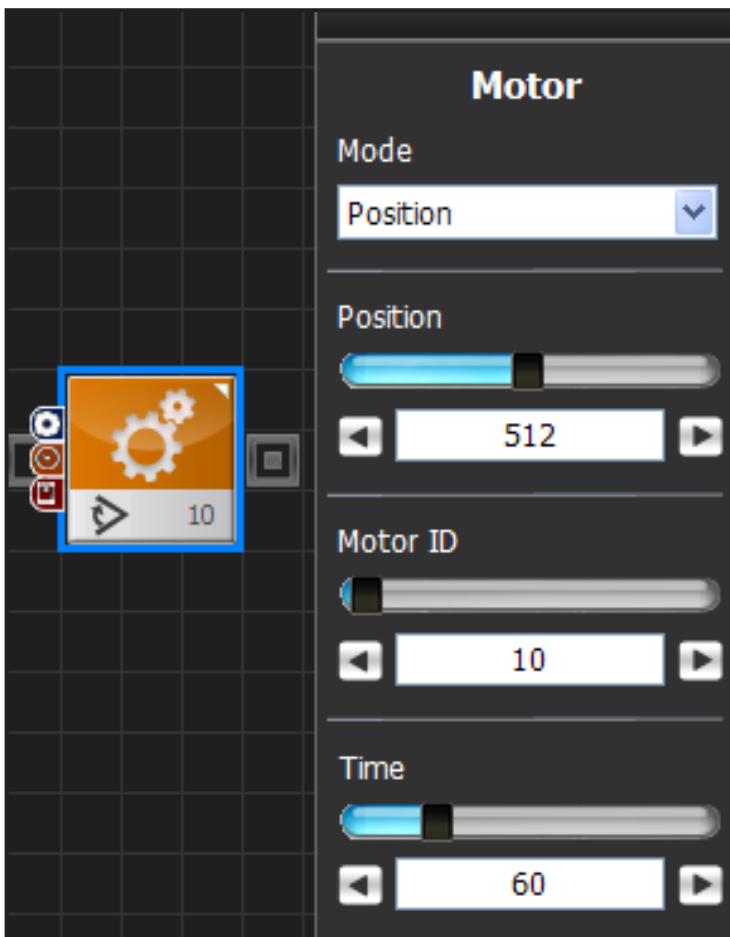


### Motor Description

Motor module has two types of operating modes, Positions control mode and Speed control model.



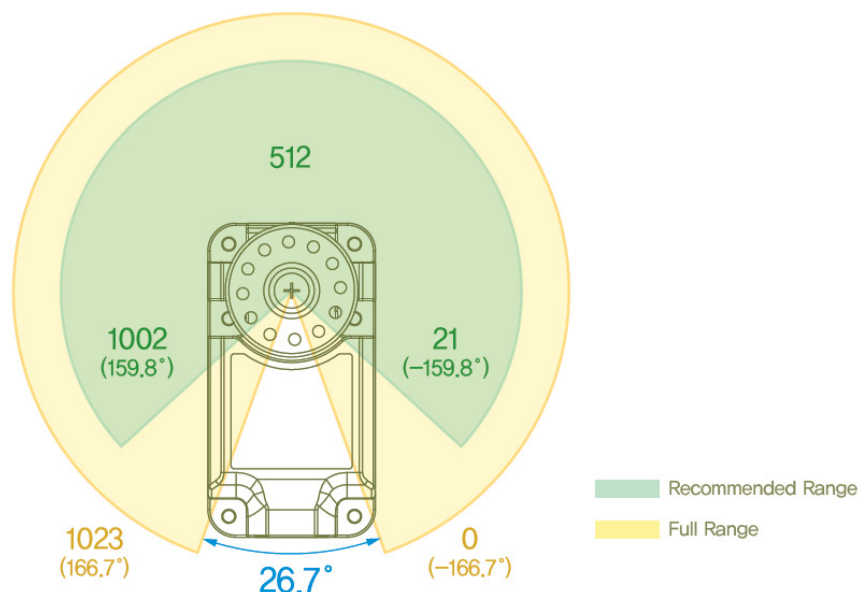
### 1 Position Control Mode

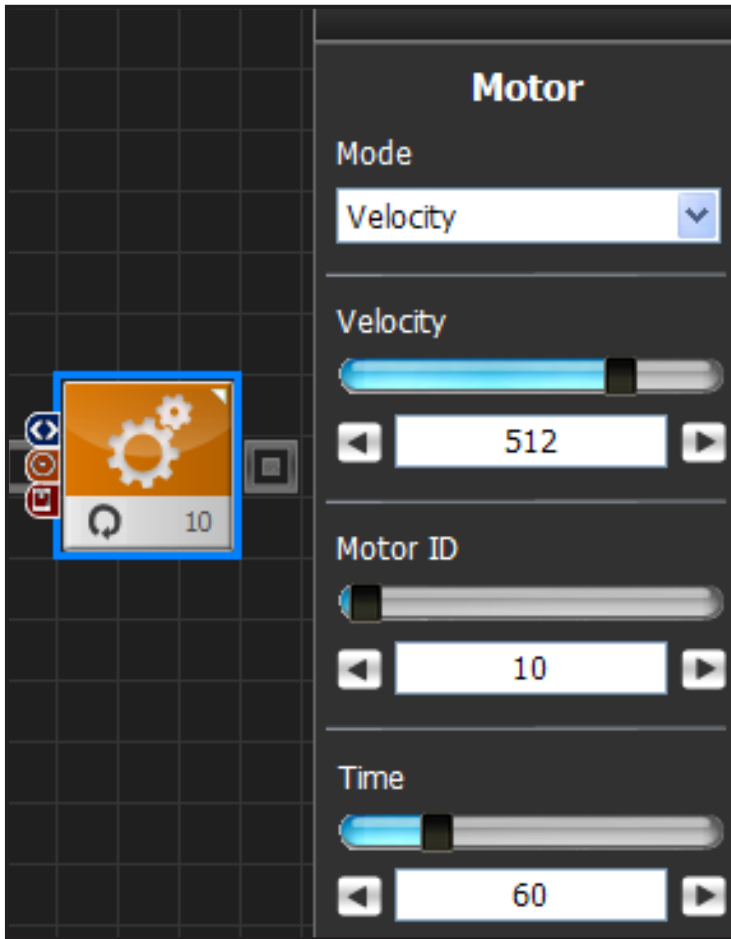
Position control mode changes the position of the selected motor to desired position.

Position has value range between  $-127 \sim 1152$ . Servos are released from the factory with default value range of  $21 \sim 1002$ . Values beyond the default range is possible with adjustment to min/max motor values and position adjustment values. Motor has regular position value of 512 which is used as a standard position value when assembling. When all Hovis motors have position value of 512, Hovis will be in standing position with both arms stretched out 90 degrees to the side. Refer to the diagram below to view position range and regular position.

Motor ID is the ID of the servo to be controlled.

Time refers to the time it takes for servo to reach the goal position. 1tick = 11,2ms. 100 tick would take the servo 1,12s to reach the goal position.





## 2 Speed(Velocity) Control Mode

Speed control mode puts the selected servo in continuous rotation with specific speed.

Velocity has a value range of  $-1023 \sim 1023$ . Larger the value, larger the output with increased rotation speed. Sign of the value determines the direction of the rotation.

Motor ID is the ID of the servo to be controlled.

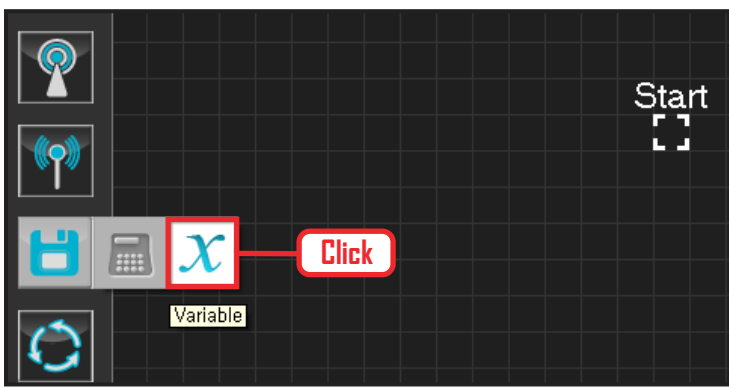
Time refers to the time it takes for servo to reach the goal position.  $1\text{tick} = 11.2\text{ms}$ . When set to 100 tick, servo would take 1.12s to gradually reach the goal speed.

### Example Step by Step

#### Example Description

Robot motions are usually made by controlling each individual servos and consolidating their response. But, controlling each servo is a complicated procedure which is why tools such as the DR-SIM (Motion Editor) is usually used.

