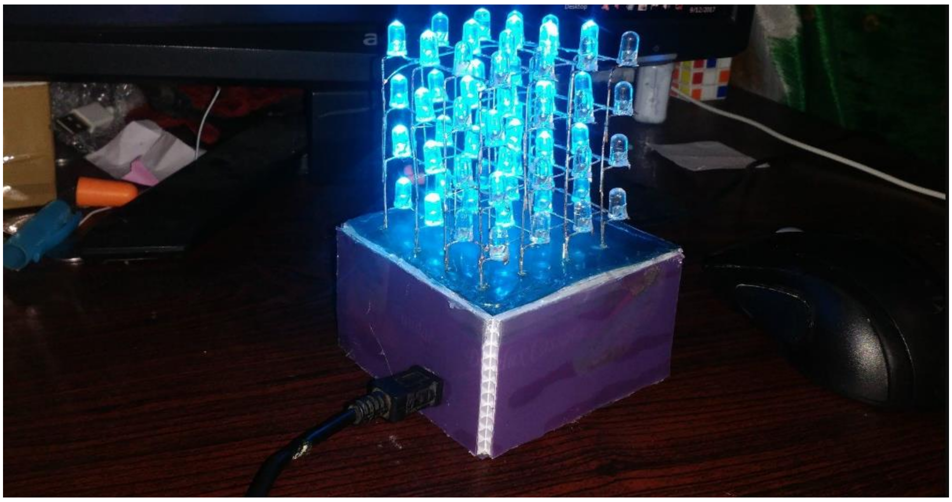
SPECTULATION DOCUMENT

4X4X4 LED CUBE

Description

We obtain various decorative and beautiful patterns on a 4*4*4 LED cube. The code for the patterns is written using Arduino. The primary purpose that the led cube serves is in the entertainment sector. For all intents and purposes, it is actually a high-tech display. Think of it as a three-dimensional display consisting of 64 pixels (or voxels in this case) which can be used to visualize any animation or graphics. The cube has commercial potential due to its advanced and unparalleled design. A led cube is like a led screen, but it is special as it has 3D. We can think of it as a low-resolution display. In normal displays, it is normal to stack pixels closer to each other in order for better resolution but the led cube has its limits. The project is mainly for entertainment purposes and can be used for decorative purposes in our houses, offices, etc. This cube can act as a mood elevator and divert your mind from stress, causing problems for some time.

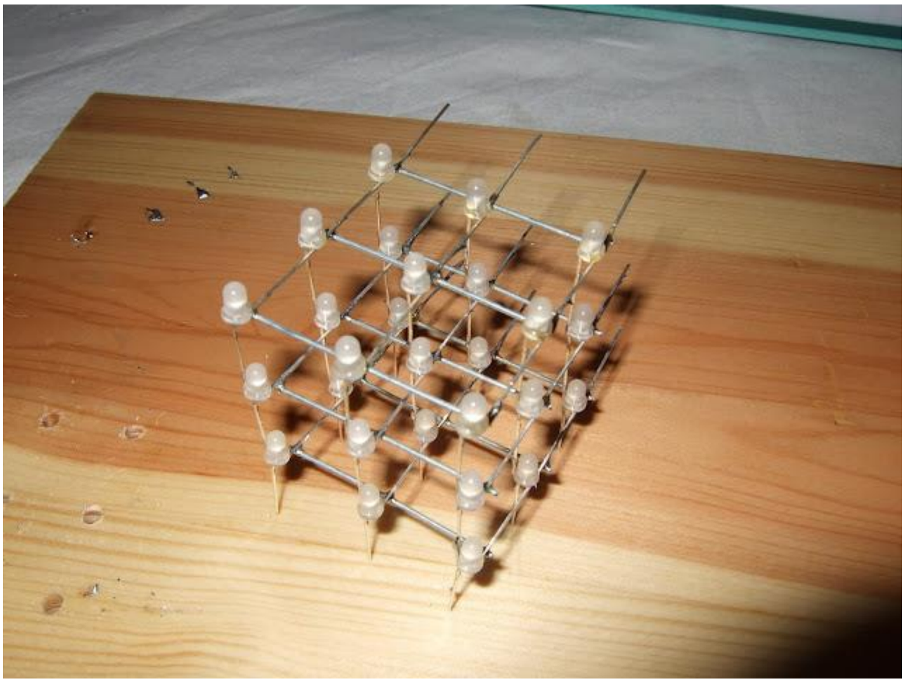


Prerequisites

- Basic knowledge of Arduino uno and shift register.
- Analog and digital electronics

