

Voice Activated LEDs Using Machine Learning

Ivanna Morales roman

Boston University, Physics Department

PY371 Electronics for Scientists

Abstract

Embedded machine learning makes it possible for devices to make smart decisions locally independent of a network connection or expensive hardware. Therefore, exploring the bounds of this technology is imperative to the innovation of smart, cost-effective and secure devices. This project will test the capabilities of the Arduino Nano in recognizing live audio input by using machine learning to make local speech-to-text conversions. To achieve this, I will be training a neural network to recognize voice commands corresponding to different colors, which will then be used to operate a strip of LED lights. The machine learning model will be trained and developed using the Edge Impulse Development platform and deployed into an Arduino Nano. The device will take the categorized audio from the Nano as serial input into an Arduino UNO to manage the LEDs.

1. Plan of Implementation

Week 1: I will start by training the model to recognize three simple words "red", "white", and "off". The model will be tested on my computer so I can debug accordingly and make sure it runs accurately before deploying to Arduino.

Week 2: The model will be deployed into the Arduino and tested using an RGB LED. The colors will be taken as commands to change to color of the LED. Once these initial tests are completed, I will connect the LCD to display the colors in text.

Week 3: Connect the device to LED light strip. Add more colors to the dataset.

Week 4: Test accuracy of the device and make the final small touches as needed.

2. List of Parts

1. Arduino Nano BLE 33 Sense
2. Arduino UNO
3. WS2812B LED Lights
4. Micro USB Cable
5. Wires and resistors

3. Block Diagram

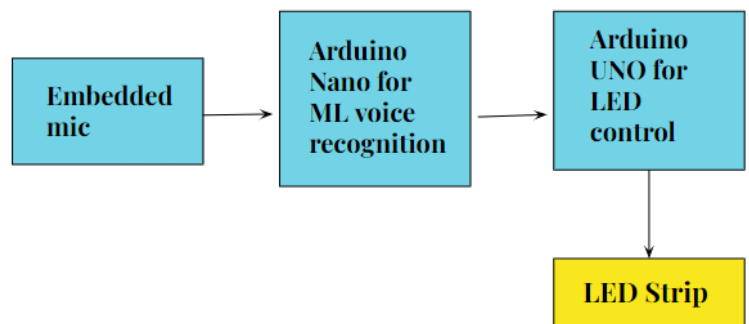


Figure 1: General Schematic of the device.

4. Data Collected/Graphics

	_NOISE	_UNKNOWN	BLUE	OFF
_NOISE	96.50%	0.90%	1.80%	0.90%
_UNKNOWN	2.60%	82.50%	5.70%	9.20%
BLUE	8.90%	0%	91.10%	0%
OFF	2.30%	3.90%	1.20%	92.70%
F1 SCORE	0.91	0.88	0.91	0.92

Figure 2: Confusion Matrix For Initial Set of Words: blue and off.

5. Software Flow Chart

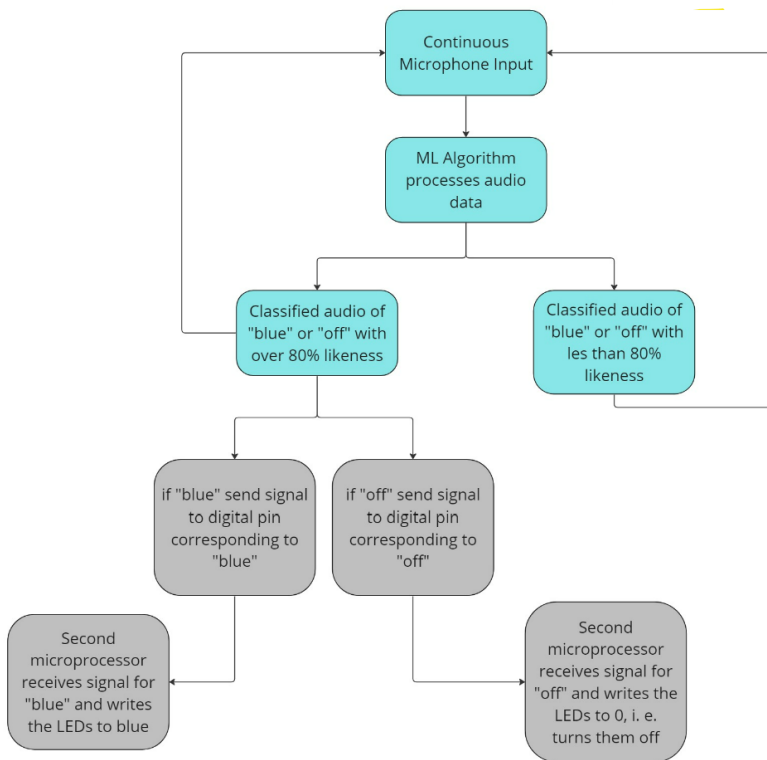


Figure 3. Software Flow Chart

6. References

Edge Impulse Documentation: <https://docs.edgeimpulse.com/docs>

Arduino Nano Documentation: https://docs.arduino.cc/hardware/nano-33-ble-sense_g1=1*1tml571*_ga*MTM40Dg20DEyNS4xNjc3MzYyNDYz*_ga_NEXN8H46L5*MTY4MDQ5NTU5OS4yNy4xLjE2ODA00TU5NjIuMC4wLjA.

Sakr, Fouad, et al. "Machine Learning on Mainstream Microcontrollers." *Sensors* 20.9 (2020): 2638. ProQuest. Web. 2 Apr. 2023. https://buprimo.hosted.exlibrisgroup.com/permalink/f/g23ind/TN_cdi_doaj_primary_oai_doaj_org_article_c25d5421f43d40a5b558c24d84e58a35