MAHIR MAHOTA

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EDUCATION

University of Waterloo – Candidate for BASc in Mechatronics Engineering Sept. 2022 – May 2027
GPA: 3.99 (94.27% Cumulative) – Dean's Honours List and Academic Representative
Relevant courses – MTE 262 (Digital Logic), MTE 140 (Data Structures and Algorithms), MTE 120 (Circuits)

SKILLS

Software: C, C++, Python, Linux, Bash, RTOS, ROS2, Git, GDB, CMake, MATLAB/Simulink, VHDL
Tools and Technologies: STM32, PIC, ESP32, Raspberry Pi, Arduino, OpenCV, TensorFlow, Pandas, NumPy
Electrical: Altium, Soldering, Oscilloscope, Logic Analyzer, DMM, Hot Air Reflow Station
Protocols: CAN, I2C, SPI, UART, SMBus/PMBus

EXPERIENCE

Embedded Software Developer Jan. 2024 – Present
Christie Digital Systems

- Designed embedded software in **C/C++** for the master control and regulation board on venue projectors
- Generated varying **software PWM** with a **PIC24**, allowing sinusoidal wave creation to drive piezo actuator
- Enabled manual control and display of peripheral wheel RPMs through the **CLI**, allowing quieter operation
- Updated laser calibration on start-up by modifying projector initialisation state, enabling colour filter use
- Wrote automation script in **Python** to parse schematic netlist files and error check 16K+ pin connections

Firmware Developer May 2023 – Aug. 2023
onsemi

- Developed firmware in **C/C++** for a multi-phase voltage controller, collaborating in an **Agile** environment
- Implemented a shared **SMBus access layer** in **C** using circular buffers, eliminating global variable reliance
- Multithreaded in **C++** to test driver functionality concurrently, using **semaphores** for resource protection
- Verified **I2C** state machine transitions, using bit masking and bitwise operations to check register values
- Conducted tests for **15+ drivers** and a PMBus library with **94% coverage**, using **GDB** for debugging issues
- Edited **CMake** and **JSON** files to include tests so they could be built and then output results successfully

Firmware Team Lead June 2023 – Present
Waterloop

- Directing **14** active members to develop software for a custom-built **hyperloop** pod used in competition
- Developed a **CAN** driver and config files for the NUCLEO-F767ZI to communicate using the **STM32 HAL**
- Created a KAC-8080N motor controller driver in **C** for closed-loop **PID** control of the **LIM** using a **DAC**
- Designed two-layer PCB in **Altium** to multiplex 48 thermistors, reducing **ADC** channels in **BMS** by 87.5%
- Ideated **Python** state machine architecture for main **RPi** to unpack CAN messages and send error codes
- Used **DMA** to gather data from ADC pin for motor thermistors and set **watchdog** timer to ensure control

PROJECTS

Eye Controlled Trolley

- Programmed an **ESP32** to drive 4 DC motors using L298N H-bridges, enabling speed control over Wi-Fi
- Interacted with AdHawk eye tracking glasses and **Python API** to monitor line of sight with **80% accuracy**
- Processed MPU6050 **gyroscope** data to drive trolley with commands received from socket interfacing

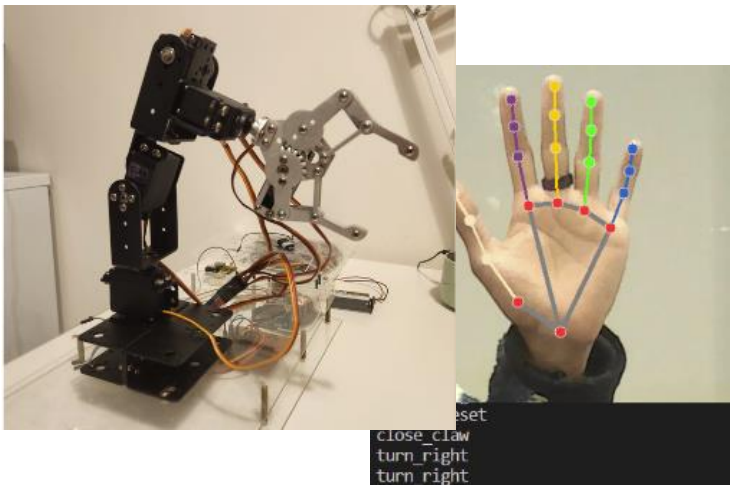
OpenCV Robotic Arm

- Implemented **C++** drivers for **UART** communication with the 6DOF arm through an HC-05 BT module
- Interfaced between **Python** program and **Arduino** using serial transmission to allow sending instructions
- Detected hand gestures with 21 coordinates generated using **OpenCV** and Google's MediaPipe library

