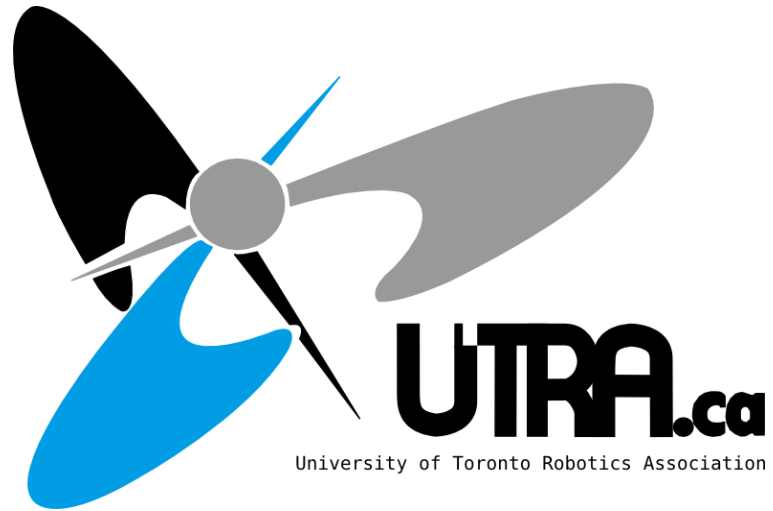


The Autonomous Robotic Systems Team



Intelligent Ground Vehicle Competition

- ▶ Rohaan Ahmed
- ▶ Hasnain Arshad
- ▶ Osman Saleem
- ▶ Matthew Cott
- ▶ Paul Giampuzzi

Intelligent Ground Vehicle Competition 2011



- Annually at Rochester, Michigan, USA – June 3-6, 2011
- Multi-disciplinary collaborative and highly recognized

Past Entries:

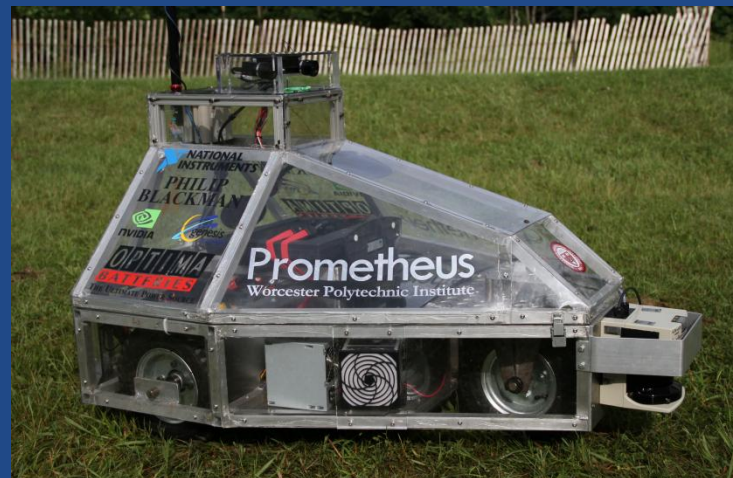
University of Detroit – Mercy (2008)



Bluefield State College (2008)



Worcester Polytechnic Institute (2010)



• Organizers & Major Sponsors include:

- Association for Unmanned Vehicle Systems International.
- United States Department of Defence.
- United States Army Tank Automotive RD&E Center.

UTRA Autonomous Robotic Systems Team



- New team under UTRA.
- Team Structural Breakdown:
 - ▶ SLAM and Navigation – Hasnain Arshad
 - ▶ Hardware and Sensors – Osman Saleem
 - ▶ **General Members**
 - ▶ Computer Vision – Matthew Cott
 - ▶ Mechanical Systems – Paul Giampuzzi
 - ▶ **General Members**
 - ▶ Power Systems – Paul Giampuzzi
 - ▶ **General Members**
 - ▶ JAUS System – Rohaan Ahmed + TBD
 - ▶ **General Members**

The Robotic Vehicle Overview

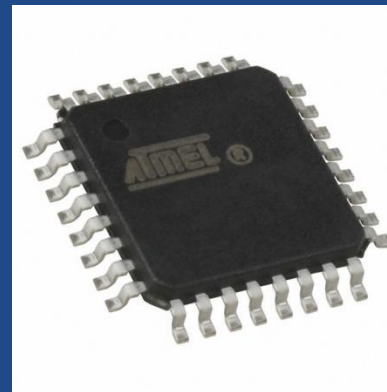


- ✓ Requirements Definition completed.
- ✓ Project Proposal completed.
- ✓ Detailed Design initiated.
- ✓ Implementation initiated.

