The Team

Capstone Team Members:
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Team Sponsors:
- Dr. Yogananda Isukapalli - Professor
- John Karasinski - NASA
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Panoptes Argus

- Greek Mythology
- Argus Panoptes a Primordial Giant and Guardian
- Is described to be “all seeing” with multiple eyes
- “Followed by the Eyes of Argus”

“And set a watch upon her, great and strong Argus, who with four eyes looks every way. And the goddess stirred in him unwearying strength: sleep never fell upon his eyes; but he kept sure watch always.”
Problem

- Astronauts perform complicated procedures
- Assistance from ground control is required
- Major issue for future space exploration missions
- Communication delay and bandwidth limitations
Solution: Procedural Tracking

- Using Computer Vision and Machine Learning
- Tracking and logging procedures
- Assembling a Trossen PhantomX Robot Turret Kit
- Similar to procedures performed on the ISS
Nvidia Jetson Nano

- 128-Core Maxwell GPU
- Quad-Core ARM A57 CPU
- 4 GB 64-bit LPDDR4 SDRAM
- 2x MIPI CSI-2 DPHY lanes
- 4x USB 3.0, USB 2.0 Micro-USB
- Computer Vision/Machine Learning Applications
  - (Coded in CUDA, Python or C++)
- Connects both cameras using CSI and WiFi
Cameras

- **Raspberry Pi Camera**
  - Sony IMX219 8-megapixel sensor
  - Capture video at 1080p30 resolution
  - Communicates using CSI Port
  - Positioned in work station

- **GoPro Hero 5**
  - Uses RTMP Protocol to stream
  - Attaches on the Astronaut’s body
  - Python is used for Jetson/GoPro communication
  - Captures in Real-Time and checks for procedural errors
Workstation

- Screws will be placed into containers with QR Codes
- Workstation will be a flat surface with few to no objects
- Two cameras: wireless on the user’s body, wired on the workstation
Software Flow

Start

Get Frame

GoPro Hero 5

Raspberry Pi Camera

Custom Object Detection Model

Frame with Bounding Box

Validation Data

Procedures

Get Procedure

Stay on step

Step Not Complete

Step Complete

Move onto next step until procedure is complete.

Completion

Procedure Complete

End

Monitor

Completion
Block Diagram/Components

- Raspberry Pi Cam
- CSI Port
- Nvidia Jetson Nano
- WIFI
- GoPro Camera
- Monitor
- HDMI
What happened so far?

- All parts purchased
- Video demonstration of the construction of the robot turret
- Split the turret construction into strictly-defined stages
- NVIDIA Jetson Nano initialized with Ubuntu, WiFi, and Bluetooth
- QR Code Detection using Raspberry Pi Cam
- Working on training a custom object detection model using ImageAI
- Video feedback for the User Interface
- Working on defining a custom dataset
Future Goals

End of Fall 2020:

- Get the main framework working. Have all the cameras detect objects and connect to each other
- Be able to display the process in our User Interface with additional features

Winter 2021:

- Recognize the parts of the Robotic Turret
- Start to work on the tracking of the procedure by notifying the user if they’re doing it correctly

Spring 2021

- Finish up the project and make it presentable without bugs
- Work on stretch goals, if time permits
  - Other procedures, sensors, Body Pose Estimation, Interactive Voice Response
Questions?