Movie Reviews Discord Bot

- Designed neural network with **TensorFlow** using text vectorisation to analyse reviews with **98%** accuracy
- Created interactive bot in **Python** with the Discord API, analysing web-scraped articles using the model

PORTFOLIO

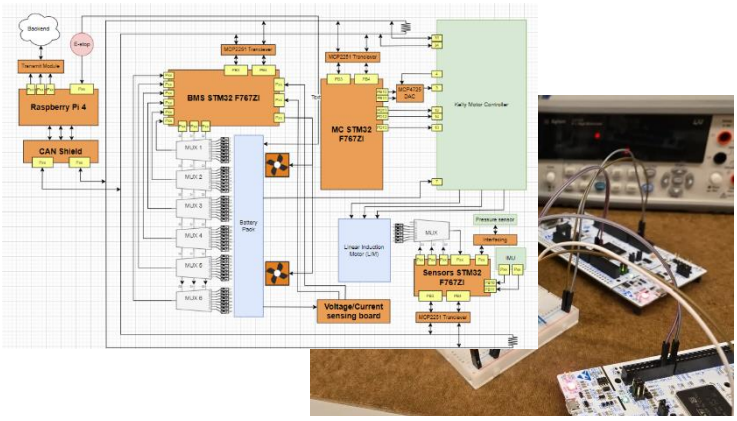


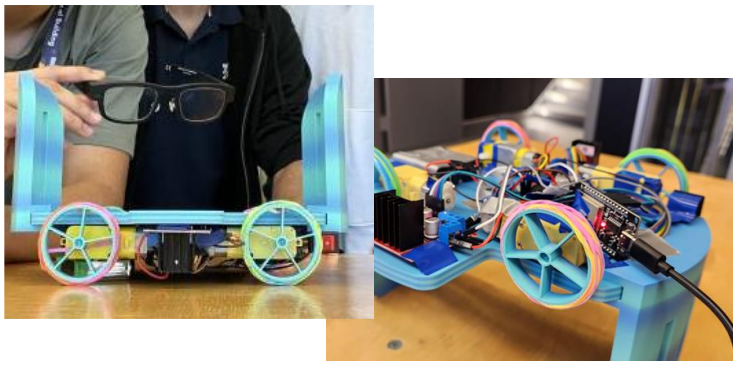
OpenCV Robotic Arm

1. Transferred OpenCV hand landmark coordinates into an array to detect when finger or hand positioning changed. These defined servo positioning commands for the Arduino sent with the Bluetooth module.
2. Wired six servo motors to properly support their stall current. Soldered servo control wires and the HC-05 to the microcontroller, enabling wireless communication in Python.
3. Troubleshooted character command sending and cleaned incoming serial data.

Waterloop Pod

1. Led team to develop competition ready firmware for motor controller, BMS and sensor sub-systems to interface together.
2. Developed CAN communication frameworks for STM32 7676ZI boards to send messages and warnings to a central Raspberry Pi.
3. Worked on driver to control the 140V-600A motor controller through an external DAC
4. Created system architecture and standards