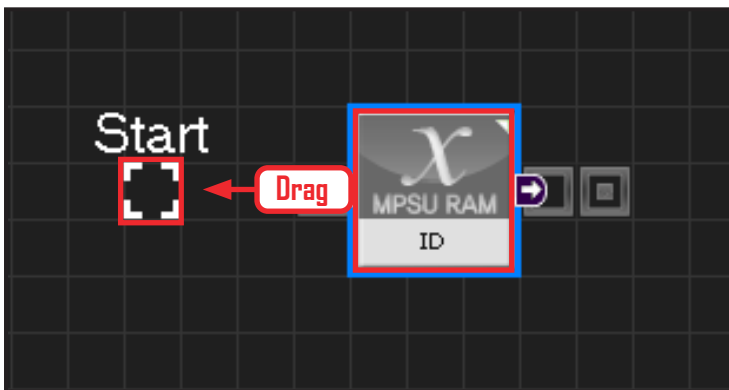
Instead of using the Motion Editor, this example will use the Task Editor to control each individual servos to produce a continuous motion. The end result of the program will be a very interesting wave dancing robot.



### 01 Assign Variable

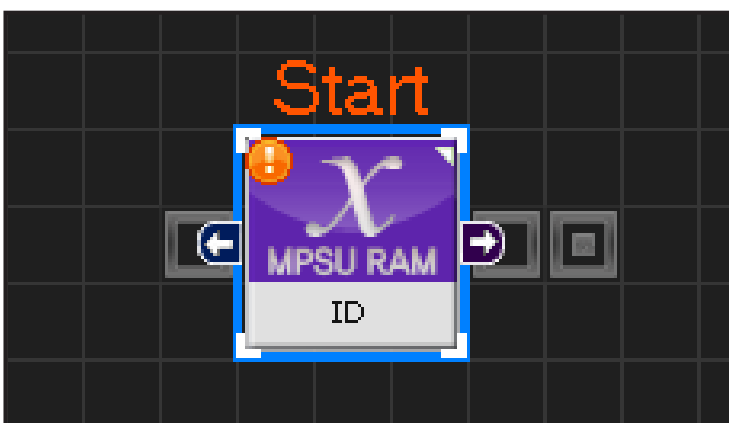
Operating the robot is same as operating the robot servo motor. Value has to be assigned so that servo will be able to operate.

Click Data > Variable module.



### 02 Start

Click and drag the connecting line located at left side of the module to the Start Point and dock.



### 03 Start Programming

When the module and the Start Point is docked properly, module will become active and change color as seen in the photo to the left.

This means programming has started.



## 04 Entire Program

Entire program controlling the motors.

```
1 void main()
2 {
3     SERVO_TorqCtrl[254]=96
4     jog( 512, 0, 254, 100 )
5     jog( 235, 0, 0, 100 )
6     jog( 235, 0, 1, 100 )
7     jog( 789, 0, 3, 100 )
8     jog( 789, 0, 4, 100 )
9     delay( 1500 )
10    jog( 374, 0, 1, 10 )
11    jog( 650, 0, 4, 10 )
12    delay( 1000 )
13    jog( 512, 0, 1, 10 )
14    jog( 512, 0, 4, 10 )
15    delay( 1000 )
16    jog( 449, 0, 4, 40 )
17    jog( 681, 0, 5, 40 )
18    delay( 300 )
19    jog( 589, 0, 2, 40 )
20    jog( 608, 0, 4, 40 )
21    jog( 416, 0, 5, 40 )
22    delay( 300 )
23    jog( 416, 0, 1, 40 )
24    jog( 608, 0, 2, 40 )
25    jog( 435, 0, 4, 40 )
26    jog( 512, 0, 5, 40 )
27    delay( 300 )
```

## 05 Viewing C-Like

Click the 'C-like' tab near the top right and task programming window will open as shown in the photo to the left. This is the task window of the entire program. Codes are very similar to the C language structure so studying the codes will help the user become familiar with the C language structure. Cursor will jump following the clicked module, making it easy to see the module changing to text

```

28     jog( 575, 0, 1, 40 )
29     jog( 343, 0, 2, 40 )
30     jog( 512, 0, 4, 40 )
31     delay( 300 )
32     jog( 512, 0, 1, 40 )
33     jog( 512, 0, 2, 40 )
34     delay( 500 )
35     jog( 374, 0, 1, 10 )
36     jog( 650, 0, 4, 10 )
37     delay( 200 )
38     jog( 235, 0, 1, 10 )
39     jog( 789, 0, 4, 10 )
40     delay( 200 )
41 }

```

The screenshot shows a software interface for configuring a servo motor. On the left, a 'Constant' block with the value 96 is connected to a 'Servo RAM TorqCtrl' block. The 'Variable' panel on the right is open, showing the following settings:

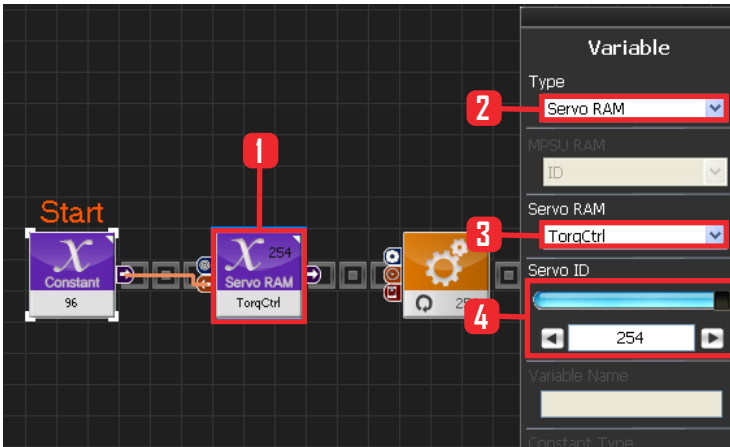
- Type: Constant
- MPSU RAM ID: (dropdown)
- Servo RAM ID: (dropdown)
- Servo ID: (slider set to 0)
- Variable Name: (text field)
- Constant Type:  Bool  Int
- Constant Value:  True  False
- Constant Value: (slider set to 96)

Red callouts indicate the following steps:

- 1 Click Start
- 2 Select Constant
- 3 Input 96

## 06 Variable Setup

This section makes the servo motor to operate on it's own. Select Constant as the Variable Type. In properties, set constant value as 96. When 96(0x60) is entered in the servo TorqControl register, servo becomes ready to operate. This value is sent to the torque value of the next moduel through the output connector.



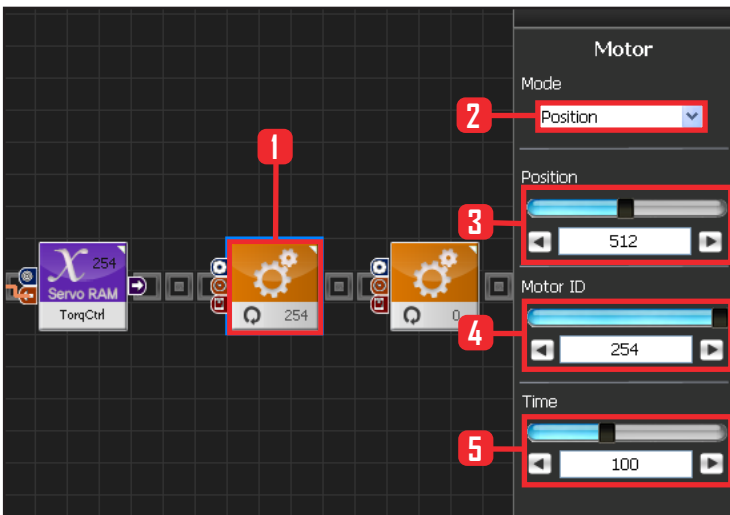
## 07 Apply to All Servos

This section applies contact value 96 to all servos.

Select Variable > Type : Servo RAM.

Select Servo RAM : TorqCtrl .

Set Servo ID : 254, 254 means it will be applied to all connected servos..



## 08 Set Angle to All Servos

Set all servo motor angles to the center.

Select Motion > Motor .

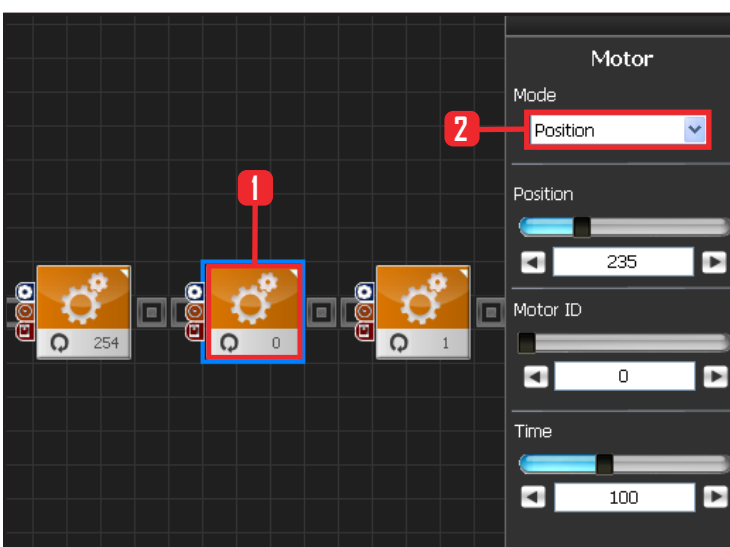
Select Mode : Position . Set angle.

