CEFET/RJ

A Robotic-agent Platform For Embedding Software Agents using Raspberry Pi and Arduino Boards

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Summary

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- Platform
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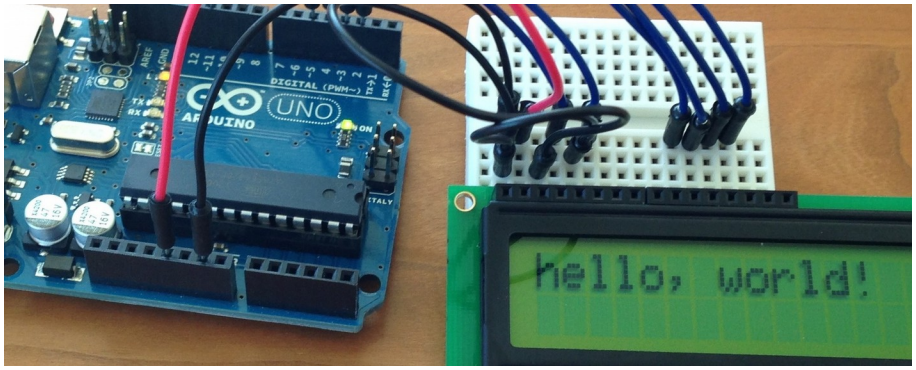
- Methodology
- Demonstration
- Conclusion

Introduction

- Several micro-controllers such as Arduino board used for small automation projects;
- Raspberry Pi board which is a tiny computer with high processing capability.



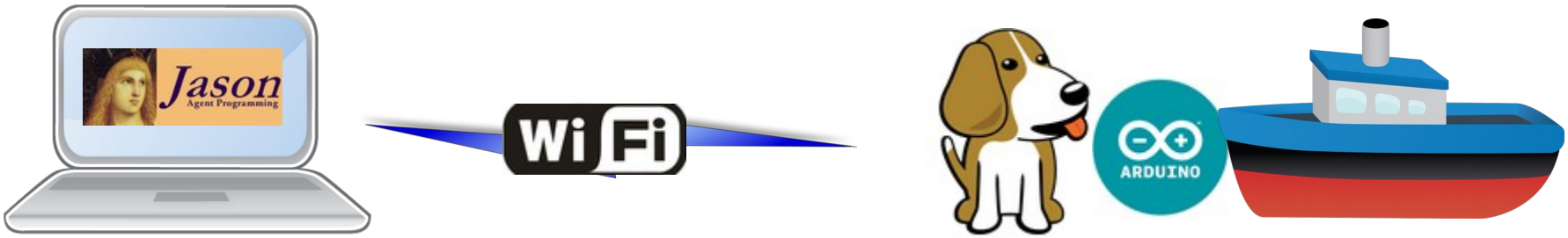
However, the Arduino processing is very slow for an embedded agent reasoning; and the Raspberry Pi although has a higher processing and memory power, it does not have an analogic interface, avoiding some sensors to be used.

Summary

Microcontroller	ATmega328
Digital I/O Pins	14 (of which 6 provide PWM outpu
Analog Input Pins	6
Flash Memory	32 KB (ATmega328) of which 0.5 K
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm

Related works

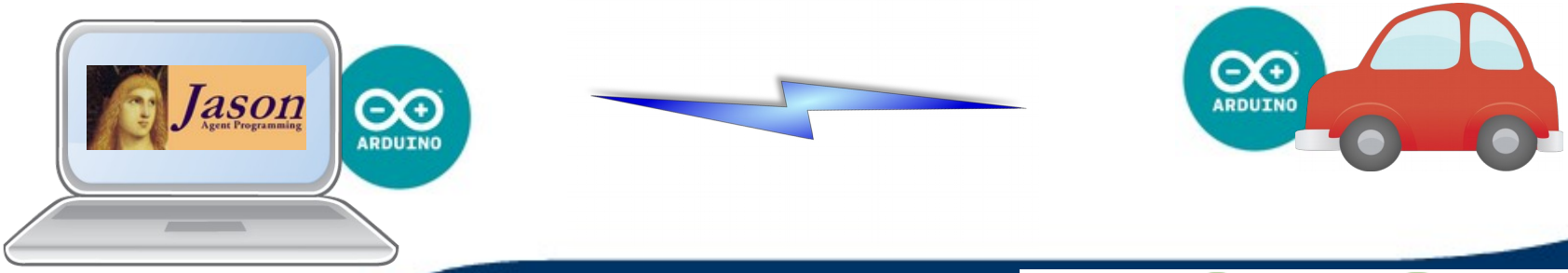
- [Calce et al., 2013] it is proposed an autonomous aquatic robot which uses Arduino together with BeagleBoard and can move point-to-point deviating from obstacles.



