

Background

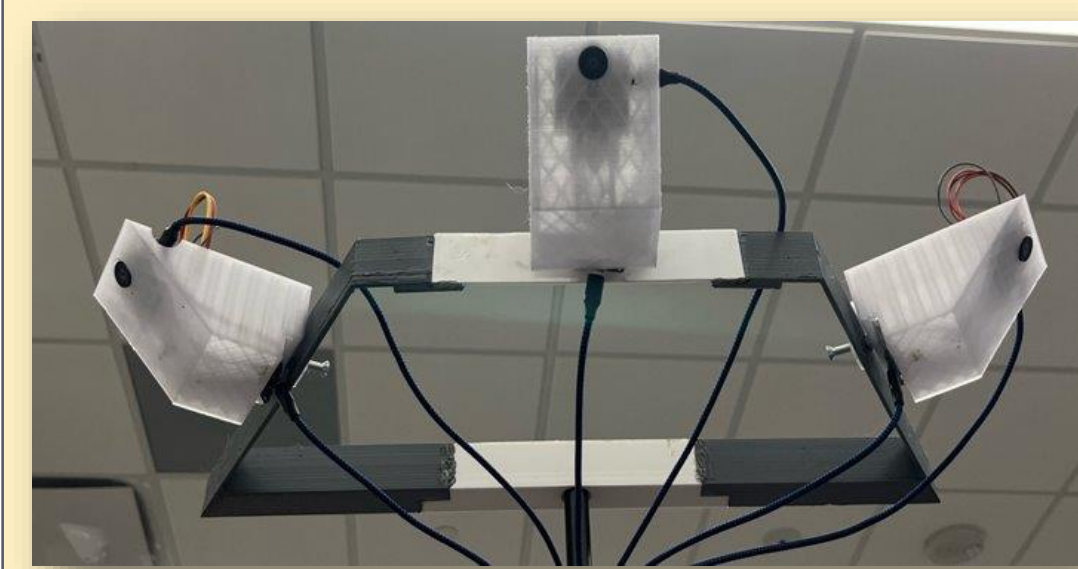
NASA conducts 45-day simulations in the HERA habitat to observe the effects of isolation and confinement on astronauts' well-being. Effects such as depression, poor sleep quality, and impaired executive function can have a negative impact on the productivity of the crew members.

Our goal is to build a system that will track 4 crew members and give their location and orientation within the simulated environment. We will accomplish this by placing multiple patch detection sensors around the habitat to detect color-coded patches worn by crew members.

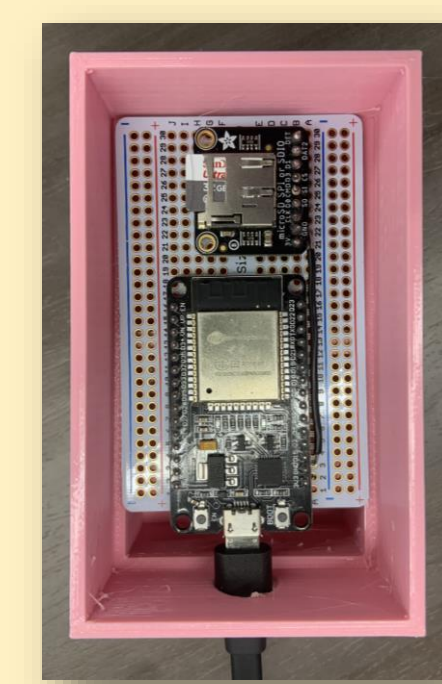
Requirements

- Track crew members in a 6m diameter room
- Detect the direction and orientation of up to 4 people
- Record 45-days' worth of crew member data
- Crew members should not interact with the system
- Data point time intervals every 15 seconds or less

System Design



3 camera system allows tracking of a circular area. Transmits data wirelessly to Central Hub

