Project Report

Pick and Place Robot

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Objective:

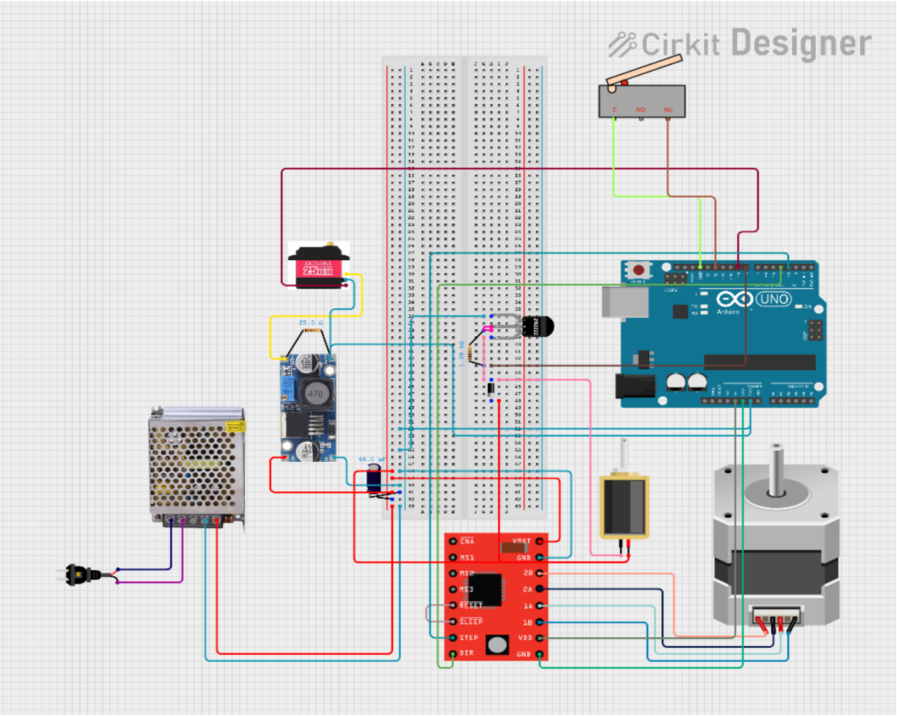
Design a Pick and Place robot with micro-electromagnet as a gripper to pick and place small metal cubes in a loop

Components Used:

Electronic Components:

- Arduino UNO
- LM2596 DC to DC Buck Converter
- A4988 Stepper Motor Driver
- 60Kg RDS5160 Servo Motor
- 42HD4045-02 Stepper Motor
- 12V Micro-Electromagnet
- 1N5399 Schottky Diode
- 2N222A NPN Transistor
- 1k and 25 Ohm Resistor
- Limit Switch
- 12V 5A SMPS
- 45 Micro-Farad Capacitor
- Jumper Wires
- 6 Pin JST PH Connector

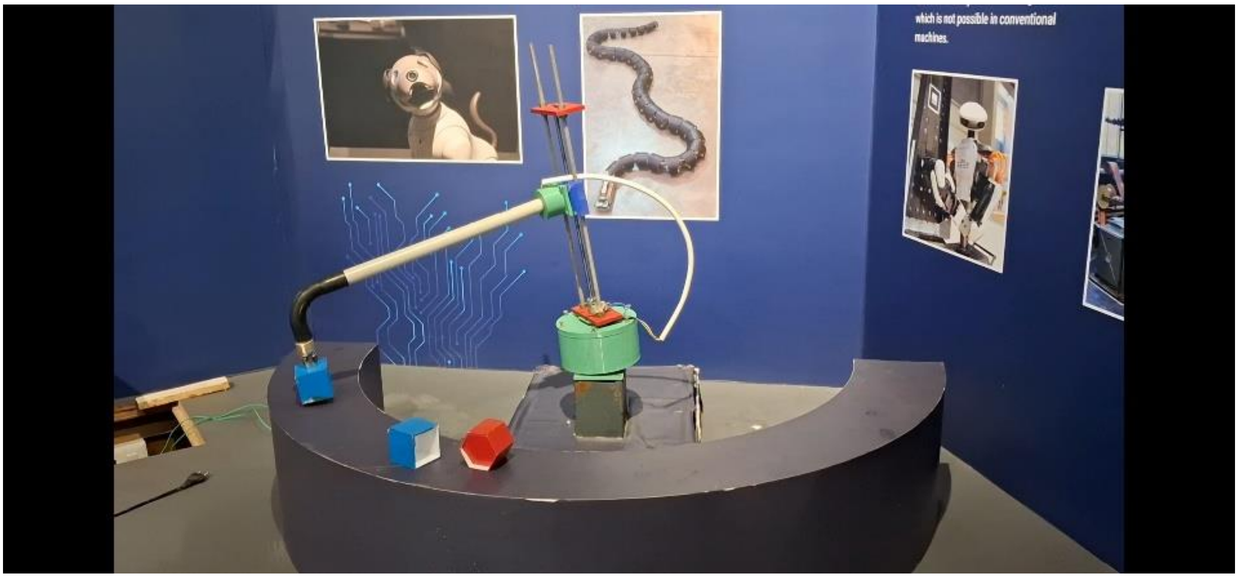
Circuit Diagram:-



Mechanical Components:

- M8 Lead Screw (x3)
- Flexible Shaft Connector
- M6 20mm Head Screw (x18)
- M3 20mm Countershink Screw (x4)
- M8 Hex-Nut (x8)
- M2 20mm Lead Screw (x5)
- M2 10mm Lead Screw (x2)
- Slider Bearing (inner D: 8mm) (x1)
- 3D Printed Parts
- PVC Pipe

