Autonomous Ground Vehicle construction and Implementation

Kuzi Rusere, Matthew Dahlin, Yan Mo and Chao Guo

Department of Physics, Linfield College , McMinnville OR

Introduction

- *WildCat* is an autonomous ground vehicle (AGV).
- *WildCat* will be entered in the Intelligent Ground Vehicle competition (IGVC)(international) held June 2016 at Oakland University in Rochester, Michigan.
  - ➢ It is a multidisciplinary, theory-based, hands-on, team implemented, and outcome-assessed competition.
- The objective of the competition is to challenge students to think creatively as a team about the evolving technologies of vehicle electronic controls, sensors, computer science, robotics and system integration throughout the design, fabrication and field testing of autonomous intelligent mobile robots.
- The vehicle will be able to compete in: 1) autonomously navigate an outdoor obstacle course as quickly as possible, keeping within the speed limit and reaching all GPS waypoints, 2) complete a course with remote (user) control, and 3) have ingenuity and uniqueness in design.

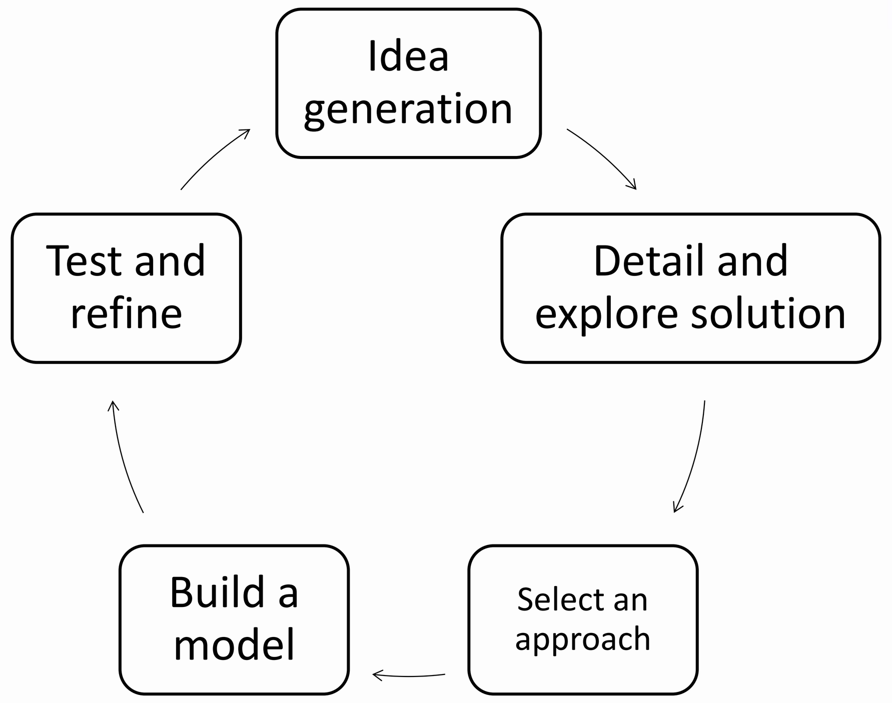
WildCat's Path Planning

- *Upon completion the WildCat* will be able to auto-navigate, detect and avoid obstacles, and line-follow. In order for the vehicle to do this, it makes use of the camera and image recognition software to detect the obstacle and line-follow.
- The image recognition software uses Open Computer Vision (*OpenCV*) libraries imported in *Visual Studio*. Three GPS Units and a Compass are used for location.
- The vehicle uses a path finding algorithm, similar to the A* path finder, programmed in C++.
- The algorithm the records the GPS coordinates that it has already been to and use the information from the camera to navigate through obstacles.

Mechanical Design

- Steering on the *WildCat* is performed by changing the relative speeds of the wheels. Therefore a front-driven design was preferable.
- The front and back axles are connected by a steel rod that allows relative rotation about the rod and strengthens the structure of the vehicle.
- A robust suspension system consists of six tension springs and two compression springs. Tension springs avoid problems of lateral movement deforming the spring. The Compression springs in the back moderate rotational and horizontal movement of the frame (relative to chassis).