Electric wheelchair chassis.

- Custom steel frame and body.
- Custom on-board sensors package.

Including: Laser Rangefinder, Video Camera, Optical Encoders, Differential GPS, Digital Compass etc.



Computer Vision - Overview

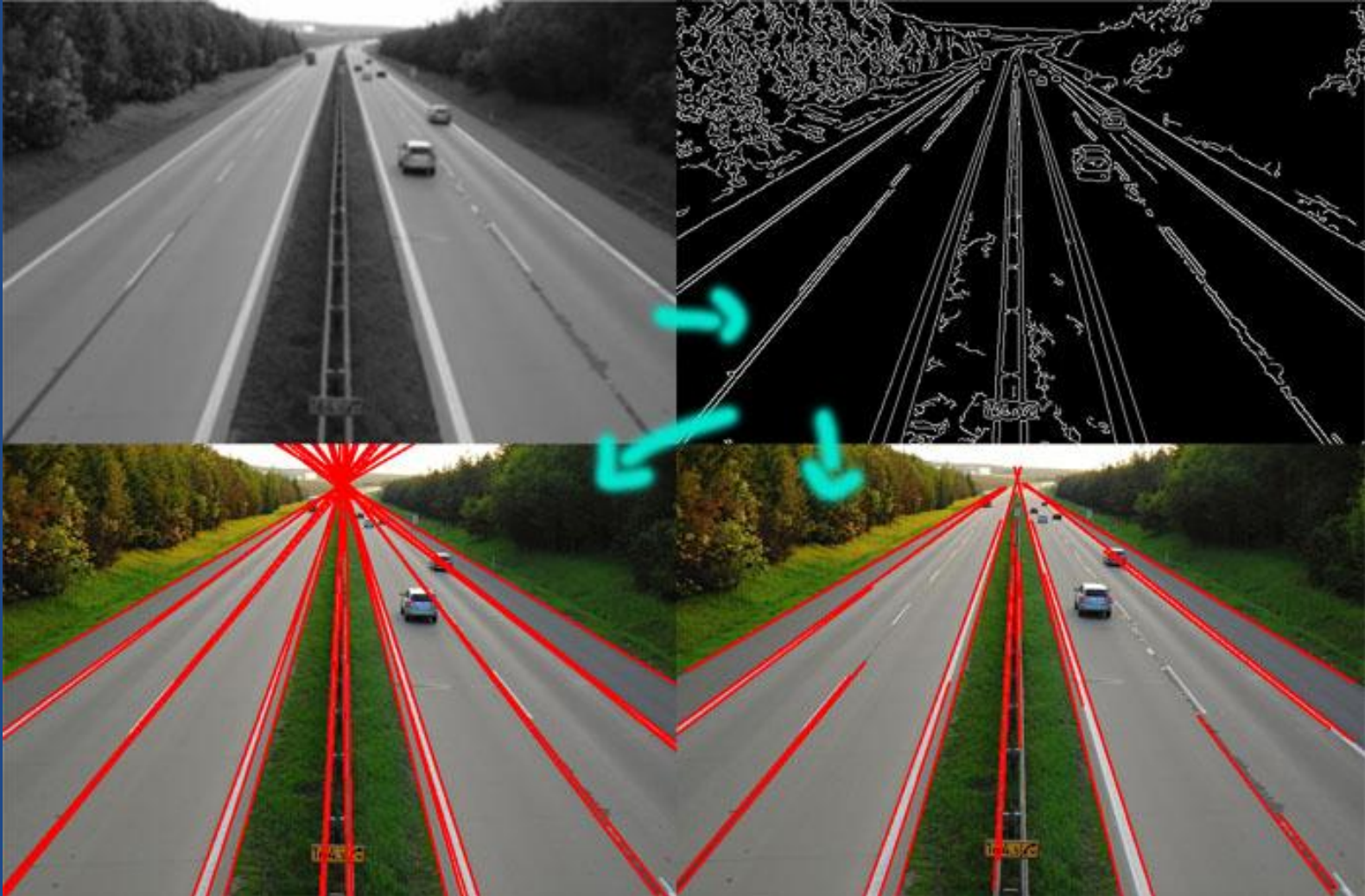


- Section Lead – Matthew Cott
- Required for the Autonomous Challenge.
- Utilize open source OpenCV in C++
 - Open Source Vision library.
 - Multiple programming languages.