WORKFLOW

❑ 1) Testing the LEDs with a 150 ohm resistor and assembling the 1st layer.
❑ 2) Assembling includes using cardboard to make a frame of the LED mesh.
❑ 3) Punching 4 LEDs in four rows.
❑ 4) Short-circuiting their cathodes using aluminum wire.
❑ 5) Creating four layers this way.
❑ 6) Short-circuiting anode of 4 LEDs of every column.
❑ 7) Stacking the layers and the cardboard is ready.
❑ 8) Writing Arduino code for various patterns and testing them virtually on Tinkercad.
❑ 9) Designing of PCB and its connections with LED and Arduino.
10) Coding in the Arduino can be modified, creating better patterns. Good mapping of 3D objects can be done



ARDUINO CODE

```
/*
  4x4x4 LED Cube
  Connection Setup:
  Columns
  [(x,y)-Pin]
  (1,1)-13
  (1,2)-12
  (1,3)-11
  (1,4)-10
  (2,1)-9
  (2,2)-8
  (2,3)-7
  (2,4)-6
  (3,1)-5
  (3-2)-4
  (3-3)-3
  (3,4)-2
  (4,1)-1
  (4,2)-0
  (4,3)-A5
  (4,4)-A4
  Layers
  [layer-Pin]
  a-A0
  b-A1
  c-A2
  d-A3
*/
```

```
//initializing and declaring led rows
  int column[16]={13,12,11,10,9,8,7,6,5,4,3,2,1,0,A5,A4};
//initializing and declaring led layers
  int layer[4]={A3,A2,A1,A0};

  int time = 250;

void setup()
{
  //setting rows to ouput
  for(int i = 0; i<16; i++)
  {
    pinMode(column[i], OUTPUT);
  }
  //setting layers to output
  for(int i = 0; i<4; i++)
  {
    pinMode(layer[i], OUTPUT);
  }
  //seeding random for random pattern
  randomSeed(analogRead(10));
}
//xxxxxxxxxxxxxxxxxxxxFUNCTION LOOPxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
//xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

void loop()
{
  turnEverythingOff();//turn all off
  flickerOn();
  turnEverythingOn();//turn all on
  delay(time);
  turnOnAndOffAllByLayerUpAndDownNotTimed();
  layerstompUpAndDown();
  turnOnAndOffAllByColumnSideways();
  delay(time);
  aroundEdgeDown();
  turnEverythingOff();
  randomflicker();
  randomRain();
  diagonalRectangle();
  goThroughAllLedsOneAtATime();
  propeller();
  spiralInAndOut();
  flickerOff();
  turnEverythingOff();
  delay(2000);
}


//xxxxxxxxxxxxxxxxxxxxFUNCTIONSxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
//xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

```
//////////////////////////////////////////////////////turn all off
void turnEverythingOff()
 {
   for(int i = 0; i<16; i++)
   {
     digitalWrite(column[i], 1);
   }
   for(int i = 0; i<4; i++)
   {
     digitalWrite(layer[i], 0);
   }
 }

