Nature Photography Robot

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Product Pitch

Animal photography is time consuming and mundane; remote controlled photography robots do little to fix this problem. Photo editing is necessary, but similarly human-capital intensive.

PhotoRobo is designed to fix this problem!!

PhotoRobo is a stationary nature photography robot that **detects an animal** (within a 25 metre radius). The robot is built to be able to **track a moving target** like a walking animal (which moves at around 2 m/s). After **focussing** on the target, it captures a photo and runs an **automated photo editing** algorithm to return a nearly professional grade photo of the animal to the user.

System Architecture

The hardware schematic diagram below shows how the different components of the robot are connected to each other.

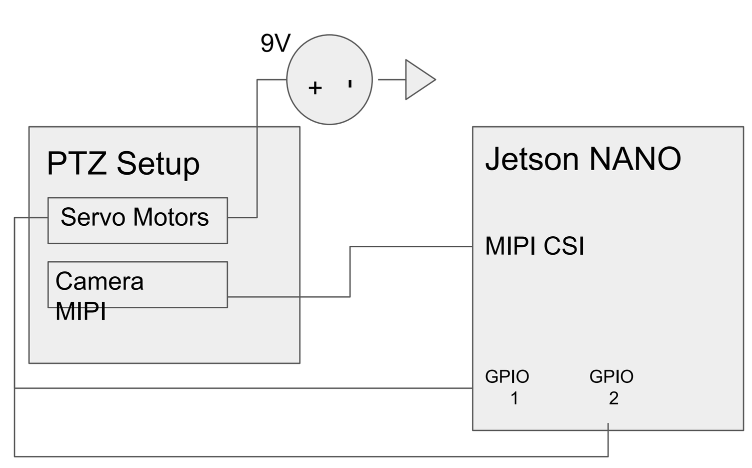

Figure 1: PhotoRobo Hardware System Schematic

Similarly, the diagram below explains the architecture of the software behind the PhotoRobo. The diagram shows how the system moves through the different phases, namely: Search & Detection, Tracking (KLT) and Image Editing, based on decisions it makes while responding to real-time inputs.

