3D Vision for the Visually Impaired

RealSense Depth Cameras Guide the Blind with Headgear from .lumen

Spotlight on .lumen

.lumen ("dot Lumen") has appropriated technology designed for autonomous vehicles and packaged it into wearable, head-mounted glasses that enhance mobility for visually impaired individuals. Equipped with RealSense modules, .lumen assistive glasses allow the blind to move confidently through unfamiliar landscapes.

"After researching every technology that could fit into a headset, we determined that no other camera system could provide the all-around performance of RealSense."

- Cornel Amariei, CEO and Founder, .lumen

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Challenge

There are approximately 40 million blind people in the world who face mobility challenges. Due to the high cost of training guide dogs and the significant responsibility placed on dog owners, there are currently only 28,000 guide dogs available—approximately one dog for every 1,400 blind people.

Solution

By fusing the unique capabilities of RealSense™ cameras with an intelligent hardware and software platform, .lumen is revolutionizing the way the blind interact with their worlds.

Results

.lumen's comfortable, portable headsets provide an augmented experience that goes beyond traditional assistance devices, duplicating the capabilities of a guide dog in a scalable, wearable headset solution.

Introduction: Revolutionizing Accessibility with AI

In the pursuit of creating a more inclusive and accessible world, .lumen, a Romanian technology company, has harnessed the power of RealSense cameras to develop assistive glasses for the visually impaired. Similar to a car's Advanced Driver Assistance System (ADAS), .lumen's glasses use sensors and cameras to detect objects and help avoid collisions. Just as a dog guides a blind person by gently pulling the leash, .lumen glasses apply force and vibration to guide the wearer's head in the right direction, using a proprietary haptic interface. RealSense machine vision technology allows the glasses to identify safe walking surfaces and avoid potential hazards.

"RealSense cameras are part of what makes the .lumen glasses the most advanced visual assistance technology in the world," says Cornel Amariei, CEO and Founder at .lumen. "We use them as the primary sensory input for helping people navigate their surroundings."

Environmental awareness is a crucial aspect of the .lumen system. The glasses must understand the world in 3D, including identifying suitable walking surfaces and avoiding hazards. They must also predict the movement of other people, vehicles, and potential obstacles, and plan ahead accordingly. RealSense cameras provide a sophisticated visual perception system, enabling .lumen's advanced software to analyze the environment and generate detailed 3D representations of the physical world. Each headset includes two RealSense Depth Camera D450 modules to gather far-field and near-field data. Using this combination of geometrically shifted modules, the glasses can understand the world in 3D.

"RealSense cameras handle far-field and near-field understanding," Amariei continues. "By using this combination of geometrically shifted modules, the glasses can comprehend the world in 3D, covering a field of view large enough to perform the sensitive task of guiding a blind individual. Redundant technologies ensure the highest level of user safety."

Selecting RealSense

.lumen needed a powerful yet compact depth camera platform with a comprehensive software development kit (SDK). Amariei and his team identified several options that were suitable for particular use cases, but none of them could match the all-around versatility of RealSense.

".lumen glasses have to work everywhere, both indoors and outdoors, and in all types of conditions," Amariei notes. "After researching every technology that could fit into a headset, we determined that no other camera system could provide the all-around performance of RealSense. Other options looked good on paper, but once we used them, it became clear that they had not been properly tested—there were still a lot of unsolved issues."

RealSense's advanced depth-sensing technology accurately

detects objects, obstacles, and even changes in ground height. This information is processed by .lumen's intelligent algorithms, which deliver real-time feedback to users so they can navigate safely and independently.

"RealSense helped us to develop the system quickly," Amariei states. "Whenever we got stuck they were there to help."
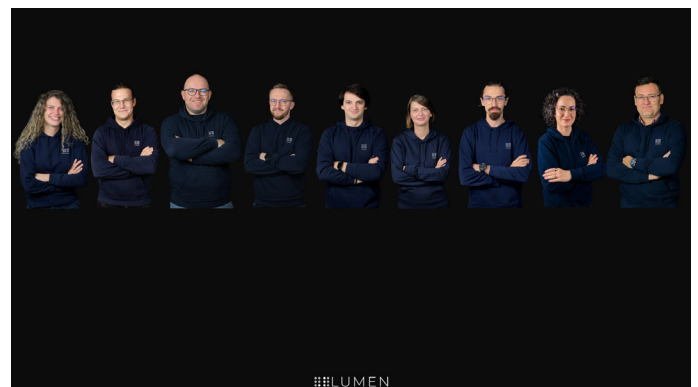
Leaders in AI-Enabled Wearables

According to Amariei, advancements in self-driving vehicles, robotics, and artificial intelligence have set the stage for .lumen's unique capabilities. Key technologies include point cloud processing, semantic segmentation, and visual-inertial odometry —driven by a machine learning model that has been tested in over 20 countries.

Visual inertial odometry is a computer vision technique for estimating the position, orientation, and velocity of a moving object. A point cloud is a set of data points that represent these 3-D objects and shapes. Semantic segmentation is a computer vision task that classifies pixels for visual mapping purposes. .lumen' glasses process this data to contextually understand how objects move and interact. The real-time data collected by

2

RealSense cameras enables wearers to receive this visual information quickly and efficiently. The software runs its patented computations 100 times per second, ensuring a steady flow of real-time guidance.

Technically, it's impressive, but Amariei prefers to focus on the human benefits: "Being able to capture depth data accurately empowers wearers to detect obstacles in real-time and avoid potential hazards," he explains. "This enhanced situational awareness helps prevent accidents and fosters a greater sense of confidence and independence."

Artificial Intelligence Meets Computer Vision

.lumen's compact glasses mimic the capabilities of a self-driving car via a computational module that is just 10 percent of the size so it can fit into an AI powered headset. The development team used the RealSense Software Development Kit (SDK) 2.0 to create the machine vision system and integrate it with the headset's other hardware and software components. The RealSense SDK supports an extensive range of programming languages, devices, and development platforms. Native integration with the Open3D library makes it easy to process 3D data, including scene reconstruction, visualization, and machine learning.

"The RealSense camera modules allow easy custom integration," Amariei adds. "It is based on a mature software platform that is well-designed, thoroughly iterated, and compatible with our selected hardware platform. Furthermore, the RealSense SDK permitted our team to efficiently use the image and depth data."

Heralding a Promising Future

By combining RealSense's cutting-edge technology with an unwavering commitment to accessibility, .lumen has created a comprehensive solution that enhances the lives of people with visual impairments. Continuous software updates allow the assistive vision system to become smarter and more capable with each release. Soon, .lumen glasses could have the potential to assist not only with physical guidance and navigation, but also with reading, shopping, hiking, and even assistive-learning tasks.

"Through collaboration with RealSense, .lumen has successfully developed an innovative headwear solution that empowers blind individuals with greater independence and enhanced navigation capabilities," Amariei concludes. "The fusion of RealSense's world-class technology and .lumen's determination to make a positive impact has reshaped the accessibility landscape. Together, we are building products that will empower the lives of millions of people."

Technical components of the solution

- RealSense Depth Camera D450
- .lumen assistive glasses

Learn More

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https://www.dotlumen.com/

- **RealSense Technology**

https://www.realsenseai.com