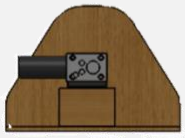
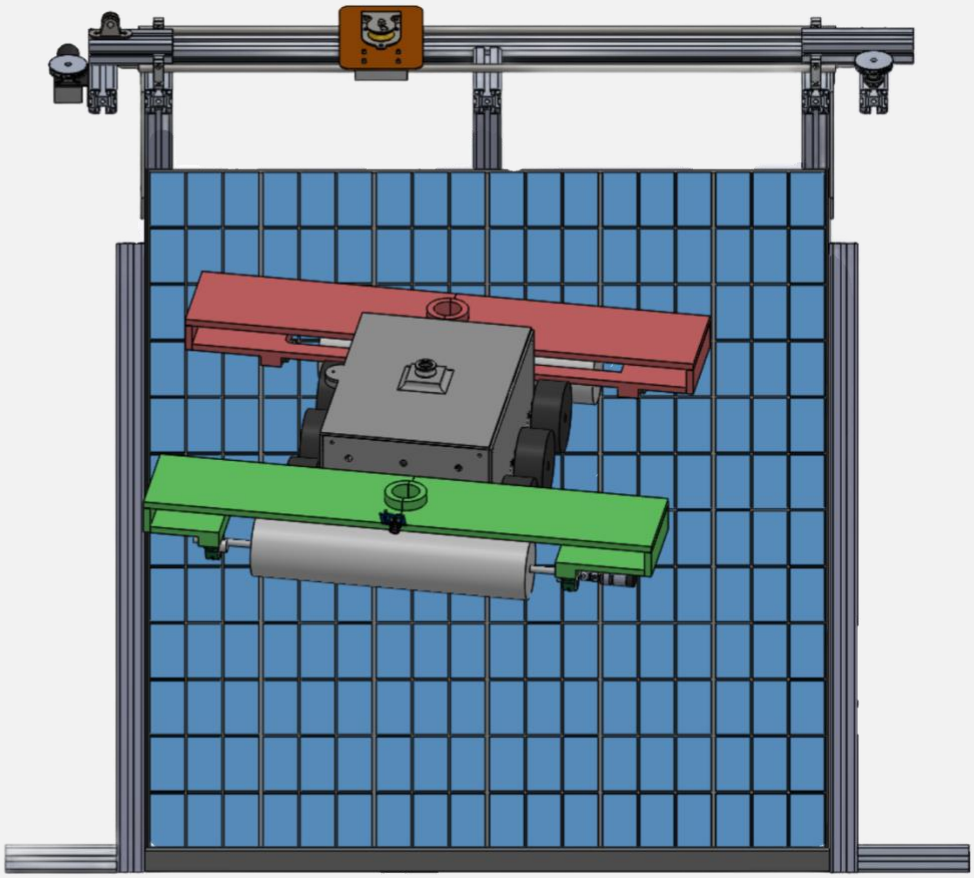
Mechatronics Project Portfolio