Set Position : 512 . 512 sets servo angle to the center

Set Motor ID : 254 . apply to all servos

Set Time : 100 . 1tick = 11,2ms, 100 tick = 1,12s.

Move to set angle for 1,12s.



## 09 Motor ID 0 (Right Shoulder) Setup

### 1st stage : Initial position

Make attention posture(Basic posture)

When all servo motors are aligned to the center, humanoid robot will be standing with both arms stretched out to the side. This stretched out arm posture need to be returned to the basic attention posture to make applying motion easier.

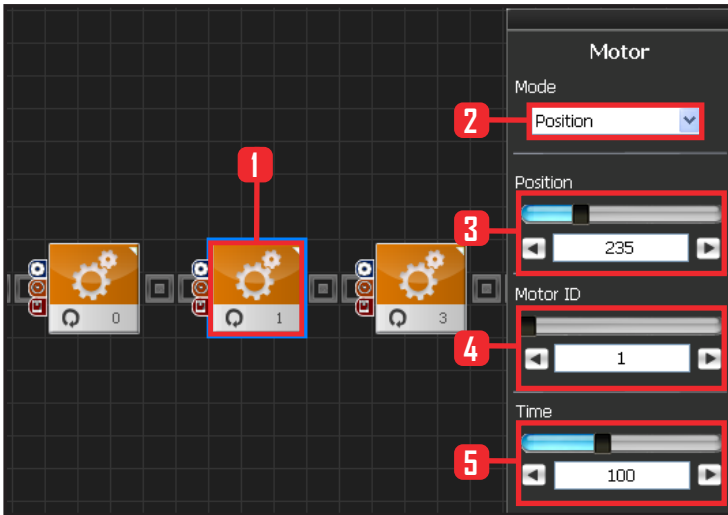
Select Motion > Motor

Select Mode : Position

Set Position : 235 . 235 turns the the motor so that the right arm in horizontal position can be lowered to vertical position.

Set Motor ID : 0, Right shoulder motor has ID 0.

Set Time : 100, Motor will turn to set angle in 1,12s.



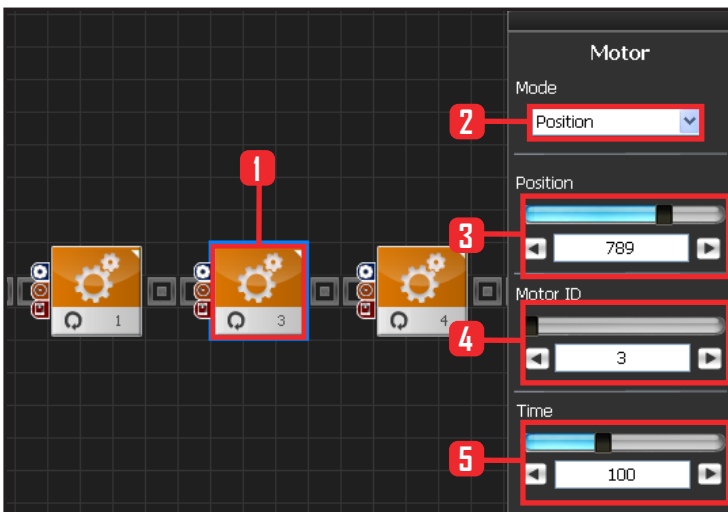
## 10 Motor ID 1 (Right Arm) Setup

Select Mode : Position .

Set Position : 235 . 235 turn the horizontal arm to vertical position.

Set Motor ID : 1, Right upper arm motor connected to the shoulder has ID 1.

Set Time : 100 . Motor will turn to set angle in 1.12s.



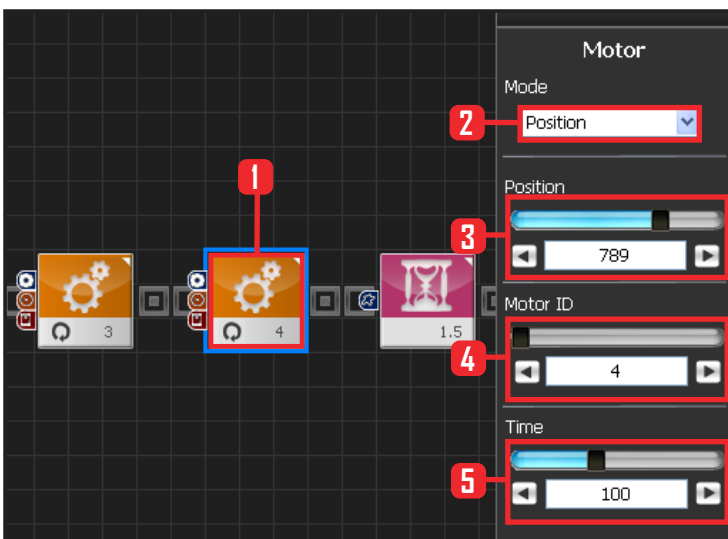
## 11 Motor ID 3(Left Shoulder) Setup

Select Mode : Position.

Set Position : 789, 789 turns the the motor so that the let arm in horizontal position can be lowered to vertical position.

Set Motor ID : 3, Left shoulder motor has ID 3.

Set Time : 100, Motor will turn to set angle in 1.12s.



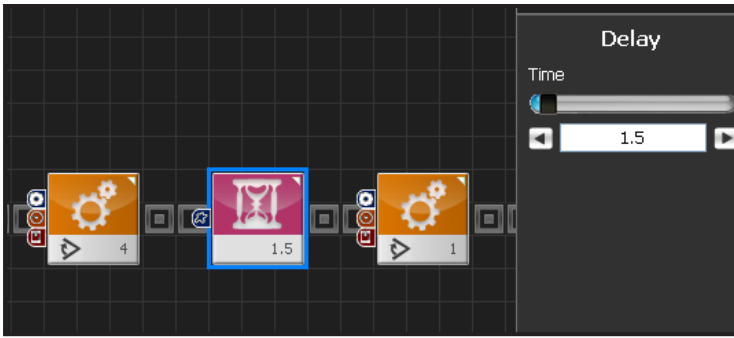
## 12 Motor ID 4(Left Arm) Setup

Select Mode : Position .

Set Position : 789 . 235 turn the horizontal arm to vertical position.

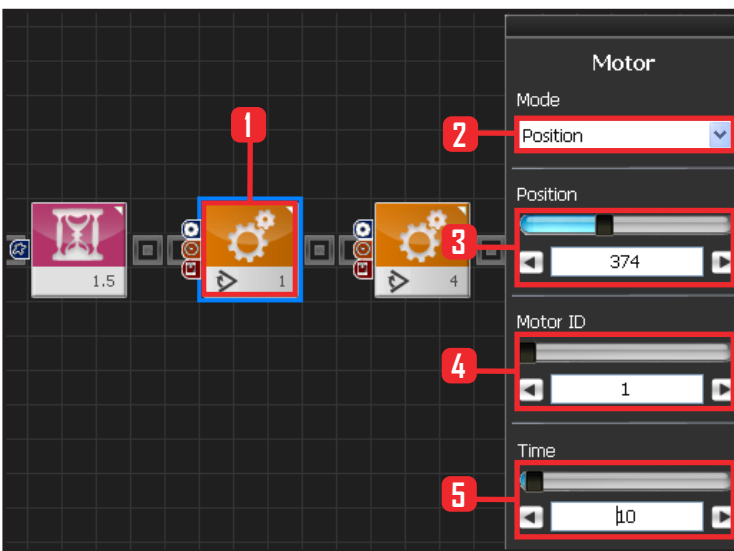
Set Motor ID : 4, Left upper arm motor connected to the shoulder has ID 4.

Set Time : 100 . Motor will turn to set angle in 1.12s.



### 13 Delay

Delay 1.5 s.



### 14 모터 ID1(Right Arm) Setup

#### 2nd Stage : Set arm angle to 45 degrees.

Set arm angle to 45 degrees to prepare the robot for the dance.

