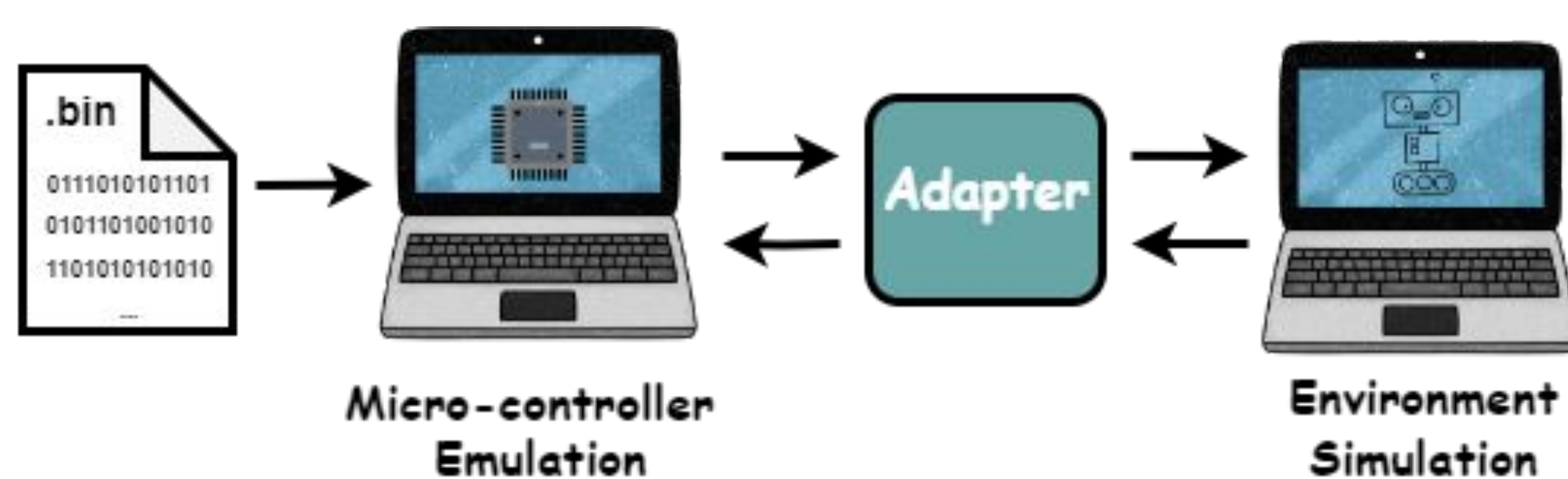


Tema:

## Embedded Systems Simulator for robotic applications

### Objective

- The project developed an Embedded Systems simulator that is able to test and validate an embedded software without any physical device.
- The project's core was to emulate a micro-controller that could run a software binary and be able to communicate with a whole simulated environment.



### Microcontroller Emulation

- To emulate a microcontroller it was used **QEMU**(Quick EMULATOR). It is a free open-source hardware emulator capable of virtualize a whole computer system inside another.
- QEMU is capable of load and run a proper binary and also reproduce it's peripherals functioning.
- In this project, it was used to emulate a **STM32 Bluepill** develop board, focusing on it's GPIO features and data processing.



