Project Scarecrow: A Smart Autonomous Surveillance System

Victor Tran (CSE), Jack Ramirez (CSE), Nhat Nguyen (CpE), and Manpreet Singh (EE)
Professor Hung Cao
Department of Electrical Engineering and Computer Science

Background

Stray animals that come in close proximity to gardens spread pathogens and ticks that harm humans, plants, and pets. Physical damages include burrowing, trampling harvest, urinating, defecating, and destroying personal property. Gardens are often where animals to congregate during mating season. Counterproductive solutions are the use of inhumane traps, pesticides, and primitive idling scarecrows.

Project Goal

- Detect, identify, and classify objects within the device's projected proximity
- Survey an area on a low-power and low-latency standard with millisecond inference times
- Once an object is classified correctly, deter the intruder with specialized audio-animatronics
- Ensure portability and handle convolutional neural network calculations offline without a cloud
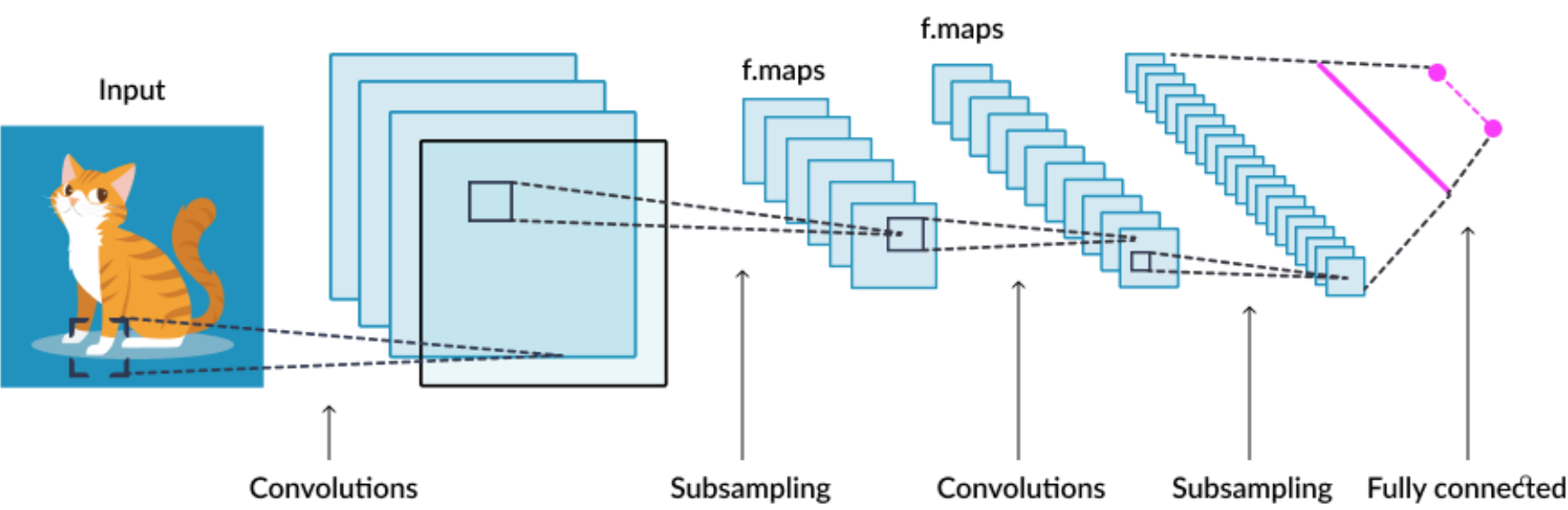
A convolutional neural network (CNN) is a multilayered system that mimics the biological neuron model. A CNN consists of an input layer, output layer, and multiple hidden layers. Each input image will pass through a series of convolution layers with filters (Kernals), pool fully connected layers (FC), and apply Softmax functions to classify an object with probabilistic values between 0 and 1.
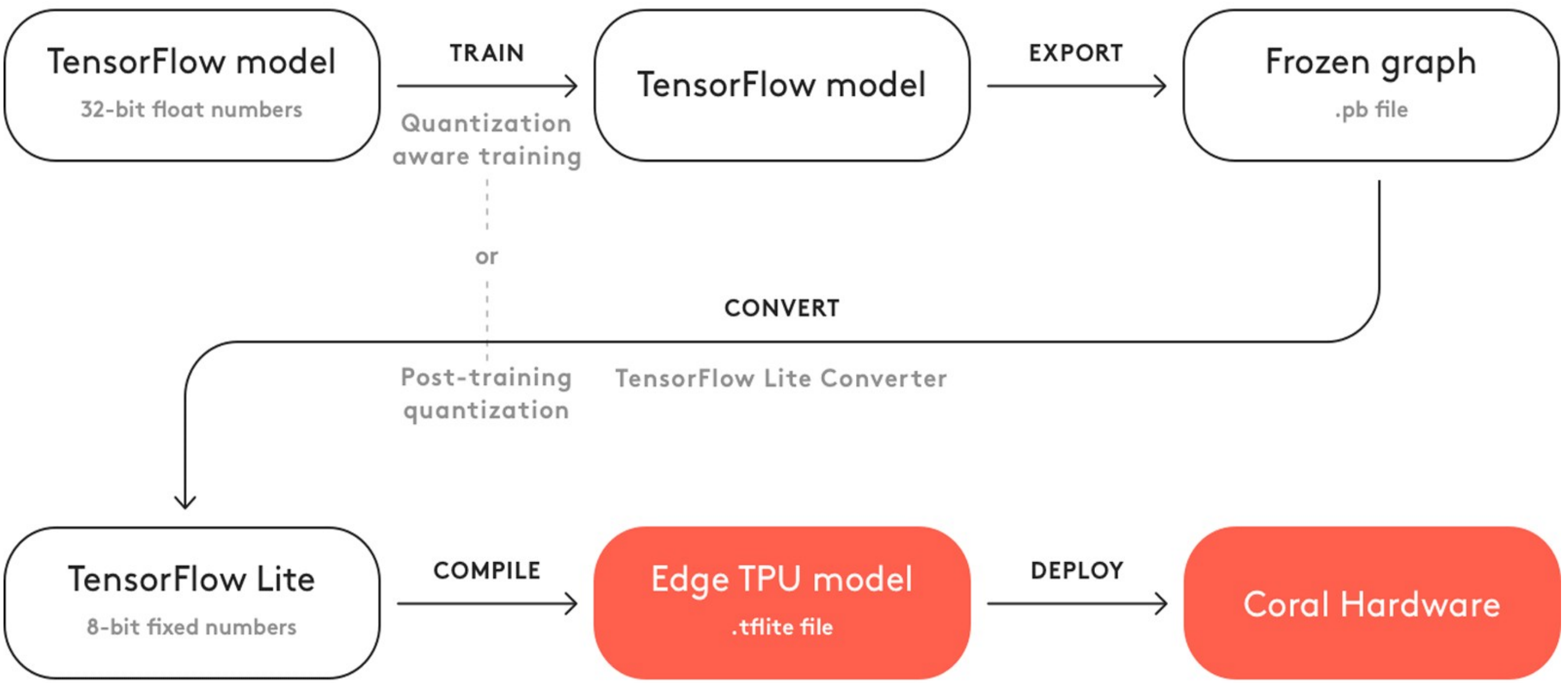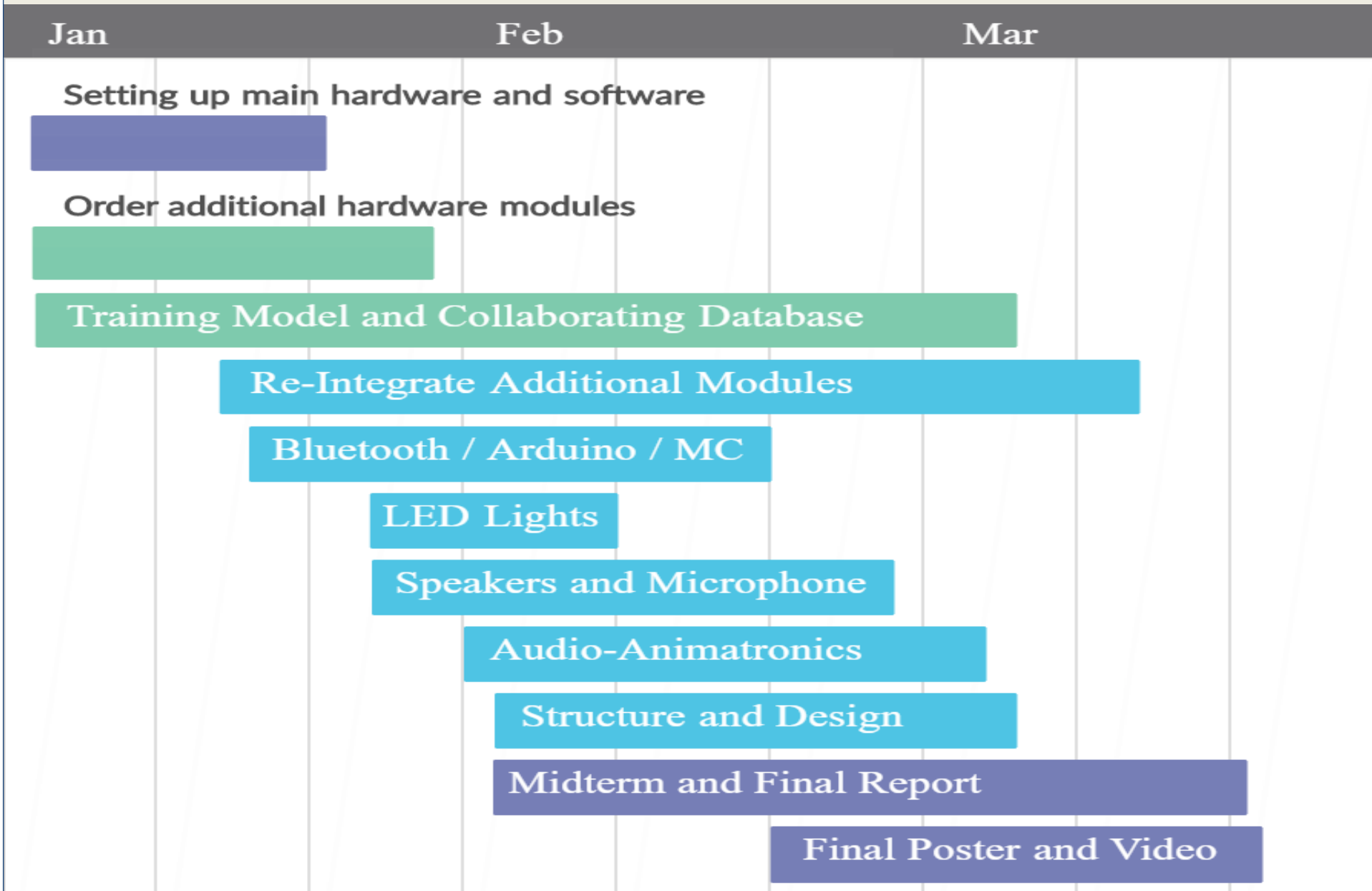

