SafeStep: Smart Blind Stick using Ultrasonic Sensor and Arduino Uno

Saif Mohammed
2121913042

Humayra Rahman Nipa
2121128042

North South University
Department of Electrical & Computer Engineering

December 11, 2025

Introduction & Objectives

- SafeStep: a low-cost smart mobility aid for visually impaired users.
- Uses HC-SR04 ultrasonic sensor + Arduino for obstacle detection.
- Provides real-time alerts within a 30–80 cm sensing range.
- Distance-based buzzer + LED signals enhance safe navigation.
- Designed to be portable, affordable, and easy to use.

Literature Review & Methodology

- Ultrasonic sensors widely used for affordable navigation aids.
- Existing devices (GuideCane, NavBelt) effective but costly.
- Gap: simple, single-sensor, low-cost solution.
- HC-SR04 used for echo-based distance measurement.
- Alert logic:
  - ≤ 30 cm: 250 ms (fast)
  - ≤ 50 cm: 500 ms (medium)
  - ≤ 80 cm: 1000 ms (slow)
- Buzzer and LED synchronized for clear feedback.
- Powered by 9V battery + LM7805 regulator.

Results & Discussion

- Accurate detection (30–80 cm) with < 2.3 cm error.
- Alert timings matched programmed delays reliably.
- Latency < 10 ms ensured fast response.
- Dual alerts improved user awareness.
- Limitations: angled/soft surfaces reduce accuracy; noise affects buzzer.
- Continuous sensing increases power use.
- Overall: low-cost system performs reliably and is upgrade-ready.

Project Costing

Serial No.	Component	Cost (BDT)
1	Arduino Uno R3	790
2	HC-SR04 Ultrasonic Sensor	100
3	Piezo Buzzer	20
4	LED	5
5	9V Battery	75
6	LM7805 Voltage Regulator	15
7	Jumper Wires	65
8	Breadboard	100
	Total	**1170**

Table: Project Costing Summary

Conclusion

- SafeStep provides an affordable and reliable obstacle-detection aid.
- Real-time audiovisual alerts enhance mobility and user safety.
- Simple design ensures accessibility, portability, and easy adoption.
- Strong performance shows potential for future upgrades (vibration, waterproofing, multi-sensor fusion).