By Viru Gurudath

+1 (604) 968 – 5595

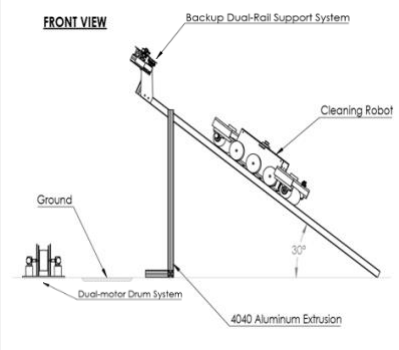
virugurudath@gmail.com

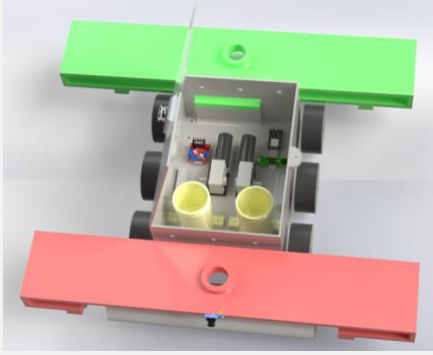
LinkedIn

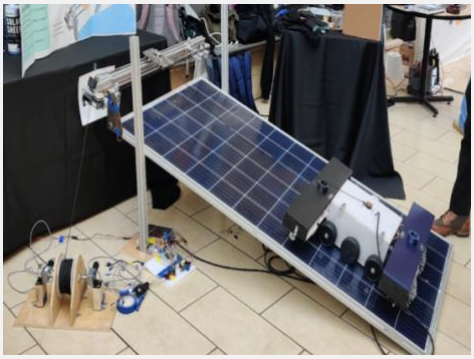
Website Portfolio

Autonomous Solar Panel Cleaning Robot – *UBC Engineering Capstone*

Mechanical







What?

- Designed and prototyped an **autonomous robot** capable of navigating and cleaning rooftop solar arrays
- Requires minimal maintenance what provides **innovative** dry and wet, **soap-based cleaning**

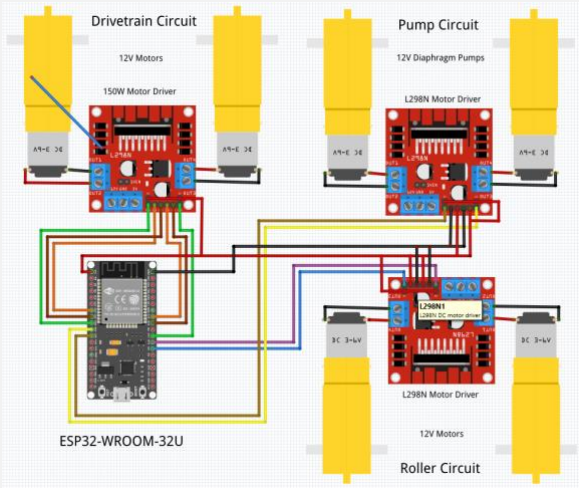
How?

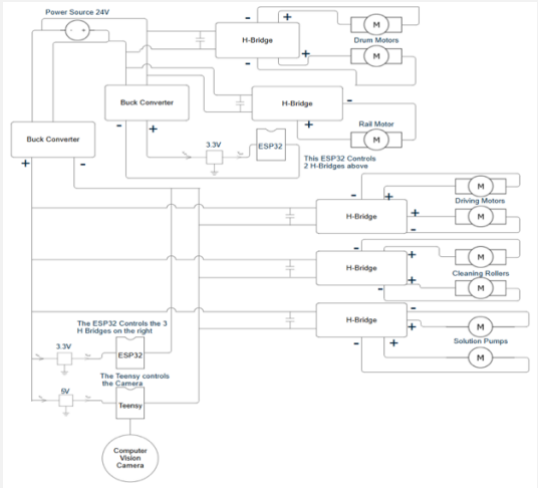
- Designed enclosure, and cleaning rollers using **SolidWorks** and **Fusion360**
- Optimised pumping system through extensive fluid dynamic and pumping head calculations

Results...

- Design fulfilled panel cleaning ability; **efficiency of 8 panels/hour**
- Soap dispersion angle of 110º enabled uniform distribution along rollers
- Turns with centralised motors with rotary encoders for successful **dead reckoning navigation**

Electrical





What?

