Aryan
A compact lamp that reacts in real time to music or ambient sound—great for parties or just fun home ambiance. A small microcontroller (e.g., ESP8266 or ESP32) with a microphone module detects audio levels or basic frequency bands, then drives RGB LED strips. When connected to Wi-Fi, you could control color schemes or effects from a smartphone app or allow the lamp to pull live data (e.g., time of day, weather) to change light patterns automatically. The system can be as simple or advanced as xyou like: from basic amplitude-based flashing to frequency analysis (e.g., splitting bass/mid/treble). Core challenges include signal processing for audio input, LED driver design (current handling, color control), and low-latency wireless updates for dynamic color changes.

Adi

The Problem: Many drivers struggle with parking in tight spaces and gauging distances to obstacles, especially in older cars without built-in sensors. Traditional parking sensors are either expensive to install or provide only basic beeping feedback.

The Solution: A standalone, easy-to-install parking assistant that shows exact distances on a small display. It mounts on your dashboard and connects to ultrasonic sensors on your rear bumper. When you're in reverse, it shows you exactly how many feet/inches you are from obstacles.

How It's Made: The system consists of three main parts that can be built in 3 weeks:

Core Components:

- Arduino Nano (main controller)
- 3 ultrasonic sensors (HC-SR04)
- Small OLED display
- Buzzer for audio feedback
- 12V to 5V car power adapter
- Simple PCB for connections

The system taps into the car's reverse light for power and activation. When you put the car in reverse, the system automatically turns on, displaying distances from left, center, and right sensors. The display shows actual numbers (like "2.5 feet") rather than just beeping.

Moon

Acupressure

Ball Sleeve

Smart Vent

Title

Team Members:

- Student 1 (netid)

- Student 2 (netid)

- Student 3 (netid)

Problem

Describe the problem you want to solve and motivate the need.

Solution

Describe your design at a high-level, how it solves the problem, and introduce the subsystems of your project.

Solution Components

Subsystem 1

Explain what the subsystem does. Explicitly list what sensors/components you will use in this subsystem. Include part numbers.

Subsystem 2

...

Criterion For Success

Describe high-level goals that your project needs to achieve to be effective. These goals need to be clearly testable and not subjective.

Acupressure

Medical Pill Dispenser

Glasses Add On

Title

Voice-Direction Smart Glasses for the Visually Impaired

Team Members

- Aryan Gosaliya
- Adi Perswal
- Aryan Moon

Problem

Visually impaired individuals often have difficulty determining **where** a person is located when they hear a voice. In social scenarios—like group conversations or crowded gatherings—lacking visual cues of **who's speaking** can be isolating or confusing.

Proposed Solution

Develop a pair of **smart glasses** that detects the **direction** of a speaker's voice and provides real-time feedback, helping the wearer orient themselves toward the active speaker. Our design includes:

1. **Microphone Array Integration**:
    - Tiny MEMS microphones (e.g., ICS-40720) mounted on the glasses' frame to capture audio from different angles.
    - An on-board **microcontroller** or small embedded processor that runs a **direction-of-arrival (DoA) algorithm**.
2. **Real-Time Direction Cues**:
    - **Discrete vibration motors** or **bone-conduction transducers** built into the temples of the glasses, buzzing on the side corresponding to the speaker's position.
    - (Optional) Small **LED indicators** on the frame (if partial vision is retained) to show the approximate angle of the voice source.
3. **Low-Power, Battery-Operated Design**:
    - A slim **rechargeable battery** integrated into the glasses' arms.
    - **Efficient** microcontroller operation to ensure several hours of continuous use.

By providing **directional feedback**, the glasses help the user effortlessly orient toward the person talking, improving **social engagement** and **situational awareness**.

Subsystem Overview

1. **Microphone Array & Analog Front-End**
   - 2–4 MEMS mics placed around the frames for **spatial audio capture**.
   - Low-noise amplifiers or direct digital outputs depending on mic choice.
2. **Embedded Processor & DoA Algorithm**
   - A DSP-capable **microcontroller** (e.g., STM32F4 series) for **phase-based** DoA (like GCC-PHAT).
   - Real-time data acquisition and processing with minimal latency (< 300–500 ms).
3. **Feedback Mechanism**
   - **Tactile**: Vibration motors or bone-conduction modules near the ears, indicating the **left–right** direction (and possibly front/back if using multiple discrete transducers).
   - **Visual** (Optional): Subtle LED lights for partially sighted wearers.
4. **Power & Control**
   - **Rechargeable Li-ion battery** (e.g., 3.7V, 500–1000mAh).
   - Battery management circuit (e.g., TP4056 module) for safe charging.
   - Low-power modes for the microcontroller when idle.

Criterion for Success

1. **Directional Accuracy**
   - The glasses must identify the dominant speaker's location within ±15° in a typical conversation circle (up to ~3 meters away).
2. **Low Latency**
   - Feedback to the user should update at least **2–5 times per second** to feel natural in conversation.
3. **User Comfort & Accessibility**
   - The frame remains **lightweight** and non-intrusive.
   - The feedback (vibration or bone conduction) is **clear** but not overwhelming.
4. **Battery Life**
   - The system should run for **2+ hours** on a single charge during active conversation scenarios.
5. **Reliability in Noise**
   - Must perform robustly in typical indoor environments with moderate background noise (cafeterias, meeting rooms, etc.).

