// "Another easier inverted pendulum balancing robot"
// You need only half a day to make it, if you have some Materials.
// (This sketch is ver.2.0.d for a digital output gyroscope.)
// No timer library is used in this version.
// But stability of robot is more improved than earlier version.
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#include <MsTimer2.h>  //01 (This line is omitted in ver.2.0 and the later.)
#include <SPI.h>  //DL1 (These 17 lines, DL1-DL17, are added in this version.)

byte countS = 0;//02 (This line is omitted in this version.)
int i = 0;  //03
long zeroOmegaI = 0;  //04 (This line is omitted in this version.)
int recOmegaI[10];//05
int omegaI = 0;//06
long thetaI = 0;//07
long sumPower = 0;//08
long sumSumP = 0;//09
const int kAngle = 50;//10
const int kOmega = 500;//11
const long kSpeed = 60;//12
const long kDistance = 20;//13
long powerScale://14
int power://15
long vE5 = 0;//16
long xE5 = 0;//17

void L3GD20_write(byte reg, byte val) {  //DL4
  digitalWrite(10, LOW);  //DL5
  SPI.transfer(reg);  //DL6
  SPI.transfer(val);  //DL7
  digitalWrite(10, HIGH);  //DL8
}  //DL9

byte L3GD20_read(byte reg) {  //DL10
  byte ret = 0;  //DL11
  digitalWrite(10, LOW);  //DL12
  SPI.transfer(reg | 0x80);  //DL13
  ret = SPI.transfer(0);  //DL14
  digitalWrite(10, HIGH);  //DL15
  return ret;  //DL16
}  //DL17

void setup () {  //18
  Serial .begin(115200);  //19
  pinMode(4, OUTPUT);  //20
  pinMode(5, OUTPUT);  //20-a
  pinMode(6, OUTPUT);  //21
  pinMode(7, OUTPUT);
  pinMode(8, OUTPUT);
  pinMode(9, OUTPUT);
  for (  int i = 0 ; i < 10 ; i++ ) { recOmegaI[i] = 0; }//25 ("int" is added instead of line 2 omitted.)

  pinMode(10, OUTPUT);  //DL18 (These 8 lines, DL18-DL25, are added in this version.)
  digitalWrite(10, HIGH);  //DL19
  SPI.begin();  //DL20
  SPI.setBitOrder(MSBFIRST);  //DL21
  SPI.setDataMode(SPI_MODE3);  //DL22
  SPI.setClockDivider(SPI_CLOCK_DIV2);  //DL23
  L3GD20_write(0x20, B11001111);  //DL24
  L3GD20_write(0x23, B00000000);  //DL25
  delay(300);  //26
  // training();  // (This line is omitted in this version.)
void loop () {  //31
  chkAndCtl();  // NL1 (This line is added in ver.2.0 and the later.)
  if ( power > 0 ) { //32
    analogWrite( 6, power );
    digitalWrite( 4, HIGH );
    digitalWrite( 5, LOW );  //35
    analogWrite( 9, power );
    digitalWrite( 7, HIGH );
    digitalWrite( 8, LOW );
  } else {  //36
    analogWrite( 6, - power );//40
    digitalWrite( 4, LOW );
    digitalWrite( 5, HIGH );
    analogWrite( 9, - power );
    digitalWrite( 7, LOW );
    digitalWrite( 8, HIGH );  //45
  }  // delayMicroseconds(3600);  // NL2 (This is omitted in this version.)
}  //30

void chkAndCtl() {  //55
  omegaI = 0;  // NL3 (These 6 lines, NL3-NL8, are omitted in this version.)
  for ( i = 0 ; i < 10 ; i++ ) {  //NL4
    omegaI = omegaI + analogRead(A5) - zeroOmegaI;  //NL5
    delayMicroseconds(10);  //NL6
  }  //NL7
  omegaI = omegaI / 10;  //NL8
  R = 0;  //DL26 (These 7 lines, DL26-DL32, are added in this version.)
  for ( int i = 0 ; i < 45 ; i++ ) {  //DL27 ("int" is added instead of line 2 omitted.)
    ry = ( (L3GD20_read(0x2B) << 8) | L3GD20_read(0x2A) );  //DL28
    R = R + ry;  //DL29
    delayMicroseconds(90);  //DL30
  }  //DL31
  omegaI = R * 0.00875 / 45; //DL32
}  //54
powerScale = ( kAngle * thetaI / 100 ) + ( kOmega * omegal / 100 ) + ( kSpeed * vE5 / 1000 ) + ( kDistance * xE5 / 1000 ) / 

power = max ( min ( 95 * powerScale / 100 . 255 ) , -255 ) : 
sumPower = sumPower + power : 
sumSumP = sumSumP + sumPower : //75
// vE5 = ??? //76
// xE5 = ??? //77
} //78
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