Warwick Mobile Robotics (WMR)
Urban Search and Rescue Robot (20)

WARWICK
SCHOOL OF ENGINEERING

WARWICK
GLOBAL RESEARCH PRIORITIES
INNOVATIVE MANUFACTURING

MOUSER ELECTRONICS

XILINX

GRM OPTIMISED ENGINEERING DESIGN

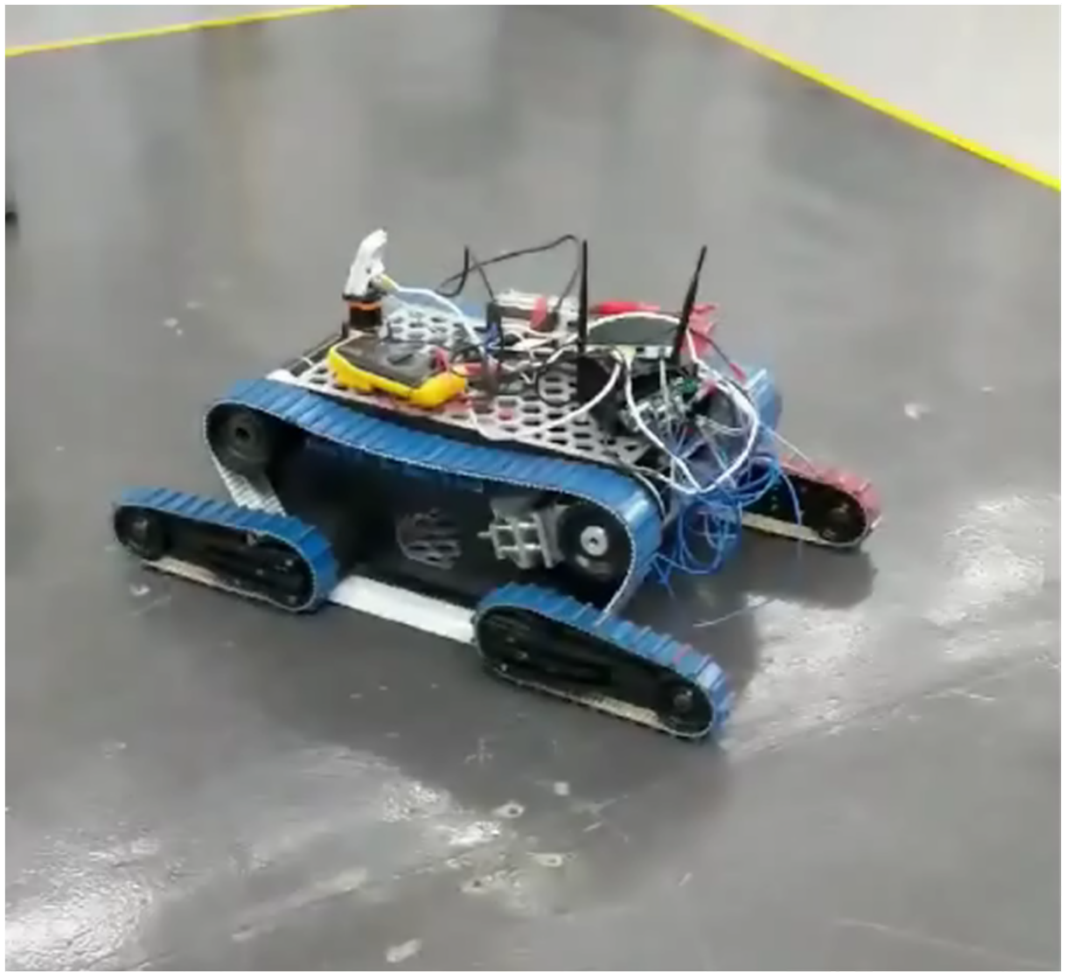
WMG
THE UNIVERSITY OF WARWICK

CATAPULT
High Value Manufacturing

WMR
Warwick Mobile Robotics

Introduction WMR

Charles Perera



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Innovative Solutions

WMR
Warwick Mobile Robotics

Contents

Charles Perera

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RoboCup Rescue League

Balint Vidos

- Complex tasks
  - Mobility
  - Sensing
  - Dexterity
- Time trials

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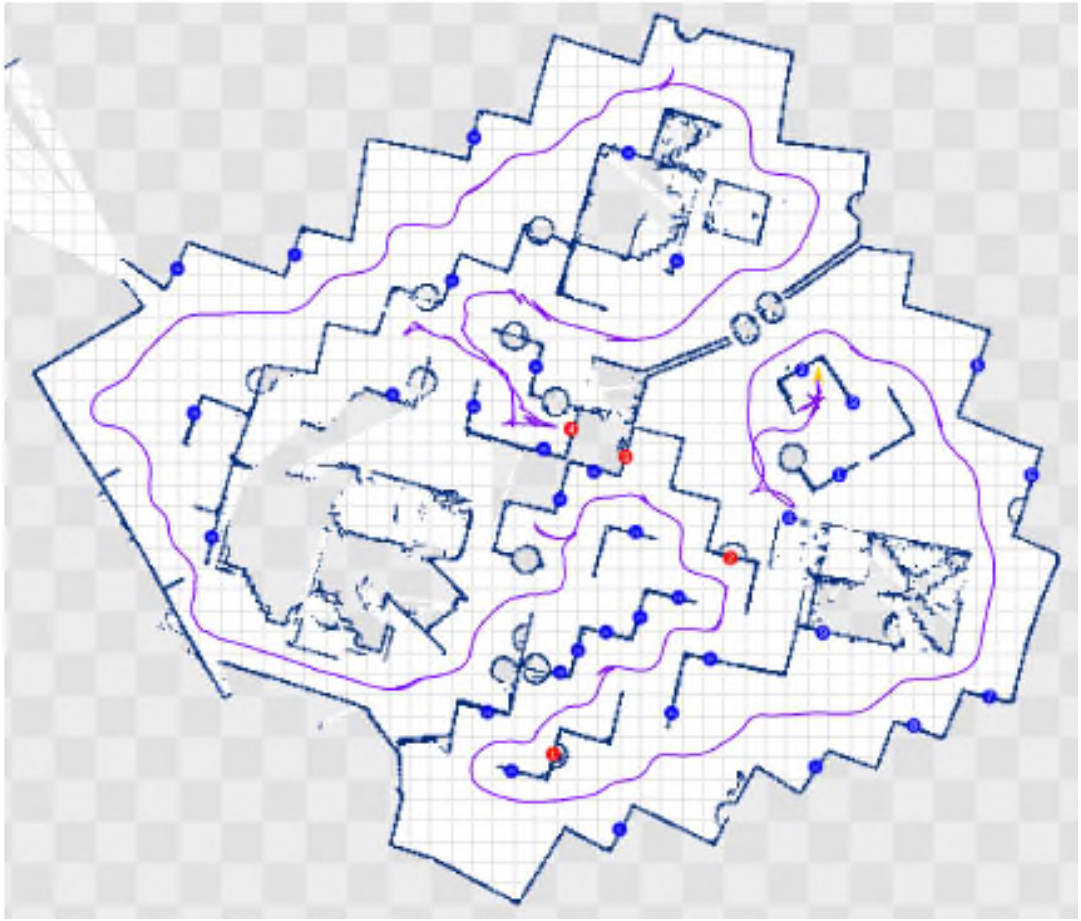
RoboCup Rescue League