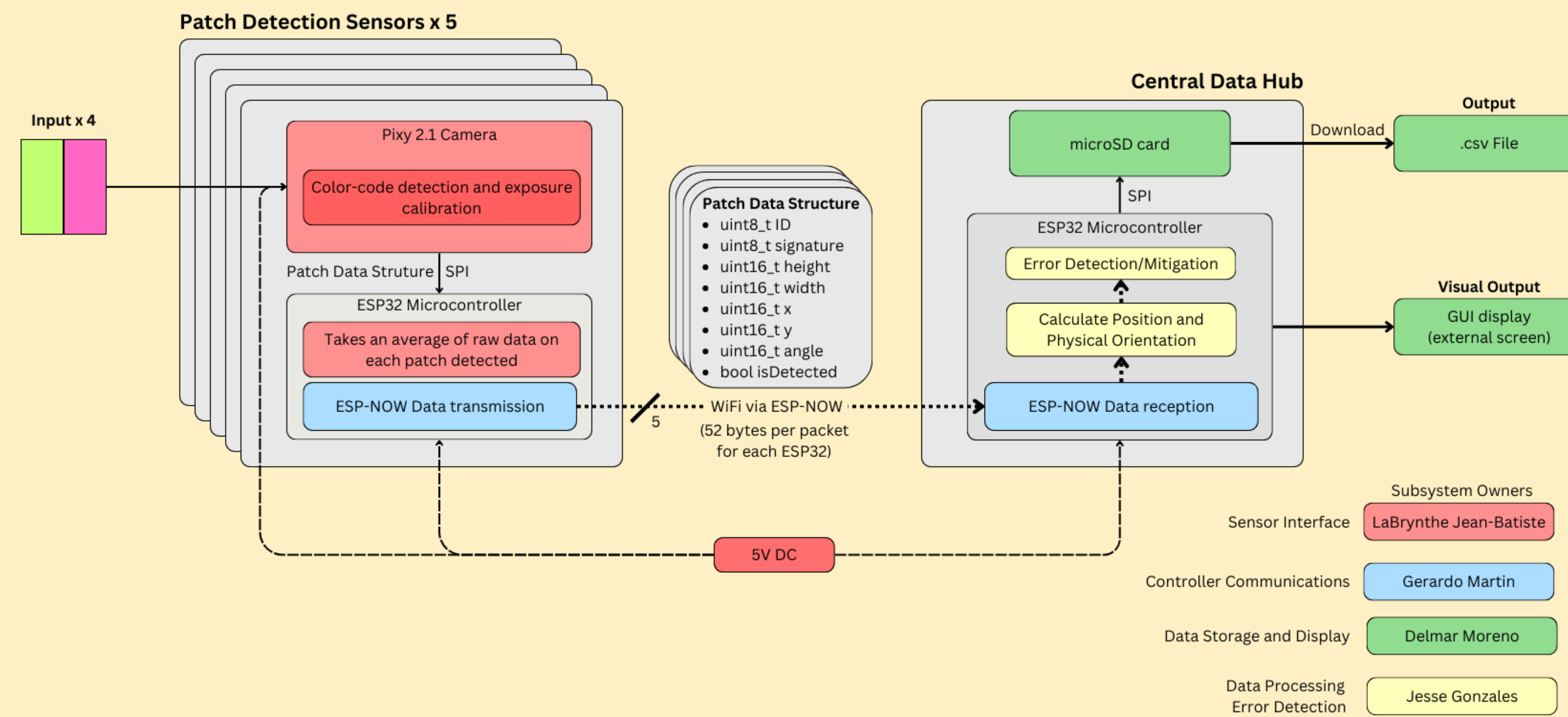


Central Hub consists of an ESP32 module and an SD card. The central hub can be plugged into a computer for a live display.

