|  |  |
| --- | --- |
| MIXED REALITY ROBOTICS |  Motors and Joints  |

There are 14 motors located all over the Pleo. These motors give the robot the ability to walk, wag its tail and crane its neck. All of these motors have force feedback sensors, so they are able to detect the environment surrounding the Pleo.

All of the motors already exist in the Pleo and the robot comes pre-programmed with some natural movements that the Pleo does on its own in a natural environment. However, because the motors move wires in the robot in response to instructions from processors, it is also possible to program more complex and unique movements that utilize these motors.

Pleo’s motors allow the robot to generate purposeful actions which often relay emotion. These movements can be in response to touch or a stimulus. Alternatively, Pleos can be programmed to do movements without any trigger.



**Head**

This motor is at neutral position, when the Pleo is looking straight ahead. Otherwise, the robot can look 90 degrees up and 90 degrees down.

**Neck (Horizontal)**

The neutral position is straight forward. The neck can, also, move 65 degrees left and right.

**Tail (Vertical)**

Neutral position is straight back. Otherwise, the tail can move 90 degrees up and 90 degrees down.

**Tail (Horizontal)**

Neutral position is straight back. Otherwise the tail can move 90 left and 90 degrees right.

**Neck (Vertical)**

This motor is at neutral position, when the Pleo is looking straight ahead. The neck can, also, move 75 degrees up or down.



**Elbows (2)**

Straight is the neutral position for this motor. The elbow motor can only move 30 degrees forward from the neutral state.

**Shoulders (2)**

Straight is the neutral position for this motor. It can also move 55 degrees forward from the neutral and state and 20 degrees backwards.



**Knee (2)**

The neutral state for this motor is straight down. The motor can also rotate 50 degrees backwards from the neutral state.

**Torso**

The neutral position is straight forward. The motor can move 35 degrees left and right.

**Hips (2)**

The neutral state for this motor type is straight down. The motor can, alos, move 45 degrees forwards and backwards.

**Terminal Command**: in order to control the movements of Pleo enter:

***help joint***

This command will give access to more ways of commanding the Pleo. For example, if **joint neutral** is entered into the terminal, the Pleo will move all of its joints to neutral position. The terminal will return the progress of each joint during the process of returning to neutral position.



**Relevant Sensor**: SENSOR\_TILT
This sensor detects the orientation of Pleo’s torso in three spaces and is triggered when the title sensor moves into a new position. The sensor can return these values…

TILT\_NONE = 0 (no orientation known)
TILT\_ON\_FEET = 1 (feet are oriented downwards with respect to torso)
TILT\_LEFT\_SIDE = 2 (on left side)
TILT\_RIGHT\_SIDE = 3 (on right side)
TILT\_ON\_NOSE = 4 (front of torso is pointed downwards)
TILT\_ON\_TAIL = 5 (aft-end of torso is pointed upwards)
TILT\_ON\_BACK = 6 (feet are pointed upwards with respect to torso)

**Relevant Sensor**: SENSOR\_SHAKE
This sensor is used to detect if the Pleo is being shaken, like, for example, when it is being woken up. The value of this sensor can be between 0 and 255. The sensor triggers when the shake frequency goes from below 75 to above 150.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Another easy way to control and create new movements for the Pleo is through a program called *MySkit*. This is very easy to use, and is basically a GUI that lets you set a routine of sound and movement for the Pleo. You then “compile” your skit and upload it to a SD card which you plug into the Pleo. When starting up, the Pleo first checks the SD card for any programs before it boots into normal routines.



Motions can be activated by connecting to Pleo via a terminal and typing the following command:

***motion play (Motion number)***

So, for example, the code for walk forward is 8330. To make Pleo walk forward, enter “**motion play 8330**” into the terminal and the robot will walk forward. For a list of all available motions, type the command “**motion show**”.