- **Drafted circuit schematic** diagram for rated operation
- Goal: **Achieve** sustained rated operation, **appropriate power delivery**, and account for current spikes

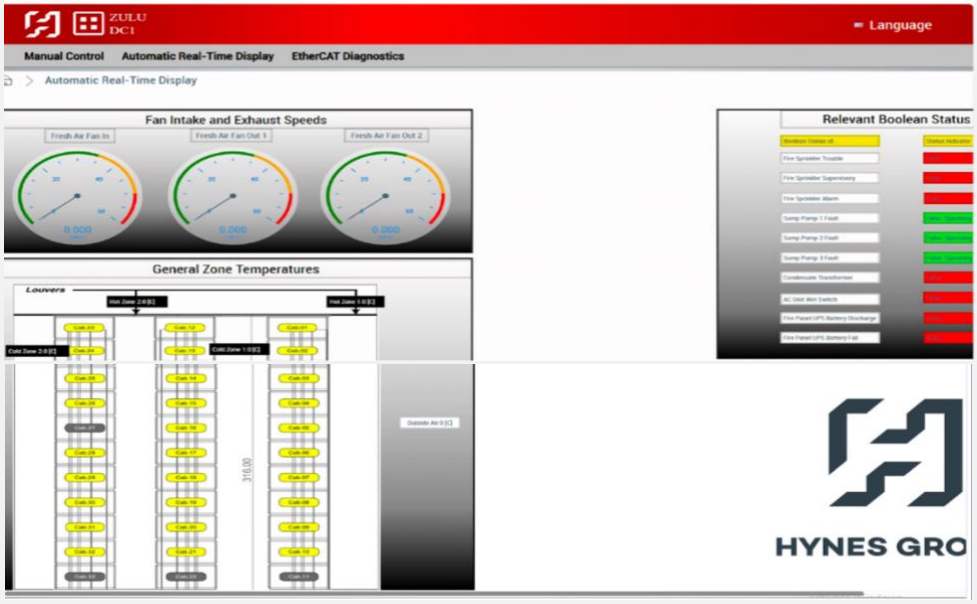
How?

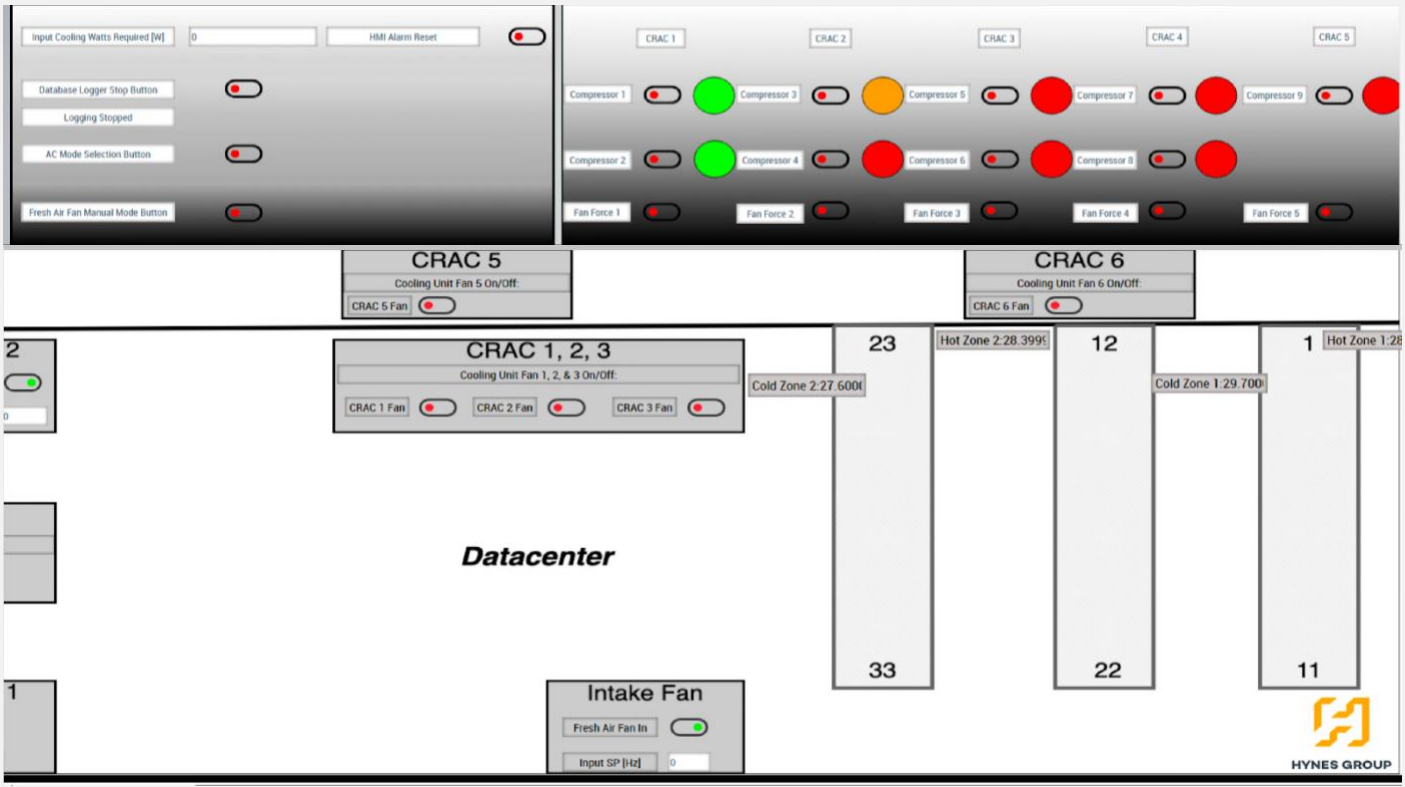
- **Incorporated buck converters,** 3.3V **regulators**, and AC to 24V_{DC} transformer to **create suitable environment**
- Tested for continuity and for **regulated voltage** while operating **at peak loads**

