

Noise Sensors for Inspection Robots

Introduction

Underground power vaults require safety, routine maintenance, and vault-explosion inspections with the goal to prevent risking the safety of power workers. Because great care is normally taken and a long list of safety procedures are required before entering a vault, the downtime of the power grid leads to inefficiency and high utility costs. To identify these concerns, robot vehicles with sensing capabilities using a variety of modern technology sensors can be used at the beginning of the inspection process. This technical paper reviews the state of the art of robot technology used when conducting vault inspections, explains the applications of noise sensors in today's technology and provides an understanding of their implementation for robot vehicles.

Robot Technology Applications in Power Vaults

A demand for an alternative risk-free pre-inspection of power vaults has led to a rise in interest for robot technology and their ability to inspect these vaults much more efficiently while following step procedure guidelines. An example where robot technology is tested and considered for power utility implementation comes from the Electric Power Research Institute (EPRI) in Palo Alto, California. A robot vehicle navigates an underground railway with inspection tools and provides the personnel with recordings, power line and equipment status results. While the technology shared in the patent is really important and meets many of the requirements set by the utilities, a financial analysis that would determine cost of mass production is still unknown [1].

Meanwhile, Pearpoint (a sales website) offers a Modular Product System (used in sewing inspections) which is a highly efficient inspection camera system in the form of a Modular Crawler capable of navigating and inspecting the vaults adhering to many of the constraints set by the utilities. Unfortunately, this product will unlikely ever be practically considered by utilities. Due to their heavy weight of 450.0 lbs. and the really high marked-up price at US\$74,000.00. They claim their price is justified when the versatility, ease of use, and their current flawless efficient use in sewer systems is considered [2].

Applications of Noise Sensors

A variation of sensors is used extensively in modern robots to supplement and fulfill the desired task at hand. Acoustic flow sensors provide a way to determine sound sources in modern technology by making directional sound detection by means of acoustic pressure using membranes at multiple spatial locations. The detection of even the smallest of sound flow in various directions is very important for robotic applications, as well as, the detection of large sound sources. Acoustic flow sensors enjoy a wide

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range of frequencies from 10 HZ to 10,000 Hz as the frequency response of their modern bi-directional technology. While this broadband sound is the most modern technology in sound detection and provide considerable benefits such as their wide frequency response. It is noted that pressure-sensing microphones is the technology commonly used for detecting sound sources in today's technology. [3]

An example are sound pressure sensors for Arduino based sound boards where the diaphragm converts the air pressure vibrations into an electrical signal [4]. The technology in this pressure sound sensors is well known by robot and non-robot designers and for these reasons they are cheap devices that are simply attached to any robot application. For example, Symmetry Electronics (a semiconductor store) develops and designs sound pressure sensors where they emphasize their breakthroughs in pressure accuracy of ± 1 Pa and efficiency of 1.3 micro-amp consumption at the low price of under US\$2.00 [5].

Implementation for Robot Vehicles

When identifying high-voltage system hazards, listening to electrical tracking and arcing require the use of noise sensors for hands-off assessment [6]. Sound sensors were used for seabed walking robots in 2014 where pressure sensors were implemented to an underwater robot. The robot was able to record the sounds coming from the seabed grounds by gathering the returning sound waves from down to 0.5-15m distances. Ultimately, the sensors were supposed to help visualize these acoustic images and the results were communicated through direct Gigabit Ethernet line connection through a series of converters and then to a computer's display. Other types of sensors and cameras along the process to fulfill the goal of the robot, and the network used was the controller area network (CAN) [7].

Conclusion

Sound pressure sensors are used in modern high-tech robots, as well as, old robot applications. Mostly, due to their well-known performance, while it might not be the best. It is the desired sensor technology recommended for everyday sound source detection application.

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