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DAFTAR LAMPIRAN

LAMPIRAN A

Listing Program Persamaan Kalman Filter Arduino

```
void setup()
{
  Serial.begin(9600);
  R = 1;
  Q = 0.01;
  Pt_prev = 10;
  // Serial.println("Initialize MPU6050");
  while                      (!mpu.begin(MPU6050_SCALE_2000DPS,
MPU6050_RANGE_2G))
  {
    delay(500);
  }
  Serial.print("pitch,KalmanPitch,roll,KalmanRoll"); // Label Plotter
  Serial.println();
}
void loop()
{
  Vector normAccel = mpu.readNormalizeAccel();

  // Kalkulasi Pitch & Roll
  pitch     =     -(atan2(normAccel.XAxis,     sqrt(normAccel.YAxis     *
normAccel.YAxis + normAccel.ZAxis * normAccel.ZAxis)) * 180.0) /
M_PI;
  roll = (atan2(normAccel.YAxis, normAccel.ZAxis) * 180.0) / M_PI;
  //Predict
  Xt_predict_pitch = Xt_prev_pitch;
  Xt_predict_roll = Xt_prev_roll;
  Pt_predict = Pt_prev + Q;
  //Update
  Kt = Pt_predict / (Pt_predict + R);
  Xt_pitch = Xt_predict_pitch + (Kt * (pitch - Xt_predict_pitch));
  Xt_roll = Xt_predict_roll + (Kt * (roll - Xt_predict_roll));
```

```
Pt = (1 - Kt) * Pt_predict;

Xt_prev_pitch = Xt_pitch;
Xt_prev_roll = Xt_roll;
Pt_prev = Pt;

KalmanPitch = Xt_pitch;
KalmanRoll = Xt_roll;


// Output
Serial.print(pitch,2);
Serial.print(", ");
Serial.print(KalmanPitch, 2);
Serial.print(", ");
Serial.print(roll,2);
Serial.print(", ");
Serial.print(KalmanRoll, 2);
Serial.println();
```