Balint Vidos



- Complex tasks
  - Mobility
  - Sensing
  - Dexterity
- Time trials

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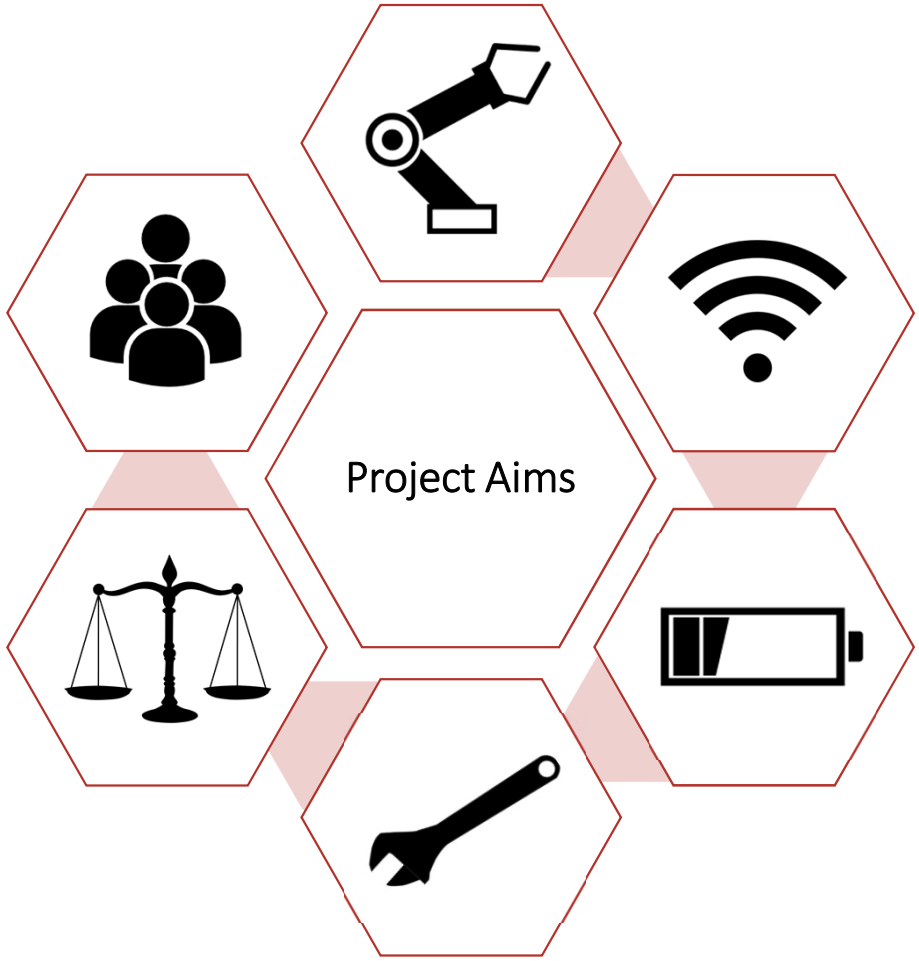
Project Aims and Specification

Eashana Chotai



- New robotic arm
- Wireless control system
- Reliable power distribution system
- Improve chassis, cladding and powertrain
- Light-weighting
- Build industrial links-sponsorship

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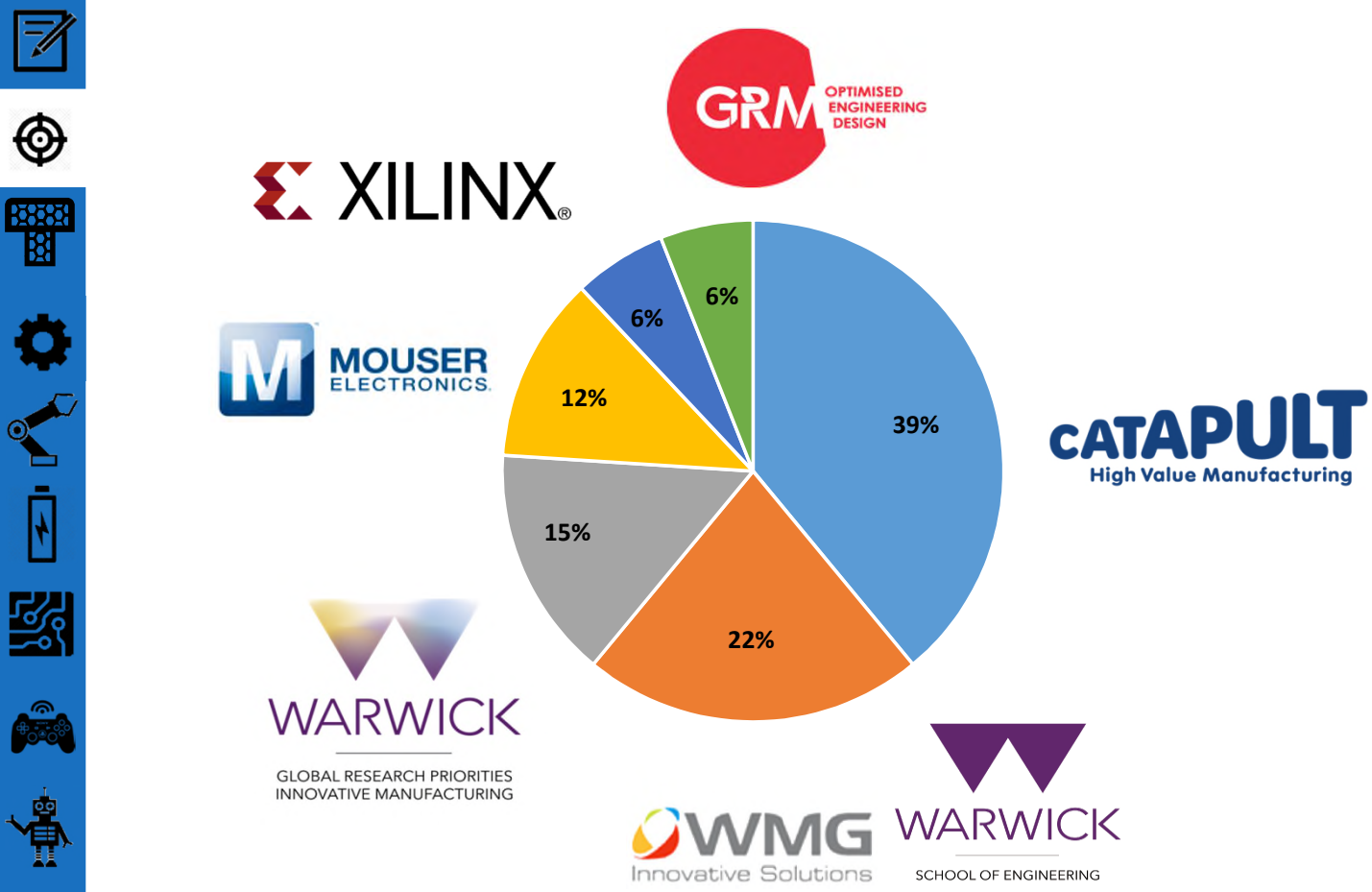
Costs and Sponsorship

Eashana Chotai



- Sustainable engineering was integral to design
- Additional funding through sponsorship
- £5,250 raised
- £940 for next year's project team

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Mechanical Introduction

Emily Carman

1. Battery Mounting
2. Electronics Mounting
3. Powertrain
4. Cladding
5. Robotic Arm

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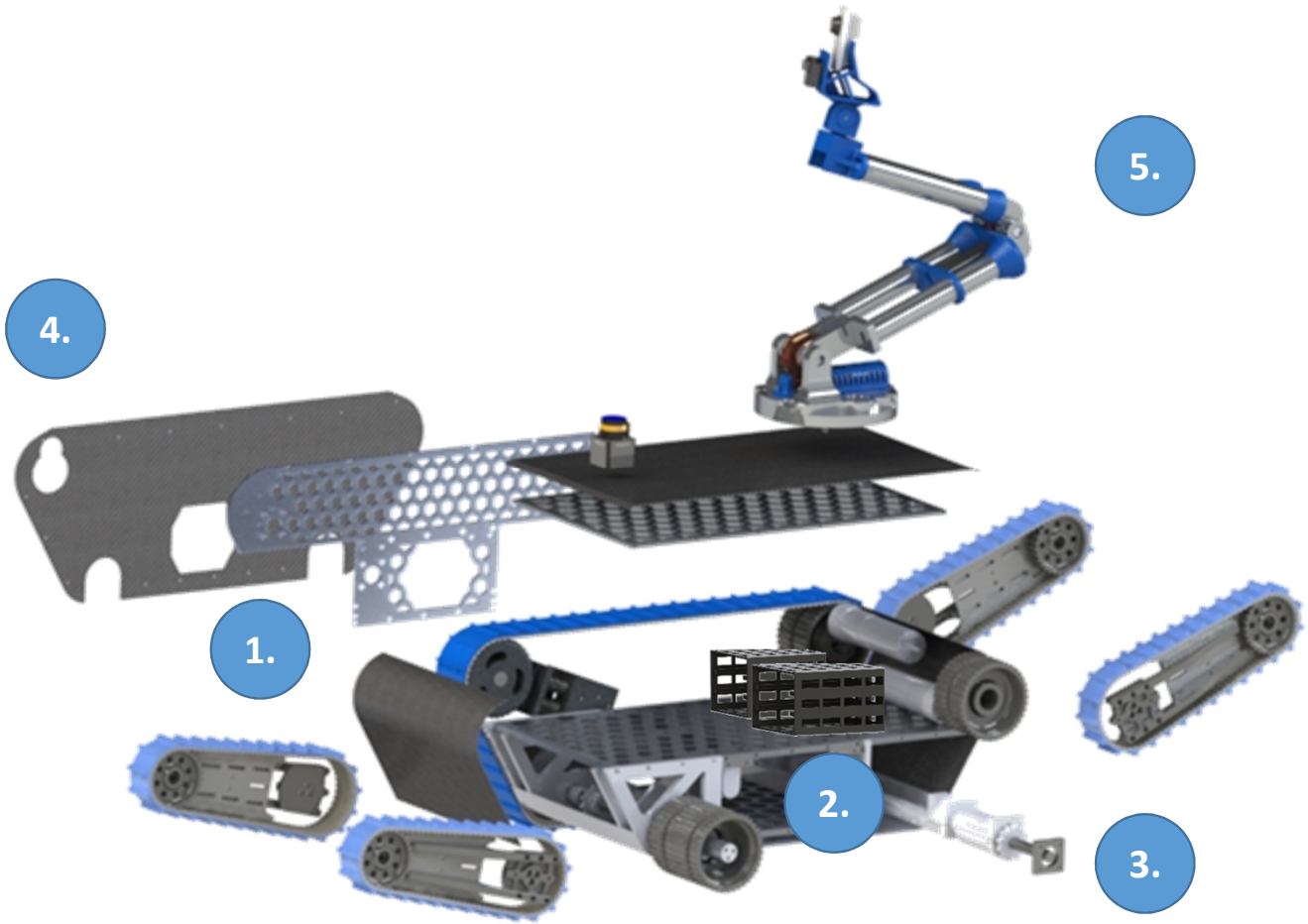
Mechanical Introduction

