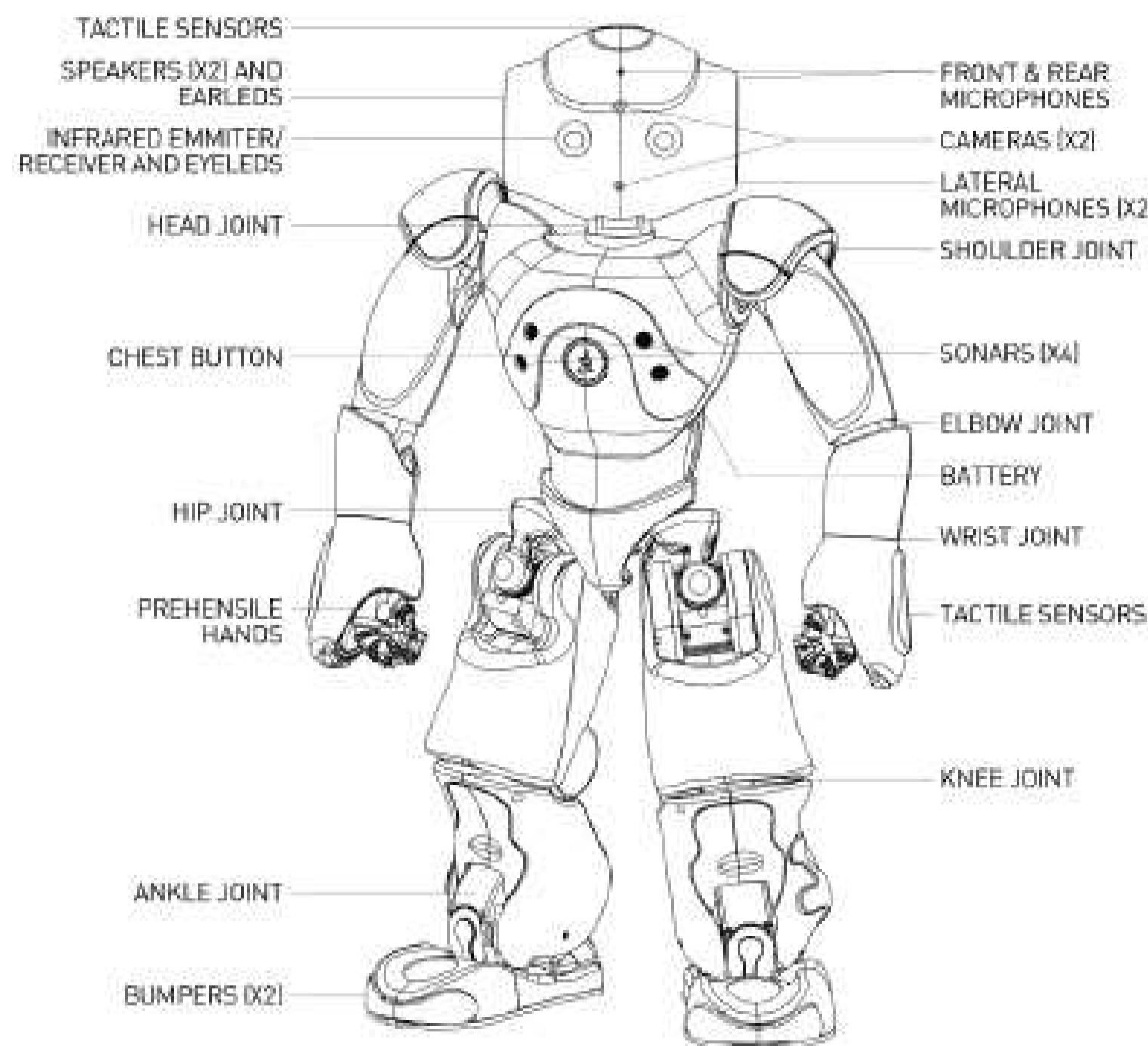


## 1. NAO Specifications

### Hardware specifications

- CPU: Intel Atom Z530 (2 × 1.6 GHz - 32 bits)
- RAM: 1 GB
- Servomotors: 24 degrees of freedom



### Embedded software

- Face detection, Sound localization
- Motion control, Posture control
- Speech recognition (predefined words or sentences in several languages)

