Project Alpha India 2

MV/AI for Wildlife Rehabilitation

ELECOMP Capstone Design Project 2025-2026

Sponsoring Company:

SANCTUARI
Box 559
Warren, RI 02885
https://sanctuari.org/

Company Overview:

SANCTUARI is a 501(c)(3) nonprofit wildlife care organization improving wildlife survival rates by leveraging modern technology. We are privately supported without federal, state, or municipal funds and are unaffiliated with other Rhode Island wildlife organizations.

Technical Director(s):

Joe Moreira
Founder and Board Chair
sanctuari.org@gmail.com

James DeMello & Yashaswini Mandalam
Consulting Technical Associates
demelloj21@gmail.com & yashmandalam@gmail.com

Project Motivation:

There are insufficient numbers of wildlife rehabilitators to serve wild animals in need. Many rehabilitators are overextended and so struggle to provide high quality care. This project aims to help solve this fundamental issue by leveraging rapidly advancing Machine Vision/Artificial Intelligence (MV/AI) technologies. These can fundamentally improve wildlife rescue and rehabilitation as well as veterinary medicine. SANCTUARI has amassed nearly 1 petabyte of proprietary, mission-critical video records. This project will build upon the previous team's work by deploying refined AI to intelligently filter those for relevant content which will then be used to further develop the AI for pairing with video monitoring systems. Those systems will greatly improve the carrying capacity and diagnostic effectiveness of wildlife caregivers via the numerous methods to be demonstrated as the project advances.

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Anticipated Best Outcome:

Completing at least **25 of the 75** items listed with parenthetical number headers in the following Project Details section will constitute achieving the Anticipated Best Outcome (ABO).

Project Details:

Executive Summary

- Team members will be empowered to function as if all are co-CEOs of a new organization. The team will achieve its goals by defining comprehensive and complete logical AI workflows for sorting video content, with substantial help from their Technical Director (TD) and Consulting Technical Associates (CTAs). One of the CTAs was a member of the previous year's Alpha India team, which built a custom hardware solution with a set of software tools to implement the most fundamental workflows. As much of the work as possible will be done with on-prem (versus cloud-based) AI given security and intellectual property protection concerns.
- This year's team will substantially expand the work of the previous team since the field of AI has so rapidly advancing.
- Multiple technical efforts will be pursued in parallel to make the project a success.
- Team members will be empowered to use *existing* AI functionality wherever possible, including standalone software packages for purchase, free apps, and more. Whatever cannot be achieved with such tools will be considered for building "from scratch."

Videos to be analyzed

- The files have **no audio**, so all work will be on **only visual content**.
- Files are from **~50 cameras** from **~4 systems** by GW, Lorex, and Firstrend.
- All cameras are in a **fixed position**, roughly half-and-half **indoor and outdoor**, each with unique filtering and masking challenges.
- All cameras have **day/night recording** capability, so filtering must be tailored and tested for full-color (daytime) and grayscale infrared (IR night vision).
- Cameras and systems have different native resolutions, frame rates, lens types, default file formats (/codecs), motion trigger sensitivities, and pre-/post-record lags, so the team will collaborate with the TD and CTAs to best (1) standardize, and in some cases (2) upconvert.

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Content filtering workflows

- Most files are generated via motion capture triggers, requiring filtering and/or area masking for non-animal triggers. Initially, as a fallback position, the team should structure AI such that it allows a user to (3) **manually mask** areas containing irrelevant motion triggers and then have the AI analyze remaining areas per what's below. The team should then allow for enablement of workflows wherein (4) the AI is intelligent enough to **ignore irrelevant motion triggers** on its own.
  - Non-animal triggers to be filtered for include **changes in illumination**, such as from (5) indoor lights turning on and off, (6) indoor lights turning on through a window which is in view of an outdoor camera, (7) sun and clouds alternating outdoors, (8) branches or power lines occulting lights at night by swaying in wind, and (9) passing vehicles, pedestrians, and any of their associated lights (especially when occulted by foreground items at night).
  - These also include **non-animal motion triggers**, such as (10) windblown items like leaves and branches, precipitation such as (11) rain, (12) snow, (13) sleet, and (14) hail (which complicates AI detection by bouncing), (15) fog and (16) pollen (night recording renders fog and pollen brightly due to their infrared reflectivity, and they are challenging to filter, as their motion can resemble animal motion, for example the nighttime eye-shine of an animal bounding across a field).
  - Videos must also be put through a "**human filter**" before all other filters and sequestered to satisfy privacy requirements (donors and rehabbers who wish to remain anonymous, Amazon delivery drivers, USPS postal workers, and so on). A tri-redundant filtering system is desired for this step. One filter was set up by the previous team, leaving (17) two more to be done. It must (18) detect partial field of view incursions (ex.: just hands, just feet, just faces), and it must be able to (19) blur faces/protect identity.
  - Videos, particularly from outdoor cameras, need to be filtered to exclude (20) insect-on-camera-lens motion triggers, especially in night/infrared mode.