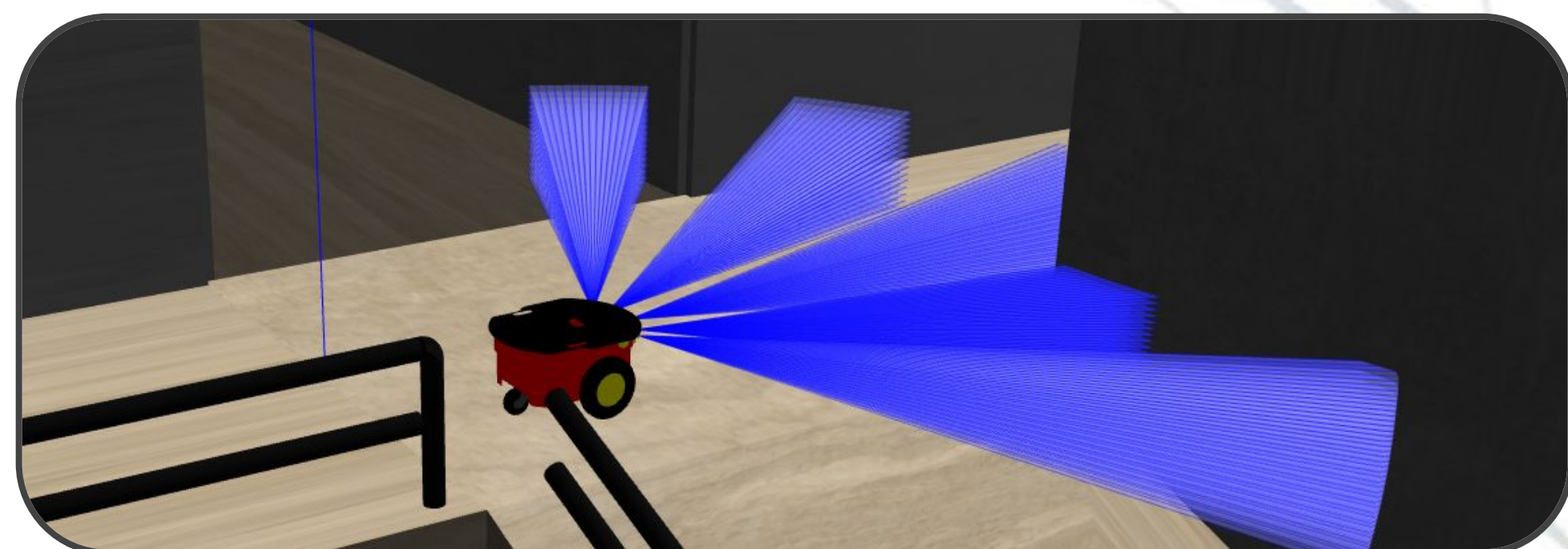
QEMU



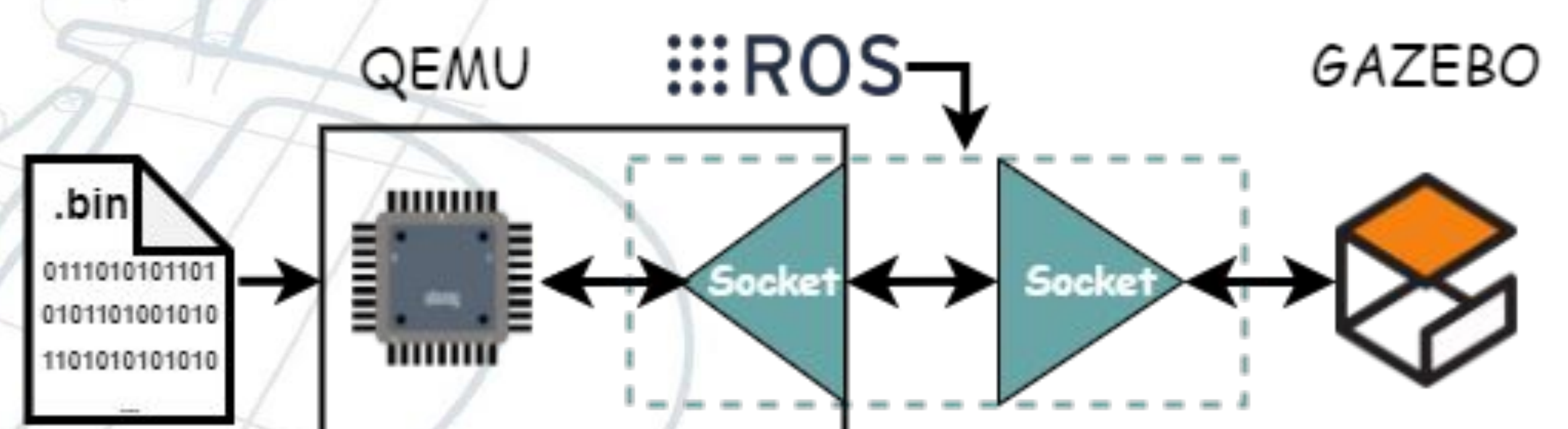
Blue Pill

### Environment Simulation

- A simulated environment should closely replicate the robot's interactions, the operational space, the robot itself, and the functioning of its sensors and motors.
- To do that it was used **Gazebo**, a widely used open source 3D robot simulator.



