Senior Design Project in Electrical Engineering

AUTONOMOUS GROUND VEHICLE

An Automated Indoor Sentry

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Component Legend

1. Air Pro 3 HD Video Camera
2. Hokuyo 04-LX LiDAR
3. Two 12V Batteries
4. On-Board Computer
5. Sabertooth 12x2 RC
6. Mode Switch/RC Receiver
7. Two Arduino Pro Minis

Autonomous Navigation

AGV navigates the EE wing of McAllister Hall using a LIDAR, an on-board computer, and an Air Pro 3.

LIDAR
- 682 data points
- Span of 240°
- Maximum range of 5.6m
- Data collection rate of 2 Hz

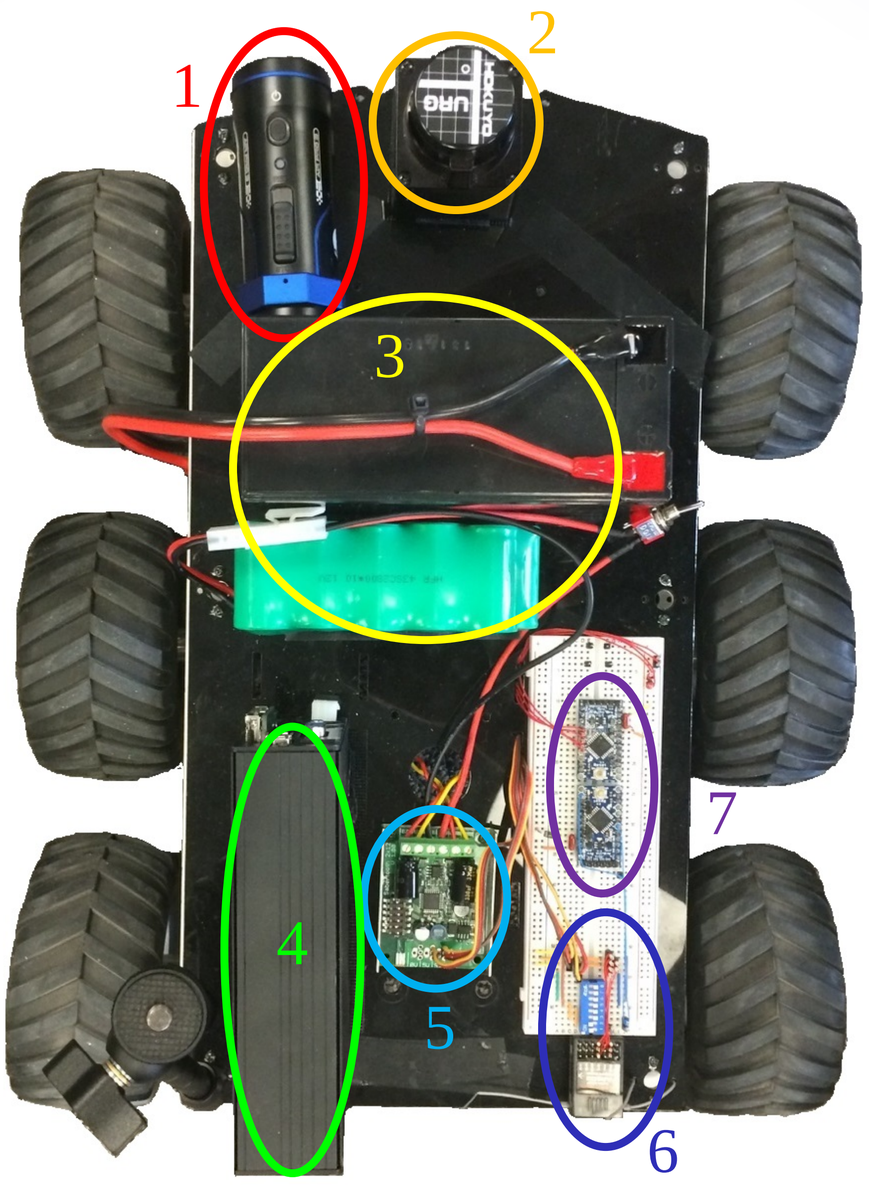
On-board Computer
- Stealth Computer, Windows XP
- Runs MATLAB code that drives the system
- User work station connects via Remote Desktop

Air Pro 3
- Wi-Fi connectivity
- Image processing of the video is used to avoid stairs

PROJECT DESCRIPTION

The Autonomous Ground Vehicle (AGV) is a first year Senior Design Project. An important aspect of the project is to promote familiarity with autonomous systems amongst the Coast Guard's Officer Corps.

