Title: **Smart Blind Stick – Assistive Navigation with Obstacle Detection and Manual Power Control**

Introduction:

This project presents the development of a low-cost, portable assistive device – a Smart Blind Stick – designed to support visually impaired individuals in navigation by detecting nearby obstacles and providing real-time feedback through sound signals. The system utilizes an Arduino Mega 2560, ultrasonic sensor, and passive buzzer to measure distances and notify the user with audio beeps that increase in frequency as obstacles get closer.

An enhancement was made by integrating a DPDT slide switch to manually control the power supply from the 9V battery. This allows the user to turn the system ON or OFF without unplugging the battery, improving usability and power efficiency.

Objectives:

- Develop an obstacle-detecting blind stick with auditory feedback.
- Use ultrasonic sensing to measure distance and trigger a buzzer with variable beep rates.
- Improve system usability by adding a DPDT slide switch to control the 9V battery's power delivery to the Arduino.

Components Used:

Component	Quantity
Arduino Mega 2560	1
Ultrasonic Sensor (HC-SR04)	1
Passive Buzzer Module	1
9V Battery + Snap Connector	1
Male-to-Male & Male-to-Female Jumper Wires	Multiple

Walking Stick	1
Scotch Tape / Cable Ties	As needed
Breadboard (optional)	1
DPDT Slide Switch (Manual Upgrade)	1

Working Principle:

- The ultrasonic sensor sends out waves and calculates the distance based on echo time.
- The Arduino Mega processes this distance and triggers the buzzer.
  - As distance decreases, beep frequency increases.
- The 9V battery powers the system.
- A DPDT switch is added between the battery and Arduino to toggle power ON/OFF manually.

Circuit Wiring Overview

Ultrasonic Sensor (HC-SR04) → Arduino Mega:

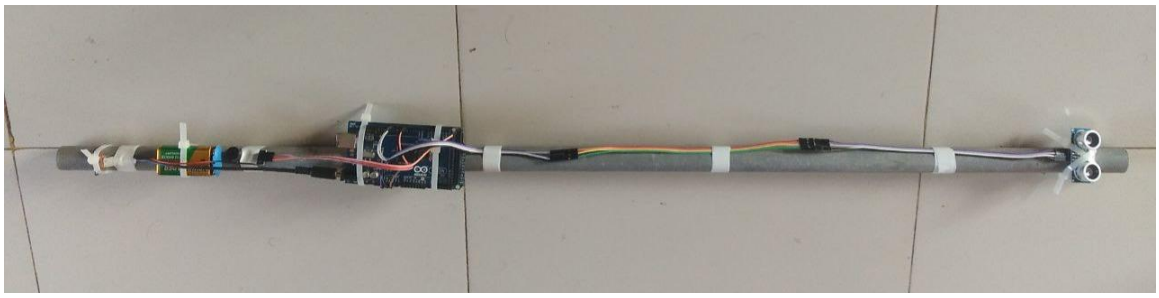
Sensor Pin	Arduino Pin	Wire Type
VCC	5V	Male-to-Female
GND	GND	Male-to-Female
TRIG	Pin 9	Male-to-Female
ECHO	Pin 10	Male-to-Female

Passive Buzzer → Arduino Mega:

Buzzer Pin	Arduino Pin	Wire Type
VCC	5V	Male-to-Female
GND	GND	Male-to-Female
I/O	Pin 5	Male-to-Female

DPDT Switch Integration (Upgrade):

- One pole of the DPDT switch is connected between the battery's positive terminal and Arduino VIN.
- When the switch is toggled, it completes or breaks the circuit, effectively turning the Arduino ON/OFF.



Arduino Code:

Below is the Arduino sketch used in the project:

```
#define trigPin 9
#define echoPin 10
#define buzzerPin 5

void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzzerPin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  long duration;
  int distance;

  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
```

```
  duration = pulseIn(echoPin, HIGH, 30000);
  if (duration == 0) {
    distance = -1;
  } else {
    distance = duration * 0.034 / 2;
  }
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");

  if (distance >= 5 && distance <= 100) {
    int beepFreq = map(distance, 20, 100, 2000, 500);
    int beepDelay = map(distance, 20, 100, 100, 600);
    tone(buzzerPin, beepFreq, beepDelay);
    delay(beepDelay * 1.5);
    noTone(buzzerPin);
  } else {
    noTone(buzzerPin);
  }

  delay(100);
}
```

Assembly Process:

1. Connect all modules as per the circuit design.
2. Test on breadboard before final mounting.
3. Secure components along the stick using tape or cable ties.
4. Mount the DPDT switch near the stick's handle for easy access.
5. Run wires from the switch to the battery snap and Arduino VIN/GND.
6. Insert the 9V battery and toggle the switch to power the system.

Testing & Results:

Test Case	Expected Result	Actual Observation
No obstacle in front	Buzzer silent	✓ As expected
Obstacle ~70 cm ahead	Medium-frequency beeps	✓ As expected
Obstacle ~20 cm ahead	Fast high-pitched beeps	✓ As expected
Toggle DPDT switch OFF	System powers down	✓ Works correctly
Toggle DPDT switch ON	System resumes operation from battery	✓ Works correctly

Conclusion:

The Smart Blind Stick was successfully built and tested. It detects obstacles and provides auditory feedback based on proximity using an ultrasonic sensor and buzzer. The addition of a DPDT slide switch significantly enhanced usability by offering manual power control, eliminating the need to disconnect the battery each time.

This upgrade improves energy efficiency, device lifespan, and convenience for users, making the stick more practical for real-world use.