Solar powered Automatic Pattern Design Grass Cutting Robot System based using Arduino

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1. Supplementary Material

1.1. Mobile Application System

Figure 1. The circuit design of pattern design grass cutter controlling system with Android mobile application using Bluetooth.

Figure 1 shows the circuit design of the grass cutter system, which is control by an android mobile application using Bluetooth. In this scenario, the robotic grass cutting system will move in the same direction as the user presses the arrow touch button or speaks the corresponding keyword. In this task, one Arduino UNO, an HC-05 Bluetooth module, an L298N motor module, IR obstacle detection sensor, geared DC motor with encoder, simple DC motor, DC battery, solar panel, and a relay module were used.

All the explanation of Object Independent Automation System has been described in the figure 6 of main manuscript and the code is written below:

```c
char Incoming_value = 0; //Variable for storing Incoming_Incoming_value
```

#define relay1 4    //N1
#define relay2 5    //N2
#define relay3 7    //N3
#define relay4 8    //N4
#define relay5 9    //motor control relay 5V
#define relay7 3
#define relay8 6

int isObstaclePin = 2; // This is our input pin
int isObstacle = HIGH; // HIGH MEANS NO OBSTACLE

void setup()
{
    Serial.begin(9600); //Sets the data rate in bits per second (baud) for serial data transmission
    pinMode(13, OUTPUT); //Sets digital pin 13 as output pin
    pinMode(relay1, OUTPUT);
    pinMode(relay2, OUTPUT);
    pinMode(relay3, OUTPUT);
    pinMode(relay4, OUTPUT);
    pinMode(relay5, OUTPUT);
    pinMode(isObstaclePin, INPUT);
}

void loop()
{
    isObstacle = digitalRead(isObstaclePin);
    if(Serial.available() > 0)
    {
        Incoming_value = Serial.read(); //Read the incoming data and store it into variable
        Serial.print(Incoming_value); //Print Incoming_value in Serial monitor
        Serial.println(""); //New line
        if (Incoming_value == '9')
        {
            if (isObstacle == LOW)
            {
                Serial.println("OBSTACLE!!, OBSTACLE!!");
                digitalWrite(relay5, HIGH);
            }
            else{
                digitalWrite(relay5, LOW);
            }
        }
        else if(Incoming_value == 'S') {
            digitalWrite(relay1, LOW);
            digitalWrite(relay2, LOW);
        }
    }
}
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
digitalWrite(relay5,HIGH);
}
//relay is off
else if( Incoming_value == 'A' ) {
  if (isObstacle == HIGH) {
    digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(3,255);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,LOW);
analogWrite(6,255);
  }
  else{
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
  }
}
else if( Incoming_value == 'B' ) {
  if (isObstacle == HIGH) {
    digitalWrite(relay1,LOW);
digitalWrite(relay2,HIGH);
analogWrite(3,255);
digitalWrite(relay3,LOW);
digitalWrite(relay4,HIGH);
analogWrite(6,255);
  }
  else{
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
  }
}
else if( Incoming_value == 'C' ) {
  if (isObstacle == HIGH) {
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
  }
  else{
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
  }
}
digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,LOW);
analogWrite(6,255);
}
else{
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
}
else if( Incoming_value == 'D' )
{
    if (isObstacle == HIGH)
    {
        digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(3,255);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
    }
    else{
        digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
    }
}
else if(Incoming_value== 'I' ) //CIRCLE
{
    if (isObstacle == HIGH)
    {
        Serial.println("OBSTACLE!!, OBSTACLE!!");
digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(relay7,255);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
    }

