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## LAMPIRAN A

### Listing Program Arduino

```
//servo
#include <Servo.h>
Servo servo;
//serial
#include <ArduinoJson.h>
DynamicJsonDocument doc(1024);
//motor
const int pinMotor[4] = {2, 3, 4, 5};
//lcd
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 20, 4);
//us
#include <Ultrasonic.h>
Ultrasonic ultrasonicA(24, 26);
Ultrasonic ultrasonicB(28, 30);
Ultrasonic ultrasonicC(32, 34);

const int width = 1280;
float servoPos = 90;
int maxPwm = 200;

void setup() {
  //serial
  Serial.begin(9600);
  //servo
  servo.attach(6);
  //motor
  for (int i = 0; i < 4; i++) {
    pinMode(pinMotor[i], OUTPUT);
  }
  //lcd
  lcd.begin();
  lcd.backlight();
  lcd.clear();
  //button
  pinMode(22, INPUT_PULLUP);
```

```

    pinMode(23, INPUT_PULLUP);
}

float offset;
String target;
float p;
int pwm1;
int pwm2;
bool stts = false;
long lastShow = 0;
int usA, usB, usC;

void loop() {
    usA = ultrasonicA.read();
    usB = ultrasonicB.read();
    usC = ultrasonicC.read();
    if (!digitalRead(22)) {
        Serial.println('1');
        while (!digitalRead(22)) {
            delay(100);
        }
    }
    if (!digitalRead(23)) {
        stts = !stts;
        show();
        analogWrite(pinMotor[0], 0);
        analogWrite(pinMotor[1], 0);
        analogWrite(pinMotor[2], 0);
        analogWrite(pinMotor[3], 0);
        while (!digitalRead(23)) {
            delay(100);
        }
    }
    if (millis() > lastShow + 1000) {
        lastShow = millis();
        show();
    }
}

```

```

void show() {
  lcd.setCursor(0, 0);
  if (offset == 0) {
    lcd.print("Tidak Terdeteksi");
  }
  else {
    lcd.print("Terdeteksi   ");
  }
  lcd.setCursor(0, 1);
  lcd.print("target:      ");
  lcd.setCursor(0, 1);
  lcd.print("target: " + doc["target"].as<String>());
  lcd.setCursor(0, 2);
  lcd.print("us   :      ");
  lcd.setCursor(0, 2);
  lcd.print("us      : " + String(usA) + "," + String(usB) + "," +
String(usC));
  lcd.setCursor(0, 3);
  lcd.print("status:      ");
  lcd.setCursor(0, 3);
  lcd.print("status: " + String(stts));
  lcd.print(" ");
  lcd.print(pwm1);
  lcd.print(",");
  lcd.print(pwm2);
}

```

```

void serialEvent() {
  if (Serial.available()) {
    String data = Serial.readStringUntil('\n');
    deserializeJson(doc, data);
    offset = doc["offset"].as<int>();
    target = doc["target"].as<String>();
    if (offset != 0 && target != "null") {
      if (offset != 0) {
        p = (offset / (width / 2)) * 5;
        servoPos = servoPos + p;
        if (servoPos > 180) servoPos = 180;
        if (servoPos < 0) servoPos = 0;
      }
    }
  }
}

```

```

    pwm1 = map(servoPos, 90, 180, maxPwm, 0);
    pwm2 = map(servoPos, 90, 0, maxPwm, 0);
  }
  else {
    pwm1 = 0;
    pwm2 = 0;
  }
}
else {
  pwm1 = 0;
  pwm2 = 0;
}
if (usA < 30) {
  pwm1 = 0;
}
if (usB < 30) {
  pwm1 = 0;
  pwm2 = 0;
}
if (usC < 30) {
  pwm2 = 0;
}
if (pwm1 > maxPwm) pwm1 = maxPwm;
if (pwm2 > maxPwm) pwm2 = maxPwm;
if (pwm1 < 0) pwm1 = 0;
if (pwm2 < 0) pwm2 = 0;
if (stts) {
  servo.write(servoPos);
  analogWrite(pinMotor[0], 0);
  analogWrite(pinMotor[1], pwm2);
  analogWrite(pinMotor[2], 0);
  analogWrite(pinMotor[3], pwm1);
}
}
}