Results...

- **Power spikes mitigated**, resulting in seamless DC electro-mechanic operation
- At full load, only a **maximum of 120% and 110% rated current** reached for driving motors and cleaning motors, respectively

Datacentre Human-Machine Interface – *Capilano University-Hynes Group*





What?

- **Designed HMI** that allows for monitoring of crucial datacentre parameters
- Implemented optimal temperature and aisle pressure monitoring as well as ability to **control fan speeds, AC output temperatures**; generalised **ON/OFF control** was necessary

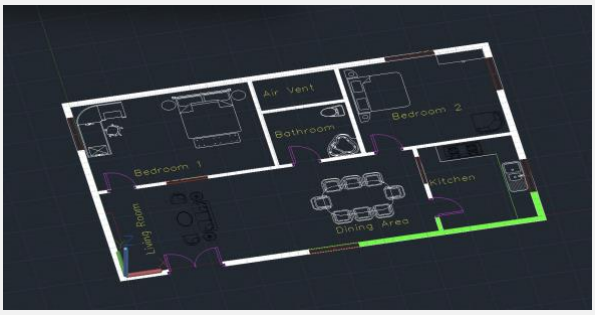
How?

- Utilised **Visual Studio** based **Beckhoff TwinCAT 3** software to design HMI
- **Mapped PLC variables to** HMI controls such as **buttons, internal symbols, gauges**, etc.
- Tested functionality and **confirmed reliable boolean logic** protocol with 'Live-View' feature

Results...

- Integrated **real-time status monitoring,** fault alerts, and manual override capabilities
- Designed **three primary pages**: Manual Control, Automatic Real-Time Display, and EtherCAT Diagnostics

Autodesk AutoCAD Floor Plan Layout – *Self-Started Personal Project*



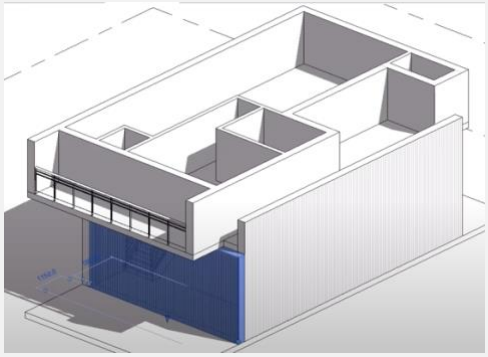
What?
- **Drafted** a residential **floor plan** showing interior walls, door swings, window placements, and **structural gridlines**
- Laid out **functional zones** including rooms, corridors, and entryways with proper **spatial relationships and proportions**

