

Autonomous vehicle – design questions to ponder

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When designing an autonomous or remotely-controlled vehicle, there are a few factors to take into consideration. Three of these are purpose, environment, and terrain.

What is the purpose of the vehicle?

Will it be used in an industrial setting with people moving around it that it must not run over?

Will it be used in a hazardous environment, like Fukushima or Chernobyl, where it would be exposed to high levels of radiation and must be cleaned or left behind? If it must be left behind, any data it has collected must be offloaded remotely.

Will it be used in fire fighting, where it will be exposed to high heat, water, and chemicals?

Will it be subject to small arms fire, as could be the case with a military or police situation? Is it quiet enough that it can avoid detection? Can it withstand being dropped or thrown through a window? If you write data to an onboard regular hard drive and it is subjected to vibration or dropping, it will probably fail. If it is a military situation, can it be destroyed remotely so it doesn't fall into enemy hands?

Will this vehicle be used in a competition, like the Sparkfun Autonomous Vehicle Challenge or Robomagellan, and have to perform reliably and have easy to change modules? How easy will it be to find spare parts?

Is it a household robot to vacuum the floor and must withstand dust and impact from running into furniture?

Is it a security or surveillance robot that must sit idle for possibly long periods of time, and still have enough battery life to complete the task?

Is it a search and rescue robot subject to a wide variety of conditions? Is it and the support equipment light enough to carry on top of all the other required equipment?

Are you using standard batteries that can be found anywhere? If not, will you be able to transport enough batteries to complete your assignment? Will you be using on-board solar panels to charge the batteries or provide power?

Is your vehicle or robot modular? Can you shut down one wheel and use one or more of the other wheels to propel the vehicle?

Are your electronics vibration resistant? If you use solid-state devices, are the connectors secure? At least one of the DARPA desert challenge groups had to fabricate a rack mounted with shock absorbers to protect their hard drives.

Will this vehicle be sent into space, subject to solar radiation, withstanding a landing and possibly never having human contact ever again?

What happens if the batteries fail or overheat and ignite?

After you decide what the vehicle will be used for, the environment it will be used in factors into the design.

Can the vehicle withstand rain or puddles of water? If used underwater, can it withstand the pressure?

Will the vehicle be used in snow? Does it have enough power and clearance to plow through the snow, and how long will that power last? Will it be light enough to "float" on top of the snow? Will the building materials become brittle in the cold? How well can it navigate ice? Will slipping on ice interfere with wheel encoder count?

Do the materials break down in direct sunlight?

If used in corrosive environments, how long will it last? Saltwater is quite corrosive.

Is the vehicle going to be used in a potentially explosive environment, like a coal mine or natural gas leak, and must eliminate sparks?

If used in a fire, can it withstand the heat and smoke? If using a first-person-view camera, how will you navigate through smoke or keep dirt and debris away from the camera?

Mud is difficult to navigate and quickly drains battery power.

Added to all this, is the terrain...

How large of an obstacle can your vehicle drive over? What happens if it gets stuck, or rolls over? Can it get a flat tire?

How steep of a hill can it climb? Do the tires have sufficient traction and the motor enough torque?

Will it be driving on snow or marshy terrain?

Can it detect ledges? Can it fly?

Can it "float" on top of sand, or just bury itself?

You may not have good GPS reception in a valley, forest, or between buildings - can it navigate by dead reckoning? How will you keep your wheel encoders clean?

These are just a few of the questions that come to mind when I think about making an autonomous or even remote operated vehicle. What are other design issues that come to mind?