///////////////////////////////////////////////////////turn all on
void turnEverythingOn()
{
  for(int i = 0; i<16; i++)
  {
    digitalWrite(column[i], 0);
  }
  //turning on layers
  for(int i = 0; i<4; i++)
  {
    digitalWrite(layer[i], 1);
  }
}
//////////////////////////////////////////////////turn columns off
void turnColumnsOff()
{
  for(int i = 0; i<16; i++)
  {
    digitalWrite(column[i], 1);
  }
}
////////////////////////////////////////////////////////flicker on
void flickerOn()
{
  int i = 150;
  while(i != 0)
  {
    turnEverythingOn();
    delay(i);
    turnEverythingOff();
    delay(i);
    i-= 5;
  }
}
/////////////turn everything on and off by layer up and down NOT TIMED
void turnOnAndOffAllByLayerUpAndDownNotTimed()
{
  int x = 75;
  for(int i = 5; i != 0; i--)
  {
    turnEverythingOn();
    for(int i = 4; i!=0; i--)
    {
     digitalWrite(layer[i-1], 0);
     delay(x);
    }
    for(int i = 0; i<4; i++)
    {
     digitalWrite(layer[i], 1);
     delay(x);
    }
     for(int i = 0; i<4; i++)
    {
     digitalWrite(layer[i], 0);
     delay(x);
    }
    for(int i = 4; i!=0; i--)
    {
     digitalWrite(layer[i-1], 1);
     delay(x);
    }
  }
}
//////////////////////////turn everything on and off by column sideways
void turnOnAndOffAllByColumnSideways()
{
  int x = 75;
  turnEverythingOff();
  //turn on layers
  for(int i = 0; i<4; i++)
  {
    digitalWrite(layer[i], 1);
  }
  for(int y = 0; y<3; y++)
  {
    //turn on 0-3
    for(int i = 0; i<4; i++)
    {
     digitalWrite(column[i], 0);
     delay(x);
    }
    //turn on 4-7
    for(int i = 4; i<8; i++)
    {
     digitalWrite(column[i], 0);
     delay(x);
    }
    //turn on 8-11
```

```
for(int i = 8; i<12; i++)
{
  digitalWrite(column[i], 0);
  delay(x);
}
//turn on 12-15
for(int i = 12; i<16; i++)
{
  digitalWrite(column[i], 0);
  delay(x);
}
//turn off 0-3
for(int i = 0; i<4; i++)
{
  digitalWrite(column[i], 1);
  delay(x);
}
//turn off 4-7
for(int i = 4; i<8; i++)
{
  digitalWrite(column[i], 1);
  delay(x);
}
//turn off 8-11
for(int i = 8; i<12; i++)
{
  digitalWrite(column[i], 1);
  delay(x);
}
//turn off 12-15
for(int i = 12; i<16; i++)
{
  digitalWrite(column[i], 1);
  delay(x);
}
//turn on 12-15
for(int i = 12; i<16; i++)
{
  digitalWrite(column[i], 0);
  delay(x);
}
//turn on 8-11
for(int i = 8; i<12; i++)
{
  digitalWrite(column[i], 0);
  delay(x);
}
//turn on 4-7
for(int i = 4; i<8; i++)
{
  digitalWrite(column[i], 0);
```

```
      delay(x);
    }
    //turn on 0-3
    for(int i = 0; i<4; i++)
    {
      digitalWrite(column[i], 0);
      delay(x);
    }
    //turn off 12-15
    for(int i = 12; i<16; i++)
    {
      digitalWrite(column[i], 1);
      delay(x);
    }
    //turn off 8-11
    for(int i = 8; i<12; i++)
    {
      digitalWrite(column[i], 1);
      delay(x);
    }
    //turn off 4-7
    for(int i = 4; i<8; i++)
    {
      digitalWrite(column[i], 1);
      delay(x);
    }
    //turn off 0-3
    for(int i = 0; i<4; i++)
    {
      digitalWrite(column[i], 1);
      delay(x);
    }
  }
}
//////////////////////////////////////////up and down single layer stomp
void layerstompUpAndDown()
{
  int x = 75;
  for(int i = 0; i<4; i++)
  {
    digitalWrite(layer[i], 0);
  }
  for(int y = 0; y<5; y++)
  {
    for(int count = 0; count<1; count++)
    {
      for(int i = 0; i<4; i++)
      {
        digitalWrite(layer[i], 1);
        delay(x);
        digitalWrite(layer[i], 0);
      }
      for(int i = 4; i !=0; i--)
      {
        digitalWrite(layer[i-1], 1);
        delay(x);
        digitalWrite(layer[i-1], 0);
      }
    }
    for(int i = 0; i<4; i++)
    {
      digitalWrite(layer[i], 1);
      delay(x);
    }
    for(int i = 4; i!=0; i--)
    {
      digitalWrite(layer[i-1], 0);
      delay(x);
    }
  }
}
///////////////////////////////////////////////////////////flicker off
void flickerOff()
{
  turnEverythingOn();
  for(int i = 0; i!= 150; i+=5)
  {
    turnEverythingOff();
    delay(i+50);
    turnEverythingOn();
    delay(i);
  }
}
///////////////////////////////////////////around edge of the cube down
void aroundEdgeDown()
{
  for(int x = 200; x != 0; x -=50)
  {
    turnEverythingOff();
    for(int i = 4; i != 0; i--)
    {
      digitalWrite(layer[i-1], 1);
      digitalWrite(column[5], 0);
      digitalWrite(column[6], 0);
      digitalWrite(column[9], 0);
      digitalWrite(column[10], 0);

      digitalWrite(column[0], 0);
      delay(x);
      digitalWrite(column[0], 1);
      digitalWrite(column[4], 0);
      delay(x);
```