Related works

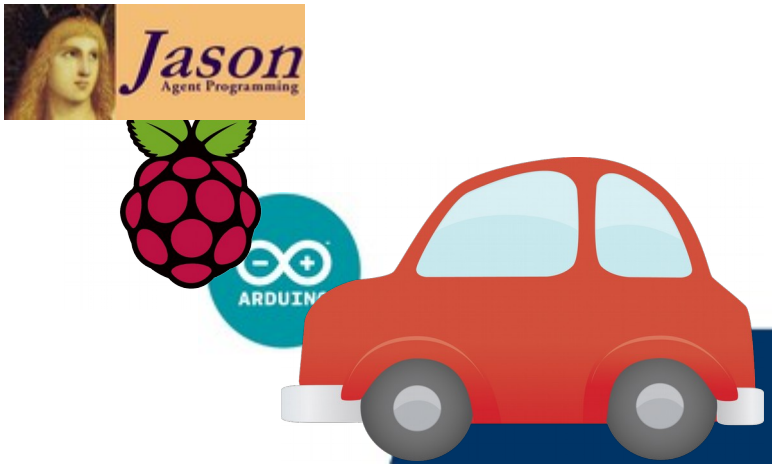
Some projects try to integrate and embed a robotic reasoning into hardware:

- [Barros et al., 2014] an automated grounded vehicle which uses Arduino to program the hardware basic functions; a java library for serial communication between the hardware and the simulated environment programmed in Java; and Jason framework for the agent programming.



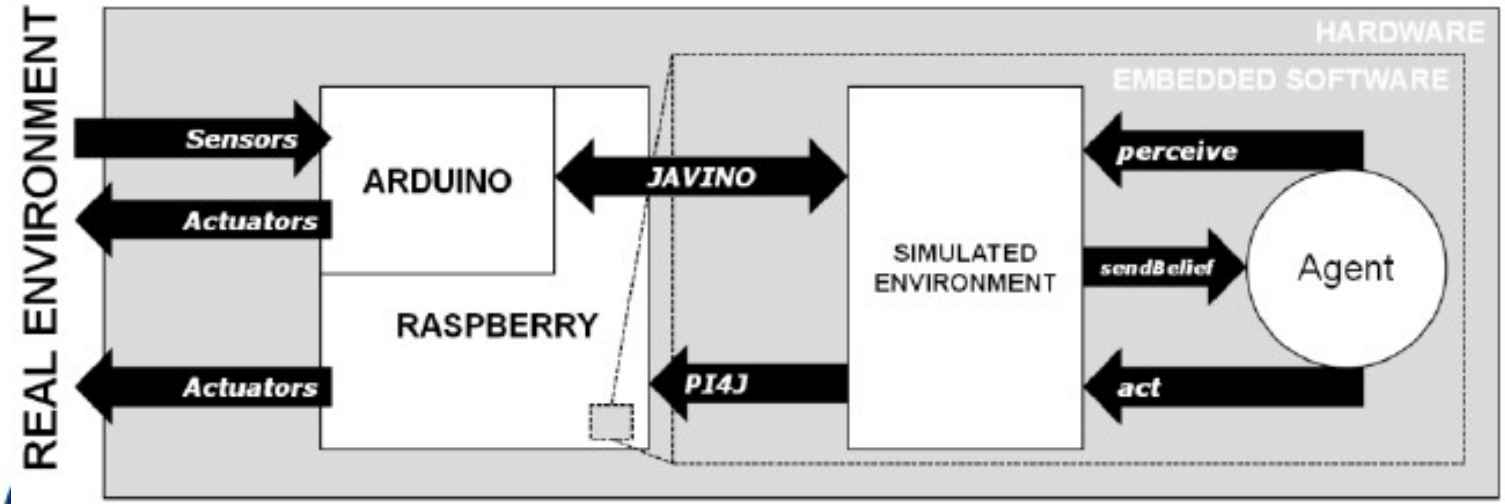
Objective

The objective of this paper is to propose a platform for robotic agents, which uses the Raspberry Pi and Arduino together to provide the hardware controls, and uses Jason framework for the agent reasoning. Besides, an improvement of [Barros et al., 2014] platform is also presented.