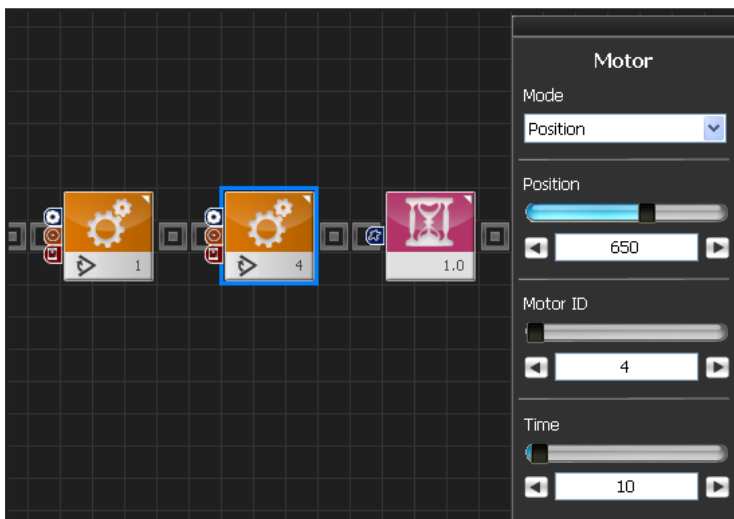
Select Motion > Motor.

Select Mode : Position.

Set Position : 374 . 374 changes the right arm angle to 45 degrees.

Select Motor ID : 1, Right upper arm motor has ID 0.

Set Time : 10. Motor will turn to set angle in 0.112s.



### 15 Motor ID 4(Right Arm) Setup

Set left upper arm motor ID 4 to 45 degrees.

Select Motion > Motor.

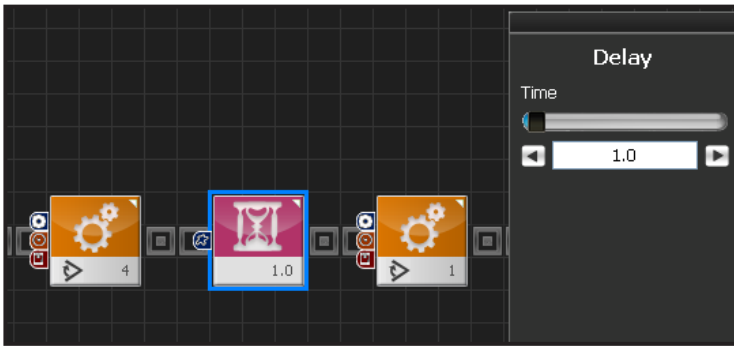
Select Mode : Position.

Set Position : 650 , 650 changes the left arm angle to 45 degrees.

Select Motor ID : 4, left upper arm motor has ID 0.

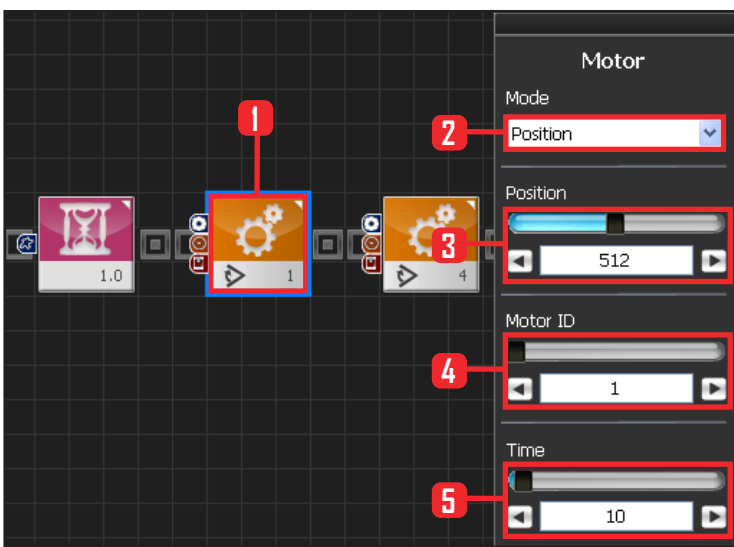
Set Time : 10. Motor will turn to set angle in 0.112s.





## 16 Delay

Delay 1s.



## 17 Motor ID 1(Right arm) Setup

**3rd Stage : Set arm angle to 90 degrees.**  
Set arm angle to 90 degrees to start the robot on the wave dance.

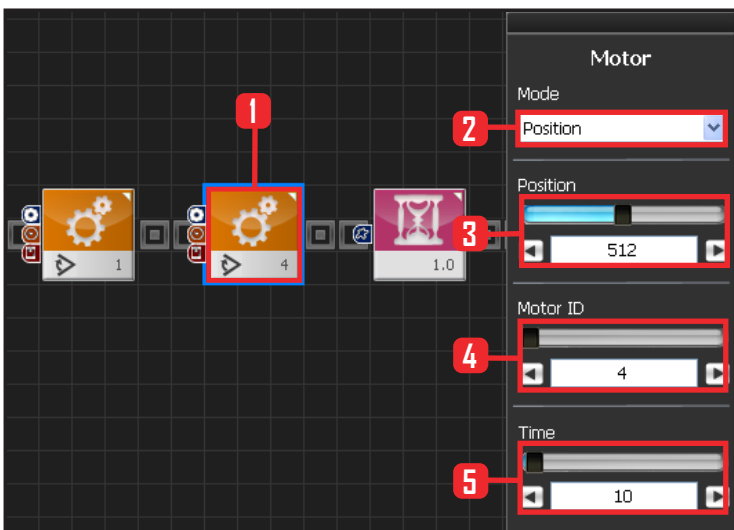
Setup Motion > Motor.

Select Mode : Position.

Set Position : 512, 512 50 changes the right arm angle to 45 degrees, 512 is also the center position of the motor. When all motors are set to the center position, robot will stretch out both arms to the side.

Set Motor ID : 1, Right upper arm motor connected to the shoulder has ID 1

SetTime : 10, Motor will turn to set angle in 0.112s.



## 18 Motor ID 4(Left Arm) Setup

**Set arm angle to 90 degrees.**

Set arm angle to 90 degrees to start the robot on the wave dance.

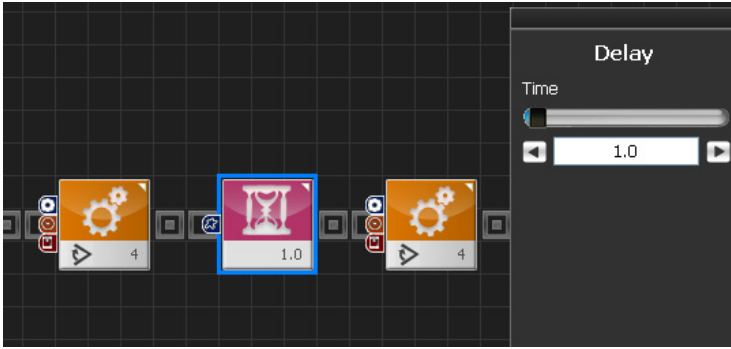
Setup Motion > Motor.

Select Mode : Position.

Set Position : 512, 512 50 changes the left arm angle to 45 degrees, 512 is also the center position of the motor. When all motors are set to the center position, robot will stretch out both arms to the side.

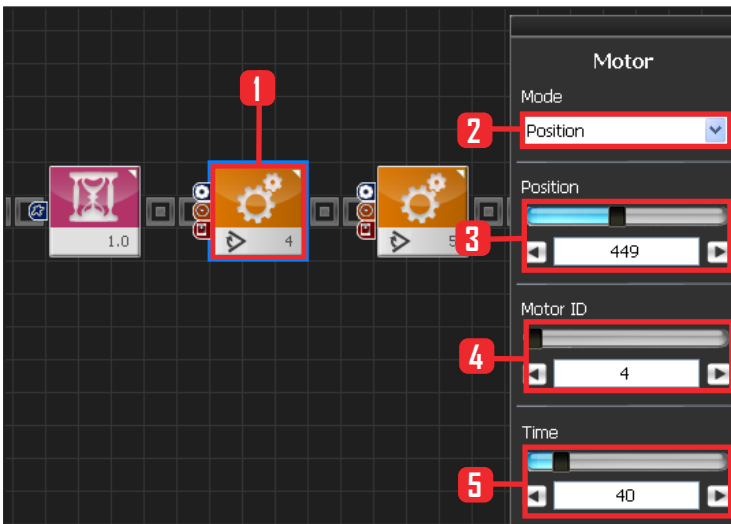
Set Motor ID : 4, Left upper arm motor connected to the shoulder has ID 4

SetTime : 10, Motor will turn to set angle in 0.112s.



## 19 Delay

Delay 1s.



## 20 Motor ID 4(Left Arm) Setup

### 4th Stage : Wave 1 stage

Start the wave from the left arm.