Emotions that Pleo Motions evoke:

|  |  |  |
| --- | --- | --- |
| **Happy** | **Sad** | Tired |
| motion ID 8320 = com\_tail\_wagmotion ID 8321 = com\_tail\_wag\_v2motion ID 8322 = com\_tilt\_back\_tickle\_lamotion ID 8323 = com\_tilt\_back\_tickle\_llmotion ID 8324 = com\_tilt\_back\_tickle\_ramotion ID 8325 = com\_tilt\_back\_tickle\_rlmotion ID 8343 = emo\_act\_happy\_v1motion ID 8344 = emo\_act\_happy\_v2motion ID 8407 = happy\_honkmotion ID 8354 = emo\_fidget\_happy\_v1motion ID 8355 = emo\_fidget\_happy\_v2 | motion ID 8467 = soc\_abuse\_whimpermotion ID 8345 = emo\_act\_sad\_v1motion ID 8346 = emo\_act\_sad\_v2motion ID 8393 = fat\_nap\_fidget\_painmotion ID 8394 = fat\_nap\_fidget\_sadmotion ID 8395 = fat\_nap\_fidget\_scaredmotion ID 8264 = com\_disappointed\_v1motion ID 8265 = com\_disappointed\_v2motion ID 8266 = com\_fallen\_l\_breath\_v1motion ID 8267 = com\_fallen\_l\_breath\_v2motion ID 8268 = com\_fallen\_tilt\_l\_inmotion ID 8269 = com\_fallen\_tilt\_l\_loop\_v1motion ID 8270 = com\_fallen\_tilt\_l\_loop\_v2motion ID 8271 = com\_fallen\_tilt\_l\_sleepmotion ID 8272 = com\_fallen\_tilt\_r\_inmotion ID 8273 = com\_fallen\_tilt\_r\_loop\_v1motion ID 8274 = com\_fallen\_tilt\_r\_loop\_v2motion ID 8275 = com\_fallen\_tilt\_r\_sleepmotion ID 8356 = emo\_fidget\_pain\_v1motion ID 8357 = emo\_fidget\_sad\_v1motion ID 8358 = emo\_fidget\_scared\_v1motion ID 8347 = emo\_act\_scared\_v1motion ID 8348 = emo\_act\_scared\_v2 | motion ID 8482 = soc\_rest\_fidget\_v1motion ID 8483 = soc\_rest\_fidget\_v2motion ID 8484 = soc\_rest\_fidget\_v3motion ID 8485 = soc\_rest\_fidget\_v4motion ID 8486 = soc\_rest\_laydownmotion ID 8487 = soc\_rest\_listenmotion ID 8488 = soc\_rest\_pantmotion ID 8489 = soc\_rest\_pant\_v1motion ID 8490 = soc\_rest\_pose\_v1motion ID 8491 = soc\_rest\_rxn\_headmotion ID 8492 = soc\_rest\_rxn\_tailmotion ID 8493 = soc\_rest\_sniffmotion ID 8566 = yawn\_3motion ID 8396 = fat\_nap\_fidget\_sniffmotion ID 8397 = fat\_nap\_fidget\_soundmotion ID 8398 = fat\_nap\_fidget\_v1motion ID 8399 = fat\_nap\_fidget\_v2motion ID 8400 = fat\_nap\_getupmotion ID 8401 = fat\_nap\_getup\_v2motion ID 8402 = fat\_nap\_getup\_v3motion ID 8403 = fat\_nap\_lay\_downmotion ID 8404 = fat\_sleep\_laymotion ID 8405 = fat\_tiredmotion ID 8406 = fat\_yawn |
| **Angry** | **Hungry** | Miscellaneous |
| motion ID 8337 = emo\_act\_angry\_v1motion ID 8338 = emo\_act\_angry\_v2motion ID 8350 = emo\_fidget\_angry\_v1motion ID 8351 = emo\_fidget\_angry\_v2motion ID 8462 = picked\_up\_shakemotion ID 8463 = picked\_up\_squirmingmotion ID 8464 = singing\_howlingmotion ID 8465 = soc\_abuse\_head\_chinmotion ID 8466 = soc\_abuse\_rxnmotion ID 8565 = upside\_downmotion ID 8388 = fat\_nap\_fidget\_angrymotion ID 8364 = exp\_object\_react\_growl | motion ID 8412 = hun\_baby\_bird\_feedingmotion ID 8413 = hun\_begmotion ID 8414 = hun\_bite\_smotion ID 8415 = hun\_chew\_dropmotion ID 8416 = hun\_chew\_drop\_stuckmotion ID 8417 = hun\_chew\_fastmotion ID 8418 = hun\_chew\_slowmotion ID 8419 = hun\_chew\_v1motion ID 8420 = hun\_dropped\_sniffmotion ID 8421 = hun\_exitmotion