 - Over 500 data types, functions and transforms.
 - Multiple color systems & image threshold systems
 - Transforms of interest include:
 - Gaussian Blur and Noise Reduction
 - Canny Edge Detector
 - Probabilistic Hough Transform
 - Segmented Hough Transform

Computer Vision - Overview



- Lane detection on highway image



Computer Vision - Overview

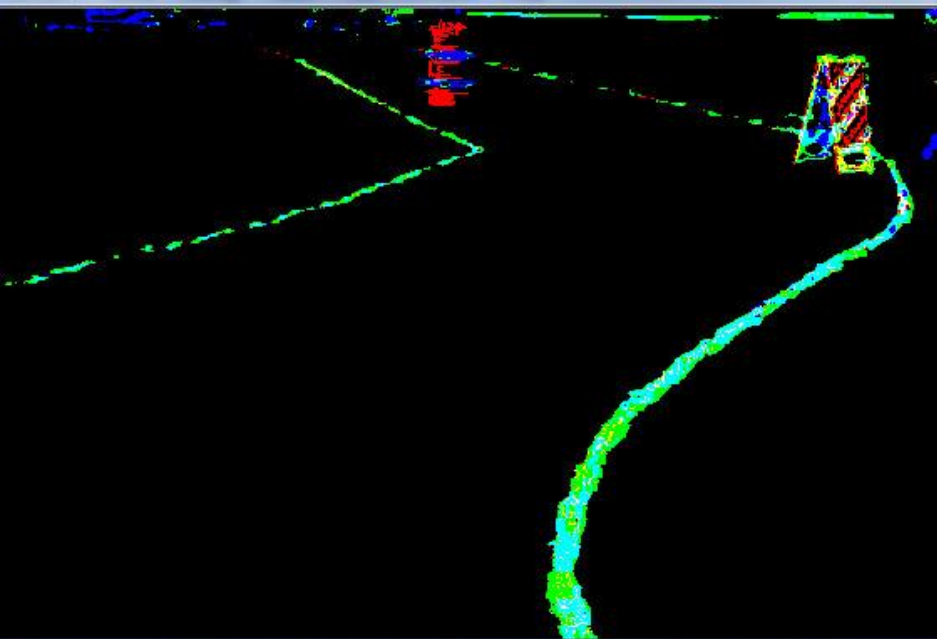
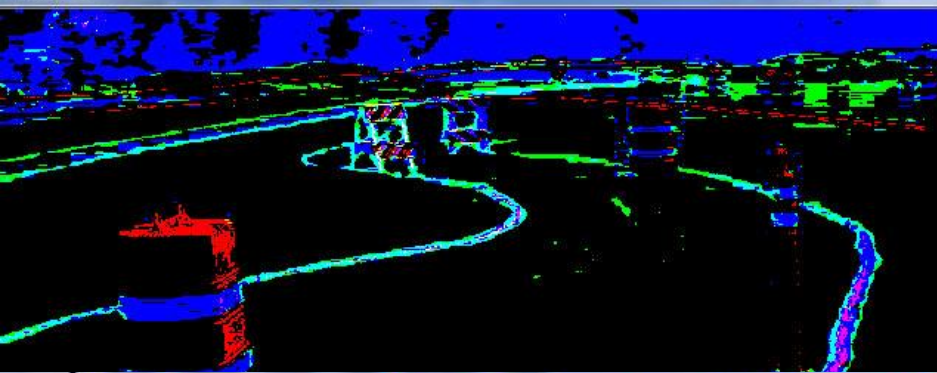