Lampiran B

List Program *Inverse Kinematics*
```
void moveleg_1(float x1, float y1, float z1) {
 L1 = sqrt(sq(x1) + sq(y1));
 if (x1 >= 0)
 {
  if (y1 == 0)
  {
   gamma1 = 90;
  }
  else if (y1 > 0)
  {
   gamma1 = atan(x1 / y1) / PI * 180;
  }
  else if (y1 < 0)
  {
   ya = y1 * -1;
   gamma1 = 180 - (atan(x1 / ya) / PI * 180);
  }
 }

 L = sqrt(sq(L1 - cx) + sq(z1));

 beta1 = 180 - acos((sq(tb) + sq(fm) - sq(L)) / (2 * tb * fm)) / PI * 180;
 a1 = acos(z1 / L) / PI * 180;
 a2 = acos((sq(fm) + sq(L) - sq(tb)) / (2 * fm * L)) / PI * 180;
 alpha1 = a1 + a2;

 leg3.write(abs(beta1));
 leg1.write(abs(gamma1));
 leg2.write(abs(180 - alpha1) + 5);

 // Serial.print("g1 = ");
 // Serial.print(abs(gamma1));
 // Serial.print(" a1 = ");
 // Serial.print(abs(alpha1));
 // Serial.print(" b1 = ");
```

```
  //  Serial.print(abs(beta1));
  //  Serial.println();
}


void moveleg_2(float x2, float y2, float z2) {
 L1 = sqrt(sq(x2) + sq(y2));
 if (x2 >= 0)
  {
   if (y2 == 0)
    {
     gamma2 = 90;
    }
   else if (y2 > 0)
    {
     gamma2 = atan(x2 / y2) * 180 / PI;
    }
   else if (y2 < 0)
    {
     ya = y2 * -1;
     gamma2 = 180 - atan(x2 / ya) * 180 / PI;
    }
  }

 L = sqrt(sq(L1 - cx) + sq(z2));
 beta2 = 180 - acos((sq(tb) + sq(fm) - sq(L)) / (2 * tb * fm)) * 180 / PI;
 a1 = acos(z2 / L) * 180 / PI;
 a2 = acos((sq(fm) + sq(L) - sq(tb)) / (2 * fm * L)) * 180 / PI;
 //  alpha2 = a1 + a2;
 alpha2 = (a1 + a2);

 leg6.write(abs(180 - beta2) + 22);
 leg4.write(abs(gamma2 - 7));
 leg5.write(abs(alpha2 - 10));

 //  Serial.print("g2 = ");
 //  Serial.print(abs(gamma2));
 //  Serial.print(" a2 = ");
 //  Serial.print(abs(alpha2));
```

```
//  Serial.print(" b2 = ");
 //  Serial.print(abs(beta2));
 //  Serial.println();
}

void moveleg_3(float x3, float y3, float z3) {
 L1 = sqrt(sq(x3) + sq(y3));
 if (x3 >= 0)
  {
   if (y3 == 0)
    {
     gamma3 = 90;
    }
   else if (y3 > 0)
    {
     gamma3 = atan(x3 / y3) * 180 / PI;
    }
   else if (y3 < 0)
    {
     ya = y3 * -1;
     gamma3 = 180 - atan(x3 / ya) * 180 / PI;
    }
  }

 L = sqrt(sq(L1 - cx) + sq(z3));
 //  beta3 = 180 - acos((sq(tb) + sq(fm) - sq(L)) / (2 * tb * fm)) * 180 / PI;
 beta3 = 180 - acos((sq(tb) + sq(fm) - sq(L)) / (2 * tb * fm)) * 180 / PI;
 a1 = acos(z3 / L) * 180 / PI;
 a2 = acos((sq(fm) + sq(L) - sq(tb)) / (2 * fm * L)) * 180 / PI;
 alpha3 = a1 + a2;

 leg9.write(abs(beta3) - 13);
 leg7.write(abs(gamma3));
 leg8.write(abs(180 - alpha3) + 5);

 //  Serial.print("g3 = ");
 //  Serial.print(abs(gamma3));
 //  Serial.print(" a3 = ");
 //  Serial.print(abs(alpha3));
```

```
Serial.print(" b3 = ");
 //  Serial.print(abs(beta3));
 //  Serial.println();
}
void moveleg_4(float x4, float y4, float z4) {
 L1 = sqrt(sq(x4) + sq(y4));
 if (x4 >= 0)
  {
   if (y4 == 0)
    {
     gamma4 = 90;
    }
   else if (y4 > 0)
    {
     gamma4 = atan(x4 / y4) * 180 / PI;
    }
   else if (y4 < 0)
    {
     ya = y4 * -1;
     gamma4 = 180 - atan(x4 / ya) * 180 / PI;
    }
  }
 L = sqrt(sq(L1 - cx) + sq(z4));
 beta4 = 180 - acos((sq(tb) + sq(fm) - sq(L)) / (2 * tb * fm)) * 180 / PI;
 a1 = acos(z4 / L) * 180 / PI;
 a2 = acos((sq(fm) + sq(L) - sq(tb)) / (2 * fm * L)) * 180 / PI;
 //  alpha4 = a1 + a2;
 alpha4 = (a1 + a2);
 leg12.write(abs(180 - beta4));
 leg10.write(abs(gamma4));
 leg11.write(abs (alpha4));
 //  Serial.print("g4 = ");
 //  Serial.print(abs(gamma4));
 //  Serial.print(" a4 = ");
 //  Serial.print(abs(alpha4));
 //  Serial.print(" b4 = ");
 //  Serial.print(abs(beta4));
 //  Serial.println();
}
```

BIODATA PENULIS

Nama   : Fikri Ramadani
Tempat/Tanggal Lahir   : Cilacap, 10 Desember 2000
Alamat   : Dusun Karangjati Rt 5 RW 5, Citepus, Jeruklegi, Cilacap.
Telepon/Hp   : 083116451588
Moto   : Sopo nandur bakal ngunduh

Riwayat Pendidikan :
- SD Negeri 1 Citepus   Tahun 2007-2013
- SMP Negeri 2 Jeruklegi   Tahun 2013-2016
- SMK Negeri 2 Cilacap   Tahun 2016-2019
- Politeknik Negeri Cilacap   Tahun 2019-2022