ID 8422 = hun\_expectingmotion ID 8423 = hun\_fidget\_scratch\_leftmotion ID 8424 = hun\_graze\_big\_bitesmotion ID 8425 = hun\_graze\_drinkmotion ID 8426 = hun\_graze\_rippingmotion ID 8427 = hun\_graze\_standmotion ID 8428 = hun\_graze\_v1motion ID 8429 = hun\_graze\_v2motion ID 8430 = hun\_graze\_v3motion ID 8431 = hun\_happy\_grazemotion ID 8432 = hun\_happy\_honkmotion ID 8433 = hun\_hatch\_birdmotion ID 8434 = hun\_hatch\_bird\_whimpermotion ID 8435 = hun\_hatch\_cry\_downmotion ID 8436 = hun\_hatch\_cry\_inwardmotion ID 8437 = hun\_hatch\_cry\_upmotion ID 8438 = hun\_hatch\_tantrum\_Amotion ID 8439 = hun\_hatch\_tantrum\_Bmotion ID 8440 = hun\_lip\_smackmotion ID 8441 = hun\_moomotion ID 8442 = hun\_paw\_ground\_lmotion ID 8443 = hun\_paw\_ground\_rmotion ID 8444 = hun\_rxn\_backmotion ID 8445 = hun\_rxn\_chinmotion ID 8446 = hun\_rxn\_headmotion ID 8447 = hun\_rxn\_lamotion ID 8448 = hun\_rxn\_ramotion ID 8449 = hun\_searchmotion ID 8450 = hun\_sniff\_lmotion ID 8451 = hun\_sniff\_rmotion ID 8452 = hun\_sniff\_smotion ID 8453 = hun\_sniff\_stand\_groundmotion ID 8454 = hun\_sniff\_walk\_airmotion ID 8455 = hun\_standmotion ID 8456 = hun\_stand\_chewing\_cudmotion ID 8457 = hun\_stand\_lookingmotion ID 8458 = hun\_stand\_sniff\_groundmotion ID 8459 = hun\_tantrum\_for\_foodmotion ID 8460 = hun\_tummy\_rumblemotion ID 8461 = hungry\_cry | motion ID 8349 = emo\_fidget\_affect\_v1motion ID 8352 = emo\_fidget\_bored\_v1motion ID 8353 = emo\_fidget\_curious\_v1motion ID 8359 = exp\_inmotion ID 8360 = exp\_object\_gonemotion ID 8361 = exp\_object\_react\_barkmotion ID 8362 = exp\_object\_react\_bitemotion ID 8363 = exp\_object\_react\_curiousmotion ID 8339 = emo\_act\_bored\_v1motion ID 8340 = emo\_act\_bored\_v2motion ID 8341 = emo\_act\_curious\_v1motion ID 8342 = emo\_act\_curious\_v2motion ID 8408 = hatch\_coax\_walk1motion ID 8409 = hatch\_coax\_walk2motion ID 8410 = hatch\_rewardmotion ID 8411 = hiccupmotion ID 8276 = com\_fidget\_coughmotion ID 8277 = com\_fidget\_sneezemotion ID 8278 = com\_hatch\_twitchy\_standmotion ID 8279 = com\_head\_held\_v1motion ID 8280 = com\_hello\_bark\_lgmotion ID 8281 = com\_hello\_bark\_smmotion ID 8282 = com\_hello\_howlmotion ID 8283 = com\_hello\_playfightmotion ID 8284 = com\_holding\_fidget\_l\_v1motion ID 8285 = com\_holding\_fidget\_l\_v2motion ID 8290 = com\_holding\_lmotion ID 8291 = com\_holding\_pre\_lmotion ID 8292 = com\_holding\_rmotion ID 8293 = com\_light\_off\_v1motion ID 8294 = com\_light\_on\_v1motion ID 8295 = com\_listen\_smotion ID 8296 = com\_obj\_detect\_lmotion ID 8297 = com\_obj\_detect\_rmotion ID 8298 = com\_obj\_detect\_smotion ID 8299 = com\_pukemotion ID 8300 = com\_rxn\_buckmotion ID 8301 = com\_rxn\_buttupmotion ID 8302 = com\_rxn\_dizzymotion ID 8303 = com\_rxn\_howlmotion ID 8304 = com\_rxn\_lite\_offmotion ID 8305 = com\_rxn\_lite\_onmotion ID 8306 = com\_rxn\_ticklemotion ID 8307 = com\_shatmotion ID 8308 = com\_sitmotion ID 8309 = com\_sneeze\_v1motion ID 8314 = com\_sniff\_neutral\_l\_v2motion ID 8318 = com\_tail\_held\_v1motion ID 8319 = com\_tail\_held\_v2(and many more… ) |