Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 11, No. 3, November : 2023

OBSTACLE DETECTION USING MACHINE LEARNING FOR VISUALLY IMPAIRED

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Abstract
With the ever-evolving technology, extending a helping hand to the less fortunate becomes our foremost duty. As blind people struggle in their most basic routine tasks, and need assistance for the same. IOT devices may become their best friend in dire times and guide them anytime as per requirements.

Keywords:
Artificial Intelligence, Internet of Things (IOT), Machine Learning, Obstacle Detection, Visual Aid

Introduction

Science and Technology have done wonders to make our lives as simple as they are today. With information on our fingertips and automation giving remote access to multiple gadgets on our smartphones have simplified our lives manifold. This paper focuses on easing out the lives of the bind who need assistance even to carry out their daily chores.
Amalgamation of Internet of Things (IOT) and Machine Learning tool of AI, will be a boon to the world of visual aids for blind. Obstacle detection using Ultrasonic sensors will help detect any hindrance even at night and accurately calculate distance also for the nearby objects to avoid collisions. Furthermore the buzzer will help the blind people estimate the approximate distance of the object and have ample time to avoid it. With various tunes playing by modifying the frequency of buzzer tunes, alerting the user can be made easy.
Machine Learning using Dataset for images of obstacles will help predict obstacle's frequency. Also, it will lead to improvisions in the device for efficient use by the user.

I. LITERATURE REVIEW

Though a lot of devices are available for the visually impaired using IoT and various kinds of sensors. [1] A fusion of obstacle and object detection is a perfect solution for such modern problems. [2] Many technologies using various kinds of infrared sensors are deployed in a stick [3]. Wearable devices give 360-degree sensing for the wearer. [4] Ultrasound sensors are more flexible and can easily distinguish even at night making them superior to infrared sensors. [5] Various embedded systems like Arduino and raspberry bi are actively allowing connections [6]. Adding such embedded systems to walking sticks will increase the mobility in manifolds [8].
Author in [9] have designed an architecture for smart parking system, where the car parking automation is achieved. With Machine Learning various images are processed for best results. [10] Using CNN and Artificial Intelligence to analyze such results will boost productivity. [11]

II. METHODOLOGY

Domain: Embedded System
Software: Arduino IDE and Python

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Ultrasonic Sensor enables us to measure the obstacle distance from the object accurately through sound waves. It is better than an infrared sensor as it measures distance unhindered even at night.

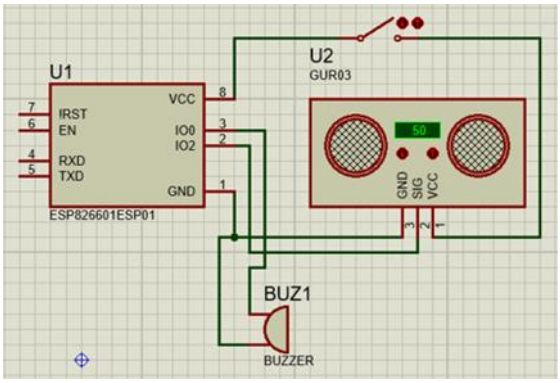

Fig 3.1 Circuit diagram of Hardware

With several jumper wires connecting the switch, two buzzers and a LED to ensure proper connection is established. After the code is compiled and debugged using Arduino IDE, the hardware part is connected using USB Cable. The LED blinks to indicate successful connection.

Using Arduino IDE, the serial monitor captures accurate distance (in cm) and displays it. Simultaneously, this distance is also displayed on the app (Blynk) for ease of access to users.

