Mark Do

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Technical Skills

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

Libraries & Frameworks: K8s, Ansible, Terraform, Gazebo, Foxglove, PyTorch, NumPy, Docker, OpenCV, ROS

Design & Prototyping: Siemens NX, SolidWorks, AutoCAD, 3D-Printing, Laser-cutting, Soldering, Oscilloscope

Education

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

- 4.0 CGPA | 94% term average | 3 x Dean's Honours List

Work Experience

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.

Test Automation Developer | *Java, Docker, Gradle, CI Pipelines* Sep. 2023 – Dec. 2023

Definity Financial *Waterloo, Canada*

- Overhauled Java test suite with > 120 test cases for Sonnet's mobile app, **reducing false positive bug detections by > 90%**.
- Developed a new automated module to **dynamically create test batches** & execute them in parallel to reduce testing time.
- Created new **automated CI pipeline for regression tests**; executing & reporting results daily to **save over >12 dev hrs/week.**

Related Experiences

Autonomous Vehicles Software Developer | ROS2, C++, Kubernetes Nov. 2023 – Present

WATONOMOUS *Waterloo, Canada*

- 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.**
- Developed a **dual-model MPC** system, joining a **Multi-Layer Perceptron** with a **traditional kinematics model** for car navigation.
- Designed high-level car **navigation controller** that uses **behaviour-trees and Reinforcement Learning** to take driving actions.

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

WARG - Waterloo Aerial Robotics Group *Waterloo, Canada*

- 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 model, ensuring correct functionality through unit tests.

BlindWatchers Project | *YoloV8, Roboflow, Object Detection, Transfer Learning*

Assistive Vision Headwear for the Blind

- Designed and **developed a smart helmet** for the visually impaired with an **NVIDIA Jetson**, integrating YOLOv8 object detection, directional audio, & Google Cloud Speech-to-Text to provide **real-time auditory descriptions of nearby object.**
- Implemented an **asynchronous architecture** with a **fast-inferencing CV model** to decrease latency between detection & audio.

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MECHATRONICS ENGINEERING AT THE UNIVERSITY OF WATERLOO

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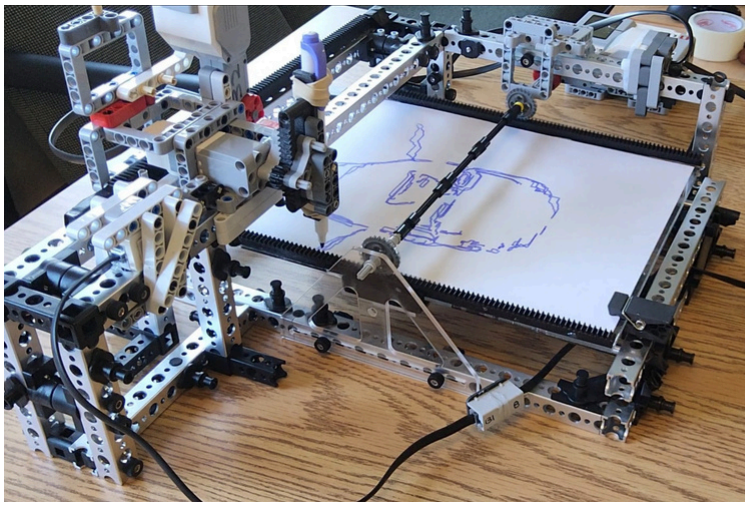
ARTICUS MAXIMUS (SKETCHING ROBOT) April 2023 - July 2023



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

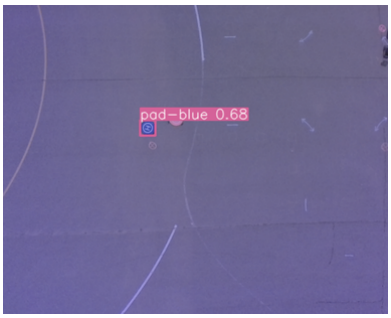
GitHub - WARG/ClusterEstimation

- 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

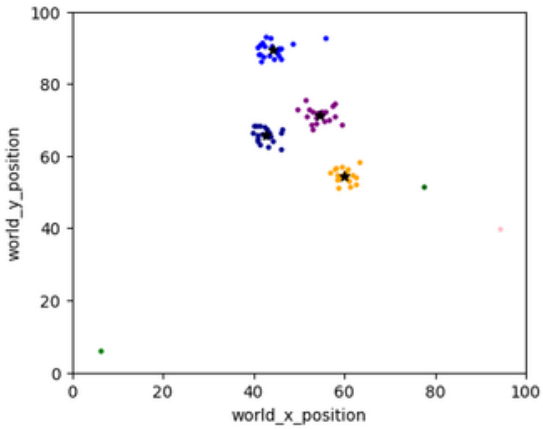
Documentation Contributions

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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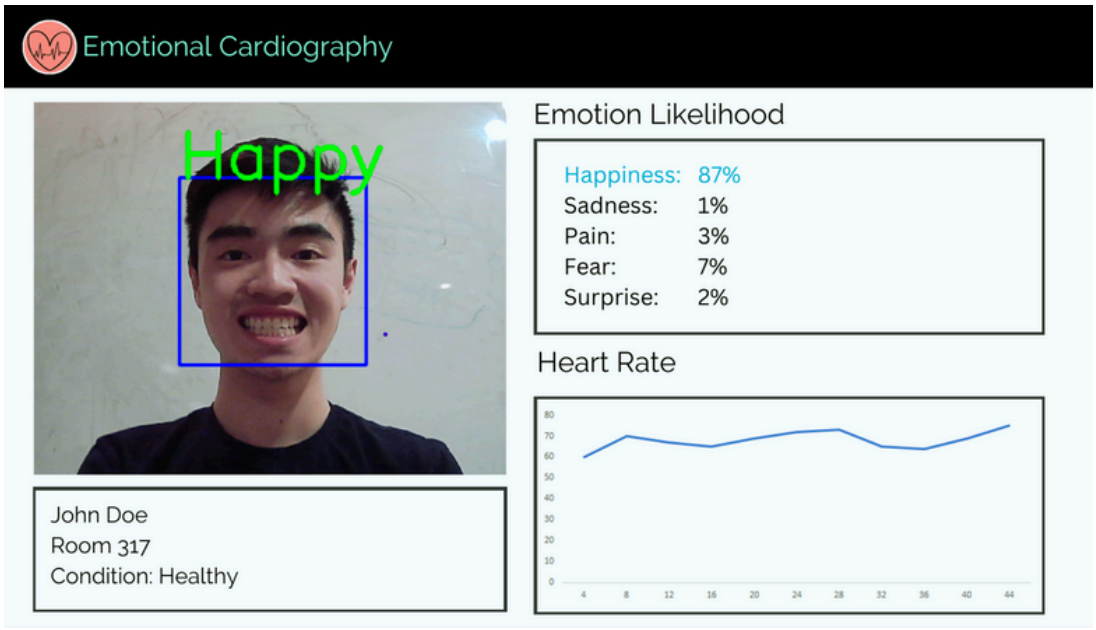
EMOTIONAL CARDIOGRAPHY (ECG) — January 2023 - March 2023



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 %