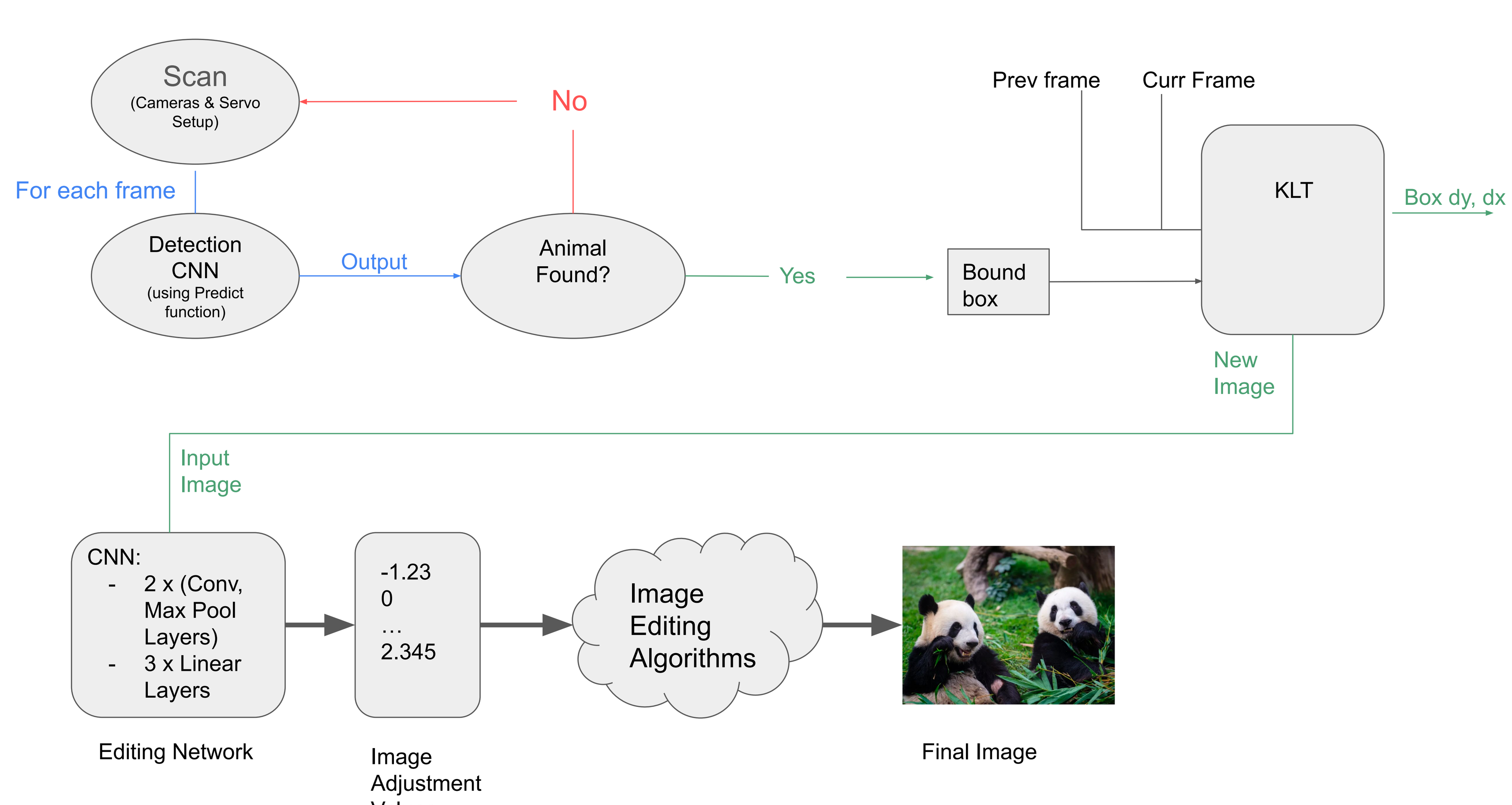

Figure 2: PhotoRobo Software System Architecture

System Description

Hardware:

- ***A Jetson Nano 2GB Developer Kit*** (Label 1) which acts as our CPU, allowing the robot to be a stand alone system. It:
  - Handles the processing needed for running the detection, tracking and editing algorithms.
  - Communicates with the camera and motors and controls their operation according to the phase of operation.
- The Camera setup:
  - An ***Arducam 8MP Pan Tilt Zoom Camera*** (Label 2) to capture real-time video feed and click pictures of the target.
  - It is connected to the MIPI port on the Jetson.
  - **A *Metal Base*** (Label 3) and **2 *Digital Servos*** (Label 4) to rotate the camera for scanning the area or tracking amd focussing on a target. Similarly, these connect to the GPIO Pins on the Jetson

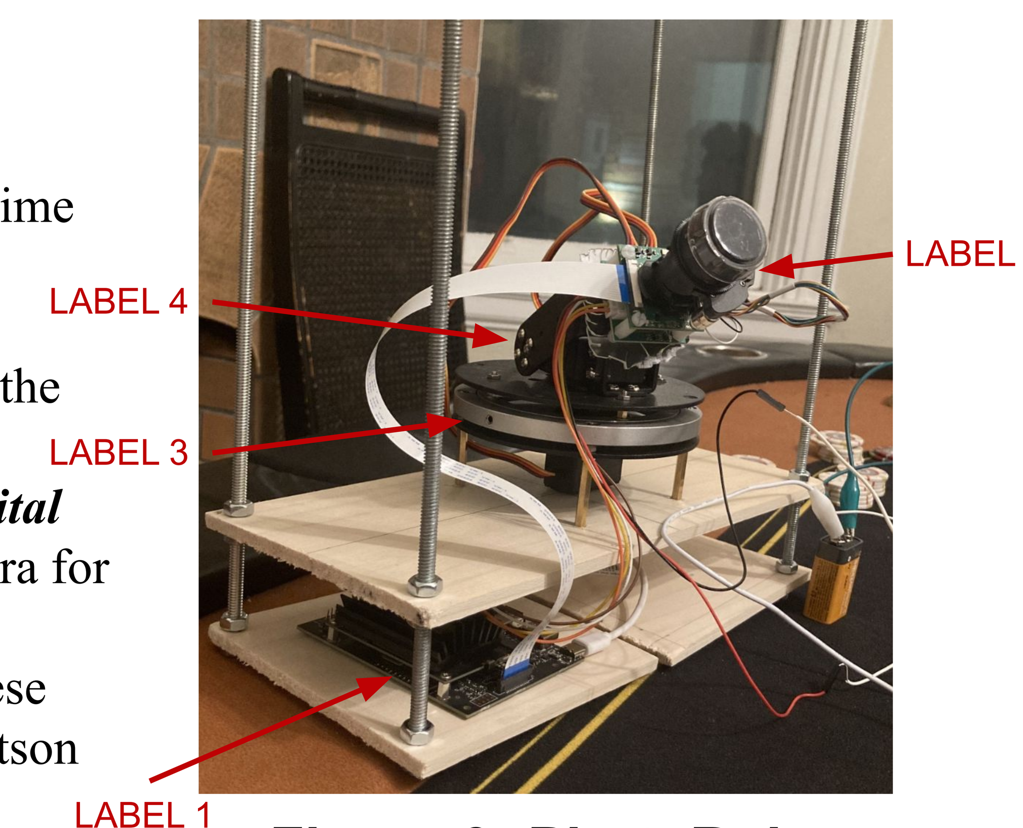

Figure 3: PhotoRobo

Software:

- ***Search and Detection:***
  - Our system uses a **YoloV5** detection model trained on the **WCS camera trap dataset**. This detector is used with a constant scanning algorithm to search for, and find animals
- ***Tracking:***
  - We use a **Kanade-Lucas-Tomasi feature tracking algorithm** to follow animals after they are found. This approach allows us to continually photograph the animal even if they are not stationary.
- ***Photo Editing:***
  - We implemented a **library of 7 image editing algorithms** (Tint, Sharpness, ect.) and trained a **CNN** to apply these algorithms to the photographs.

