Needs Assessment

EML 4551C – Senior Design– Fall 2012 Deliverable

Team 10 – CISCOR Autonomous Ground Vehicle

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Needs Assessment

The increased use of autonomous vehicle both in the private and public sector has grown dramatically in the past forty years. The wide platform usage of these autonomous vehicles makes them a favorite among the defense sector and plays an integral part in today's battlefield. However, the battlefield isn't the only place where these autonomous vehicles are used. Today, many commercial vehicles are more intelligent and responsive than ever. Many modern cars now have the ability to adapt to terrain and different weather conditions automatically, which in turn relates to the autonomous functionality of an autonomous vehicle.

This project will be the used to implement a platform for research and development of ground vehicle's autonomous systems. Currently, CISCOR does not own a four-wheel drive vehicle that can successfully drive over multiple terrain surfaces, both on and off road for testing and developments of it's autonomous ground vehicle systems. Therefore, there is a need for a vehicle platform that will be able to drive autonomously and unmanned through multiple on and off road terrain. Once such vehicle platform is designed and implemented it is possible to research, develop and test autonomous drive systems.

Project Scope

Problem statement:

There is no vehicle platform to research, develop and test autonomous ground vehicle systems in an off road environment.

Justification/Background:

This project is being developed as a vehicle platform project for CISCOR (Center for Intelligent Systems, Control, and Robotics) for further research in the area of autonomous systems in an off-road environment. Furthermore, after successful completion of this project, this vehicle will be used as a platform for larger more extensive research project. This in turn will generate more research funding and grants to fund further research in the areas of autonomous design.

Objective:

The main objective is to develop and integrate DC driven electrical drives (Servo Motors, Actuators) that can control the four user inputs required for driving an ATV without limiting the vehicles original functionality. Installing vibration resistant mounts for the computers required to control the motors, and installing wires from the computers to the actuators. Develop kinematic models to allow computational calculations for computing ATV's trajectory. Also mounting multiple sensors that will be used by the computers for autonomous systems. These sensors include but not limited to: Encoders, SICK laser sensors, GPS, Gyrometers and Optical sensors.

This will be accomplished by April 2013.

Methodology:

In order for successful completion of this project, the following will be implemented in a timely, orderly fashion by collective collaboration of each team member. Upon delivery of the ATV unit, the first stage is to successfully create an accurate kinematic model of the vehicle. Second stage of the project will be to research, design and fabricate encoder mounts for each wheel of the ATV and then mount encoders on each wheel. The third stage of this project will be to research, design and fabricate actuator and servo motor mounts. Once these mounts are successfully mounted, it is possible to install actuators and motors for controlling the user selected inputs electronically. The fourth stage of the project will be to research, design, and fabricate sensor mounts for each sensor and computer(s). After successfully mounting the mounts it is possible to attach the sensors and computer(s) to the ATV. Once steps 1-4 are complete it is possible to begin autonomous system development.

Expected Results:

The final products of the project will include a kinematic model of the ATV that will simulate the steering of the ATV given steering angle and speed inputs. The finished ATV will be capable of being driven through computer control. This includes steering, throttle, brake, and gear selection. The vehicle will feature mounts for various sensors to include encoders, lasers, stereo-optics, and mounts for the controlling computers. The vehicle will be capable of being operated through the use of the original controls by a rider mounted upon the vehicle.

Constraints:

The vehicle must be ready for automated operation by the conclusion of the project timetable in April 2013. The mounts for the sensors on the vehicle must protect those sensors from damage or misalignment without hindering their operation. The vehicle must remain operable by a rider. The actuators on the vehicle must be of sufficient dimensions and strength to steer the vehicle. The vehicle must be able to change gears remotely. The actuators must be mounted in a manner that allows them to suffer no damage from expected shocks during operation. The vehicle must include multiple kill switches which will bring the vehicle to an immediate stop.