|  |
| --- |
| import processing.serial.\*; |
|  |

|  |
| --- |
| Serial myPort; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| int BAUD\_RATE = 115200; |
|  |

|  |
| --- |
| int SERVO\_NUM = 7; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| double[] posD = new double[SERVO\_NUM]; |
|  |

|  |
| --- |
| int[] force = new int[SERVO\_NUM]; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| boolean isAllConverge = false; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| void setup() |
|  |

|  |
| --- |
| { |
|  |

|  |
| --- |
| // Open Serial Port: Your should change PORT\_ID accoading to |
|  |

|  |
| --- |
| // your own situation. |
|  |

|  |
| --- |
| // Please refer to: https://www.processing.org/reference/libraries/serial/Serial.html |
|  |

|  |
| --- |
| int PORT\_ID = 3; |
|  |

|  |
| --- |
| myPort = new Serial(this, Serial.list()[PORT\_ID], BAUD\_RATE); |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // Delay 2 seconds to wait 7Bot waking up |
|  |

|  |
| --- |
| delay(2000); |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| // 1- change forece status |
|  |

|  |
| --- |
| setForceStatus(0); // change forece status to forceless |
|  |

|  |
| --- |
| delay(5000); |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| setForceStatus(1); // change forece status to normal servo |
|  |

|  |
| --- |
| delay(2000); |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| setForceStatus(2); // change forece status to protection |
|  |

|  |
| --- |
| delay(5000); |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| // 2- speed & pose setting |
|  |

|  |
| --- |
| setForceStatus(1); delay(2000); // reboot 7Bot if previous status is not normal servo |
|  |

|  |
| --- |
| // To make motion much more stable, highly recommend you use fluency all the time. |
|  |

|  |
| --- |
| boolean[] fluentEnables = {true, true, true, true, true, true, true}; |
|  |

|  |
| --- |
| int[] speeds\_1 = {50, 50, 50, 200, 200, 200, 200}; |
|  |

|  |
| --- |
| setSpeed(fluentEnables, speeds\_1); // set speed |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| float[] angles\_1 = {45, 115, 65, 90, 90, 90, 80}; |
|  |

|  |
| --- |
| setServoAngles(angles\_1); // set pose |
|  |

|  |
| --- |
| while(!isAllConverge){delay(200);} // wait motion converge |
|  |

|  |
| --- |
| float[] angles\_2 = {135, 115, 65, 90, 90, 90, 80}; |
|  |

|  |
| --- |
| setServoAngles(angles\_2); |
|  |

|  |
| --- |
| while(!isAllConverge){delay(200);} |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| int[] speeds\_2 = {150, 150, 150, 200, 200, 200, 200}; |
|  |

|  |
| --- |
| setSpeed(fluentEnables, speeds\_2); // change speed |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| float[] angles\_3 = {45, 135, 65, 90, 90, 90, 80}; |
|  |

|  |
| --- |
| setServoAngles(angles\_3); |
|  |

|  |
| --- |
| while(!isAllConverge){delay(200);} |
|  |

|  |
| --- |
| float[] angles\_4 = {135, 135, 65, 90, 90, 90, 80}; |
|  |

|  |
| --- |
| setServoAngles(angles\_4); |
|  |

|  |
| --- |
| while(!isAllConverge){delay(200);} |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| // 3- IK setting |
|  |

|  |
| --- |
| PVector j6 = new PVector(-100, 250, 50); |
|  |

|  |
| --- |
| PVector vec56 = new PVector(0, 0, -1); |
|  |

|  |
| --- |
| PVector vec67 = new PVector(1, 0, 0); |
|  |

|  |
| --- |
| float theta6 = 10; |
|  |

|  |
| --- |
| setIK(j6, vec56, vec67, theta6); |
|  |

|  |
| --- |
| delay(1500); |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| j6 = new PVector(0, 250, 150); |
|  |

|  |
| --- |
| vec56 = new PVector(0, 1, 0); |
|  |

|  |
| --- |
| vec67 = new PVector(1, 0, 0); |
|  |

|  |
| --- |
| theta6 = 55; |
|  |

|  |
| --- |
| setIK(j6, vec56, vec67, theta6); |
|  |

|  |
| --- |
| delay(1500); |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| // 4- recevie and print pose |
|  |

|  |
| --- |
| setForceStatus(2); |
|  |

|  |
| --- |
| for(int i=0; i<30; i++) { |
|  |

|  |
| --- |
| delay(300); |
|  |

|  |
| --- |
| println("Detect Poses: ", posD[0], posD[1], posD[2], posD[3], posD[4], posD[5], posD[6]); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| // 5- recevie and print force |
|  |

