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An Agent-oriented Ground Vehicle's Automation Using Jason Framework

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Abstract:

This paper proposes an agent-oriented ground vehicle automation that uses low-cost hardware. The vehicle's platform consists in a group of hardware and software layers that acts with the Jason programming language for unmanned vehicles automation. This paper also presents a methodology with four programming layers to facilitate the hardware integration and implementation. To validate and demonstrate the platform an unmanned ground vehicle was constructed using an ATMEGA328 microcontroller, a library for serial communication and a six-function remote controlled vehicle. The vehicle is able to move from one point to another based on its global position.

Introduction:

Recently, a new applicability of Multi-Agent Systems (MAS) is the development of autonomous unmanned vehicles systems. These vehicles do not need embedded pilots and, in many cases, are guided by a portable or mobile control station. In this process, a group of problems can be identified like human failure and communication that interferes the vehicle's mission.

There are several frameworks that use the agent-oriented approach and looks for the Unmanned Aerial Vehicles (UAV). However these works do not present hardware connections, acting only with simulations. There are some platforms that embed MAS into a specific hardware, e.g. (Karim; Heinze, 2005), which provides an agent architecture programmed in JACK for the *Codarra Avatar.* However, the platform do not allow other UAV integration and the vehicle needs to be manned until reach a safe altitude. In (Hama et al.,2011), the UAVAS platform uses the Jason (Bordini et al., 2007) framework that is a set of hardware and software used for the Microcopter quadricopter automation. Despite the idea of a generic architecture and the possibility of others firmware integration, this platform is specific for aerial vehicles.

Objective:

So, the objective of this paper is to propose an agent-oriented ground vehicle that uses a set of low-cost hardware and software layers supported by the Jason framework. Besides, the vehicle's platform can be used with any vehicle (aquatic, aerial and ground). To exemplify the vehicle's operation will be used: an ATMEGA328 microcontroller; the RXTX library for serial communication, and a six-function remote controlled vehicle.

The Platform:

The platform permits any hardware automation that can use a microcontroller and this work focuses on autonomous vehicles. The platform allows the low-cost hardware integration and uses a set of free software that is platform-independent, making the solution accessible for many objectives. To use and implement the vehicle's platform is necessary to follow a specific development methodology in order to integrate correctly the several hardware-software layers. There were identified four programming layers that need developers' intervention: the *Hardware; the firmware; the Simulated Environment; and the Agent Reasoning.*

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The methodology presented allows the use of several independent abstraction levels by the developer. It starts with the hardware choice and analyze until the vehicle's cognitive programming. The layers are integrated from a series of communication and data flow methods. Thus, it is possible to reutilize existent architectures, microcontrollers and libraries for unmanned vehicles automation or begin a new prototype, if it is desirable.

Example:

The example consists of a ground vehicle that moves from one point to another based on its global position. The initial point is obtained by the GPS device installed in the vehicle, while the end point is informed manually. For demonstration it will not be considered any obstacles between the initial and the end point. The example uses the ATMEGA328 microcontroller; the *RxTxComm* library for the serial communication that is free; a Pentium IV computer; and the Jason framework. The platform is embedded into a six-function remote controlled vehicle.

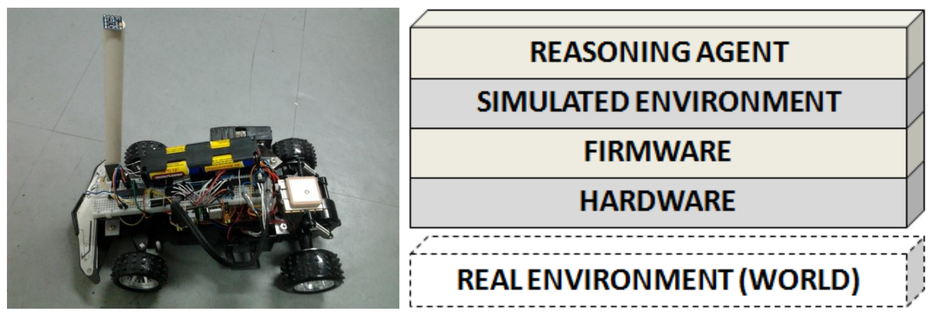

Figure1: The prototype and the methodology layers.

Conclusion:

The platform allows the automation of all types of vehicles and can work with all kind of hardware. The major objective of the platform is to provide a simple agent-oriented methodology that can be used for unmanned vehicles for any programmer.

The layers are composed of extent technologies that are widely used by programmers. In fact, there are no difficulties to handle those codifications steps. The methodology forces the programmer intervention in all development phases, providing a certain degree of freedom in the components selection. However, the platform demands much more development time and movements expertise compared with the other platforms.

References:

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