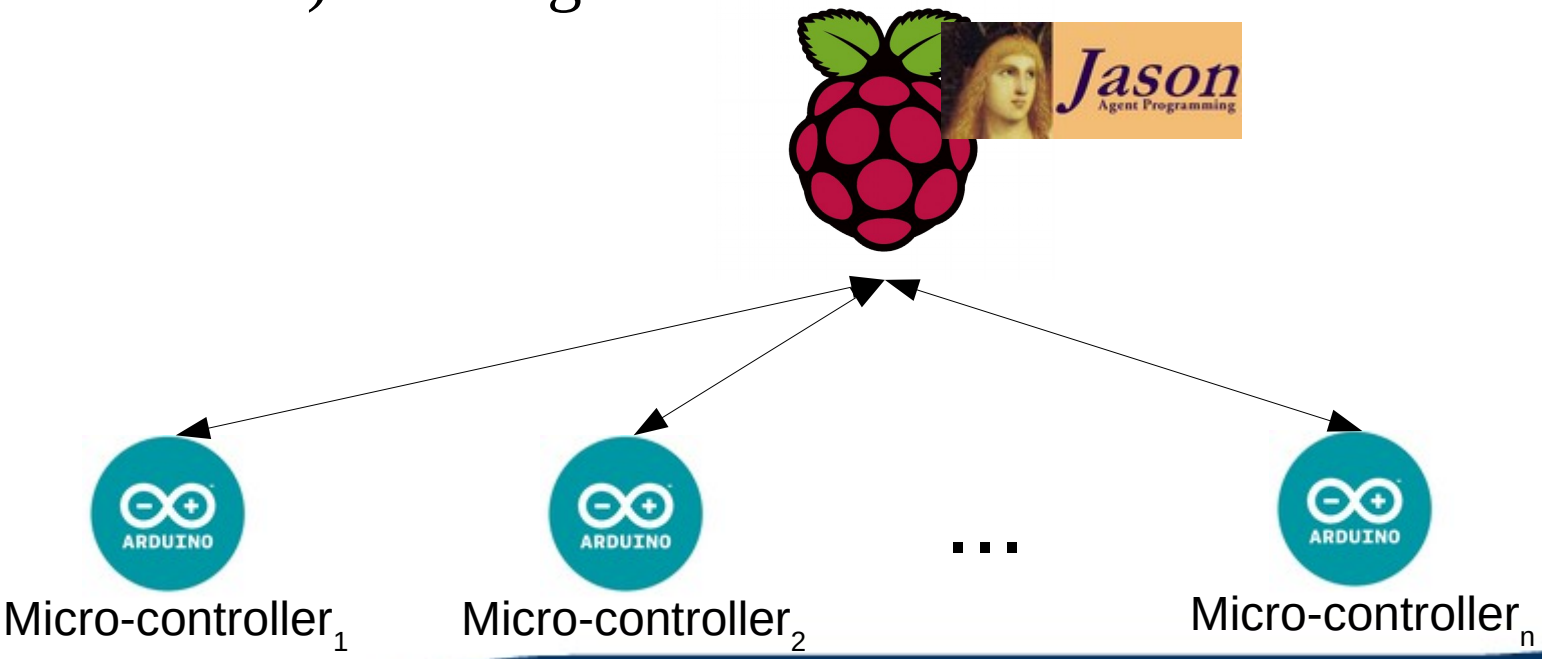
The robotic-agent platform

Consists in an embedded software (agent) into a hardware platform (robot). The hardware platform is composed of the Arduino and Raspberry Pi boards where Arduino is connected on the top of Raspberry Pi (using a USB port) to provide analogic hardwares to be used once Raspberry does not provide analogic pins.



The robotic-agent platform

One of the advantages of using Raspberry Pi is that it is possible to connect up to 127 Arduino boards (the USB device limit) in a single board.