```

## **LAMPIRAN B**

Listing Program Phyton

```
import numpy as np
import cv2
import json
import serial

webcam = cv2.VideoCapture(0)

arduino = serial.Serial(port='/dev/ttyUSB0', baudrate=9600, timeout=.1)

target = [0, 0, 0]
tolerance = 20
isSend = False

while(1):

    _, imageFrame = webcam.read()
    height, width = imageFrame.shape[:2]

    imageFrame = cv2.flip(imageFrame, 1)

    hsvFrame = cv2.cvtColor(imageFrame, cv2.COLOR_BGR2HSV)

    target_lower = np.array([target[0] - tolerance, target[1] - tolerance,
target[2] - tolerance])
    target_upper = np.array([target[0] + tolerance, target[1] + tolerance,
target[2] + tolerance])
    target_mask = cv2.inRange(hsvFrame, target_lower, target_upper)

    kernal = np.ones((5, 5))

    target_mask = cv2.dilate(target_mask, kernal)

    contours, hierarchy = cv2.findContours(target_mask,
cv2.RETR_TREE, cv2.CHAIN_APPROX_SIMPLE)
```

```

if len(contours) :
    c = max(contours, key=cv2.contourArea)
    x, y, w, h = cv2.boundingRect(c)
    cv2.rectangle(imageFrame, (x, y), (x + w, y + h), (0, 0, 255), 2)
    M = cv2.moments(c)
    cX = int(M["m10"] / M["m00"])
    cY = int(M["m01"] / M["m00"])
    offset = cX - width/2
    dataObject = {
        "offset": offset
    }
    dataJson = json.dumps(dataObject)
    print(dataJson)
    if isSend :
        arduino.write((dataJson + '\n').encode())

cv2.line(imageFrame, (0, int(height/2)), (width, int(height/2)), (0, 0,
0), 1)
cv2.line(imageFrame, (int(width/2), 0), (int(width/2), height), (0, 0,
0), 1)
cv2.circle(imageFrame, (int(width/2), int(height/2)), 10, (0, 0, 0), 1)

cv2.imshow("Real-Time", imageFrame)

key = cv2.waitKey(1)
if key > 0 :
    if chr(key) == 'c' :
        centerColor = hsvFrame[int(height/2), int(width/2)]
        print(centerColor[0], centerColor[1], centerColor[2])
        target[0] = centerColor[0]
        target[1] = centerColor[1]
        target[2] = centerColor[2]
    elif chr(key) == 's' :
        isSend = not isSend

```



## LAMPIRAN C

### Hasil Alat dan Pengujian



Gambar (a) Troli Tampak Depan



Gambar (b) Troli Tampak Kanan



Gambar (c) Troli Tampak Kiri



Gambar (d) Posisi Sensor Ultrasonik Bagian Depan



Gambar (e) Posisi Sensor Ultrasonik Bagian Kanan



Gambar (f) Posisi Sensor Ultrasonik Bagian Kiri



Gambar (g) Hasil Pengujian Jarak Webcam

00:06.28

Gambar (h) Waktu Trolis Bergerak sejauh 200m tanpa Beban

00:07.50

Gambar (i) Waktu Troli Bergerak sejauh 200m dengan Beban 15Kg

00:07.96

Gambar (j) Waktu Troli Bergerak sejauh 200m dengan Beban 20Kg

00:09.82

Gambar (k) Waktu Troli Bergerak sejauh 200m dengan Beban 31,8Kg

00:09.90

Gambar (l) Waktu Troli Bergerak sejauh 200m dengan Beban 42,6Kg

00:12.11

Gambar (m) Waktu Troli Bergerak sejauh 200m dengan Beban 46Kg

00:14.20

Gambar (n) Waktu Troli Bergerak sejauh 200m dengan Beban 55Kg



## Biodata Penulis



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