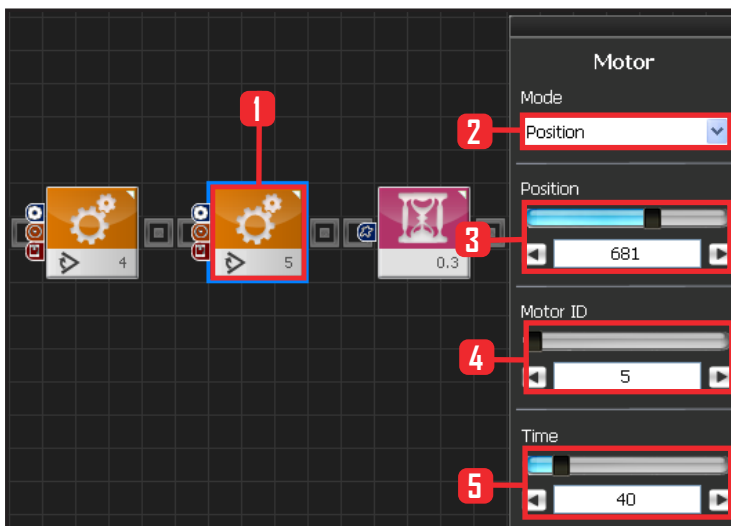
Select Motion > Motor.

Select Mode : Position.

Set Position : 449, 449 changes the left arm angle to the start of the wave dance.

Set Motor ID : Left upper arm motor connected to the shoulder has ID 4

Set Time : 40 . Motor will turn to set angle in 0.448s.



## 21 Motor ID 5(Lower Left Arm) Setup

Lower left arm wave.

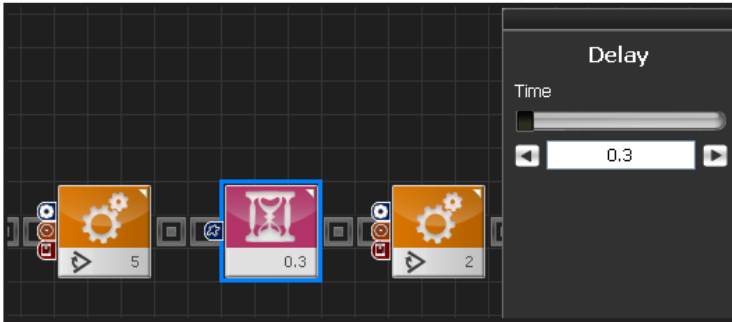
Select Motion > Motor.

Select Mode : Position.

Set Position : 681.

Set Motor ID : 5, Lower left arm motor has ID 5.

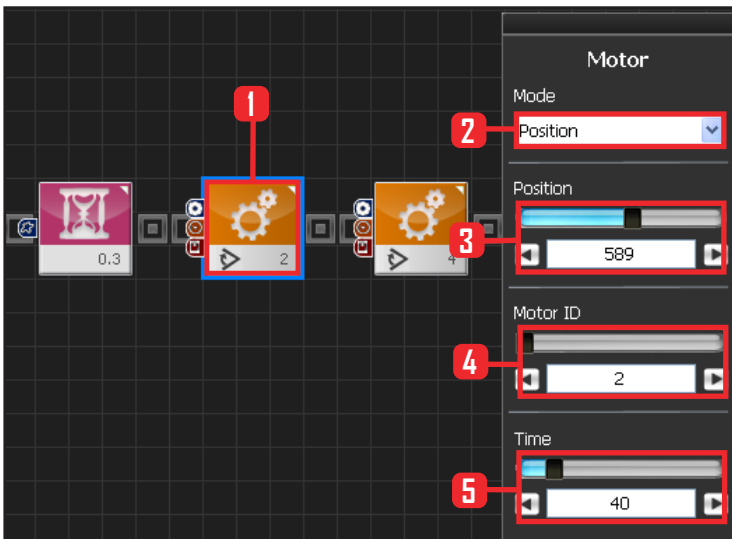
Set Time : 40 . Motor will turn to set angle in 0.448s.



## 22 Delay

Delay 0.3s.

Short delay as dance has started.



## 23 Motor ID 2(Lower Right Arm) Setup

### 5th Stage : Wave 2 Stage

Lower right arm wave.

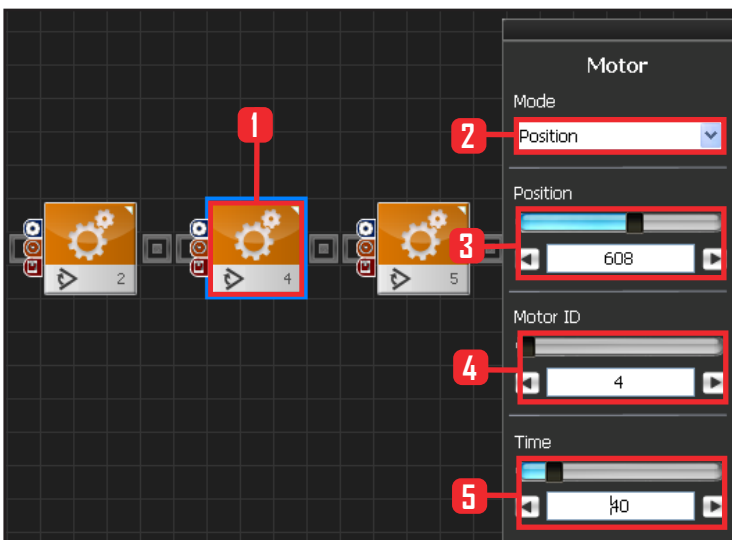
Select Motion > Motor.

Select Mode : Position .

Set Position : 589.

Set Motor ID : 2. Lower right arm motor has ID 2.

Set Time : 40 . Motor will turn to set angle in 0.448s.



## 24 Motor ID 4(Left Right Arm) Setup

Change the motor angle slightly to give wave effect.

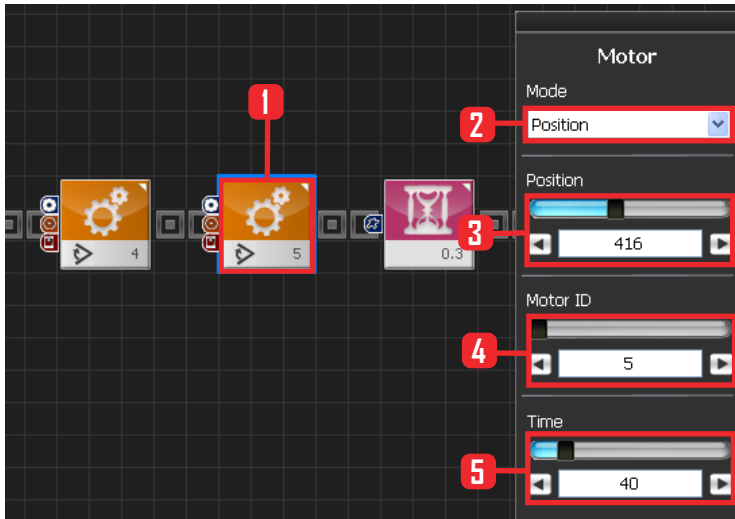
Select Motion > Motor.

Select Mode : Position .

Set Position : 608 .

Set Motor ID : 4 .

Set Time : 40 . Motor will turn to set angle in 0.448s.



## 25 Motor ID 5(Lower Left Arm) Setup

Change the motor angle slightly to give wave effect.

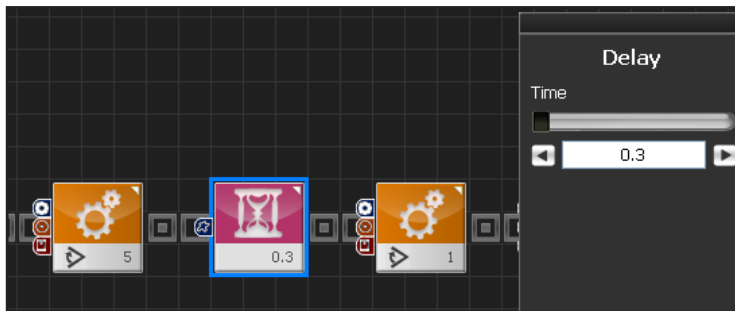
Select Motion > Motor.

Select Mode : Position .

Set Position : 416.

Set Motor ID : 5 .

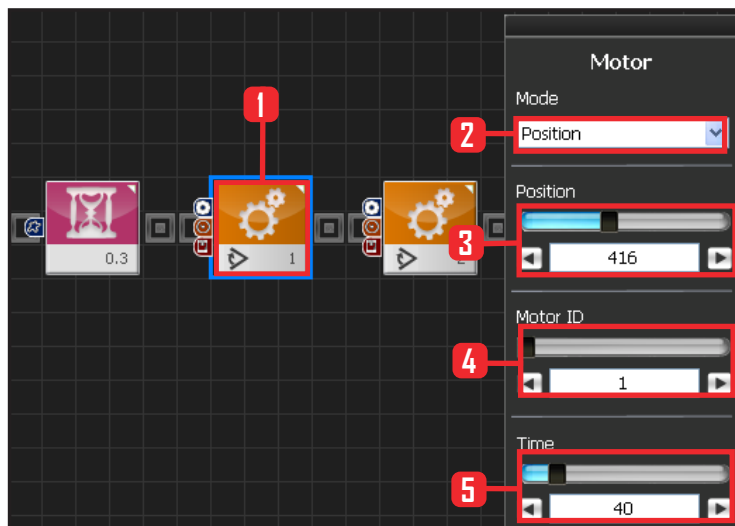
Set Time : 40 . Motor will turn to set angle in 0,448s.