Future Improvements

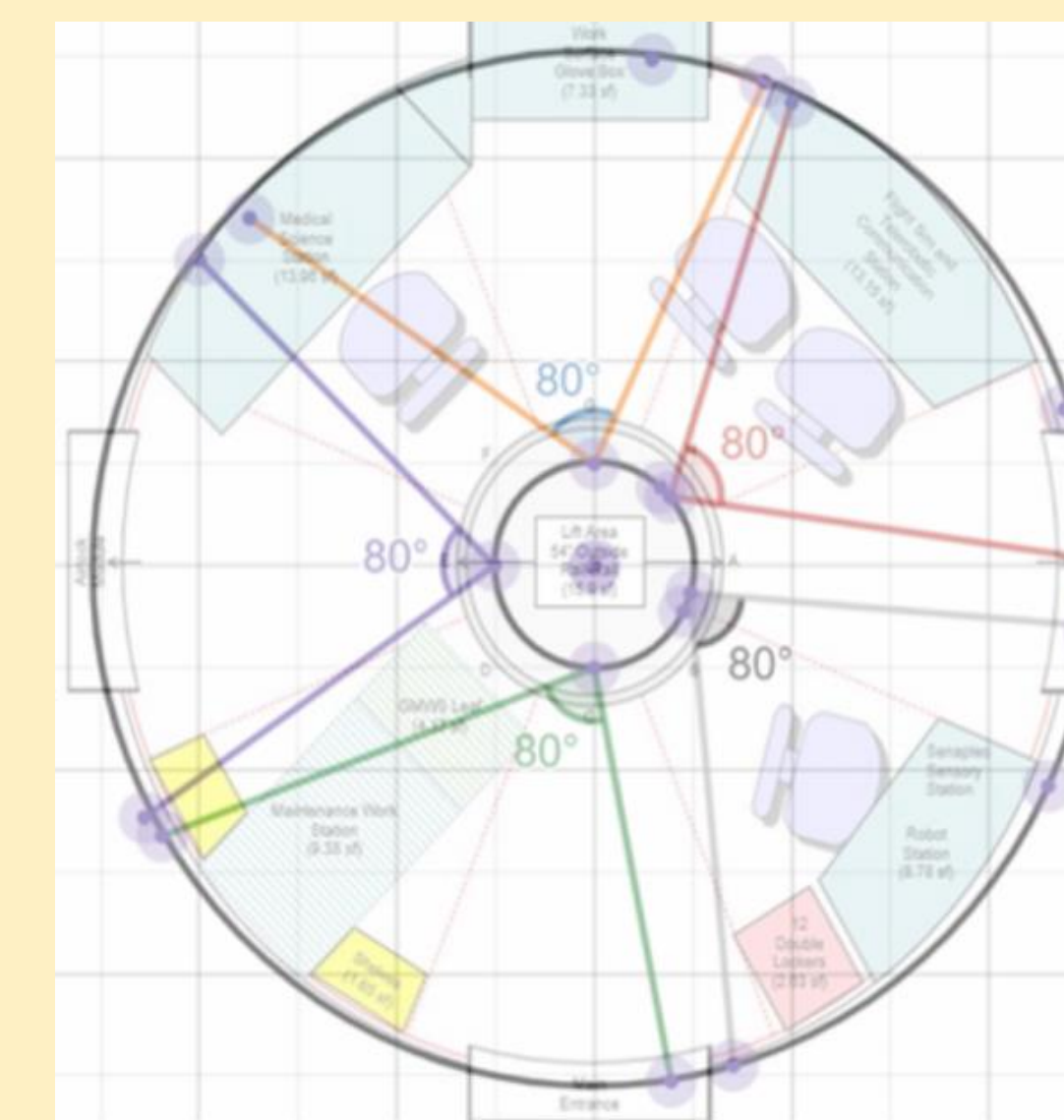
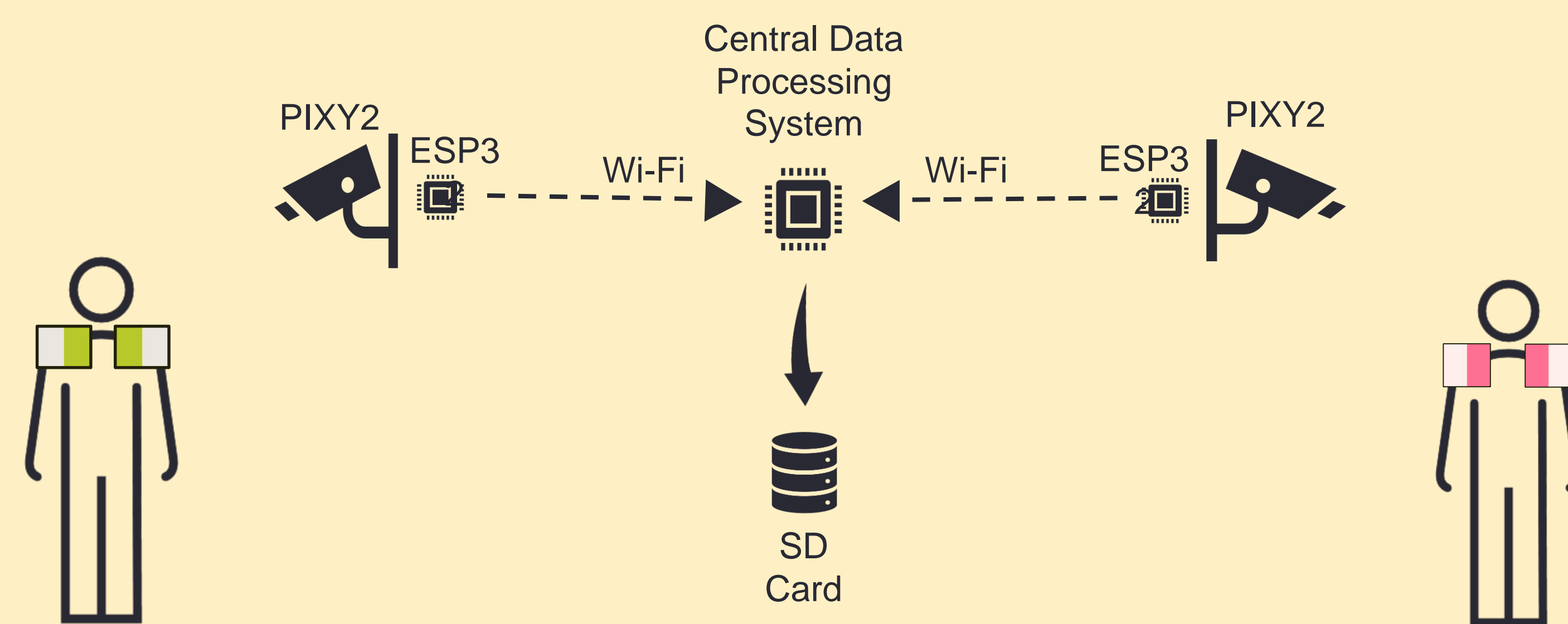
- Implement machine learning techniques to determine position and physical orientation
- Further implement fault detection for incorrect data or camera dropouts
- Implement auto-brightness and auto-exposure based on room light intensity, to improve detection rates