Assembled Robot:-



Arduino Code:-

```
#include <Servo.h>


#define REFERENCE 55

#define WORKING_LENGTH 20

#define PICKUP_DELAY 2500

#define RELEASE_DELAY 2000


//define pins

const int electroMagnetPin = 12;

const int dirPin = 4;

const int stepPin = 3;

const int stepsPerRevolution = 200;

const int buttonPin = 8;

const int servoPin = 9;


bool start = true;


// creating base servo object

Servo robotBase;


// defining EndEffect class

class EndEffector {

private:

  int pin;


public:

  EndEffector(int pin)

    : pin(pin) {}


  void setup() {

    pinMode(pin, OUTPUT);
  }

  void ON() {
    digitalWrite(pin, HIGH);
  }

  void OFF() {
    digitalWrite(pin, LOW);
  }
};

//creting an EndEffector object
EndEffector Magnet(electroMagnetPin);

// function for moving servo to any Angle
void toAngle(int x) {
  int pos = robotBase.read();
  if (pos > x) {
    int count = 0;
    while (pos != x) {
      robotBase.write(pos);

      if (count < 5) {
        delay(20);
      } else {
        delay(15);
      }
      pos--;
      count++;
    }
  } else if (pos < x) {
    int count = 0;
    while (pos != x) {
      robotBase.write(pos);
      if (count < 5) {
        delay(20);
      } else {
        delay(15);
      }
      pos++;
      count++;
    }
  }
}

// function to move to the bottom most position of working length
void toBottom() {
  digitalWrite(dirPin, HIGH);
  for (int i = 0; i < WORKING_LENGTH; i++) {
    for (int x = 0; x < stepsPerRevolution; x++) {
      digitalWrite(stepPin, HIGH);
      delayMicroseconds(500);
      digitalWrite(stepPin, LOW);
      delayMicroseconds(500);
    }
  }
}

// function to move to the top most position of working length
void toTop() {
  digitalWrite(dirPin, LOW);
  for (int i = 0; i < WORKING_LENGTH; i++) {
    for (int x = 0; x < stepsPerRevolution; x++) {
      digitalWrite(stepPin, HIGH);
      delayMicroseconds(500);
      digitalWrite(stepPin, LOW);
      delayMicroseconds(500);
    }
  }
}

// Debounce function: returns true when stable press is detected
bool waitForDebouncedPress() {
  while (true) {
    if (digitalRead(buttonPin) == LOW) {
      delay(20);  // debounce delay
      if (digitalRead(buttonPin) == LOW) {
        // Wait for release to prevent repeated triggering
        while (digitalRead(buttonPin) == LOW)
          ;
        return true;
      }
    }
  }
}

// Homing function
void home() {
  if (digitalRead(buttonPin) != LOW) {
    int i = 0;
    digitalWrite(dirPin, HIGH);
    while (digitalRead(buttonPin) == HIGH) {
      for (int x = 0; x < stepsPerRevolution; x++) {
        digitalWrite(stepPin, HIGH);
        delayMicroseconds(500);
        digitalWrite(stepPin, LOW);
        delayMicroseconds(500);
      }
    }
  }
}

// Function for reaching to reference point
void reference() {
  digitalWrite(dirPin, LOW);
  for (int i = 0; i < REFERENCE; i++) {
    for (int x = 0; x < stepsPerRevolution; x++) {
      digitalWrite(stepPin, HIGH);
      delayMicroseconds(500);
      digitalWrite(stepPin, LOW);
      delayMicroseconds(500);
    }
  }
  delay(1000);
}




void setup() {
  pinMode(stepPin, OUTPUT);
  pinMode(dirPin, OUTPUT);
  pinMode(buttonPin, INPUT_PULLUP);  // Use internal pull-up
  robotBase.attach(servoPin);
  robotBase.write(0);
  Magnet.setup();
  Serial.begin(9600);
```

```
}


void loop() {
  if(start){
    if (waitForDebouncedPress()) {
    delay(300);
    home();
    reference();
    start = false;
  }
  }
  else{
  toAngle(10);
  toBottom();
  Magnet.ON();
  delay(PICKUP_DELAY);
  toTop();
  toAngle(80);
  toBottom();
  Magnet.OFF();
  delay(RELEASE_DELAY);
  toTop();
  toAngle(40);
  toBottom();
  Magnet.ON();
  delay(PICKUP_DELAY);
  toTop();
  toAngle(120);
  toBottom();
  Magnet.OFF();
  delay(RELEASE_DELAY);
  toTop();
```

```
toAngle(90);

toBottom();

Magnet.ON();

delay(PICKUP_DELAY);

toTop();

toAngle(170);

toBottom();

Magnet.OFF();

delay(RELEASE_DELAY);

toTop();

toBottom();

Magnet.ON();

delay(PICKUP_DELAY);

toTop();

toAngle(90);

toBottom();

Magnet.OFF();

delay(RELEASE_DELAY);

toTop();

toAngle(120);

toBottom();

Magnet.ON();

delay(PICKUP_DELAY);

toTop();

toAngle(40);

toBottom();

Magnet.OFF();

delay(RELEASE_DELAY);

toTop();

toAngle(80);

toBottom();

Magnet.ON();
```

```
  delay(PICKUP_DELAY);
  toTop();
  toAngle(10);
  toBottom();
  Magnet.OFF();
  delay(RELEASE_DELAY);
  toTop();
  toAngle(0);
  while(digitalRead(buttonPin)==HIGH); // Remove this line if want to keep it in loop
}



}
```