## 26 Delay

Delay 0,3s.

Short delay as dance has started.



## 27 Motor ID 1(Upper Right Arm) Setup

### 6th Stage : Wave 3 Stage

Return motor to original position.

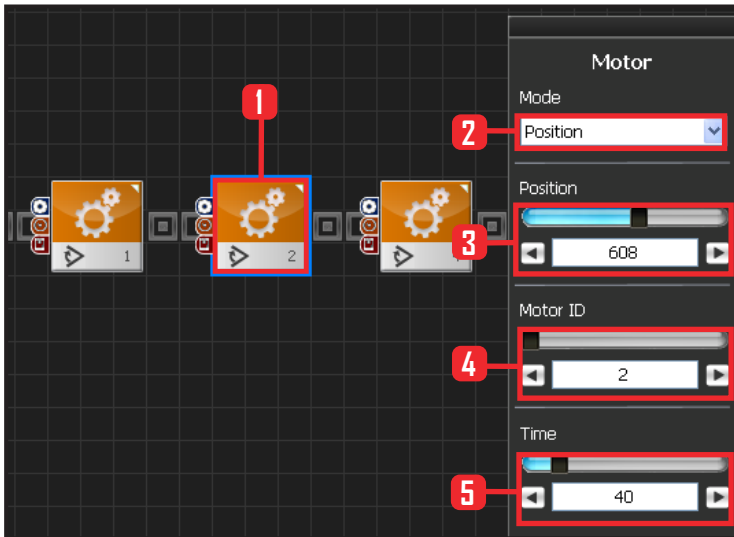
Select Motion > Motor.

Select Mode : Position .

Set Position : 416.

Set Motor ID : 1 .

Set Time : 40 . Motor will turn to set angle in 0,448s.



## 28 Motor ID 2(Lower Right Arm) Setup

Return motor to original position.

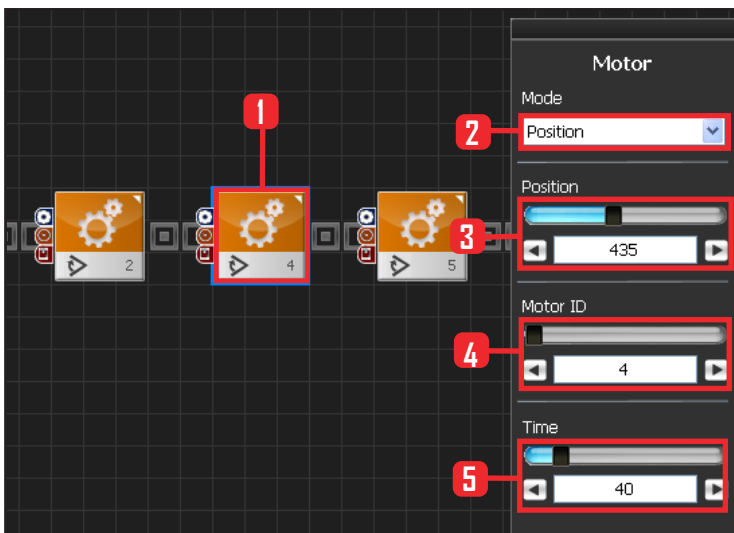
Select Motion > Motor.

Select Mode : Position .

Set Position : 608.

Set Motor ID : 2.

Set Time : 40 . Motor will turn to set angle in 0,448s.



## 29 Motor ID 4(Upper Left Arm) Setup

Return motor to original position.

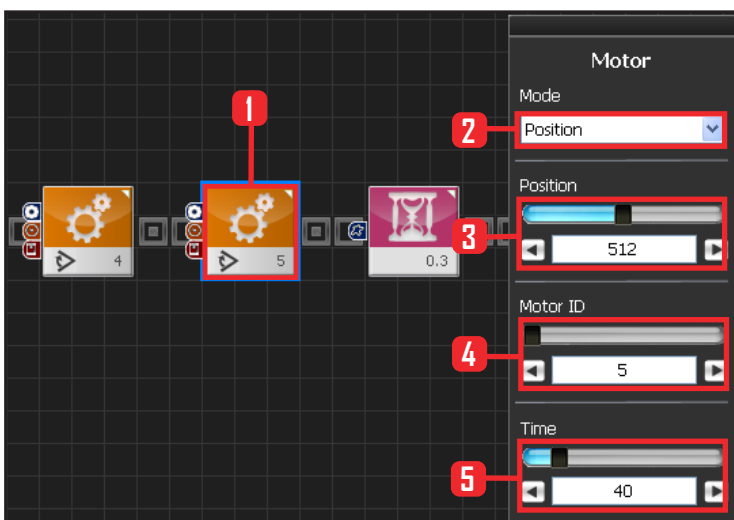
Select Motion > Motor.

Select Mode : Position .

Set Position : 435.

Set Motor ID : 4.

Set Time : 40 . Motor will turn to set angle in 0,448s.



## 30 Motor ID 5(Lower Left Arm) Setup

Return motor to original position.

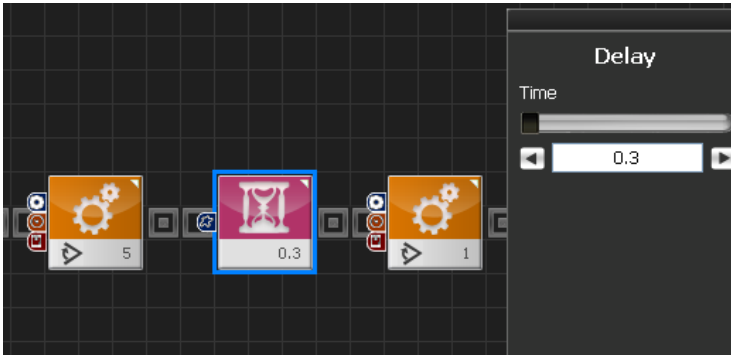
Select Motion > Motor.

Select Mode : Position .

Set Position : 512.

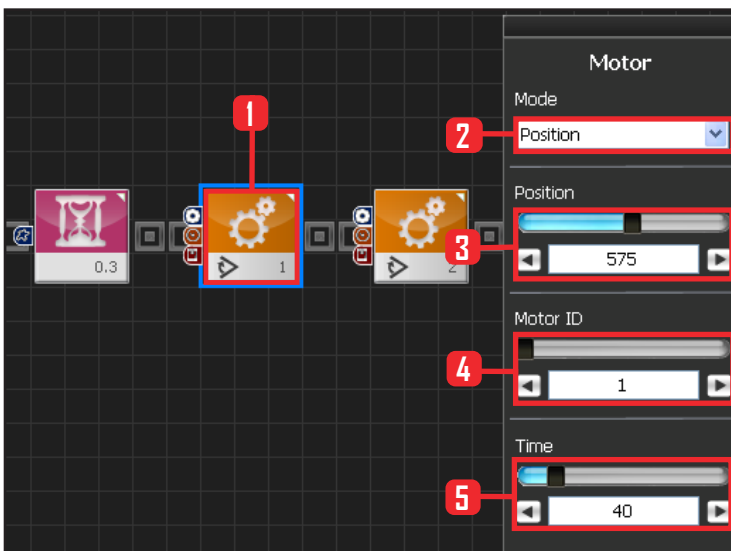
Set Motor ID : 5.

Set Time : 40 . Motor will turn to set angle in 0,448s.



### 31 Delay

Delay 0.3s.  
Short delay as dance has started.

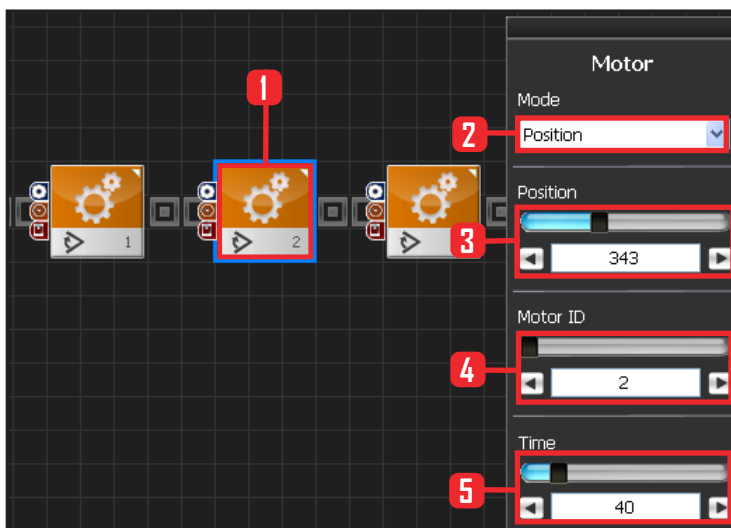


### 32 Motor ID 1(Upper Right Arm) Setup

#### 7th Stage : Wave 4 Stage

End Wave.