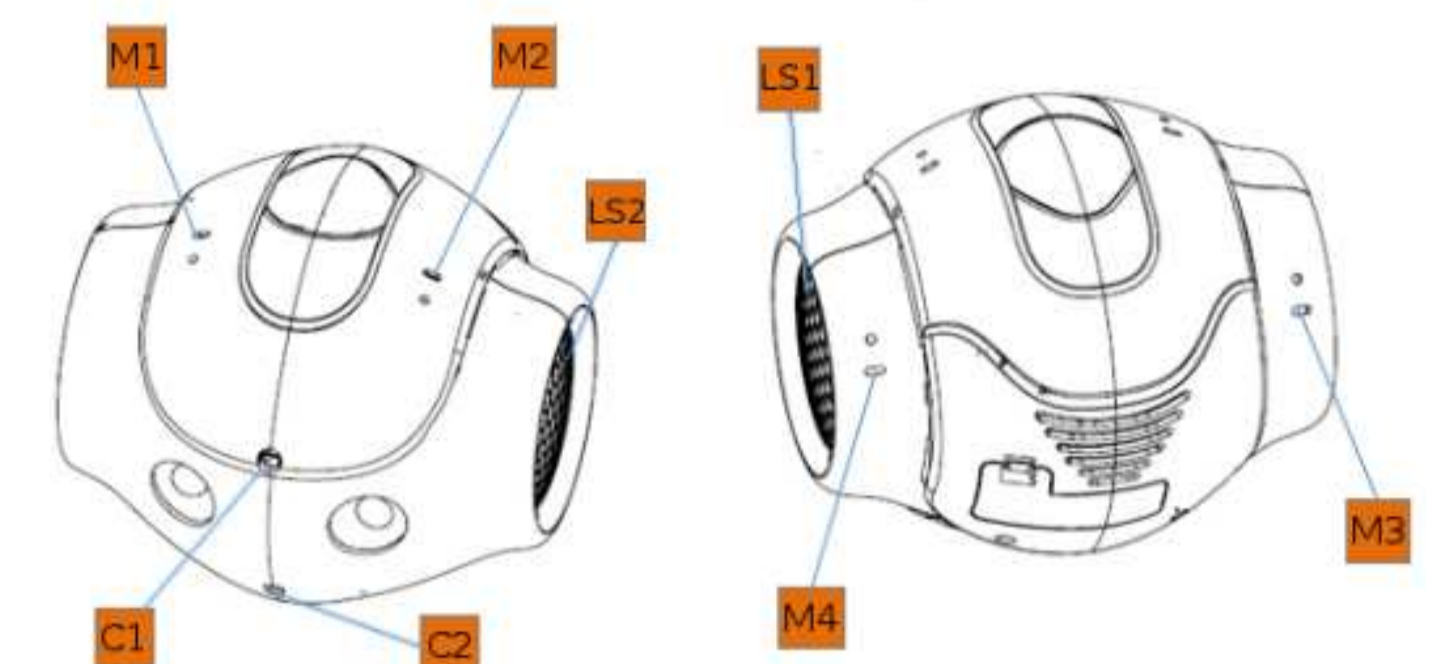
### Current limitations:

- 1- Limited on-board computing resources
- 2- Require advanced embedded-programming skills
- 3- Only few functionalities available

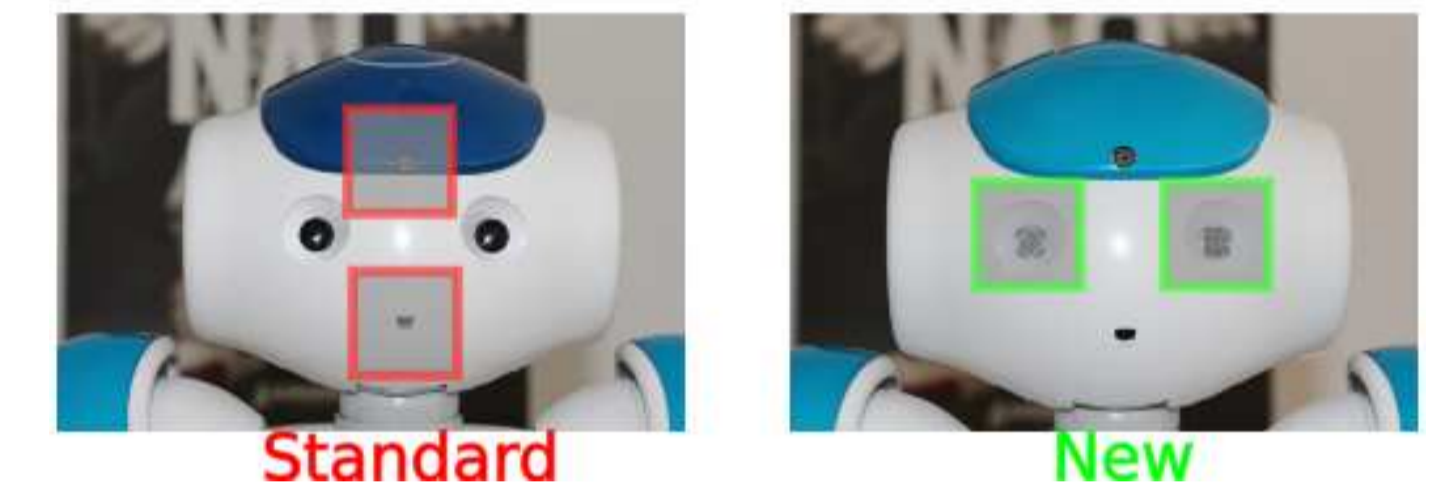
### Challenges: Easy and fast software development for NAO