Emily Carman



1. Battery Mounting
2. Electronics Mounting
3. Powertrain
4. Cladding
5. Robotic Arm

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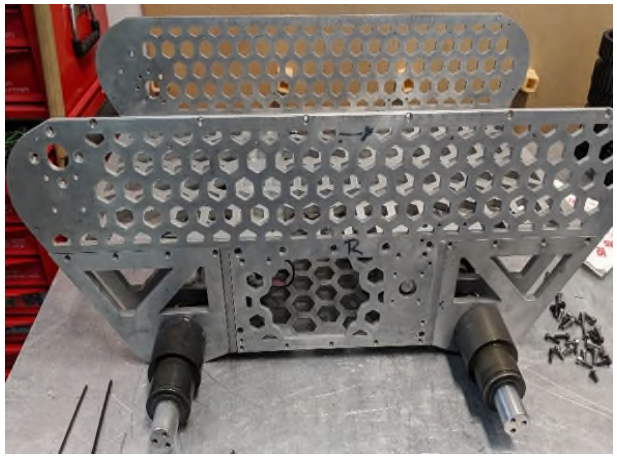
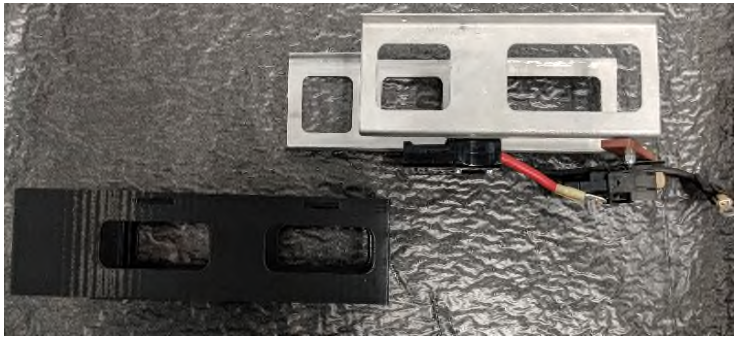
Battery Mounting

Emily Carman





1. **Battery Mounting**

- Space saving
- Easily accessible
- Fan mounting
- 3D printing

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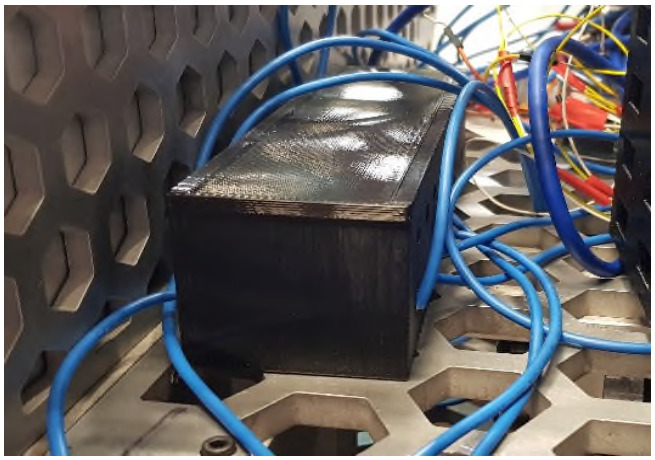
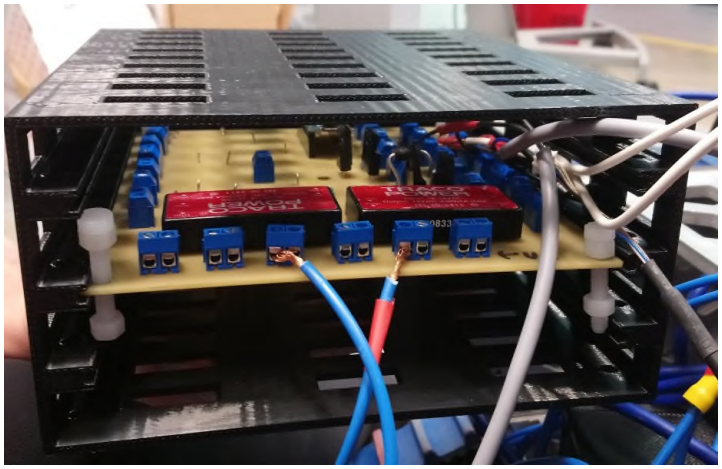
Electronics Mounting

Emily Carman





2. Electronics Mounting

- Bus Bar box
- PCB storage
- Easily ascessible
- Modular

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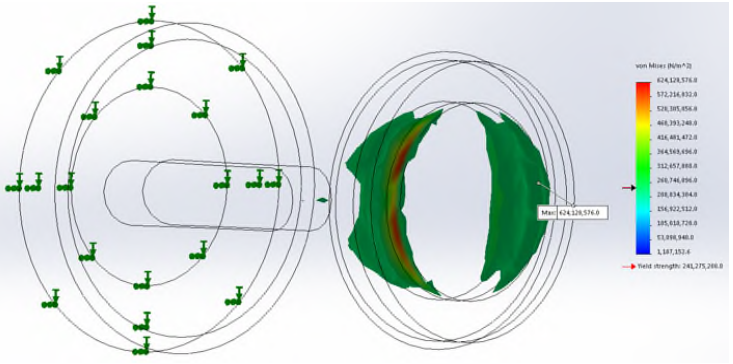
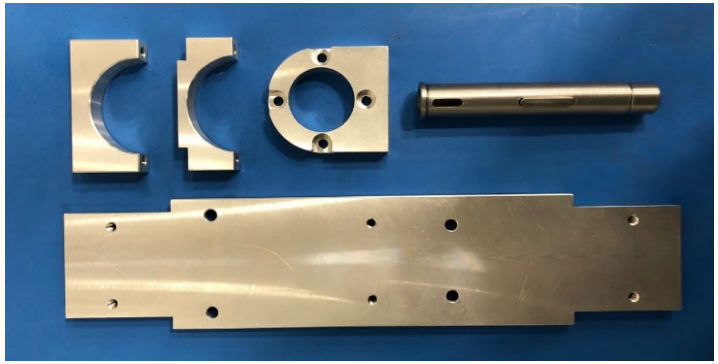
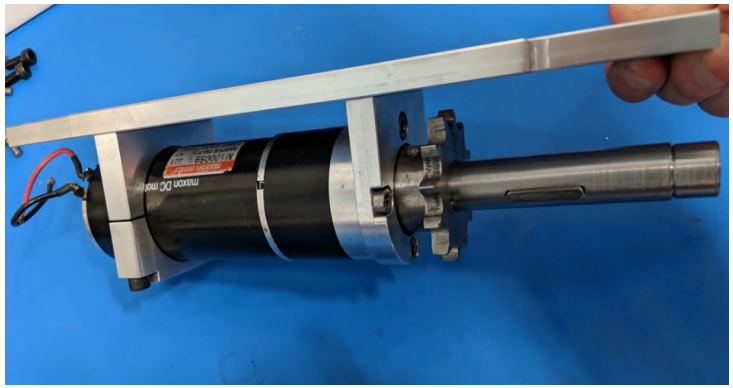
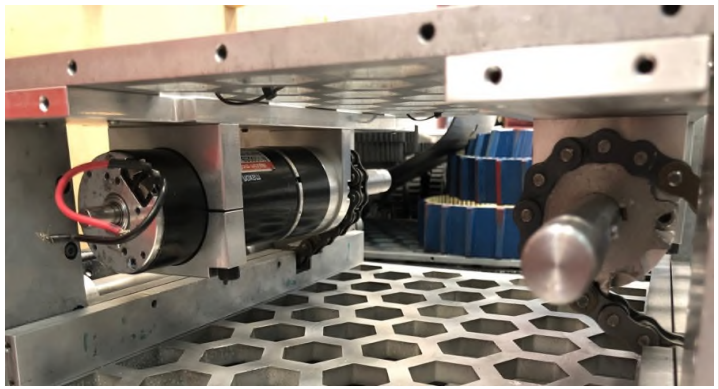
Powertrain