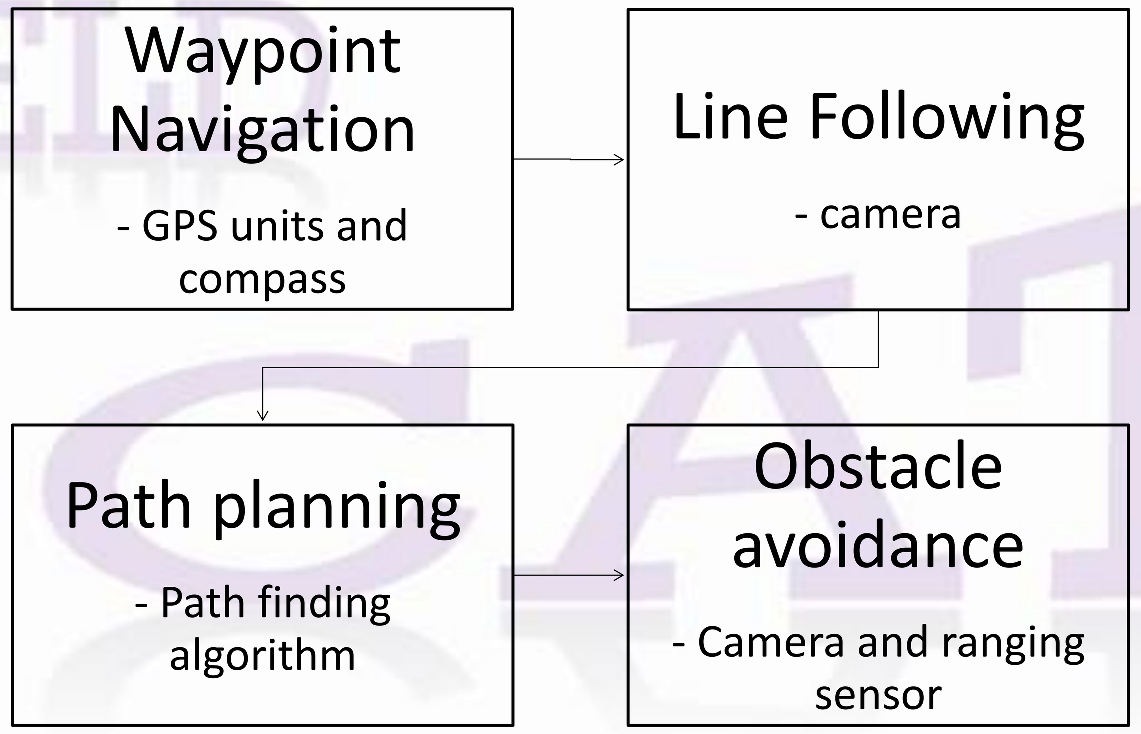
Design Methodology



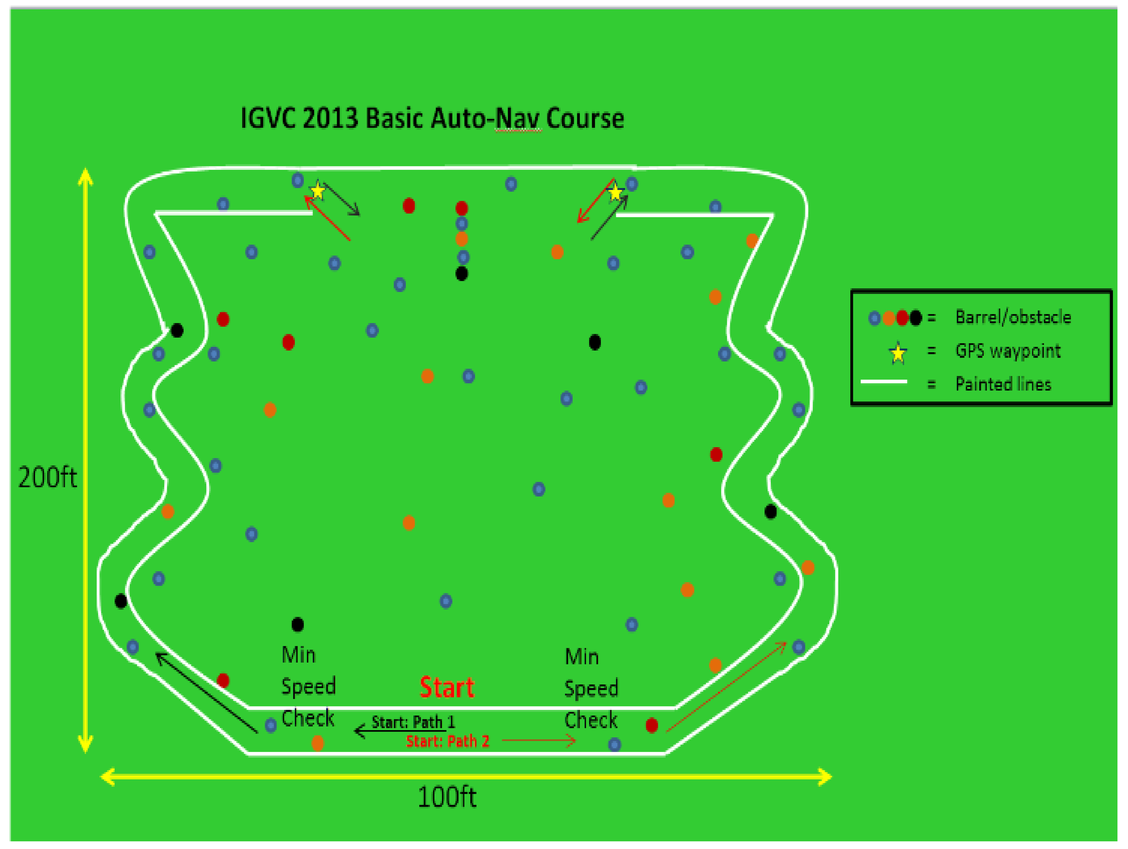
Electrical System

- Powered by two Duracell deep cycle 12-volt batteries.
- A *Roboteq* AX2850 Dual Channel High Power Digital Motor Controller controls regulates power supplied to each of the two 24 volt, 240 RPM, 20:1 gear-ratio *NPC* DC motors.
- Motor Encoders give feedback to the Motor controller.
- On-board computer (running windows OS), which receives input from the cameras, 3 GPS Units, and compass.
- The computer sends commands to the Motor controller.
- An RC switch allows automatic remote switching between autonomous mode and remote-controlled mode.

