

Ideation Report Template

Project Title : Visual Doorbell Alert System for Deaf Individuals

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LPI project Link :

<https://projects.learningplanetinstitute.org/projects/sound-to-light-doorbell-alert-system-for-deaf/summary>

1. Introduction

This project aims to convert specific sound signals, such as a doorbell, into visual light signals. The goal is to assist deaf or hard-of-hearing individuals by providing an alternative way to perceive important household sounds.

Addressed Problem

Deaf individuals cannot hear auditory alerts like doorbells or household sound signals. This can affect safety, communication, and daily convenience. The project focuses on detecting these sounds and translating them into visible LED notifications.

Relation to Higher-Scale Problems (SDGs)

This project relates primarily to:

- Good Health and Well-being (SDG 3): supporting accessibility for people with hearing impairments
- Reduced Inequalities (SDG 10): promoting inclusive assistive technology

Local or Global Problem

This is a global accessibility issue, affecting millions of hearing-impaired individuals worldwide. However, the solution can be implemented locally in homes, workplaces, or care facilities.

Benefits of this Application

Tangible Benefits

- Real-time visual alerts for important sounds
- Low-cost assistive technology solution
- Easy integration into home environments

Intangible Benefits

- Improved independence for deaf individuals
- Increased safety and comfort

- Enhanced accessibility and inclusivity

2. Market survey / Bibliography

Project 1: IoT Wireless Alert System for Hearing-Impaired Individuals

Website:

https://www.researchgate.net/publication/382566614_IoT_based_Wireless_Alert_System_for_Individuals_with_Impaired_Hearing

This project proposes an IoT-based alert system that notifies hearing-impaired users about doorbell events and other alerts using wireless communication and connected devices.

Comparison with Our Project:

- Uses IoT connectivity and remote alerts
- More complex hardware and networking required
- Our project focuses on a simpler standalone sound-to-light system without internet dependency

Project 2: Assistive Doorbell System Using Arduino

Website:

<https://www.hackster.io/krishnatcs17/assistive-door-for-the-deaf-and-hard-of-hearing-43ff15>

This Arduino-based project detects doorbell signals and provides visual notifications for deaf individuals.

Comparison with Our Project:

- Uses Arduino microcontroller similar to ours
- Detects electrical doorbell signal rather than sound frequency
- Our project focuses on sound detection instead of wired trigger detection

Project 3: Wearable Doorbell Notification System

Website:

<https://ijettjournal.org/archive/ijett-v51p220>

This system sends wireless alerts to wearable devices that notify deaf users via vibrations or LED signals.

Comparison with Our Project:

- Requires wearable receiver device
- Wireless communication involved

- Our solution uses ambient LED lighting instead of wearable devices

Project 4: Assistive Visual Alert Devices (Hearing Accessibility)

Website:

<https://www.nidcd.nih.gov/health/assistive-devices-people-hearing-voice-speech-or-language-disorders>

This resource explains commercial assistive devices that convert sound alerts into visual or vibration signals for hearing-impaired individuals.

Comparison with Our Project:

- Similar visual alert concept
- Commercial devices are often expensive
- Our project aims at a low-cost DIY solution

Project 5: Sound Detection Assistive Prototype for Deaf Users

Website:

https://www.academia.edu/83752568/Prototype_Design_of_Alert_Device_for_Hearing_Impaired_Users

This prototype detects various household sounds and converts them into visual alerts.

Comparison with Our Project:

- Multi-sound detection capability
- More advanced classification methods
- Our project currently focuses on doorbell-specific sound detection

Market Position Summary

Compared with existing solutions:

- Many systems rely on wired triggers or IoT infrastructure
- Commercial devices can be costly

Our project emphasizes:

- Low-cost accessibility solution
- Simple hardware setup
- Sound-based detection without networking
- Assistive technology for daily household use

3. How you will solve this problem

Proposed Solution

The proposed solution is to develop a sound-to-light alert system that detects specific household sounds, particularly a doorbell, and converts them into visual light signals using LED strips. The system uses a microphone sensor to capture sound signals, a microcontroller (Arduino Leonardo) to process the audio input, and LED lights to provide visual notification for deaf or hard-of-hearing individuals.

The main objective is to provide an accessible, low-cost assistive solution that allows users to perceive important auditory events through visual cues.

The system works in three main steps:

1. **Sound Detection:**

A MAX9814 microphone sensor captures environmental sound signals.

2. **Signal Processing:**

The Arduino microcontroller analyzes the sound intensity and characteristics to distinguish significant sounds from normal background noise.

3. **Visual Notification:**

When a relevant sound is detected, an LED strip lights up to alert the user visually.

To reduce false detection, the system uses threshold tuning and sound proximity filtering so that only close and significant sounds (e.g., doorbell near sensor) trigger the alert.

Comparison with Existing Projects

Compared with similar assistive alert systems:

- Many existing systems rely on wired doorbell triggers or IoT connectivity, whereas our solution uses direct sound detection without requiring network infrastructure.
- Some projects require wearable notification devices, while our system provides ambient visual alerts through LED lighting.
- Commercial assistive devices can be costly, whereas our approach focuses on affordability and DIY accessibility.
- If you start from an existing project, please specify what original contribution

Original contribution

Our project proposes a simple standalone sound-to-light alert system without IoT dependency. It focuses on low-cost hardware and practical home installation. The design was optimized by switching from ESP32 to Arduino Leonardo for better 5V compatibility and stable LED control, along with tuning to detect doorbell sounds while minimizing false triggers. This makes the solution accessible, economical, and suitable for real-world use.

4.Expected List of Features

Our project is expected to support a sound-to-light alert system for Deaf/Hard-of-Hearing users, focusing on reliable doorbell notification through LEDs. The core features include doorbell

sound detection using the MAX9814 microphone module to generate a trigger event, and a clear visual alert using a WS2812 LED strip (blink/strobe or a dedicated color pattern) that is easily noticeable from a distance. To ensure real-world usability, the system will include noise rejection through thresholding combined with persistence/cooldown logic, so that normal room speech and background noise do not cause frequent false alarms. Another essential feature is stable and safe power/wiring, using a 5V-compatible setup (Arduino Leonardo with shared/common ground) to avoid inconsistent behavior.

In addition to these core functions, the project may include secondary improvements such as user-adjustable sensitivity/calibration to adapt to different noise environments, hold-time and cooldown behavior to make alerts readable and prevent repeated triggers from a single event, and multiple LED patterns to allow future expansion to different household alerts. A further upgrade would be frequency-based detection (e.g., Goertzel or band-check) to better isolate doorbell-like tones from voice and random noise. Finally, a simple enclosure or mounting solution may be added to support practical placement near a door or sound source.

5. List of equipment to order

Budget is ~100€/project

No need to list the materials we already have at makerlab

Suppliers order : 1/amazon.fr (prime) 2/ leroy merlin-castorama (in person) 3/ rs component (electronics) 4/mouser (electronics)

6. References

1. IoT Wireless Alert System for Hearing-Impaired Individuals
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4. Assistive Devices for Hearing-Impaired Individuals (NIDCD Resource)
<https://www.nidcd.nih.gov/health/assistive-devices-people-hearing-voice-speech-or-language-disorders>
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6. MAX9814 Microphone Amplifier Datasheet
<https://www.analog.com/en/products/max9814.html>
7. Adafruit NeoPixel LED Strip Guide
<https://learn.adafruit.com/adafruit-neopixel-uberguide>