Mark Safford









3. Powertrain

- Inherited a broken powertrain
- Motor safety critical concern
- Strength & safety
- Extensive FEA testing
- Innovative shaft weakness

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Cladding

Mark Safford

4. Cladding

- Composite material research
- Recycled carbon fibre
- Prototype component
- Entire carbon fibre chassis
- Carbon fibre reinforced with steel
- 50% chassis weight reduction

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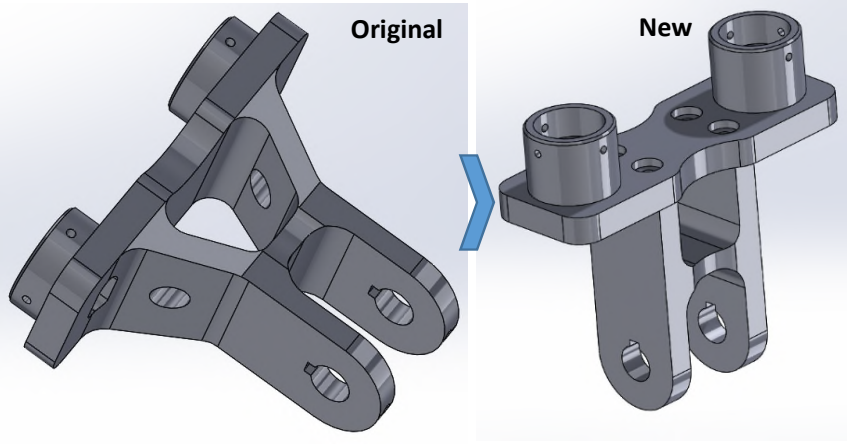
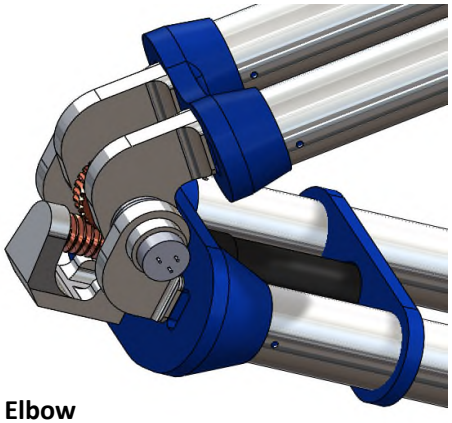
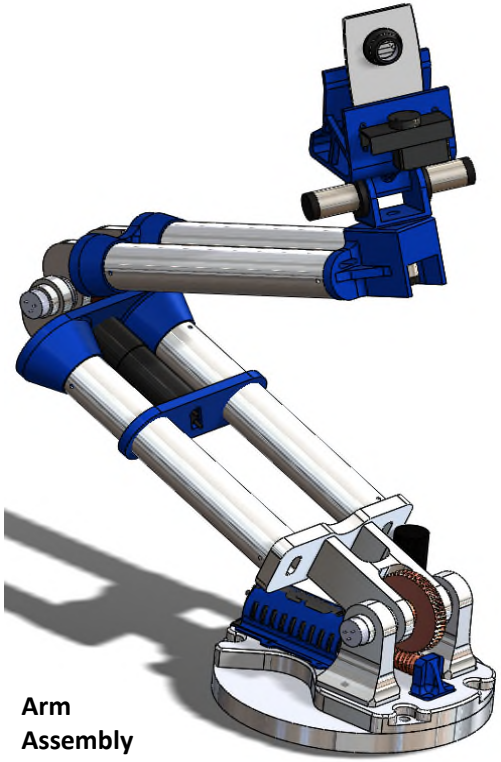
Arm – Design, Development and Aims

Tom de Oliveira




Elbow


Arm Assembly

5. Robotic Arm

- Evolution of old arm design
- More modular and reusable
- Redesign of base and head
- Modified elbow part designs
- Cheaper materials
- Easier to manufacture

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Arm – Manufacture and Final Specification

Tom de Oliveira

Assembled Base

Final Assembled Arm

Assembled Elbow

5. Robotic Arm

- Changes to head
- Can be mounted on robot
- Demonstration separate
- Gripper mounted after testing of other parts

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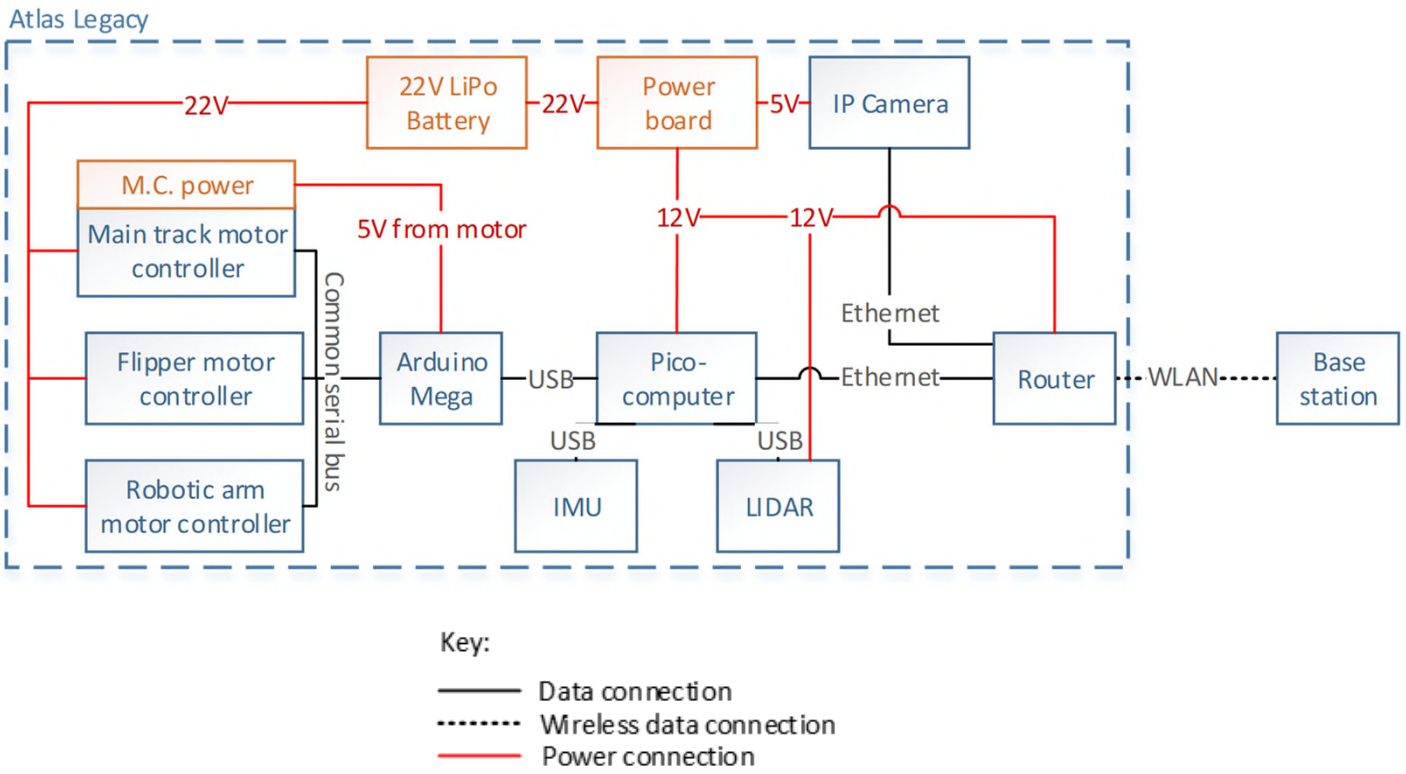
Electronic System Design

