A very easy and simple inverted pendulum balancing robot
You need only half a day to make it, if you have some Materials.
(This sketch is ver.2.0)
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 this version.)
int i = 0;  //02
byte countS = 0;  //03
long zeroOmegaI = 0;  //04
int recOmegaI[10];  //05
int omegaI = 0;  //06
long thetal = 0;  //07
long sumPower = 0;  //08
long sumSumP = 0;  //09
const int kAngle = 54;  //10
const int kOmega = 170;  //11
const long kSpeed = 60;  //12
const long kDistance = 60;  //13
long powerScale;  //14
int power;  //15
long vE5 = 0;  //16
long xE5 = 0;  //17

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 ( i = 0 ; i < 10 ; i++ ) { recOmegaI[i] = 0; }  //25
  delay(300);
  training();
  //  MsTimer2::set(5, chkAndCtl);  // (This line is omitted in this version.)
  //  MsTimer2::start();  // (This line is omitted in this version.)
}  //30
void loop () { //31
  chkAndCtl(); // NL1 (This is a new line in this version.)
  if ( power > 0 ) {
    analogWrite( 6, power );
    digitalWrite( 4, HIGH );
    digitalWrite( 5, LOW ); //35
    analogWrite( 9, power );
    digitalWrite( 7, HIGH );
    digitalWrite( 8, LOW );
  } else {
    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 a new line in this version.)
} //47

void training(){ //48
  delay (1000);
  for ( i = 0 ; i < 500 ; i++ ){ //50
    zeroOmegaI = zeroOmegaI + analogRead(A5);
  }
  zeroOmegaI = zeroOmegaI / i;
} //54

void chkAndCtl() { //55
  omegal = 0; // NL3 (These 6 lines, NL3-NL8, are added in this version.)
  for ( i = 0 ; i < 10 ; i++ ) { //NL4
    omegal = omegal + analogRead(A5) - zeroOmegaI; //NL5
    delayMicroseconds(10); //NL6
  } //NL7
  omegal = omegal / 10; //NL8

  // omegal = analogRead(A5) - zeroOmegaI; // (This line is omitted in this
  if ( abs( omegal ) < 3 ) { omegal = 0; } // (The lower bound is less than
  recOmega[0] = omegal;
  thetaI = thetaI + omegal;
  countS = 0; //60
for ( i = 0 ; i < 10 ; i++ ) {
    if ( abs( recOmegaI[i] ) < 8 ) { countS++; }
}
if ( countS > 9 ) {
    thetaI = 0; //65
    vE5 = 0;
    xE5 = 0;
    sumPower = 0;
    sumSumP = 0;
}
for ( i = 9 ; i > 0 ; i-- ) { recOmegaI[ i ] = recOmegaI[ i-1 ]; }

powerScale = ( kAngle * thetaI / 200 ) + ( kOmega * omegaI / 78 ) + ( k

power = max ( min ( 95 * powerScale / 100 , 255 ) , -255 );

sumPower = sumPower + power;

sumSumP = sumSumP + sumPower;//75

// vE5 = ??? //76
// xE5 = ??? //77
}

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