Mark Do

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Technical Skills

Languages: Python, C++, Java, JavaScript, Scala, ROS2, Bash, Arduino, MATLAB, SQL

Libraries & Frameworks: PyTorch, Ultralytics, TensorFlow, OpenCV, Scikit-learn, Docker, Node.js, React, AWS, PyTrees

DevOps: Docker, Kubernetes, Terraform, Ansible, Git, GitHub, GitLab

Education

University of Waterloo - *Candidate for* ***Bachelor of Mechatronics Engineering*** 2022 - 2027

- 4.0 Cumulative GPA | 94% term average | 3X Dean's Honours List

Experiences

Robotics Software Developer| Python, Django, NumPy May. 2024 – Dec. 2024

Rapyuta Robotics *Tokyo, Japan*

- Developed Task Planner **component that plans robot & item movement** for an **Automated Storage and Retrieval System**.
- **Scaled Task Planner** to manage **x10 more robots** (6 to 60) **within 4 months** through extensive reliability features.
- Created robot replanning behaviours to **operate despite failures**, enabling **company's first deployment to customers sites.**
- Developed a **fast, lightweight & non-dockerized sim** to mock robot error & **design recoveries for over 20 undefined states.**
- Optimized warehouse **order execution priorities** with an algorithm that creates & **solves a Travelling Salesman Problem.**
- Designed and implemented a **5-component pipeline** that analyzes customer data & generates theoretically optimized ASRS.
- Developed **Genetic Algorithms** to solve the non-convex Blackbox problems of maximizing item throughput for the system.

Autonomous Software Developer | C++, Casadi, Kubernetes, Terraform, PyTrees Nov. 2023 – July 2024

WATonomous (Waterloo Autonomous Vehicles)

- Designed high-level car **navigation controller** that uses **behaviour-trees** and **Reinforcement Learning** to take driving actions.
- Developed a **dual-model MPC** system, joining a **Multi-Layer Perceptron** with a **traditional kinematics model** for car navigation.
- Managed server hardware & cloud infrastructure to support workflows for **over 50 developers across 3 universities**.
- Created an Asset Manager that manage website assets using **self-hosted Ceph S3 Buckets** & **deployed on a Kubernetes Cluster.**

Autonomy Developer | *Unsupervised Learning, Scikit-learn, Linux, Clustering algorithms* Apr. 2023 – Sep. 2023

Waterloo Aerial Robotics Group

- Developed a clustering algorithm for an **autonomous drone's** onboard **perception system** to postprocess landing pad CV model.
- Implemented a **VGMM as the clustering algorithm** to **differentiate real landing locations** from false positives.
- Integrated the module into a producer-consumer multi-processing architecture, ensuring correct behaviour with unit tests.

Projects

EEG Motor Imagery Classifier | *PyTorch, Motor Imagery, Deep Learning* GitHub

- Developing deep learning model on EEG brain data for motor imagery classification task on 64-channel MI dataset.
- Converted 64-channel time series data into volumes in the time-frequency domain using FFTs for use with convolutional kernels.
- Wrote custom data samplers in PyTorch with weak shuffling to optimize data read speeds for training batches from .h5 files.

Defect Detection Model | *YoloV8, Ultralytics, Roboflow, Object Detection, Transfer Learning* GitHub

Toyota Design Challenge

- Created an object detection model using transfer learning on YoloV8 to recognize & localize misplaced stickers on car chassis.
- Engineered the ML model to prioritize high recall and work with a fast-moving camera to match Toyota's QC requirements.
- Used semi-supervised training with extensive data augmentation to get a mAP50 score of 0.95 using just 300 training images.

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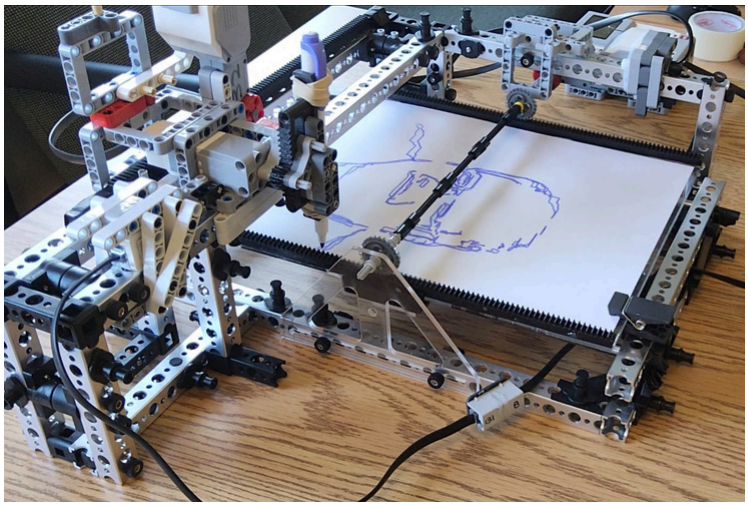
ARTICUS MAXIMUS (SKETCHING ROBOT) April 2023 - July 2023



Project Description:

- Articus Maximus is a 2-axis-gantry robot that sketches images from a file onto paper as line-art

Image Processing Algorithm

- Python pipeline starts with pre-processing (Gaussian blur, greyscale, and resizing) input JPG/PNG files
- **Canny edge detection** and **contour detection** applied
- Contour detection output still contained redundant lines: combined **Hu Moments** and position matching algorithm to remove duplicates
- Simplified each contour using a recursive **Douglas-Peucker algorithm** to decrease drawing time

Robot Control Systems

- Created a PID controller in C for X and Y-axis motors with Heuristic tuning
- Controller uses a **low pass filter, anti-windup**, and a 1D **motion profile** to draw lines accurate to within 2 degrees.