- **Lane detection system**
 - Noise reduction filters.
 - Edge detection and line drawings.
 - Identify significant lines, pass into object plane.
- **Pothole detection system**
 - Image masks, template matching.
 - Pass into object plane.
- **Ramp detection system**
 - Image masks, template matching.
 - Alert remaining system of upcoming ramp
 - Object detection support, support to navigation module

Computer Vision - Overview



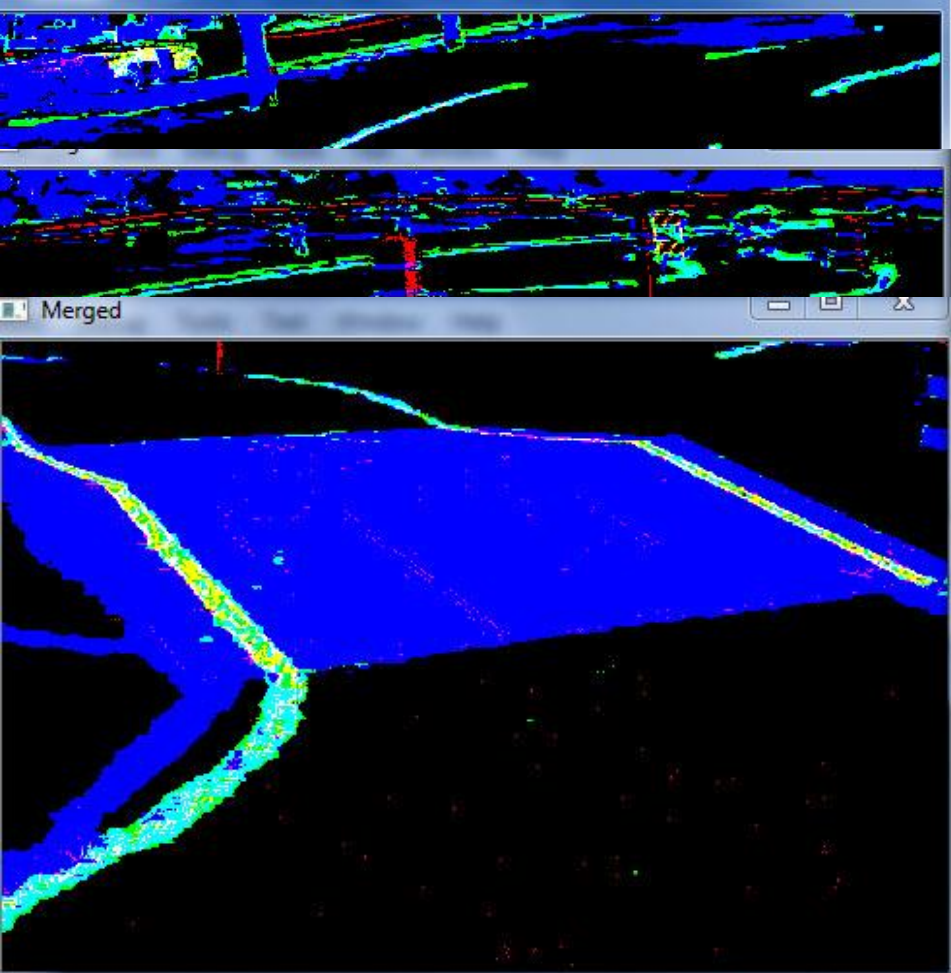
- Lane detection in competition setting



Computer Vision - Overview



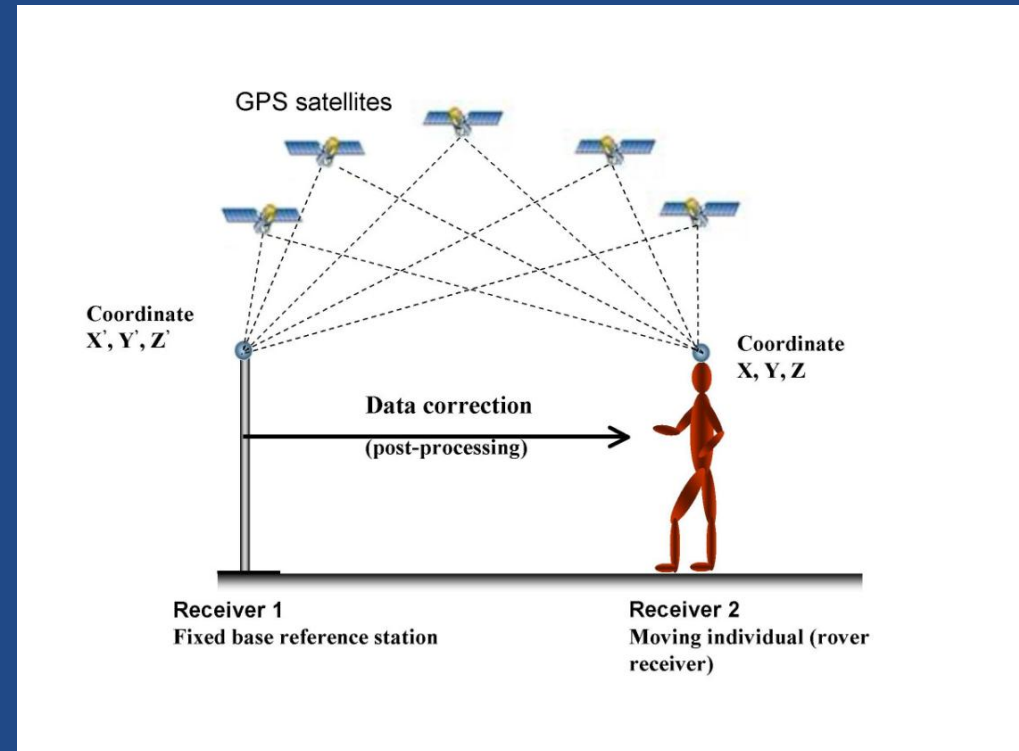
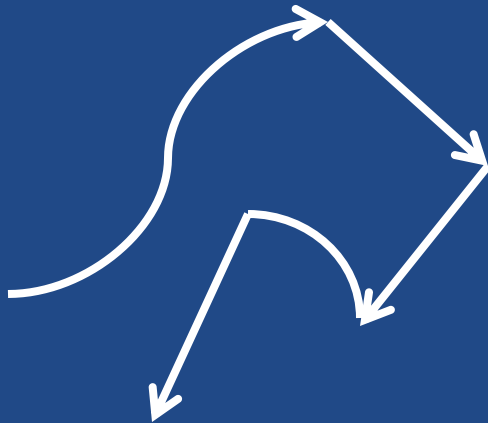
- Lane and Ramp detection in competition setting



Simultaneous Localization & Mapping and Navigation



- Section Lead – Hasnain Arshad
- Localization
 - DGPS.
 - “Dead Reckoning”



- Mapping [Navigation Challenge]

