motor Integration	Assemble belt drive and test	All
Electrical Integration	Wire slip ring to ESP32 and LEDs and test	All

[illegible]