LiDAR-based Assistive Stick for the Visually Impaired Using YDLIDAR SDM15

Abstract:
The global population includes approximately 285 million visually impaired individuals, with 39 million experiencing complete blindness. Navigating daily life presents significant challenges for these individuals. To address this issue, this project focuses on developing an innovative assistive device: a smart stick designed to aid visually impaired individuals in their daily navigation. This smart stick integrates a YDLIDAR SDM15 sensor and a Raspberry Pi 4 microcontroller to detect obstacles and provide intuitive feedback, enhancing user mobility and confidence.

The YDLIDAR SDM15 sensor, a high-precision single-point laser ranging module, is central to this design. Known for its minimal error margin and robust stability, the YDLIDAR SDM15 operates on the Time of Flight (ToF) ranging principle, using laser beams to measure distances to objects. This sensor is instrumental in detecting obstacles in the user's path, providing the foundational data necessary for the device's operation.

Serving as the device's processing unit, the Raspberry Pi 4 microcontroller manages data from the YDLIDAR SDM15 sensor and controls a vibration motor. This motor delivers tactile feedback to the user, with vibration intensity varying based on the proximity of detected obstacles. This feedback mechanism is designed to be intuitive, allowing users to better understand their surroundings and navigate with greater assurance.

The hardware components of the smart stick are strategically housed within a sturdy, ergonomic design. The Raspberry Pi 4 and vibration motor are located in the handle, ensuring they are easily accessible, while the YDLIDAR SDM15 sensor is positioned at the lower end of the stick to effectively detect ground-level obstacles. To maintain portability and ease of use, a lightweight battery pack powers the device.

On the software side, a Python script plays a crucial role in the device's functionality. This script reads data from the YDLIDAR SDM15 sensor, processes the information to calculate distances to obstacles, and subsequently controls the vibration motor's intensity based on this data. The YDLIDAR SDM15 sensor's compatibility with Python libraries simplifies the coding process, making the development and integration of software components straightforward and efficient.

This smart stick project signifies a notable advancement in assistive technology for the visually impaired. By leveraging the advanced capabilities of the YDLIDAR SDM15 sensor within a practical and user-friendly design, the device offers a cost-effective solution to a pervasive challenge. The integration of laser ranging technology with tactile feedback mechanisms provides users with a reliable means to navigate their environments more safely and confidently.

In summary, this project aims to bridge a significant gap in assistive technology by providing a practical, technologically advanced solution to aid visually impaired individuals in their daily lives. The combination of the YDLIDAR SDM15 sensor and Raspberry Pi 4 microcontroller within a smart stick design enhances the user's ability to detect and navigate around obstacles. This intuitive feedback system, housed within a portable and sturdy design, represents a meaningful improvement in the quality of life for visually impaired users, offering them greater independence and confidence in their daily navigation. Through this innovative approach, the project addresses a critical need for effective, affordable, and user-friendly assistive devices in the visually impaired community.