```
   digitalWrite(column[4], 1);
   digitalWrite(column[8], 0);
   delay(x);
   digitalWrite(column[8], 1);
   digitalWrite(column[12], 0);
   delay(x);
   digitalWrite(column[12], 1);
   digitalWrite(column[13], 0);
   delay(x);
   digitalWrite(column[13], 1);
   digitalWrite(column[15], 0);
   delay(x);
   digitalWrite(column[15], 1);
   digitalWrite(column[14], 0);
   delay(x);
   digitalWrite(column[14], 1);
   digitalWrite(column[11], 0);
   delay(x);
   digitalWrite(column[11], 1);
   digitalWrite(column[7], 0);
   delay(x);
   digitalWrite(column[7], 1);
   digitalWrite(column[3], 0);
   delay(x);
   digitalWrite(column[3], 1);
   digitalWrite(column[2], 0);
   delay(x);
   digitalWrite(column[2], 1);
   digitalWrite(column[1], 0);
   delay(x);
   digitalWrite(column[1], 1);
  }
 }
}
/////////////////////////////////////////////////////////random flicker
void randomflicker()
{
 turnEverythingOff();
 int x = 10;
 for(int i = 0; i !=750; i+=2)
 {
 int randomLayer = random(0,4);
 int randomColumn = random(0,16);

 digitalWrite(layer[randomLayer], 1);
 digitalWrite(column[randomColumn], 0);
 delay(x);
 digitalWrite(layer[randomLayer], 0);
 digitalWrite(column[randomColumn], 1);
 delay(x);
 }
```

```
}
////////////////////////////////////////////////////////////random rain
void randomRain()
{
  turnEverythingOff();
  int x = 100;
  for(int i = 0; i!=60; i+=2)
  {
    int randomColumn = random(0,16);
    digitalWrite(column[randomColumn], 0);
    digitalWrite(layer[0], 1);
    delay(x+50);
    digitalWrite(layer[0], 0);
    digitalWrite(layer[1], 1);
    delay(x);
    digitalWrite(layer[1], 0);
    digitalWrite(layer[2], 1);
    delay(x);
    digitalWrite(layer[2], 0);
    digitalWrite(layer[3], 1);
    delay(x+50);
    digitalWrite(layer[3], 0);
    digitalWrite(column[randomColumn], 1);
  }
}
//////////////////////////////////////////////////////diagonal rectangle
void diagonalRectangle()
{
  int x = 350;
  turnEverythingOff();
  for(int count = 0; count<5; count++)
  {
    //top left
    for(int i = 0; i<8; i++)
    {
      digitalWrite(column[i], 0);
    }
    digitalWrite(layer[3], 1);
    digitalWrite(layer[2], 1);
    delay(x);
    turnEverythingOff();
    //middle middle
    for(int i = 4; i<12; i++)
    {
      digitalWrite(column[i], 0);
    }
    digitalWrite(layer[1], 1);
    digitalWrite(layer[2], 1);
    delay(x);
    turnEverythingOff();
    //bottom right
```

```
for(int i = 8; i<16; i++)
{
  digitalWrite(column[i], 0);
}
digitalWrite(layer[0], 1);
digitalWrite(layer[1], 1);
delay(x);
turnEverythingOff();
//bottom middle
for(int i = 4; i<12; i++)
{
  digitalWrite(column[i], 0);
}
digitalWrite(layer[0], 1);
digitalWrite(layer[1], 1);
delay(x);
turnEverythingOff();
//bottom left
for(int i = 0; i<8; i++)
{
  digitalWrite(column[i], 0);
}
digitalWrite(layer[0], 1);
digitalWrite(layer[1], 1);
delay(x);
turnEverythingOff();
//middle middle
for(int i = 4; i<12; i++)
{
  digitalWrite(column[i], 0);
}
digitalWrite(layer[1], 1);
digitalWrite(layer[2], 1);
delay(x);
turnEverythingOff();
//top right
for(int i = 8; i<16; i++)
{
  digitalWrite(column[i], 0);
}
digitalWrite(layer[2], 1);
digitalWrite(layer[3], 1);
delay(x);
turnEverythingOff();
//top middle
for(int i = 4; i<12; i++)
{
  digitalWrite(column[i], 0);
}
digitalWrite(layer[2], 1);
digitalWrite(layer[3], 1);
```