|  |
| --- |
| setForceStatus(1); |
|  |

|  |
| --- |
| delay(2000); |
|  |

|  |
| --- |
| for(int i=0; i<60; i++) { |
|  |

|  |
| --- |
| delay(300); |
|  |

|  |
| --- |
| println("Detect Forces: ", force[0], force[1], force[2], force[3], force[4], force[5], force[6]); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // Stop with protection mode |
|  |

|  |
| --- |
| setForceStatus(2); |
|  |

|  |
| --- |
| println("The End"); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| void draw() |
|  |

|  |
| --- |
| { |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| /\* SENT DATA TO 7BOT \*/ |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // set motor force status: 0-forceless, 1-normal servo, 2-protection |
|  |

|  |
| --- |
| void setForceStatus(int status) { |
|  |

|  |
| --- |
| myPort.write(0xFE); |
|  |

|  |
| --- |
| myPort.write(0xF5); |
|  |

|  |
| --- |
| myPort.write(status & 0x7F); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // set motion fluency & speeds (0~250 ---> 0~25) |
|  |

|  |
| --- |
| void setSpeed(boolean fluentEnables[], int speeds[]) { |
|  |

|  |
| --- |
| // 1- Process Data |
|  |

|  |
| --- |
| int[] sendData = new int[SERVO\_NUM]; |
|  |

|  |
| --- |
| for (int i=0; i<SERVO\_NUM; i++) { |
|  |

|  |
| --- |
| sendData[i] = constrain(speeds[i], 0, 250)/10; |
|  |

|  |
| --- |
| if (fluentEnables[i]) sendData[i] += 64; |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| // 2- Send Data |
|  |

|  |
| --- |
| myPort.write(0xFE); |
|  |

|  |
| --- |
| myPort.write(0xF7); |
|  |

|  |
| --- |
| for (int i=0; i<SERVO\_NUM; i++) { |
|  |

|  |
| --- |
| myPort.write(sendData[i] & 0x7F); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // set Servo angles |
|  |

|  |
| --- |
| void setServoAngles(float servoAngles[]) { |
|  |

|  |
| --- |
| isAllConverge = false; |
|  |

|  |
| --- |
| // 1- Process Data |
|  |

|  |
| --- |
| int[] sendData = new int[SERVO\_NUM]; |
|  |

|  |
| --- |
| for (int i=0; i<SERVO\_NUM; i++) { |
|  |

|  |
| --- |
| sendData[i] = (int)(servoAngles[i]\*50/9); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| // 2- Send Data |
|  |

|  |
| --- |
| myPort.write(0xFE); |
|  |

|  |
| --- |
| myPort.write(0xF9); |
|  |

|  |
| --- |
| for (int i=0; i<SERVO\_NUM; i++) { |
|  |

|  |
| --- |
| myPort.write((sendData[i]/128) & 0x7F); |
|  |

|  |
| --- |
| myPort.write(sendData[i] & 0x7F); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // IK6(6 angles) |
|  |

|  |
| --- |
| // j6:mm(-500~500), vec:(-1.0~1.0)--->(-500~500), theta:Degrees |
|  |

|  |
| --- |
| void setIK(PVector j6, PVector vec56, PVector vec67, float theta6) { |
|  |

|  |
| --- |
| isAllConverge = false; |
|  |

|  |
| --- |
| // 1- Process Data |
|  |

|  |
| --- |
| PVector j6\_c = new PVector(constrain(j6.x, -500, 500), constrain(j6.y, -500, 500), constrain(j6.z, -500, 500)); |
|  |

|  |
| --- |
| PVector vec56\_c = vec56; |
|  |

|  |
| --- |
| vec56\_c.normalize(); |
|  |

|  |
| --- |
| vec56\_c.mult(500); |
|  |

|  |
| --- |
| PVector vec67\_c = vec67; |
|  |

|  |
| --- |
| vec67\_c.normalize(); |
|  |

|  |
| --- |
| vec67\_c.mult(500); |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| int[] sendData = new int[10]; |
|  |

|  |
| --- |
| sendData[0] = (int)abs(j6\_c.x); |
|  |

|  |
| --- |
| if (j6\_c.x<0) sendData[0] += 1024; |
|  |

|  |
| --- |
| sendData[1] = (int)abs(j6\_c.y); |
|  |

|  |
| --- |
| if (j6\_c.y<0) sendData[1] += 1024; |
|  |

|  |
| --- |
| sendData[2] = (int)abs(j6\_c.z); |
|  |

|  |
| --- |
| if (j6\_c.z<0) sendData[2] += 1024; |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| sendData[3] = (int)abs(vec56\_c.x); |
|  |