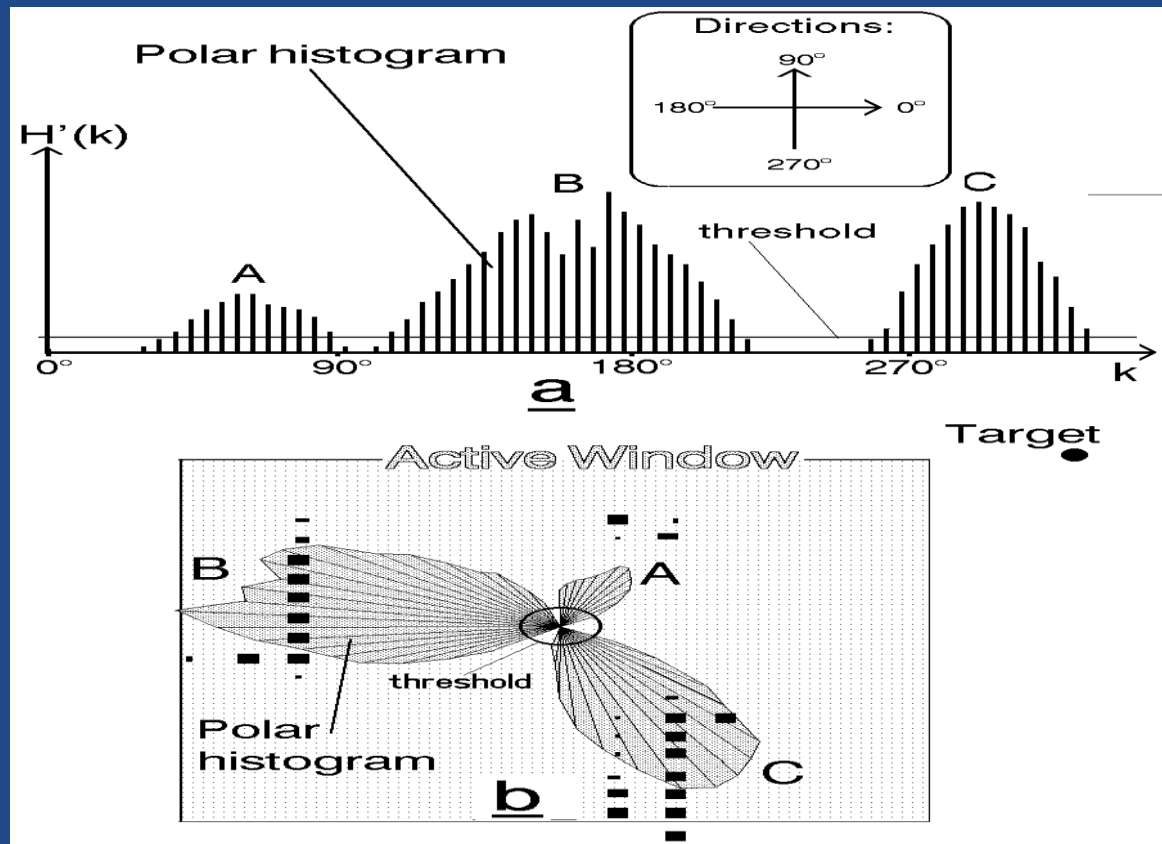
- Acquire information regarding obstacle location.
- Create local map of data.

Simultaneous Localization & Mapping and Navigation



- **Obstacle Avoidance**

- Intelligently plan path considering obstacle data.
- Use of Vector Field Histogram.

