G17 - PH222 Progress

Sun Tracking Solar Panel

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Abstract

The report details the progress on the target of building a sun tracking solar panel to increase efficiency of solar power harvesting. The rotating apparatus for sun-tracking is completely built and thoroughly tested. The hardware for the line follower apparatus has been built and acquired as required (same goes for LCD), but no testing has been done as of now. The code to be tentatively used to test for line following has also been developed and some initial ideas for placement in locations of maximum brightness have been discussed.

1. **What is the technological motivation behind pursuing this idea ?**
    1. The motivation behind building this project is to increase the efficiency of solar power generation
    2. This solution is relevant to the problem of improving energy generation through renewable sources in a sustainable manner.
    3. The Arduino will aid in the rotation and line following functionality for solar tracking.
2. **What is the exact design that will be used to achieve this goal ?**
   The project focuses on building a device to move a solar panel such that it optimally harvests solar power.

   To achieve this, the position of the sun will be tracked through the day through a rotation mechanism (with 2 degrees of freedom) for the panel, to ensure that the sun is always directly overhead the face of the panel. Rotation will be implemented by mounting 4 photodiodes on a specially designed 3D printed structure (a base with a cylindrical 4 sector protruding out of it) to impose a sense of direction. The photodiodes will receive variable brightness of sunlight if the panel is not aligned perpendicular to direction of sunlight.

   Line following will be used to move the panel across the entire roof every few hours. This will allow it to determine the spot on the roof where the brightness is maximum.

   The relative intensity with respect to a pre-decided (through a representative set of special measurements) optimal intensity level will also be displayed in real time.
3. **So far, what are the components from the proposed set that have been procured/fabricated and put to use ?**
    1. Solar Panel
    2. LCD Display (not put to use yet)
    3. 2 Arduino UNOs
    4. The Rotation Apparatus :

(a) Cylindrical 4 sector divider
(b) Robust Servo Mounts
(c) Sturdy Base Structure
(d) Photodiodes
(e) Slant Support Structure (new)
(f) Servo Motors

5. Line Follower Apparatus (not tested)
   (a) Line Follower Chassis
   (b) DC Motors
   (c) Li-Ion Battery (DC Power Source)
   (d) DC Motor Shield
   (e) Motor Mounts
   (f) Wheels
   (g) IR Sensors

4. **Are there any visible results despite the project not having reached completion ?**
   Even though the data hasn't been tabulated, an increase of voltage across the solar panel (as displayed on the Serial Monitor) was observed from a mean of 1.8 V to 2 to 2.1 V as the divider and solar panel aligned with the mobile phone flash light.

5. **Summarise the fail-safes implemented to counter the problems faced and the direction the project will head in from here on.**

   1. One important fail-safe was implemented to counter the issue of restricted movement of the rotation apparatus. It wasn't becoming completely flat when the flashlight was overhead the apparatus and would go down further than was required. This was recognised and an isosceles right triangular wedge was 3D printed to offset the rotation. No other major issues faced till now.
   2. Direction to head in :
      (a) Line follower assembly completion and testing.
      (b) To identify the spot of maximum brightness, the line on the rooftop will have equally spaced white spots at which the line follower will halt and the value of voltage corresponding to the spot number will be recorded. After completing the loop on the roof, the line follower will be sent to the spot number corresponding to the highest brightness. Lowest brightness will also be recorded, and efficiency will thus be calculated as -

$$Efficiency = \frac{HighestIntensity - LowestIntensity}{LowestIntensity}$$

      .

6. **Show a brief demonstration of what has been done so far and what code has been used.**