Jan Specht



- Battery monitoring
- Power distribution
- Motor control
- Instrumentation
- Wireless control

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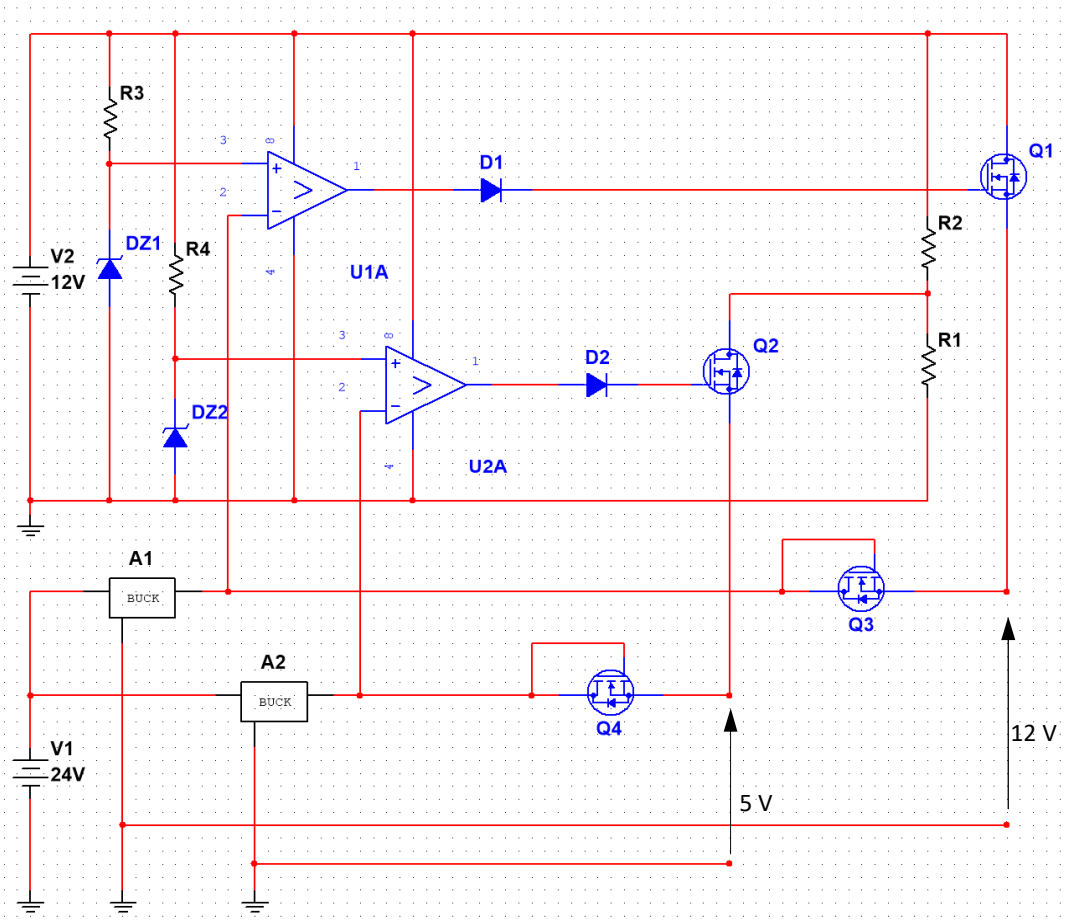
Electronic System Design

Jan Specht



- Power distribution
  - 3 voltage levels
  - DC/DC conversion
  - Isolation
  - Emergency power

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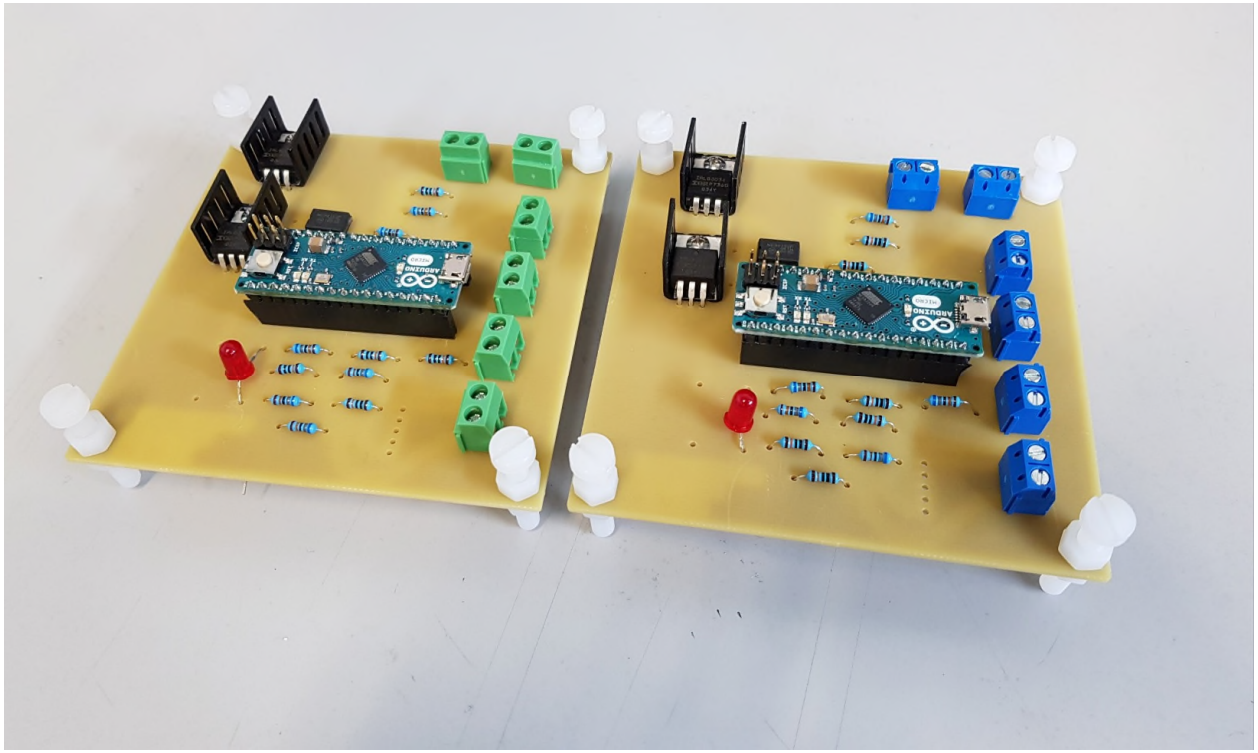
Electronic System Design