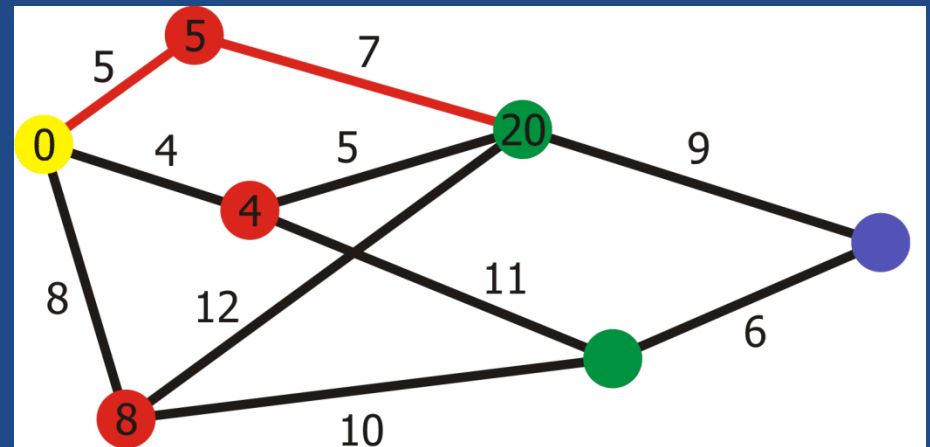
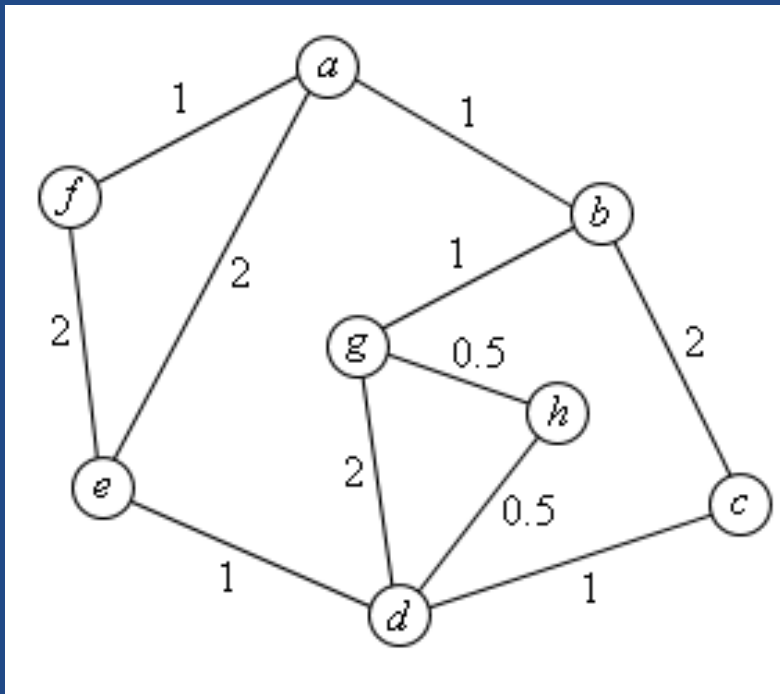


Simultaneous Localization & Mapping and Navigation



Navigation

- Intelligently plan path considering obstacle data.
- Use Dijkstra's Algorithm for path planning.
- Local map used for optimal planning.



Mechanical and Power Systems Design



- Section Lead – Paul Giampuzzi
- Chassis
 - Upgrade existing wheelchair chassis.
 - Testing of wheelchair chassis.
 - Customization of chassis to IGVC specs.
- Body
 - Design of robot body in SolidWorks.
 - Consultation with Hardware and Sensors Lead.
- Motor Control
- Power System
 - Testing of batteries and integration in chassis.
 - Wiring.
- This area is open to the all members.

Hardware and Sensors



- Section Lead – Osman Saleem
- Sensors
 - Selection of optimum sensors.
 - Integration of sensors and software.
 - Testing of systems.
- Emergency Stop
 - Design of E-Stop switch and wireless relay.
 - Selection of parts.
 - Integration and implementation.
- Miscellaneous
- **This area is open to the all members.**

JAUS



- Joint Architecture for Unmanned Systems.
- Section Lead position is open
- Originally US DoD Standard.
- Open Architecture.
- Implemented on all NATO unmanned systems.
- This area is open to the all members.

- JAUS Requirements for IGVC
 - Research required.
 - Consultation with Project Lead.

Timeline



- **Currently underway:**
 - Detailed Design
 - Code Development
 - SLAM, Navigation and Computer Vision
- **Soon to begin**
 - Vehicle chassis upgrade and testing
 - Vehicle body design
 - JAUS Implementation
- **Timeline**
 - Initial dev completed by mid Dec.
 - Code-vehicle integration begins in Jan.
 - Vehicle construction completed by Jan.

Benefits



- Invaluable Engineering experience.
- International competition experience.
- Exposure to Canadian and American organizations.
- Looks ideal on job application.
- Way more interesting than *most* PEY and Internships
- Most importantly... Lots of fun!

Thank you!

For more information, contact:

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www.UTRA.ca/IGVC