- 1- Using various programming environments (C++, Matlab, python)
- 2- Combining external toolboxes (OpenCV, etc.) with embedded software

### Microphone configuration

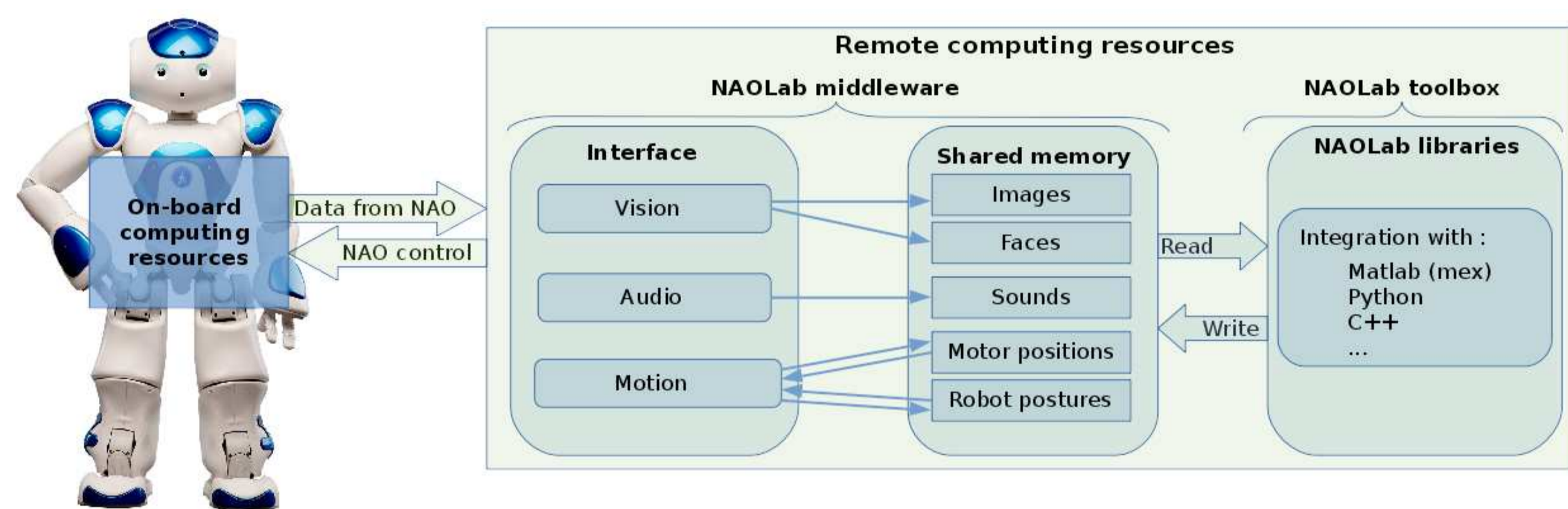


### Camera configurations



## 2. Proposed solution

A middleware to **access** and **control** NAO  
[Advantage] Deploy advanced algorithms without embedded-software constraints



## 3. Toolbox to interact with NAO

Provides the following features:  
1- The middleware complexity is transparent to the users  
2- A user-friendly interface is provided (NAOLab C++ and python libraries)

### NAOLab C++ library

	Access:	Control:
Vision	getImage()	getImage(), getFaces()
	setResolution()	setCamera()
Audio	getSound()	
	textToSpeech()	playAudioFile()
Motion	getAllMotorInfo()	getMotorInfo(), getPosture()
	moveHead()	moveMotor(), moveToPoint(), setPosture()

## 4. Example: Sound source localization (SSL) in Matlab

**Requirements:** Vision (grab images from left camera + face positions), Audio (grab sound buffers from microphones), Motion (control head motors)