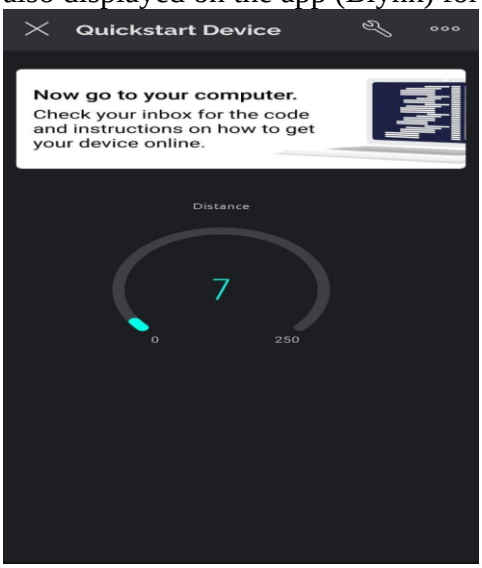

Fig 3.2 Blynk App displaying obstacle dist.

Also, the Fashion-MNIST dataset is used for Machine Learning techniques for successful predictions. Many images of several obstacles which may incur were recorded in this dataset and using Awesome-CV algorithm we have accurately predicted minimum distance for beep for visually impaired people.

```
predictions[0]

array([2.7097163e-05, 1.0450791e-09, 5.2412897e-08, 6.8056963e-08,
       1.8665391e-07, 1.2862514e-02, 2.0404127e-06, 1.8392621e-02,
       2.2097242e-06, 9.6871322e-01], dtype=float32)
```

III. Results and Discussion

Thus, the ultrasonic sensor successfully measures the distance and appropriately beeps as distance reduces. The buzzer 1 beeps when distance is between 10-20 cm while both buzzers beep together when distance is less than 10cm. with advanced technologies enabled in it. Hence, the user will know when any obstacle is approaching. Both the serial monitor and the BLYNK app indicate the accurate distance for display, which can be converted to speech in future. For a wider range better ultrasonic sensors may be used.

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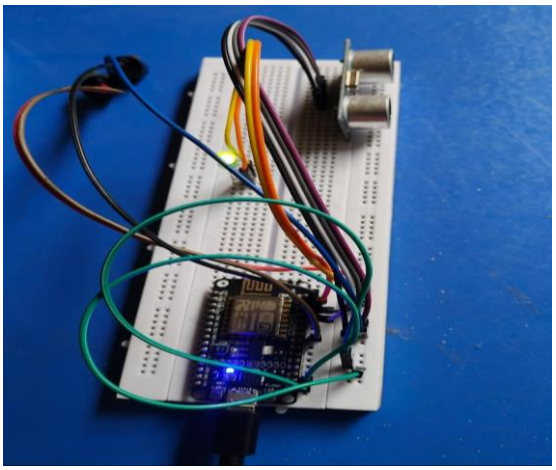
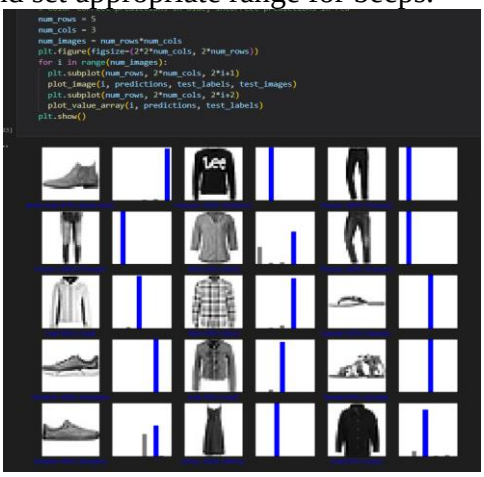


Fig 4.1 A working visual aid prototype

Also, using Machine Learning, the visual aid system can be improved tremendously. The dataset further helps us monitor varied objects that might be encountered routinely. Thus, further training our device to be vary and set appropriate range for beeps.



IV. Future Scope

- Customized devices according to the environmental factor of the user.
- 360˚ camera to detect obstacles from all around the user.
- More range of sensor with a cost-effective solution
- Various beeping sounds on different distances from obstacles to help users know the accurate distance.
- Real-time object detection prediction

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