    Serial.println("pattern's");
}
else if(Incoming_value== 'I' ) //CIRCLE
{
    if (isObstacle == HIGH)
    {
        Serial.println("OBSTACLE!!, OBSTACLE!!");
digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(relay7,255);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
    }
}
analogWrite(relay8,50);
digitalWrite(relay5, LOW);
delay(3300);
digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(relay7,200);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,LOW);
analogWrite(relay8,150);
digitalWrite(relay5, LOW);
delay(1000);
digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
analogWrite(relay7,200);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
analogWrite(relay8,150);
digitalWrite(relay5, LOW);
delay(1000);
    digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(relay7,255);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
analogWrite(relay8,50);
digitalWrite(relay5, LOW);
delay(3300);
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
analogWrite(relay7,200);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
analogWrite(relay8,150);
digitalWrite(relay5, HIGH);
delay(1000);
} 
else{
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
digitalWrite(relay5, HIGH);
else if(Incoming_value== 'J') //Spiral
{
    if (isObstacle == HIGH)
    {
        digitalWrite(relay1,HIGH);
        digitalWrite(relay2,LOW);
        analogWrite(relay7,255);
        digitalWrite(relay3,HIGH);
        digitalWrite(relay4,LOW);
        for (int i = 0; i <= 20; i++)
        {
            analogWrite(relay8, i);
            digitalWrite(relay5, LOW);
            delay(50);
        }
        delay(10000);
        digitalWrite(relay1,LOW);
        digitalWrite(relay2,LOW);
        digitalWrite(relay3,LOW);
        digitalWrite(relay4,LOW);
        digitalWrite(relay5, HIGH);
        delay(1000);
    }
    else{
        digitalWrite(relay1,LOW);
        digitalWrite(relay2,LOW);
        digitalWrite(relay3,LOW);
        digitalWrite(relay4,LOW);
        digitalWrite(relay5, HIGH);
    }
}
else if(Incoming_value== 'K') //Square
{
    if (isObstacle == HIGH)
    {
        Serial.println("OBSTACLE!!, OBSTACLE!!");
        digitalWrite(relay1,HIGH);
        digitalWrite(relay2,LOW);
        analogWrite(relay7,255);
        digitalWrite(relay3,HIGH);
        digitalWrite(relay4,LOW);
        analogWrite(relay8,150);
        digitalWrite(relay5, HIGH);
        delay(1000);
    }
    else if(Incoming_value== 'K') //Square
    {
        Serial.println("OBSTACLE!!, OBSTACLE!!");
        digitalWrite(relay1,HIGH);
        digitalWrite(relay2,LOW);
        analogWrite(relay7,255);
        digitalWrite(relay3,HIGH);
    }
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1500);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1900);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1500);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1900);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1500);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, LOW);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1900);
digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(relay7,255);
digitalWrite(relay3,HIGH);
digitalWrite(relay4,LOW);
analogWrite(relay8,220);
digitalWrite(relay5, LOW);
delay(1500);
digitalWrite(relay1,HIGH);
digitalWrite(relay2,LOW);
analogWrite(relay7,255);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
analogWrite(relay8,220);
digitalWrite(relay5, LOW);
delay(1900);

digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
analogWrite(relay7,200);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
analogWrite(relay8,150);
digitalWrite(relay5, HIGH);
delay(1000);
}

} //RECTANGLE

else if(Incoming_value== 'L')
{
if (isObstacle == HIGH)
{
Serial.println("OBSTACLE!!, OBSTACLE!!");
digitalWrite(relay1,HIGH);
} else if(Incoming_value== 'L' )
{
if (isObstacle == HIGH)
{
Serial.println("OBSTACLE!!, OBSTACLE!!");
digitalWrite(relay1,HIGH);
}
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1700);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(3700);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1700);
digitalWrite(relay1, LOW);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(3700);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1700);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(3700);
digitalWrite(relay1, HIGH);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 220);
digitalWrite(relay5, LOW);
delay(1700);
digitalWrite(relay1, LOW);
digitalWrite(relay2, LOW);
analogWrite(relay7, 255);
digitalWrite(relay3, HIGH);
digitalWrite(relay4, LOW);
analogWrite(relay8, 255);
digitalWrite(relay5, LOW);
delay(3700);
	digitalWrite(relay1, LOW);
digitalWrite(relay2, LOW);
analogWrite(relay7, 200);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
analogWrite(relay8, 150);
digitalWrite(relay5, HIGH);
delay(1000);
} 
else{
    digitalWrite(relay1, LOW);
digitalWrite(relay2, LOW);
digitalWrite(relay3, LOW);
digitalWrite(relay4, LOW);
digitalWrite(relay5, HIGH);
} 
else if(Incoming_value == 'M') 
{
    digitalWrite(relay1, LOW);
digitalWrite(relay2, LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
    digitalWrite(relay5,HIGH);
}

else if (isObstacle == LOW)
{
    digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
digitalWrite(relay5,HIGH);
}

}