Jan Specht



- Battery monitoring
  - 6 Cell batteries
  - MOSFETs
  - Arduino micro

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Electronic System Design

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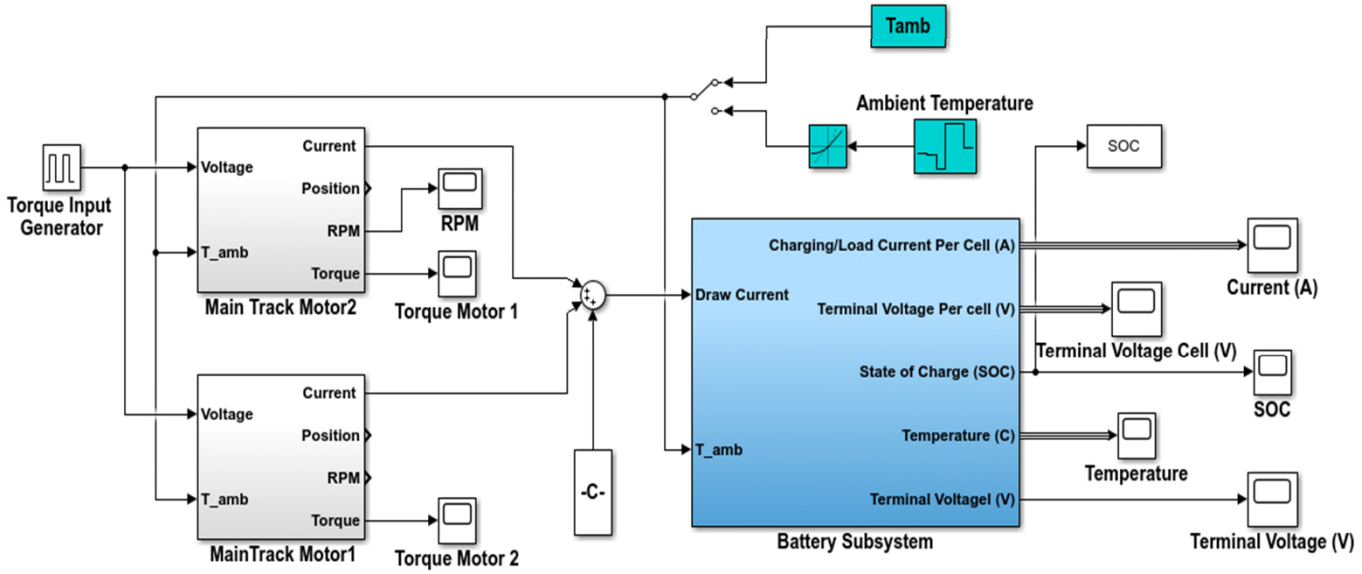

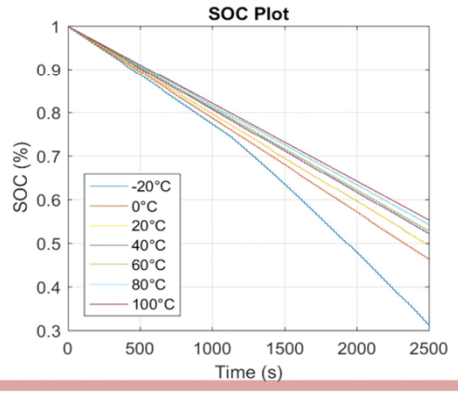

- Battery Monitoring
  - Lithium battery
  - State-Of-Charge
  - Charge-Counting
  - Simulink

$$SOC = SOC_0 - \int \left(\frac{i_{battery}}{Q_{usable}} \right) dt$$

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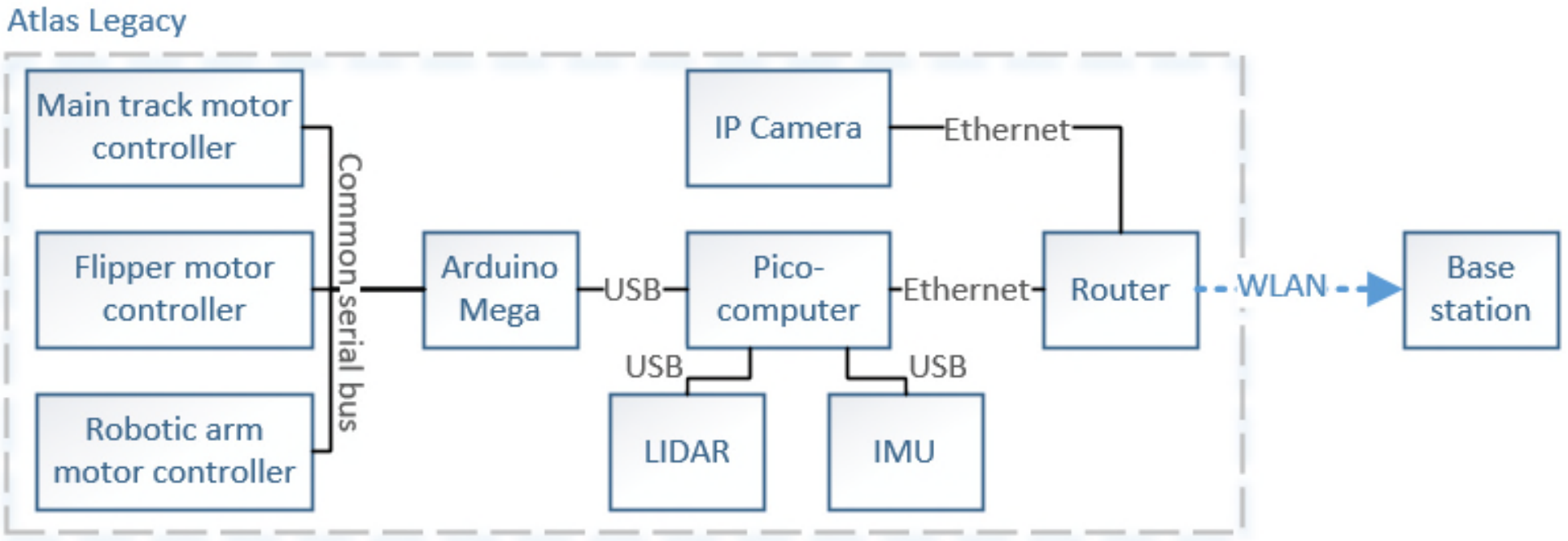
Robot Control System

Balint Vidos



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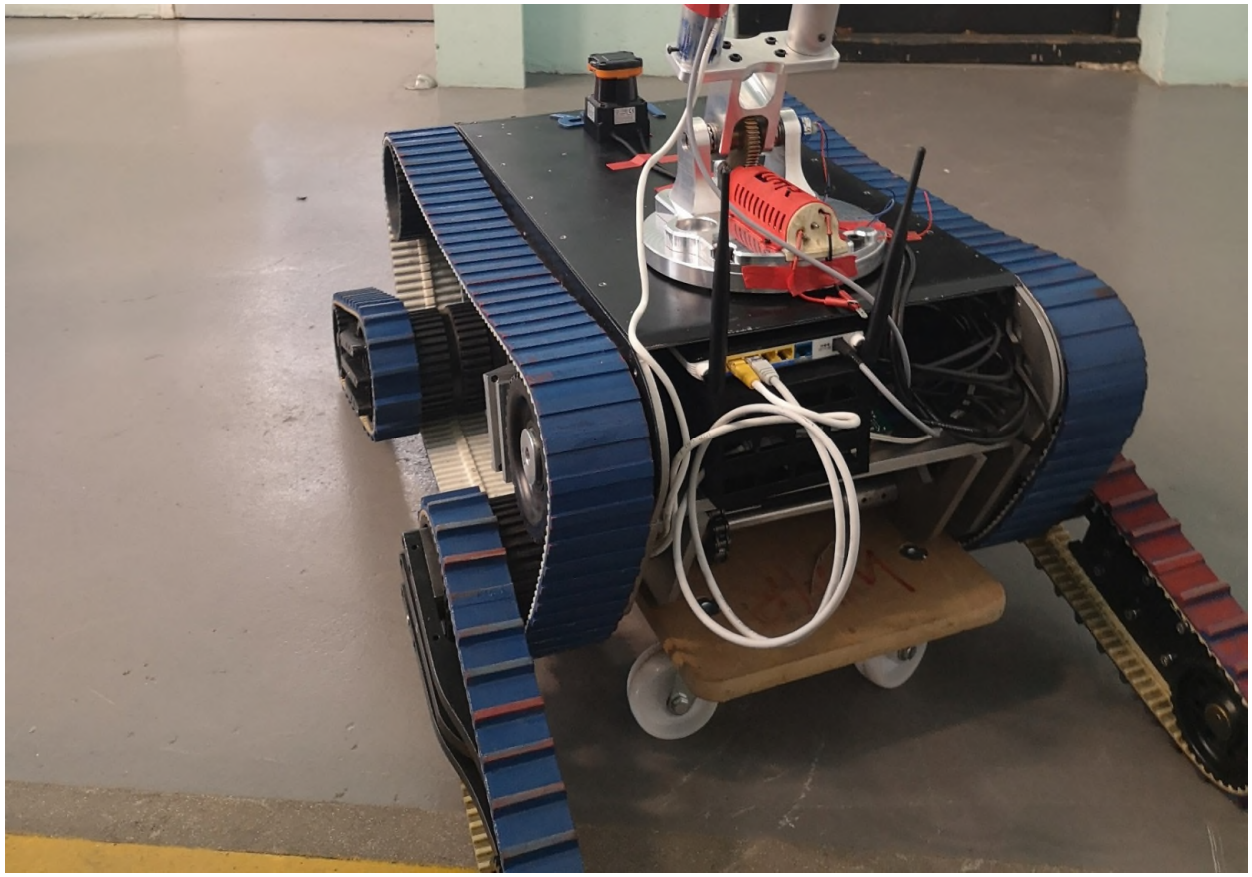
Wireless communications

