

## Introduction

The ACSO - Research Center in Computer Architecture, Intelligent Systems and Robotics at the State University of Bahia - UNEB, Brazil, introduces BILL (the Bot, Intelligent, Large capacity and Low cost). BILL is part of the RoboCup@Home league of RoboCup Competition, which aims to promote research on assistive robot technology and the development of fully autonomous robots capable of interacting with a domestic environment.

## Bill - Bot Intelligent Large capacity Low cost

Bill is a service robot capable of communicating with humans through natural language processing and recognizing people and objects. In its third generation Bill, codename Estranho, had its architecture completely redesigned and was updated to ROS 2.



Figura 1: BILL Estranho

Bill's main components include:

- Two monitors, one representing Bill's face and another used for input and output via console
- A microphone and speakers
- Lidar, Kinect, and webcam
- Additional manual control performed via a joystick using a mobile application
- A gateway and a computer as part of his body.
- Access for installing new software performed remotely using VNC software

## Bill's Architecture

The Bill's architecture is basically divided into levels: a high level, containing the functions related to the robot's abilities; and the low level, containing the controllers and drivers that send signals and receive commands from the sensors.

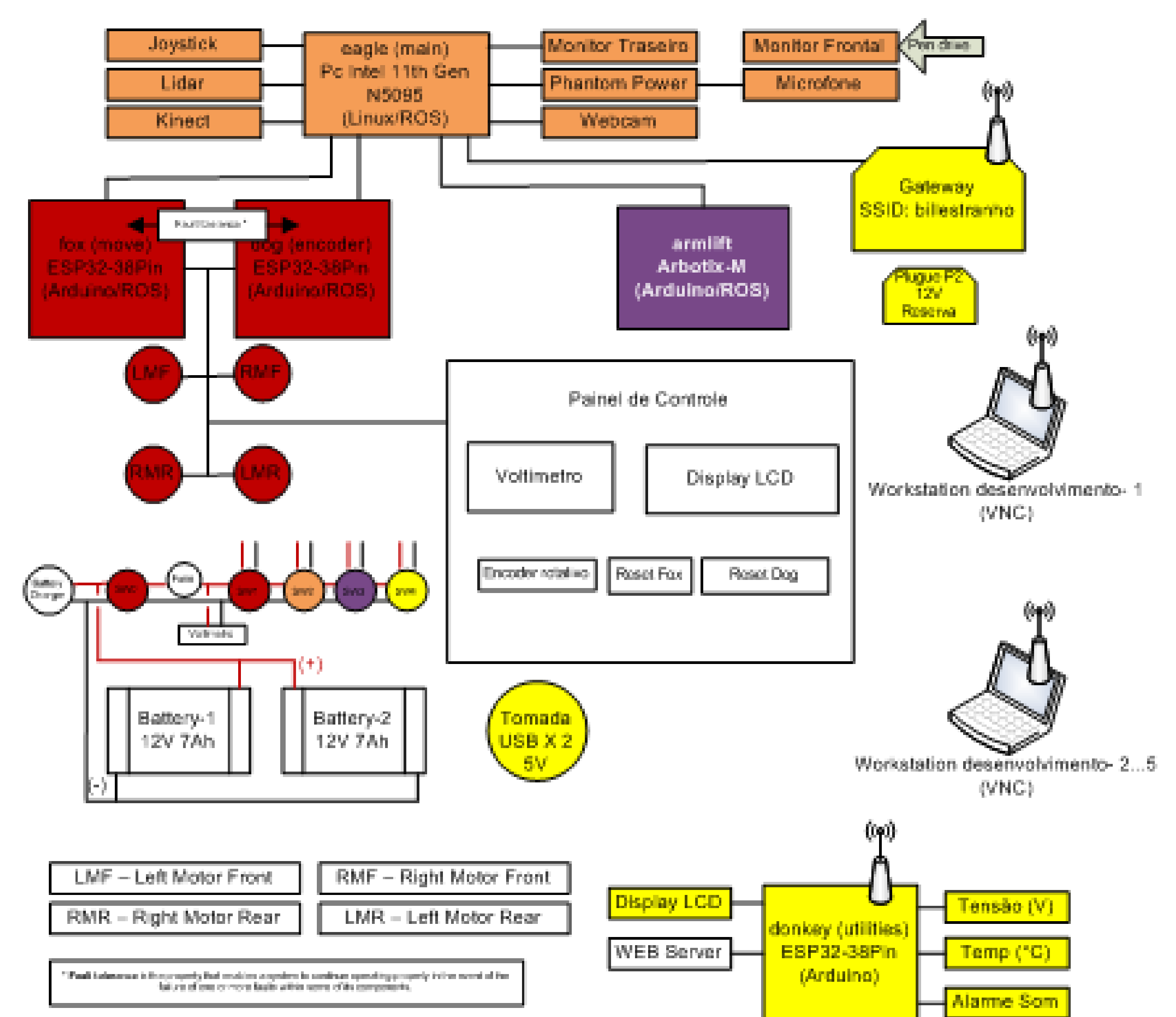


Figura 2: Bill's Architecture

The fault-tolerance Fox-Dog method is implemented using two ESP32 micro-controllers replicated with ROS. They control the left/right motor front and the left/right motor rear. So, if one microcontroller fails, the other takes over. Bill also contains a control panel with LCD display that allows monitoring voltage, temperature, and connection, generating alarms in dangerous situations. In addition, two batteries provide energy.

## Bill's Abilities

- Object Detection, using Yolo
- People Recognition, using OpenCV library for facial detection and classification, and the Dlib algorithm for recognition
- Motion, using 4 Mecanum wheels, which allow it to move in any direction and turn around its own axis with ease
- Navigation, using encoders, ROS modules, and a 360° laser scanner for accurate robot control, mapping, and obstacle avoidance
- Speech Recognition and Voice, using Google Speech Recognition software to enable voice interaction

## Conclusion

Bill Estranho presents significant progress, specially in architecture. The combination of high-level functions and efficient low-level controls, including fault tolerance techniques, stands out. Furthermore, the mecanum wheels give Bills a versatile movement that improves its navigation possibilities.

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