Echo GUARDIAN

Group 6

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01 PROBLEM

Blindness is a major challenge faced by millions of people around the world. According to global health organizations, an estimated 43 million people are blind, and many more live with severe vision impairment. Despite medical advances, many cases of blindness are either preventable or treatable, especially in low- and middle-income countries where access to care is limited. Beyond health, blindness affects education, employment, and social inclusion. The lack of accessible environments and supportive technologies often increases the difficulties blind individuals face, making it important to address blindness not only as a medical issue but also as a social one.

Technology must play a key role in supporting blind individuals by providing better navigation tools, accessible devices, and inclusive designs. Through creation followed by innovation, technology can help break barriers, promote independence, and create a more inclusive world for everyone.

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02 GENERATING IDEAS

First, a brainstorming session was done and all the ideas was gathered . A ll the focus was on the problem of the white cane used by blind people, and how it can be tiring for them.
The problem was broken down into smaller parts, and the question of why it should be solved was asked. Both divergent and convergent thinking were used.
Divergent thinking helped to explore as many ideas as possible by thinking creatively. The team thought about alot of ideas to put sensor like a belt,cap,bag or even a cane. Then, convergent thinking was used to choose the most practical and impactful solution and to determine how it could be used.

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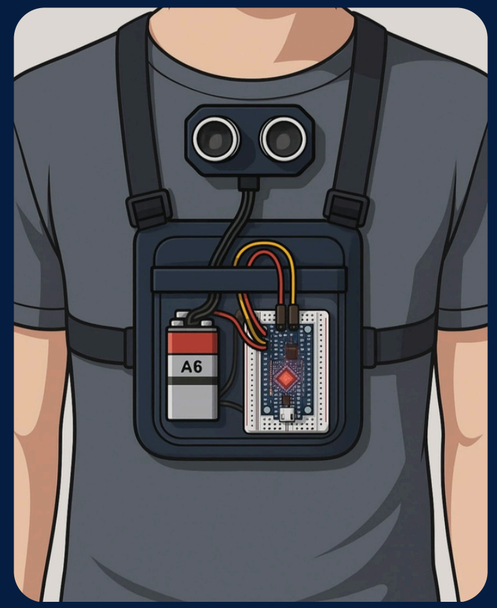
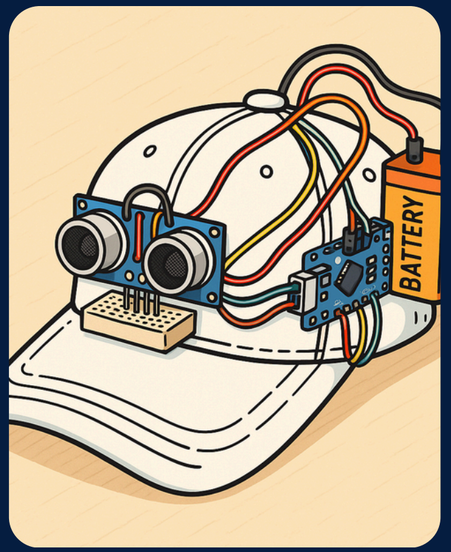
03 SELECTING IDEA

After the brainstorming session, all the best ideas were gathered, the best option was to design a smart bag and cap.
These can detect everything in front of the user, and they also look stylish and can be worn in different ways.The team also chose to make the device portable, so if the user wants to place it somewhere else, they can do that easily.





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04 IMPLEMENTING IDEA

The device were to be worn in a small bag with a waist and a neck strap to be fixed on the chest of the blind person. Also, it has a sensor that senses nearby obstacles up to three meters ahead to make the buzzer vibrate before collision.

To provide another option, a cap was added.

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05 HARDWARE

Selections

Availablity

The components to be used are desired to be available and have alternatives, so that if anything is broken , it can be replaced without affecting the functionality.

Cost

The components to be used should be priced affordably across all social classes, so that they can be purchased and used by everyone.

Interface

The components used should be understandable and workable by both specialists and even ordinary people who are not experts.