Balint Vidos



- Tether, cellular
- Wi-Fi
  - Fast
  - High bandwidth

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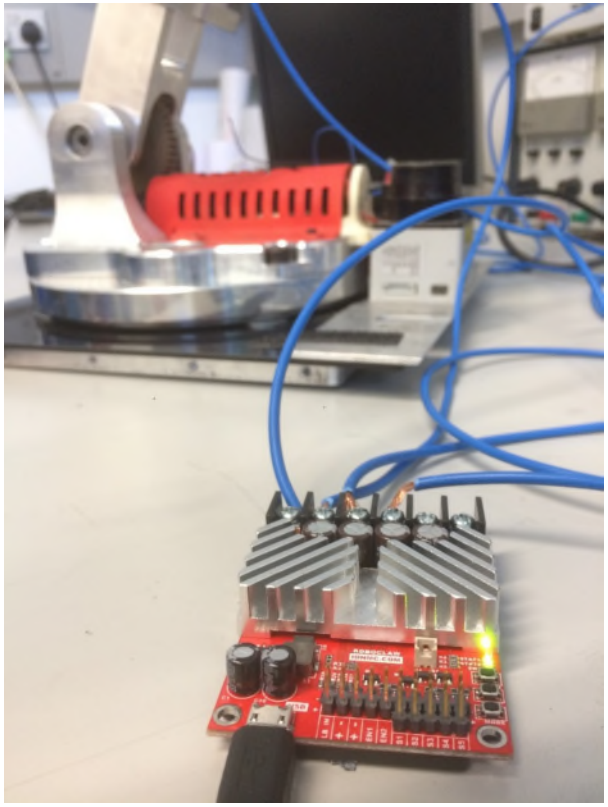
Robot Main Computer

Balint Vidos



- Pico computer connects:
  - Sensors
  - Motor controllers
  - Communications
- ROS
- Roboclaw-Arduino-Pico-Base
- Safe operation

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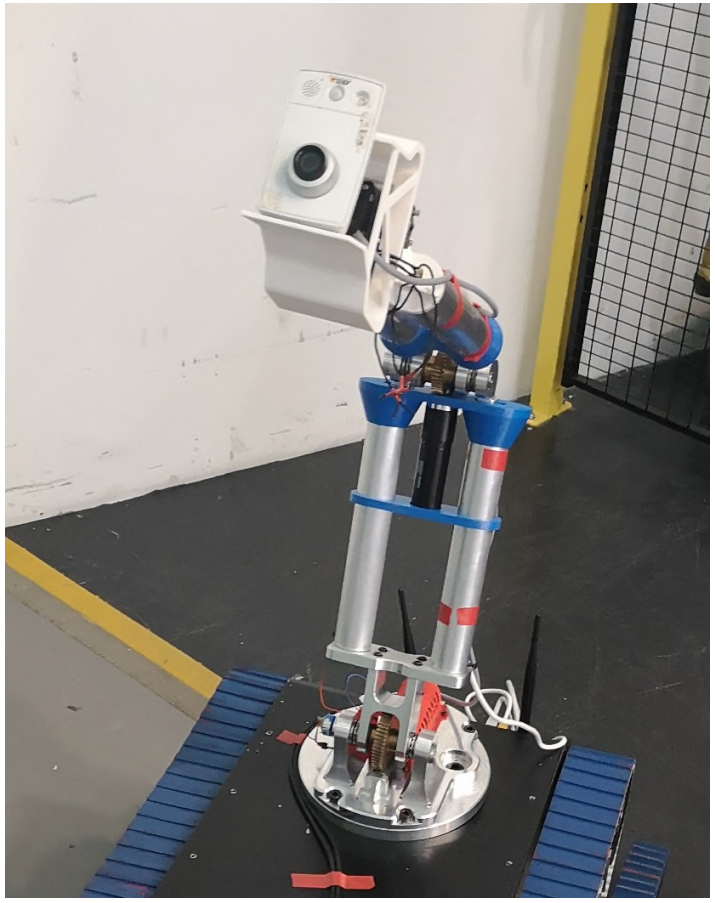
Sensors

Balint Vidos



- Camera
- IMU
- LIDAR and SLAM

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Sensors

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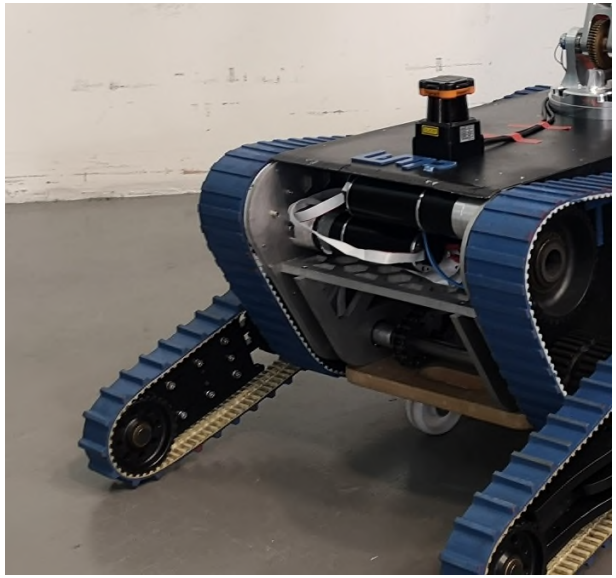

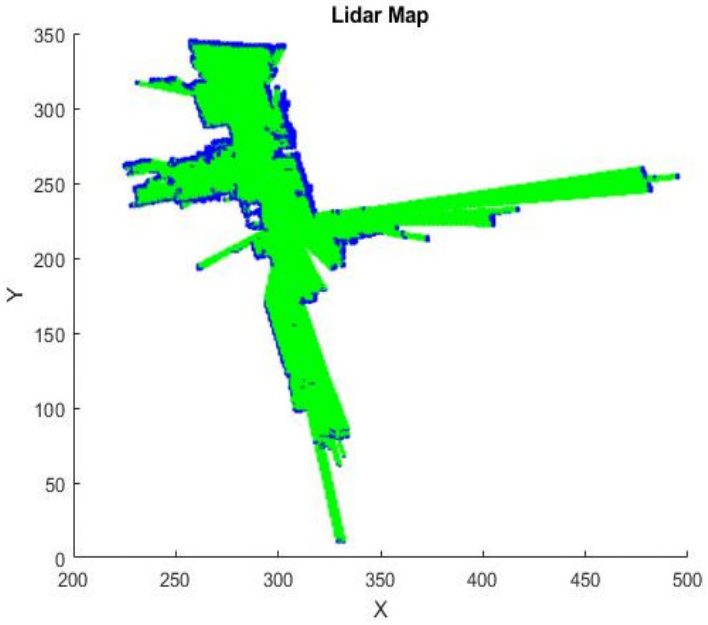

- Camera
- IMU
- LIDAR and SLAM

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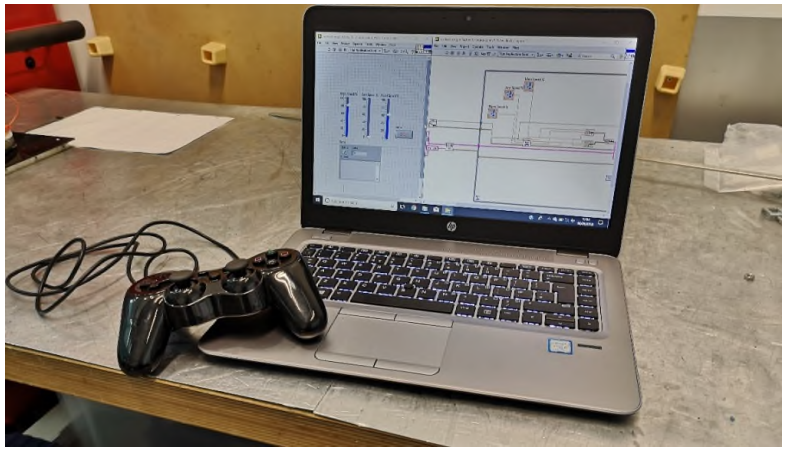
Base Computer