|  |
| --- |
| if (vec56\_c.x<0) sendData[3] += 1024; |
|  |

|  |
| --- |
| sendData[4] = (int)abs(vec56\_c.y); |
|  |

|  |
| --- |
| if (vec56\_c.y<0) sendData[4] += 1024; |
|  |

|  |
| --- |
| sendData[5] = (int)abs(vec56\_c.z); |
|  |

|  |
| --- |
| if (vec56\_c.z<0) sendData[5] += 1024; |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| sendData[6] = (int)abs(vec67\_c.x); |
|  |

|  |
| --- |
| if (vec67\_c.x<0) sendData[6] += 1024; |
|  |

|  |
| --- |
| sendData[7] = (int)abs(vec67\_c.y); |
|  |

|  |
| --- |
| if (vec67\_c.y<0) sendData[7] += 1024; |
|  |

|  |
| --- |
| sendData[8] = (int)abs(vec67\_c.z); |
|  |

|  |
| --- |
| if (vec67\_c.z<0) sendData[8] += 1024; |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| sendData[9] = (int)(theta6\*50/9); |
|  |

|  |
| --- |
| // 2- Send Data |
|  |

|  |
| --- |
| myPort.write(0xFE); |
|  |

|  |
| --- |
| myPort.write(0xFA); |
|  |

|  |
| --- |
| for (int i=0; i<10; i++) { |
|  |

|  |
| --- |
| myPort.write((sendData[i]/128) & 0x7F); |
|  |

|  |
| --- |
| myPort.write(sendData[i] & 0x7F); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // IK5(5 angles) |
|  |

|  |
| --- |
| // j6:mm(-500~500), vec:(-1.0~1.0)--->(-500~500), theta:Degrees |
|  |

|  |
| --- |
| void setIK(PVector j6, PVector vec56, float theta5, float theta6) { |
|  |

|  |
| --- |
| isAllConverge = false; |
|  |

|  |
| --- |
| // 1- Process Data |
|  |

|  |
| --- |
| PVector j6\_c = new PVector(constrain(j6.x, -500, 500), constrain(j6.y, -500, 500), constrain(j6.z, -500, 500)); |
|  |

|  |
| --- |
| PVector vec56\_c = vec56; |
|  |

|  |
| --- |
| vec56\_c.normalize(); |
|  |

|  |
| --- |
| vec56\_c.mult(500); |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| int[] sendData = new int[8]; |
|  |

|  |
| --- |
| sendData[0] = (int)abs(j6\_c.x); |
|  |

|  |
| --- |
| if (j6\_c.x<0) sendData[0] += 1024; |
|  |

|  |
| --- |
| sendData[1] = (int)abs(j6\_c.y); |
|  |

|  |
| --- |
| if (j6\_c.y<0) sendData[1] += 1024; |
|  |

|  |
| --- |
| sendData[2] = (int)abs(j6\_c.z); |
|  |

|  |
| --- |
| if (j6\_c.z<0) sendData[2] += 1024; |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| sendData[3] = (int)abs(vec56\_c.x); |
|  |

|  |
| --- |
| if (vec56\_c.x<0) sendData[3] += 1024; |
|  |

|  |
| --- |
| sendData[4] = (int)abs(vec56\_c.y); |
|  |

|  |
| --- |
| if (vec56\_c.y<0) sendData[4] += 1024; |
|  |

|  |
| --- |
| sendData[5] = (int)abs(vec56\_c.z); |
|  |

|  |
| --- |
| if (vec56\_c.z<0) sendData[5] += 1024; |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| sendData[6] = (int)(theta5\*50/9); |
|  |

|  |
| --- |
| sendData[7] = (int)(theta6\*50/9); |
|  |

|  |
| --- |
| // 2- Send Data |
|  |

|  |
| --- |
| myPort.write(0xFE); |
|  |

|  |
| --- |
| myPort.write(0xFB); |
|  |

|  |
| --- |
| for (int i=0; i<8; i++) { |
|  |

|  |
| --- |
| myPort.write((sendData[i]/128) & 0x7F); |
|  |

|  |
| --- |
| myPort.write(sendData[i] & 0x7F); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // IK3(3 angles) |
|  |