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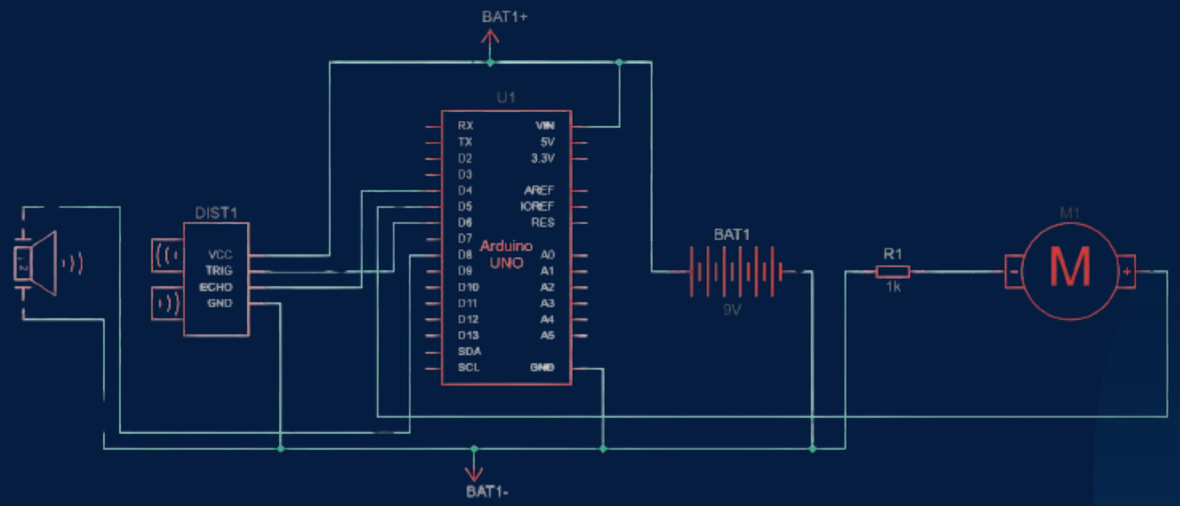
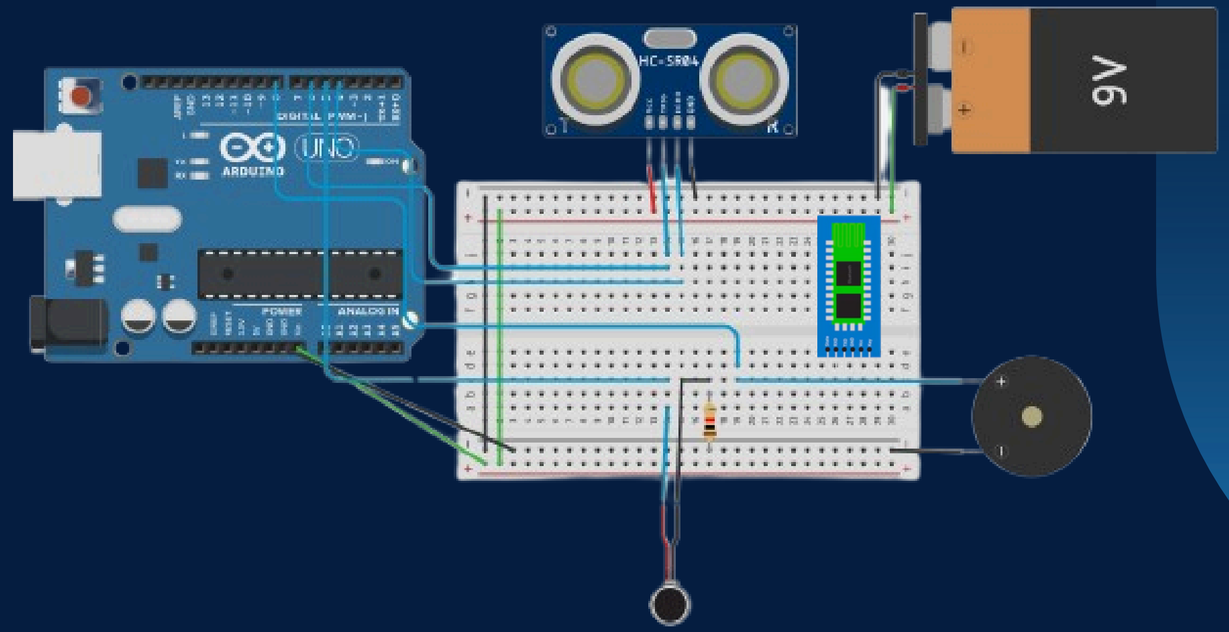
05

HARDWARE



The components we used are :

- Arduino nano
- Battery 9v
- Ultrasonic Sensor
- Buzzer
- Vibration Motor
- Bluetooth module



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CODING

The device was programmed with an Arduino Nano to control the components and the mechanism. An Arduino Nano was used because it supports a wide range of sensors and modules, has a small size, and consumes little power, making it perfect for the device.

