Cornell MineSweeper

CORNELL MINESWEEPER

The Mission

Cornell **MineSweeper** strives to design and fabricate a cost-effective, **autonomous** robotic vehicle to accurately **detect landmines** and facilitate their clearance in post-conflict areas. To demonstrate the functionality of the ground vehicle platform of the project, the Cornell **MineSweeper** vehicle will enter the 2008 **International Ground Vehicle Competition** (IGVC) as an interim milestone.

The Landmine Crisis

Landmines are not a relic of some distant past. There are currently **56 million active landmines** in the world, most of them in civilian areas. Landmine Monitor reports 15,000 to 20,000 landmine casualties occur every year. That's one person setting off a mine **every 22 minutes**. The current cost to detect and defuse a landmine of $1200 is prohibitive for many under-development countries.

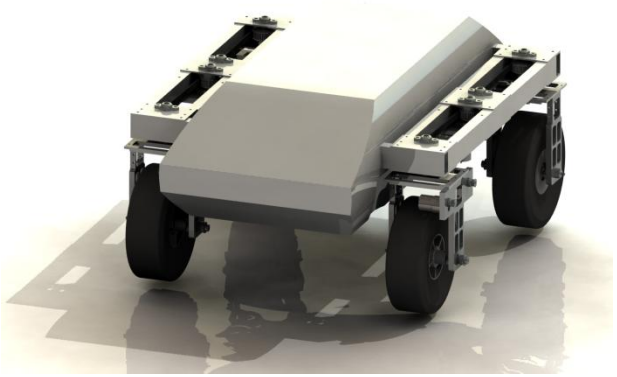


Figure 1: Cornell Gladiator Chassis

The Technology

Our current platform design is christened **Cornell Gladiator**. The robotic vehicle is an **intelligent** all-terrain sensor platform which can operates in both remotely operated and autonomous modes. The vehicle's **navigation system** is based on a combined output of inertial, magnetic and global positioning sensors. The **terrain detection** is done using a combination of robotic vision and laser detection and ranging. The data from all the sensors is gathered by a centralized **software system** responsible for data fusion, high-level information extraction, decision taking and vehicle control. The **propulsion system** of the vehicle is based on a dual-motor four-wheel configuration allowing a zero radius turn capability. The whole system is entirely battery operated and built with an environment friendly approach. This ground vehicle platform is the first step toward the autonomous mine detection goal.

The Challenge

Several mine clearing and autonomous ground vehicle technologies have been proposed over the years but they all possess a common shortcoming: their **hefty price tag**. With a strict cost reduction approach, the Cornell **MineSweeper** project target a price tag of $1000 per robot in a mass-production environment.

The Team

Since 2006, Cornell **MineSweeper** is a **student run** project comprises of 30 undergraduate and graduate students drawn from various disciplines and various levels of expertise across Cornell University. The team is organized under 5 major groups: **Business, Computing, Controls, Frame and Power**.

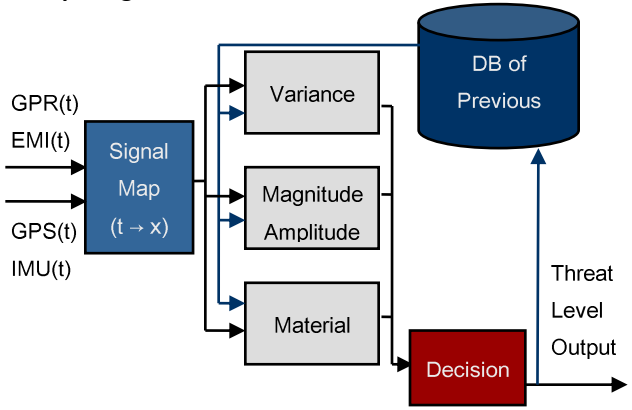
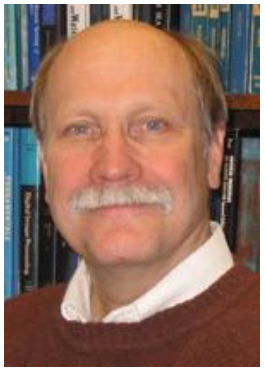


Figure 2: Landmine Detection Sensor Pod Algorithm

Advisors

Although completely student led, Cornell **MineSweeper** is especially advised by **Dr. Ephrahim Garcia**, head of Cornell's Laboratory for Intelligent Machine Systems. Dr. Garcia contributes to the team with his many years of experience in the development of Distributed Intelligence in Small Robotic Swarms, and Autonomous Robots. Moreover, his experience as a DARPA project manager represents an important asset to the team.



The team is also supported by **Dr. William Philpot**, currently the Associate Director of the School of Civil & Environmental Engineering. Dr. Philpot is also the program leader for remote sensing at the Cornell Institute for Resource Information Systems (IRIS). His research interests are in the physics of optical remote sensing, spatial and spectral pattern recognition, and image processing.

Competition

To warrant the performance of our intelligent sensor platform, we are competing in the **Intelligent Ground Vehicle Competition**. The competition tests the robot's navigation and obstacle avoidance autonomy and is organized by **TARDEC, DoD and AUVSI**. The competition is held at Oakland University, Michigan and more information can be availed at **http://www.igvc.org**

Cornell Gladiator | Technical Specifications

All-terrain Chassis	
Configuration	4WD, bi-steering, Rolling zero point turns
Dimensions	3'x3'x2'
Weight	25kg
Payload	10kg
Drivetrain	4 wheel drive. 2.5Nm per wheel Dual motors configuration per wheel
Power	NiMH battery packs
Max Speed	1.5m/s
Max Incline	20%
Construction	Aluminum, Steel, Nylon
Runtime	~2 hours (nominal)
Sensors and Control	
Positioning	GPS (< 2m positioning accuracy) IMU-3 axis Dead Reckoning
Obstacle Avoidance	Cameras, LIDAR, SONAR
Landmine Detection	Metal Detector (EMI) Array Ground Penetration Radar
Computing	
Algorithms	Image Processing, Navigation, Positioning and Machine Learning
Low-level Control	Atmega32 Microprocessors
Primary Computer	Mini-ITX Core 2 Duo, 2Ghz, 2GB RAM
Safety	
E-Stop	RF control Manual Override

Sponsors

Gladiator Technologies, Inc.

Cornell University College of Engineering

Kionix

MaxBotix® Inc.

LEGEND TECHNOLOGIES

SUNSTONE CIRCUITS

Why sponsor our team?

Research and Technology

Our sponsors and friends will be privy to any technology and detection methods Cornell **MineSweeper** implements or develops. These technologies include Computer Vision, AI, and autonomous design among others.

Publicity

Cornell **MineSweeper** represents an excellent opportunity to:

- Interact with talented and promising students
- Associate at a professional level with Cornell University
- Make a humanitarian difference

Opportunities to be advertised at exclusive events at Cornell University include:

- BOOM (Bits On Our Minds)
- Cornell Engineering Project Showcases
- Cornell **MineSweeper** Presentations
- Intelligent Ground Vehicle Competition (IGVC)

Benefits:

- Advertisement Space :
  - The Robot
  - Presentations
  - Events (BOOM, Competitions)
  - Inclusion in our Newsletter and Sponsorship Packages
  - Inclusion in our Website (including links)
- Official Cornell **MineSweeper** Merchandise
- All donations are tax exempt

Contact Us

Cornell **MineSweeper**

B62-P4, Upson Hall

Ithaca, NY 14853

http://minesweeper.engineering.cornell.edu

minesweeper_business@cornell.edu