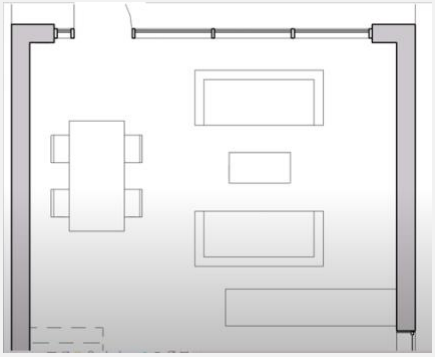
How?
- **Organized** drawing **elements** with a **structured Layer system**, separating walls, doors, windows, dimensions, and annotations for visual clarity and efficient editing while adhering to architectural drafting standards
- **Applied Hatch patterns** to represent material fills (e.g., concrete, tile, drywall) and distinguish between cut and open spaces in sectioned views

Results...
- Produced a clear, **construction-ready floor plan** adhering to architectural drafting standards, with precise wall offsets and symbol conventions for doors/windows
- Ensured **seamless interpretability** for construction teams by aligning annotations, using **consistent lineweights**, and adhering to typical architectural scale and layout practices

---

Autodesk Revit Building Information Management – *Self-Started Personal Project*





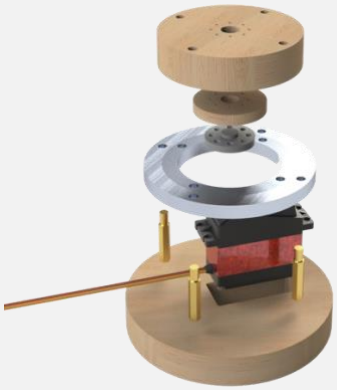
What?
- Designed a two-storey residential building in Revit, including walls, doors, windows, curtain walls, floors, stairs, balconies, and roofing systems
- Modelled architectural elements using BIM standards, ensuring spatial logic, elevation relationships, and system family behaviour across views

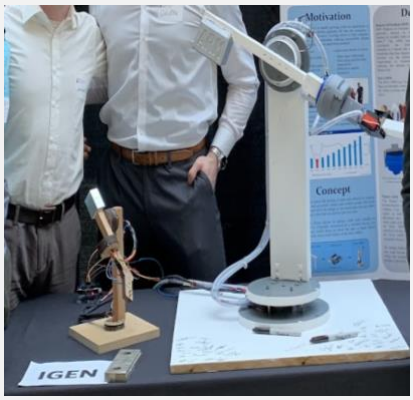
How?
- Modelled architectural elements using Levels, Grids, and Snaps to accurately place walls, curtain walls, stairs, balconies, and roofs with system family tools such as **Wall by Face**, **Curtain Wall**, and **Roof by Footprint**.
• Placed and aligned parametric **families** with dynamic **tags**, and generated **section views** and live **schedules** that reflect model changes

Results...
-Delivered a clean, presentation-ready Revit model demonstrating proficiency in layout planning, BIM workflows, and architectural drafting standards.
- Created detailed annotated **section cuts,** visualizing internal partitions; used tags, **material layers**, and linework customisation for construction-grade vertical views

A.R.M. (Arduino Robot Muscle) – *UBC 2nd Year Engineering Capstone*

Mechanical





What?

- **Designed 4 DOF robotic arm** with master-slave control system
- **Intuitive Control system** reduces learning curve and bridges gap between industrial and collaborative robotic systems

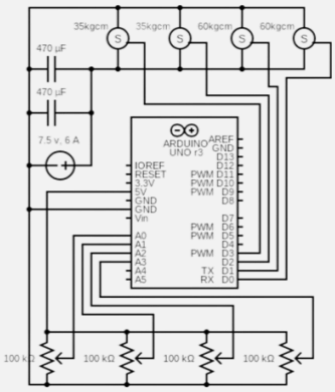
How?