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```
#define trigPin 6
#define echoPin 4
#define buzzerPin 8
#define vibrator1Pin 5

#include <SoftwareSerial.h>

SoftwareSerial EchoGuardian(10,12);

long duration;
int distance;

// Variables for timing
unsigned long under20StartTime = 0;
bool under20TimerRunning = false;
const unsigned long alertDuration = 10000; // 10 seconds in milliseconds

void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzerPin, OUTPUT);
  pinMode(vibrator1Pin, OUTPUT);

  Serial.begin(9600);
  EchoGuardian.begin(9600);
  }

void loop() {
  // Trigger the ultrasonic sensor
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.0343 / 2;

  Serial.print("Distance (cm): ");
  Serial.println(distance);

  // Vibration and Buzzer Alerts
  if (distance < 20) {
    digitalWrite(vibrator1Pin, HIGH);
    tone(buzzerPin, 1800);
    delay(100);
  }
```

```
  else if (distance < 60) {
    digitalWrite(vibrator1Pin, HIGH);
    tone(buzzerPin, 1200);
    delay(50);
    noTone(buzzerPin);
    delay(50);
  }
  else if (distance < 100) {
    digitalWrite(vibrator1Pin, LOW);
    tone(buzzerPin, 900);
    delay(100);
    noTone(buzzerPin);
    delay(100);
  }
  else if (distance < 150) {
    digitalWrite(vibrator1Pin, LOW);
    tone(buzzerPin, 700);
    delay(150);
    noTone(buzzerPin);
    delay(150);
  }
  else if (distance < 200) {
    digitalWrite(vibrator1Pin, LOW);
    delay(200);
    noTone(buzzerPin);
    delay(200);
  }
  else {
    digitalWrite(vibrator1Pin, LOW);
    noTone(buzzerPin);
  }

  // Bluetooth Message Logic
  if (distance < 20) {
    if (!under20TimerRunning) {
      under20StartTime = millis();   // Start timing
      under20TimerRunning = true;
    }
    else {
      if (millis() - under20StartTime >= alertDuration) {
        EchoGuardian.println("WARNING: Object under 20cm for 10 seconds!");
        Serial.println("Message Sent via Bluetooth!");
        under20TimerRunning = false; // Reset timer after sending
      }
    }
  }
  else {
    under20TimerRunning = false; // Reset if distance becomes safe
  }