Materials

Hardware

- Google Coral Development Board
- Coral camera module
- Stepper motor(s) and driver
- Arduino Uno and Atmega32
- HM-10 Bluetooth 4.0 module
- 1W LEDs, 20W speaker

Software

- Debian Linux (Mendel 4.0)
- C, Python, Anaconda
- OpenCV and GStreamer
- TensorFlow v1.14
- LabelImg
- Solidworks and Atmel Studio

Milestones

Future Work

- Include a near-infrared camera and biosensors to monitor pollution
- Create quality audio/visual animatronics to accompany deterrent protocols
- Transfer learning by quantization-aware training
- Design and build the scarecrow structure with 3D printed models and natural materials.
- Use a video-writer to create snippet videos of animals and store them for future inspection

References

[1] Koehler, Ann E., Rex E. Marsh, and Terrell P. Salmon. "Frightening methods and devices/stimuli to prevent mammal damage--a review." (1990). Proceedings of the Fourteenth Vertebrate Pest Conference 1990. 50. [Online] Available: http://digitalcommons.unl.edu/vpc14/50. [Accessed: October 15, 2019].
[2] P. A. Dhulekar, S. T. Gandhe, G. R. Bagad, S. S. Dwivedi, "Vision Based Technique for Animal Detection", Advances in Communication and Computing Technology (ICACCT) 2018 International Conference On, pp. 344-348, 2018. [Online]. Available: DOI: 10.1109/ICACCT.2018.8529660. [Accessed Nov. 11, 2019].
[3] Parikh, Mansi, Miral Patel, and Dulari Bhatt. "Animal detection using template matching algorithm." International Journal of Research in Modern Engineering and Emerging Technology 1.3 (2013): 26-32.
[4] T. V. Price & C. F. Osborne,"Computer imaging and its application to some problems in agriculture and plant science," Critical Reviews in Plant Sciences, 9:3, 235–266, 1990. [Online]. Available: https://doi.org/10.1080/07352689009382289. [Accessed Nov. 11, 2019].