InFrame

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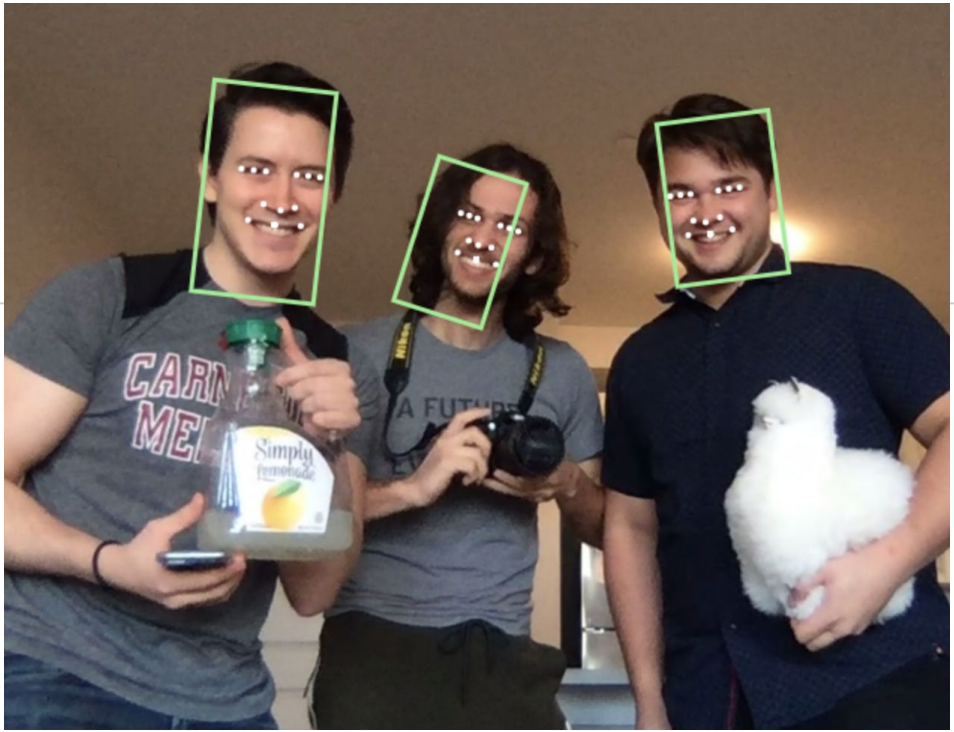


Our team!

The Inspiration

Use Case

- Saving position and camera angle snapshots (keyframes)
- Facial tracking to keep subjects InFrame
- 360° Panoramic guide/stitching portal
- Remote Control iOS interface
- Timelapse

Requirements: Hardware

Motion

2DoF. 360° pan, 180° tilt. Based on keyframe mode upper bounds:

Zoom/Focus adjustment: 90°/s.

About vertical axis (pan): 180°/s.

About horizontal axis (tilt): 45°/s.

Battery Life

8+ hours of recording time.

Interchangeable and rechargeable batteries.

Battery level indicator facing subject.

Form Factor

Portable System with table or tripod mount.

Supports DSLR cameras <=5 lbs, smartphones, and action cameras (e.g. GoPros).

Requirements: Software

Real Time Tracking

Video lag over 60ms becomes noticeable. Facial tracking and movement must be <60ms. A 30 FPS camera grants us 30ms for CV decision and 30ms for movement.

Computer Vision

Determines position ±10% in frame of subject within 30ms with at least 70% confidence for objects and 90% for faces (a bit below state of the art since we prioritize speed over accuracy).

Companion App

Switch between modes of operation.

Communicate over bluetooth with on-board SBC.

Solution Approach

Embedded Computer & Camera

We will be using an NVIDIA Jetson Nano. This SBC has enough power to run our CV algorithms. We will use a RPI camera, it is supported by Jetson and has 30FPS 720P.

Power and Motion

Power tool batteries have a high power density and built in protection circuitry. This battery voltage will need to get regulated to system voltage levels.

Using high torque servos, good formfactor and ease of use.

Form Factor

3D printed mechanisms for pan and tilt.

Slot for exchangeable batteries.

Standard camera screw for tripod and DSLR.

Clip for phones.

Solution Approach

Computer Vision

YOLOv2 for object detection at 40-90 fps with 76.8% accuracy. If not fast enough on Jetson Nano, Tiny YOLO instead for higher speeds but lower accuracy.

Facial recognition using Google FaceNet and one-shot learning to fine-tune using fewer images.

Companion App

iOS app framework, including the use of UIKit for managing an event-driven GUI, and Core Bluetooth to send commands to on-board SBC.

Testing, Verification and Metrics

Motion

- Movement no-mass (degrees/second)
- Holding Mass (kg) how much can be held at full extension
- Loaded Movement (degrees/second/kg) how fast can it move with a camera on it.