```
    delay(x);
    turnEverythingOff();
  }
  //top left
  for(int i = 0; i<8; i++)
  {
    digitalWrite(column[i], 0);
  }
  digitalWrite(layer[3], 1);
  digitalWrite(layer[2], 1);
  delay(x);
  turnEverythingOff();
}
////////////////////////////////////////////////////////propeller
void propeller()
{
  turnEverythingOff();
  int x = 90;
  for(int y = 4; y>0; y--)
  {
    for(int i = 0; i<6; i++)
    {
      //turn on layer
      digitalWrite(layer[y-1], 1);
      //a1
      turnColumnsOff();
      digitalWrite(column[0], 0);
      digitalWrite(column[5], 0);
      digitalWrite(column[10], 0);
      digitalWrite(column[15], 0);
      delay(x);
      //b1
      turnColumnsOff();
      digitalWrite(column[4], 0);
      digitalWrite(column[5], 0);
      digitalWrite(column[10], 0);
      digitalWrite(column[11], 0);
      delay(x);
      //c1
      turnColumnsOff();
      digitalWrite(column[6], 0);
      digitalWrite(column[7], 0);
      digitalWrite(column[8], 0);
      digitalWrite(column[9], 0);
      delay(x);
      //d1
      turnColumnsOff();
      digitalWrite(column[3], 0);
      digitalWrite(column[6], 0);
      digitalWrite(column[9], 0);
      digitalWrite(column[12], 0);
      delay(x);
      //d2
      turnColumnsOff();
      digitalWrite(column[2], 0);
      digitalWrite(column[6], 0);
      digitalWrite(column[9], 0);
      digitalWrite(column[13], 0);
      delay(x);
      //d3
      turnColumnsOff();
      digitalWrite(column[1], 0);
      digitalWrite(column[5], 0);
      digitalWrite(column[10], 0);
      digitalWrite(column[14], 0);
      delay(x);
    }
  }
  //d4
  turnColumnsOff();
  digitalWrite(column[0], 0);
  digitalWrite(column[5], 0);
  digitalWrite(column[10], 0);
  digitalWrite(column[15], 0);
  delay(x);
}
/////////////////////////////////////////////////////spiral in and out
void spiralInAndOut()
{
  turnEverythingOn();
  int x = 60;
  for(int i = 0; i<6; i++)
  {
    //spiral in clockwise
    digitalWrite(column[0], 1);
    delay(x);
    digitalWrite(column[1], 1);
    delay(x);
    digitalWrite(column[2], 1);
    delay(x);
    digitalWrite(column[3], 1);
    delay(x);
    digitalWrite(column[7], 1);
    delay(x);
    digitalWrite(column[11], 1);
    delay(x);
    digitalWrite(column[15], 1);
    delay(x);
    digitalWrite(column[14], 1);
    delay(x);
    digitalWrite(column[13], 1);
    delay(x);
```

```
digitalWrite(column[12], 1);
delay(x);
digitalWrite(column[8], 1);
delay(x);
digitalWrite(column[4], 1);
delay(x);
digitalWrite(column[5], 1);
delay(x);
digitalWrite(column[6], 1);
delay(x);
digitalWrite(column[10], 1);
delay(x);
digitalWrite(column[9], 1);
delay(x);
////////////////////////////////////////spiral out counter clockwise
digitalWrite(column[9], 0);
delay(x);
digitalWrite(column[10], 0);
delay(x);
digitalWrite(column[6], 0);
delay(x);
digitalWrite(column[5], 0);
delay(x);
digitalWrite(column[4], 0);
delay(x);
digitalWrite(column[8], 0);
delay(x);
digitalWrite(column[12], 0);
delay(x);
digitalWrite(column[13], 0);
delay(x);
digitalWrite(column[14], 0);
delay(x);
digitalWrite(column[15], 0);
delay(x);
digitalWrite(column[11], 0);
delay(x);
digitalWrite(column[7], 0);
delay(x);
digitalWrite(column[3], 0);
delay(x);
digitalWrite(column[2], 0);
delay(x);
digitalWrite(column[1], 0);
delay(x);
digitalWrite(column[0], 0);
delay(x);
////////////////////////////////////////spiral in counter clock wise
digitalWrite(column[0], 1);
delay(x);
digitalWrite(column[4], 1);
```

