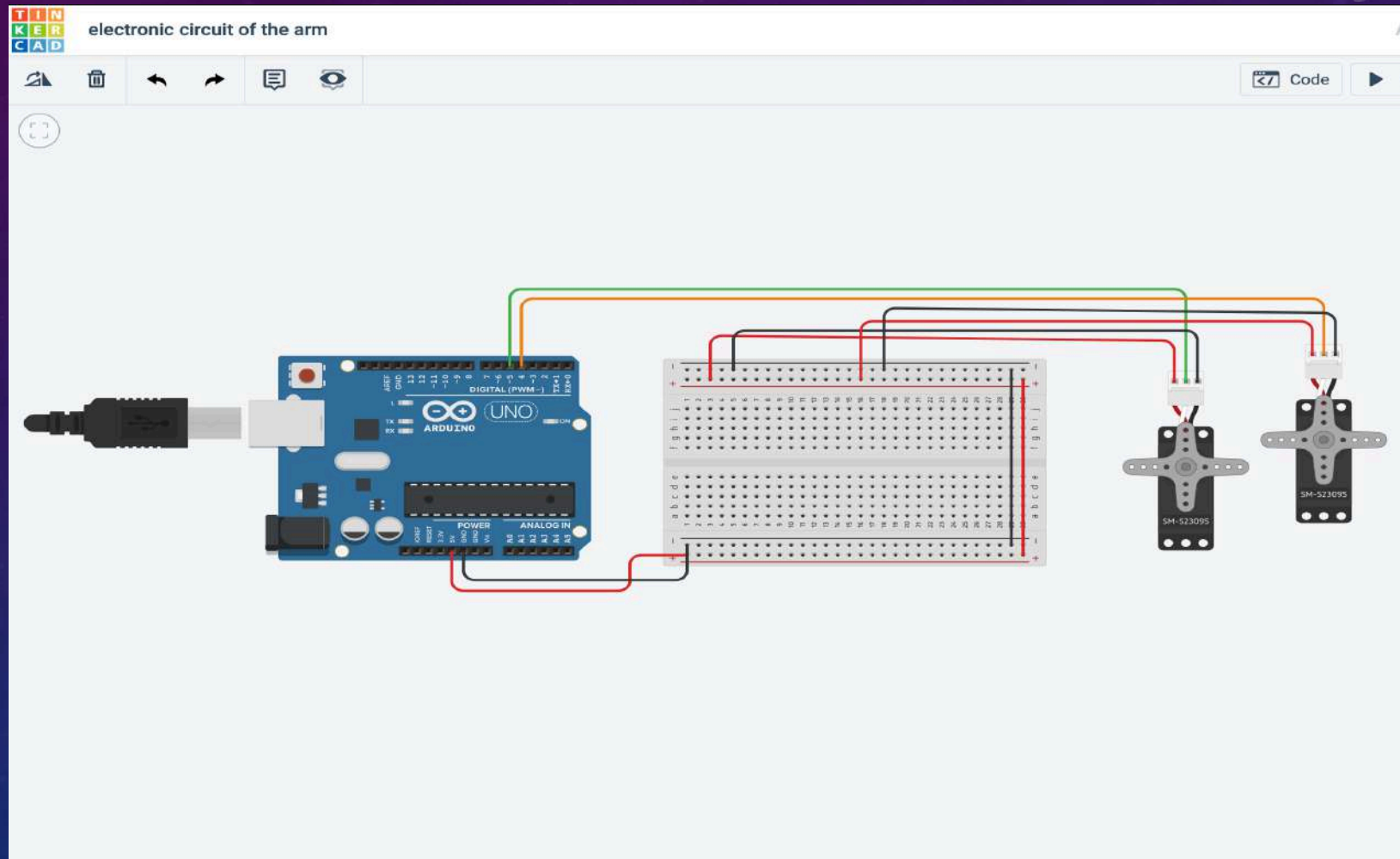


The background is a dark blue gradient with a subtle pattern of white dots. On the left side, there are several concentric circles and a large circular scale with degree markings from 140 to 260. The scale is marked with small tick marks and larger numbers at 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, and 260. There are also some curved arrows and dashed lines scattered around the scale.

ELECTRONIC CIRCUIT OF THE ARM.