Communication Protocol

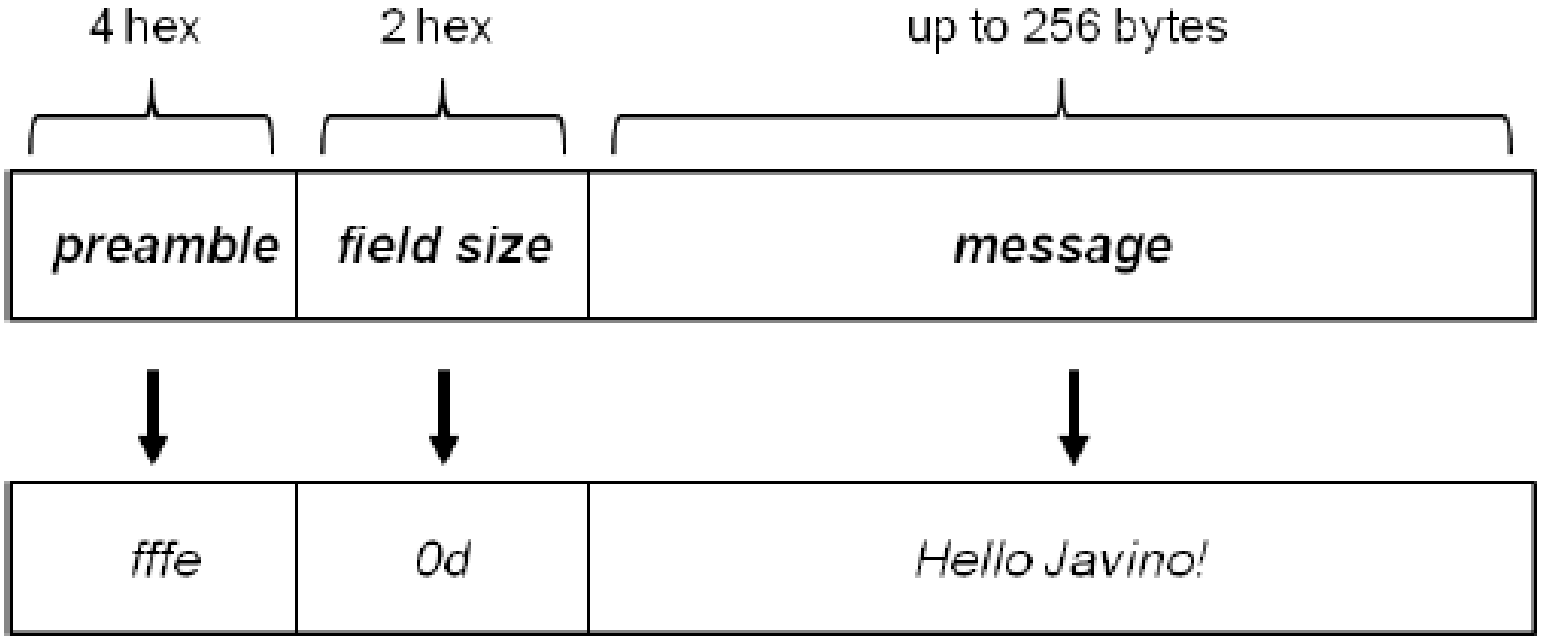
The Javino

Was create a double-side library for exchanging messages between an Arduino and Java program using a serial port. Others libraries (e.g., RxTx) just provide message treatment for one side, leaving the other side to the programmer.
The Javino aims to fill this gap because it offers a double-side communication library based on the platform functioning: the Javino for Arduino and Javino for Java. They work together to provide a message exchange.