```
delay(x);
digitalWrite(column[8], 1);
delay(x);
digitalWrite(column[12], 1);
delay(x);
digitalWrite(column[13], 1);
delay(x);
digitalWrite(column[14], 1);
delay(x);
digitalWrite(column[15], 1);
delay(x);
digitalWrite(column[11], 1);
delay(x);
digitalWrite(column[7], 1);
delay(x);
digitalWrite(column[3], 1);
delay(x);
digitalWrite(column[2], 1);
delay(x);
digitalWrite(column[1], 1);
delay(x);
digitalWrite(column[5], 1);
delay(x);
digitalWrite(column[9], 1);
delay(x);
digitalWrite(column[10], 1);
delay(x);
digitalWrite(column[6], 1);
delay(x);
///////////////////////////////////////////////spiral out clock wise
digitalWrite(column[6], 0);
delay(x);
digitalWrite(column[10], 0);
delay(x);
digitalWrite(column[9], 0);
delay(x);
digitalWrite(column[5], 0);
delay(x);
digitalWrite(column[1], 0);
delay(x);
digitalWrite(column[2], 0);
delay(x);
digitalWrite(column[3], 0);
delay(x);
digitalWrite(column[7], 0);
delay(x);
digitalWrite(column[11], 0);
delay(x);
digitalWrite(column[15], 0);
delay(x);
digitalWrite(column[14], 0);
```

```
    delay(x);
    digitalWrite(column[13], 0);
    delay(x);
    digitalWrite(column[12], 0);
    delay(x);
    digitalWrite(column[8], 0);
    delay(x);
    digitalWrite(column[4], 0);
    delay(x);
    digitalWrite(column[0], 0);
    delay(x);
  }
}
///////////////////////////////////////go through all leds one at a time
void goThroughAllLedsOneAtATime()
{
  int x = 15;
  turnEverythingOff();
  for(int y = 0; y<5; y++)
  {
    //0-3
    for(int count = 4; count != 0; count--)
    {
      digitalWrite(layer[count-1], 1);
      for(int i = 0; i<4; i++)
      {
        digitalWrite(column[i], 0);
        delay(x);
        digitalWrite(column[i], 1);
        delay(x);
      }
    digitalWrite(layer[count-1], 0);
    }
    //4-7
    for(int count = 0; count < 4; count++)
    {
      digitalWrite(layer[count], 1);
      for(int i = 4; i<8; i++)
      {
        digitalWrite(column[i], 0);
        delay(x);
        digitalWrite(column[i], 1);
        delay(x);
      }
    digitalWrite(layer[count], 0);
    }
    //8-11
    for(int count = 4; count != 0; count--)
    {
      digitalWrite(layer[count-1], 1);
      for(int i = 8; i<12; i++)
      {
        digitalWrite(column[i], 0);
        delay(x);
        digitalWrite(column[i], 1);
        delay(x);
      }
    digitalWrite(layer[count-1], 0);
    }
    //12-15
    for(int count = 0; count < 4; count++)
    {
      digitalWrite(layer[count], 1);
      for(int i = 12; i<16; i++)
      {
        digitalWrite(column[i], 0);
        delay(x);
        digitalWrite(column[i], 1);
        delay(x);
      }
    digitalWrite(layer[count], 0);
    }
  }
}
```

Learnings

- We got to learn about the working of Shift Register IC 74HC595.
- Learnt about Arduino microcontroller
- Improves knowledge of Digital Electronics.
- Improves coding skills.

References

- 4*4*4 LED CUBE : 5 Steps (with Pictures) – Instructables.
- How to Make a 4x4x4 LED Cube Using Arduino | by DiY Projects Lab | Medium
- GITHUB LINK:-
- Editing ARIES_4-4-4-LED-CUBE/README.md at main · Krish-Roorkee/ARIES_4-4-4-LED-CUBE · GitHub