Why It Suits ECE 445

- **Hardware–Software Complexity**: Involves **microphone array design**, **signal processing**, **low-power embedded control**, and **wearable ergonomics**.
- **Measurable Goals**: Accuracy (direction detection), real-time feedback, user comfort, and battery life can all be tested and validated.
- **Meaningful Application**: Improves social interactions for visually impaired individuals—an ethical and practical design challenge.

This setup provides a **self-contained** and **engineering-rich** project for ECE 445, tackling real-time **DSP**, **embedded systems**, and **human-centered design** in a **wearable** form factor.

Smart Medical Pill Dispenser

Problem
People often struggle with two major medication challenges. First, they forget to take their medications at the right time or take incorrect amounts. Second, they spend time sorting multiple medications into daily doses, which is both time-consuming and prone to errors. This is especially difficult for the elderly with multiple prescriptions they organize each week.

Solution
An intelligent device that both sorts and dispenses medications automatically. Instead of manually organizing pills into compartments, users simply load entire bottles of medication one at a time into the device. The system then automatically sorts these pills into correct daily doses and dispenses them at scheduled times.

Solution Components
1. A real-time clock (RTC) module (DS3231) to ensure accurate dispensing schedules.
2. Speakers or buzzers for audible alerts and LEDs for visual notifications.
3. Wi-Fi or Bluetooth modules (ESP8266 or HC-05) to send reminders via a mobile app or text messages.
4. Pill holding tubes to hold pills using 3D printing
5. A rotating cylinder with a hole that fits one pill at a time. The cylinder rotates (using a stepper motor) to release pills into the final compartment.
6. Microcontroller: The microcontroller drives the stepper motors that rotate the dispensing cylinder. It will make sure that the pills were dispensed at the right time (aka did you take your medication). The microcontroller activates buzzers or speakers for audible notifications and LEDs for visual alerts when it is time to take medication. Using modules like ESP8266 or HC-05, the microcontroller connects to a mobile app or cloud service to send reminders, allow remote monitoring, and enable users to adjust schedules.

Criterion for Success
Accurately identify and sort pills into correct daily doses without errors.
1. Dispense the correct medication dose at scheduled times reliably.
2. Provide clear notifications to users when it is time to take their medication.
3. Be easy to use, allowing users to load medications and program schedules without difficulty.
4. Ensure safety by preventing cross-contamination of pills

Budget
The total estimated cost of all items together is $43 - $96

Title

Smart Sleeve for Muscle Recovery

Team Members:

- Aryan Moon
- Adi Perswal
- Aryan Gosaliya

Problem

Muscle soreness and fatigue are common issues for athletes, fitness enthusiasts, and individuals recovering from physical injuries. Often, people have difficulty identifying the precise areas of soreness or knowing how to address them effectively. Current recovery solutions like foam rollers or massage guns provide generalized relief but lack the precision and automation needed for targeted treatment. This leads to inefficient recovery and prolonged discomfort.

Solution

The Smart Sleeve for Muscle Recovery is a wearable device designed to enhance muscle recovery by identifying and treating sore areas with precision. The sleeve will be worn around specific muscle groups, such as the calf or thigh, and will incorporate temperature sensors to detect areas with elevated temperatures, a potential indicator of soreness or inflammation. Once detected, the sleeve will use embedded massage balls equipped with vibration motors to deliver targeted massage therapy to those areas. The system will feature user-friendly controls for adjusting intensity and duration, making it an effective and personalized recovery solution.

Solution Components

Subsystem 1: Temperature Detection

This subsystem will identify sore or inflamed areas by measuring temperature variations along the muscle.

- **Components**:
    - Temperature sensors: TMP117 precision temperature sensors
    - Microcontroller: ESP32 (to process sensor data)
    - Power source: Rechargeable lithium-ion battery

Subsystem 2: Massage Mechanism

This subsystem will provide targeted massage therapy using vibration motors and massage balls.

- **Components**:
    - Vibration motors: Precision micro vibration motors (e.g., NFP-F20-1234)
    - Massage balls: Small silicone-based balls with integrated mounts
    - Motor controller: L298N motor driver module
    - Microcontroller: Shared with the temperature detection subsystem

Subsystem 3: User Interface and Control

This subsystem will allow the user to monitor detected soreness areas and control massage intensity and duration.

- **Components**:
    - Smartphone app: Built with Bluetooth connectivity for remote control
    - Bluetooth module: Integrated into the ESP32 microcontroller
    - LEDs: Indicate system status

Criterion for Success

- The sleeve accurately detects areas of elevated temperature corresponding to muscle soreness or inflammation.
- Massage balls deliver effective vibration therapy to the identified areas, with adjustable intensity and duration controlled by the user.
- The system operates seamlessly and is comfortable to wear for extended periods.
- The user interface (smartphone app) provides clear feedback on detected soreness areas and offers intuitive control options for customization.
- The sleeve is lightweight, durable, and easy to maintain.