Communication Protocol

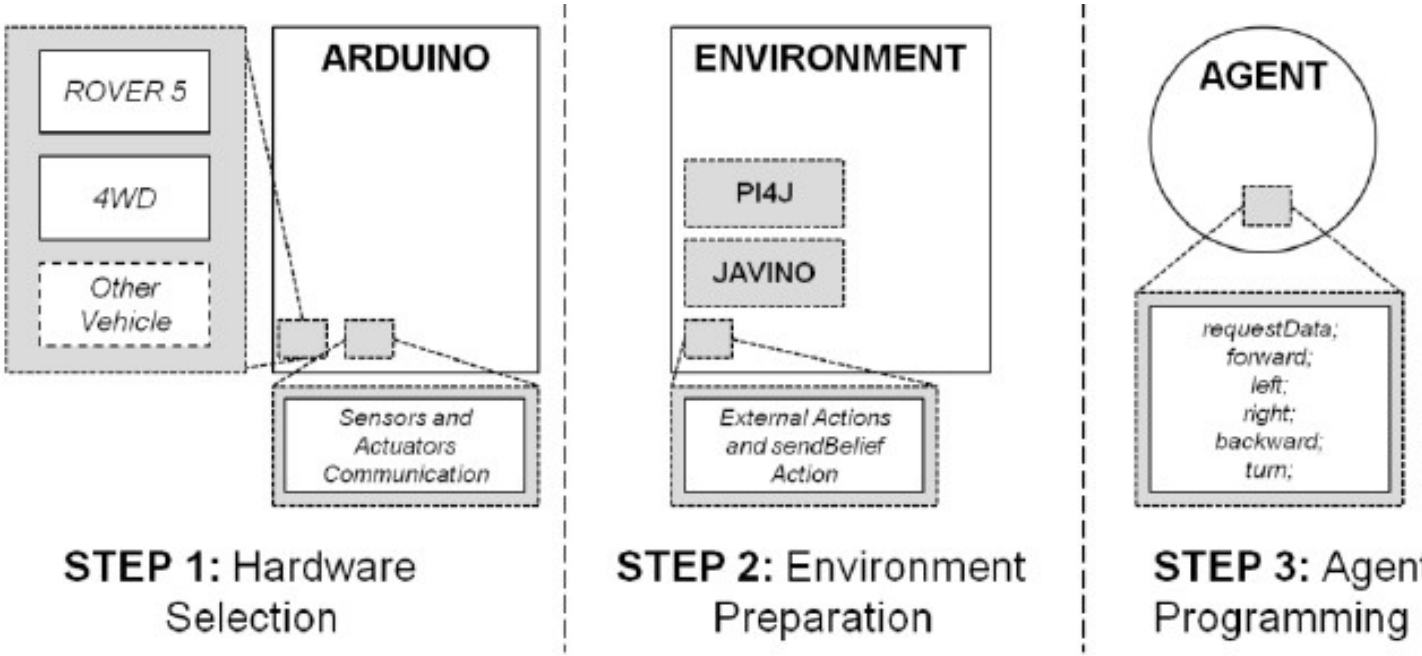
The message format

The message is composed of a preamble, a field size and the message content. The preamble and the field size are used together to avoid errors in case of loss of information during the message transmission.



Methodology

The methodology aims to guide the programmer between phases that will need some programming intervention, since the platform uses Arduino, Raspberry Pi and Jason. The methodology is composed by three steps



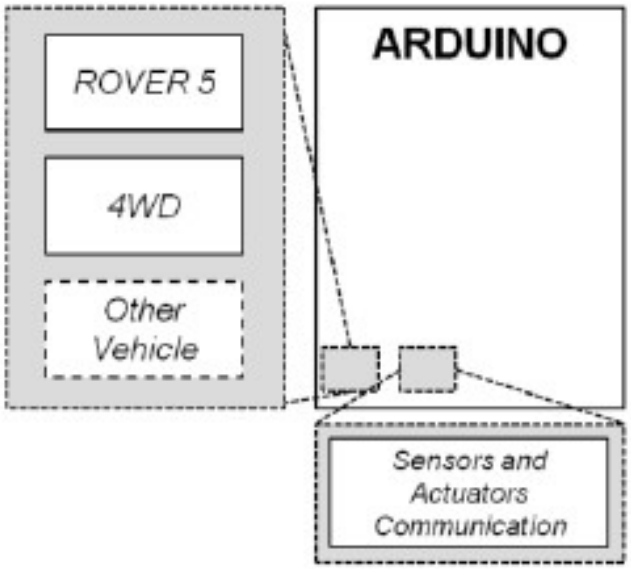
Methodology

Hardware Selection

The selection consists in choose one pre-defined file for Arduino robots available with the methodology. Until now, there are two pre-defined robot chassis available:

- Rover 5, a tank style vehicle;
- 4WD, a four-wheel drive vehicle.

These pre-defined files guarantee all basic movements (forward, reward, left, right, turn, etc.) for those robot chassis.



STEP 1: Hardware Selection

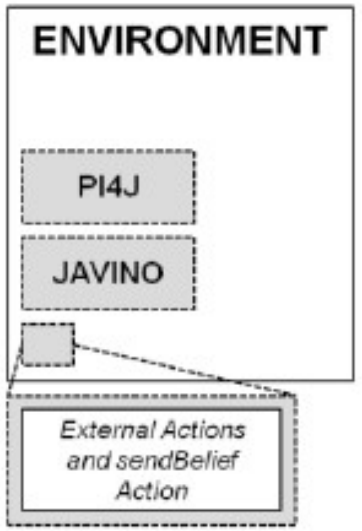
Methodology

Environment Preparation

As the platform uses the Jason framework, it is used the basic Java environment where the agent's external actions are programmed.