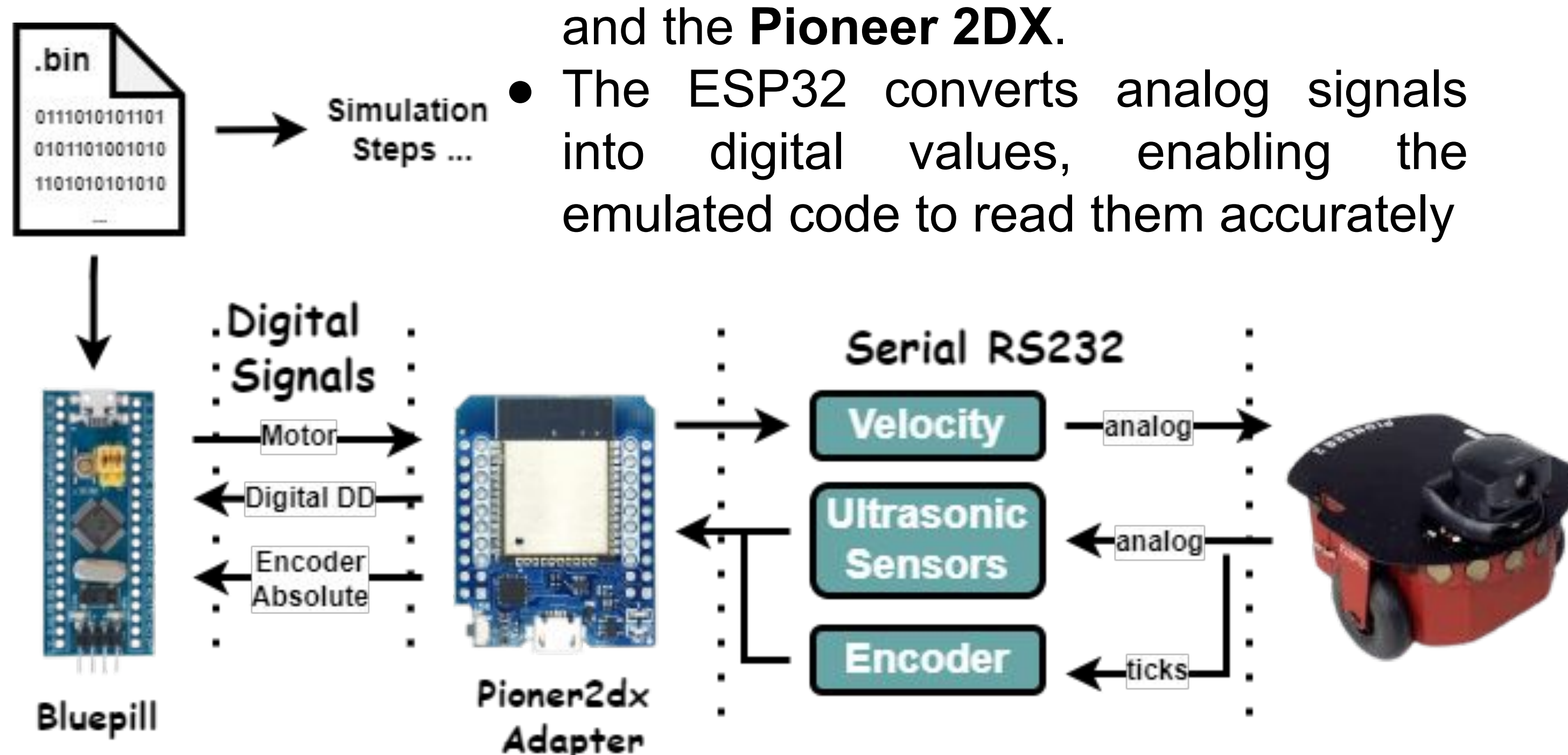
### Emulator integration with Simulator



- The information flow between the emulation and the simulation is done with ROS Noetic.
- The TCP/IP socket connects the ROS provider inside the QEMU emulation with the ROS provider outside it.

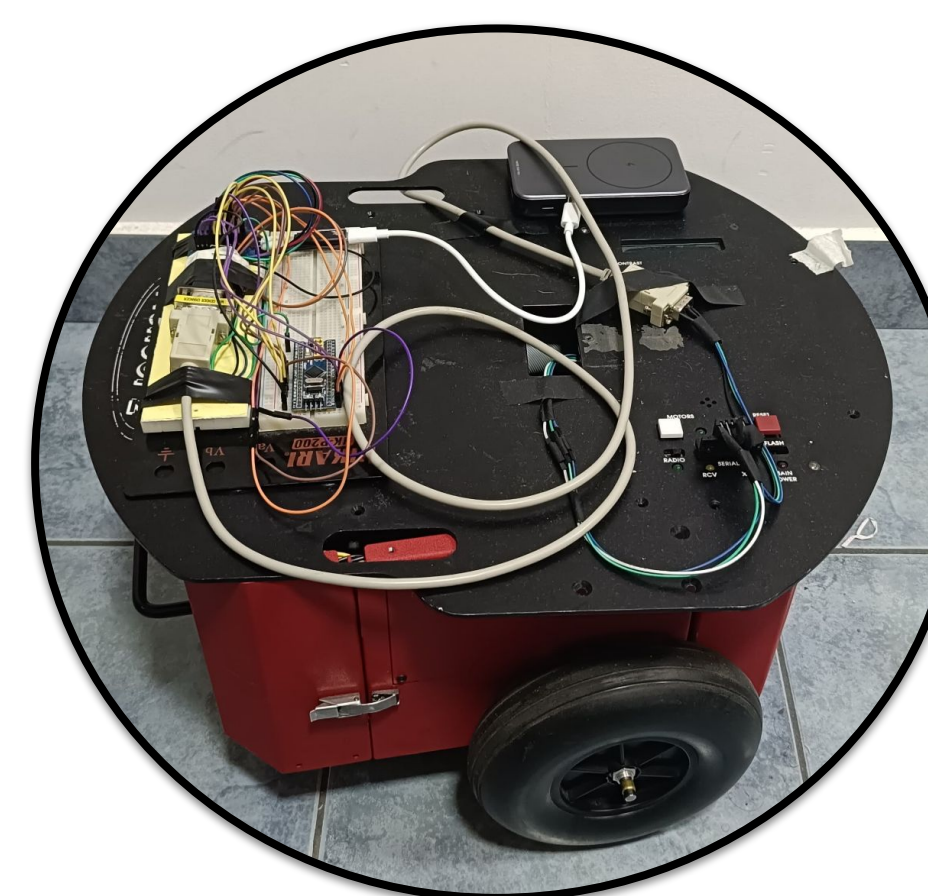
### Project Test

- The **ESP32 D1 Mini** handles communication between the Bluepill and the **Pioneer 2DX**.
- The ESP32 converts analog signals into digital values, enabling the emulated code to read them accurately



### Results

- They could test and validate the whole simulation.
- They could create a functional communication interface with Pioneer 2DX.



### Agradecimentos



### References

- QEMU. A generic and open source machine emulator and virtualizers. [S.I.], 2024. Disponível em: <<https://www.qemu.org>>.
- ROS FOUNDATION INC. ROS - Robot Operating System. [S.I.], 2024. Disponível em: <<https://www.ros.org>>.
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