System Evaluation

Photo Editing Testing Results (Percent Correct Guesses)		
No Modification	Heuristic Editing Rules (Original Approach)	Neural Network Approach
91%	85%	68%

Figure 4: Comparison of Photo Editing Methods

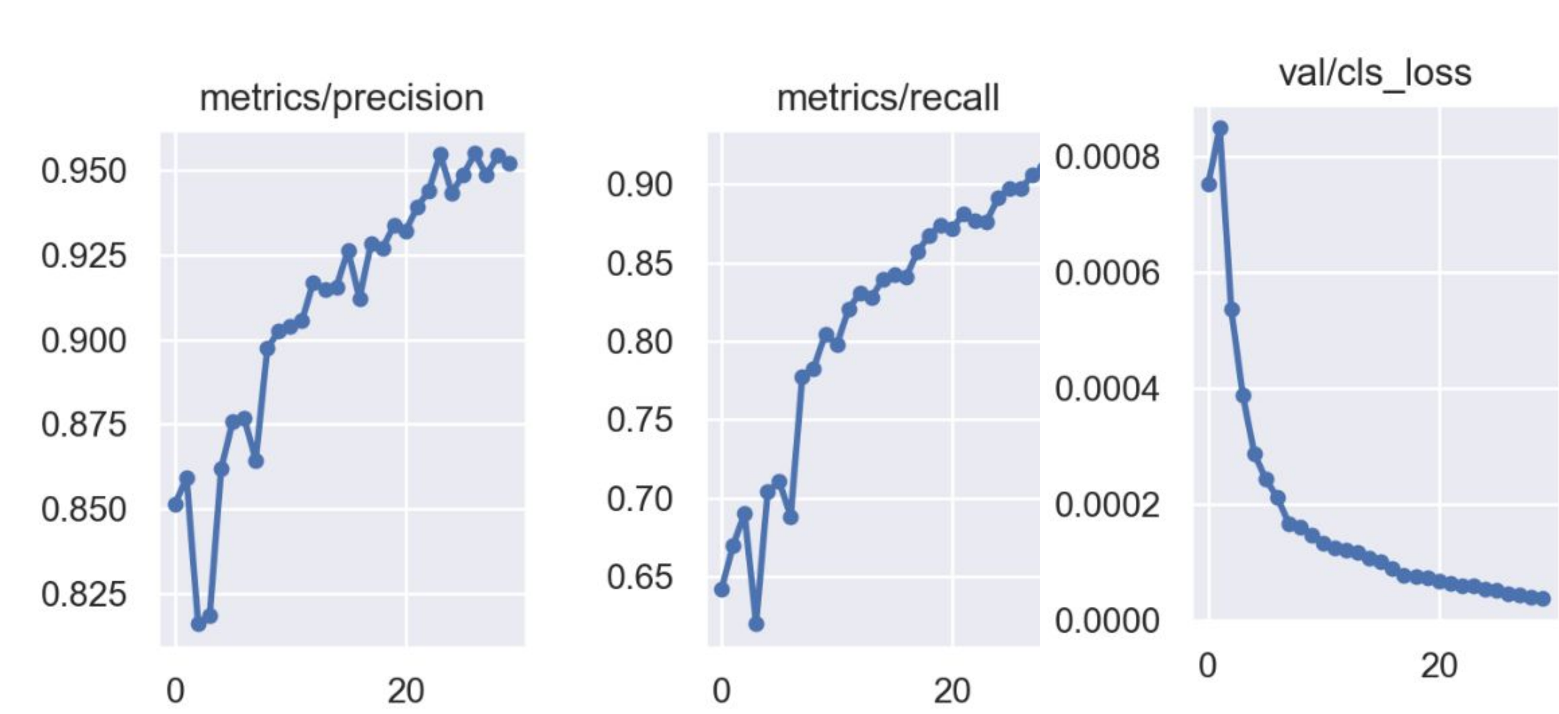

Figure 5: YOLOv5 Model Results

Distance (m)	5	15	25	35
Autofocus ability				
Detection ability				
Min. Tracking Duration Passed (5 secs)				

Figure 6: KLT Testing Metrics (Low Lighting / Regular Lighting)

Conclusions & Additional Information

Our results show that it is possible to automate animal photography. Future work should extend this project to other fields of photography, and develop a more professional system with higher quality components. With a DLSR camera and stronger computational resources, we believe that our methods could rival professional quality photography.
Please see our testing handout for the most up to date and detailed testing results.

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