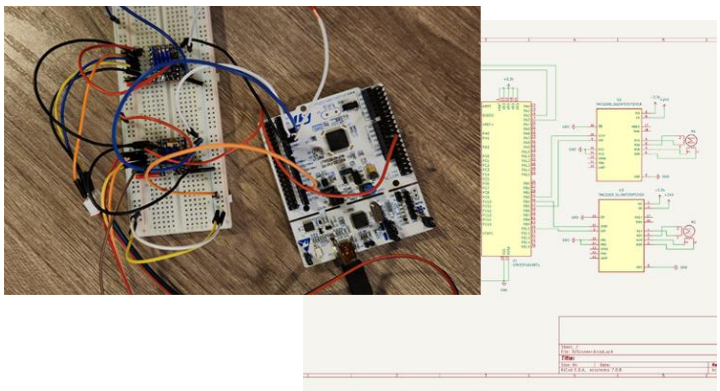


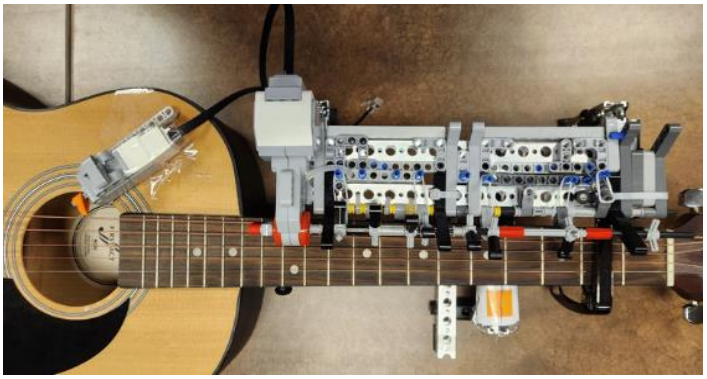
Eye Controlled Trolley

1. Cleaned accelerometer and gyroscope data by polling at fixed intervals, averaging values and correcting for drift inaccuracies.
2. Had the ESP32 drive four DC motors through two H-bridges, using the onboard WiFi module to send commands directly from the Python script wirelessly.
3. Calculated blinks and gaze coordinates

Brick Scanner

1. Wrote object-oriented C++ driver for controlling a NEMA-17 stepper motor through an STM32 NUCLEO-F401RE. Incorporated micro stepping capabilities for increased resolution. Two motor objects were defined to move a camera arm.
2. Set up communication with RPI using UART and interrupts for important messages such as when the next measurement was urgent.





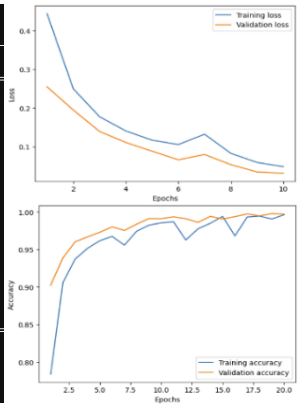
Guitar Playing Robot

1. Wrote drivers in C for colour reading, fretting, and strumming. Used colour and ultrasonic sensors to detect progress of tasks. Designed for first year design project.
2. Built camshaft system to press on the string at different frets depending on the angle a motor is rotated. The rotation of the motor was tracked using onboard motor encoders

Movie Reviews Discord Bot

1. Created NLP model with TensorFlow using a dataset of 50K IMDb reviews. Processed data by vectorising it and creating an input pipeline with separate training, validation, and testing sets.
2. Interacted with the Discord API to get access to user messages. Programmed a web-scraping script that collects URLs from a Google query search and then extracts text from the main body of the websites.

```
Model: "Movie Reviews Analysis"
_________________________________________________________________
 Layer (type)                Output Shape
=================================================================
 Layer_1 (Embedding)         (None, None, 32)

 Layer_2 (Bidirectional)     (None, 64)

 Layer_3 (Dense)             (None, 256)

 Layer_4 (Dense)             (None, 512)

 Layer_5 (Dense)             (None, 256)

 Layer_6 (Dense)             (None, 1)

=================================================================
Total params: 16,296,481
Trainable params: 16,296,481
Non-trainable params: 0
```



OpenCV Wheel Tracking Program

1. Developed successful program in sub 12 hours for digital wheel detection instead of the current standard of mechanical triggers, improving accuracy.
2. Used OpenCV, applying Hough transforms and contour detection. An image is taken when a wheel passes the vertical red line.
3. Adapted depth camera for Python instead of C++ using WSL, allowing easier detection of stickered holes in the car chassis.