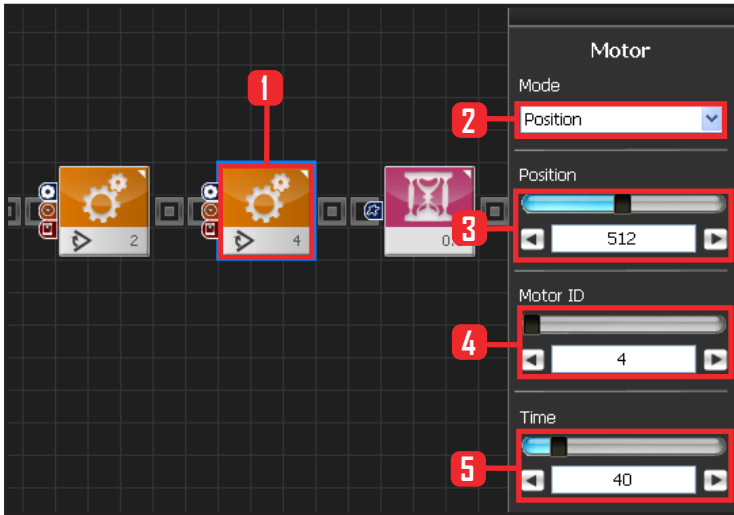
Select Motion > Motor.  
Select Mode : Position .  
Set Position : 575.  
Set Motor ID : 1.  
Set Time : 40 . Motor will turn to set angle in 0.448s.



### 33 Motor ID 2(Lower Right Arm) Setup

End Wave.

Select Motion > Motor.  
Select Mode : Position .  
Set Position : 343.  
Set Motor ID : 2.  
Set Time : 40 . Motor will turn to set angle in 0.448s.



### 34 Motor ID 4(Left Upper Arm) Setup

End Wave.

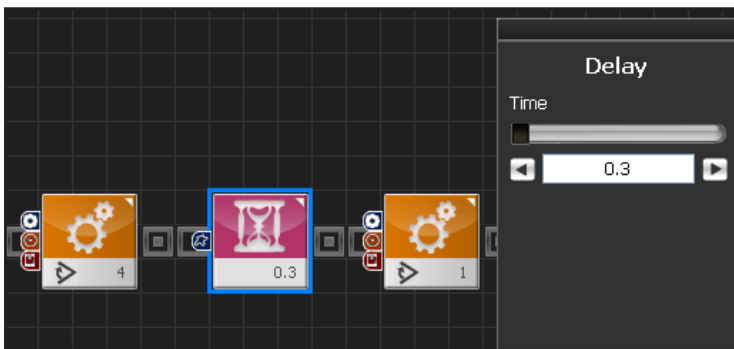
Select Motion > Motor.

Select Mode : Position .

Set Position : 512,

Set Motor ID : 4,

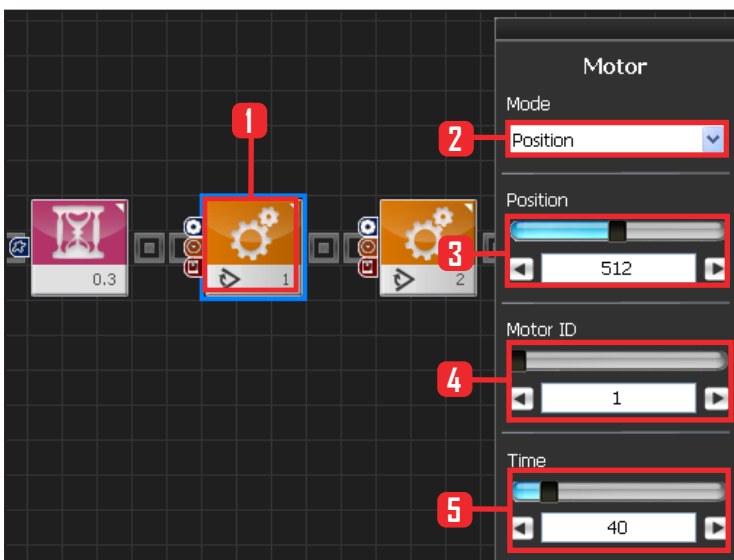
Set Time : 40 . Motor will turn to set angle in 0.448s.



### 35 Delay

Delay 0.3s.

Short delay as dance has started.



### 36 Motor ID 1(Right Upper Amr) Setup

#### 8th Stage : Wave 5 Stage

Extend both arms to the side .

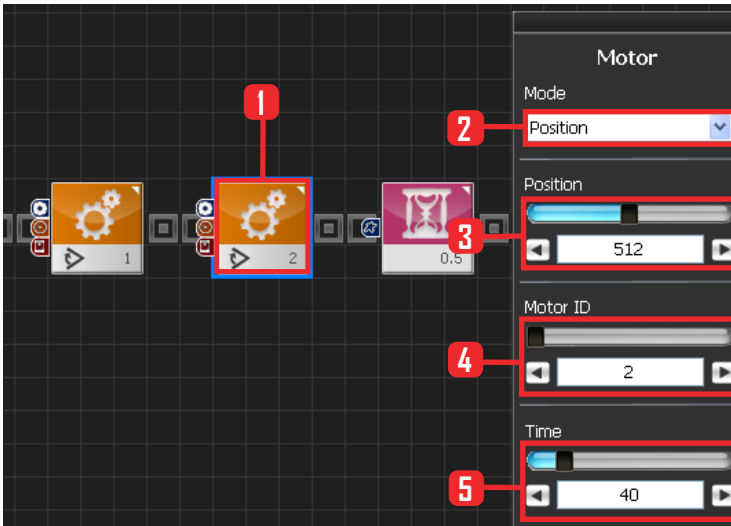
Select Motion > Motor.

Select Mode : Position .

Set Position : 512,

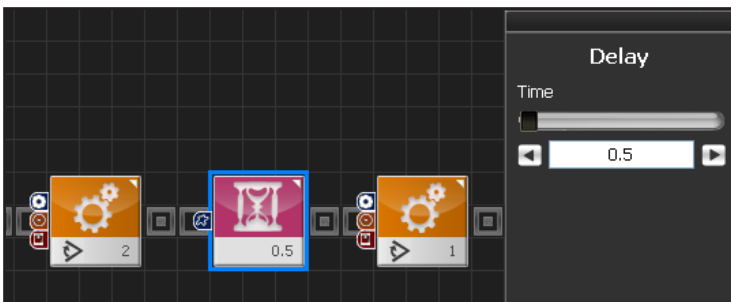
Set Motor ID : 1,

Set Time : 40 . Motor will turn to set angle in 0.448s.



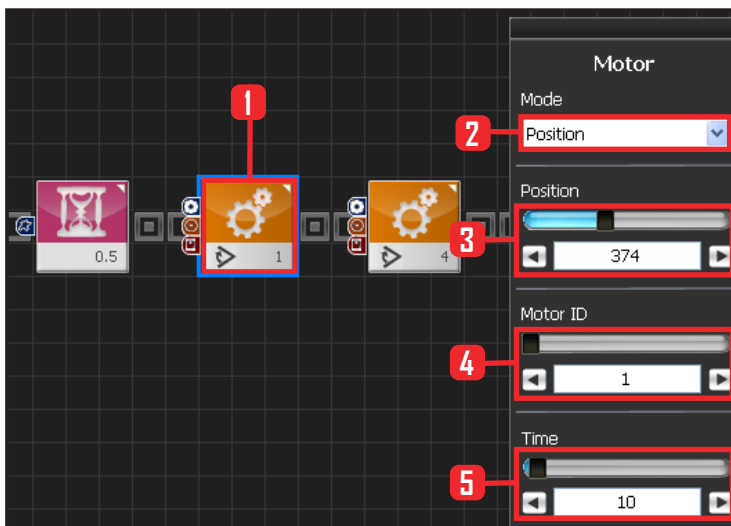
### 37 Motor ID 2(Lower Right Am) Setup

Extend both arms to the side .  
 Select Motion > Motor.  
 Select Mode : Position .  
 Set Position : 512.  
 Set Motor ID : 2.  
 Set Time : 40 , Motor will turn to set angle in 0,448s.