Advanced AI recognition of filtered content

- The Alpha India 2 team will test and possibly refine the previous team's existing AI system to (21) sort existing motion-triggered video content accurately and precisely into four categories based on content: animal, human, both, and neither.

- The Alpha India 2 team will test and possibly refine the previous team's existing AI hardware platform to (22) improve its computational efficiency. The current system can process at a 16:1 ratio for most video formats (takes 1 hour to process and label every single frame of 16 hours of videos).
- Some, but not all, AI uses for distinguishment of video content or input which otherwise passes all preceding animal relevancy filters include…
  - (23) species distinguishment (and number of each) in frame, including, for animals in rehabilitator care, (24) alarming when an animal is not in frame but should be (alarm feature to indicate missing animal), with all the following to be considered on a per-species basis:
  - (25) distinguishment of individuals within each species in frame, including (26) recognition of juvenile evolution to adult and (27) weight gain/loss or other size/form factor changes
  - (28) animal positioning relative to camera, including (29) recognition of abnormal posture (indicating pain, such as nose-to-ground or "S-pose")
  - macroscopic, visible injuries such as (30) missing limbs, eyes, ears, noses, etc., (31) lack of eye shine in infrared, (32) missing patches of fur, (33) mange, (34) lacerations and/or bleeding, (35) abscesses, common parasitic issues such as (36) fleas, (37) ticks, and (38) fly strike
  - (39) breathing rate, when visible (depth, wave motion, abnormal or alarming known breathing patterns) and similarly with (40) pulse/heart rate where discernible (stress-startle, healthy/unhealthy)
  - (41) juvenile group monitoring (distinguishment of fighting vs. playing),
  - sortation of basic activity types such as (42) foraging, (43) eating, (44) drinking, (45) grooming, (46) resting and awake vs. (47) sleeping vs. (48) dreaming motions, (49) carrying items, (50) playing, (51) sitting vs. (52) standing vs. (53) warning displays, (54) walking vs. (55) running, (56) normal vs. abnormal gait, (57) climbing vs. (58) falling, (59) jumping
  - (60) coughing vs. (61) choking vs. (62) gaping vs. (63) yawning vs. (64) clicking vs. (65) chuffing vs. (66) hissing vs. (67) other warning displays (again from video imagery only without sound)
  - (68) seizing vs. (69) convulsing vs. (70) voiding
  - For animals in rehabilitator care, (71) presence/absence of food and (72) water in frame, (73) need for cleaning, enablement of (74) manual masking for exercise wheel recognition or even (75) AI recognition of wheel use and speed

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Composition of Team:

1 Computer Engineering major and 1 Electrical Engineering major

Skills Required:

The most important team member attribute is deep concern for animal welfare. SANCTUARI's extensive experience with these types of projects shows us that a group of engineers with "mediocre grades" who are passionate about the mission will be much more successful than a group of "A+ coders" who are ambivalent about the mission. Other desired traits include:

- Quick learning; high curiosity; comfort with various technologies/schemes.
- Propensity for meticulous analysis and testing.
- Self-motivation respecting research of existing, relevant solutions; capability to aggregate and compare strengths/weaknesses of "competitors" and useful related tech; willingness to engage with outside organizations to collaborate.
- Accountability and willingness to "own" the system design as a good startup CEO would.
- Desire to be hands-on with testing and drive to optimize and wring out design performance, allowing the system to "tell the engineers what it needs next."

Anticipated Best Outcome's Impact on Company's Business & Economic Impact:

Successful execution will allow us to rapidly produce and distribute devices and educational materials to our network of carers and supporters, including veterinarians and licensed rehabilitators. This will help fundamentally improve the quality of wildlife care.

Broader Implications of the Best Outcome on the Company's Industry:

Saving one animal, or expediting their recovery, along with proper documentation and communication, can quickly lead to the saving of thousands more. This project will generate systems to better care for wildlife and will generate data enabling carers to correlate, aggregate, publish, and refine best practices, giving animals better opportunities to thrive.

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