|  |
| --- |
| // j5:mm(-500~500), theta:Degrees |
|  |

|  |
| --- |
| void setIK(PVector j5, float theta3, float theta4, float theta5, float theta6) { |
|  |

|  |
| --- |
| isAllConverge = false; |
|  |

|  |
| --- |
| // 1- Process Data |
|  |

|  |
| --- |
| PVector j5\_c = new PVector(constrain(j5.x, -500, 500), constrain(j5.y, -500, 500), constrain(j5.z, -500, 500)); |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| int[] sendData = new int[7]; |
|  |

|  |
| --- |
| sendData[0] = (int)abs(j5\_c.x); |
|  |

|  |
| --- |
| if (j5\_c.x<0) sendData[0] += 1024; |
|  |

|  |
| --- |
| sendData[1] = (int)abs(j5\_c.y); |
|  |

|  |
| --- |
| if (j5\_c.y<0) sendData[1] += 1024; |
|  |

|  |
| --- |
| sendData[2] = (int)abs(j5\_c.z); |
|  |

|  |
| --- |
| if (j5\_c.z<0) sendData[2] += 1024; |
|  |

|  |
| --- |
| // |
|  |

|  |
| --- |
| sendData[3] = (int)(theta3\*50/9); |
|  |

|  |
| --- |
| sendData[4] = (int)(theta4\*50/9); |
|  |

|  |
| --- |
| sendData[5] = (int)(theta5\*50/9); |
|  |

|  |
| --- |
| sendData[6] = (int)(theta6\*50/9); |
|  |

|  |
| --- |
| // 2- Send Data |
|  |

|  |
| --- |
| myPort.write(0xFE); |
|  |

|  |
| --- |
| myPort.write(0xFC); |
|  |

|  |
| --- |
| for (int i=0; i<7; i++) { |
|  |

|  |
| --- |
| myPort.write((sendData[i]/128) & 0x7F); |
|  |

|  |
| --- |
| myPort.write(sendData[i] & 0x7F); |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| //////////////////////////////////////////////////////////////////////////////////////////// |
|  |

|  |
| --- |
| /\* RECEIVE DATA FROM 7BOT \*/ |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| int[] dataBuf = new int[60]; |
|  |

|  |
| --- |
| boolean beginFlag = false; |
|  |

|  |
| --- |
| int instruction = 0; |
|  |

|  |
| --- |
| int cnt = 0; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| void serialEvent(Serial myPort) { |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| while (myPort.available () > 0) { |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| // read data |
|  |

|  |
| --- |
| int rxBuf = myPort.read(); |
|  |

|  |
| --- |
| if (!beginFlag) |
|  |

|  |
| --- |
| { |
|  |

|  |
| --- |
| beginFlag = rxBuf == 0xFE ? true : false; // Beginning Flag 0xFE |
|  |

|  |
| --- |
| } else |
|  |

|  |
| --- |
| { |
|  |

|  |
| --- |
| if (instruction == 0) instruction = rxBuf - 240; |
|  |

|  |
| --- |
| else { |
|  |

|  |
| --- |
| switch (instruction) { |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| case 9: |
|  |

|  |
| --- |
| dataBuf[cnt++] = rxBuf; |
|  |

|  |
| --- |
| if (cnt >= SERVO\_NUM \* 2 + 1) |
|  |

|  |
| --- |
| { |
|  |

|  |
| --- |
| beginFlag = false; |
|  |

|  |
| --- |
| instruction = 0; |
|  |

|  |
| --- |
| cnt = 0; |
|  |

|  |
| --- |
| for (int i = 0; i < SERVO\_NUM; i++) { |
|  |

|  |
| --- |
| int posCode = dataBuf[i \* 2] \* 128 + dataBuf[i \* 2 + 1]; |
|  |

|  |
| --- |
| force[i] = posCode%16384/1024; |
|  |

|  |
| --- |
| if (posCode/16384>0) force[i] = - force[i]; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| posD[i] = (posCode%1024)\*9/50; // convert 0~1000 code to 0~180 degree(accuracy 0.18 degree) |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| if (dataBuf[(SERVO\_NUM-1) \* 2 + 2] == 1) isAllConverge = true; |
|  |

|  |
| --- |
| else isAllConverge = false; |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| break; |
|  |

|  |
| --- |
|  |
|  |

|  |
| --- |
| default: |
|  |

|  |
| --- |
| beginFlag = false; |
|  |

|  |
| --- |
| instruction = 0; |
|  |

|  |
| --- |
| cnt = 0; |
|  |

|  |
| --- |
| break; |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

|  |
| --- |
| } |
|  |

}