To have the communication between the software agent and the hardware it is necessary to import two libraries into Jason's simulated environment:

- Javino library – for Arduino;
- The Pi4J library – for Raspberry Pi pins;



STEP 2: Environment Preparation

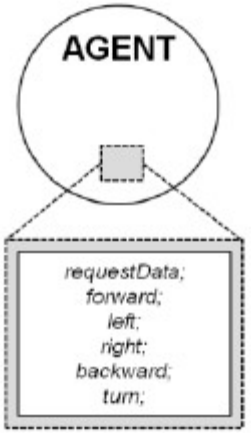
Methodology

Agent Programming

At last, the STEP 3 is the agent programming using AgentSpeak.

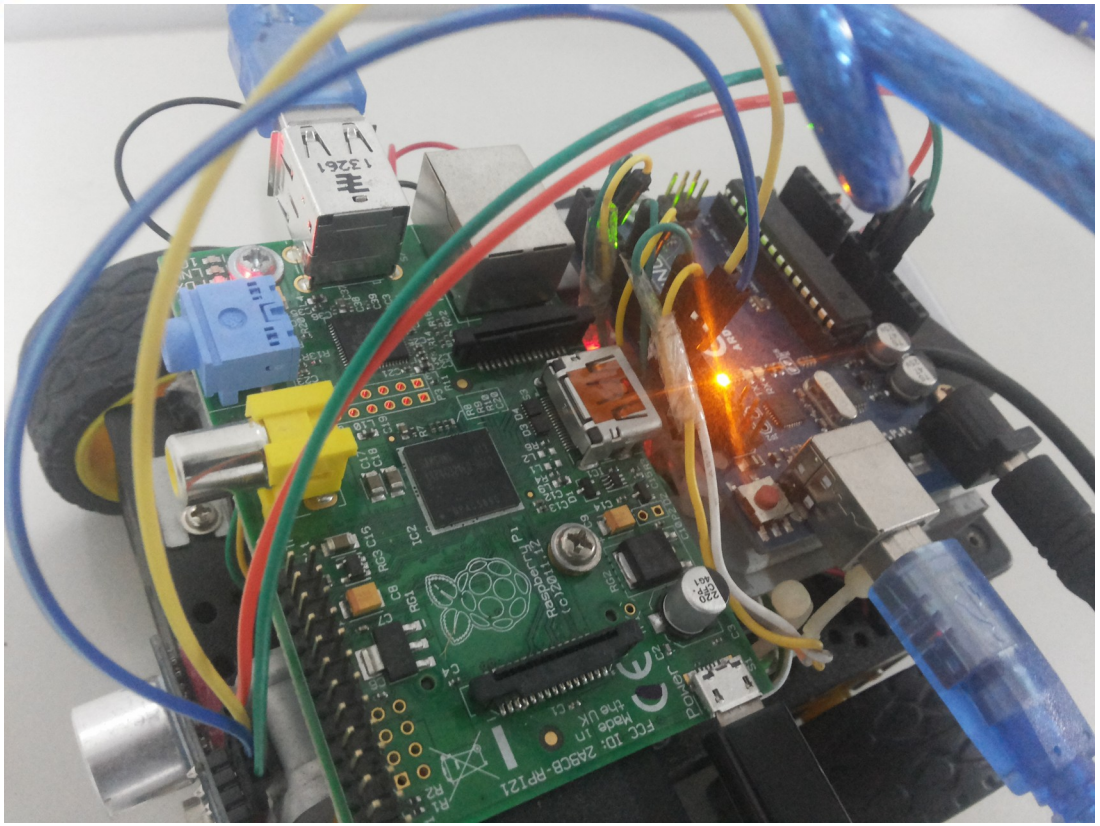
In this phase it is just necessary to program normal agents using Jason framework.

The agent's plan should have external actions to perform actions into the simulated environment.



STEP 3: Agent Programming

Demonstration



https://youtu.be/tv96cbreN4A

Conclusion

We presented a robotic-agent platform that uses Arduino and Raspberry to automate hardware functions and Jason to provide intelligent reasoning.

Besides, it also presented the Javino library, which is a communication protocol to exchange messages between Java and Arduino using serial port.

A simple example using 4WD chassis was implemented to evaluate both platform and methodology.