  delay(30); // Small delay for smoother loop
}
```

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07 DESIGN CHALLENGES

1) How to place the sensor correctly so that it could detect everything that might interrupt or obstruct the blind person.
2) How to design the bag so that the user could wear it comfortably.
3)The project involved a lot of wires, which had to be covered neatly.
4) How to make the device easier to be used more than the traditional cane, and what features would make it special.

Being portable was one of the objectives, and here comes the cap version of the project which had its own challenges.
1)How to attach the sensor securely to the cap.
2) Where exactly to place the board on the cap.
3)The thought of putting the sensor inside an acrylic box and fixing it with Scotch glue (adhesive tape) was considered, but it was impractical

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07 DESIGN SOLUTION

Crossbody bag that can be worn in different ways was the best solution to all of these challenges:

1)The sensor was sewn into the bag, and a support was added from the back to keep the sensor upright.

2)They could carry their personal belongings inside the bag and also, looks civil.

3) It has a pocket inside the bag to hold the board securely, two holes in the bag to fit the wires.

4)We lined the inside of the bag to protect the components and prevent any damage.

And for the cap,

1) The sensor was placed at the top of the cap for better obstacle detection with with.

2) A scotch tape was designed at the front of the cap so it could hold the board safely.

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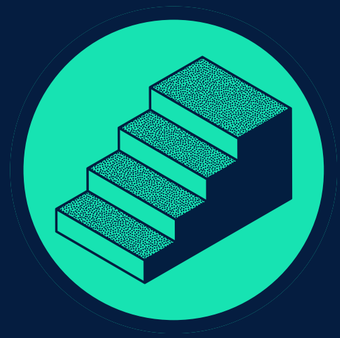
08 FUTURE ENHANCEMENTS

REAL-TIME LOCATION ALERT SYSTEM

In the future, we plan to integrate a feature that automatically sends the blind user's location to a family member or caregiver. This will allow them to quickly reach the user in case of an emergency, such as a fall or an accident, ensuring faster assistance and improved safety.



SMART GLOVE FOR STAIRS

In the future, we plan to add a smart glove with an ultrasonic sensor. It will check the distance between the user's hand and the ground. If there is a sudden change—like stairs—the glove will vibrate and make a sound. This will help the blind user notice the stairs and stay safe.

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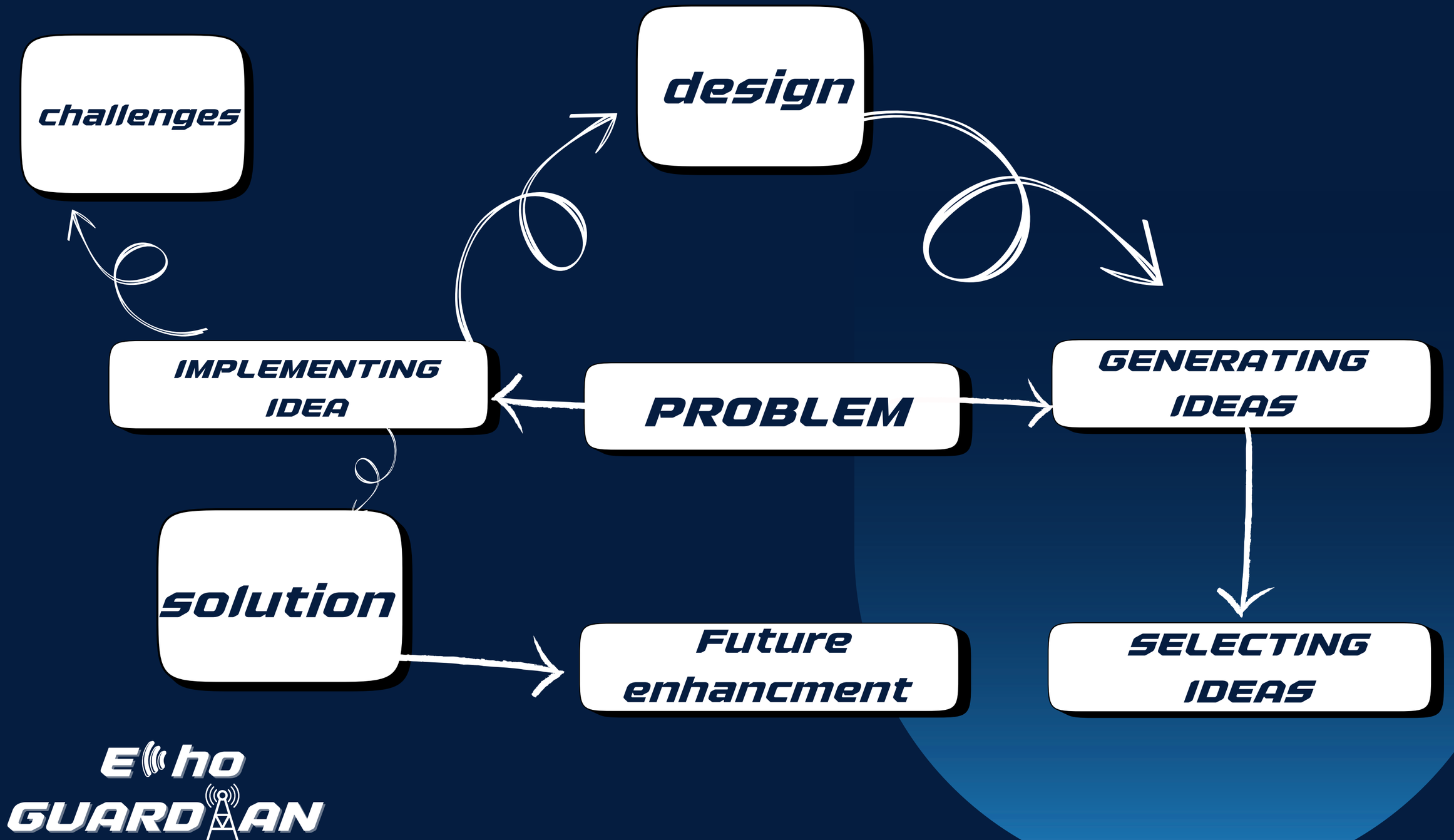

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09 Cost

Version	Cap (75)	Bag (150)
Arduino nano	250	250
Battery 9v	45	45
Buzzer	10	10
Ultrasonic Sensor	50	50
Vibration motor	15	15
Total	445 (8.75$)	520 (10.23$)

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FINAL PROJECT

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