### 38 Delay

Delay 0,5s

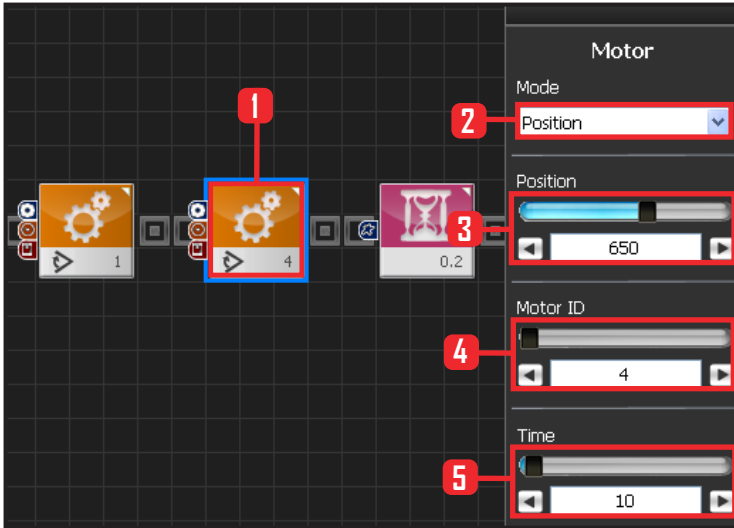


### 39 Motor ID 1(Upper Right Arm) Setup

**9th Stage : Lower arm to 45 degrees**  
 Return to attention posture, change arm angle to 45 degrees first.

Select Motion > Motr.  
 Select Mode : Position.  
 Set Position : 374.  
 Set Motor ID : 1.  
 Set Time : 10 .

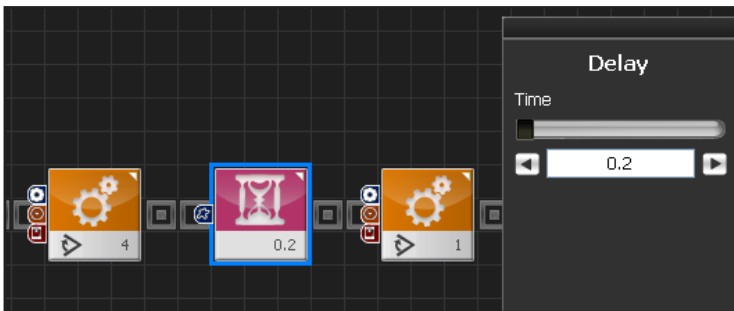




#### 40 Motor ID 4(Left Upper Arm) Setup

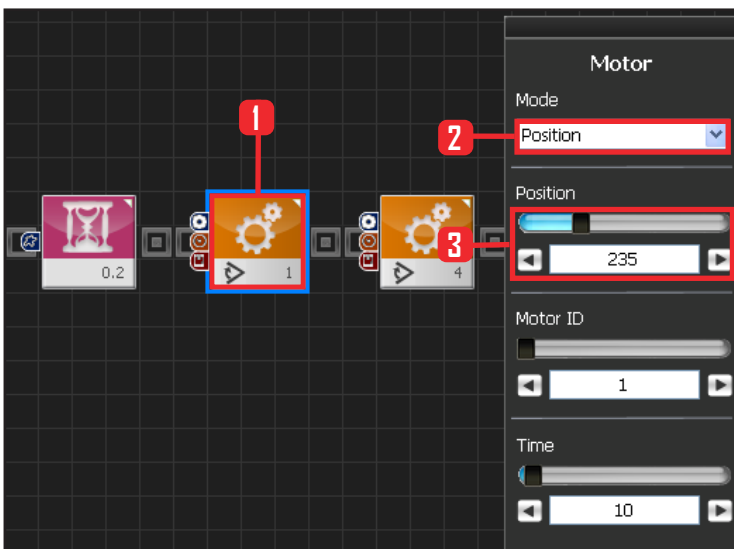
Return to attention posture, change arm angle to 45 degrees first.

Select Motion > Motor.  
 Select Mode : Position,  
 Set Position : 650,  
 Set Motor ID : 4,  
 Set Time : 10 .



#### 41 Delay

Delay 0.2s .

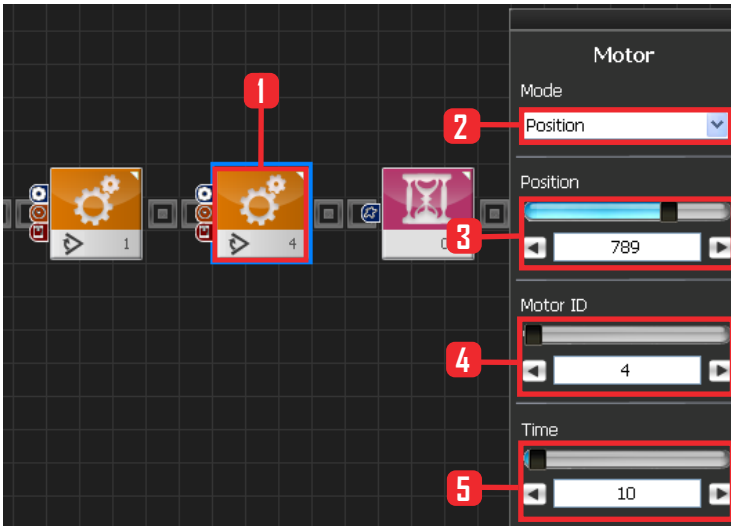


#### 42 Motor ID 1(Upper Right Arm) Setup

##### 10th Stage : Dance Complete

Return to attention posture.

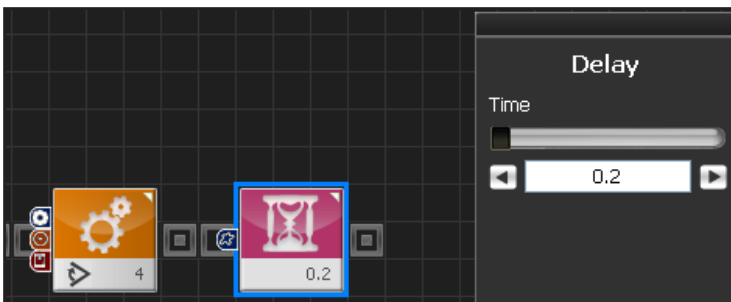
Select Motion > Motor.  
 Select Mode : Position,  
 Set Position : 235,  
 Set Motor ID : 1,  
 Set Time : 10 .



### 43 Motor ID 4(Upper Left Arm) Setup

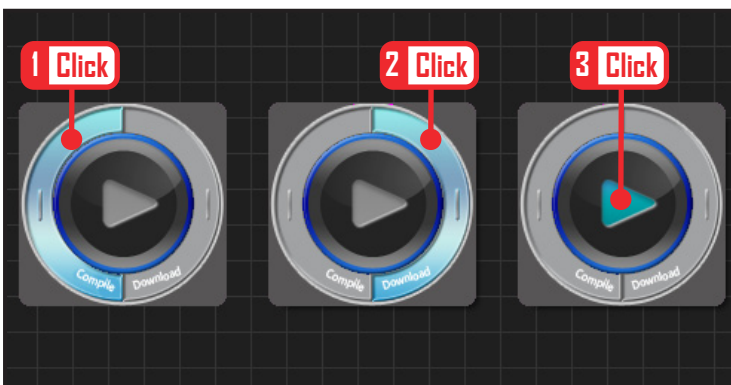
Return to attention posture.

Select Motion > Motor.  
 Select Mode : Position.  
 Set Position : 235.  
 Set Motor ID : 4.  
 Set Time : 10 .



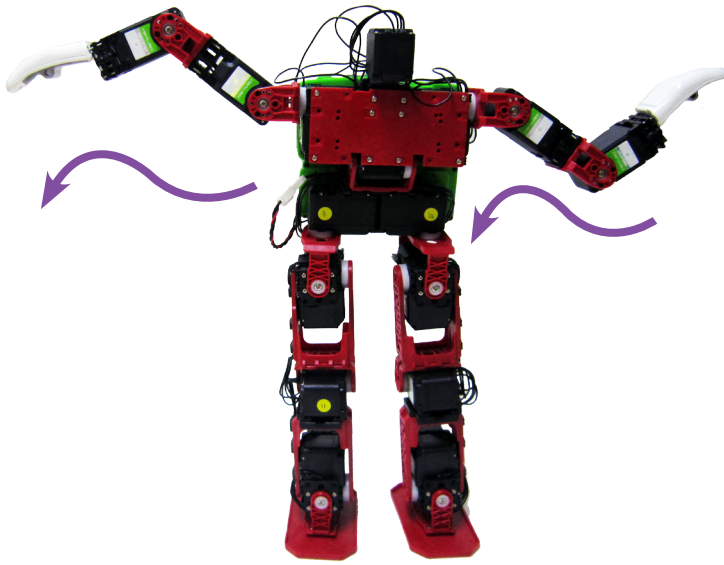
### 44 Delay

Delay 0,2s .



### 45 Compile, Download, Run

Click 'Compile'. Click 'download' on the right if there is no compilation error. Download to robot. Click 'Run' button (Arrow button) after the download.



## 46 Robot Motion

Wave dance will start from the left arm.