Bat-Inspired Tech Could Help Blind People See with Sound

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The guide dogs have helped the visually impaired for a very long time. Guide dogs are going to be here for a long time, but some people don’t want a guide dog weather it’s because of cultural reasons, allergies, personal preferences, or the dog might be ill. Visually impaired have different abilities to get around in the modern world. For example “some can sense light but not see objects, others can echolocate with ease while for still others the concept of space is so challenging that they navigate by running their fingers along the wall”. What could be a technological solution that could help blind people, with different abilities to get around, “see” their surroundings without the help of a guide dog?

A natural inspiration to solve the problem is bats. Bats hunt during the night, but just like most mammals bats can’t see when it’s dark. Instead, they use a high-frequency system called echolocation. Echolocation is similar to sonar and is all in their brains. When the bat makes a call, it listens to the amount of time it takes for the echo to return. Using this it can make a sonic map of its surroundings, and can tell how far away its prey is located. The organ that helps it echolocate is the cochleae “the spiral section of the inner ear devoted to hearing, are organized in such a way that different parts of the sensory tissue process different frequencies”. They are able to differentiate between sounds as short as one microsecond apart; that is one hundred times finer and faster than a fully developed nervous system. The speed at which bats process the sounds id due to the retained gap junctions in certain neurons that are used to process sounds. In most mammals and humans the gap junctions decrease sharply after birth. Somehow big brown bats were able to retain gap cells in some cochlear cells due to evolution.

A technological solution, the UltraCane, was created by observing bats. It was first invented by the minds at England’s Leeds University. It emits ultrasonic pulses, 60,000 per second, just like echolocation in the bat. Ultrasonic waves are emitted through two transducers on the handle of the UltraCane which are thrusting out intense beams of ultrasounds, so loud that if we could hear them we would be deaf. These beams bounce off objects in the path of the user and informs the user about the obstacles and if he needs to change his path to avoid it. “The UltraCane has two ranges to choose from: a short range mode, which detects obstacles within approximately 2 meters of the handle, and a long range mode, which detects obstacles within 4 meters of the handle.  The upper transducer can locate objects approximately 1.6 meters from the handle”. Information about the pathway is provided through buttons that vibrate on the handle. It was first introduced in 2011 and is still being used by the blind. The UltraCane help the blind move around more safely, and confidently.

There were some devices named “Sonic Pathfinder”, “Sonic Torch”, and “SonicGuide” all these devices use the similar technology based on sonic but have failed due to their limited functionality. Most of them were just clear path indicators or buzz more intensely when there was an obstruction. And also, these devices were heavier because of the batteries and providing unnecessary information. There is no way to find the size of the object or the material that the objects were made out off. All these issues are due to lack of research findings or the lack of advancement in technology to precisely find how bats were processing the sounds.

In the future, the goal is to develop a more advanced biomimetic device for the blind. The device should accommodate a wide variety of preferences which deals with different abilities of visually impaired. Seth Horowitz was a bioacoustician and worked as a neuroscientist at Brown University. He was astonished by the bat's ability to fly at night at about 30 mph and has done some research on the bats and their ability to echolocate. Currently, he is a CEO and chief neuroscientist for NeuroPop “a company that explores applications of sound technology”. He is working on a project to develop an assistive device for the blind which “won’t give them sight, but if it works, it could come pretty close”.

The road map for his project is to the differences between bats and humans and how they process the sounds. He is working on a sensor which creates a different range of frequencies and these return information about the surroundings with different levels of details. For example, some sense large and stationary objects while the other could pick up on smaller and fast moving obstacles. This will help us paint the surroundings with more detail and give us necessary information for the blind people. If the sensor he develops is a success, then this would be a next generation device compared to the tools that we had in the past.

Currently, the device that helps the blind in the UltraCane; in the future, it could be the Sensor. The interesting thing about the present innovation is that it was a success unlike all the other devices in the past and has all the necessities that can help a blind person move around freely. But in the near future, the Sensor could be the greatest advancement of all time because of its ability paint a picture of the surroundings into the human brain. This design will send echoes into the surrounding, registering any obstacles on the path and transmits the information to the brain.

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