Software system implementation

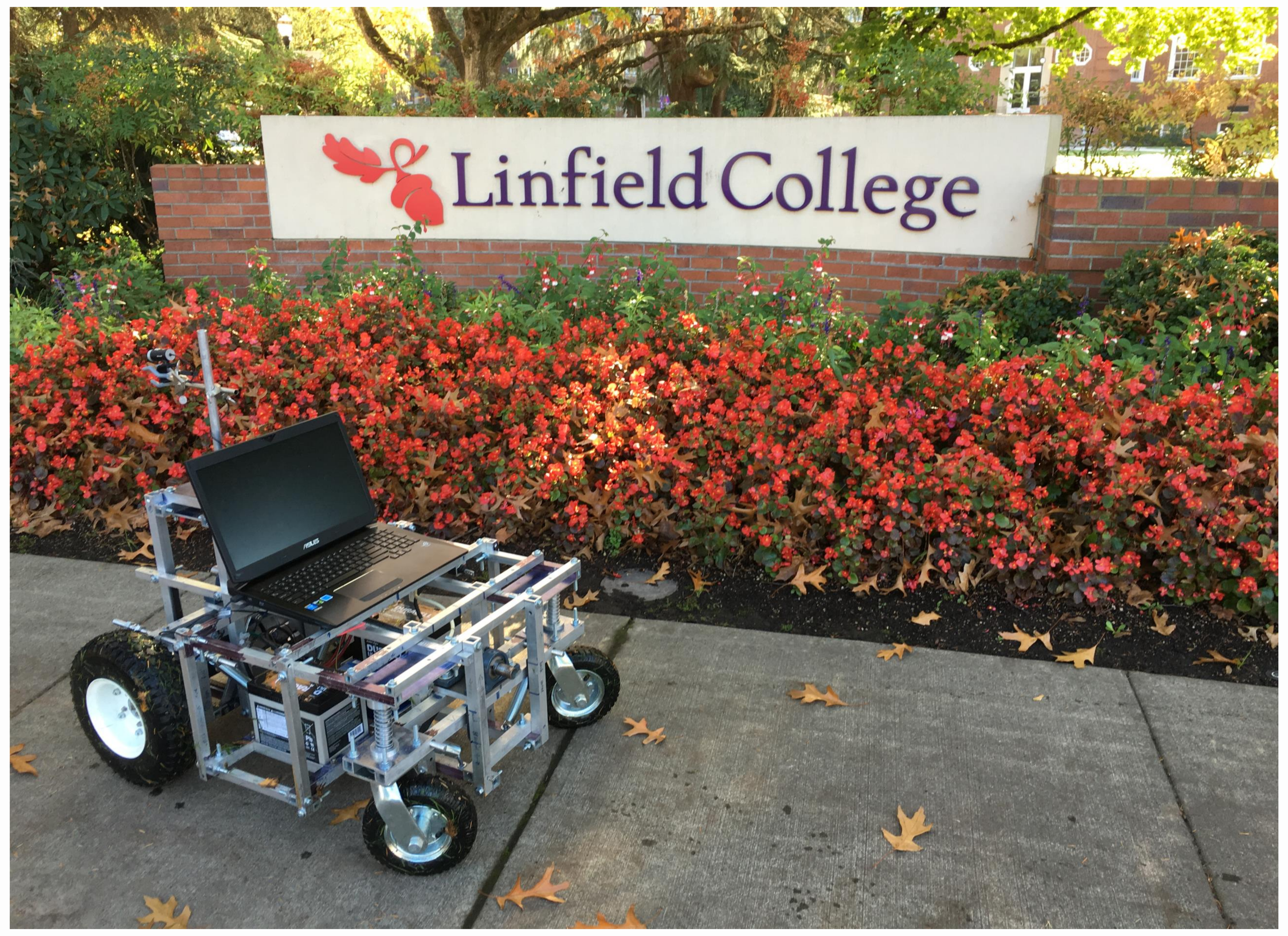


Example of the Auto Navigation course



Future Improvements

1. Two alternatives for obstacle detection are LIDAR (light detection and ranging) system and binocular vision (using two cameras). The LIDAR system has batter ranging than binocular vision.
2. The current suspension system is prone to vibrations, Shock absorbers are desired to damp these vibrations.
3. Integration of Solar cells to power the vehicle.



Acknowledgements

- ➢ Dr. Tianbao Xie—Linfield College physics professor, without whom this project would never had happened.
- ➢ Wendell L. Foote—Science Endowment
- ➢ Student Faculty Collaborate Research Grant of Linfield college
- ➢ Linfield Department of Physics—for allowing use the facility and equipment required in the construction of the vehicle.