Charles Perera



- Control the robot
  - LabVIEW control
  - Basic automation
  - GUI system
  - PS3 controller

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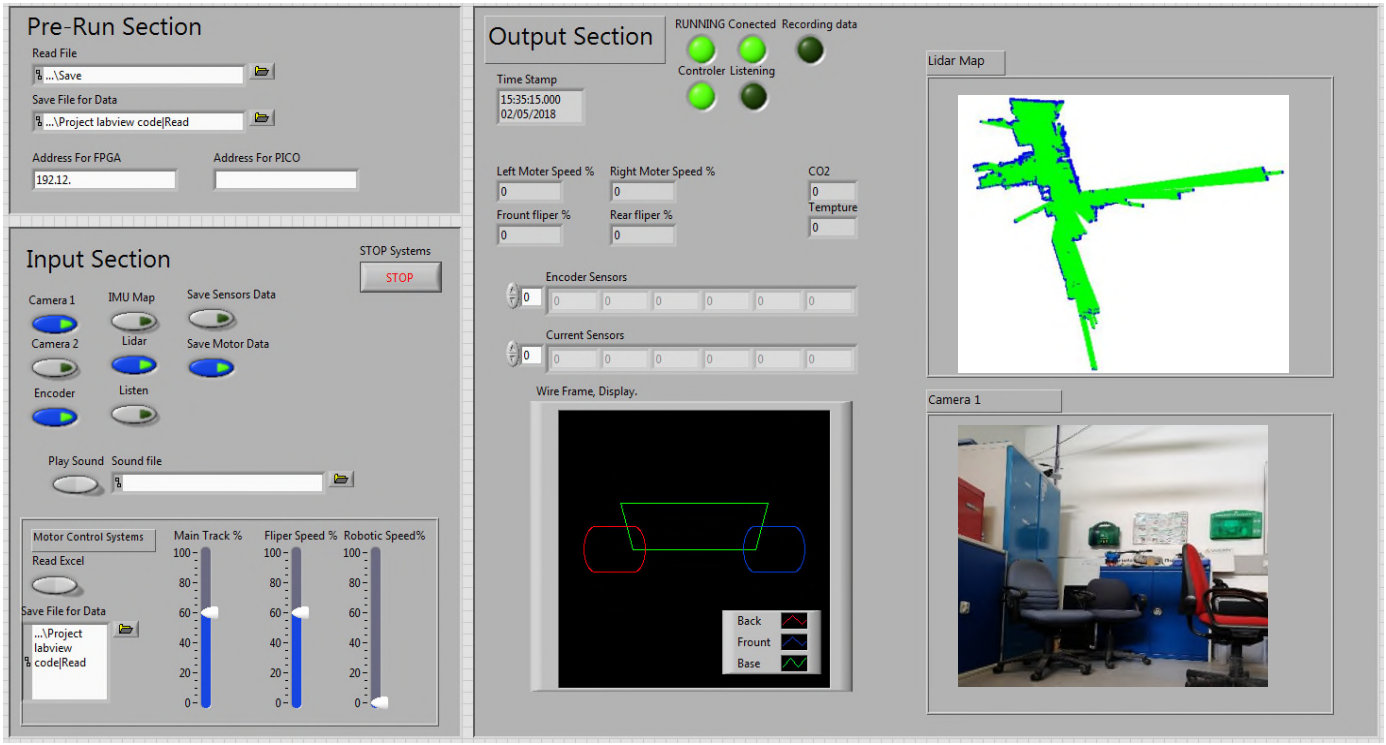
Base Computer

Charles Perera



- Control the robot
  - LabVIEW control
  - Basic automation
  - GUI system
  - PS3 controller

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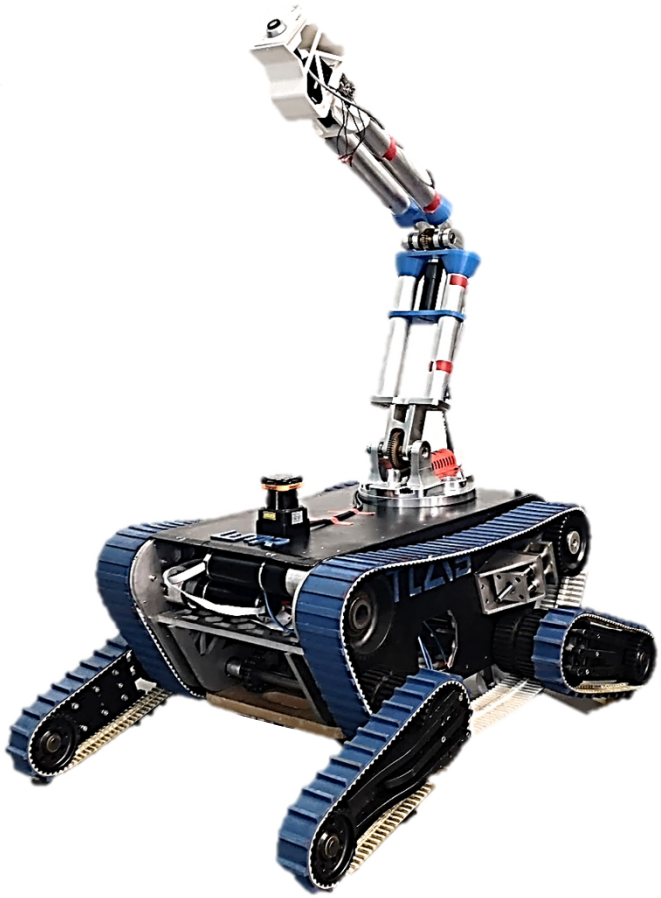
Project Evaluation

Eashana Chotai



- Working robot produced to the RoboCup requirements
- Aims and objectives were all met
- Light weighting opportunities, battery research and money for next year's project team

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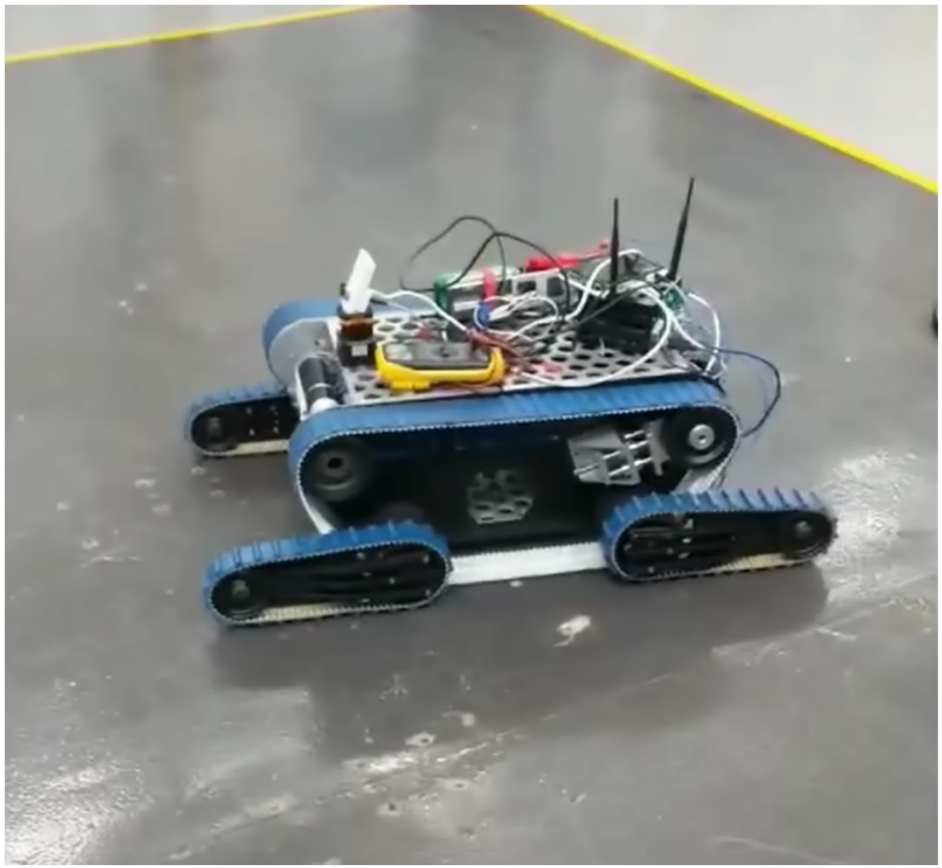
Questions?

Team



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