DESIGN THE ELECTRONIC CIRCUIT OF THE ARM.



#CONVERT THE INFERRED EQUATION TO CODE.

```
Text 1 (Arduino Uno R3)
1 #include <Servo.h>
2 Servo motor_1;
3 Servo motor_2;
4 float theta_1; // angle in degree.
5 float theta_2; // angle in degree.
6 float L1;
7 float L2;
8 float x_coor;
9 float y_coor;
10 float theta;
11 float theta_r;
12 float theta_r1; // angle in radian.
13 float theta_r2; // angle in radian.
14 float x_coor_2;
15 float y_coor_2;
16 float L1_2;
17 float L2_2;
18 // Two ways of calculating the movement of the arm:
19 // 1- Forward Kinematic: by finding the values of (x & y).
20 // 2- Inverse Kinematic: by finding the values of (theta_1 & theta_2).
21
22 int calculate; // the choice between forward or inverse kinematic.
23 void setup()
24 {
25   Serial.begin(9600);
26   motor_1.attach(4);
27   motor_2.attach(5);
28   Serial.println("Enter the calculation method: (1) forward/(10) Inverse");
29   while (Serial.available()==0){}
30   calculate=Serial.parseInt();
31   // Method 1: Forward Kinematic
32   if (calculate==1){
33     Serial.println("Enter the 1st length L1: ");
34     while (Serial.available()==0){}
35     L1=Serial.parseFloat();
36     Serial.println("Enter the 2nd length L2: ");
37     while (Serial.available()==0){}
38     L2=Serial.parseFloat();
39     Serial.println("Enter the 1st angle: ");
40     while (Serial.available()==0){}
41     theta_1=Serial.parseFloat();
```


1

```
Text 1 (Arduino Uno R3)
42   theta_r1=theta_1*3.14/180;
43   Serial.println("Enter the 2nd angle: ");
44   while (Serial.available()==0){}
45   theta_2=Serial.parseFloat();
46   // degree to radian.
47   theta_r2=theta_2*3.14/180;
48   Serial.println(theta_r1);
49   Serial.println(theta_r2);
50   // calculate the x coordinat value.
51   x_coor=L1*cos(theta_r1)+L2*cos(theta_r1+theta_r2);
52   Serial.print("x coordinate= ");
53   Serial.println(x_coor);
54   // calculate the y coordinate value.
55   y_coor=L1*sin(theta_r1)+L2*sin(theta_r1+theta_r2);
56   Serial.print("y coordinate= ");
57   Serial.println(y_coor);
58   }
59
60   else if (calculate==10){
61     Serial.println("Enter the 1st length L1: ");
62     while (Serial.available()==0){}
63     L1=Serial.parseFloat();
64     Serial.println("Enter the 2nd length L2: ");
65     while (Serial.available()==0){}
66     L2=Serial.parseFloat();
67     Serial.println("Enter the angle: ");
68     while (Serial.available()==0){}
69     theta=Serial.parseFloat();
70     Serial.println("Enter the x coordinate: ");
71     while (Serial.available()==0){}
72     x_coor=Serial.parseFloat();
73     Serial.println("Enter the y coordinate: ");
74     while (Serial.available()==0){}
75     y_coor=Serial.parseFloat();
76     // calculate theta_2:
77     x_coor_2=pow(x_coor,2);
78     y_coor_2=pow(y_coor,2);
79     L1_2=pow(L1,2);
80     L2_2=pow(L2,2);
81     float n= x_coor_2+y_coor_2-L1_2-L2_2; // the equation's numerator.
82     float d=2*L1*L2; // the equation's denominator.
```

2

#CONVERT THE INFERRED EQUATION TO CODE.

```
82  float d=2*L1*L2; // the equation's denominator.
83  theta_r2= acos(n/d);
84  theta_2=theta_r2*180/3.14;
85  Serial.print("the 2nd angle= ");
86  Serial.println(theta_2);
87  Serial.print("the 1st angle= ");
88  theta_1=theta-theta_2;
89  Serial.println(theta_1);
90  }
91  }
92
93  void loop()
94  {
95    motor_1.write(theta_1);
96    motor_2.write(theta_2);
97
98  }
```

 Serial Monitor

3

#RUN AND EXPLAIN THE CODE AND HOW IT WORKS.