Top-level Block Diagram



HERA Habitat and System Design (camera placement)

- The HERA habitat is of a cylindrical shape, with a staircase in the middle. This is where the cameras should be placed to reduce blind spots given our design implementation.
- The Pixy2.1 is capable of visualizing an area spanning forty degrees in the vertical direction and eighty degrees in the horizontal direction. Each camera is angled about 40 degrees down for optimal detection of patches.



HERA Habitat layout

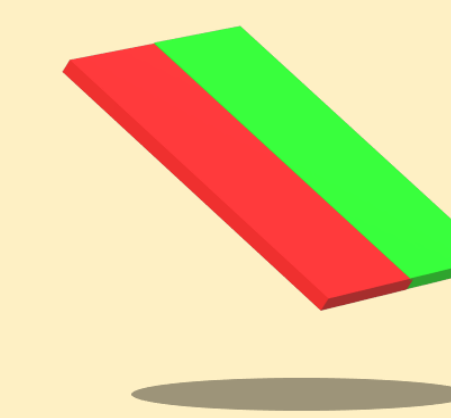
Pixy2 & Patch Design



Pixy 2.1 CMUcam5 Image Sensor

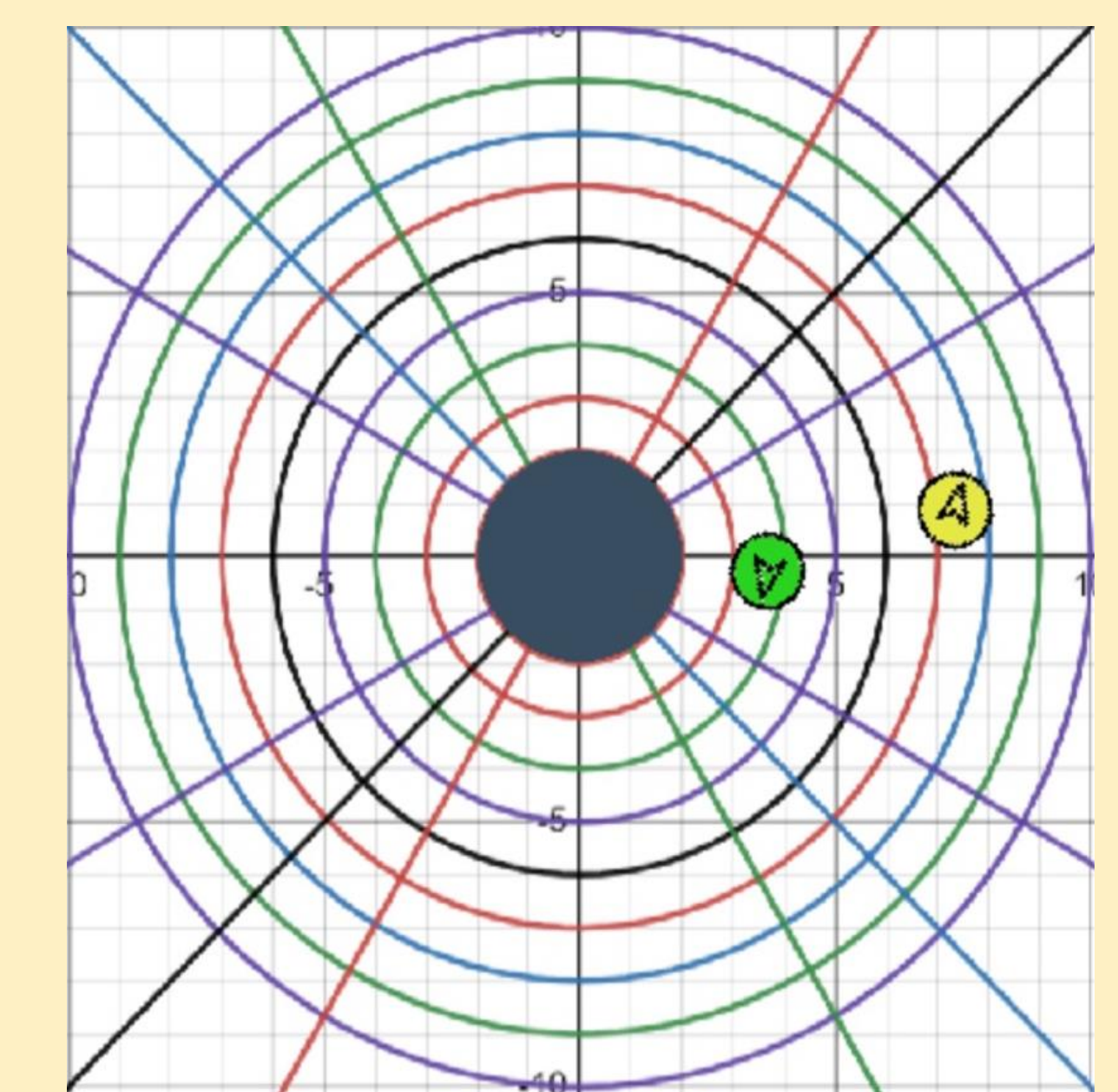


Example of Detected Patch



- 14 x 28 cm
- Made of Cotton
- Two Distinctive Colors

Example Output Data



R, θ , α : 58.91, 352.60, 3.00
Radius, Azimuth angle, Observer_angle
R, θ , α : 69.70, 352.40, 357.00
Radius, Azimuth angle, Observer_angle

Results

- Tracks 4 unique color-coded patches within a 6m area
- Calculates position within 0.15m of actual location.
- Percent difference in physical orientation of about 15-20%
- Data point time intervals are within one second
- Data storage does not exceed 1GB
- Completely passive system. Maintenance will be needed if a component malfunctions