AGV is implemented in a modular design to set the foundation for future research in the field as well as to facilitate system testing.



Project Requirements

Major requirements identified for the project are:
- Obstacle avoidance
- Fully autonomous navigation
- Video stream available to user
- Location available to user
- User Friendly

Motor Control

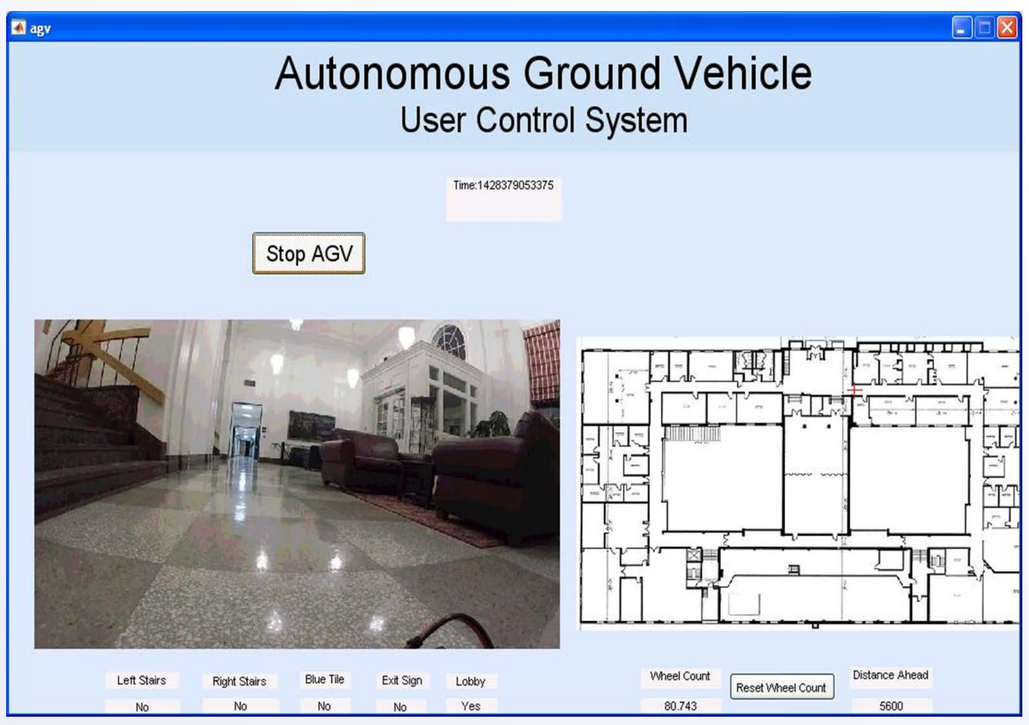
AGV uses 6 motors that are controlled through an Arduino Pro Mini microcontroller.

Power Supply
- 12V DC
- Independent supply for motors and processor

Arduino Pro Mini
- Receives serial commands from the On-board Computer
- 100 Hz timer-based Interrupt Service Routine
- Finite State Machine determines direction and speed
- Produces Pulse Width Modulation (PWM) signals for Sabertooth motor controller

Sabertooth 2x12 RC
- Translates PWM signal into DC Voltage
- Independent motor control for each motor set

Graphical User Interface (GUI)



Video Stream (left)
- Air Pro 3 HD video camera
- 300x600 video resolution.
- 2 Hz refresh rate.

Localization (right)
- Image processing, range data, and wheel count measurements are used to determine location
- Location is provided in the form of a red '+' on the map.
- About 2 Hz refresh rate.

Mode Switch

AGV is equipped with an RC-Autonomous mode switch.

Remote Control
- Spektrum DX5e controller
- User tunable

RC Receiver
- Spektrum AR600 receiver
- Produces PWM signals for the Sabertooth motor controller

Mode Switch
- User-selectable
- Autonomous or RC modes