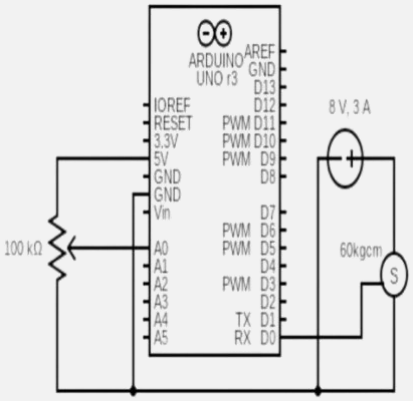
- **Modelled** all **joints** in **SolidWorks** and manufactured with PLA and wood
- Slave ARM made from DXF file **laser cut parts** to **house potentiometer** (for angle measuring)
- **Slave ARM transmits data to Master ARM** servos

Results...

- Achieved **smooth and responsive** motion with **sub-1s latency** (~300 ms), accurately mirroring Master ARM input.
- **Met all mechanical requirements**, including 4 DOF, ±1cm precision, and > 400g payload at full extension

Electrical





What?

- **Developed** an electrical **control system** to **relay** real-time **joint angle** data **from** the **Master ARM to** the **Slave ARM**
- Aimed to achieve **low-latency**, **accurate** motion replication via a simple, **low-cost** hardware setup with minimal computational overhead.

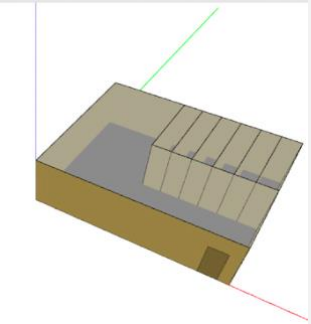
How?

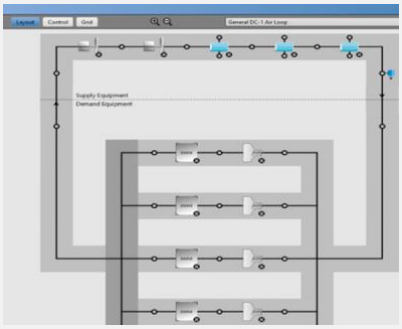
- **Used potentiometers embedded in Master ARM joints** to measure angles via voltage divider circuits
- **Mapped analog readings to servo angles** and transmitted corresponding PWM signals

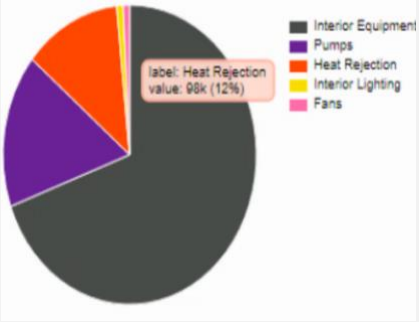
Results...

- **Met all electrical requirements:** no current spikes, all motors operated within nominal ranges
- Complete **integration within budget**; system remained stable under dynamic mechanical loads

OpenStudio/EnergyPlus BIM Analysis – *Capilano University-Hynes Group*







What?

- Built a detailed **OpenStudio model** of a real datacenter**, simulating airflow**, thermal zones, HVAC systems, and server heat loads for energy analysis

- **Simulation** aimed to **visualise power consumption**, **identify high energy consuming HVAC equipment**, and implement power scheduling to **save long-term costs**

How?

- **Created 3D geometry and thermal zones** reflecting temperature-critical areas
- **Built custom materials and assemblies** on-site data and engineering estimates
- **Developed and refined HVAC loop models** to simulate realistic operation
- **Configured weekly and holiday schedules** for server loads

Results...

- Identified that **server loads accounted for ~69% of total** energy **consumption**
- **Confirmed cooling coil functionality** through simulation experiments
- **12%** projected **decrease** in **power usage** with HVAC power scheduling