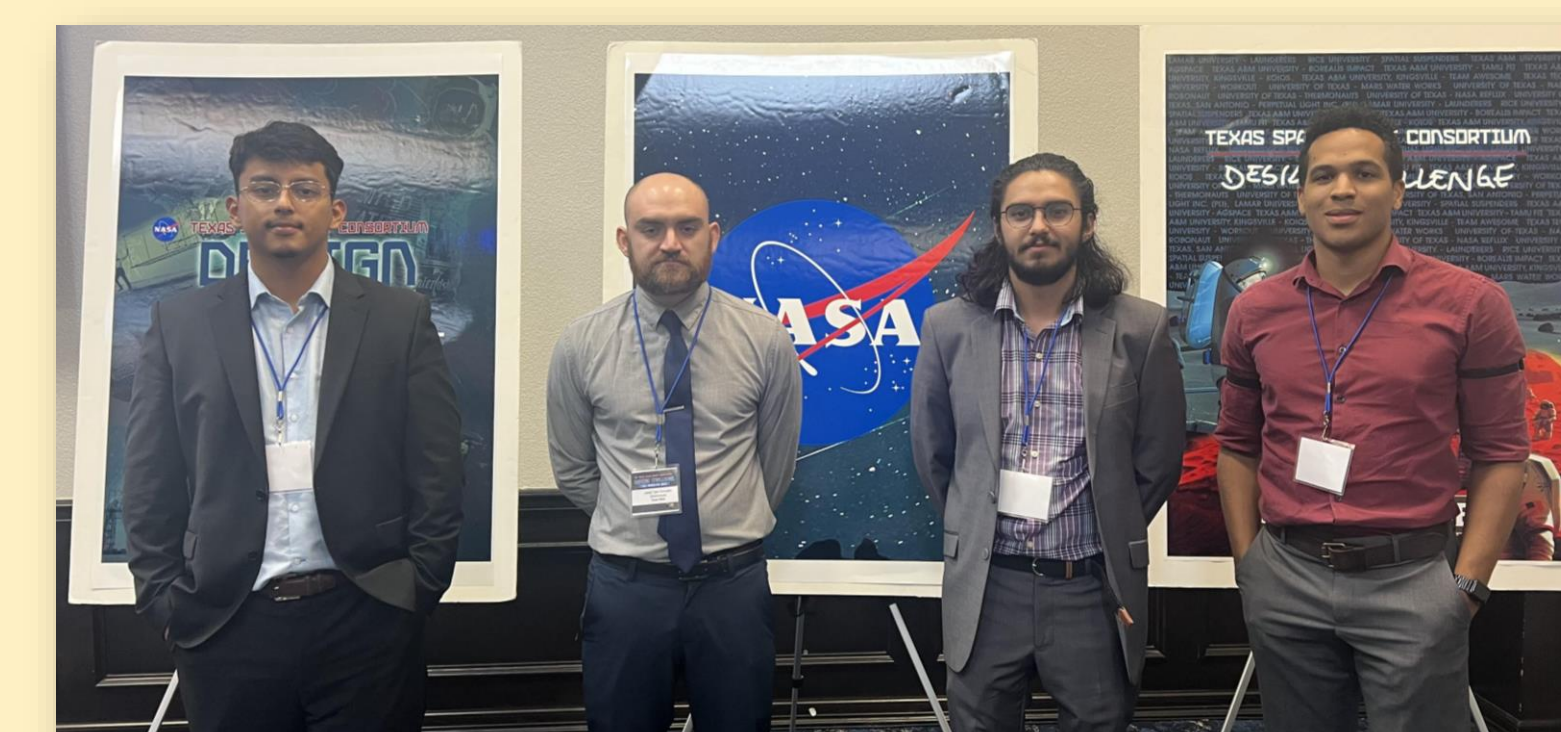
Acknowledgements

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Principal Investigator/Faculty Advisor: Dr. Cecil Compeau
TX State Faculty: Mr. Mark Welker, Mr. Jeff Stevens
Previous TSGC team: Electro-magicians

Budget

Item	Quantity	Unit Price	Subtotal
Pixy Camera	5	\$69.99	\$349.95
ESP32 Module	6	\$5.96	\$35.76
SD board	1	\$5.99	\$5.99
32GB microSD	1	\$9.99	\$9.99
MicroUSB cable	11	\$3.95	\$43.45
Dual USB power adapter	5	\$2.75	\$13.75
Total Cost:			\$458.90

Team Electronauts



Delmar Moreno | Jesse Gonzales | Gerardo Martin | LaBrynthe Jean-Batiste
Storage/GUI | Data Processing | Communications | Sensor Interface