   1. Here's a link of a demonstration of the rotation apparatus.
   2. Code for Rotation Apparatus :

```
int topleft;
int topright;
int downleft;
int downright;
float waittime = 0.1;

// Define the pin for solar panel voltage input
const int solarPanelPin = A4;

void setup() {
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);

  // Initialize Serial communication
  Serial.begin(9600);

  TCCR1A = 0;
  TCCR1A = (1 << COM1A1) | (1 << COM1B1) | (1 << WGM11);
  TCCR1B = 0;
  TCCR1B = (1 << WGM13) | (1 << WGM12) | (1 << CS11);
  ICR1 = 40000;
  OCR1A = 4000;
  OCR1B = 4000;
}

void loop() {
  topleft = analogRead(A0);
  topright = analogRead(A1);
  downleft = analogRead(A2);
  downright = analogRead(A3);

  // Read the solar panel voltage
  float solarVoltage = analogRead(solarPanelPin);

  // Print the solar panel voltage value
  Serial.print("Solar Panel Voltage: ");
  Serial.println(solarVoltage/255);
```

```
  if (topleft > topright) {
    OCR1A = OCR1A + 1;
    delay(waittime);}
  if (downleft > downright) {
    OCR1A = OCR1A + 1;
    delay(waittime);}
  if (topleft < topright) {
    OCR1A = OCR1A - 1;
    delay(waittime);}
  if (downleft < downright) {
    OCR1A = OCR1A - 1;
    delay(waittime);}
  if (OCR1A > 4000) {
    OCR1A = 4000;}
  if (OCR1A < 2000) {
    OCR1A = 2000;}
  if (topleft > downleft) {
    OCR1B = OCR1B - 1;
    delay(waittime);}
  if (topright > downright) {
    OCR1B = OCR1B - 1;
    delay(waittime);}
  if (topleft < downleft) {
    OCR1B = OCR1B + 1;
    delay(waittime);
  }
  if (topright < downright) {
    OCR1B = OCR1B + 1;
    delay(waittime);
  }
  if (OCR1B > 4200) {
    OCR1B = 4200;
  }
  if (OCR1B < 3000) {
    OCR1B = 3000;
  }
}
```

3. (Tentative) Code for Line Follower :

```
#include <AFMotor.h>

//defining pins and variables
#define left A2
#define right A5

//defining motors
AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);



void setup() {
  //declaring pin types
  pinMode(left,INPUT);
  pinMode(right,INPUT);
  //begin serial communication
  Serial.begin(9600);

}

void loop(){
  int line;   // set it to 0 if line is black, and 1 if line is white
  line = 0;



  int rpm;
  rpm = 130;  // rpm at which motors rotate
  int rpm2=200;
  int rpm3=230;
  //printing values of the sensors to the serial monitor
  Serial.println(digitalRead(left));

  Serial.println(digitalRead(right));

  // motor1.run(FORWARD);
  // motor2.run(FORWARD);
  // motor2.setSpeed(rpm);
```

```
  // motor3.run(FORWARD);
  // motor4.run(FORWARD);

  //line detected by both
  if(digitalRead(left)==line && digitalRead(right)==line){
    //Forward
    motor1.run(FORWARD);
    motor1.setSpeed(rpm);
    motor2.run(FORWARD);
    motor2.setSpeed(rpm);
    motor3.run(FORWARD);
    motor3.setSpeed(rpm);
    motor4.run(FORWARD);
    motor4.setSpeed(rpm);
  }
  //line detected by left sensor
  else if(digitalRead(left)==line && !digitalRead(right)==line){
    //turn left
    motor1.run(BACKWARD);
    motor1.setSpeed(rpm2);
    motor2.run(BACKWARD);
    motor2.setSpeed(rpm2);
    motor3.run(FORWARD);
    motor3.setSpeed(rpm2);
    motor4.run(FORWARD);
    motor4.setSpeed(rpm2);

  }
  //line detected by right sensor
  else if(!digitalRead(left)==line && digitalRead(right)==line){
    //turn right
    motor1.run(FORWARD);
    motor1.setSpeed(rpm3);
    motor2.run(FORWARD);
    motor2.setSpeed(rpm3);
    motor3.run(BACKWARD);
    motor3.setSpeed(rpm3);
    motor4.run(BACKWARD);
    motor4.setSpeed(rpm3);

  }
```

```
  //line detected by none
  else if(!digitalRead(left)==line && !digitalRead(right)==line){
    //stop
    motor1.run(RELEASE);
    motor1.setSpeed(0);
    motor2.run(RELEASE);
    motor2.setSpeed(0);
    motor3.run(RELEASE);
    motor3.setSpeed(0);
    motor4.run(RELEASE);
    motor4.setSpeed(0);

  }

}
```

7. **Credits and Resources :**

    1. 3D Printing and Laser Cutting : Design Studio and IDC.
    2. Nice illustration of basic circuit and concept.
    3. Illustration of an idea for coding the set-up.