GitHub - Articus Maximus

AUTONOMY DEVELOPER - WARG April 2023 - Sep 2023

WARG is a a design team focused on the unmanned aerial vehicle industry, which develops open-source autonomous flight software.

Clustering Algorithm

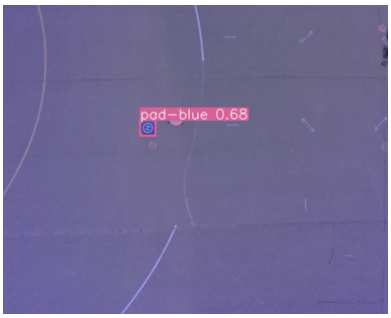
GitHub - WARG/ClusterEstimation

- Developed a clustering module for the perception-decision-controls system to predict drone landing locations.
- Landing pad detections from camera has positional inaccuracies and false positives.
- Module uses a Variational Gaussian mixture model to group all detections to find probability centers and predict most likely landing pad locations

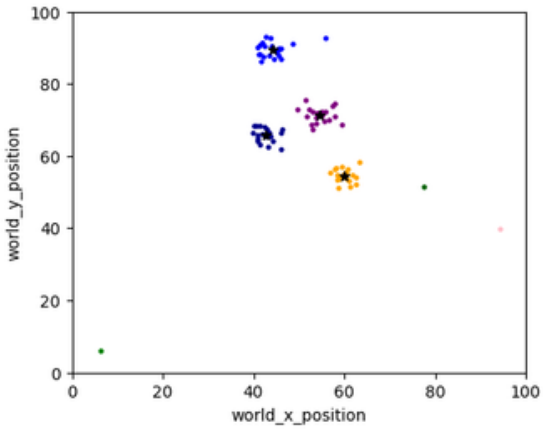
Documentation Contributions

Confluence Documentation

- Wrote post-mortem summaries after test flights.
- Created high level documentation for cluster module, programmed according to PEP 8 & internal style guide.



Sample model result for input data with outliers and poor distribution



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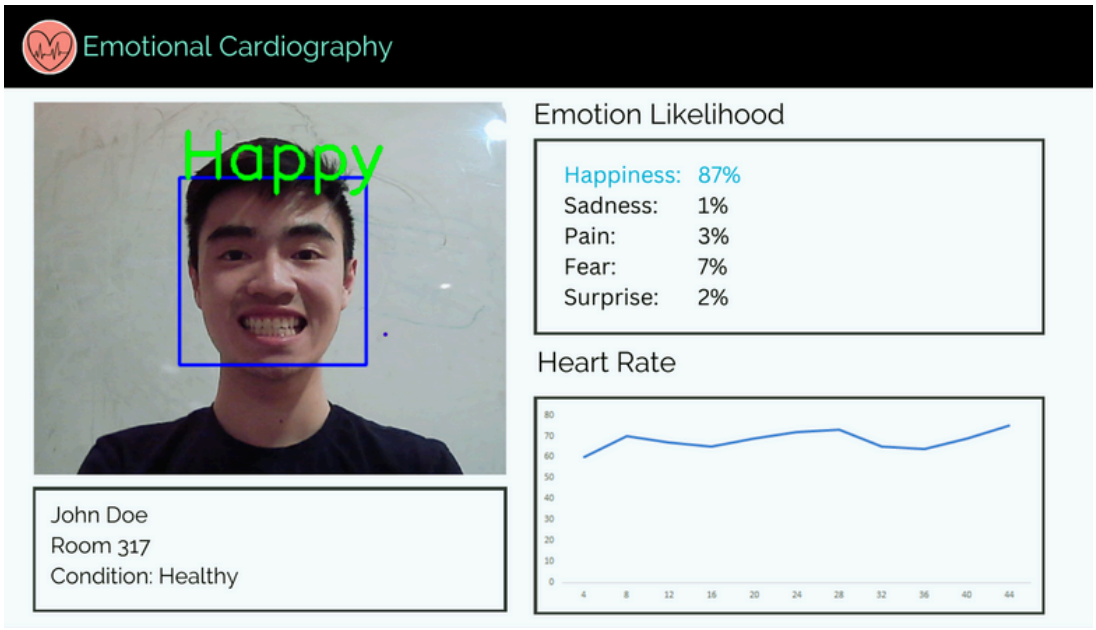
EMOTIONAL CARDIOGRAPHY (ECG) — January 2023 - March 2023



Project Description:

- ECG is an application that monitors a patient's emotional state and heart rate using OpenCV, Machine Learning & heartrate sensors.

Software:

- Emotion recognition CNN model built on Python with **OpenCV and TensorFlow Keras**
- Built a **web application** that receives all the data and displays it to a doctor, with an algorithm that predicts the patients state based off sensor data.
- Streamed video feed and model predictions a website.

[GitHub - ECG]

Neural Network

- ResNet-inspired network with skip-connections to mitigate gradient-vanishing problem
- Improved accuracy with error analysis

IoT Soil Humidity System — Oct 2023 - Present

Project Description:

- A system that tracks soil humidity data for house plants, sending an email notification if any plant is < its set threshold %.
- Failure occurs when any plant falls < 15% soil humidity in a month.

System Design

- ESP8266 wireless boards are used to power the capacitive soil humidity sensors
- Data sent to **MQTT topic on AWS IoT core**
- Message payloads re-routed into a **AWS DynamoDB database** for cheap long-term storage & instant data access
- **AWS Lambda** function triggered each time the DynamoDB is updated
- Lambda function **publishes an email** via **AWS SNS** if readings in the last hour averaged < humidity threshold %