



# Designing an Autonomous Unmanned Ground Vehicle

## Introduction

This case study showcases Mistral's expertise in the design & development of Autonomous / Unmanned Ground Vehicles.

An unmanned ground vehicle [UGV] can run independent of a human operator. It depends on a set of sensors to observe and cognize the environment around it. The vehicle is operated using a drive-by-wire technology. The vehicle movement commands are generated by the vision & navigation algorithms in lieu of a human operator. These vehicles can be used for surveillance and real-time situational awareness in areas where it might be inconvenient, hostile or impossible to have a human presence.



“ This case study showcases Mistral's expertise in the design and development of Autonomous Unmanned Ground Vehicles using Robot Operating System (ROS) and drive-by-wire techniques. ”

## The Customer

The customer is a leading Defense lab involved in the research of Information & Communication Technology and Development of Intelligent Systems.

## The Requirement

Mistral was approached by the customer to develop an Autonomous Unmanned Ground Vehicle to be used over various security & surveillance operations.

- ▲ Rugged all-terrain vehicle enabled with autonomous driving for perimeter surveillance
- ▲ Ideal for 24x7 patrolling of vital installations with seamless Video Surveillance capability
- ▲ Act as the first response vehicle in a hostile environment
- ▲ Lead convoy vehicle

Mistral was entrusted to design the complete vehicle, developing & integrating various sensors, software, mechanical outfits and components ensuring high protection from shock and vibration, and providing ruggedization for all weather, all-terrain operation.

## Solution Provided

Mistral partnered with one of leading electric vehicle manufacturers to custom design and develop the platform to suit customer requirement. Mistral developed a state-of-the-art electronic design based on the customized vehicle platform and integrated electric motor controller, brake, parking, steering actuators and sensors to enable drive-by-wire. The selected all-terrain vehicle platform is fitted with multiple sensors like LIDAR, RADAR, Ultrasonic, and Ambient light to observe and cognize the environment around it.

The vehicle is equipped with:

- ▲ GPS/INS sensor and RTK base-station for real-time positioning error correction
- ▲ Two wide angle cameras at the front and rear providing a 360° bird's eye view

- Multiple cameras which assist in judgmental decision making and to act according to the situation and surroundings
- A PTZ camera and thermal Camera for seamless day/night Video surveillance
- Powerful embedded computers with graphics processor that run compute intensive navigational and visual algorithms. These algorithms provide instructions based on the data gathered, analyzed and interpreted from the surroundings about vehicle movement.

The Design and development of the battery operated vehicle platform includes:

- Integrate the drive by wire actuators & sensors
- Installation and customization of an ROS (Robot Operating System) framework on ruggedized computational units
- Integration of sensors module to ROS
- Integrate the navigational and visual algorithms
- Develop the Web based GIS system for defining the route maps, roads and building
- Developed web based applications to remotely configure and tele-operate the vehicle.

## The Challenges

- To select the right Platform for cross-country all weather operations. This was addressed by,
  - Identifying a proven base platform ideal for defense applications and ensuring it is operational worthy in all-weather/all-terrain

- Identifying the right motor controller to electrify platform and ensure it supports all use-cases and safety interlocks
- Selecting the right actuators to ensure accurate and quick response time equivalent or better than a human operator behind the wheel
- Developing the Web based GIS system
  - Integrating the open source web based GIS system and integrated with ROS
  - Integrating the algorithm to identify & define the path of the vehicle and turn by turn navigation support
  - Added the edit support for terrains for which road networks are not available.

## Customer Benefits

- Leveraged Mistral's proven expertise in framework development to architect and roll out the final solution in a record span of time
- Mistral offered a one-stop, comprehensive solution to the customer, covering both hardware, software and system integration which helped the customer achieve a quick turnaround for present and future designs without compromising on quality.



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