Electronics

- Power Consumption (W)

  Ensure batteries will last at least 8 hours
- Thermal testing (°C)

  Prove it will not overheat
- Power management, ensure all devices are receiving required power

Testing, Verification and Metrics

Computer Vision

- Subject position within 10% of subject bounding box center.
- Subject position estimate determined within 30ms of input frame.
- Subject confidence of at least 70% for objects and 90% for people.

Companion App

- Data transmission: Serial data over bluetooth is received on system.
- App state updated through app is consistent with state on system.
- Interactions between activities triggered by appropriate events.

Tasks and Division of Labor

Diego Martinez

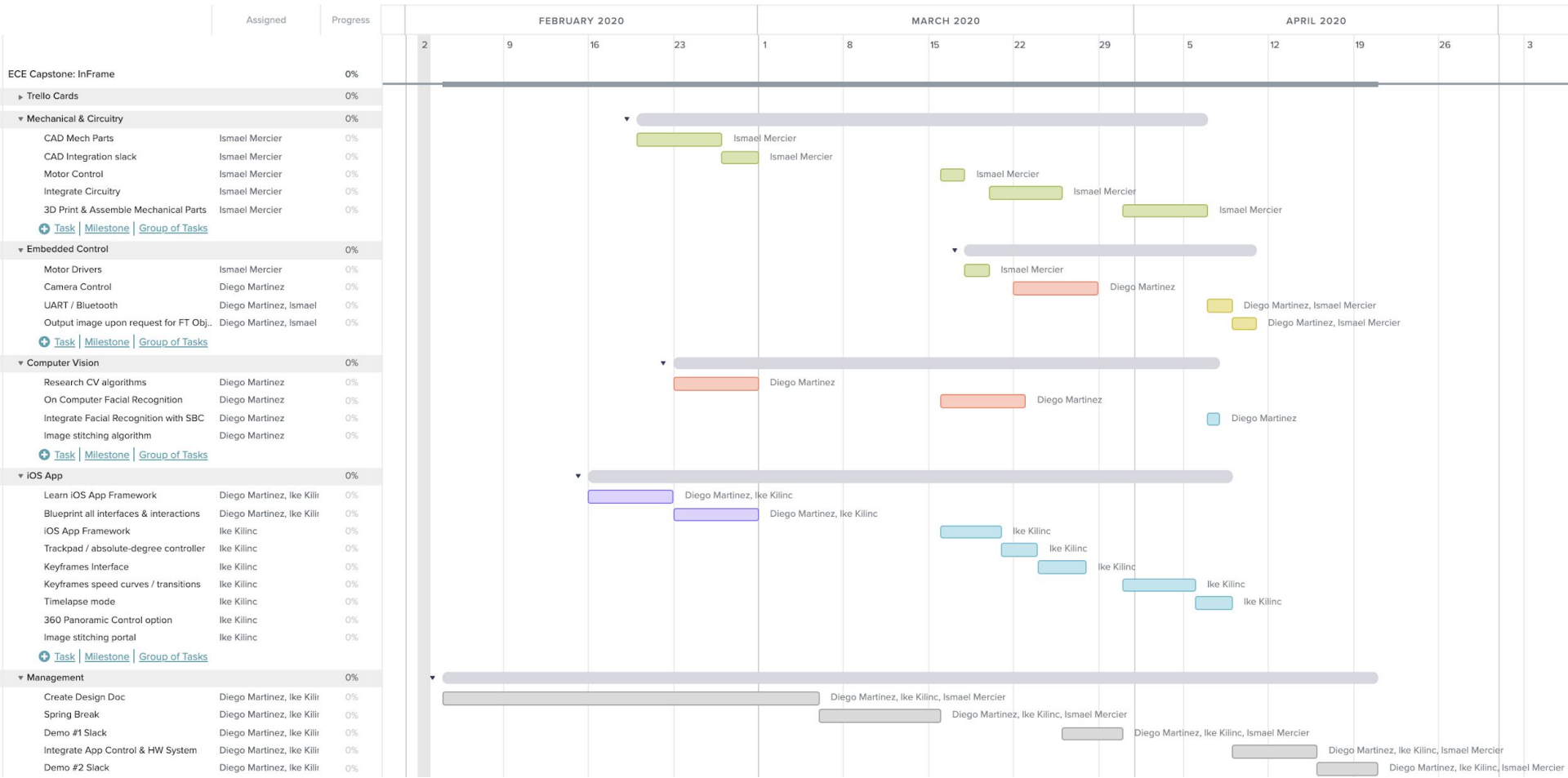
- Facial Tracking
- Object Detection and Image Segmentation
- Camera Drivers
- Bluetooth Drivers
- iOS App

Ike Kilinc

- Manual Remote Camera Control
- Keyframes and Transitions
- UX/UI Design
- iOS App

Thor Mercier

- Power Circuits
- Motor Drivers
- 3D Modeling and Manufacturing
- Embedded Firmware



Schedule Gantt Chart